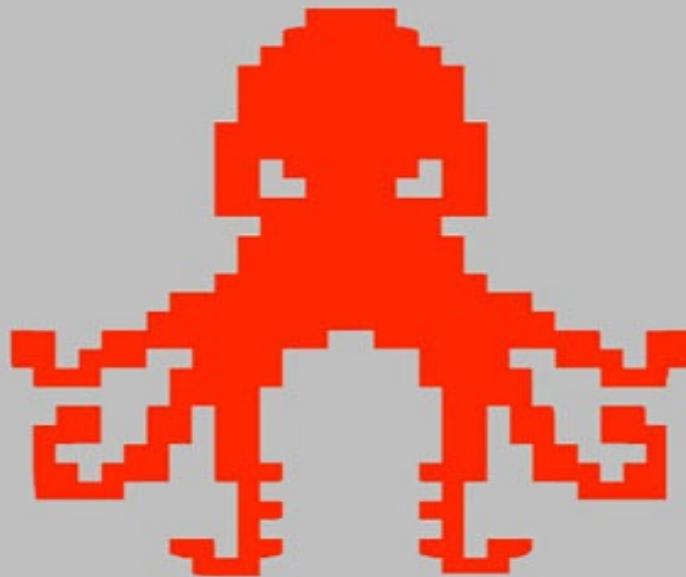


HASH CRACK

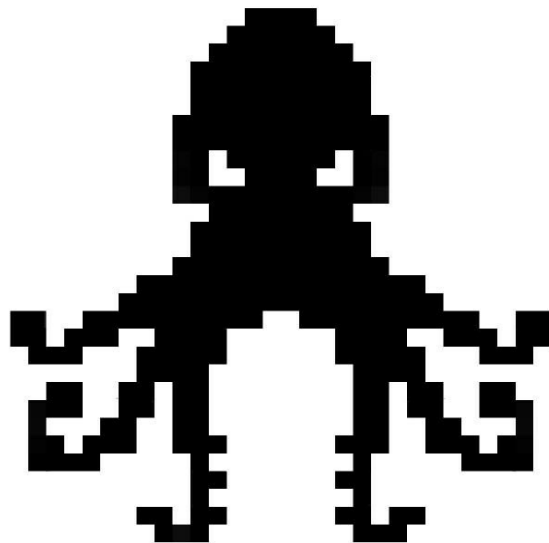
PASSWORD CRACKING MANUAL



V2.0

HASH CRACK

PASSWORD CRACKING MANUAL



NETMUX

V2.0

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INTRO

This manual is meant to be a reference guide for cracking tool usage and supportive tools that assist network defenders and pentesters in password recovery (cracking). This manual will not be covering the installation of these tools, but will include references to their proper installation, and if all else fails, Google. Updates and additions to this manual are planned yearly as advancements in cracking evolve. Password recovery is a battle against math, time, cost, and human behavior; and much like any battle, the tactics are constantly evolving.

ACKNOWLEDGEMENTS

This community would not enjoy the success and diversity without the following community members and contributors:

Alexander ‘Solar Designer’ Peslva, John The Ripper Team, & Community
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Jeremi ‘epixoip’ Gosney
Korelogic & the Crack Me If You Can Contest
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CynoSure Prime Team
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Blandyuk & Rurapenthe (HashKiller Contest)
Peter ‘iphelix’ Kacherginsky (PACK)
Royce ‘tychotithonus’ Williams
‘Waffle’

And many, many, many more contributors. If a name was excluded from the above list please reach out and the next version will give them their due

credit.

Lastly, the tools, research, and resources covered in the book are the result of people's hard work. As such, I HIGHLY encourage all readers to DONATE to help assist in their efforts. A portion of the proceeds from this book will be distributed to the various researchers/projects.

Suggestions or comments, send your message to hashcrack@netmux.com

REQUIRED SOFTWARE

In order to follow many of the techniques in this manual, you will want to install the following software on your Windows or *NIX host. This book does not cover how to install said software and assumes you were able to follow the included links and extensive support websites.

HASHCAT v3.6 (or newer)

<https://hashcat.net/hashcat/>

JOHN THE RIPPER (v1.8.0 JUMBO)

<http://www.openwall.com/john/>

PACK V0.0.4 (Password Analysis and Cracking Toolkit)

<http://thesprawl.org/projects/pack/>

Hashcat-utils v1.7

https://hashcat.net/wiki/doku.php?id=hashcat_utils

Additionally you will need dictionaries/wordlists and highly recommend the below sources:

WEAKPASS DICTIONARY

<https://weakpass.com/wordlist>

CRACKSTATION DICTIONARY

<https://crackstation.net/buy-crackstation-wordlist-password-cracking-dictionary.htm>

SKULL SECURITY WORDLISTS

<https://wiki.skullsecurity.org/index.php?title=Passwords>

Throughout the manual, generic names have been given to the various inputs

required in a cracking commands structure. Legend description is below:

COMMAND STRUCTURE LEGEND

hashcat = Generic representation of the various Hashcat binary names

john = Generic representation of the John the Ripper binary names

#type = Hash type; which is an abbreviation in John or a number in Hashcat

hash.txt = File containing target hashes to be cracked

dict.txt = File containing dictionary/wordlist

rule.txt = File containing permutation rules to alter dict.txt input

passwords.txt = File containing cracked password results

outfile.txt = File containing results of some functions output

Lastly, as a good reference for testing various hash types to place into your “hash.txt” file, the below sites contain all the various hashing algorithms and example output tailored for each cracking tool:

HASHCAT HASH FORMAT EXAMPLES

https://hashcat.net/wiki/doku.php?id=example_hashes

JOHN THE RIPPER HASH FORMAT EXAMPLES

<http://pentestmonkey.net/cheat-sheet/john-the-ripper-hash-formats>

<http://openwall.info/wiki/john/sample-hashes>

CORE HASH CRACKING KNOWLEDGE

ENCODING vs HASHING vs ENCRYPTING

Encoding = transforms data into a publicly known scheme for usability

Hashing = one-way cryptographic function nearly impossible to reverse

Encrypting = mapping of input data and output data reversible with a key

CPU vs GPU

CPU = 2-72 cores mainly optimized for sequential serial processing

GPU = 1000's of cores with 1000's of threads for parallel processing

CRACKING TIME = KEYSPACE / HASHRATE

Keyspace: $\text{charset}^{\text{length}}$ (?a?a?a?a = $95^4 = 81,450,625$)

Hashrate: hashing function / hardware power (bcrypt / GTX1080 = 13094 H/s)

Cracking Time: $81,450,625 / 13094 \text{ H/s} = 6,220 \text{ seconds}$

*Keyspace displayed and Hashrate vary by tool and hardware used

SALT = random data that's used as additional input to a one-way function

ITERATIONS = the number of times an algorithm is run over a given hash

HASH IDENTIFICATION: there isn't a foolproof method for identifying which hash function was used by simply looking at the hash, but there are reliable clues (i.e. \$6\$ sha512crypt). The best method is to know from where the hash was extracted and identify the hash function for that software.

DICTIONARY/WORDLIST ATTACK = straight attack uses a precompiled list of words, phrases, and common/unique strings to attempt to match a password.

BRUTE-FORCE ATTACK = attempts every possible combination of a given character set, usually up to a certain length.

RULE ATTACK = generates permutations against a given wordlist by modifying, trimming, extending, expanding, combining, or skipping words.

MASK ATTACK = a form of targeted brute-force attack by using placeholders for characters in certain positions (i.e. ?a?a?a?l?d?d).

HYBRID ATTACK = combines a Dictionary and Mask Attack by taking input from the dictionary and adding mask placeholders (i.e. dict.txt ?d?d?d).

CRACKING RIG = from a basic laptop to a 64 GPU cluster, this is the hardware/ platform on which you perform your password hash attacks.

EXPECTED RESULTS

Know your cracking rig's capabilities by performing benchmark testing and don't assume you can achieve the same results posted by forum members without using the exact same dictionary, attack plan, or hardware setup. Cracking success largely depends on your ability to use resources efficiently and make calculated trade-offs based on the target hash.

DICTIONARY/WORDLIST vs BRUTE-FORCE vs ANALYSIS

Dictionaries and brute-force are not the end all be all to crack hashes. They are merely the beginning and end of an attack plan. True mastery is everything in the middle, where analysis of passwords, patterns, behaviors, and policies affords the ability to recover that last 20%. Experiment with your attacks and research and compile targeted wordlists with your new knowledge. Do not rely heavily on dictionaries because they can only help you with what is "known" and not the unknown.

CRACKING METHODOLOGY

Following is basic cracking methodology broken into steps, but the process is subject to change based on current/future target information uncovered during the cracking process.

1-EXTRACT HASHES

Pull hashes from target, identify hashing function, and properly format output for your tool of choice.

2-FORMAT HASHES

Format your hashes based on your tool's preferred method. See tool documentation for this guidance. Hashcat, for example, on each line takes <user>:<hash> OR just the plain <hash>.

3-EVALUATE HASH STRENGTH

Using the [Appendix](#) table "Hash Cracking Speed (Slow-Fast)" assess your target hash and it's cracking speed. If it's a slow hash, you will need to be more selective at what types of dictionaries and attacks you perform. If it's a fast hash, you can be more liberal with your attack strategy.

4-CALCULATE CRACKING RIG CAPABILITIES

With the information from evaluating the hash strength, baseline your cracking rig's capabilities. Perform benchmark testing using John The Ripper and/or Hashcat's built-in benchmark ability on your rig.

john --test

hashcat -b

Based on these results you will be able to better assess your attack options by knowing your rigs capabilities against a specific hash. This will be a more accurate result of a hash's cracking speed based on your rig. It will be useful to save these results for future reference.

5-FORMULATE PLAN

Based on known or unknown knowledge begin creating an attack plan. Included on the next page is a “Basic Cracking Playbook” to get you started.

6-ANALYZE PASSWORDS

After successfully cracking a sufficient amount of hashes analyze the results for any clues or patterns. This analysis may aid in your success on any remaining hashes.

7-CUSTOM ATTACKS

Based on your password analysis create custom attacks leveraging those known clues or patterns. Examples would be custom mask attacks or rules to fit target users’ behavior or preferences.

8-ADVANCED ATTACKS

Experiment with Princeprocessor, custom Markov-chains, maskprocessor, or custom dictionary attacks to shake out those remaining stubborn hashes. This is where your expertise and creativity really come into play.

9-REPEAT

Go back to STEP 4 and continue the process over again, tweaking dictionaries, mask, parameters, and methods. You’re in the grind at this point and need to rely on skill and luck.

BASIC CRACKING PLAYBOOK

This is only meant as a basic guide to processing hashes and each scenario will obviously be unique based on external circumstances. For this attack plan we will assume we know the password hashes are raw MD5 and assume we have already captured some plain text passwords of users. If we had no knowledge of plain text passwords we would most likely skip to DICTIONARY/WORDLIST attacks. Lastly, since MD5 is a “Fast” hash we can be more liberal with our attack plan.

1-CUSTOM WORDLIST

First compile your known plain text passwords into a custom wordlist file. Pass this to your tool of choice as a straight dictionary attack.

```
hashcat -a 0 -m 0 -w 4 hash.txt custom_list.txt
```

2-CUSTOM WORDLIST + RULES

Run your custom wordlist with permutation rules to crack slight variations.

```
hashcat -a 0 -m 0 -w 4 hash.txt custom_list.txt -r best64.rule --loopback
```

3 -DICTIONARY/WORDLIST

Perform a broad dictionary attack, looking for common passwords and leaked passwords in well known dictionaries/wordlists.

```
hashcat -a 0 -m 0 -w 4 hash.txt dict.txt
```

4-DICTIONARY/WORDLIST + RULES

Add rule permutations to the broad dictionary attack, looking for subtle changes to common words/phrases and leaked passwords.

```
hashcat -a 0 -m 0 -w 4 hash.txt dict.txt -r best64.rule --loopback
```

5-CUSTOM WORDLIST + RULES

Add any newly discovered passwords to your custom wordlist and run an

attack again with permutation rules, looking any other subtle variations.

```
awk -F ":" '{print $2}' hashcat.potfile >> custom_list.txt  
hashcat -a 0 -m 0 -w 4 hash.txt custom_list.txt -r dive.rule --loopback
```

6-MASK

Now we will use mask attacks included with Hashcat to search the keyspace for common password lengths and patterns, based on the RockYou dataset.

```
hashcat -a 3 -m 0 -w 4 hash.txt rockyou-1-60.hcmask
```

7-HYBRID DICTIONARY + MASK

Using a dictionary of your choice, conduct hybrid attacks looking for larger variations of common words or known passwords by appending/prepending masks to those candidates.

```
hashcat -a 6 -m 0 -w 4 hash.txt dict.txt rockyou-1-60.hcmask  
hashcat -a 7 -m 0 -w 4 hash.txt rockyou-1-60.hcmask dict.txt
```

8-CUSTOM WORDLIST + RULES

Add any newly discovered passwords back to your custom wordlist and run an attack again with permutation rules looking any other subtle variations.

```
awk -F ":" '{print $2}' hashcat.potfile >> custom_list.txt  
hashcat -a 0 -m 0 -w 4 hash.txt custom_list.txt -r dive.rule --loopback
```

9-COMBO

Using a dictionary of your choice, perform a combo attack by individually combining the dictionary's password candidates together to form new candidates.

```
hashcat -a 1 -m 0 -w 4 hash.txt dict.txt dict.txt
```

10-CUSTOM HYBRID ATTACK

Add any newly discovered passwords back to your custom wordlist and perform a hybrid attack against those new acquired passwords.

```
awk -F ":" '{print $2}' hashcat.potfile >> custom_list.txt
```



```
hashcat -a 6 -m 0 -w 4 hash. txt custom_list.txt rockyou-1-60.hcmask  
hashcat -a 7 -m 0 -w 4 hash. txt rockyou-1-60.hcmask custom_list.txt
```

11-CUSTOM MASK ATTACK

By now the easier, weaker passwords may have fallen to cracking, but still some remain. Using PACK (on [pg.51](#)) create custom mask attacks based on your currently cracked passwords. Be sure to sort out masks that match the previous rockyou-1-60.hcmask list.

```
hashcat -a 3 -m 0 -w 4 hash.txt custom_masks.hcmask
```

12-BRUTE-FORCE

When all else fails begin a standard brute-force attack, being selective as to how large a keyspace your rig can adequately brute-force. Above 8 characters this is typically pointless due to hardware limitations and password entropy/complexity.

```
hashcat -a 3 -m 0 -w 4 hash.txt -i ?a?a?a?a?a?a?a
```




CHEAT SHEETS



JOHN THE RIPPER CHEAT SHEET

ATTACK MODES

BRUTEFORCE ATTACK

john --format=#type hash.txt

DICTIONARY ATTACK

john --format=#type --wordlist=dict.txt hash.txt

MASK ATTACK

john --format=#type --mask=?l?l?l?l?l?l hash.txt -min-len=6

INCREMENTAL ATTACK

john --incremental hash.txt

DICTIONARY + RULES ATTACK

john --format=#type --wordlist=dict.txt --rules

RULES

--rules=Single

--rules=Wordlist

--rules=Extra

--rules=Jumbo

--rules=KoreLogic

--rules=All

INCREMENT

--incremental=Digits

--incremental=Lower

--incremental=Alpha

--incremental=Alnum

PARALLEL CPU or GPU

LIST OpenCL DEVICES

john --list=opencl-devices

LIST OpenCL FORMATS

john --list=formats --format=opencl

MULTI-GPU (example 3 GPU's)

john --format=<OpenCLformat> hash.txt --wordlist=dict.txt --rules --

dev=<#> --fork=3

MULTI-CPU (example 8 cores)

john --wordlist=dict.txt hash.txt --rules --dev=<#> --fork=8

MISC

BENCHMARK TEST

john --test

SESSION NAME

john hash.txt --session=example_name

SESSION RESTORE

john --restore=example_name

SHOW CRACKED RESULTS

john hash.txt --pot=<john potfile> --show

WORDLIST GENERATION

john --wordlist=dict.txt --stdout --external:[filter name] > out.txt

BASIC ATTACK METHODOLOGY

1- DEFAULT ATTACK

john hash.txt

2- DICTIONARY + RULES ATTACK

john --wordlist=dict.txt --rules

3- MASK ATTACK

john --mask=?l?l?l?l?l?l hash.txt -min-len=6

4- BRUTEFORCE INCREMENTAL ATTACK

john --incremental hash.txt

HASH TYPES (SORTED ALPHABETICAL)

7z	HMAC-SHA384	ntlmv2-openc1	Raw-SHA224
7z-openc1	HMAC-SHA512	o5logon	Raw-SHA256
AFS	hMailServer	o5logon-openc1	Raw-SHA256-ng
agilekeychain	hsrp	ODF	Raw-SHA256-openc1
agilekeychain-openc1	IKE	ODF-AES-openc1	Raw-SHA384
aix-smd5	ipb2	ODF-openc1	Raw-SHA512
aix-ssha1	KeePass	Office	Raw-SHA512-ng
aix-ssha256	keychain	office2007-openc1	Raw-SHA512-openc1
aix-ssha512	keychain-openc1	office2010-openc1	ripemd-128
asa-md5	keyring	office2013-openc1	ripemd-160
bcrypt	keyring-openc1	oldoffice	rsvp
bcrypt-openc1	keystore	oldoffice-openc1	Salted-SHA1
bfegg	known_hosts	OpenBSD-SoftRAID	sapb
Bitcoin	krb4	openssl-enc	sapg
blackberry-es10	krb5	OpenVMS	scrypt
Blockchain	krb5-18	oracle	sha1-gen
blockchain-openc1	krb5pa-md5	oracle11	sha1crypt
bsdicrypt	krb5pa-md5-openc1	osc	sha1crypt-openc1
chap	krb5pa-sha1	Panama	sha256crypt
Citrix_NS10	krb5pa-sha1-openc1	PBKDF2-HMAC-SHA1	sha256crypt-openc1
Clipperz	kwallet	PBKDF2-HMAC-SHA256	sha512crypt
cloudkeychain	LastPass	PBKDF2-HMAC-SHA256-openc1	sha512crypt-openc1
cq	LM	PBKDF2-HMAC-SHA512	Siemens-S7
CRC32	lotus5	pbkdf2-hmac-sha512-openc1	SIP
crypt	lotus5-openc1	PDF	skein-256
dahua	lotus85	PFX	skein-512
decrypt	LUKS	phpass	skey
decrypt-openc1	MD2	phpass-openc1	Snefru-128
Django	md4-gen	PHPS	Snefru-256
django-scrypt	md5crypt	pix-md5	SSH
dmd5	md5crypt-openc1	PKZIP	SSH-ng
dmg	md5ns	po	ssha-openc1
dmg-openc1	mdc2	postgres	SSHA512
dominosec	MediaWiki	PST	STRIP
dragonfly3-32	MongoDB	PuTTY	strip-openc1
dragonfly3-64	Mozilla	pwsafe	SunMD5
dragonfly4-32	mscash	pwsafe-openc1	sxc
dragonfly4-64	mscash2	RACF	sxc-openc1
Drupal7	mscash2-openc1	RAAdmin	Sybase-PROP
dummy	MSCHAPv2	RAKP	sybasease
dynamic_n	mschapv2-naive	RAKP-openc1	tc_aes_xts
eCryptfs	mssql	rar	tc_ripemd160
EFS	mssql05	rar-openc1	tc_sha512
eigrp	mssql12	RAR5	tc_whirlpool
EncFS	mysql	RAR5-openc1	tcp-md5
encfs-openc1	mysql-sha1	Raw-Blake2	Tiger
EPI	mysql-sha1-openc1	Raw-Keccak	tripcode
EPiServer	mysqlna	Raw-MD4	VNC
fde	net-md5	Raw-MD4-openc1	vtp
FormSpring	net-sha1	Raw-MD5	wbb3
Fortigate	nethalflm	Raw-MD5-openc1	whirlpool
gost	netlm	Raw-MD5u	whirlpool0
gpg	netlmv2	Raw-SHA	whirlpool1
gpg-openc1	netntlm	Raw-SHA1	WoWSRP
HAVAL-128-4	netntlm-naive	Raw-SHA1-Linkedin	wpapsk
HAVAL-256-3	netntlmv2	Raw-SHA1-ng	wpapsk-openc1
hdaa	nk	Raw-SHA1-openc1	xsha
HMAC-MD5	nsldap		xsha512
HMAC-SHA1	NT		XSHA512-openc1
HMAC-SHA224	nt-openc1		ZIP
HMAC-SHA256	nt2		zip-openc1

HASHCAT CHEAT SHEET

ATTACK MODES

DICTIONARY ATTACK

hashcat -a 0 -m #type hash.txt dict.txt

DICTIONARY + RULES ATTACK

hashcat -a 0 -m #type hash.txt dict.txt -r rule.txt

COMBINATION ATTACK

hashcat -a 1 -m #type hash.txt dict1.txt dict2.txt

MASK ATTACK

hashcat -a 3 -m #type hash.txt ?a?a?a?a?a

HYBRID DICTIONARY + MASK

hashcat -a 6 -m #type hash.txt dict.txt ?a?a?a?a

HYBRID MASK + DICTIONARY

hashcat -a 7 -m #type hash.txt ?a?a?a?a dict.txt

RULES

RULEFILE -r

hashcat -a 0 -m #type hash.txt dict.txt -r rule.txt

MANIPULATE LEFT -j

hashcat -a 1 -m #type hash.txt left_dict.txt right_dict.txt -j <option>

MANIPULATE RIGHT -k

hashcat -a 1 -m #type hash.txt left_dict.txt right_dict.txt -k <option>

INCREMENT

DEFAULT INCREMENT

hashcat -a 3 -m #type hash.txt ?a?a?a?a?a --increment

INCREMENT MINIMUM LENGTH

hashcat -a 3 -m #type hash.txt ?a?a?a?a?a --increment-min=4

INCREMENT MAX LENGTH

hashcat -a 3 -m #type hash.txt ?a?a?a?a?a --increment-max=5

MISC

BENCHMARK TEST (HASH TYPE)

hashcat -b -m #type

SHOW EXAMPLE HASH

hashcat -m #type --example-hashes

DISABLE PASSWORD LENGTH LIMIT (Max Length 256)

hashcat -a 0 -m #type --length-limit-disable hash.txt dict.txt

SESSION NAME

hashcat -a 0 -m #type --session <uniq_name> hash.txt dict.txt

SESSION RESTORE

hashcat -a 0 -m #type --restore --session <uniq_name> hash.txt dict.txt

SHOW KEYSPACE

hashcat -a 0 -m #type --keyspace hash.txt dict.txt -r rule.txt

OUTPUT RESULTS FILE -o

hashcat -a 0 -m #type -o results.txt hash.txt dict.txt

CUSTOM CHARSET -1 -2 -3 -4

hashcat -a 3 -m #type hash.txt -1 ?l?u -2 ?l?d?s ?l?2?a?d?u?l

ADJUST PERFORMANCE -w

hashcat -a 0 -m #type -w <1-4> hash.txt dict.txt

BASIC ATTACK METHODOLOGY

1- DICTIONARY ATTACK

hashcat -a 0 -m #type hash.txt dict.txt

2- DICTIONARY + RULES

hashcat -a 0 -m #type hash.txt dict.txt -r rule.txt

3- HYBRID ATTACKS

hashcat -a 6 -m #type hash.txt dict.txt ?a?a?a?a

4- BRUTEFORCE

hashcat -a 3 -m #type hash.txt ?a?a?a?a?a?a?a

HASH TYPES (SORTED ALPHABETICAL)

6600	1Password, agilekeychain
8200	1Password, cloudkeychain
14100	3DES (PT = \$salt, key = \$pass)
11600	7-Zip
6300	AIX {smd5}

6400	AIX {ssha256}
6500	AIX {ssha512}
6700	AIX {ssha1}
5800	Android PIN
8800	Android FDE < v4.3
12900	Android FDE (Samsung DEK)
1600	Apache \$apr1\$
125	ArubaOS
12001	Atlassian (PBKDF2-HMAC-SHA1)
13200	AxCrypt
13300	AxCrypt in memory SHA1
3200	bcrypt \$2*\$, Blowfish(Unix)
600	BLAKE2-512
12400	BSDiCrypt, Extended DES
11300	Bitcoin/Litecoin wallet.dat
12700	Blockchain, My Wallet
15200	Blockchain, My Wallet, V2
15400	ChaCha20
2410	Cisco-ASA
500	Cisco-IOS \$1\$
5700	Cisco-IOS \$4\$
9200	Cisco-IOS \$8\$
9300	Cisco-IOS \$9\$
2400	Cisco-PIX
8100	Citrix Netscaler
12600	ColdFusion 10+
10200	Cram MD5
11500	CRC32
14000	DES (PT = \$salt, key = \$pass)
1500	decrypt, DES(Unix), Traditional DES
8300	DNSSEC (NSEC3)
124	Django (SHA-1)

10000	Django (PBKDF2-SHA256)
1100	Domain Cached Credentials (DCC), MS Cache
2100	Domain Cached Credentials 2 (DCC2), MS Cache 2
15300	DPAPI masterkey file v1 and v2
7900	Drupal7
12200	eCryptfs
141	EPiServer 6.x < v4
1441	EPiServer 6.x > v4
15600	Ethereum Wallet, PBKDF2-HMAC-SHA256
15700	Ethereum Wallet, PBKDF2-SCRYPT
15000	FileZilla Server >= 0.9.55
7000	Fortigate (FortiOS)
6900	GOST R 34.11-94
11700	GOST R 34.11-2012 (Streebog) 256-bit
11800	GOST R 34.11-2012 (Streebog) 512-bit
7200	GRUB 2
50	HMAC-MD5 (key = \$pass)
60	HMAC-MD5 (key = \$salt)
150	HMAC-SHA1 (key = \$pass)
160	HMAC-SHA1 (key = \$salt)
1450	HMAC-SHA256 (key = \$pass)
1460	HMAC-SHA256 (key = \$salt)
1750	HMAC-SHA512 (key = \$pass)
1760	HMAC-SHA512 (key = \$salt)
5100	Half MD5
5300	IKE-PSK MD 5
5400	IKE-PSK SHA1
2811	IPB (Invison Power Board)
7300	IPMI2 RAKP HMAC-SHA1
14700	iTunes Backup < 10.0
14800	iTunes Backup >= 10.0
4800	iSCSI CHAP authentication, MD5(Chap)
15500	JKS Java Key Store Private Keys (SHA1)

11	Joomla < 2.5.18
400	Joomla > 2.5.18
15100	Juniper/NetBSD sha1crypt
22	Juniper Netscreen/SSG (ScreenOS)
501	Juniper IVE
13400	Keepass 1 (AES/Twofish) and Keepass 2 (AES)
7500	Kerberos 5 AS-REQ Pre-Auth etype 23
13100	Kerberos 5 TGS-REP etype 23
6800	Lastpass + Lastpass sniffed
3000	LM
8600	Lotus Notes/Domino 5
8700	Lotus Notes/Domino 6
9100	Lotus Notes/Domino 8
14600	LUKS
900	MD4
0	MD5
10	md5(\$pass.\$salt)
20	md5(\$salt.\$pass)
30	md5(unicode(\$pass).\$salt)
40	md5(\$salt.unicode(\$pass))
3710	md5(\$salt.md5(\$pass))
3800	md5(\$salt.\$pass.\$salt)
3910	md5(md5(\$pass).md5(\$salt))
4010	md5(\$salt.md5(\$salt.\$pass))
4110	md5(\$salt.md5(\$pass.\$salt))
2600	md5(md5(\$pass))
4400	md5(sha1(\$pass))
4300	md5(strtoupper(md5(\$pass)))
500	md5crypt \$1\$, MD5(Unix)
9400	MS Office 2007
9500	MS Office 2010
9600	MS Office 2013

9700	MS Office <= 2003 \$0
9710	MS Office <= 2003 \$0
9720	MS Office <= 2003 \$0
9800	MS Office <= 2003 \$3
9810	MS Office <= 2003 \$3
9820	MS Office <= 2003 \$3
12800	MS-AzureSync PBKDF2-HMAC-SHA256
131	MSSQL(2000)
132	MSSQL(2005)
1731	MSSQL(2012)
1731	MSSQL(2014)
3711	Mediawiki B type
2811	MyBB
11200	MySQL CRAM (SHA1)
200	MySQL323
300	MySQL4.1/MySQL5
1000	NTLM
5500	NetNTLMv1
5500	NetNTLMv1 + ESS
5600	NetNTLMv2
101	nsldap, SHA-1(Base64), Netscape LDAP SHA
111	nsldaps, SSHA-1(Base64), Netscape LDAP SSHA
13900	OpenCart
21	osCommerce
122	OSX V10.4, OSX V10.5, OSX V10.6
1722	OSX V10.7
7100	OSX V10.8, OSX V10.9, OSX v10.10
112	Oracle S: Type (Oracle 11+)
3100	Oracle H: Type (Oracle 7+)
12300	Oracle T: Type (Oracle 12+)
11900	PBKDF2-HMAC-MD5
12000	PBKDF2-HMAC-SHA1

10900	PBKDF2-HMAC-SHA256
12100	PBKDF2-HMAC-SHA512
10400	PDF 1.1 - 1.3 (Acrobat 2 - 4)
10410	PDF 1.1 - 1.3 (Acrobat 2 - 4), collider #1
10420	PDF 1.1 - 1.3 (Acrobat 2 - 4), collider #2
10500	PDF 1.4 - 1.6 (Acrobat 5 - 8)
10600	PDF 1.7 Level 3 (Acrobat 9)
10700	PDF 1.7 Level 8 (Acrobat 10 - 11)
400	phpBB3
400	phpass
2612	PHPS
5200	Password Safe v3
9000	Password Safe v2
133	PeopleSoft
13500	PeopleSoft Token
99999	Plaintext
12	PostgreSQL
11100	PostgreSQL CRAM (MD5)
11000	PrestaShop
4522	PunBB
8500	RACF
12500	RAR3-hp
13000	RAR5
9900	Radmin2
7600	Redmine
6000	RipeMD160
7700	SAP CODVN B (BCODE)
7800	SAP CODVN F/G (PASSCODE)
10300	SAP CODVN H (PWDSALTEDHASH) iSSHA-1
8900	scrypt
1300	SHA-224

1400	SHA-256
1411	SSHA-256(Base64), LDAP {SSHA256}
5000	SHA-3(Keccak)
10800	SHA-384
1700	SHA-512
100	SHA1
14400	SHA1(CX)
110	sha1(\$pass.\$salt)
120	sha1(\$salt.\$pass)
130	sha1(unicode(\$pass).\$salt)
140	sha1(\$salt.unicode(\$pass))
4500	sha1 sha1(\$pass))
4520	sha1(\$salt.sha1(\$pass))
4700	sha1(md5(\$pass))
4900	sha1(\$salt.\$pass.\$salt)
1410	sha256(\$pass.\$salt)
1420	sha256(\$salt.\$pass)
1440	sha256(\$salt.unicode(\$pass))
1430	sha256(unicode(\$pass).\$salt)
7400	sha256crypt \$5\$, SHA256(Unix)
1710	sha512(\$pass.\$salt)
1720	sha512(\$salt.\$pass)
1740	sha512(\$salt.unicode(\$pass))
1730	sha512(unicode(\$pass).\$salt)
1800	sha512crypt \$6\$, SHA512(Unix)
11400	SIP digest authentication (MD5)
121	SMF (Simple Machines Forum)
1711	SSHA-512(Base64), LDAP {SSHA512}
10100	SipHash
14900	Skip32
23	Skype

8000	Sybase ASE
62XY	TrueCrypt
X	1 = PBKDF2-HMAC-RipeMD160
X	2 = PBKDF2-HMAC-SHA512
X	3 = PBKDF2-HMAC-Whirlpool
X	4 = PBKDF2-HMAC-RipeMD160 + boot-mode
Y	1 = XTS 512 bit pure AES
Y	1 = XTS 512 bit pure Serpent
Y	1 = XTS 512 bit pure Twofish
Y	2 = XTS 1024 bit pure AES
Y	2 = XTS 1024 bit pure Serpent
Y	2 = XTS 1024 bit pure Twofish
Y	2 = XTS 1024 bit cascaded AES-Twofish
Y	2 = XTS 1024 bit cascaded Serpent-AES
Y	2 = XTS 1024 bit cascaded Twofish-Serpent
Y	3 = XTS 1536 bit all
2611	vBulletin < V3.8.5
2711	vBulletin > V3.8.5
137XY	VeraCrypt
X	1 = PBKDF2-HMAC-RipeMD160
X	2 = PBKDF2-HMAC-SHA512
X	3 = PBKDF2-HMAC-Whirlpool
X	4 = PBKDF2-HMAC-RipeMD160 + boot-mode
X	5 = PBKDF2-HMAC-SHA256
X	6 = PBKDF2-HMAC-SHA256 + boot-mode
Y	1 = XTS 512 bit pure AES
Y	1 = XTS 512 bit pure Serpent
Y	1 = XTS 512 bit pure Twofish
Y	2 = XTS 1024 bit pure AES
Y	2 = XTS 1024 bit pure Serpent
Y	2 = XTS 1024 bit pure Twofish
Y	2 = XTS 1024 bit cascaded AES-Twofish

Y	2 = XTS 1024 bit cascaded Serpent-AES
Y	2 = XTS 1024 bit cascaded Twofish-Serpent
Y	3 = XTS 1536 bit all
8400	WBB3 (Wolflab Burning Board)
2500	WPA/WPA2
2501	WPA/WPA2 PMK
6100	Whirlpool
13600	WinZip
13800	Windows 8+ phone PIN/Password
400	Wordpress
21	xt:Commerce

TERMINAL COMMAND CHEAT SHEET

Ctrl + u

delete everything from the cursor to the beginning of the line

Ctrl + w

delete the previous word on the command line before the cursor

Ctrl + l

clear the terminal window

Ctrl + a

jump to the beginning of the command line

Ctrl + e

move your cursor to the end of the command line

Ctrl + r

search command history in reverse, continue pressing key sequence to continue backwards search. Esc when done or command found.

FILE MANIPULATION CHEAT SHEET

Extract all lowercase strings from each line and output to wordlist.

sed 's/[^a-z]*//g' wordlist.txt > outfile.txt

Extract all uppercase strings from each line and output to wordlist.

sed 's/[^A-Z]*//g' wordlist.txt > outfile.txt

Extract all lowercase/uppercase strings from each line and output to wordlist.

sed 's/[^a-Z]*//g' wordlist.txt > outfile.txt

Extract all digits from each line in file and output to wordlist.

sed 's/[^0-9]*//g' wordlist.txt > outfile.txt

Watch hashcat potfile or designated output file live.

watch -n .5 tail -50 <hashcat.potfile or outfile.txt>

Pull 100 random samples from wordlist/passwords for visual analysis.

```
shuf -n 100 file.txt
```

Print statistics on length of each string and total counts per length.

```
awk '{print length}' file.txt | sort -n | uniq -c
```

Remove all duplicate strings and count how many times they are present; then sort by their count in descending order.

```
uniq -c file.txt | sort -nr
```

Command to create quick & dirty custom wordlist with length 1-15 character words from a designated website into a sorted and counted list.

```
curl -s http://www.netmux.com | sed -e 's/<[^>]*>//g' | tr " " "\n" | tr -dc '[:alnum:]\n\r' | tr '[:upper:]' '[:lower:]' | cut -c 1-15 | sort | uniq -c | sort -nr
```

MD5 each line in a file (Mac OSX).

```
while read line; do echo -n $line | md5; done < infile.txt > outfile.txt
```

MD5 each line in a file (*Nix).

```
while read line; do echo -n $line | md5sum; done < infile.txt | awk -F " " '{print $1}' > outfile.txt
```

Remove lines that match from each file and only print remaining from file2.txt.

```
grep -vwF -f file1.txt file2.txt
```

Take two ordered files, merge and remove duplicate lines and maintain ordering.

```
nl -ba -s ': ' file1.txt >> outfile.txt  
nl -ba -s ': ' file2.txt >> outfile.txt  
sort -n outfile.txt | awk -F ":" '{print $2}' | awk '!seen[$0]++' > final.txt
```

Extract strings of a specific length into a new file/wordlist.

```
awk 'length == 8' file.txt > 8len-out.txt
```

Convert alpha characters on each line in file to lowercase characters.

tr [A-Z] [a-z] < infile.txt > outfile.txt

Convert alpha characters on each line in file to uppercase characters.

tr [a-z] [A-Z] < infile.txt > outfile.txt

Split a file into separate files by X number of lines per outfile.

split -d -l 3000 infile.txt outfile.txt

Reverse the order of each character of each line in the file.

rev infile.txt > outfile.txt

Sort each line in the file from shortest to longest.

awk '{print length,\$0}' "" \$0; }' infile.txt | sort -n | cut -d ' ' -f2-

Sort each line in the file from longest to shortest.

awk '{print length,\$0}' "" \$0; }' infile.txt | sort -r -n | cut -d ' ' -f2-

Substring matching by converting to HEX and then back to ASCII.

(Example searches for 5 character strings from file1.txt found as a substring in 20 character strings in file2.txt)

strings file1.txt | xxd -u -ps -c 5 | sort -u > out1.txt

strings file2.txt | xxd -u -ps -c 20 | sort -u > out2.txt

grep -Ff out1.txt out2.txt | xxd -r -p > results.txt

Clean dictionary/wordlist of newlines and tabs.

cat dict.txt | tr -cd "[:print :][\n\t]\n" > outfile.txt



EXTRACT HASHES



SYSTEM HASH EXTRACTION

WINDOWS

METERPRETER HASHDUMP

Post exploitation dump local SAM database:

meterpreter> run post/windows/gather/hashdump

CREDDUMP

<https://github.com/Neohapsis/creddump7>

Three modes of attack: cachedump, lsadump, pwdump

DUMP DOMAIN CACHED CREDENTIALS

Save Windows XP/Vista/7 registry hive tables

C:\WINDOWS\system32>reg.exe save HKLM\SAM sam_backup.hiv

**C:\WINDOWS\system32>reg.exe save HKLM\SECURITY
sec_backup.hiv**

C:\WINDOWS\system32>reg.exe save HKLM\system sys_backup.hiv

Run creddump tools against the saved hive files:

**cachedump.py <system hive> <security hive> <Vista/7>
(Vista/7)**

**cachedump.py sys_backup.hiv sec_backup.hiv true
(XP)**

cachedump.py sys_backup.hiv sec_backup.hiv false

DUMP LSA SECRETS

lsadump.py sys_backup.hiv sec_backup.hiv

DUMP LOCAL PASSWORD HASHES

pwdump.py sys_backup.hiv sec_backup.hiv

MIMIKATZ

Post exploitation commands must be executed from SYSTEM level privileges.

mimikatz # privilege::debug

mimikatz # token::whoami

mimikatz # token::elevate

mimikatz # lsadump::sam

Save Windows XP/Vista/7 registry tables

C:\WINDOWS\system32>reg.exe save HKLM\SAM sam_backup.hiv

C:\WINDOWS\system32>reg.exe save HKLM\SECURITY

C:\WINDOWS\system32>reg.exe save HKLM\system

mimikatz # lsadump::sam SystemBkup.hiv SamBkup.hiv

***NIX**

Requires root level privileges.

cat /etc/shadow

Example *NIX sha512crypt hash

root:\$6\$52450745\$k5ka2p8bFuSmoVTltz0yyuaREkkKBcCNqoDKzYiDI

MAC OSX 10.5-10.7

Manual OSX Hash Extraction

dscl localhost -read /Search/Users/<username>|grep GeneratedUID|cut -c15-cat /var/db/shadow/hash/<GUID> | cut -c169-216 > osx_hash.txt

MAC OSX 10.8-10.12

Manual OSX Hash Extraction

sudo defaults read /var/db/dslocal/nodes/Default/users/<username>.plist ShadowHashData|tr -dc ' 0-9a-f'|xxd -p -r|plutil -convert xml1 - -o -

Scripted OSX Hash Extraction

HASHCAT

<https://gist.github.com/nueh/8252572>

sudo plist2hashcat.py

/var/db/dslocal/nodes/Default/users/<username>.plist

JOHN

<https://github.com/truongkma/ctf-tools/blob/master/John/run/ml2john.py>

sudo ml2john.py /var/db/dslocal/nodes/Default/users/<username>.plist

PCAP HASH EXTRACTION

LOCAL NETWORK AUTHENTICATION

PCREDZ

Extracts network authentication hashes from pcaps.

Single pcap file:

Pcredz -f example.pcap

Multiple pcap files in a directory:

Pcredz -d /path/to/pcaps

Interface to listen on and collect:

Pcredz -i eth0

WPA/WPA2 PSK AUTHENTICATION

Capture the 4-way WPA/WPA2 authentication handshake.

AIRMON-NG / AIRODUMP-NG / AIREPLAY-NG

Step 1: Create monitoring interface mon0 Ex) interface wlan0

airmon-ng start wlan0

Step 2: Capture packets to file on target AP channel Ex) channel 11

airodump-ng mon0 --write capture.cap -c 11

Step 3: Start deauth attack against BSSID Ex) bb:bb:bb:bb:bb:bb

aireplay-ng --deauth 0 -a bb:bb:bb:bb:bb:bb mon0

Step 4: Wait for confirmation to appear at top of terminal:

CH 11][Elapsed: 25 s][<DATE / TIME>][WPA handshake: **

Step 5: Extract handshake into JOHN or HASHCAT format:

JOHN FORMAT EXTRACT

Step1: cap2hccap.bin -e '<ESSID>' capture.cap capture_out.hccap

Step2: hccap2john capture_out.hccap > jtr_capture

HASHCAT FORMAT EXTRACT

cap2hccapx.bin capture.cap capture_out.hccapx

MISC WLAN TOOLS

HCXTOOLS: capture and convert packets from wlan devices for use with Hashcat.

<https://github.com/ZerBea/hcxtools>

DATABASE HASH EXTRACTION

SQL queries require administrative privileges.

ORACLE 10g R2

**SELECT username, password FROM dba_users WHERE
username='<username>';**

ORACLE 11g R1

**SELECT name, password, spare4 FROM sys.user\$ WHERE
name='<username>';**

MySQL4.1 / MySQL5+

**SELECT User, Password FROM mysql.user INTO OUTFILE
'/tmp/hash.txt' ;**

MSSQL(2012), MSSQL(2014)

SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;

POSTGRES

SELECT username, passwd FROM pg_shadow;

MISCELLANEOUS HASH EXTRACTION

John The Ripper Jumbo comes with various programs to extract hashes:

NAME	DESCRIPTION
1password2john.py	1Password vault hash extract
7z2john.py	7zip encrypted archive hash extract
androidfde2john.py	Android FDE convert disks/images into JTR format
aix2john.py	AIX shadow file /etc/security/passwd
apex2john.py	Oracle APEX hash forming
bitcoin2john.py	Bitcoin old wallet hash extraction (check btcrecover)
blockchain2john.py	Blockchain wallet extraction
cisco2john.pl	Cisco config file ingestion/ extract
cracf2john.py	CRACF program crafc.txt files
dmg2john.py	Apple encrypted disk image
ecryptfs2john.py	eCryptfs disk encryption software
efs2john.py	Windows Encrypting File System (EFS) extract
encfs2john.py	EncFS encrypted filesystem userspace
gpg2john	PGP symmetrically encrypted files
hccap2john	Convert pcap capture WPA file to JTR format
htdigest2john.py	HTTP Digest authentication
ikescan2john.py	IKE PSK SHA256 authentication
kdcdump2john.py	Key Distribution Center (KDC) servers
keepass2john	Keepass file hash extract
keychain2john.py	Processes input Mac OS X keychain files
keyring2john	Processes input GNOME Keyring files

keystore2john.py	Output password protected Java KeyStore files
known_hosts2john.py	SSH Known Host file
kwallet2john.py	KDE Wallet Manager tool to manage the passwords
ldif2john.pl	LDAP Data Interchange Format (LDIF)
lion2john.pl	Converts an Apple OS X Lion plist file
lion2john-alt.pl	
lotus2john.py	Lotus Notes ID file for Domino
luks2john	Linux Unified Key Setup (LUKS) disk encryption
mcafee_epo2john.py	McAfee ePolicy Orchestrator password generator
ml2john.py	Convert Mac OS X 10.8 and later plist hash
mozilla2john.py	Mozilla Firefox, Thunderbird, SeaMonkey extract
odf2john.py	Processes OpenDocument Format ODF files
office2john.py	Microsoft Office [97-03, 2007, 2010, 2013) hashes
openbsd_softraid2john.py	OpenBSD SoftRAID hash
openssl2john.py	OpenSSL encrypted files
pcap2john.py	PCAP extraction of various protocols
pdf2john.py	PDF encrypted document hash extract
pfx2john	PKCS12 files
putty2john	PuTTY private key format
pwsafe2john	Password Safe hash extract
racf2john	IBM RACF binary database files
radius2john.pl	RADIUS protocol shared secret

rar2john	RAR 3.x files input into proper format
sap2john.pl	Converts password hashes from SAP systems
sipdump2john.py	Processes sipdump output files into JTR format
ssh2john	SSH private key files
sshng2john.py	SSH-ng private key files
strip 2john.py	Processes STRIP Password Manager database
sxc2john.py	Processes SXC files
truecrypt_volume2john	TrueCrypt encrypted disk volume
uaf2john	Convert OpenVMS SYSUAF file to unix-style file
vncpcap2john	TightVNC/RealVNCpcapsvs c3.3, 3.7 and 3.8 RFB
wpapcap2john	Converts PCAP or IVS2 files to JtR format
zip2john	Processes ZIP files extracts hash into JTR format



PASSWORD ANALYSIS



PASSWORD ANALYSIS

HISTORICAL PASSWORD ANALYSIS TIPS

- The average password length is 7-9 characters.
- The average English word is 5 characters long.
- The average person knows 50,000 to 150,000 words.
- 50% chance a user's password will contain one or more vowels.
- Women prefer personal names in their passwords, and men prefer hobbies.
- Most likely to be used symbols: ~, !, @, #, \$, %, &, *, and ?
- If a number, it's usually a 1 or 2, sequential, and will likely be at the end.
- If more than one number it will usually be sequential or personally relevant.
- If a capital letter, it's usually the beginning, followed by a vowel.
- 66% of people only use 1 - 3 passwords for all online accounts.
- One in nine people have a password based on the common Top 500 list.
- Western countries use lowercase passwords and Eastern countries prefer digits.

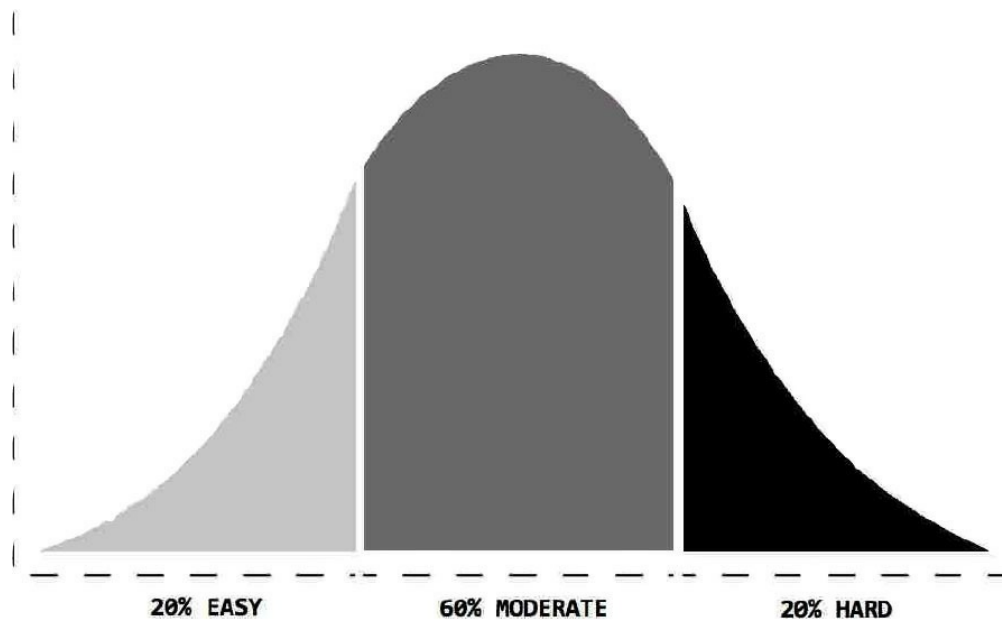
20-60-20 RULE

20-60-20 rule is a way to view the level of difficulty typically demonstrated by a large password dump, having characteristics that generally err on the side of a Gaussian Curve, mirroring the level of effort to recover said password dump.

20% of passwords are **easily** guessed dictionary words or known common passwords.

60% of passwords are **moderate** to slight variations of the earlier 20%.

20% of passwords are **hard**, lengthy, complex, or of unique characteristics.



EXAMPLE HASHES & PASSWORDS

This is an example list of passwords to help convey the variation and common complexities seen with typical password creation. It also shows individual user biases to aid in segmenting your attacks to be tailored toward a specific user.

#	HASH (MySQL 323)	PASSWORD	MASK
1	24CA195A48D85A11	BlueParrot345	?u?l?l?l?u?l?l?l?l?l?d?d?d
2	020261361E63A3FE	r0b3rt2017!	?u?d?l?d?l?l?d?d?d?d?s
3	42DF901246D99098	Ralph@Netmux.com	?u?l?l?l?l?s?u?l?l?l?l?l?s?l?l?l
4	7B6C1F5173EB4DD6	RedFerret789	?u?l?l?u?l?l?l?l?l?d?d?d
5	01085B1F3C3F49D2	Jennifer1981!	?u?l?l?l?l?l?l?l?l?d?d?d?s
6	080DBDB42AE6C3D7	7482Sacrifice	?d?d?d?d?u?l?l?l?l?l?l?l?l
7	111C232F67BC52BB	234CrowBlack	?d?d?d?u?l?l?l?u?l?l?l?l
8	1F3EF64F35878031	brownbooklamp	?l?l?l?l?l?l?l?l?l?l?l?l?l
9	4A659CDA12E9F2F1	Solitaire7482	?u?l?l?l?l?l?l?l?l?l?d?d?d?d
10	0B034EC713F89A68	password123	?l?l?l?l?l?l?l?l?l?d?d?d
11	28619CFE477235DE	5713063528	?d?d?d?d?d?d?d?d?d?d
12	60121DFD757911C3	74821234WorldCup	?d?d?d?d?d?d?d?d?u?l?l?l?l?u?l?l
13	6E84950D7FC8D13B	!q@w#e\$r%t^y	?s?l?s?l?s?l?s?l?s?l?s?l
14	33F82FA23197EBD3	1qaz2wsx3edc!@#	?d?l?l?l?d?l?l?l?d?l?l?l?s?s?s
15	544B4D3449C08787	X9z-2Qp-3qm-WGN	?u?d?l-?d?u?l-?d?l?l-?u?u?u

ALICE PASSWORDS	#(2,5,8,11,14)
BOB PASSWORDS	#(1,4,7,10,13)
CRAIG PASSWORDS	#(3,6,9,12,15)

CRACKING TIPS FOR EACH PASSWORD

ALICE PASSWORDS

R0b3rt2017!
Jennifer1981!
brownbooklamp
5713063528
1qaz2wsx3edc!@#

SIMPLE ANALYSIS

L33t Speak Name + Date !
Simple Name + Date !
3 Common Words Phrase
Possible Phone Number
Vertical+ Horizontal Walk

BASIC ATTACK STRATEGY

Simple Dictionary + Rule Attack
Hybrid Attack Dict + Mask
Combinator3 + Simple Dictionary
Custom or Simple Digit Mask
Straight Dict or Kwpprocessor

BOB PASSWORDS

BlueParrot345
RedFerret789
234CrowBlack
password123
!q@w#e\$r%t^y

SIMPLE ANALYSIS

Color+Animal+3_Seq_digits
Color+Animal+3_Seq_digits
3_Seq_digits+Animal+Color
Lowercase_word+3_Seq_digits
Vertical Keyboard Walk

BASIC ATTACK STRATEGY

Combo Dictionary + Rule Attack
Combo Dictionary + 3 Digit Mask
3 Digit Mask + Combo Dictionary
Straight Dictionary Attack
Straight Dictionary Attack

CRAIG PASSWORDS

Ralph@Netmux.com
7482Sacrifice
Solitaire7482
74821234WorldCup
X9z-2Qp-3qm-WGN

SIMPLE ANALYSIS

Name + Domain Name
4 Digits + Simple Word
Simple Word + 4 Digits
7482+ 4_Seq_digits+ Dict
Structured Random Pattern

BASIC ATTACK STRATEGY

Hybrid Attack Dict + @Netmux.com
Hybrid Attack Mask + Dict
Hybrid Attack Dict + Mask
Hybrid Attack 7482?d?d?d?d + Dict
Custom Mask X9z-2Qp-?d?l?l-?u?u?u

**This List of passwords will be referenced throughout the book and the List can also be found online at: <https://github.com/netmux/HASH-CRACK>*

PASSWORD PATTERN ANALYSIS

A password can contain many useful bits of information related to it's creator and their tendencies/patterns, but you have to break down the structure to decipher the meaning. This analysis process could be considered a sub-category of *Text Analytics*' and split into three pattern categories I'm calling: **Basic Pattern, Macro-Pattern, & Micro-Pattern.**

**Refer to [EXAMPLE HASH & PASSWORDS](#) chapter (pg.29) for numbered examples.*

Basic Pattern : visually obvious when compared to similar groupings (i.e. language and base word/words & digits). Let's look at Alice's passwords

(2,5):

R0b3rt**2017!**

Jennifer**1981!**

-Each password uses a name: R0b3rt & Jennifer

-Ending in a 4 digit date with common special character: **2017! & 1981!**

!TIP! This type of basic pattern lends itself to a simple dictionary and L33T speak rule appending dates or hybrid mask attack appending Dict+ ?d?d?d?d?s

Macro-Pattern : statistics about the passwords underlying structure such as length and character set. Let's look at Craig's passwords (6,9):

7482Sacrifice

Solitaire**7482**

-Length structure can be summed up as: **4 Digits** + 7 Alpha & 7 Alpha + **4 Digits**

-Uses charsets ?l?u?d , so we may be able to ignore special characters.

-Basic Pattern preference for the numbers **7482** and Micro-Pattern for capitalizing words beginning in “S”.

!TIP! You can assume this user is ‘unlikely’ to have a password less than 12 characters (+-1 char) and the 4 digit constant lowers the work to 8 chars. These examples lend themselves to a Hybrid Attack (Dict + 7482) or (7482 + Dict).

Micro-Pattern : subtlety and context which expresses consistent case changes, themes, and personal data/interest. Let's look at Bob's passwords (1,4)

BlueParrot**345**

RedFerret**789**

-Each password begins with a color: Blue & Red

-Second word is a type of animal: **Parrot & Ferret**

-Consistent capitalization of all words

-Lastly, ending in a 3 digit sequential pattern: 345 & 789

!TIP! This pattern lends itself to a custom combo dictionary and rule or hybrid mask attack appending sequential digits ?d?d?d

So when analyzing passwords be sure to group passwords and look for patterns such as language, base word/digit, length, character sets, and subtle themes with possible contextual meaning or password policy restrictions.

WESTERN COUNTRY PASSWORD ANALYSIS

Password Length Distribution based on large corpus of English website dumps:

7=15% 8=27% 9=15% 10=12% 11=4.8% 12=4.9% 13=

Character frequency analysis of a large corpus of English texts:

etaoinshrdlcumwfgypbvkjxqz

Character frequency analysis of a large corpus of English password dumps:

aeionrlstmcdyhubkgpjvfwzqxq

Top Western password masks out of a large corpus of English website dumps:

?1?1?1?1?1?1	6-Lowercase
?1?1?1?1?1?1?1	7-Lowercase
?1?1?1?1?1?1?1?1	8-Lowercase
?d?d?d?d?d?d	6-Digits
?1?1?1?1?1?1?1?1?1?1?1?1?1?1	12-Lowercase
?1?1?1?1?1?1?1?1?1	9-Lowercase
?1?1?1?1?1?1?1?1?1?1	10-Lowercase
?1?1?1?1?1	5-Lowercase
?1?1?1?1?1?1?d?d?1?1?1?1	6-Lowercase + 2-Digits + 4-Lowercase
?d?d?d?d?d?d?d?d?1?1?1?1	8-Digits + 4-Lowercase
?1?1?1?1?1?d?d	5-Lowercase + 2-Digits
?d?d?d?d?d?d?d?d	8-Digits
?1?1?1?1?1?1?d?d	6-Lowercase + 2-Digits
?1?1?1?1?1?1?1?1?d?d	8-Lowercase + 2-Digits

EASTERN COUNTRY PASSWORD ANALYSIS

Password Length Distribution based on large corpus of Chinese website dumps:

7=21% 8=22% 9=12% 10=12% 11=4.2% 12=.9% 13=.

Character frequency analysis of a large corpus of Chinese texts:

a**i****e****o****h****g****l****w****u****y****s****z****x****q****c****d****j****m****b****t****f****r****k****p****v**

Character frequency analysis of a large corpus of Chinese password dumps:

i**n****a****u****h****e****g****o****y****s****z****d****j****m****x****w****q****b****c****t****l****p****f****r****k****v**

Top Eastern password masks out of a large corpus of Chinese website dumps:

?d?d?d?d?d?d?d	8-Digits
?d?d?d?d?d?d	6-Digits
?d?d?d?d?d?d?d	7-Digits
?d?d?d?d?d?d?d?d	9-Digits
?d?d?d?d?d?d?d?d?d	10-Digits
?1?1?1?1?1?1?1?1	8-Digits
?d?d?d?d?d?d?d?d?d?d	11-Digits
?1?1?1?1?1?1	6-Lowercase
?1?1?1?1?1?1?1?1?1	9-Lowercase
?1?1?1?1?1?1?1	7-Lowercase
?1?1?1?d?d?d?d?d?d	3-Lowercase + 6-Digits
?1?1?d?d?d?d?d?d	2-Lowercase + 6-Digits
?1?1?1?1?1?1?1?1?1?1	10-Lowercase
?d?d?d?d?d?d?d?d?d?d?d	12-Digits

PASSWORD MANAGER ANALYSIS

Apple Safari Password Generator

-default password 15 characters with “-” & four groups of three random
u=ABCDEFGHIJKLMNOPQRSTUVWXYZ l=abcdefghijklmnopqrstuvwxyz and
d=3456789

Example) **X9z-2Qp-3qm-WGN**

XXX-XXX-XXX-XXX where X = ?u?l?d

Dashlane

-default password 12 characters using just letters and digits.

Example) **Up0k9ZAj54Kt**

XXXXXXXXXXXX where X = ?u?l?d

KeePass

-default password 20 characters using uppercase, lowercase, digits, and special.

Example) **\$Zt={EcgQ.Umf)R,C7XF**

XXXXXXXXXXXXXXXXXXXX where X = ?u?l?d?s

LastPass

-default password 12 characters using at least one digit, uppercase and lowercase.

Example) **msfNdkG29n38**

XXXXXXXXXXXX where X = ?u?l?d

RoboForm

-default password 15 characters using uppercase, lowercase, digits, and special with a minimum of 5 digits.

Example) **871v2%%4F0w31zJ**

XXXXXXXXXXXXXXX where X = ?u?l?d?s

Symantec Norton Identity Safe

-default password 8 characters using uppercase, lowercase, and digits.

Example) **Ws81f0Zg**

XXXXXXX where X = ?u?l?d

True Key

-default password 16 characters using uppercase, lowercase, digits, and special.

Example) **1B1H:9N+@>+sgWs**

XXXXXXXXXXXXXXXXXX where X = ?u?l?d?s

1Password v6

-default password 24 characters using uppercase, lowercase, digits, and special.

Example) **cTmM7Tzm6iPhCdpMu. * V] , VP**
XXXXXXXXXXXXXXXXXXXXXXXXXXXX where X = ?u?!?d?s

PACK (Password Analysis and Cracking Kit)

<http://thesprawl.org/projects/pack/>

STATSGEN

Generate statistics about the most common length, percentages, character-set and other characteristics of passwords from a provided list.

python statsgen.py passwords.txt

STATSGEN OPTIONS

-o <file.txt>	output stats and masks to file
--hiderare	hide stats of passwords with less than 1% of occurrence
--minlength=	minimum password length for analysis
--maxlength=	maximum password length for analysis
--charset=	password char filter: loweralpha, upperalpha, numeric, special
--simplemask=	password mask filter: string, digit, special

STATSGEN EXAMPLES

Output stats of passwords.txt to file example.mask:

python statsgen.py passwords.txt -o example.mask

Hide less than 1% occurrence; only analyze passwords 7 characters and greater:

python statsgen.py passwords.txt --hiderare --minlength=7 -o example.mask

Stats on passwords with only numeric characters:

python statsgen.py passwords.txt --charset=numeric

ZXCVBN (LOW-BUDGET PASSWORD STRENGTH ESTIMATION)

A realistic password strength (entropy) estimator developed by Dropbox.

<https://github.com/dropbox/zxcvbn>

PIPAL (THE PASSWORD ANALYSER)

Password analyzer that produces stats and pattern frequency analysis.

<https://digi.ninja/projects/pipal.php>

pipal.rb -o outfile.txt passwords.txt

PASSPAT (PASSWORD PATTERN IDENTIFIER)

Keyboard pattern analysis tool for passwords.

<https://digi.ninja/projects/passpat.php>

passpat.rb --layout us passwords.txt

CHARACTER FREQUENCY ANALYSIS

Character frequency analysis is the study of the frequency of letters or groups of letters in a corpus/text. This is the basic building block of Markov chains.

Character-Frequency-CLI-Tool

Tool to analyze a large list of passwords and summarize the character frequency. <https://github.com/jcchurch/Character-Frequency-CLI-Tool>

charfreq.py <options> passwords.txt

Options: -w Window size to analyze, default=1
 -r Rolling window size

-s Skip spaces, tabs, newlines

ONLINE PASSWORD ANALYSIS RESOURCES

WEAKPASS

Analyzes public password dumps and provides efficient dictionaries for download.

<http://weakpass.com/>

PASSWORD RESEARCH

Important password security and authentication research papers in one place.

<http://www.passwordresearch.com/>

THE PASSWORD PROJECT

Compiled analysis of larger password dumps using PIPAL and PASSPAL tools.

http://www.thepasswordproject.com/leaked_password_lists_and_dictionaries



DICTIONARY / WORDLIST



DICTIONARY / WORDLIST

DOWNLOAD RESOURCES

WEAKPASS

<http://weakpass.com/wordlist>

CRACKSTATION DICTIONARY

<https://crackstation.net/buy-crackstation-wordlist-password-cracking-dictionary.htm>

HAVE I BEEN PWNED

*You'll have to crack the SHA1's

<https://haveibeenpwned.com/passwords>

SKULL SECURITY WORDLISTS

<https://wiki.skullsecurity.org/index.php?title=Passwords>

CAPSOP

<https://wordlists.capsop.com/>

UNIX-NINJA DNA DICTIONARY

Dictionary link at bottom of article

https://www.unix-ninja.com/p/Password_DNA

PROBABLE-WORDLIST

<https://github.com/berzerk0/Probable-Wordlists>

EFF-WORDLIST

Long-list (7,776 words) & Short-list (1,296 words)

https://www.eff.org/files/2016/07/18/eff_large_wordlist.txt

https://www.eff.org/files/2016/09/08/eff_short_wordlist_1.txt

RAINBOW TABLES

Rainbow Tables are for the most part obsolete but provided here for reference

<http://project-rainbowcrack.com/table.htm>

WORDLIST GENERATION

JOHN THE RIPPER

Generate wordlist that meets complexity specified in the complex filter.

```
john --wordlist=dict.txt --stdout --external : [filter name] > outfile.txt
```

STEMMING PROCESS

Stripping characters from a password list to reach the “stem” or base word/words of the candidate password. Commands are from “File Manipulation Cheat Sheet”.

Extract all lowercase strings from each line and output to wordlist.

```
sed 's/^[a-z]*//g' passwords.txt > outfile.txt
```

Extract all uppercase strings from each line and output to wordlist.

```
sed 's/^[A-Z]*//g' passwords.txt > outfile.txt
```

Extract all lowercase/uppercase strings from each line and output to wordlist.

```
sed 's/^[a-Z]*//g' passwords.txt > outfile.txt
```

Extract all digits from each line in file and output to wordlist.

```
sed 's/^[0-9]*//g' passwords.txt > outfile.txt
```

HASHCAT UTILS

https://hashcat.net/wiki/doku.php?id=hashcat_utils

COMBINATOR

Combine multiple wordlists with each word appended to the other.

```
combinator.bin dict1.txt dict2.txt > combined_dict.txt
```

```
combinator3.bin dict1.txt dict2.txt dict3.txt > combined_dict.txt
```

CUTB

Cut the specific length off the existing wordlist and pass it to STDOUT.

```
cutb.bin offset [length] < infile.txt > outfile.txt
```

Example to cut first 4 characters in a wordlist and place into a file:

```
cutb.bin 0 4 < dict.txt > outfile.txt
```

RLI

Compares a file against another file or files and removes all duplicates.

```
rli dict1.txt outfile.txt dict2.txt
```

REQ

Dictionary candidates are passed to stdout if it matches an specified password group criteria/requirement. Groups can be added together (i.e. 1 + 2 = 3)

1 = LOWER (abcdefghijklmnopqrstuvwxyz)

2 = UPPER (ABCDEFGHIJKLMNOPQRSTUVWXYZ)

4 = DIGIT (0123465789)

8 = OTHER (All other characters not matching 1,2, or 4)

This example would stdout all candidates matching upper and lower characters

```
req.bin 3 < dict.txt
```

COMBIPOW

Creates “unique combinations” of a custom dictionary; dictionary cannot be greater than 64 lines; option -1 limits candidates to 15 characters.

```
combipow.bin dict.txt
```

```
combipow.bin -1 dict.txt
```

EXPANDER

Dictionary into stdin is parsed and split into all its single chars (up to 4) and sent to stdout.

```
expander.bin < dict.txt
```

LEN

Each candidate in a dictionary is checked for length and sent to stdout.

```
len.bin <min len> <max len> < dict.txt
```

This example would send to stdout all candidates 5 to 10 chars long.

```
len.bin 5 10 < dict.txt
```

MORPH

Auto generates insertion rules for the most frequent chains of characters

```
morph.bin dict.txt depth width pos_min pos_max
```

PERMUTE

Dictionary into stdin parsed and run through “The Countdown QuickPerm Algorithm”

```
permute.bin < dict.txt
```

CRUNCH

Wordlist generator can specify a character set and generate all possible combinations and permutations.

<https://sourceforge.net/projects/crunch-wordlist/>

```
crunch <min length> <max length> <character set> -o outfile.txt
```

```
crunch 8 8 0123456789ABCDEF -o crunch_wordlist.txt
```

TARGETED WORDLISTS

CeWL

Custom wordlist generator scrapes & compiles keywords from websites.

<https://digi.ninja/projects/cewl.php>

Example scan depth of 2 and minimum word length of 5 output to wordlist.txt

cewl -d 2 -m 5 -w wordlist.txt http://<target website>

SMEEGESCRAPE

Text file and website scraper which generates custom wordlists from content.

<http://www.smeegesec.com/2014/01/smeegescrape-text-scraper-and-custom.html>

Compile unique keywords from text file and output into wordlist.

SmeegScrape.py -f file.txt -o wordlist.txt

Scrape keywords from target website and output into wordlist.

SmeegScrape.py -u http://<target website> -si -o wordlist.txt

GENERATE PASSWORD HASHES

Use the below methods to generate hashes for specific algorithms.

HASHCAT

<https://github.com/hashcat/hashcat/tree/master/tools>

test.pl passthrough <#type> <#> dict.txt

MDXFIND

<https://hashes.org/mdxfind.php>

echo | mdxfind -z -h '<#type>' dict.txt

LYRICPASS (Song Lyrics Password Generator)

<https://github.com/initstring/lyricpass>

Generator using song lyrics from chosen artist to create custom dictionary.

python lyricpass.py "Artist Name" artist-dict.txt

CONVERT WORDLIST ENCODING

HASHCAT

Force internal wordlist encoding from X

hashcat -a 0 -m #type hash.txt dict.txt --encoding-from=utf-8

Force internal wordlist encoding to X

hashcat -a 0 -m #type hash.txt dict.txt --encoding-to=iso-8859-15

ICONV

Convert wordlist into language specific encoding

iconv -f <old_encode> -t <new_encode> < dict.txt | sponge dict.txt.enc

CONVERT HASHCAT \$HEX OUTPUT

Example of converting \$HEX[] entries in hashcat.potfile to ASCII

```
grep '$HEX' hashcat.pot | awk -F ":" { 'print $2' } | perl -ne ' i f ($_ =~ m/$HEX\ ([A-Za-f0-9]+\))/ {print pack ("H*", $1), "\n"}'
```

EXAMPLE CUSTOM DICTIONARY CREATION

1-Create a custom dictionary using CeWL from www.netmux.com website:

cewl -d 2 -m 5 -w custom_dict.txt <http://www.netmux.com>

2-Combine the new custom_dict.txt with the Google 10,000 most common English words: <https://github.com/first20hours/google-10000-english>

cat google-1000.txt >> custom_dict.txt

3-Combine with Top 196 passwords from “Probable Wordlists”:
github.com/berzerk0/Probable-Wordlists/blob/master/Real-Passwords

cat Top196-probable.txt >> custom_dict.txt

4-Combo the Top196-probable.txt together using Hashcat-util
“combinator.bin” and add it to our custom_dict.txt

**combinator.bin Top196-probable.txt Top196-probable.txt >>
custom_dict.txt**

5-Run the best64.rule from Hashcat on Top196-probable.txt and send that
output into our custom dictionary:

**hashcat -a 0 Top196-probable.txt -r best64.rule --stdout >>
custom_dict.txt**

Can you now come up with an attack that can crack this hash?

e4821dl6a298092638ddb7cad26d32f

**Answer in the Appendix*



RULES & MASKS



RULES & MASKS

RULE FUNCTIONS

Following are compatible between Hashcat, John The Ripper, & PasswordPro https://hashcat.net/wiki/doku.php?id=rule_based_attack

NAME	FUNCTION	DESCRIPTION
Nothing	:	Do nothing
Lowercase	l	Lowercase all letters
Uppercase	u	Uppercase all letters
Capitalize	c	Capitalize the first letter and lower the rest
Invert Capitalize	C	Lowercase first character, uppercase rest
Toggle Case	t	Toggle the case of all characters in word.
Toggle @	TN	Toggle the case of characters at position N
Reverse	r	Reverse the entire word
Duplicate	d	Duplicate entire word
Duplicate N	pN	Append duplicated word N times
Reflect	f	Duplicate word reversed
Rotate Left	{	Rotates the word left.
Rotate Right	}	Rotates the word right
AppendChar	\$X	Append character X to end
PrependChar	^X	Prepend character X to front
Truncate left	[	Deletes first character
Truncate right	]	Deletes last character
Delete @ N	DN	Deletes character at position N
Extract range	xNM	Extracts M characters, starting at position N
Omit range	ONM	Deletes M characters, starting at position N
Insert @ N	iNX	Inserts character X at position N
Overwrite @ N	oNX	Overwrites character at position N with X
Truncate @ N	'N	Truncate word at position N
Replace	sXY	Replace all instances of X with Y
Purge	@X	Purge all instances of X
Duplicate first N	zN	Duplicates first character N times
Duplicate last N	ZN	Duplicates last character N times
Duplicate all	q	Duplicate every character
Extract memory	XNMI	Insert substring of length M starting at position N of word in memory at position I
Append memory	4	Append word in memory to current word
Prepend memory	6	Prepend word in memory to current word
Memorize	M	Memorize current word

RULES TO REJECT PLAINS

https://hashcat.net/wiki/doku.php?id=rule_based_attack

NAME	FUNCTION	DESCRIPTION
Reject less	<N	Reject plains of length greater than N
Reject greater	>N	Reject plains of length less than N
Reject contain	!X	Reject plains which contain char X
Reject not contain	/X	Reject plains which do not contain char X
Reject equal first	(X	Reject plains which do not start with X
Reject equal last	)X	Reject plains which do not end with X
Reject equal at	=NX	Reject plains which do not have char X at position N
Reject contains	%NX	Reject plains which contain char X less than N times
Reject contains	Q	Reject plains where the memory saved matches current word

IMPLEMENTED SPECIFIC FUNCTIONS

Following functions are not compatible with John The Ripper & PasswordPro

NAME	FUNCTION	DESCRIPTION
Swap front	k	Swaps first two characters
Swap back	K	Swaps last two characters
Swap @ N	*XY	Swaps character X with Y
Bitwise shift left	LN	Bitwise shift left character @ N
Bitwise shift right	RN	Bitwise shift right character @ N
Ascii increment	+N	Increment character @ N by 1 ascii value
Ascii decrement	-N	Decrement character @ N by 1 ascii value
Replace N + 1	.N	Replaces character @ N with value at @ N plus 1
Replace N - 1	,N	Replaces character @ N with value at @ N minus 1
Duplicate block front	yN	Duplicates first N characters
Duplicate block back	YN	Duplicates last N characters
Upper Lower	E	Lower case the whole line, then upper case the first letter and every letter after a space

RULE ATTACK CREATION

EXAMPLE RULE CREATION & OUTPUT

Below we apply basic rules to help explain the expected output when using rules.

<u>WORD</u>	<u>RULE</u>	<u>OUTPUT</u>
password	\$1	password1
password	^!^1	1!password
password	so0 sa@	p@ssw0rd
password	c so0 sa@ \$1	P@ssw0rd1
password	u r	DROWSSAP

MASKPROCESSOR HASHCAT-UTIL

<https://github.com/hashcat/maskprocessor>

Maskprocessor can be used to generate a long list of rules very quickly.

Example rule creation of prepend digit and special char to dictionary candidates (i.e. ^! ^! , ^2 ^@ , . . .) :

```
mp64.bin '^?d ^?s' -o rule.txt
```

Example creating rule with custom charset appending lower, uppercase chars and all digits to dictionary candidates (i.e. \$a \$Q \$1 , \$e \$ A \$2, . . .) :

```
mp64.bin -1 aeiou -2 QAZWSX '$?1 $?2 $?d'
```

GENERATE RANDOM RULES ATTACK (i.e. “Raking”)

```
hashcat -a 0 -m #type -g <#rules> hash.txt dict.txt
```

GENERATE RANDOM RULES FILE USING HASHCAT-UTIL

```
generate-rules.bin <#rules> <seed> | ./cleanup-rules.bin [1=CPU,2=GPU] > out.txt
```

```
generate-rules.bin 1000 42 | ./cleanup-rules.bin 2 > out.txt
```

SAVE SUCCESSFUL RULES/METRICS

```
hashcat -a 0 -m #type --debug-mode=1 --debug-file=debug.txt hash.txt -r rule.txt
```

SEND RULE OUTPUT TO STDOUT / VISUALLY VERIFY RULE OUTPUT

```
hashcat dict.txt -r rule.txt --stdout
```

```
john --wordlist=dict.txt --rules=example --stdout
```

PACK (Password Analysis and Cracking Kit) RULE CREATION

<http://thesprawl.org/projects/pack/>

RULEGEN

Advanced techniques for reversing source words and word mangling rules from already cracked passwords by continuously recycling/expanding generated rules and words. Outputs rules in Hashcat format.

<http://thesprawl.org/research/automatic-password-rule-analysis-generation/>

****Ensure you install 'AppleSpell' 'aspell' module using packet manager****

```
python rulegen.py --verbose --password P@ssw0rdl23
```

RULEGEN OPTIONS

-b rockyou	Output base name. The following files will be generated: basename.words, basename.rules and basename.stats
-w wiki.dict	Use a custom wordlist for rule analysis.
-q, --quiet	Don't show headers.
--threads=THREADS	Parallel threads to use for processing.

Fine tune source word generation::

--maxworddist=10	Maximum word edit distance (Levenshtein)
--maxwords=5	Maximum number of source word candidates to consider

--morewords	Consider suboptimal source word candidates
--simplewords	Generate simple source words for given password

Fine tune rule generation::

--maxrulelen=10	Maximum number of operations in a single rule
--maxrules=5	Maximum number of rules to consider
--morerules	Generate suboptimal rules
--simplerules	Generate simple rules insert,delete,replace
--bruterules	Bruteforce reversal and rotation rules (slow)

Fine tune spell checker engine::

--providers=aspell,myspell	Comma-separated list of provider engines
----------------------------	--

Debugging options::

-v, --verbose	Show verbose information.
-d, --debug	Debug rules.
--password	Process the last argument as a password not a file
--word=Password	Use a custom word for rule analysis
--hashcat	Test generated rules with hashcat-cli

RULEGEN EXAMPLES

Analysis of a single password to automatically detect rules and potential source word used to generate a sample password:

```
python rulegen.py --verbose --password P@ssw0rdl23
```

Analyze passwords.txt and output results:

```
python rulegen.py passwords.txt -q
```

analysis.word - unsorted and non-unique source words
analysis-sorted.word - occurrence sorted and unique source words
analysis.rule - unsorted and non-unique rules
analysis-sorted.rule - occurrence sorted and unique rules

HASHCAT INCLUDED RULES**Approx # Rules**

Incisive-leetspeak.rule	15,487
InsidePro-HashManager.rule	6,746
InsidePro-PasswordsPro.rule	3,254
T0XlC-insert_00-99_1950-2050_toprules_0_F.rule	4,019
T0XlC-insert_space_and_special_0_F.rule	482
T0XlC-insert_top_100_passwords_1_G.rule	1,603
T0XlC.rule	4,088
T0XlCv1.rule	11,934
best64.rule	77
combinator.rule	59
d3ad0ne.rule	34,101
dive.rule	99,092
generated.rule	14,733
generated2.rule	65,117
leetspeak.rule	29
oscommerce.rule	256
rockyou-30000.rule	30,000
specific.rule	211
toggles1.rule	15
toggles2.rule	120
toggles3.rule	575
toggles4.rule	1,940
toggles5.rule	4,943
unix-ninja-leetspeak.rule	3,073

JOHN INCLUDED RULES**Approx # Rules**

All (Jumbo + KoreLogic)	7,074,300
Extra	17
Jumbo (Wordlist + Single + Extra + NT + OldOffice)	226
KoreLogic	7,074,074
Loopback (NT + Split)	15

NT	14
OldOffice	1
Single	169
Single-Extra (Single + Extra + OldOffice)	187
Split	1
Wordlist	25

<http://www.openwall.com/john/doc/RULES.shtml>

CUSTOM RULE PLANS

<u>L33TSP3@K RULES</u>	<u>2 DIGIT APPEND</u>	<u>\$APPEND/^PREPEND DATE</u>
so0	\$0 \$0	\$1 \$9 \$9 \$5
si1	\$0 \$1	^5 ^9 ^9 ^1
se3	\$0 \$2	\$2 \$0 \$0 \$0
ss5	\$1 \$1	^0 ^0 ^0 ^2
sa@	\$1 \$2	\$2 \$0 \$1 \$0
s00	\$1 \$3	^0 ^1 ^0 ^2
sI1	\$2 \$1	\$2 \$0 \$1 \$7
sE3	\$2 \$2	^7 ^1 ^0 ^2
ss5	\$6 \$9	\$2 \$0 \$1 \$8
sA@	\$9 \$9	^8 ^1 ^0 ^2

<u>TOP 10 dive.rule</u>	<u>TOP 10 best64.rule</u>	<u>TOP 10 rockyou.rule</u>
c	:	:
l	r	\$1
u	u	r
T0	T0	\$2
\$1	\$0	\$1 \$2 \$3
} } } }	\$1	\$1 \$2
p3	\$2	\$3
[	\$3	\$7
\$.	\$4	^1
]	\$5	\$1 \$3

MASK ATTACK CREATION

DEBUG / VERIFY MASK OUTPUT

```
hashcat -a 3 ?a?a?a?a --stdout  
john --mask=?a?a?a?a --stdout
```

HASHCAT MASK ATTACK CREATION

Example usage:

```
hashcat -a 3 -m #type hash.txt <mask>
```

Example brute-force all possible combinations 7 characters long:

```
hashcat -a 3 -m #type hash.txt ?a?a?a?a?a?a
```

Example brute-force all possible combinations 1 - 7 characters long:

```
hashcat -a 3 -m #type hash.txt -i ?a?a?a?a?a?a
```

Example brute-force uppercase first letter, 3 unknown middle characters, and ends in 2 digits (i.e. Pass12):

```
hashcat -a 3 -m #type hash.txt ?u?a?a?a?d?d
```

Example brute-force known first half word “secret” and unknown ending:

```
hashcat -a 3 -m #type hash.txt secret?a?a?a
```

Example hybrid mask (leftside) + wordlist (rightside) (i.e. 123!Password)

```
hashcat -a 7 -m #type hash.txt ?a?a?a?a dict.txt
```

Example wordlist (leftside) + hybrid mask (rightside) (i.e. Password123!)

```
hashcat -a 6 -m #type hash.txt dict.txt ?a?a?a?a
```

HASHCAT CUSTOM CHARSETS

Four custom buffer charsets to create efficient targeted mask attacks defined as: -1 -2 -3 -4

Example custom charset targeting passwords that only begin in a,A,b,B,or c,C , 4 unknown middle characters, and end with a digit (i.e. a17z#q7): hashcat -a 3 -m #type hash.txt -1 abcABC ?l?a?a?a?a?d

Example custom charset targeting passwords that only begin in uppercase or lowercase, 4 digits in the middle, and end in special character !,@,\$ (i.e. W7462! or f1234\$):

```
hashcat -a 3 -m #type hash.txt -1 ?u?l -2 !@$ ?l?d?d?d?d?2
```

Example using all four custom charsets at once (i.e. pow!12er):

```
hashcat -a 3 -m #type hash.txt -1 qwer -2 poiu -3 123456 -4 !@#% ?2?2?1?  
4?3?3? 1?1
```

JOHN MASK ATTACK CREATION

Example usage:

```
john --format=#type hash.txt --mask=<mask>
```

Example brute-force all possible combinations up to 7 characters long:

```
john --format=#type hash.txt --mask=?a?a?a?a?a?a?
```

Example brute-force uppercase first letter, 3 unknown middle characters, and ends in 2 digits (i.e. Passl2):

```
john --format=#type hash.txt --mask=?u?a?a?a?d?d
```

Example brute-force known first half word “secret” and unknown ending:

```
john --format=#type hash.txt --mask=secret?a?a?a?
```

Example mask (leftside) + wordlist (rightside) (i.e. 123!Password)

```
john --format=#type hash.txt --wordlist=dict.txt --mask=?a?a?a?a?w
```

Example wordlist (leftside) + mask (rightside) (i.e. Password123!)

```
john --format=#type hash.txt --wordlist=dict.txt --mask=?w?a?a?a?
```

JOHN CUSTOM CHARSETS

Nine custom buffer charsets to create efficient targeted mask attacks defined as: -1 -2 -3 -4 -5 -6 -7 -8 -9

Example custom charset targeting passwords that only begin in a,A,b,B,or c,C , 4 unknown middle characters, and end with a digit (i.e. a17z#q7):

```
john --format=#type hash.txt -1=abcABC --mask=?l?a?a?a?a?d
```

Example custom charset targeting passwords that only begin in uppercase or lowercase, 4 digits in the middle, and end in special

character !, @, \$ (i.e. W7462! or f1234\$):

john --format=#type hash.txt -1=?u?l -2=!@\$ --mask=?l?d?d?d?d?2

Example using four custom charsets at once (i.e. pow!12er):

john --format=#type hash.txt -1=qwer -2=poiu -3=123456 -4=!@\$%, --mask=?2?2?l?4? 3?3?1?1

HASHCAT MASK CHEAT SHEET

?l	= lowercase	= 26 chars	= abcdefghijklmnopqrstuvwxyz
?u	= uppercase	= 26 chars	= ABCDEFGHIJKLMNOPQRSTUVWXYZ
?d	= digits	= 10 chars	= 0123456789
?s	= special	= 33 chars	= «space»!"#\$%&'()*+,-./:;<=>?@[\\]^_`{ }~
?a	= all	= 95 chars	= lowercase+uppercase+digits+special
?h	= hex	= 16 chars	= 0123456789abcdef
?H	= HEX	= 16 chars	= 0123456789ABCDEF
?b	= byte	= 256 byte	= 0x00 - 0xff

JOHN MASK CHEAT SHEET

?l	= lowercase	= 26 chars	= abcdefghijklmnopqrstuvwxyz
?u	= uppercase	= 26 chars	= ABCDEFGHIJKLMNOPQRSTUVWXYZ
?d	= digits	= 10 chars	= 0123456789
?s	= special	= 33 chars	= «space»!"#\$%&'()*+,-./:;<=>?@[\\]^_`{ }~
?a	= all	= 95 chars	= lowercase+uppercase+digits+special
?h	= hex	= 0x80 - 0xff	
?A	= all valid characters in the current code page		
?h	= all 8-bit (0x80-0xff)		
?H	= all except the NULL character		
?L	= non-ASCII lower-case letters		
?U	= non-ASCII upper-case letters		
?D	= non-ASCII "digits"		
?S	= non-ASCII "specials"		
?w	= Hybrid mask mode placeholder for the original word		

MASK FILES

Hashcat allows for the creation of mask files by placing custom masks, one

per line, in a text f i l e with “.hcmask” extension.

HASHCAT BUILT-IN MASK FILES	Approx # Masks
8char-11-1u-1d-1s-compliant.hcmask	40,824
8char-11-1u-1d-1s-noncompliant.hcmask	24,712
rockyou-1-60.hcmask	836
rockyou-2-1800.hcmask	2,968
rockyou-3-3600.hcmask	3,971
rockyou-4-43200.hcmask	7,735
rockyou-5-86400.hcmask	10,613
rockyou-6-864000.hcmask	17,437
rockyou-7-2592000.hcmask	25,043

WESTERN COUNTRY TOP MASKS

?1?1?1?1?1?1	6-Lowercase
?1?1?1?1?1?1?1	7-Lowercase
?1?1?1?1?1?1?1?1	8-Lowercase
?d?d?d?d?d?d	6-Digits
?1?1?1?1?1?1?1?1?1?1?1?1	12-Lowercase
?1?1?1?1?1?1?1?1?1	9-Lowercase
?1?1?1?1?1?1?1?1?1?1	10-Lowercase
?1?1?1?1?1	5-Lowercase
?1?1?1?1?1?1?d?d?1?1?1?1	6-Lowercase + 2-Digits + 4-Lowercase
?d?d?d?d?d?d?d?d?1?1?1?1	8-Digits + 4-Lowercase
?1?1?1?1?1?d?d	5-Lowercase + 2-Digits
?d?d?d?d?d?d?d?d	8-Digits
?1?1?1?1?1?1?d?d	6-Lowercase + 2-Digits
?1?1?1?1?1?1?1?1?d?d	8-Lowercase + 2-Digits

EASTERN COUNTRY TOP MASKS

?d?d?d?d?d?d?d?d	8-Digits
?d?d?d?d?d?d	6-Digits
?d?d?d?d?d?d?d	7-Digits
?d?d?d?d?d?d?d?d	9-Digits
?d?d?d?d?d?d?d?d?d	10-Digits
?1?1?1?1?1?1?1?1	8-Digits
?d?d?d?d?d?d?d?d?d?d	11-Digits
?1?1?1?1?1?1	6-Lowercase
?1?1?1?1?1?1?1?1	9-Lowercase
?1?1?1?1?1?1?1	7-Lowercase
?1?1?1?d?d?d?d?d?d	3-Lowercase + 6-Digits
?1?1?d?d?d?d?d?d	2-Lowercase + 6-Digits
?1?1?1?1?1?1?1?1?1	10-Lowercase
?d?d?d?d?d?d?d?d?d?d	12-Digits

PACK (Password Analysis and Cracking Kit) MASK CREATION

<http://thesprawl.org/projects/pack/>

MASKGEN

MaskGen allows you to automatically generate pattern-based mask attacks from known passwords and filter by length and desired cracking time.

python maskgen.py example.mask

MASKGEN OPTIONS

-t target cracking time of all masks combined (seconds)
 -o <file.hcmask> output masks to a file
 --showmasks show matching masks

Individual Mask Filter Options:

--minlength=8 Minimum password length
 --maxlength=8 Maximum password length
 --mintime=3600 Minimum mask runtime (seconds)
 --maxtime=3600 Maximum mask runtime (seconds)
 --mincomplexity=1 Minimum complexity
 --maxcomplexity=100 Maximum complexity
 --minoccurrence=1 Minimum occurrence
 --maxoccurrence=100 Maximum occurrence

Mask Sorting Options:

--optindex sort by mask optindex (default)
--occurrence sort by mask occurrence
--complexity sort by mask complexity

Check mask coverage:

--checkmasks=?u?1?1?1?1?1?d,?1?1?1?1?1?d?d check mask coverage
--checkmasksfile=masks.hcmask check mask coverage in a file

Miscellaneous options:

--pps=1000000000 Passwords per Second

MASKGEN EXAMPLES

Gather stats about cracked passwords.txt and hide the less than 1% results:

python statsgen.py --hiderare passwords.txt

Save masks stats to a .mask file for further analysis:

python statsgen.py --hiderare passwords.txt -o example.mask

Analyze example.mask results, number of masks, estimated time to crack, etc...

python maskgen.py example.mask

Create 24 hour (86400 seconds) mask attack based on cracking speed of a single GTX 1080 against MD5 hashes 24943.1 MH/s(based on appendix table).

!Substitute your GPU's cracking speed against MD5 (c/s)!.

python maskgen.py example.mask --targettime=86400 --optindex --pps=24943000000 -q

Output 24 hour mask attack to a .hcmask file for use in Hashcat:

python maskgen.py example.mask --targettime=86400 --optindex --pps=24943000000 -q -o example.hcmask

Use your new example.hcmask file with Hashcat in mask attack mode:

hashcat -a 3 -m #type hash.txt example.hcmask

TIME TABLE CHEAT SHEET

60 seconds	1 minute
3,600 seconds	1 hour
86,400 seconds	1 day
604,800 seconds	1 week
1,209,600 seconds	1 fortnight
2,419,200 seconds	1 month (30days)
31,536,000 seconds	1 year

POLICYGEN

Generate a collection of masks following the password complexity in order to significantly reduce the cracking time.

python policygen.py [options] -o example.hcmask

POLICYGEN OPTIONS

-o masks.hcmask	Save masks to a file
--pps=1000000000	Passwords per Second
--showmasks	Show matching masks
--noncompliant	Generate masks for noncompliant passwords
-q, --quiet	Don't show headers.

Password Policy:

Define the minimum (or maximum) password strength policy that you would like to test

--minlength=8	Minimum password length
--maxlength=8	Maximum password length
--mindigit=1	Minimum number of digits
--minlower=1	Minimum number of lower-case characters
--minupper=1	Minimum number of upper-case characters
--minspecial=1	Minimum number of special characters
--maxdigit=3	Maximum number of digits
--maxlower=3	Maximum number of lower-case characters
--maxupper=3	Maximum number of upper-case characters
--maxspecial=3	Maximum number of special characters

POLICYGEN EXAMPLES

Generate mask attack for password policy 8 character length requiring at least 1 lowercase, 1 uppercase, 1 digit, and 1 special character:

```
python policygen.py --minlength 8 --maxlength 8 --minlower 1 --minupper 1
--mindigit 1 --minspecial 1 -o example.hcmask
```

Generate mask attack and estimate time of completion based on GTX

1080 against MD5 hashes 24943.1 MH/s(based on appendix table) for password policy 8 character length requiring at least 1 lowercase, 1 uppercase, 1 digit, and 1 special character:

```
python policygen.py --minlength 8 --maxlength 8 --minlower 1 --minupper 1  
--mindigit 1 --minspecial 1 -o example.hcmask --pps=24943000000
```

CUSTOM MASK PLANS

DATE YYMMDD MASK

```
hashcat -a 3 -m #type hash.txt -1 12 -2 90 -3 01 -4 123 ?l?2?3?d?4?d
```

DATE YYYYMMDD MASK

```
hashcat -a 3 -m #type hash.txt -1 12 -2 90 -3 01 -4 123 ?l?2?d?d?3?d? 4?d
```

3 SEQUENTIAL NUMBERS MASK + SPECIAL

```
hashcat -a 3 -m #type hash.txt -1 147 -2 258 -3 369 ?l?2?3?s
```




FOREIGN CHARACTER SETS



FOREIGN CHARACTER SETS

UTF8 POPULAR LANGUAGES

**Incremental four character password examples*

Arabic

UTF8 (d880-ddbf)

hashcat -a 3 -m #type hash.txt --hex-charset -1 d8d9dadbdcd -2

80818283848586

8788898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0ala2a3a4a5a6a
afb0blb2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?1?2?1?2?1?2

Bengali

UTF8 (e0a680-e0adbf)

hashcat -a 3 -m #type hash.txt --hex-charset -1 e0 -2 a6a7a8a9aaabacad -3

8081

82838485868788898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0ala
aaabacadaeafb0blb2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?3?1?2?3?1?2?3?
1?2?3

Chinese (Common Characters)

UTF8 (e4b880-e4bbbf)

hashcat -a 3 -m #type hash.txt --hex-charset -1 e4 -2 b8b9babb -3

808182838485

868788898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0ala2a3a4a5a
aeafb0blb2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?3?1?2?3?1?2?3?1?2?3

Japanese (Katakana & Hiragana)

UTF8 (e38180-e3869f)

hashcat -a 3 -m #type hash.txt --hex-charset -1 e3 -2 818283848586 -3

80818283

8485868788898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0ala2a3a
acadaeafb0blb2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?3?1?2?3?1?2?3?1?2?

Russian

UTF8 (d080-d4bf)

hashcat -a 3 -m #type hash.txt --hex-charset -1 d0d1d2d3d4 -2

8081828384858687

88898a8b8c8d8e8f909192939495969798999a9b9c9d9e9fa0ala2a3a4a5a6a7a

b0blb2b3b4b5b6b7b8b9babbbcbdbebf -i ?1?2?1?2?1?2?1?2

HASHCAT BUILT-IN CHARSETS**German**

hashcat -a 3 -m #type hash.txt -1 charsets/German.hcchr -i ?1?1?1?1

French

hashcat -a 3 -m #type hash.txt -1 charsets/French.hcchr -i ?1?1?1?1

Portuguese

hashcat -a 3 -m #type hash.txt -1 charsets/Portuguese.hcchr -i ?1?1?1?1

SUPPORTED LANGUAGE ENCODINGS**hashcat -a 3 -m #type hash.txt -1 charsets/<language>.hcchr -i ?1?1?1?1**

Bulgarian, Castilian, Catalan, English, French, German, Greek, Greek
 Polytonic, Italian, Lithuanian, Polish, Portuguese, Russian, Slovak, Spanish

JOHN UTF8 & BUILT-IN CHARSETS**OPTIONS:**

--encoding=NAME	input encoding (eg. UTF-8, ISO- 8859-1).
--input-encoding=NAME	input encoding (alias for --encoding)
--internal-encoding=NAME	encoding used in rules/masks (see doc/ENCODING)

- **--target-encoding=NAME** output encoding (used by format)

Example LM hashes from Western Europe, using a UTF-8 wordlist:

```
john --format=lm hast.txt --encoding=utf8 --target:cp850 --wo:spanish.txt
```

Example using UTF-8 wordlist with internal encoding for rules processing:

```
john --format=#type hash.txt --encoding=utf8 --internal=CP1252 --wordlist=french.1st --rules
```

Example mask mode printing all possible “Latin-1” words of length 4:

```
john --stdout --encoding=utf8 --internal=8859-1 --mask:?1?1?1?1
```

SUPPORTED LANGUAGE ENCODINGS

UTF-8, ISO-8859-1 (Latin), ISO-8859-2 (Central/Eastern Europe), ISO-8859-7 (Latin/Greek), ISO-8859-15 (Western Europe), CP437 (Latin), CP737 (Greek), CP850 (Western Europe), CP852 (Central Europe), CP858 (Western Europe), CP866 (Cyrillic), CP1250 (Central Europe), CP1251 (Russian), CP1252 (Default Latin1), CP1253 (Greek) and KOI8-R (Cyrillic).

HASHCAT ?b BYTE CHARSET

If your unsure as to position of a foreign character set contained within your target password, you can attempt the ?b byte charset in a mask using a sliding window. For example if we have a password 6 characters long:

?b = 256 byte = **0x00 - 0xff**

hashcat -a 3 -m #type	?b ?a?a?a?a?a
hash.txt	?a? b ?a?a?a?a
	?a?a? b ?a?a?a
	?a?a?a? b ?a?a
	?a?a?a?a? b ?a
	?a?a?a?a?a? b

CONVERT ENCODING

HASHCAT

Force internal wordlist encoding from X

```
hashcat -a 0 -m #type hash.txt dict.txt --encoding-from=utf-8
```

Force internal wordlist encoding to X

```
hashcat -a o -m #type hash.txt dict.txt --encoding-to=iso-8859-15
```

ICONV

Convert wordlist into language specific encoding

```
iconv -f <old_encode> -t <new_encode> < dict.txt | sponge dict.txt.enc
```

CONVERT HASHCAT \$HEX OUTPUT

Example of converting \$HEX[] entries in hashcat.pot f i l e to ASCII

```
grep '$HEX' hashcat.pot | awk -F ":" { 'print$2' } | perl -ne ' i f ($_ =~ m/$HEX\[([A-Fa-f0-9]+\)\]/) {print pack("H*", $1), "\n"}'
```




ADVANCED ATTACKS



ADVANCED ATTACKS

PRINCE ATTACK

PRINCE (PRobability INfinite Chained Elements) Attack takes one input wordlist and builds “chains” of combined words automatically.

HASHCAT PRINCEPROCESSOR

<https://github.com/hashcat/princeprocessor>

Attack slow hashes:

```
pp64.bin dict.txt | hashcat -a 0 -m #type hash.txt
```

Amplified attack for fast hashes:

```
pp64.bin --case-permute dict.txt | hashcat -a 0 -m #type hash.txt -r rule.txt
```

Example PRINCE attack producing minimum 8 char candidates with 4 elements piped directly into Hashcat with rules attack.

```
pp64.bin --pw-min=8 --limit=4 dict.txt|hashcat -a 0 -m # hash.txt -r  
best64.rule
```

PRINCECEPTION ATTACK (epixoip)

Piping the output of one PRINCE attack into another PRINCE attack.

```
pp64.bin dict.txt | pp64.bin | hashcat -a 0 -m #type hash.txt
```

JOHN BUILT-IN PRINCE ATTACK

```
john --prince=dict.txt hash.txt
```

MASK PROCESSOR

Mask attack generator with a custom configurable charset and ability to limit consecutive and repeating characters to decrease attack keyspace.

<https://github.com/hashcat/maskprocessor>

Limit 4 consecutive identical characters in the password string “-q” option:

```
mp64.bin -q 4 ?d?d?d?d?d?d?d?d | hashcat -a 0 -m #type hash.txt
```

Limit 4 identical characters in the password string “-r” option:

```
mp64.bin -r 4 ?d?d?d?d?d?d?d?d | hashcat -a 0 -m #type hash.txt
```

Limit 2 consecutive and 2 identical characters in the password string:

```
mp64.bin -r 2 -q 2 ?d?d?d?d?d?d?d?d | hashcat -a 0 -m #type hash.txt
```

Custom charset limiting 2 consecutive and 2 identical characters in the password string:

```
mp64.bin -r 2 -q 2 -1 aeiuo -2 TGBYHN ?l?2?l?2?d?d?d?d | hashcat -a 0 -m #type hash.txt
```

CUSTOM MARKOV MODEL / STATSPROCESSOR

Word-generator based on the per-position markov-attack.

<https://github.com/hashcat/statsprocessor>

HCSTATGEN

Create custom Markov models using hashcat-util hcstatgen.bin based on cracked target passwords. The util hcstatgen makes a 32MB file each time no matter how small/large the password list provided. Highly recommended you make custom Markov models for different target sets.

```
hcstatgen.bin outfile.hcstat < passwords.txt
```

STATSPROCESSOR

Is a high-performance word-generator based on a user supplied per-position Markov model (hcstat file) using mask attack notation.

Step 1: Create your custom Markov model

```
hcstatgen.bin out.hcstat < passwords.txt
```

Step 2.1: Supply your new Markov model to Hashcat as mask or rule attack.

```
hashcat -a 3 -m #type hash.txt --markov-hcstat=out.hcstat ?a?a?a?a?a?a
```

```
hashcat -a 0 -m #type hash.txt dict.txt -r rule.txt --markov-hcstat=out.hcstat
```

Step 2.2: OR Supply your new Markov model with sp64 and pipe into Hashcat.

```
sp64.bin --pw-min 3 --pw-max 5 out.hcstat ?1?1?1?1?1?1 | hashcat -a 0 -m  
#type hash.txt
```

KEYBOARD WALK PROCESSOR

Keyboard-walk generator with configurable base chars, keymappings and routes. <https://github.com/hasheat/kwprocessor>

Example keyboard walk with tiny charset in english mapping and with 2-10 adjacent keys piping out results into a hashcat attack:

```
kwp.bin basechar/tiny.base keymaps/en.keymap routes/2-to-10-max-3 -0  
-z | hashcat -a 0 -m #type hash.txt
```

Example keyboard walk with full charset in english mapping and with 3x3 adjacent keys piping out results into a hashcat attack:

```
./kwp basechars/full.base keymaps/en.keymap routes/3-to-3-  
exhaustive.route | hashcat -a 0 -m #type hash.txt
```

[FULL LIST OF OPTIONS]

```
./kwp [options]... basechars-file keymap-file routes-file  
-V, --version          Print version  
-h, --help            Print help  
-o, --output-file      Output-file  
-b, --keyboard-basic   Characters reachable without holding shift or altgr  
-s, --keyboard-shift   Characters reachable by holding shift  
-a, --keyboard-altgr   Characters reachable by holding altgr (non-english)  
-z, --keyboard-all    Shortcut to enable all --keyboard-* modifier  
-1, --keywalk-south-west Routes heading diagonale south-west  
-2, --keywalk-south    Routes heading straight south  
-3, --keywalk-south-east Routes heading diagonale south-east  
-4, --keywalk-west     Routes heading straight west  
-5, --keywalk-repeat   Routes repeating character  
-6, --keywalk-east     Routes heading straight east  
-7, --keywalk-north-west Routes heading diagonale north-wes  
-8, --keywalk-north    Routes heading straight north  
-9, --keywalk-north-east Routes heading diagonale north-east  
-0, --keywalk-all     Shortcut to enable all --keywalk-* directions  
-n, --keywalk-distance-min Minimum allowed distance between keys  
-x, --keywalk-distance-max Maximum allowed distance between keys
```

MDXFIND / MDSPLIT

<https://hashes.org/mdxfind.php>

(credit 'Waffle')

MDXFINd is a program which allows you to run large numbers of unsolved hashes of any type, using many algorithms concurrently, against a large number of plaintext words and rules, very quickly. It's main purpose was to deal with large lists (20 million, 50 million, etc) of unsolved hashes and run them against new dictionaries as you acquire them.

So when would you use MDXFINd on a pentest? If you dump a database tied to website authentication and the hashes are not cracking by standard attack plans. The hashes may be generated in a unique nested hashing series. If you are able to view the source code of said website to view the custom hashing function you can direct MDXFINd to replicate that hashing series. If not, you can still run MDXFINd using some of the below 'Generic Attack Commands'. MDXFINd is tailored toward intermediate to expert level password cracking but is extremely powerful and flexible.

Example website SHA1 custom hashing function performing multiple iterations:

```
$hash = sha1($password . $salt);  
for ($i = 1; $i <= 65000; ++$i)  
{  
    $hash = sha1($hash . $salt);  
}
```

MDXFINd

COMMAND STRUCTURE THREE METHODS 1-STDOUT 2-STDIN 3-File

1- Reads hashes coming from cat (or other) commands stdout.

cat hash.txt | mdxfind -h <regex #type> -i <#iterations> dict.txt > out.txt

2- Takes stdin from outside attack sources in place of dict.txt when using the options variable '-f' to specify hash.txt file location and variable 'stdin'.

mp64.bin ?d?d?d?d?d?d | mdxfind -h <regex #type> -i <#iterations> -f

hash.txt stdin > out.txt

3- Specify file location '-f' with no external stdout/stdin sources.

mdxfind -h <regex #type> -i <#iterations> -f hash.txt dict.txt > out.txt

[FULL LIST OF OPTIONS]

- a Do email address munging
- b Expand each word into unicode, best effort
- c Replace each special char (<>&, etc) with XML equivalents
- d De-duplicate wordlists, best effort...but best to do ahead of time
- e Extended search for truncated hashes
- p Print source (filename) of found plain-texts
- q Internal iteration counts for SHA1MD5X, and others. For example, if you have a hash that is SHA1(MD5(MD5(MD5(MD5(\$pass))))), you would set -q to 5.
- g Rotate calculated hashes to attempt match to input hash
- s File to read salts from
- u File to read Userid/Usernames from
- k File to read suffixes from
- n Number of digits to append to passwords. Other options, like: -n 6x would append 6 digit hex values, and 8i would append all ipv4 dotted-quad IP-addresses.
- i The number of iterations for each hash
- t The number of threads to run
- f file to read hashes from, else stdin
- l Append CR/LF/CRLF and print in hex
- r File to read rules from
- v Do not mark salts as found.
- w Number of lines to skip from first wordlist
- y Enable directory recursion for wordlists
- z Enable debugging information/hash results
- h The hash types: 459 TOTAL HASHES SUPPORTED

GENERIC ATTACK PLANS

This is a good general purpose MDXFINd command to run your hashes against if you suspect them to be “non-standard” nested hashing sequences. This command says “Run all hashes against dict.txt using 10 iterations except ones having a salt, user, or md5x value in the name.” It’s smart to skip salted/user hash types in MDXFINd unless you are confident a salt value has been used.

```
cat hash.txt | mdxfind -h ALL -h '!salt,!user,!md5x' -i 10 dict.txt > out.txt
```

The developer of MDXFINd also recommends running the below command options as a good general purpose attack:

```
cat hash.txt | mdxfind -h <^md5$,^sha1$,^md5md5pass$,^md5sha1$' -i 5 dict.txt > out.txt
```

And you could add a rule attack as well:

```
cat hash.txt | mdxfind -h <^md5$,^sha1$,^md5md5pass$,^md5sha1$' -i 5 dict.txt -r best64.rule > out.txt
```

GENERAL NOTES ABOUT MDXFINd

- Can do multiple hash types/files all during a single attack run.

```
cat sha1/*.txt sha256/*.txt md5/*.txt salted/*.txt | mdxfind
```

- Supports 459 different hash types/sequences

- Can take input from special ‘stdin’ mode

- Supports VERY large hashlists (100mil) and 10kb character passwords

- Supports using hashcat rule files to integrate with dictionary

- Option ‘-z’ outputs ALL viable hashing solutions and file can grow very large

- Supports including/excluding hash types by using simple regex parameters

- Supports multiple iterations (up to 4 billion times) by tweaking -i parameter for instance:

MD5X01 is the same as md5(\$Pass)

MD5x02 is the same as md5(md5(\$pass))

MD5X03 is the same as md5(md5(md5(\$pass)))

...

MD5x10 is the same as

md5(md5(md5(md5(md5(md5(md5(md5(md5(md5(\$pass))))))))))

-Separate out -usernames -email -ids -salts to create custom attacks

-If you are doing brute-force attacks, then hashcat is probably better route

-When MDXfind finds any solution, it outputs the kind of solution found, followed by the hash, followed by the salt and/or password. For example:

Solution	HASH	:PASSWORD
----------	------	-----------

MD5X01	000012273bc5cab48bf3852658b259ef:lEb0TBK3	
--------	---	--

MD5X05	033blll073e5f64ee59f0be9d6b8a561:08061999	
--------	---	--

MD5X09	aadb9dlb23729a3e403d7fc62d507df7:1140	
--------	---------------------------------------	--

MD5X09	326d921d591162eed302ee25a09450ca:1761974	
--------	--	--

MDSPLIT

When cracking large lists of hashes from multiple file locations, MDSPLIT will help match which files the cracked hashes were found in, while also outputting them into separate files based on hash type. Additionally it will remove the found hashes from the original hash file.

COMMAND STRUCTURE TWO METHODS **1-STDOUT 2-STDIN 3-File**

1- Matching MDXFIN results files with their original hash_orig.txt files.

cat hashes_out/out_results.txt | mdsplit hashes_orig/hash_orig.txt

OR perform matching against a directory of original hashes and their results.

cat hashes_out/* | mdsplit hashes_orig/*

2- Piping MDXFIN results directly into MDSPLIT to sort in real-time results.

cat *.txt | mdxfind -h ALL -h '!salt,!user,!md5x' -i 10 dict.txt | mdsplit *.txt

3- Specifying a file location in MDXFIN results to match results in real-time.

```
mdxfind -h ALL -f hashes.txt -i 10 dict.txt | mdsplit hashes.txt
```

GENERAL NOTES ABOUT MDSPLIT

-MDSPLIT will append the final hash solution to the end of the new filename. For example, if we submitted a 'hashes.txt' and the solution to the hashes was "MD5x01" then the results file would be 'hashes.MD5x01'. If multiple hash solutions are found then MDSPLIT knows how to deal with this, and will then remove each of the solutions from hashes.txt, and place them into 'hashes.MD5x01', 'hashes.MD5x02', 'hashes.SHA1'... and so on.

-MDSPLIT can handle sorting multiple hash files, types, and their results all at one time. Any solutions will be automatically removed from all of the source files by MDSPLIT, and tabulated into the correct solved files. For example:

```
cat dirl/*.txt dir2/*.txt dir3/*.txt | mdxfind -h '^md5$,^sha1$,^sha256$' -i 10  
dict.txt | mdsplit dirl/*.txt dir2/*.txt dir3/*.txt
```

DISTRIBUTED / PARALLELIZATION CRACKING

HASHCAT

<https://hashcat.net/forum/thread-3047.html>

Step 1: Calculate keypace for attack (Example MD5 Brute Force x 3nodes)

```
hashcat -a 3 -m 0 ?a?a?a?a?a?a --keyspace  
81450625
```

Step 2: Distribute work through keypace division (s)kip and (l)imit

```
81450625 / 3 = 27150208.3
```

```
Node1# hashcat -a 3 -m 0 hash.txt ?a?a?a?a?a?a -s 0 -1 27150208
```

```
Node2# hashcat -a 3 -m 0 hash.txt ?a?a?a?a?a?a -s 27150208 -1 27150208
```

```
Node3# hashcat -a 3 -m 0 hash.txt ?a?a?a?a?a?a -s 54300416 -1 27150209
```

JOHN

<http://www.openwall.com/john/doc/OPTIONS.shtml>

Manual distribution using Options --node & --fork to 3 similar CPU nodes utilizing 8 cores:

Node# john --format=<#> hash.txt --wordlist=dict.txt --rules=All --fork=8 --node=1-8/24

Node2# john --format=<#> hash.txt --wordlist=dict.txt --rules=All --fork=8 --node=9-16/24

Node3# john --format=<#> hash.txt --wordlist=dict.txt --rules=All --fork=8 --node=17-24/24

Other John Options for parallelization:

Option 1:Enable OpenMP through uncommenting in Makefile

Option 2:Create additional incremental modes in john.conf

Option 3:Utilize built-in MPI parallelization

PASSWORD GUESSING FRAMEWORK

<https://github.com/RUB-SysSec/Password-Guessing-Framework>

<https://www.password-guessing.org/>

Password Guessing Framework is an open source tool to provide an automated and reliable way to compare password guessers. It can help to identify individual strengths and weaknesses of a guesser, it's modes of operation, or even the underlying guessing strategies. Therefore, it gathers information about how many passwords from an input file (password leak) have been cracked in relation to the amount of generated guesses. Subsequent to the guessing process an analysis of the cracked passwords is performed.

OTHER CREATIVE ADVANCED ATTACKS

Random creative password attacks using the power of stdin and stdout. Not

implying they're useful but to demonstrate the power of mixing and matching. Go forth and create something useful.

PRINCE-MDXFIND ATTACK

```
pp64.bin dict.txt | mdxfind -h ALL -f hash.txt -i 10 stdin > out.txt
```

HASHCAT-UTIL COMBONATOR PRINCE

```
combinator.bin dict.txt dict.txt | pp64.bin | hashcat -a 0 -m #type hash.txt -r best64.rule
```

```
combinator3.bin dict.txt dict.txt dict.txt | pp64.bin | hashcat -a 0 -m #type hash.txt -r rockyou-30000.rule
```

HASHCAT STDOUT ATTACKS PRINCE

```
hashcat -a 0 dict.txt -r dive.rule --stdout | pp64.bin | hashcat -a 0 -m #type hash.txt
```

```
hashcat -a 6 dict.txt ?a?a?a?a --stdout | pp64.bin --pw-min=8 | hashcat -a 0 -m #type hash.txt
```

```
hashcat -a 7 ?a?a?a?a dict.txt --stdout | pp64.bin --pw-min=8 | hashcat -a 0 -m #type hash.txt
```

```
hashcat -a 6 dict.txt rockyou-1-60.hcmask --stdout | pp64.bin --pw-min=8 --pw-max=14 | hashcat -a 0 -m #type hash.txt
```

```
hashcat -a 7 rockyou-1-60.hcmask dict.txt --stdout | pp64.bin --pw-min=8 --pw-max=14 | hashcat -a 0 -m #type hash.txt
```

DISTRIBUTED CRACKING SOFTWARE

HASHTOPUSSY

<https://bitbucket.org/seinlc/hashtopussy/>

HASHSTACK

<https://sagitta.pw/software/>

DISTHC

<https://github.com/unix-ninja/disthc>

CRACKLORD

<http://jmmcatee.github.io/cracklord/>

HASHTOPUS

<http://hashtopus.org/Site/>

HASHVIEW

<http://www.hashview.io/>

CLORTHO

<https://github.com/ccdes/clortho>

ONLINE HASH CRACKING SERVICES

GPUHASH

<https://gpuhash.me/>

CRACKSTATION

<https://crackstation.net/>

ONLINE HASH CRACK

<https://www.onlinehashcrack.com/>

HASH HUNTERS

<http://www.hashhunters.net/>



CRACKING CONCEPTS



Information in this chapter is an attempt to summarize a few of the basic and more complex concepts in password cracking. This allows all skill levels to grasp these concepts without needing a Linguistics or Mathematics Degree. It's an almost impossible task to condense into one paragraph, but the following is an attempt. For a deeper understanding, I highly encourage you to read the Resource links included below each section.

PASSWORD ENTROPY vs CRACK TIME

Password entropy is a measure of how random/unpredictable a password could have been, so it does not really relate to the password itself, but to a selection process. When judging human generated passwords for entropy, it frankly isn't an accurate measurement. This is true mainly because humans like to use memorable words/sequences and thus a myriad of attacks account for that behavior. However, entropy is good for measuring randomly generated passwords from password managers, such as 1Password or KeePass, in that each default character set used can be calculated. Password entropy is measured in bits and uses the following formula where C=Size of Character set & L=Length of password: $\log(C) / \log(2) * L$

To calculate the time to crack, just use the benchmarking function on your favorite cracking software against your mode of hash to obtain cracks per second. The table below estimates password length using an MD4 hashing function against an 8 GPU x Nvidia GTX1080 system:

Length	Alphanumeric 0-9, a-z, A-Z	Time to Crack (350 GH/s)
8	47 bits	~15 Mins
9	59 bits	
10	65 bits	~457 Hours
11	65 bits	~3.3 Years
12	71 bits	~214 Years
13	77 bits	~13,690 Years
14	80 bits	~109,500 Years
15	89 bits	~56,080,000 Years
20	119 bits	~Doesn't Matter

**Table only truly matters for randomly generated passwords*

Resources

Password Complexity versus Password Entropy

<https://blogs.technet.microsoft.com/msftcam/2015/05/19/password-complexity-versus-password-entropy/>

WHAT IS A CRYPTOGRAPHIC HASH?

A cryptographic hash function is a subclass of the general hash function which possesses properties lending its use in cryptography. Cryptographic hash functions are mathematical algorithms which map data of any size to a string containing a fixed length, and should make it infeasible to reverse. For instance, the string “password,” when mapped using the MD5 hash function, returns a fixed length 32 character string

“5f4dcc3b5aa765d61d8327deb882cf99”. The 32 character string cannot theoretically be reversed with any other mapped input data except “password”. The current method of recreating this input data “password” is through a dictionary/mask/brute-force attack of all possible inputs matching the hashed value; also called a pre-image attack. Generally speaking, hash functions should possess the below characteristics:

- Be computationally infeasible to find two different sets of input data with the same hash value (also called a collision).

- The hash value should be “quick” to compute (i.e. > ~1 second).
- It should be difficult to generate the input data Just by looking at the hash value.
- One simple change to the input data should drastically change the resultant hash value.

Resources

How Hash Algorithms Work

<http://www.metamorphosite.com/one-way-hash-encryption-sha1-data-software>

MARKOV CHAINS

Markov Chains are created, for our password cracking purposes, by statistical analysis of a large list of passwords/words (i.e. the RockYou password dataset). The resultant analysis of these words and their per-position character frequency/probability are stored in a table. This table is referenced when performing brute-force/mask attacks to prevent having to generate password candidates in a sequential order, which is very inefficient. Instead, the most common characters are attempted first in order of preceding character probability. So let's see sequential brute-force ?a?a?a with out Markov Chains applied:

aaaa	aaad	aaag
aaab	aaae	aaah
aaac	aaaf	

Now the same brute-force attack with Markov Chains applied:

sari	aari	pari
mari	cari	2ari
1ari	bari	

Markov Chains predict the probability of the next character in a password based on the previous characters, or context characters. It's that simple.

Resources

Fast Dictionary Attacks on Passwords Using Time-Space Tradeoff

http://www.cs.utexas.edu/~shmat/shmat_ccs05pwd.pdf

OMEN: Faster Password Guessing Using an Ordered Markov Enumerator

<https://hal.inria.fr/hal-01112124/document>

PROBABILISTIC CONTEXT-FREE GRAMMARS (PCFG)

A Probabilistic Context Free Grammar (PCFG) consists of terminal and nonterminal variables. Each feature to be modeled has a production rule that is assigned a probability, estimated from a training set of RNA structures. Production rules are recursively applied until only terminal residues are left. The notion supporting PCFGs is that passwords are constructed with template structures and terminals that fit into those structures. For example, the password candidate ‘passwordl23!’ is 8 letters, 3 digits, 1 special and would be noted as ‘ $L_8D_3S_1$ ’. A password’s probability of occurring is the probability of its structure, multiplied by those of its underlying terminals.

Resources

Password Cracking Using Probabilistic Context-Free Grammars

https://sites.google.com/site/reusablesec/Home/password-cracking-tools/probabilistic_cracker

Next Gen PCFG Password Cracking

https://github.com/lakiw/pcfg_cracker

NEURAL NETWORKS

Artificial Neural Networks or Neural Networks (NN) is a machine-learning technique composed of nodes called Artificial Neurons, just like the brain possesses. Such systems use Machine Learning to approximate highly

dimensional functions and progressively learn through examples of training set data, or in our case a large password dump. They have shown initial promise to be effective at generating original yet representative password candidates. Advantages to NN's for password cracking are the low overhead for storing the final NN model, approximately 500kb, and the ability to continually learn over time through retraining or transfer learning.

Resources

Fast, Lean, and Accurate: Modeling Password Guessability Using Neural Networks (USENIX '16)

https://www.usenix.org/system/files/conference/usenixsecurity16/sec16_paper

https://github.com/cupslab/neural_network_cracking



COMMON HASH EXAMPLES



COMMON HASH EXAMPLES

MD5, NTLM, NTLMv2, LM, MD5crypt, SHA1, SHA256, bcrypt, PDF 1.4 - 1.6 (Acrobat 5-8), Microsoft OFFICE 2013, RAR3-HP, Winzip, 7zip, Bitcoin/Litecoin, MAC OSX v10.5-v10.6, MySQL 4.1-5+, Postgres, MSSQL(2012)-MSSQL(2014), Oracle 11g, Cisco TYPE 4 5 8 9, WPA PSK / WPA2 PSK

MDS

HASHCAT

HASH FORMAT

8743b52063cd84097a65dl633f5c74f5

BRUTE FORCE ATTACK

hashcat -m 0 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 0 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 0 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

8743b52063cd84097a65dl633f5c74f5

BRUTE FORCE ATTACK

john --format=raw-md5 hash.txt

WORDLIST ATTACK

john --format=raw-md5 wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=raw-md5 wordlist=dict.txt --rules hash.txt

NTLM (PWDUMP)

HASHCAT

HASH FORMAT

b4b9b02e6f09a9bd760f388b67351e2b

BRUTE FORCE ATTACK

hashcat -m 1000 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 1000 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 1000 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

b4b9b02e6f09a9bd760f388b67351e2b

BRUTE FORCE ATTACK

john --format=nt hash.txt

WORDLIST ATTACK

john --format=nt wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=nt wordlist=dict.txt --rules hash.txt

NTLM V2

HASHCAT

HASH FORMAT

username::N46iSNekpT:08ca45b7d7ea58ee:88dcbe4446168966a153a006495f
C7830310000000000000b45c67103d07d7b95acd12ffall230e0000000052920f
3b92f5d765c783030

BRUTE FORCE ATTACK

hashcat -m 5600 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 5600 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 5600 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

username:\$NETNTLMv2\$NTLMV2TESTWORKGROUP\$11223344556677
5C87EC1D5\$01010000000000000006CF6385B74CA01B3610B02D99732DE
0052004B00470052004F00550050000100200044004100540041002E004200
00450043005500520049000000000000

BRUTE FORCE ATTACK

john --format=netntlmv2 hash.txt

WORDLIST ATTACK

john --format=netntlmv2 wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=netntlmv2 wordlist=dict.txt --rules hash.txt

LM

HASHCAT

HASH FORMAT

299bdl28cll01fd6

BRUTE FORCE ATTACK

hashcat -m 3000 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 3000 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 3000 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

\$LM\$a9c604d244c4e99d

BRUTE FORCE ATTACK

john --format=lm hash.txt

WORDLIST ATTACK

john --format=lm wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=lm wordlist=dict.txt --rules hash.txt

MD5CRYPT

HASHCAT

HASH FORMAT

\$1\$28772684\$iEwNOgGugq09.bIz5sk8k/

BRUTE FORCE ATTACK

hashcat -m 500 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 500 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 500 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

\$1\$28772684\$iEwNOgGugq09.bIz5sk8k/

BRUTE FORCE ATTACK

john --format=md5crypt hash.txt

WORDLIST ATTACK

john --format=md5crypt wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=md5crypt wordlist=dict.txt --rules hash.txt

SHA1

HASHCAT

HASH FORMAT

b89eaac7e61417341b710b727768294d0e6a277b

BRUTE FORCE ATTACK

hashcat -m 100 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 100 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 100 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

b89eaac7e61417341b710b727768294d0e6a277b

BRUTE FORCE ATTACK

john --format=raw-sha1 hash.txt

WORDLIST ATTACK

john --format=raw-sha1 wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=raw-sha1 wordlist=dict.txt --rules hash.txt

SHA256

HASHCAT

HASH FORMAT

127e6fbfe24a750e72930c220a8e138275656b8e5d8f48a98c3c92df2caba935

BRUTE FORCE ATTACK

hashcat -m 1400 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 1400 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 1400 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

127e6fbfe24a750e72930c220a8el38275656b8e5d8f48a98c3c92df2caba935

BRUTE FORCE ATTACK

john --format=raw-sha256 hash.txt

WORDLIST ATTACK

john --format=raw-sha256 wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=raw-sha256 wordlist=dict.txt --rules hash.txt

BCRYPT

HASHCAT

HASH FORMAT

\$2a\$05\$LhayLxezLhKlLhWvKxCyLOj0jlu.Kj0jZ0pEmml34uzrQlFvQDLF6

BRUTE FORCE ATTACK

hashcat -m 3200 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 3200 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 3200 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

\$2a\$05\$LhayLxezLhKlLhWvKxCyLOj0jlu.Kj0jZ0pEmml34uzrQlFvQDLF6

BRUTE FORCE ATTACK

john --format=bcrypt hash.txt

WORDLIST ATTACK

john --format=bcrypt wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=bcrypt wordlist=dict.txt --rules hash.txt

PDF 1.4 - 1.6 (ACROBAT 5-8)

HASHCAT

HASH FORMAT

[illegible]

EXTRACT HASH

```
pdf2hashcat.py example.pdf > hash.txt
```

BRUTE FORCE ATTACK

```
hashcat -m 10500 -a 3 hash.txt ?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 10500 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 10500 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

\$pdf\$Standard*badadle86442699427116d3e5d5271bc80a27814fc5e80f815ef89ece9b5ce451a5d7064693dab3badfl01112131415161718191alblclldlelf*16*af681a9b63fa8bf563b*!l*0*l*4*128*-4*3*2

EXTRACT HASH

```
pdf2john.py example.pdf > hash.txt
```

BRUTE FORCE ATTACK

```
john --format=pdf hash.txt
```

WORDLIST ATTACK

```
john --format=pdf wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=pdf wordlist=dict.txt --rules hash.txt
```

MICROSOFT OFFICE 2013

HASHCAT

HASH FORMAT

example.docx:\$office\$*2013*100000*256*16*7dd611d7eb4c899f74816dlde
b2c2c6c32fl4b5995a543ad037*0b7ee0e48e935f937192a59de48a7d561ef269.
04402a94895

EXTRACT HASH

office2hashcat.py example.docx > hash.txt

BRUTE FORCE ATTACK

hashcat -m 9600 -a 3 --username hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 9600 -a 0 --username hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 9600 -a 0 --username hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

example.docx:\$office\$*2013*100000*256*16*7dd611d7eb4c899f74816dlde
04402a94895

EXTRACT HASH

office2john.py example.docx > hash.txt

BRUTE FORCE ATTACK

john --format=office2013 hash.txt

WORDLIST ATTACK

john --format=office2013 wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=office2013 wordlist=dict.txt --rules hash.txt

RAR3-HP (ENCRYPTED HEADER)

HASHCAT

HASH FORMAT

\$RAR3\$*0*45109af8ab5f297a*adbf6c5385d7a40373e8f77d7b89d317

#!Ensure to remove extraneous rar2john output to match above hash!#

EXTRACT HASH

rar2john.py example.rar > hash.txt

BRUTE FORCE ATTACK

hashcat -m 12500 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 12500 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 12500 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

example.rar:\$RAR3\$*l*20e041a232b4b7f0*5618c5f0*1472*2907*0*/Path/T

example.rar*138*33:1::example.txt

EXTRACT HASH

rar2john.py example.rar > hash.txt

BRUTE FORCE ATTACK

john --format=rar hash.txt

WORDLIST ATTACK

john --format=rar wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=rar wordlist=dict.txt --rules hash.txt

WINZIP

HASHCAT

HASH FORMAT

\$zip2\$*0*3*0*b5d2b7bf57ad5e86a55c400509c672bd*d218*0**ca3d736d03
zip2\$

#!Ensure to remove extraneous zip2john output to match above hash!#

EXTRACT HASH

zip2john.py example.zip > hash.txt

BRUTE FORCE ATTACK

hashcat -m 13600 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 13600 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 13600 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

example.zip:\$zip2\$*0*3*0*5b0a8bl53fb94bf719abb81a80e90422*8e91*9*0l
938ce9c*3f37001e241el96195al*\$/zip2\$: : ::example.zip

EXTRACT HASH

zip2john.py example.zip > hash.txt

BRUTE FORCE ATTACK

john --format=ZIP hash.txt

WORDLIST ATTACK

john --format=ZIP wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=ZIP wordlist=dict.txt --rules hash.txt

7-ZIP

HASHCAT

HASH FORMAT

\$7z\$0\$19\$0\$salt\$8\$f6196259a7326e3f0000000000000000\$185065650\$112\$
419a25acd40c0c2d75421cf23263f69c51bl3f9blaada41a8a09f9adeae45d67c60

0dcc5eb811c7a61128ee0746f922cdb9c59096869f341c7a9cblac7bb7d771f54(
Cd4b61751e4d8de66dd6e2dfb5b7dl022d2211e2d66eal703f96

#!Ensure to remove extraneous 7zip2john output to match above hash!#

EXTRACT HASH

7z2john.py example.7z > hash.txt

BRUTE FORCE ATTACK

hashcat -m 11600 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 11600 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 11600 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

example.7z:\$7z\$0\$19\$0\$salt\$8\$f6196259a7326e3f0000000000000000\$1850
3bc2a88062c419a25acd40c0c2d75421cf23263f69c51bl3f9blaada41a8a09f9ac
6aad338f20c0dcc5eb811c7a61128ee0746f922cdb9c59096869f341c7a9cblac7
Cf4e6flla5ecd4b61751e4d8de66dd6e2dfb5b7dl022d2211e2d66eal703f96

EXTRACT HASH

7z2john.py example.7z > hash.txt

BRUTE FORCE ATTACK

john --format=7z hash.txt

WORDLIST ATTACK

john --format=7z wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=7z wordlist=dict.txt --rules hash.txt

BITCOIN / LITECOIN

HASHCAT

HASH FORMAT

\$bitcoin\$96\$d011alb6a8d675b7a36d0cd2efaca32a9f8dcld57d6d01a58399ea0
99039326f7a00fl71a7bbc854a54\$16\$1563277210780230\$158555\$96\$62883
57044857153635251074082323305571584532274162540768587307602723
25882875480513751851333441623702852811440775888122046360561760

EXTRACT HASH

bitcoin2john.py wallet.dat > hash.txt

BRUTE FORCE ATTACK

hashcat -m 11300 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 11300 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 11300 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

\$bitcoin\$96\$d011alb6a8d675b7a36d0cd2efaca32a9f8dcld57d6d01a58399ea0
99039326f7a00fl71a7bbc854a54\$16\$1563277210780230\$158555\$96\$62883
57044857153635251074082323305571584532274162540768587307602723
25882875480513751851333441623702852811440775888122046360561760

EXTRACT HASH

bitcoin2john.py wallet.dat > hash.txt

BRUTE FORCE ATTACK

john --format=bitcoin hash.txt

WORDLIST ATTACK

john --format=bitcoin wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=bitcoin wordlist=dict.txt --rules hash.txt

MAC OS X 10.8-10.12

HASHCAT

HASH FORMAT

username:\$ml\$35714\$50973de90d336b5258f01e48ab324aa9ac81ca7959ac47
398\$631a0ef84081b37cfe594a5468cf3a63173cd2ec25047b89457ed300f2b41

C5f3f7be8f74b7269ee3713172642de96ee482432a8dl2bf291a

EXTRACT HASH

sudo plist2hashcat.py /var/db/dslocal/nodes/Default/users/<username>.plist

BRUTE FORCE ATTACK

hashcat -m 122 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 122 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 122 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

username:\$pbkdf2-hmac-

sha512\$31724.019739e90d326b5258f01e483bl24aa9ac81ca7959acb
70c3d9c4297af924398.631a0bf84081b37dae594a5468cf3a63183cd2ec25047l
1b40a0793a39512fc5a3f7ae8f74b7269ee3723172642de96eee82432a8dllbf36
501:20 : HOST

NAME:/bin/bash:/var/db/dslocal/nodes/Default/users/username.plist

EXTRACT HASH

sudo ml2john.py /var/db/dslocal/nodes/Default/users/<username>.plist

BRUTE FORCE ATTACK

john --format=xsha hash.txt

WORDLIST ATTACK

john --format=xsha wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=xsha wordlist=dict.txt --rules hash.txt

MYSQL4.1 / MYSQL5+ (DOUBLE SHA1)

HASHCAT

HASH FORMAT

FCF7C1B8749CF99D88E5F34271D636178FB5D130

EXTRACT HASH

SELECT user,password FROM mysql.user INTO OUTFILE '/tmp/hash.txt';

BRUTE FORCE ATTACK

hashcat -m 300 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 300 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 300 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

*FCF7C1B8749CF99D88E5F34271D636178FB5D130

EXTRACT HASH

SELECT user,password FROM mysql.user INTO OUTFILE '/tmp/hash.txt';

BRUTE FORCE ATTACK

john --format=mysql-sha1 hash.txt

WORDLIST ATTACK

john --format=mysql-sha1 wordlist=dict.txt hash.txt

POSTGRESQL

HASHCAT

HASH FORMAT

a6343a68d964ca596d9752250d54bb8a:postgres

EXTRACT HASH

SELECT username, passwd FROM pg_shadow;

BRUTE FORCE ATTACK

hashcat -m 12 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 12 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 12 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

a6343a68d964ca596d9752250d54bb8a:postgres

EXTRACT HASH

```
SELECT username, passwd FROM pg_shadow;
```

BRUTE FORCE ATTACK

```
john --format=postgres hash.txt
```

WORDLIST ATTACK

```
john --format=postgres wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

```
john --format=postgres wordlist=dict.txt --rules hash.txt
```

MSSQL(2012), MSSQL(2014)

HASHCAT

HASH FORMAT

```
0x02000102030434ealbl7802fd95ea6316bd61d2c94622ca3812793e8fbl6724f  
2ab4a78890d563d2fcf5663e46fe797d71550494be50cf4915d3f4d55ec375
```

EXTRACT HASH

```
SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;
```

BRUTE FORCE ATTACK

```
hashcat -m 1731 -a 3 hash.txt ?a?a?a?a?a
```

WORDLIST ATTACK

```
hashcat -m 1731 -a 0 hash.txt dict.txt
```

WORDLIST + RULE ATTACK

```
hashcat -m 1731 -a 0 hash.txt dict.txt -r rule.txt
```

JOHN

HASH FORMAT

```
0x02000102030434ealbl7802fd95ea6316bd61d2c94622ca3812793e8fbl6724f  
2ab4a78890d563d2fcf5663e46fe797d71550494be50cf4915d3f4d55ec375
```

EXTRACT HASH

```
SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;
```

BRUTE FORCE ATTACK

```
john --format=mssql12 hash.txt
```

WORDLIST ATTACK

```
john --format=mssql12 wordlist=dict.txt hash.txt
```

WORDLIST + RULE ATTACK

john --format=mssql12 wordlist=dict.txt --rules hash.txt

ORACLE 11G

HASHCAT

HASH FORMAT

ac5fle62d21fd0529428b84d42e8955b04966703:38445748184477378130

EXTRACT HASH

SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;

BRUTE FORCE ATTACK

hashcat -m 112 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 112 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 112 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

ac5fle62d21fd0529428b84d42e8955b04966703:38445748184477378130

EXTRACT HASH

SELECT SL.name,SL.password_hash FROM sys.sql_logins AS SL;

BRUTE FORCE ATTACK

john --format=oracle11 hash.txt

WORDLIST ATTACK

john --format=oracle11 wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=oracle11 wordlist=dict.txt --rules hash.txt

CISCO TYPE 4 (SHA256)

HASHCAT

HASH FORMAT

2btjy78REtmYkkW0csHUbDZOstRXoWdX1mGrmmfeHI

BRUTE FORCE ATTACK

hashcat -m 5700 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 5700 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 5700 -a 0 hash.txt dict.txt -r rule.txt

CISCO TYPE 5 (MD5)

HASHCAT

HASH FORMAT

\$l\$28772684\$iEwN0gGugq09.bIz5sk8k/

BRUTE FORCE ATTACK

hashcat -m 500 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 500 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 500 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

\$l\$28772684\$iEwN0gGugq09.bIz5sk8k/

BRUTE FORCE ATTACK

john --format=md5crypt hash.txt

WORDLIST ATTACK

john --format=md5crypt wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=md5crypt wordlist=dict.txt --rules hash.txt

CISCO TYPE 8 (PBKDF2+SHA256)

HASHCAT

HASH FORMAT

\$8\$TnGX/fE4KGH0VU\$pEhnEvxrvaynpi8j4f.EMHr6M.FzU8xnZnBr/tJdFV

BRUTE FORCE ATTACK

hashcat -m 9200 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 9200 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 9200 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

\$8\$TnGX/fE4KGH0VU\$pEhnEvxrvaynpi8j4f.EMHr6M.FzU8xnZnBr/tJdFV

BRUTE FORCE ATTACK

john --format=pbkdf2-hmac-sha256 hash.txt

WORDLIST ATTACK

john --format=pbkdf2-hmac-sha256 wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=pbkdf2-hmac-sha256 wordlist=dict.txt --rules hash.txt

CISCO TYPE 9 (SCRIPT)

HASHCAT

HASH FORMAT

\$9\$2MJB0zw/9R3UsU\$21FhcKvpghcyw8deP25G0fyZaagyU0GBymkryv0dl

BRUTE FORCE ATTACK

hashcat -m 9300 -a 3 hash.txt ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 9300 -a 0 hash.txt dict.txt

WORDLIST + RULE ATTACK

hashcat -m 9300 -a 0 hash.txt dict.txt -r rule.txt

JOHN

HASH FORMAT

\$9\$2MJB0zw/9R3UsU\$21FhcKvpghcyw8deP25G0fyZaagyU0GBymkryv0di

BRUTE FORCE ATTACK

john --format=scrypt hash.txt

WORDLIST ATTACK

john --format=scrypt wordlist=dict.txt hash.txt

WORDLIST + RULE ATTACK

john --format=scrypt wordlist=dict.txt --rules hash.txt

WPA PSK / WPA2 PSK

HASHCAT

HASH FORMAT

*Capture 4-way authentication handshake > capture.cap

cap2hccapx.bin capture.cap capture_out.hccapx

BRUTE FORCE ATTACK

hashcat -m 2500 -a 3 capture_out.hccapx ?a?a?a?a?a

WORDLIST ATTACK

hashcat -m 2500 -a 3 capture_out.hccapx dict.txt

WORDLIST + RULE ATTACK

hashcat -a 0 capture_out.hccapx dict.txt -r rule.txt

JOHN

HASH FORMAT

*Capture 4-way authentication handshake > capture.cap

cap2hccapx.bin -e '<ESSID>' capture.cap capture_out.hccap

hccap2john capture_out.hccap > jtr_capture

BRUTE FORCE ATTACK

```
john --format=wpapsk jtr_capture
```

WORDLIST ATTACK

```
john --format=wpapsk wordlist=dict.txt jtr_capture
```

WORDLIST + RULE ATTACK

```
john --format=wpapsk wordlist=dict.txt --rules jtr_capture
```




APPENDIX



APPENDIX

TERMS

BRUTE-FORCE ATTACK - the act of trying every possible combination of a given keyspace or character set for a given length

DICTIONARY - a collection of common words, phrases, keyboard patterns, generated passwords, or leaked passwords, also known as a wordlist

DICTIONARY ATTACK - using a file containing common or known password combinations or words in an attempt to match a given hashing function's output by running said words through the same target hashing function

HASH - the fixed bit result of a hash function

HASH FUNCTION - maps data of arbitrary size to a bit string of a fixed size (a hash function) which is designed to also be a one-way function, that is, a function which is infeasible to invert

ITERATIONS - the number of times an algorithm is run over a given hash

KEYSPACE - the number of possible combinations for a given character set to the power of its length (i.e. $\text{charset}^{\text{length}}$)

MASK ATTACK - using placeholder representations to try all combinations of a given keyspace, similar to brute-force but more targeted and efficient

PASSWORD ENTROPY - an estimation of how difficult a password will be to crack given its character set and length

PLAINTEXT - unaltered text that hasn't been obscured or algorithmically altered through a hashing function

RAKING - generating random password rules/candidates in an attempt to discover a previously unknown matching password pattern

RAINBOW TABLE - a precomputed table of a targeted cryptographic hash function of a certain minimum and maximum character length

RULE ATTACK - similar to a programming language for generating candidate passwords based on some input such as a dictionary

SALT - random data that used as additional input to a one-way function

WORDLIST - a collection of commons words, phrases, keyboard patterns, generated passwords, or leaked passwords, also known as a dictionary

TIME TABLE

60 seconds	1 minute
3,600 seconds	1 hour
86,400 seconds	1 day
604,800 seconds	1 week
1,209,600 seconds	1 fortnight
2,419,200 seconds	1 month (30days)
31,536,000 seconds	1 year

ONLINE RESOURCES

JOHN

<http://openwall.info/wiki/john>

<http://openwall.info/wiki/john/sample-non-hashes>

<http://pentestmonkey.net/cheat-sheet/john-the-ripper-hash-formats>

<https://countuponsecurity.com/2015/06/14/jonh-the-ripper-cheat-sheet/>

<https://xinn.org/blog/JtR-AD-Password-Auditing.html>

<https://www.owasp.org/images/a/af/2011-Supercharged-Slides-Redman-OWASP-Feb.pdf>

HASHCAT

<https://hashcat.net/wiki/>

https://hashcat.net/wiki/doku.php?id=hashcat_utils

<https://hashcat.net/wiki/doku.php?id=statsprocessor>

<http://www.netmux.com/blog/ultimate-guide-to-cracking-foreign-character-passwords-using-has>

<http://www.netmux.com/blog/cracking-12-character-above-passwords>

CRACKING RIGS

<http://www.netmux.com/blog/how-to-build-a-password-cracking-rig>

<https://www.unix->

ninja.com/p/Building_a_Password_Cracking_Rig_for_Hashcat_-_Part_III

EXAMPLE HASH GENERATION

<https://www.onlinehashcrack.com/hash-generator.php>

<https://www.tobtu.com/tools.php>

<http://hash.online-convert.com/>

https://www.tools4noobs.com/online_tools/hash/

<https://quickhash.com/>

<http://bitcoinvalued.com/tools.php>

<http://www.sha1-online.com/>

<http://www.freeformatter.com/hmac-generator.html>

<http://openwall.info/wiki/john/Generating-test-hashes>

OTHER

<http://blog.thireus.com/cracking-story-how-i-cracked-over-122-million-sha1->

[and-md5-hashed-passwords/](#)
<http://www.utf8-chartable.de/>
<http://thesprawl.org/projects/pack/>
<https://blog.gotmilk.com/2011/06/dictionaries-wordlists/>
<http://wpengine.com/unmasked/>
https://www.unix-ninja.com/p/A_cheat-sheet_for_password_crackers
<https://room362.com/post/2017/05-06-2017-password-magic-numbers/>
<http://www.netmux.com/blog/how-to-build-a-password-cracking-rig>
<http://passwordchart.com/>
<http://www.vigilante.pw>

NETMUX

<http://www.netmux.com>
<http://www.hashcrack.io>
<https://github.com/netmux>
<https://twitter.com/netmux>
<https://www.instagram.com/netmux/>

*****ANSWER TO CUSTOM DICTIONARY CREATION HASH:
e4821dl6a298092638ddb7cad26d32f = letmein123456Netmux**

10 CRACK COMMANDMENTS

1. Thou shalt know hash types and their origin/function
2. Thou shalt know cracking software strengths & weaknesses
3. Thou shalt study & apply password analysis techniques
- 4 Thou shalt be proficient at hash extraction methods
5. Thou shalt create custom/targeted dictionaries
6. Thou shalt know thy cracking rigs capabilities
7. Thou shalt understand basic human psychology/behavior
8. Thou shalt create custom masks, rules, and Markov chains

9. Thou shalt continually experiment with new techniques
10. Thou shalt support thy fellow cracking community members

JOHN THE RIPPER HELP MENU

John the Ripper password cracker, version 1.8.0-jumbo-1 [darwin15.6.0 64-bit AVX2-autoconf]

Copyright (c) 1996-2014 by Solar Designer and others

Homepage: <http://www.openwall.com/john/>

Usage: john [OPTIONS] [PASSWORD-FILES]

--single[=SECTION]	“single crack” mode
--wordlist[=FILE] --stdin	wordlist mode, read words from FILE or stdin
--pipe	like --stdin, but bulk reads, and allows rules
--loopback[=FILE]	like --wordlist, but fetch words from a .pot file
--dupe-suppression	suppress all dupes in wordlist (and force preload)
--encoding=NAME	input encoding (eg. UTF-8, ISO-8859-1). See also doc/ENCODING and --list=hidden-options.
--rules[=SECTION]	enable word mangling rules for wordlist modes
--incremental[=MODE]	“incremental” mode [using section MODE]
--mask=MASK	mask mode using MASK
--markov[=OPTIONS]	“Markov” mode (see doc/MARKOV)
--external=MODE	external mode or word filter
--stdout[=LENGTH]	just output candidate passwords [cut

	at LENGTH]
--restore[=NAME]	restore an interrupted session [called NAME]
--session=NAME	give a new session the NAME
--status[=NAME]	print status of a session [called NAME]
--make-charset=FILE	make a charset file. It will be overwritten
--show[=LEFT]	show cracked passwords [if =LEFT, then uncracked]
--test[=TIME]	run tests and benchmarks for TIME seconds each
--users=[-]LOGIN UID[,..]	[do not] load this (these) user(s) only
--groups=[-]GID[,..]	load users [not] of this (these) group(s) only
--shells=[-]SHELL[,..]	load users with[out] this (these) shell(s) only
--salts=[-]COUNT[:MAX]	load salts with[out] COUNT [to MAX] hashes
--save-memory=LEVEL	enable memory saving, at LEVEL 1..3
--node=MIN[-MAX]/TOTAL	this node's number range out of TOTAL count
--fork=N	fork N processes
--pot=NAME	pot file to use
--list=WHAT	list capabilities, see --list=help or doc/OPTIONS
--devices=N[,..] devices)	set OpenCL device(s) (list using --list=opencl-
--format=NAME	force hash type NAME:

7z 7z-opencl AFS agilekeychain agilekeychain-opencl aix-smd5 aix-ssh1
aix-ssh256 aix-ssh512 asa-md5 bcrypt bcrypt-opencl bfegg Bitcoin
blackberry-es10 Blockchain blockchain-opencl bsdicrypt chap Citrix_NS10
Clipperz cloudkeychain cq CRC32 crypt dahua decrypt decrypt-opencl
Django django-scrypt dmd5 dmg dmg-opencl dominosec dragonfly3-32

dragonfly3-64 dragonfly4-32 dragonfly4-64 Drupal7 dummy dynamic_n
eCryptfs EFS eigrp EncFS encfs-openc1 EPI EPiServer fde FormSpring
Fortigate gost gpg gpg-openc1 HAVAL-128-4 HAVAL-256-3 hdaa HMAC-
MD5 HMAC-SHA1 HMAC-SHA224 HMAC-SHA256 HMAC-SHA384
HMAC-SHA512 hMailServer hsrp IKE ipb2 KeePass keychain keychain-
openc1 keyring keyring-openc1 keystore known_hosts krb4 krb5 krb5-18
krb5pa-md5 krb5pa-md5-openc1 krb5pa-sha1 krb5pa-sha1-openc1 kwallet
LastPass LM lotus5 lotus5-openc1 lotus85 LUKS MD2 md4-gen md5crypt
md5crypt-openc1 md5ns mdc2 MediaWiki MongoDB Mozilla mscash
mscash2 mscash2-openc1 MSCHAPv2 mschapv2-naive mssql mssql05
mssql2 mysql mysql-sha1 mysql-sha1-openc1 mysqlna net-md5 net-sha1
nethalflm netlm netlmv2 netntlm netntlm-naive netntlmv2 nk nsldap NT nt-
openc1 nt2 ntlmv2-openc1 o51ogon o51ogon-openc1 ODF ODF-AES-openc1
ODF-openc1 Office office2007-openc1 office2010-openc1 office2013-openc1
oldoffice oldoffice-openc1 OpenBSD-SoftRAID openssl-enc OpenVMS
oracle oracle11 osc Panama PBKDF2-HMAC-SHA1 PBKDF2-HMAC-
SHA1-openc1 PBKDF2-HMAC-SHA256 PBKDF2-HMAC-SHA256-openc1
PBKDF2-HMAC-SHA512 pbkdf2-hmac-sha512-openc1 PDF PFX phpass
phpass-openc1 PHPS pix-md5 PKZIP po postgres PST PuTTY pwsafe
pwsafe-openc1 RACF RAdmin RAKP RAKP-openc1 rar rar-openc1 RAR5
RAR5-openc1 Raw-Blake2 Raw-Keccak Raw-Keccak-256 Raw-MD4 Raw-
MD4-openc1 Raw-MD5 Raw-MD5-openc1 Raw-MD5u Raw-SHA Raw-
SHA1 Raw-SHA1-Linkedin Raw-SHA1-ng Raw-SHA1-openc1 Raw-
SHA224 Raw-SHA256 Raw-SHA256-ng Raw-SHA256-openc1 Raw-
SHA384 Raw-SHA512 Raw-SHA512-ng Raw-SHA512-openc1 ripemd-128
ripemd-160 rsvp Salted-SHA1 sapb sapg scrypt sha1-gen sha1crypt
sha1crypt-openc1 sha256crypt sha256crypt-openc1 sha512crypt sha512crypt-
openc1 Siemens-S7 SIP skein-256 skein-512 skey Snefru-128 Snefru-256
SSH SSH-ng ssh-openc1 SSHA512 STRIP strip-openc1 SunMD5 sxc sxc-
openc1 Sybase-PROP sybasease tc_aes_xts tc_ripemdl60 tc_sha512
tc_whirlpool tcp-md5 Tiger tripcode VNC vtp wbb3 whirlpool whirlpool0
whirlpool1 WoWSRP wpapsk wpapsk-openc1 xsha xsha512 XSHA512-
openc1 ZIP zip-openc1

HASHCAT HELP MENU

hashcat 3.6 - advanced password recovery

Usage: hashcat [options]... hash[hash-file|hccapxfile [dictionary|mask|
directory]...

- [Options] -

Options Short / Long	Description
-m, --hash-type	Hash-type, see references below
-a, --attack-mode	Attack-mode, see references below
-V, --version	Print version
-h, --help	Print help
--quiet	Suppress output
--hex-charset	Assume charset is given in hex
--hex-salt	Assume salt is given in hex
--hex-wordlist	Assume words in wordlist are given in hex
--force	Ignore warnings
--status	Enable automatic update of the status screen
--status-timer	Sets seconds between status screen updates to X
--machine-readable	Display status view in machine-readable format
--keep-guessing	Keep guessing hash after it has been cracked
--loopback	Add new plains to induct directory
--weak	Threshold X to stop checking for weak hashes
--markov-hcstat	Specify hcstat file to use
--markov-disable	Disables markov-chains, classic brute-force
--markov-classic	Enables classic markov-chains, no per-position
-t, --markov-threshold	Threshold X to stop accepting new markov-chains
--runtime	Abort session after X seconds of runtime
--session	Define specific session name
--restore	Restore session from --session
--restore-disable	Do not write restore file
--restore-file-path	Specific path to restore file
-o, --outfile	Define outfile for recovered hash
--outfile-format	Define outfile-format X for recovered hash
--outfile-autohex-disable	Disable the use of \$HEX[] in output plains
--outfile-check-timer	Sets seconds between outfile checks to X
-p, --separator	Separator char for hashlists and outfile
--stdout	Do not crack a hash, print candidates only
--show	Compare hashlist with potfile; show cracked
--left	Compare hashlist with potfile; show uncracked
--username	Enable ignoring of usernames in hashfile
--remove	Enable removal of hashes once they are cracked
--remove-timer	Update input hash file each X seconds
--potfile-disable	Do not write potfile
--potfile-path	Specific path to potfile
--encoding-from	Force internal wordlist encoding from X
--encoding-to	Force internal wordlist encoding to X
--debug-mode	Defines the debug mode 1-4
--debug-file	Output file for debugging rules
--induction-dir	Specify induction directory to use for loopback
--outfile-check-dir	Specify outfile directory to monitor for plains
--logfile-disable	Disable the logfile
--hccapx-message-pair	Load only message pairs from hccapx matching X
--nonce-error-corrections	BF size range to replace AP's nonce last bytes
--truecrypt-keyfiles	Keyfiles to use, separated with commas
--veracrypt-keyfiles	Keyfiles to use, separated with commas
--veracrypt-pim	VeraCrypt personal iterations multiplier
-b, --benchmark	Run benchmark

--speed-only	Return expected speed of the attack, then quit
--progress-only	Return ideal step size and time to process
-c, --segment-size	Sets size in MB to cache from the wordfile to X
--bitmap-min	Sets minimum bits allowed for bitmaps to X
--bitmap-max	Sets maximum bits allowed for bitmaps to X
--cpu-affinity	Locks to CPU devices, separated with commas
-I, --openccl-info	Show info on detected OpenCL platforms/devices
--openccl-platforms	OpenCL platforms to use, separated with commas
-d, --openccl-devices	OpenCL devices to use, separated with commas
-D, --openccl-device-types	OpenCL device-types to use, separate with commas
--openccl-vector-width	Manually override OpenCL vector-width to X
-w, --workload-profile	Enable a specific workload profile, 1-4
-n, --kernel-accel	Workload tuning, set outerloop step size to X
-u, --kernel-loops	Workload tuning, set innerloop step size to X
--nvidia-spin-damp	Workaround NVIDIAs CPU burning loop bug
--gpu-temp-disable	Disable temperature, fanspeed reads, triggers
--gpu-temp-abort	Abort if GPU temperature reaches X degrees C
--gpu-temp-retain	Try to retain GPU temperature at X degrees C
--powertune-enable	Enable power tuning. Restores settings
--scrypt-tmt0	Manually override TMT0 value for scrypt to X
-s, --skip	Skip X words from the start
-l, --limit	Limit X words from the start + skipped words
--keyspace	Show keyspace base:mod values and quit
-j, --rule-left	Single rule applied to word from left wordlist
-k, --rule-right	Single rule applied to word from right wordlist
-r, --rules-file	Multiple rules applied to word from wordlists
-g, --generate-rules	Generate X random rules
--generate-rules-func-min	Force min X functions per rule
--generate-rules-func-max	Force max X functions per rule
--generate-rules-seed	Force RNG seed set to X
-1, --custom-charset1	User-defined charset ?1
-2, --custom-charset2	User-defined charset ?2
-3, --custom-charset3	User-defined charset ?3
-4, --custom-charset4	User-defined charset ?4
-i, --increment	Enable mask increment mode
--increment-min	Start mask incrementing at X
--increment-max	Stop mask incrementing at X

- [Hash modes] -

#	Name	Category
900	MD4	Raw Hash
0	MD5	Raw Hash
5100	Half MD5	Raw Hash
100	SHA1	Raw Hash
1300	SHA-224	Raw Hash
1400	SHA-256	Raw Hash
10800	SHA-384	Raw Hash
1700	SHA-512	Raw Hash
5000	SHA-3 (Keccak)	Raw Hash
600	BLAKE2b-512	Raw Hash
10100	SipHash	Raw Hash
6000	RIPEMD-160	Raw Hash
6100	Whirlpool	Raw Hash
6900	GOST R 34.11-94	Raw Hash
11700	GOST R 34.11-2012 (Streebog) 256-bit	Raw Hash
11800	GOST R 34.11-2012 (Streebog) 512-bit	Raw Hash
10	md5(\$pass.\$salt)	Raw Hash, Salted and/or Iterated
20	md5(\$salt.\$pass)	Raw Hash, Salted and/or Iterated
30	md5(utf16le(\$pass).\$salt)	Raw Hash, Salted and/or Iterated
40	md5(\$salt.utf16le(\$pass))	Raw Hash, Salted and/or Iterated
3800	md5(\$salt.\$pass.\$salt)	Raw Hash, Salted and/or Iterated
3710	md5(\$salt.md5(\$pass))	Raw Hash, Salted and/or Iterated

4010	md5(\$salt.md5(\$salt.\$pass))	Raw Hash, Salted and/or Iterated
4110	md5(\$salt.md5(\$pass.\$salt))	Raw Hash, Salted and/or Iterated
2600	md5(md5(\$pass))	Raw Hash, Salted and/or Iterated
3910	md5(md5(\$pass).md5(\$salt))	Raw Hash, Salted and/or Iterated
4300	md5(strtoupper(md5(\$pass)))	Raw Hash, Salted and/or Iterated
4400	md5(sha1(\$pass))	Raw Hash, Salted and/or Iterated
110	sha1(\$pass.\$salt)	Raw Hash, Salted and/or Iterated
120	sha1(\$salt.\$pass)	Raw Hash, Salted and/or Iterated
130	sha1(utf16le(\$pass).\$salt)	Raw Hash, Salted and/or Iterated
140	sha1(\$salt.utf16le(\$pass))	Raw Hash, Salted and/or Iterated
4500	sha1(sha1(\$pass))	Raw Hash, Salted and/or Iterated
4520	sha1(\$salt.sha1(\$pass))	Raw Hash, Salted and/or Iterated
4700	sha1(md5(\$pass))	Raw Hash, Salted and/or Iterated
4900	sha1(\$salt.\$pass.\$salt)	Raw Hash, Salted and/or Iterated
14400	sha1(CX)	Raw Hash, Salted and/or Iterated
1410	sha256(\$pass.\$salt)	Raw Hash, Salted and/or Iterated
1420	sha256(\$salt.\$pass)	Raw Hash, Salted and/or Iterated
1430	sha256(utf16le(\$pass).\$salt)	Raw Hash, Salted and/or Iterated
1440	sha256(\$salt.utf16le(\$pass))	Raw Hash, Salted and/or Iterated
1710	sha512(\$pass.\$salt)	Raw Hash, Salted and/or Iterated
1720	sha512(\$salt.\$pass)	Raw Hash, Salted and/or Iterated
1730	sha512(utf16le(\$pass).\$salt)	Raw Hash, Salted and/or Iterated
1740	sha512(\$salt.utf16le(\$pass))	Raw Hash, Salted and/or Iterated
50	HMAC-MD5 (key = \$pass)	Raw Hash, Authenticated
60	HMAC-MD5 (key = \$salt)	Raw Hash, Authenticated
150	HMAC-SHA1 (key = \$pass)	Raw Hash, Authenticated
160	HMAC-SHA1 (key = \$salt)	Raw Hash, Authenticated
1450	HMAC-SHA256 (key = \$pass)	Raw Hash, Authenticated
1460	HMAC-SHA256 (key = \$salt)	Raw Hash, Authenticated
1750	HMAC-SHA512 (key = \$pass)	Raw Hash, Authenticated
1760	HMAC-SHA512 (key = \$salt)	Raw Hash, Authenticated
14000	DES (PT = \$salt, key = \$pass)	Raw Cipher, Known-Plaintext
14100	3DES (PT = \$salt, key = \$pass)	Raw Cipher, Known-Plaintext
14900	Skip32 (PT = \$salt, key = \$pass)	Raw Cipher, Known-Plaintext
15400	ChaCha20	Raw Cipher, Known-Plaintext
400	phpass	Generic KDF
8900	scrypt	Generic KDF
11900	PBKDF2-HMAC-MD5	Generic KDF
12000	PBKDF2-HMAC-SHA1	Generic KDF
10900	PBKDF2-HMAC-SHA256	Generic KDF
12100	PBKDF2-HMAC-SHA512	Generic KDF
23	Skype	Network Protocols
2500	WPA/WPA2	Network Protocols
2501	WPA/WPA2 PMK	Network Protocols
4800	iSCSI CHAP authentication, MD5(CHAP)	Network Protocols
5300	IKE-PSK MD5	Network Protocols
5400	IKE-PSK SHA1	Network Protocols
5500	NetNTLMv1	Network Protocols
5500	NetNTLMv1+ESS	Network Protocols
5600	NetNTLMv2	Network Protocols
7300	IPMI2 RAKP HMAC-SHA1	Network Protocols
7500	Kerberos 5 AS-REQ Pre-Auth etype 23	Network Protocols
8300	DNSSEC (NSEC3)	Network Protocols
10200	CRAM-MD5	Network Protocols
11100	PostgreSQL CRAM (MD5)	Network Protocols
11200	MySQL CRAM (SHA1)	Network Protocols
11400	SIP digest authentication (MD5)	Network Protocols
13100	Kerberos 5 TGS-REP etype 23	Network Protocols
121	SMF (Simple Machines Forum) > v1.1	Forums, CMS, E-Commerce
400	phpBB3 (MD5)	Forums, CMS, E-Commerce
2611	vBulletin < v3.8.5	Forums, CMS, E-Commerce
2711	vBulletin >= v3.8.5	Forums, CMS, E-Commerce
2811	MyBB 1.2+	Forums, CMS, E-Commerce
2811	IPB2+ (Invision Power Board)	Forums, CMS, E-Commerce
8400	WBB3 (Woltlab Burning Board)	Forums, CMS, E-Commerce
11	Joomla < 2.5.18	Forums, CMS, E-Commerce
400	Joomla >= 2.5.18 (MD5)	Forums, CMS, E-Commerce
400	WordPress (MD5)	Forums, CMS, E-Commerce
2612	PHPS	Forums, CMS, E-Commerce
7900	Drupal7	Forums, CMS, E-Commerce
21	osCommerce	Forums, CMS, E-Commerce
21	xt:Commerce	Forums, CMS, E-Commerce

11000	PrestaShop	Forums, CMS, E-Commerce
124	Django (SHA-1)	Forums, CMS, E-Commerce
10000	Django (PBKDF2-SHA256)	Forums, CMS, E-Commerce
3711	MediaWiki B type	Forums, CMS, E-Commerce
13900	OpenCart	Forums, CMS, E-Commerce
4521	Redmine	Forums, CMS, E-Commerce
4522	PunBB	Forums, CMS, E-Commerce
12001	Atlassian (PBKDF2-HMAC-SHA1)	Forums, CMS, E-Commerce
12	PostgreSQL	Database Server
131	MSSQL (2000)	Database Server
132	MSSQL (2005)	Database Server
1731	MSSQL (2012, 2014)	Database Server
200	MySQL323	Database Server
300	MySQL4.1/MySQL5	Database Server
3100	Oracle H: Type (Oracle 7+)	Database Server
112	Oracle S: Type (Oracle 11+)	Database Server
12300	Oracle T: Type (Oracle 12+)	Database Server
8000	Sybase ASE	Database Server
141	Episerver 6.x < .NET 4	HTTP, SMTP, LDAP Server
1441	Episerver 6.x >= .NET 4	HTTP, SMTP, LDAP Server
1600	Apache \$apr1\$ MD5, md5apr1, MD5 (APR)	HTTP, SMTP, LDAP Server
12600	ColdFusion 10+	HTTP, SMTP, LDAP Server
1421	hMailServer	HTTP, SMTP, LDAP Server
101	nsldap, SHA-1(Base64), Netscape LDAP SHA	HTTP, SMTP, LDAP Server
111	nsldaps, SSHA-1(Base64), Netscape LDAP SSHA	HTTP, SMTP, LDAP Server
1411	SSHA-256(Base64), LDAP {SSHA256}	HTTP, SMTP, LDAP Server
1711	SSHA-512(Base64), LDAP {SSHA512}	HTTP, SMTP, LDAP Server
15000	FileZilla Server >= 0.9.55	FTP Server
11500	CRC32	Checksums
3000	LM	Operating Systems
1000	NTLM	Operating Systems
1100	Domain Cached Credentials (DCC), MS Cache	Operating Systems
2100	Domain Cached Credentials 2 (DCC2), MS Cache 2	Operating Systems
15300	DPAPI masterkey file v1 and v2	Operating Systems
12800	MS-AzureSync PBKDF2-HMAC-SHA256	Operating Systems
1500	descrypt, DES (Unix), Traditional DES	Operating Systems
12400	BSDi Crypt, Extended DES	Operating Systems
500	md5crypt, MD5 (Unix), Cisco-IOS \$1\$ (MD5)	Operating Systems
3200	bcrypt \$2*\$, Blowfish (Unix)	Operating Systems
7400	sha256crypt \$5\$, SHA256 (Unix)	Operating Systems
1800	sha512crypt \$6\$, SHA512 (Unix)	Operating Systems
122	OSX v10.4, OSX v10.5, OSX v10.6	Operating Systems
1722	OSX v10.7	Operating Systems
7100	OSX v10.8+ (PBKDF2-SHA512)	Operating Systems
6300	AIX {smd5}	Operating Systems
6700	AIX {ssh1}	Operating Systems
6400	AIX {ssh256}	Operating Systems
6500	AIX {ssh512}	Operating Systems
2400	Cisco-PIX MD5	Operating Systems
2410	Cisco-ASA MD5	Operating Systems
500	Cisco-IOS \$1\$ (MD5)	Operating Systems
5700	Cisco-IOS type 4 (SHA256)	Operating Systems
9200	Cisco-IOS \$8\$ (PBKDF2-SHA256)	Operating Systems
9300	Cisco-IOS \$9\$ (scrypt)	Operating Systems
22	Juniper NetScreen/SSG (ScreenOS)	Operating Systems
501	Juniper IVE	Operating Systems
15100	Juniper/NetBSD shalcrypt	Operating Systems
7000	FortiGate (FortiOS)	Operating Systems
5800	Samsung Android Password/PIN	Operating Systems
13800	Windows Phone 8+ PIN/password	Operating Systems
8100	Citrix NetScaler	Operating Systems
8500	RACF	Operating Systems
7200	GRUB 2	Operating Systems
9900	Radmin2	Operating Systems
125	ArubaOS	Operating Systems
7700	SAP CODVN B (BCODE)	Enterprise Application Software
7800	SAP CODVN F/G (PASSCODE)	Enterprise Application Software
10300	SAP CODVN H (PWDSALTEDHASH) iSSHA-1	Enterprise Application Software
8600	Lotus Notes/Domino 5	Enterprise Application Software
8700	Lotus Notes/Domino 6	Enterprise Application Software
9100	Lotus Notes/Domino 8	Enterprise Application Software
133	PeopleSoft	Enterprise Application Software

13500	PeopleSoft PS_TOKEN	Enterprise Application Software
11600	7-Zip	Archives
12500	RAR3-hp	Archives
13000	RAR5	Archives
13200	AxCrypt	Archives
13300	AxCrypt in-memory SHA1	Archives
13600	WinZip	Archives
14700	iTunes backup < 10.0	Backup
14800	iTunes backup >= 10.0	Backup
62XY	TrueCrypt	Full-Disk Encryption (FDE)
X	1 = PBKDF2-HMAC-RIPEMD160	Full-Disk Encryption (FDE)
X	2 = PBKDF2-HMAC-SHA512	Full-Disk Encryption (FDE)
X	3 = PBKDF2-HMAC-Whirlpool	Full-Disk Encryption (FDE)
X	4 = PBKDF2-HMAC-RIPEMD160 + boot-mode	Full-Disk Encryption (FDE)
Y	1 = XTS 512 bit pure AES	Full-Disk Encryption (FDE)
Y	1 = XTS 512 bit pure Serpent	Full-Disk Encryption (FDE)
Y	1 = XTS 512 bit pure Twofish	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit pure AES	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit pure Serpent	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit pure Twofish	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit cascaded AES-Twofish	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit cascaded Serpent-AES	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit cascaded Twofish-Serpent	Full-Disk Encryption (FDE)
Y	3 = XTS 1536 bit all	Full-Disk Encryption (FDE)
8800	Android FDE <= 4.3	Full-Disk Encryption (FDE)
12900	Android FDE (Samsung DEK)	Full-Disk Encryption (FDE)
12200	eCryptfs	Full-Disk Encryption (FDE)
137XY	VeraCrypt	Full-Disk Encryption (FDE)
X	1 = PBKDF2-HMAC-RIPEMD160	Full-Disk Encryption (FDE)
X	2 = PBKDF2-HMAC-SHA512	Full-Disk Encryption (FDE)
X	3 = PBKDF2-HMAC-Whirlpool	Full-Disk Encryption (FDE)
X	4 = PBKDF2-HMAC-RIPEMD160 + boot-mode	Full-Disk Encryption (FDE)
X	5 = PBKDF2-HMAC-SHA256	Full-Disk Encryption (FDE)
X	6 = PBKDF2-HMAC-SHA256 + boot-mode	Full-Disk Encryption (FDE)
Y	1 = XTS 512 bit pure AES	Full-Disk Encryption (FDE)
Y	1 = XTS 512 bit pure Serpent	Full-Disk Encryption (FDE)
Y	1 = XTS 512 bit pure Twofish	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit pure AES	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit pure Serpent	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit pure Twofish	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit cascaded AES-Twofish	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit cascaded Serpent-AES	Full-Disk Encryption (FDE)
Y	2 = XTS 1024 bit cascaded Twofish-Serpent	Full-Disk Encryption (FDE)
Y	3 = XTS 1536 bit all	Full-Disk Encryption (FDE)
14600	LUKS	Full-Disk Encryption (FDE)
9700	MS Office <= 2003 \$0/\$1, MD5 + RC4	Documents
9710	MS Office <= 2003 \$0/\$1, MD5 + RC4, collider #1	Documents
9720	MS Office <= 2003 \$0/\$1, MD5 + RC4, collider #2	Documents
9800	MS Office <= 2003 \$3/\$4, SHA1 + RC4	Documents
9810	MS Office <= 2003 \$3, SHA1 + RC4, collider #1	Documents
9820	MS Office <= 2003 \$3, SHA1 + RC4, collider #2	Documents
9400	MS Office 2007	Documents
9500	MS Office 2010	Documents
9600	MS Office 2013	Documents
10400	PDF 1.1 - 1.3 (Acrobat 2 - 4)	Documents
10410	PDF 1.1 - 1.3 (Acrobat 2 - 4), collider #1	Documents
10420	PDF 1.1 - 1.3 (Acrobat 2 - 4), collider #2	Documents
10500	PDF 1.4 - 1.6 (Acrobat 5 - 8)	Documents
10600	PDF 1.7 Level 3 (Acrobat 9)	Documents
10700	PDF 1.7 Level 8 (Acrobat 10 - 11)	Documents
9000	Password Safe v2	Password Managers
5200	Password Safe v3	Password Managers
6800	LastPass + LastPass sniffed	Password Managers
6600	1Password, agilekeychain	Password Managers
8200	1Password, cloudkeychain	Password Managers
11300	Bitcoin/Litecoin wallet.dat	Password Managers
12700	Blockchain, My Wallet	Password Managers
15200	Blockchain, My Wallet, V2	Password Managers
13400	KeePass 1 (AES/Twofish) and KeePass 2 (AES)	Password Managers
15500	JKS Java Key Store Private Keys (SHA1)	Password Managers
15600	Ethereum Wallet, PBKDF2-HMAC-SHA256	Password Managers
15700	Ethereum Wallet, SCRYPT	Password Managers

- [Outfile Formats] -

#	Format
1	hash[:salt]
2	plain
3	hash[:salt]:plain
4	hex_plain
5	hash[:salt]:hex_plain
6	plain:hex_plain
7	hash[:salt]:plain:hex_plain
8	crackpos
9	hash[:salt]:crack_pos
10	plain:crack_pos
11	hash[:salt]:plain:crack_pos
12	hex_plain:crack_pos
13	hash[:salt]:hex_plain:crack_pos
14	plain:hex_plain:crack_pos
15	hash[:salt]:plain:hex_plain:crack_pos

- [Rule Debugging Modes] -

#	Format
1	Finding-Rule
2	Original-Word
3	Original-Word:Finding-Rule
4	Original-Word:Finding-Rule:Processed-Word

- [Attack Modes] -

#	Mode
0	Straight
1	Combination
3	Brute-force
6	Hybrid Wordlist + Mask
7	Hybrid Mask + Wordlist

- [Built-in Charsets] -

?	Charset
l	abcdefghijklmnopqrstuvwxyz
u	ABCDEFGHIJKLMNOPQRSTUVWXYZ
d	0123456789
h	0123456789abcdef
H	0123456789ABCDEF
s	!"#\$%&'()*+,-./:;<=>?@[\\]^_`{ }~
a	?l?u?d?s
b	0x00 - 0xff

- [OpenCL Device Types] -

#	Device Type
1	CPU
2	GPU
3	FPGA, DSP, Co-Processor

- [Workload Profiles] -

#	Performance	Runtime	Power Consumption	Desktop Impact
1	Low	2 ms	Low	Minimal
2	Default	12 ms	Economic	Noticeable
3	High	96 ms	High	Unresponsive
4	Nightmare	480 ms	Insane	Headless

- [Basic Examples] -

Attack- Mode	Hash- Type	Example command
Wordlist	\$P\$	hashcat -a 0 -m 400 example400.hash example.dict
Wordlist + Rules	MD5	hashcat -a 0 -m 0 example0.hash example.dict -r rules/best64.rule
Brute-Force	MD5	hashcat -a 3 -m 0 example0.hash ?a?a?a?a?a
Combinator	MD5	hashcat -a 1 -m 0 example0.hash example.dict

If you still have no idea what just happened, try the following pages:

- * https://hashcat.net/wiki/#howtos_videos_papers_articles_etc_in_the_wild
- * <https://hashcat.net/faq/>



HASH CRACKING BENCHMARKS



****HASH CRACKING BENCHMARK tables are meant to be a reference to enable users to gauge how SLOW or FAST a hashing algorithm is before formulating an attack plan. Nvidia GTX2080 was chosen as the default due to its prevalence among the cracking community and it's position as a top performing GPU card.*

HASH CRACKING BENCHMARKS (ALPHABETICAL)

1Password, agilekeychain	3319.2 kH/s
1Password, cloudkeychain	10713 H/s
3DES (PT = \$salt, key = \$pass)	594.3 MH/s
7-Zip	7514 H/s
AIX	14937.2 kH/s
AIX	44926.1 kH/s
AIX	6359.3 kH/s
AIX	9937.1 kH/s
Android FDE (Samsung DEK)	291.8 kH/s
Android FDE <= 4.3	803.0 kH/s
Android PIN	5419.4 kH/s
ArubaOS	6894.7 MH/s
Atlassian (PBKDF2-HMAC-SHA1)	283.6 kH/s
AxCrypt	113.9 kH/s
AxCrypt in memory SHA1	7503.3 MH/s
bcrypt, Blowfish(OpenBSD)	13094 H/s
BSDiCrypt, Extended DES	1552.5 kH/s
Bitcoin/Litecoin wallet.dat	4508 H/s
BLAKE2-512	1488.9 MH/s
Blockchain, My Wallet	50052.3 kH/s
Blockchain, My Wallet, V2	305.2 kH/s
ChaCha20	3962.0 MH/s
Cisco \$8\$	59950 H/s

Cisco \$9\$	22465 H/s
Cisco-ASA MD5	17727.2 MH/s
Cisco-IOS SHA256	2864.3 MH/s
Cisco-PIX MD5	16407.2 MH/s
Citrix NetScaler	7395.3 MH/s
ColdFusion 10+	1733.6 MH/s
DES (PT = \$salt, key = \$pass)	19185.7 MH/s
decrypt, DES(Unix), Traditional DES	906.7 MH/s
DNSSEC (NSEC3)	3274.6 MH/s
Django (PBKDF2-SHA256)	59428 H/s
Django (SHA-1)	6822.6 MH/s
Domain Cached Credentials (DCC), MS Cache	11195.8 MH/s
Domain Cached Credentials 2 (DCC2), MS Cache 2	317.5 kH/s
DPAPI masterkey file v1 and v2	73901 H/s
Drupal7	56415 H/s
eCryptfs	13813 H/s
Ethereum Wallet, PBKDF2-HMAC-SHA256	4518 H/s
Ethereum Wallet, SCRYPT	29 H/s
EPiServer 6.x < v4	6818.5 MH/s
EPiServer 6.x > v4	2514.4 MH/s
FileZilla Server >= 0.9.55	565.2 MH/s
FortiGate (FortiOS)	6386.2 MH/s
GOST R 34.11-2012 (Streebog) 256-bit	50018.8 kH/s
GOST R 34.11-2012 (Streebog) 512-bit	49979.4 kH/s
GOST R 34.11-94	206.2 MH/s
GRUB 2	43235 H/s
Half MD5	15255.8 MH/s
hMailServer	2509.6 MH/s
IKE-PSK MD5	1834.0 MH/s
IKE-PSK SHA1	788.2 MH/s
IPB2+, MyBB1.2+	5011.8 MH/s
IPMI2 RAKP HMAC-SHA1	1607.3 MH/s
iTunes backup < 10.0	140.2 kH/s

iTunes backup >= 10.0	94 H/s
JKS Java Key Store Private Keys (SHA1)	7989.4 MH/s
Joomla < 2.5.18	25072.2 MH/s
Juniper IVE	9929.1 kH/s
Juniper/NetBSD sha1crypt	144.1 kH/s
Juniper Netscreen/SSG (ScreenOS)	12946.8 MH/s
Keepass 1 (AES/Twofish) and Keepass 2 (AES)	139.8 kH/s
Kerberos 5 AS-REQ Pre-Auth etype 23	291.5 MH/s
Kerberos 5 TGS-REP etype 23	291.1 MH/s
LM	18382.7 MH/s
Lastpass	2331.2 kH/s
Lotus Notes/Domino 5	205.2 MH/s
Lotus Notes/Domino 6	69673.5 kH/s
Lotus Notes/Domino 8	667.2 kH/s
LUKS	8703 H/s
MD4	43722.9 MH/s
MD5	24943.1 MH/s
md5(md5(\$pass).md5(\$salt))	4291.9 MH/s
md5(\$salt.md5(\$salt.\$pass))	5037.7 MH/s
md5(\$salt.md5(\$pass.\$salt))	5401.6 MH/s
md5apr1, MD5(APR), Apache MD5	9911.5 kH/s
md5crypt, MD5(Unix), FreeBSD MD5, Cisco-IOS MD5	9918.1 kH/s
MS Office <= 2003 MD5+RC4,collision-mode #1	339.9 MH/s
MS Office <= 2003 MD5+RC4,oldoffice\$0,oldoffice\$l	219.6 MH/s
MS Office <= 2003 SHA1+RC4,collision-mode #1	330.8 MH/s
MS Office <= 2003 SHA1+RC4,oldoffice\$3,oldoffice\$4	296.7 MH/s
MS-AzureSync PBKDF2-HMAC-SHA256	10087.9 kH/s
MSSQL(2000)	8609.7 MH/s
MSSQL(2005)	8636.4 MH/s
MSSQL(2012)	1071.3 MH/s

Mediawiki B type	6515.8 MH/s
MySQL Challenge-Response Authentication (SHA1)	2288.0 MH/s
MySQL323	51387.0 MH/s
MySQL4.1/MySQL5	3831.5 MH/s
NTLM	41825.0 MH/s
NetNTLMv1-VANILLA / NetNTLMv1+ESS	22308.5 MH/s
NetNTLMv2	1634.9 MH/s
osCommerce, xt	12883.7 MH/s
OSX V10.4, V10.5, V10.6	6831.3 MH/s
OSX V10.7	834.1 MH/s
OSX V10.8+	12348 H/s
Office 2007	134.5 kH/s
Office 2010	66683 H/s
Office 2013	8814 H/s
OpenCart	2097.0 MH/s
Oracle H	851.6 MH/s
Oracle S	8565.0 MH/s
Oracle T	104.7 kH/s
Password Safe v2	332.0 kH/s
Password Safe v3	1233.4 kH/s
PBKDF2-HMAC-MD5	7408.3 kH/s
PBKDF2-HMAC-SHA1	3233.9 kH/s
PBKDF2-HMAC-SHA256	1173.1 kH/s
PBKDF2-HMAC-SHA512	431.4 kH/s
PDF 1.1 - 1.3 (Acrobat 2 - 4)	345.0 MH/s
PDF 1.1 - 1.3 (Acrobat 2 - 4) + collider-mode #1	373.4 MH/s
PDF 1.4 - 1.6 (Acrobat 5 - 8)	16048.0 kH/s
PDF 1.7 Level 3 (Acrobat 9)	2854.1 MH/s
PDF 1.7 Level 8 (Acrobat 10 - 11)	30974 H/s
PeopleSoft	8620.3 MH/s
PeopleSoft PS_TOKEN	3226.5 MH/s
phpass, MD5 Wordpress, MD5 phpBB3,	6917.9 kH/s

MD5(Joomla)	
PHPS	6972.6 MH/s
Plaintext	37615.5 MH/s
PostgreSQL	25068.0 MH/s
PostgreSQL Challenge-Response Auth (MD5)	6703.0 MH/s
PrestaShop	8221.3 MH/s
PunBB	2837.7 MH/s
RACF	2528.4 MH/s
RAR3-hp	29812 H/s
RAR5	36473 H/s
Radmin2	8408.3 MH/s
Redmine Project Management Web App	2121.3 MH/s
RipeMD160	4732.0 MH/s
SAP CODVN B (BCODE)	1311.2 MH/s
SAP CODVN F/G (PASSCODE)	739.3 MH/s
SAP CODVN H (PWDSALTEDHASH) iSSHA-1	6096.6 kH/s
scrypt	435.1 kH/s
SHA-1(Base64), nsldap, Netscape LDAP SHA	8540.0 MH/s
SHA-3(Keccak)	769.8 MH/s
SHA1	8538.1 MH/s
SHA1(CX)	291.8 MH/s
sha1(\$salt.sha1(\$pass))	2457.6 MH/s
SHA-224	3076.6 MH/s
SHA256	2865.2 MH/s
sha256crypt, SHA256(Unix)	388.8 kH/s
SHA384	1044.8 MH/s
SHA512	1071.1 MH/s
sha512crypt, SHA512(Unix)	147.5 kH/s
SIP digest authentication (MD5)	2004.3 MH/s
SKIP32	4940.9 MH/s
SMF > v1.1	6817.7 MH/s
SSHA-1(Base64), nsldaps, Netscape LDAP SSHA	8584.5 MH/s

SSHA-256(Base64), LDAP {SSHA256}	3216.9 MH/s
SSHA-512(Base64), LDAP	1072.2 MH/s
SipHash	28675.1 MH/s
Skype	12981.9 MH/s
Sybase ASE	398.1 MH/s
TrueCrypt PBKDF2-HMAC-RipeMD160+XTS512bit+boot-mode	512.4 kH/s
TrueCrypt PBKDF2-HMAC-RipeMD160+XTS512bit	277.0 kH/s
TrueCrypt PBKDF2-HMAC-SHA512+XTS512 bit	376.2 kH/s
TrueCrypt PBKDF2-HMAC-Whirlpool+XTS512 bit	36505 H/s
vBulletin < V3.8.5	6947.7 MH/s
vBulletin > V3.8.5	4660.5 MH/s
VeraCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit	907 H/s
VeraCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit+boot-mode	1820 H/s
VeraCrypt PBKDF2-HMAC-SHA256+XTS 512bit	1226 H/s
VeraCrypt PBKDF2-HMAC-SHA256+XTS 512bit+boot-mode	3012 H/s
VeraCrypt PBKDF2-HMAC-SHA512+XTS 512bit	830 H/s
VeraCrypt PBKDF2-HMAC-Whirlpool+XTS 512bit	74 H/s
WBB3, Woltlab Burning Board 3	1293.3 MH/s
WPA/WPA2	396.8 kH/s
Whirlpool	253.9 MH/s
WinZip	1054.4 kH/s

**CRACKING SPEED BASED ON NVIDIA GTX 1080 & HASHCAT v3.6*



HASH CRACKING SPEED



HASH CRACKING SPEED (SLOW - FAST)

Ethereum Wallet, SCRYPT	29 H/s
VeraCrypt PBKDF2-HMAC-Whirlpool+XTS 512bit	74 H/s
iTunes backup >= 10.0	94 H/s
VeraCrypt PBKDF2-HMAC-SHA512+XTS 512bit	830 H/s
VeraCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit	907 H/s
VeraCrypt PBKDF2-HMAC-SHA256+XTS 512bit	1226 H/s
VeraCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit+boot-mode	1820 H/s
VeraCrypt PBKDF2-HMAC-SHA256+XTS 512bit+boot-mode	3012 H/s
Bitcoin/Litecoin wallet.dat	4508 H/s
Ethereum Wallet, PBKDF2-HMAC-SHA256	4518 H/s
7-Zip	7514 H/s
LUKS	8703 H/s
Office 2013	8814 H/s
1Password, cloudkeychain	10713 H/s
OSX V10.8+	12348 H/s
bcrypt, Blowfish(OpenBSD)	13094 H/s
eCryptfs	13813 H/s
Cisco \$9\$	22465 H/s
RAR3-hp	29812 H/s
PDF 1.7 Level 8 (Acrobat 10 - 11)	30974 H/s
RAR5	36473 H/s
TrueCrypt PBKDF2-HMAC-Whirlpool+XTS512 bit	36505 H/s
GRUB 2	43235 H/s
Drupal7	56415 H/s
Django (PBKDF2-SHA256)	59428 H/s
Cisco \$8\$	59950 H/s
Office 2010	66683 H/s

DPAPI masterkey file v1 and v2	73901 H/s
Oracle T	104.7 kH/s
AxCrypt	113.9 kH/s
Office 2007	134.5 kH/s
Keepass 1 (AES/Twofish) and Keepass 2 (AES)	139.8 kH/s
iTunes backup < 10.0	140.2 kH/s
Juniper/NetBSD sha1crypt	144.1 kH/s
sha512crypt, SHA512(Unix)	147.5 kH/s
TrueCrypt PBKDF2-HMAC-RipeMD160+XTS512 bit	277.0 kH/s
Atlassian (PBKDF2-HMAC-SHA1)	283.6 kH/s
Android FDE (Samsung DEK)	291.8 kH/s
Blockchain, My Wallet, V2	305.2 kH/s
Domain Cached Credentials 2 (DCC2), MS Cache 2	317.5 kH/s
Password Safe v2	332.0 kH/s
TrueCrypt PBKDF2-HMAC-SHA512+XTS512 bit	376.2 kH/s
sha256crypt, SHA256(Unix)	388.8 kH/s
WPA/WPA2	396.8 kH/s
PBKDF2-HMAC-SHA512	431.4 kH/s
scrypt	435.1 kH/s
TrueCrypt PBKDF2-HMAC-RipeMD160+XTS 512bit+boot-mode	512.4 kH/s
Lotus Notes/Domino 8	667.2 kH/s
Android FDE <= 4.3	803.0 kH/s
WinZip	1054.4 kH/s
PBKDF2-HMAC-SHA256	1173.1 kH/s
Password Safe v3	1233.4 kH/s
BSDiCrypt, Extended DES	1552.5 kH/s
Lastpass	2331.2 kH/s
PBKDF2-HMAC-SHA1	3233.9 kH/s
1Password, agilekeychain	3319.2 kH/s
Android PIN	5419.4 kH/s
SAP CODVN H (PWDSALTEDHASH) iSSHA-1	6096.6 kH/s

AIX	6359.3 kH/s
phpass, MD5 Wordpress, MD5 phpBB3, MD5 Joomla)	6917.9 kH/s
PBKDF2-HMAC-MD5	7408.3 kH/s
md5apr1, MD5(APR), Apache MD5	9911.5 kH/s
md5crypt, MD5(Unix), FreeBSD MD5, Cisco-IOS MD5	9918.1 kH/s
Juniper IVE	9929.1 kH/s
AIX	9937.1 kH/s
MS-AzureSync PBKDF2-HMAC-SHA256	10087.9 kH/s
AIX	14937.2 kH/s
PDF 1.4 - 1.6 (Acrobat 5 - 8)	16048.0 kH/s
AIX	44926.1 kH/s
GOST R 34.11-2012 (Streebog) 512-bit	49979.4 kH/s
GOST R 34.11-2012 (Streebog) 256-bit	50018.8 kH/s
Blockchain, My Wallet	50052.3 kH/s
Lotus Notes/Domino 6	69673.5 kH/s
Lotus Notes/Domino 5	205.2 MH/s
GOST R 34.11-94	206.2 MH/s
MS Office <= 2003 MD5+RC4,oldoffice\$0, oldoffice\$l	219.6 MH/s
Whirlpool	253.9 MH/s
Kerberos 5 TGS-REP etype 23	291.1 MH/s
Kerberos 5 AS-REQ Pre-Auth etype 23	291.5 MH/s
SHA1(CX)	291.8 MH/s
MS Office <= 2003 SHA1+RC4,oldoffice\$3, oldoffice\$4	296.7 MH/s
MS Office <= 2003 SHA1+RC4,collision-mode #1	330.8 MH/s
MS Office <= 2003 MD5+RC4,collision-mode #1	339.9 MH/s
PDF 1.1 - 1.3 (Acrobat 2 - 4)	345.0 MH/s
PDF 1.1 - 1.3 (Acrobat 2 - 4) + collider-mode #1	373.4 MH/s
Sybase ASE	398.1 MH/s
FileZilla Server >= 0.9.55	565.2 MH/s

3DES (PT = \$salt, key = \$pass)	594.3 MH/s
SAP CODVN F/G (PASSCODE)	739.3 MH/s
SHA-3(Keccak)	769.8 MH/s
IKE-PSK SHA1	788.2 MH/s
OSX V10.7	834.1 MH/s
Oracle H	851.6 MH/s
decrypt, DES(Unix), Traditional DES	906.7 MH/s
SHA384	1044.8 MH/s
SHA512	1071.1 MH/s
MSSQL(2012)	1071.3 MH/s
SSHA-512(Base64), LDAP	1072.2 MH/s
WBB3, Woltlab Burning Board 3	1293.3 MH/s
SAP CODVN B (BCODE)	1311.2 MH/s
BLAKE2-512	1488.9 MH/s
IPMI2 RAKP HMAC-SHA1	1607.3 MH/s
NetNTLMv2	1634.9 MH/s
ColdFusion 10+	1733.6 MH/s
IKE-PSK MD5	1834.0 MH/s
SIP digest authentication (MD5)	2004.3 MH/s
OpenCart	2097.0 MH/s
Redmine Project Management Web App	2121.3 MH/s
MySQL Challenge-Response Authentication (SHA1)	2288.0 MH/s
sha1(\$salt.sha1(\$pass))	2457.6 MH/s
hMailServer	2509.6 MH/s
EPiServer 6.x > v4	2514.4 MH/s
RACF	2528.4 MH/s
PunBB	2837.7 MH/s
PDF 1.7 Level 3 (Acrobat 9)	2854.1 MH/s
Cisco-IOS SHA256	2864.3 MH/s
SHA256	2865.2 MH/s
SHA-224	3076.6 MH/s
SSHA-256(Base64), LDAP {SSHA256}	3216.9 MH/s
PeopleSoft PS_TOKEN	3226.5 MH/s

DNSSEC (NSEC3)	3274.6 MH/s
MySQL4.1/MySQL5	3831.5 MH/s
ChaCha20	3962.0 MH/s
md5(md5(\$pass).md5(\$salt))	4291.9 MH/s
vBulletin > V3.8.5	4660.5 MH/s
RipeMD160	4732.0 MH/s
SKIP32	4940.9 MH/s
IPB2+, MyBB1.2+	5011.8 MH/s
md5(\$salt.md5(\$salt.\$pass))	5037.7 MH/s
md5(\$salt.md5(\$pass.\$salt))	5401.6 MH/s
FortiGate (FortiOS)	6386.2 MH/s
Mediawiki B type	6515.8 MH/s
PostgreSQL Challenge-Response Authentication (MD5)	6703.0 MH/s
SMF > v1.1	6817.7 MH/s
EPiServer 6.x < v4	6818.5 MH/s
Django (SHA-1)	6822.6 MH/s
OSX V10.4, V10.5, V10.6	6831.3 MH/s
ArubaOS	6894.7 MH/s
vBulletin < V3.8.5	6947.7 MH/s
PHPS	6972.6 MH/s
Citrix NetScaler	7395.3 MH/s
AxCrypt in memory SHA1	7503.3 MH/s
JKS Java Key Store Private Keys (SHA1)	7989.4 MH/s
PrestaShop	8221.3 MH/s
Radmin2	8408.3 MH/s
SHA1	8538.1 MH/s
SHA-1(Base64), nsldap, Netscape LDAP SHA	8540.0 MH/s
SSHA-1(Base64), nsldaps, Netscape LDAP SSHA	8584.5 MH/s
MSSQL(2000)	8609.7 MH/s
PeopleSoft	8620.3 MH/s
MSSQL(2005)	8636.4 MH/s

Oracle S	8565.0 MH/s
Domain Cached Credentials (DCC), MS Cache	11195.8 MH/s
osCommerce, xt	12883.7 MH/s
Juniper Netscreen/SSG (ScreenOS)	12946.8 MH/s
Skype	12981.9 MH/s
Half MD5	15255.8 MH/s
Cisco-PIX MD5	16407.2 MH/s
Cisco-ASA MD5	17727.2 MH/s
LM	18382.7 MH/s
DES (PT = \$salt, key = \$pass)	19185.7 MH/s
NetNTLMv1-VANILLA / NetNTLMv1+ESS	22308.5 MH/s
MD5	24943.1 MH/s
PostgreSQL	25068.0 MH/s
Joomla < 2.5.18	25072.2 MH/s
SipHash	28675.1 MH/s
Plaintext	37615.5 MH/s
MD4	43722.9 MH/s
NTLM	41825.0 MH/s
MySQL323	51387.0 MH/s

**Speed based on NVIDIA GTX 1080 Running Hashcat v3.6*

NOTES
