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San Francisco | March 4–8 | Moscone Center

SESSION ID: HT-T06C

The Quest for Usable and Secure Passwords

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The Quest for Usable and Secure Passwords

Felicia Alfieri, Maung Aung, **Lujo Bauer**, Jonathan Bees, **Nicolas Christin**, Jessica Colnago, **Lorrie Faith Cranor**, Summer Devlin, Harold Dixon, Adam L. Durity, Serge Egelman, Pardis Emami-Naeini, Alain Forget, Hana Habib, Philip (Seyoung) Huh, Noah Johnson, Pranshu Kalvani, Patrick Gage Kelley, **Saranga Komanduri**, Joel Lee, Julio López, Michael Maass, **Michelle L. Mazurek**, Darya Melicher, **William Melicher**, Fumiko Noma, Maggie Oates, Timothy Passaro, Sarah Pearman, **Sean M. Segreti**, **Richard Shay**, Chelse Swoopes, Jeremy Thomas, **Blase Ur**, Timothy Vidas

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

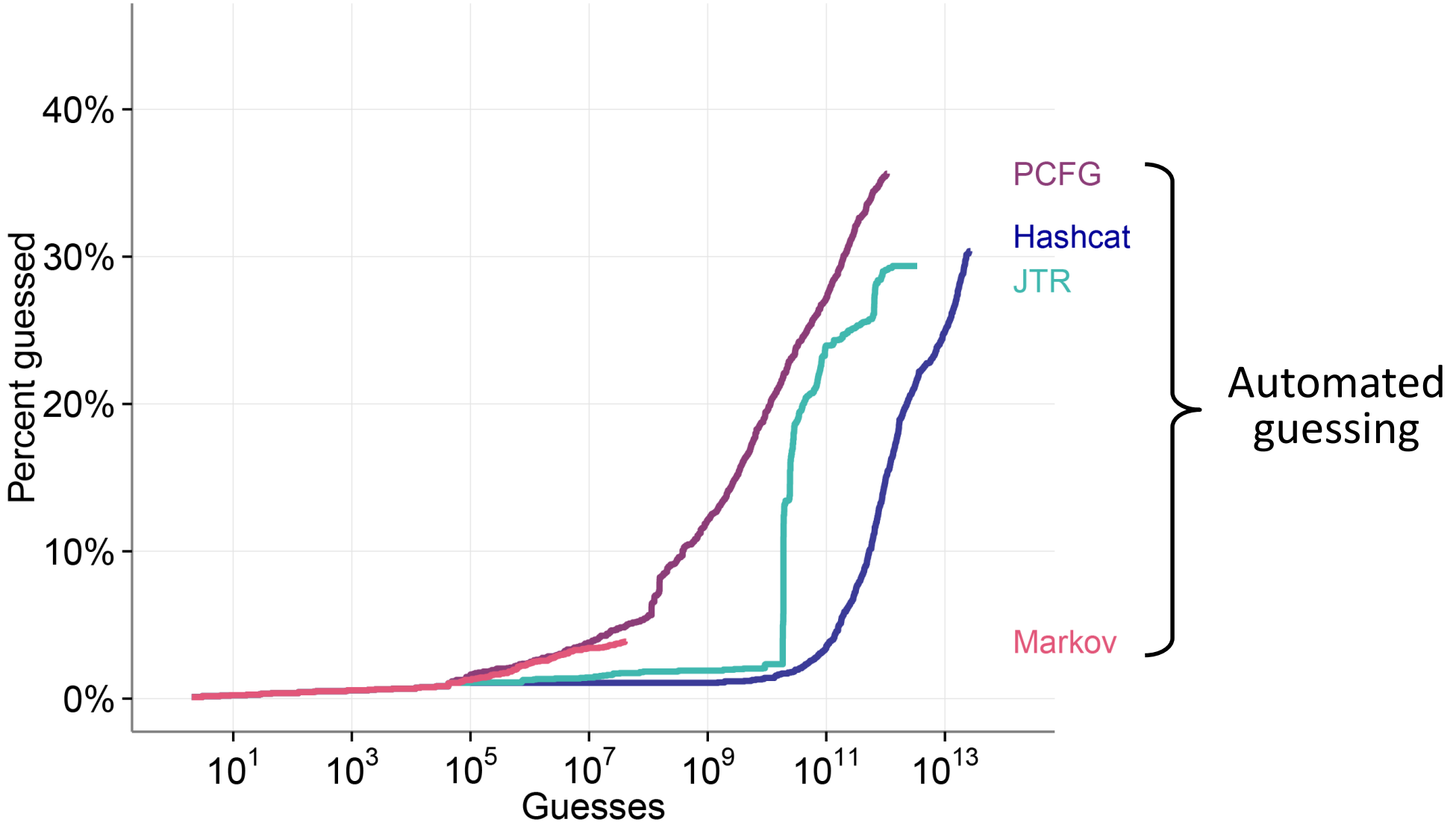
How to Simulate Attacker?

- 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



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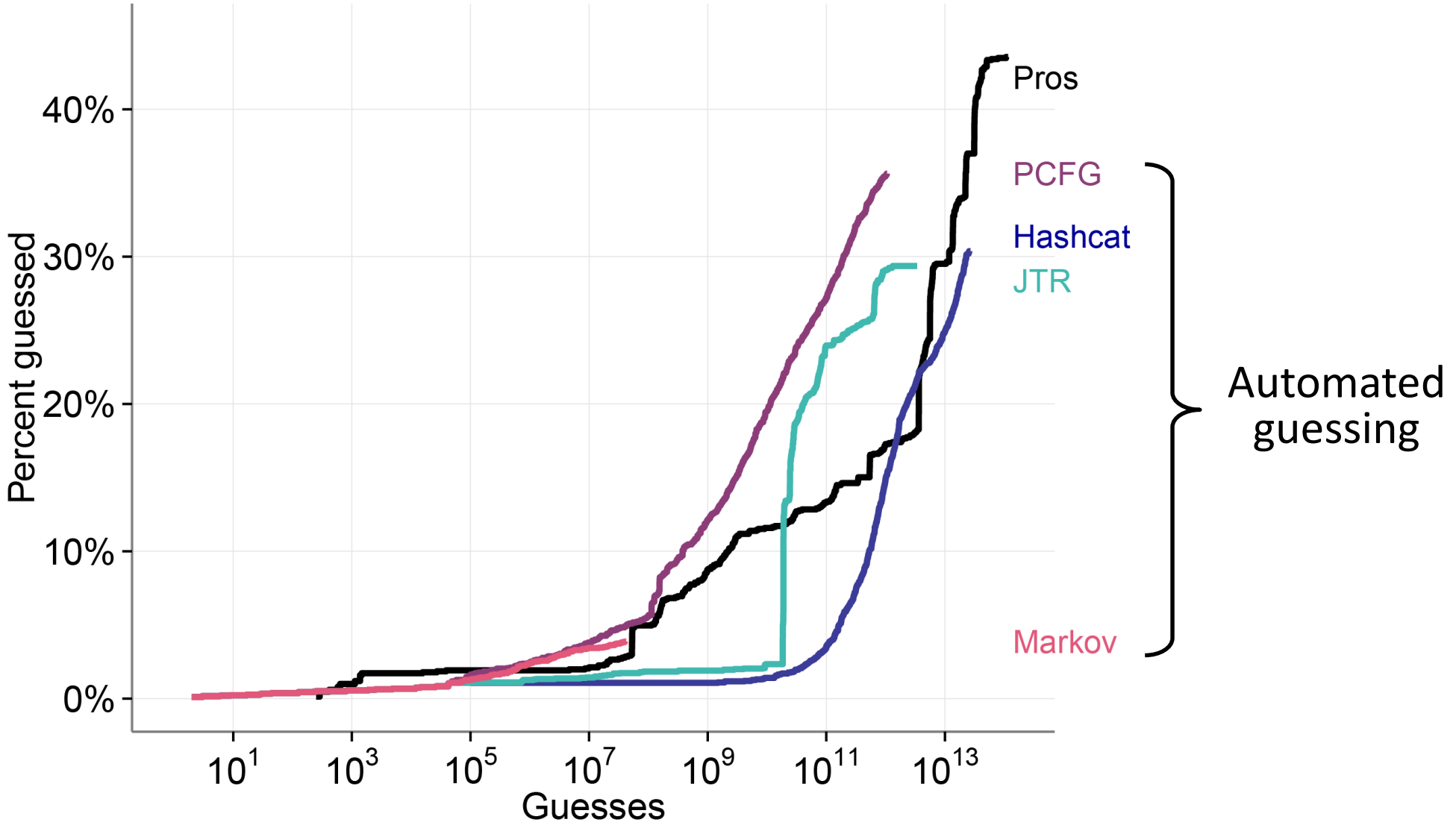
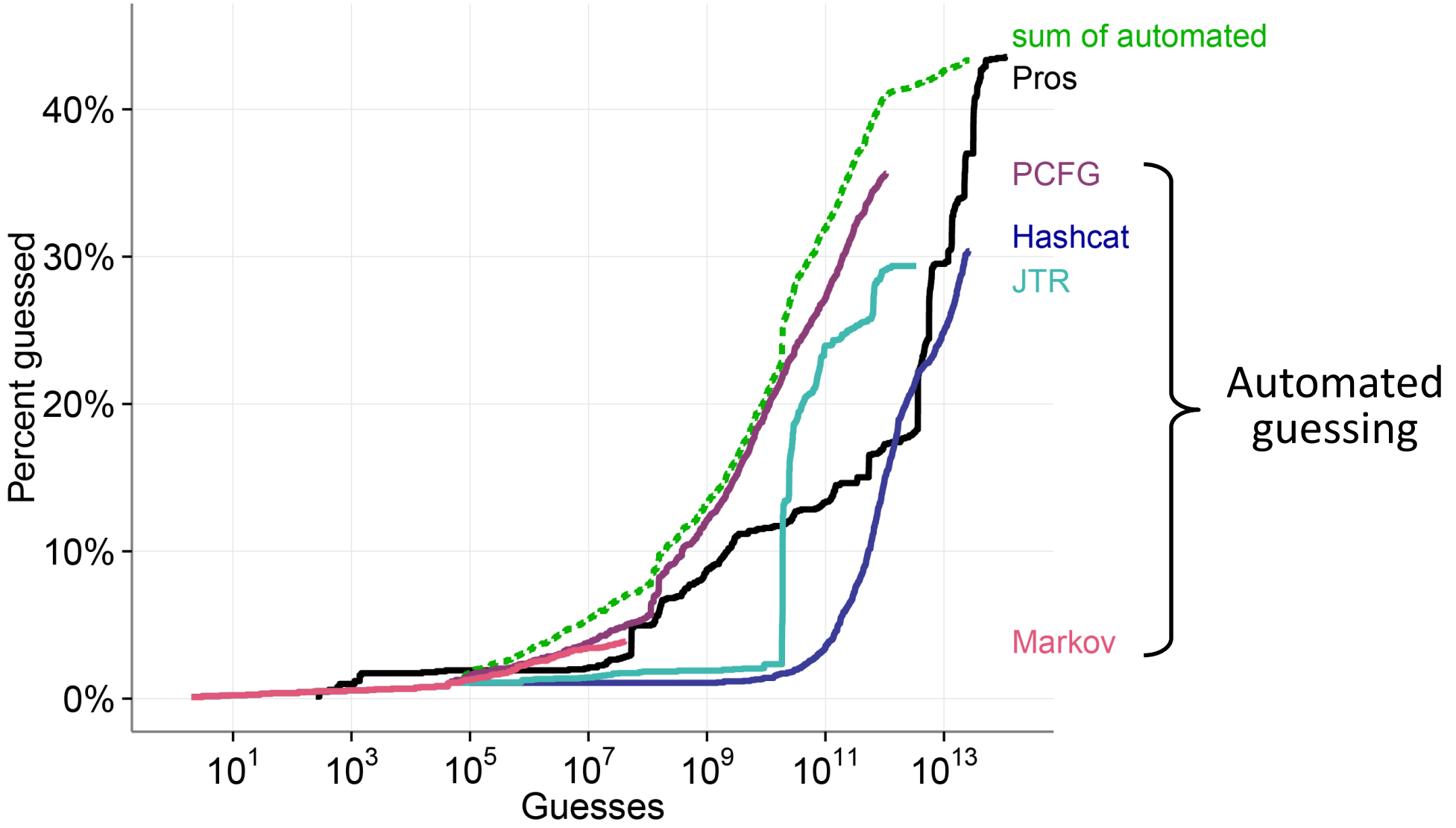


Finding: Sum of Automated Guessing ≈ Attackers



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efficiently ?

Deep learning can measure password strength faster and more accurately!

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Pwd strength calculation service:
pgs.ece.cmu.edu

Neural network:
github.com/cupslab/neural_network_cracking

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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

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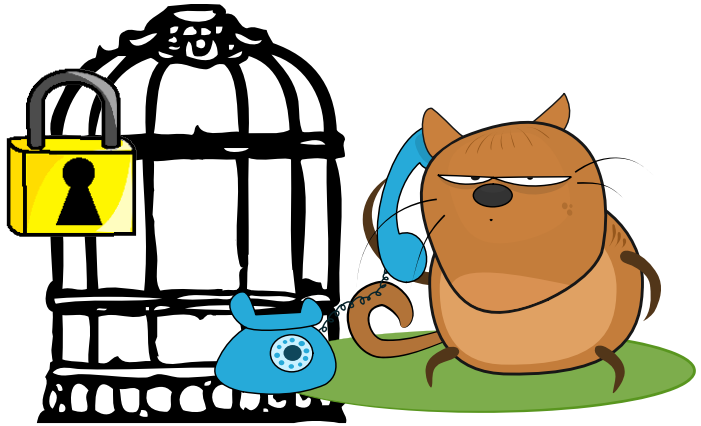

How to Obtain Passwords to Study?

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***

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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

+

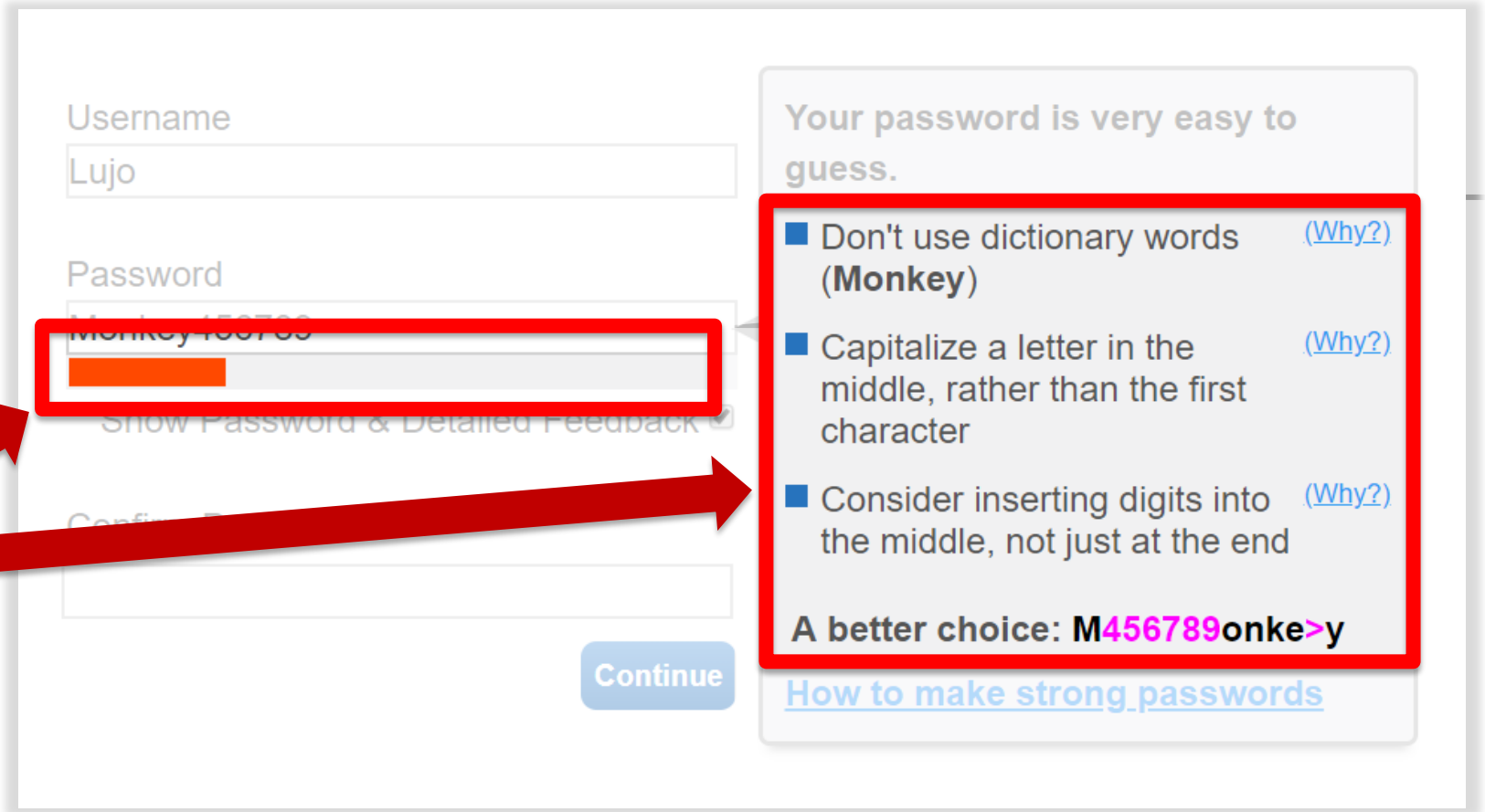
neural networks to measure strength

=

an effective, deployable password meter

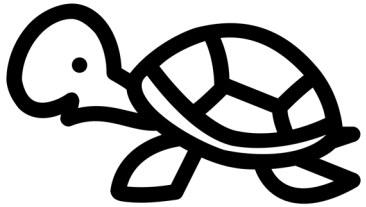
100,000+ User Study Passwords Later …

Feedback based on data + measurement!



What Can Users Do?

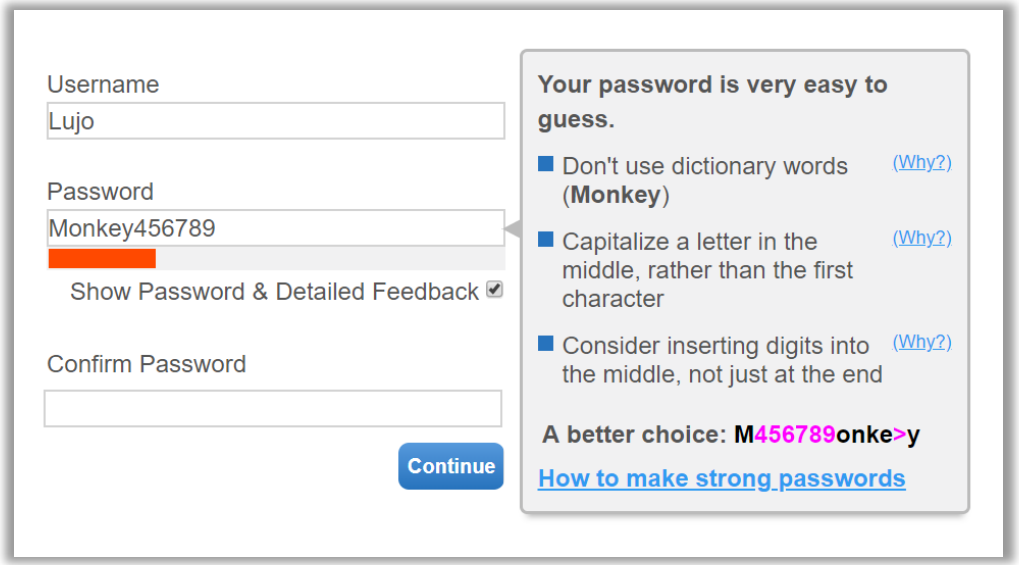
- Don’t reuse passwords!
- Pick longer passwords, include symbols and numbers (and not just at the end)
- Don’t use your pet turtle’s name, even if you didn’t tell anyone what it was



- Use a password manager to *auto-generate and store passwords*

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



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