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BETTER.

SESSION ID: SEM-M01

The Quest for Usable and Secure Passwords

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The Quest for Usable and Secure Passwords

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What’s a Good Password?

What's a Good Password? (If You Ask a Search Engine)

"A strong password consists of at least six characters…"

"Has 12 characters, minimum."

"A strong password should balance the
ease of remembering it with the complexity."

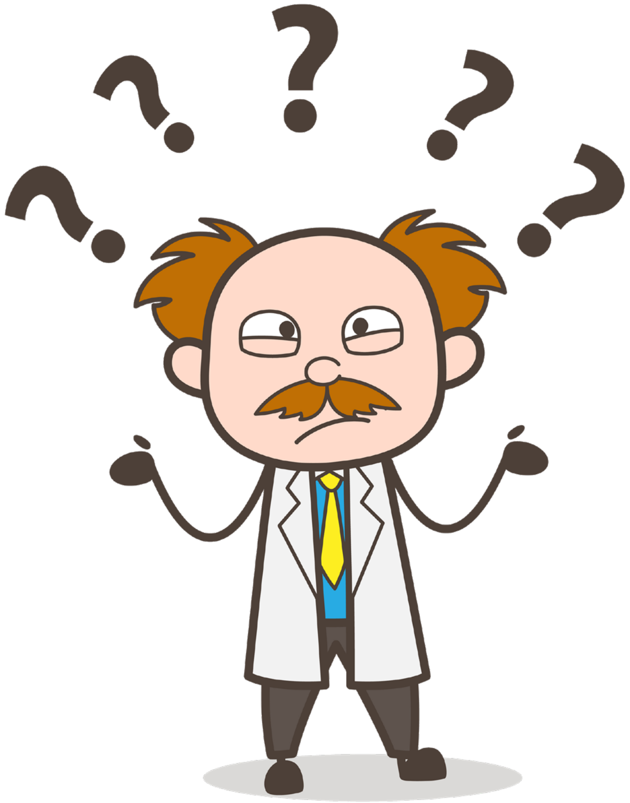
"The best passwords are random…"

"… create a strong password ideas list
and use it for all your online accounts."

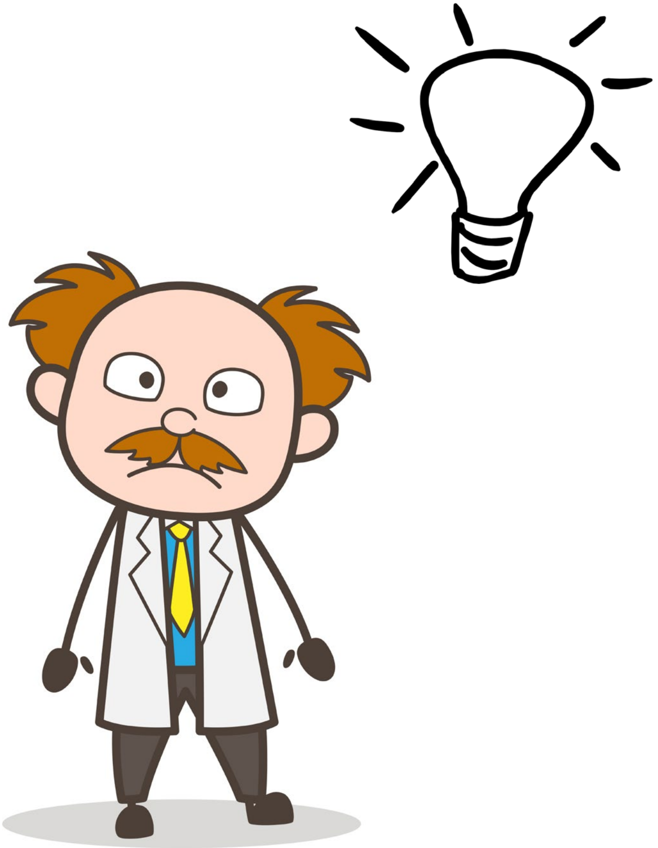
"Learn the secrets to a strong password and
dramatically improve your password."

What’s a Good Password? (If You Ask a Scientist)

In 2008



In 2018



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Our Decade-long Quest for Secure and Usable Passwords

How Do We Make Passwords Better?

Goal: Make passwords harder to guess
… without making them too hard to remember

Tools: Password-composition policies,
password meters, user education, …

Problem: How to apply and evaluate these tools?

Scientific Experiments Need Data and Measurement

- What to measure?
  - Security (historically: entropy)
  - Usability ≈ recall rates, timings, sentiment, …
- How to obtain passwords?
  - Created under different policies, with/without meters, …
  - Potential sources: Leaked plaintext passwords, leaked + cracked passwords, online studies, lab studies, real passwords

How to Measure Security of Passwords?

Easy for an attacker to guess → weak / insecure password

Hard for an attacker to guess → strong / secure password

Our approach: Measure security by simulating how long an attacker would need to guess a password

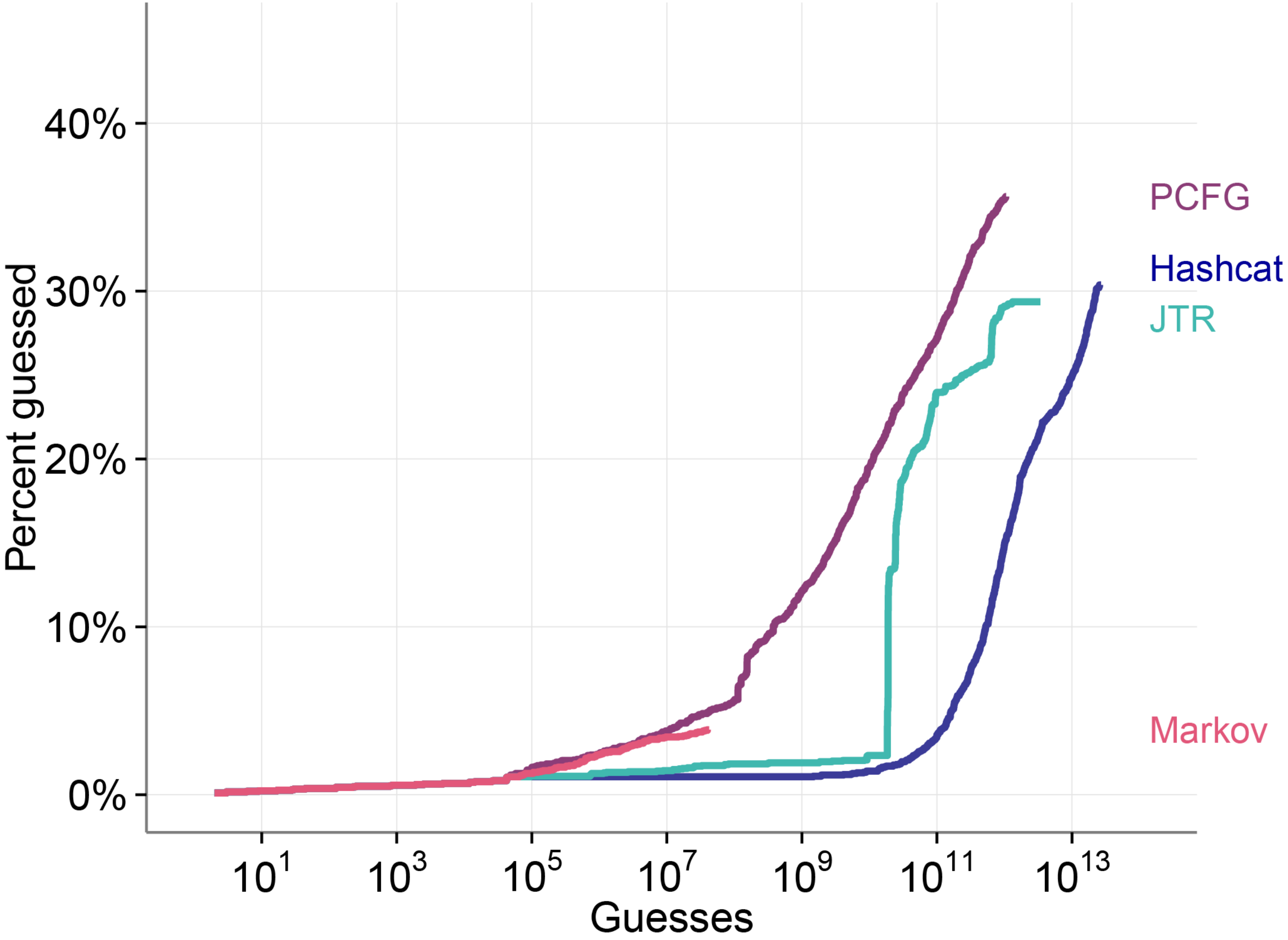
How to Simulate Attacker?

- Compared 4 main guessing algorithms/tools
  - John the Ripper (JTR)
  - Hashcat
  - Markov model-based
  - PCFG

× many configs and training data sets

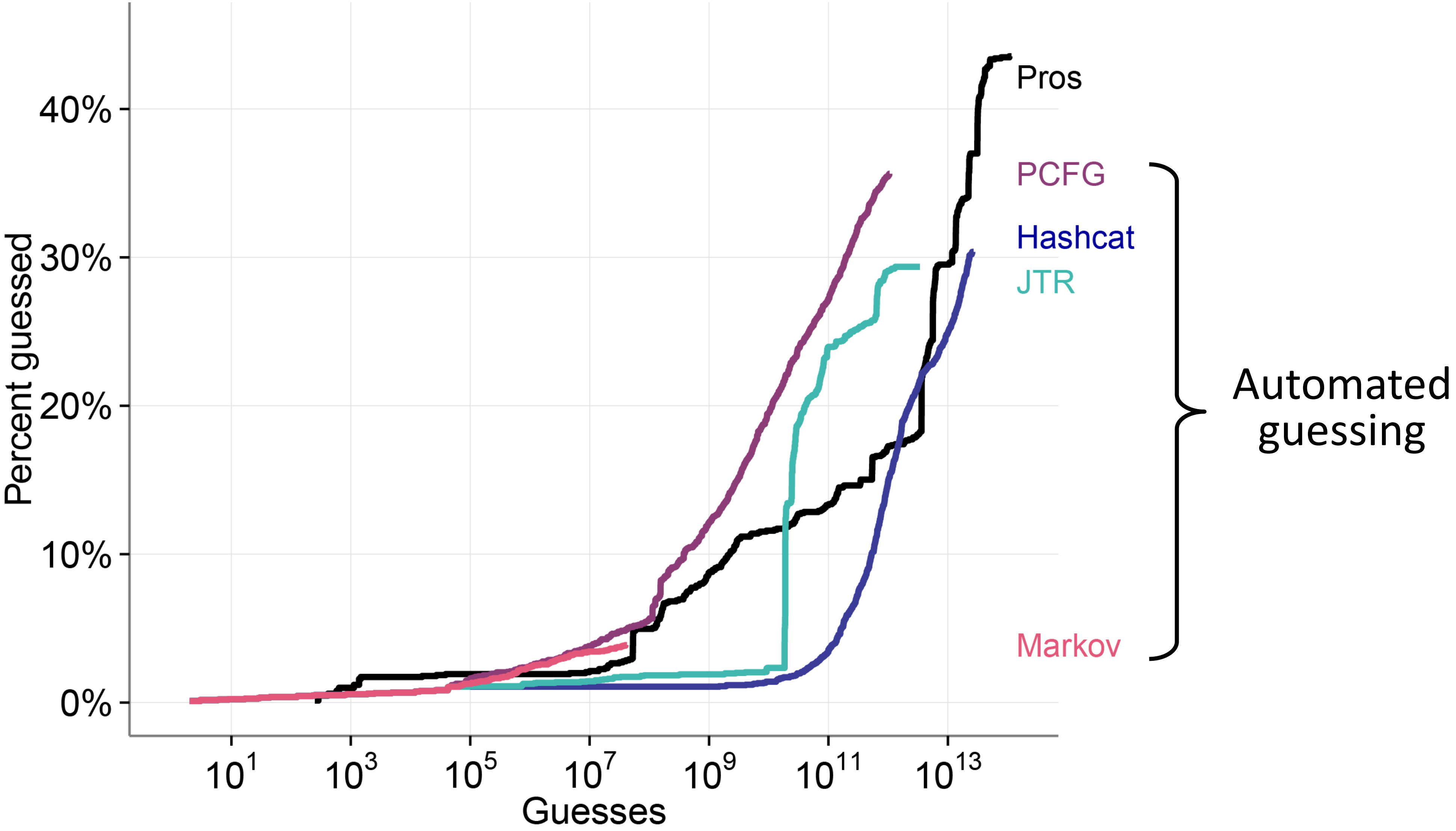
- And hired a professional password recovery firm!
  - Professionals ≈ attackers

Comparing Approaches to Simulate Attacker

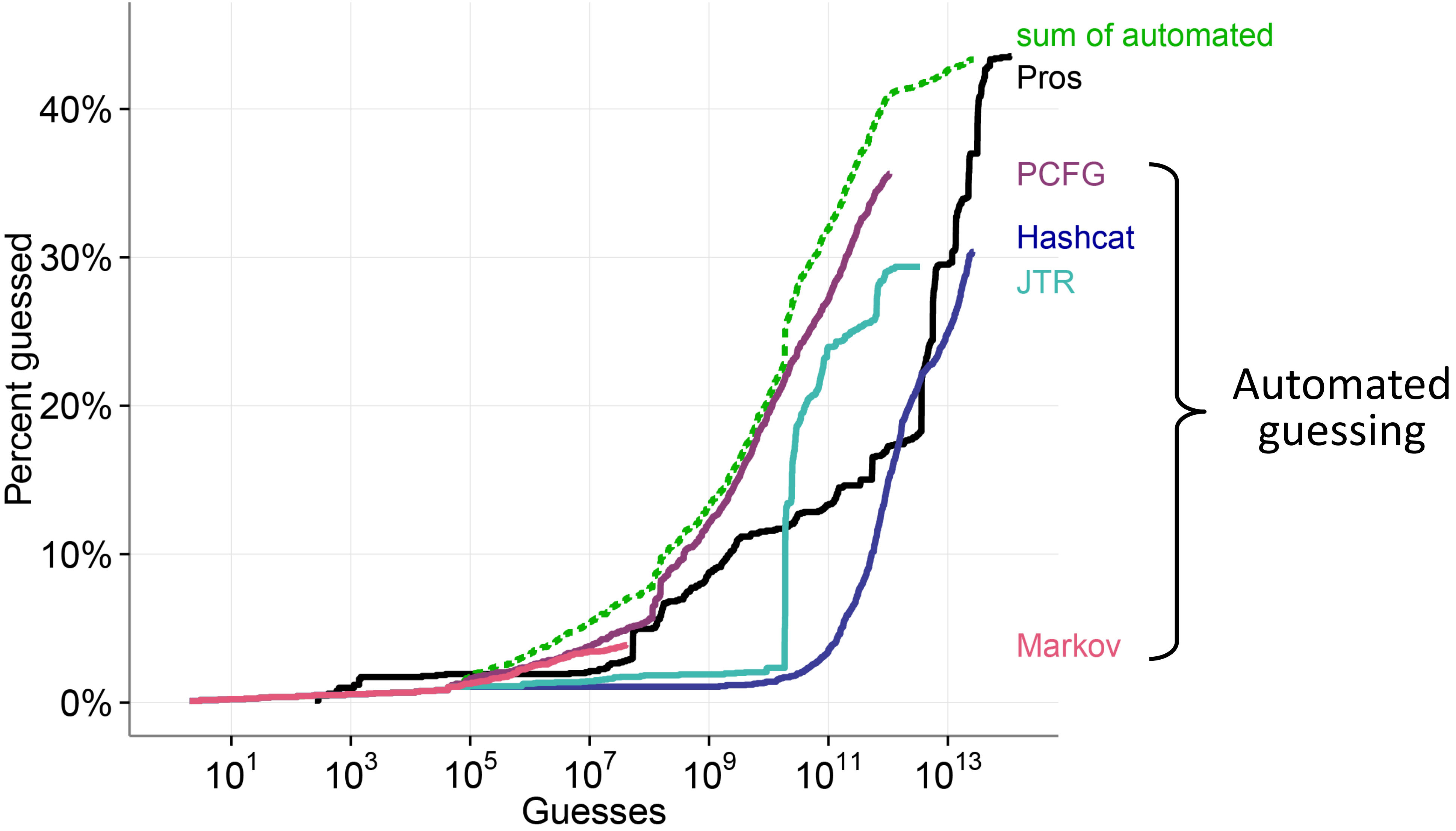


Automated guessing

Comparing Approaches to Simulate Attacker



Finding: Sum of Automated Guessing ≈ Attackers



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Scientific Experiments Need Data and Measurement

- What to measure?
  - Security ≈ guessability ✓
  - Usability ≈ recall rates, timings, sentiment, …
- How to obtain passwords?
  - Created under different policies, with/without meters, …
  - Potential sources: Leaked plaintext passwords, leaked + cracked passwords, online studies, lab studies, real passwords

Scientific Experiments Need Data and Measurement

- What to measure? *efficiently* ?
  - Security ≈ guessability
  - Usability ≈ recall rates, timings, sentiment, …

Deep learning can measure password strength faster and more accurately!

- How to obtain passwords?
  - Created under different policies, with/without meters, …
  - Potential sources: Leaked plaintext passwords, leaked + cracked passwords, online studies, lab studies, real passwords

Scientific Experiments Need Data and Measurement

- What to measure? *efficiently*
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Pwd strength calculation service:
pgs.ece.cmu.edu

Neural network:
github.com/cupslab/neural_network_cracking

Scientific Experiments Need Data and Measurement

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How to Obtain Passwords to Study?

Recipe:

1. Become *very* good friends with IT and information security groups at your institution

2. Collect real-world plaintext passwords for analysis

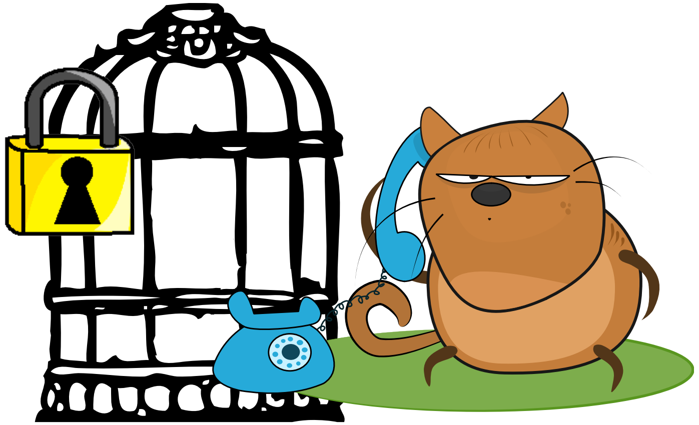
3. Compare strength against: leaked plaintext passwords, leaked + cracked passwords, online studies, lab studies

How to Obtain Passwords to Study?

Recipe:

1. Become *very* good friends with IT and information security groups at your institution

2. Collect real-world plaintext passwords for analysis



How to Obtain Passwords to Study?

Outcome:

1. Passwords collected in *carefully crafted* online studies can be a good approximation of real-world passwords*
2. Yes, computer scientists have stronger passwords than engineers**
3. ... but both have much stronger passwords than business school students and faculty***

Scientific Experiments Need Data and Measurement

- What to measure?
  - Security ≈ guessability
  - Usability ≈ recall rates, timings, sentiment, …

✓

- How to obtain passwords?
  - Created under different policies, with/without meters, …
  - Potential sources: Leaked plaintext passwords, leaked + cracked passwords, online studies, lab studies, real passwords

? ✓

100,000+ User Study Passwords Later …

Some insights and guidelines for strong and usable passwords

- Length is better than complexity for both security and usability
  - But need a little complexity, too
- Blacklisting weak passwords is a must
  - But have to explain reasoning to users, too
- Feedback to users can help to create stronger passwords
  - But can’t be too strict or too complicated
- …

100,000+ User Study Passwords Later …

Some insights and guidelines for strong and usable passwords

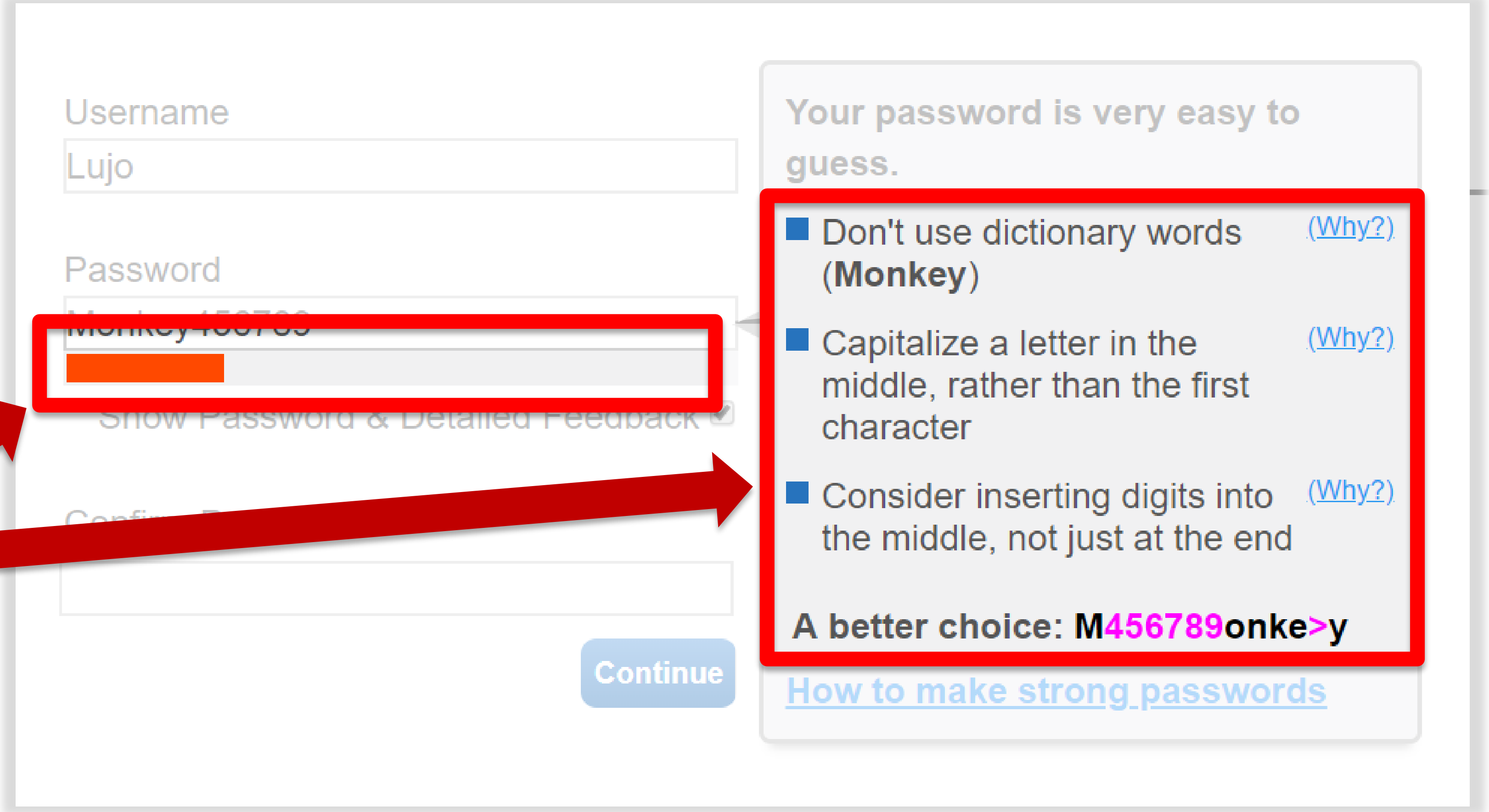
+

neural networks to measure strength

=

an effective, deployable password meter

100,000+ User Study Passwords Later …



Username

Lujo

Password

Monkey456789

Show Password & Detailed Feedback ☑

Your password is very easy to guess.

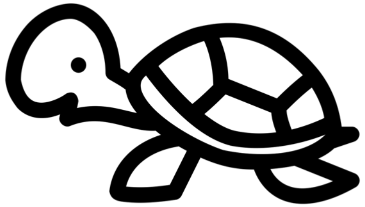
- Don't use dictionary words (**Monkey**) (Why?)
- Capitalize a letter in the middle, rather than the first character (Why?)
- Consider inserting digits into the middle, not just at the end (Why?)

A better choice: M456789onke>y

Feedback based on data + measurement!

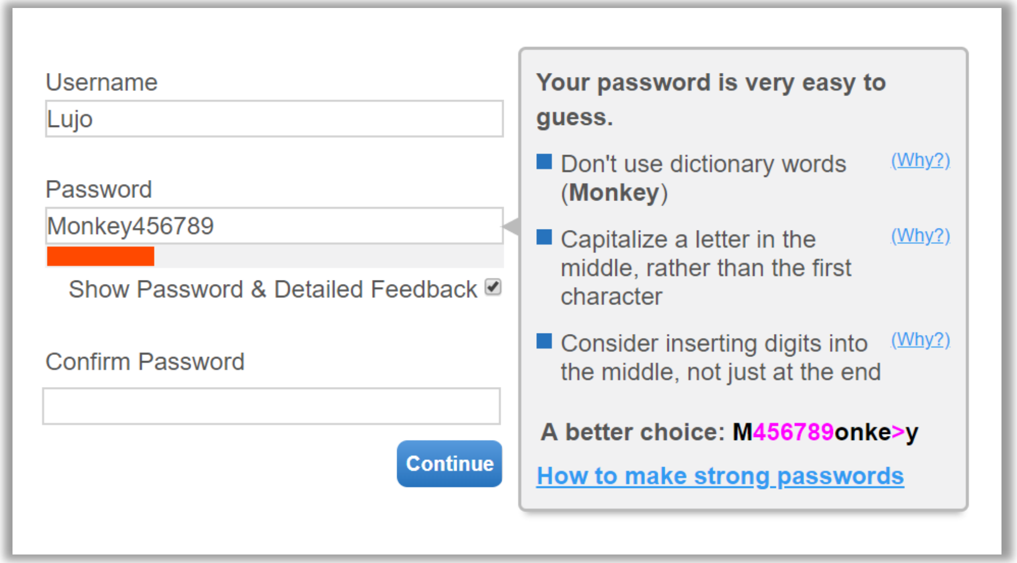
What Can Users Do?

- Don’t reuse passwords!
- Pick longer passwords, include symbols and numbers (and not just at the end)
- Don’t use your pet turtle’s name,
  even if you didn’t tell anyone what it was



What Can Information Security Officers Do?

- Relax rules, but weed out common passwords
- Give users feedback about their password: cups.cs.cmu.edu/meter
- Remember that users have 100 other accounts that are just as important to them



Username

Lujo

Password

Monkey456789

Show Password & Detailed Feedback ☑

Confirm Password

Your password is very easy to guess.

- Don't use dictionary words (**Monkey**) (Why?)
- Capitalize a letter in the middle, rather than the first character (Why?)
- Consider inserting digits into the middle, not just at the end (Why?)

A better choice: M456789onke>y

How to make strong passwords

What Can Usable Security Researchers Do?

- Adopt our methodology to study passwords (and other usability problems!)
- Use our password guessability service: pgs.ece.cmu.edu