

Identifying Offenders Through their Passwords: The Similarity and Difference Between Network of Users

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Influence of the environment on password choice

- **Country** (Grobler et al., 2020)
- Level of literacy in their country (Bergeron, 2022)
- > Data breaches exposure (Bergeron, 2022)
- Sexe (Juozapavičius et al., 2022)
- > Age (Juozapavičius et al., 2022)
- > **Religion** (He et al., 2021)
- > Web services (Wei et al., 2018)





What do those studies tell us?

- There seems to be an informal share of passwords inside a network of users
- Social identity seems to play a role in password choice. Individual digital identity cannot be understand in isolation from the broader social identity that exists.





Hypotheses

Observe if the criminal nature of a network influences password characteristics and strength

Characteristics of the passwords of both networks will be different from one another

Criminal network of online offenders will be more likely to choose stronger password than a non-offenders' network



irror_mod = modifier_of mirror object to mirror object to mirror object irror_mod.mirror_object Peration == "MIRROR_X": irror_mod.use_X = True irror_mod.use_Y = False Operation == "MIRROR_Y irror_mod.use_Y = True operation == "MIRROR_Z irror_mod.use_X = False operation == "MIRROR_Z irror_mod.use_Y = False irror_mod.use_Y = False irror_mod.use_Z = True

election at the end -add _ob.select= 1 er_ob.select=1 ntext.scene.objects.action "Selected" + str(modifient irror_ob.select = 0 bpy.context.selected_ob ata.objects[one.name].selected_objected_obje

int("please select exactly

ypes.Operator):
X mirror to the selectr
ject.mirror_mirror_x"
ror X"

context):
context.active_object is not
c

Method

➢Open-source data

- Databases were illegally hacked by individuals and put online
- Leaked databases found online

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Database with passwords

Username	Password	
mvilleneuve@hotmail.com	llovemom	
ddh@yahoo.com	password	
Akimmika@gmail.com	qwerty	
Fyscillia.R@gmail.com	P@ssword123	
cutecatlove@hotmail.com	LouisH2019	
fredaubin222@gmail.com	43556423111	

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Hashed passwords

9c898fc91987d3a07e92efdb22f0a533:2fnKDAsf

b2bd18b0081c0ddfb4abd5996ac62916:OE2SuGcP

1d61f91492b6c2144adf33bbad7c9918:7FcslRvM

fae2dff15bd864fdf13a9f71dddd35d4:PTYPYK6M

207ea21eaa47b28728bc298a786fb101:JoRrEUV7

d9bf6bb63cdc61ead6e288557973bc54:aCy54uQC

What is a hash?

Objective: attributing unique value

Irreversible

Example:

andrea = 1c42f9c1ca2f65441465b43cd9339d6c

Andrea = 28f719c89ef7f33ce2e178490676b5ab

Hashed passwords

9c898fc91987d3a07e92efdb22f0a533:2fnKDAsf

b2bd18b0081c0ddfb4abd5996ac62916:OE2SuGcP

1d61f91492b6c2144adf33bbad7c9918:7FcslRvM

fae2dff15bd864fdf13a9f71dddd35d4:PTYPYK6M

207ea21eaa47b28728bc298a786fb101:JoRrEUV7

d9bf6bb63cdc61ead6e288557973bc54:aCy54uQC

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Tables to compare hash values

Popular passwords Dictionnary words Names

Word in clear text	Hash value
123456	e10adc3949ba59abbe56e057f20883e
123456789	25f9e794323b453885f5181f16624d0b
Password	5f4dcc3b5aa765d61d8327deb882cf99
Adobe123	7558af202997483d3afef3bb265a709d
12345678	25d55ad283a400af464c76d713c07ad
Qwerty	d8578edf8458ce06fbc5bb76a585ca4
1234567	fcea920f7412b5da7be0cf42b8c93759
111111	96e79218965eb72c92a549dd5a330112
Photoshop	c7c9cfbb7ed7d1cebb7a4442de308776
123123	4297f441395523524562497399d7a93

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Brute force attacks

Trying everything



Time to crack a password according to its characteristics

Number of Characters	Numbers Only	Lowercase Letters	Upper and Lowercase Letters	Numbers, Upper and Lowercase Letters	Numbers, Upper and Lowercase Letters, Symbols
4	Instantly	Instantly	Instantly	Instantly	Instantly
5	Instantly	Instantly	Instantly	Instantly	Instantly
6	Instantly	Instantly	Instantly	1 sec	5 secs
7	Instantly	Instantly	25 secs	1 min	6 mins
8	Instantly	5 secs	22 mins	1 hour	8 hours
9	Instantly	2 mins	19 hours	3 days	3 weeks
10	Instantly	58 mins	1 month	7 months	5 years
11	2 secs	1 day	5 years	41 years	400 years
12	25 secs	3 weeks	300 years	2k years	34k years
13	4 mins	1 year	16k years	100k years	2m years
14	41 mins	51 years	800k years	9m years	200m years
15	6 hours	Tk years	43m years	600m years	15 bn years
16	2 days	34k years	2bn years	37bn years	1tn years
17	4 weeks	800k years	100bn years	2tn years	93tn years
18	9 months	23m years	6tn years	100 tn years	7qd years



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Characteristics of strong passwords





Contains letter and number (not one or the other alone)

E Contains symbols



Does not contain dictionary words



Samples: two networks to compare





OGUsers Offenders 125,560 passwords

ECURE

GrinderScape Non-offenders

1,358,535 passwords

Offenders vs non-offenders network

Mean length of passwords



Offenders vs non-offenders network

Characteristics of weak passwords



Offenders vs non-offenders network

Characteristics of stronger passwords





Other interesting characteristics

Use of profanity words in passwords



■ OGUsers ■ Grinderscape



Other interesting characteristics

Use of dictionary words in passwords





Analysis - Logistic regression

COMPARISON BETWEEN OFFENDERS AND NON-OFFENDERS' PASSWORDS CHARACTERISTICS

Length of password	0.012411***
Password is only lowercase letters	-0.12354***
Password contains all the elements (letter, number, symbol)	0.294831***
Password is only numbers	-0.09376***
Password contains a dictionary word	0.033848***
Password contains a profanity word	0.110573***

N=1,484,095 ***p<0.001

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Comparison between offenders and non-offenders' passwords characteristics (Logistic Regression)

Associated with non-offenders

Associated with offenders



Offenders have stronger passwords. Why is that?

- 1. Because they have something to hide and therefore benefit from protecting their account.
- 2. Because they have higher digital skills



Samples: Adding a third network







OGUsers Black Network 125 560 passwords Grinderscape White network 1 358 535 passwords Ashley Madison Grey network 376 189 passwords

Samples: Adding a third network







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Comparing the 3 samples

Characteristics associated with strong passwords



Comparing the 3 samples

Characteristics associated with weaker passwords





Password choice is influenced by your network

Online offenders have stronger passwords and it might be because they have stronger digital skills

It is possible to characterize hackers passwords



Questions?

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