Crowdsourcing Distractors for Cybersecurity Multiple-Choice Assessments

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Cybersecurity Assessment Tool Project

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- University of Minnesota Duluth
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Cybersecurity Assessment Tools Project

- We are developing tools to assess teaching methods
- CISSP - informational, not conceptual
- We are developing two concept inventories:

  Cybersecurity Concept Inventory - for students in a first course

  Cybersecurity Curriculum Assessment - for graduates entering the workforce

Concept Inventories

- Criterion-referenced test designed to determine whether a student has an accurate working knowledge of a specific set of **concepts**
- Based on extensive research
- Typically comprised of multiple choice questions
- Comprised of 1 correct choice and N incorrect choices
  - Collectively called distractors which are based on common misconceptions
- Example: Force Concept Inventory for physics

How can we generate multiple-choice questions more quickly, easily, cheaply?

- traditional methods - difficult, slow, expensive
  - interview students, uncover misconceptions, devise distractors
- crowdsourcing - our new methodology to generate distractors
  - subjects answer open-ended stems

How did we create our concept inventories?

- Identify timeless concepts (Delphi study)
- Uncover misconceptions (interviews)
- Generate assessment items - stems + alternatives (experts)
- Validate (pilot testing, expert review)

=> crowdsourcing is new way to generate distractors

What is our problem?

- Question generation is difficult
- Experts are ill equipped to understand gaps in knowledge

  “How can someone not understand public key cryptography?”

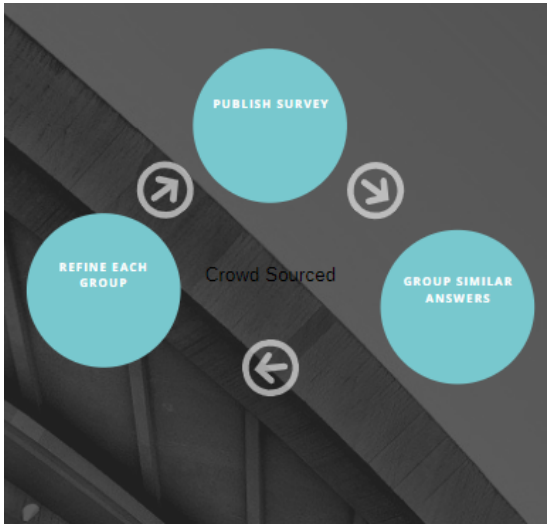
- Feedback loops take weeks to months

Distractor generation techniques

Traditional

30 weeks x 8 hours x 50 dollars = $12,000

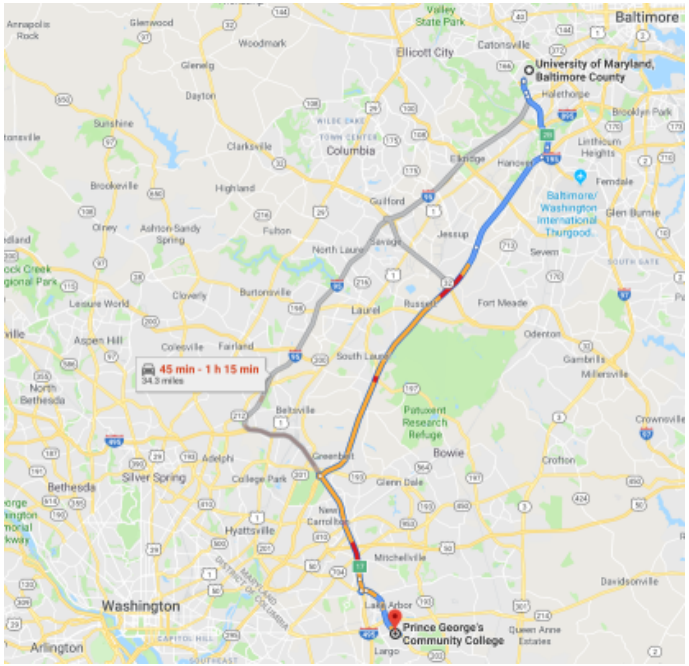
Crowd Sourced



1 week x 6 hours x 50 dollars = $300

Access to subjects

- Best case is on campus recruiting
- We had to travel

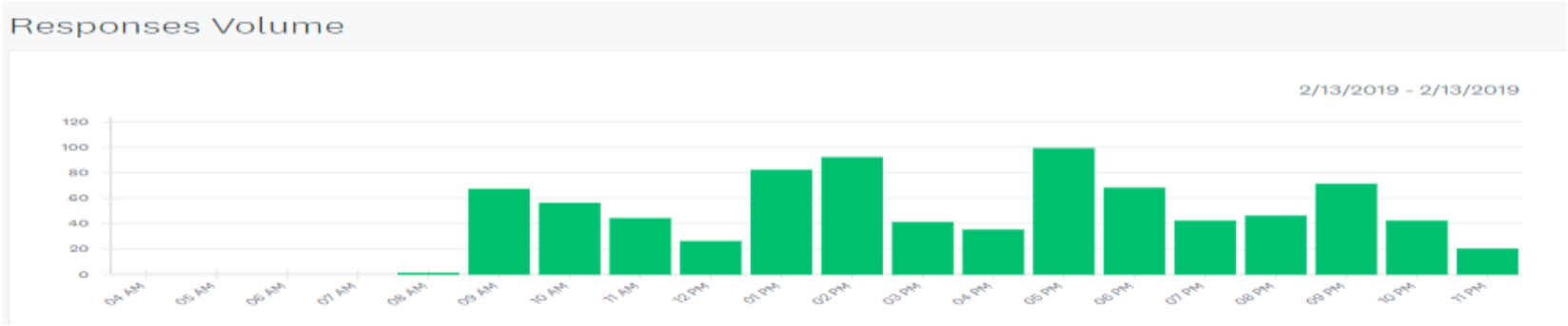


Mechanical Turk - to the rescue

- Feedback loop minutes to hours
- No more sitting on the DC Beltway
- Subjects can be reached anywhere the internet exists
- Use limited campus subjects for field testing

What did Mechanical Turk provide?

- He might have shuttered his acclaimed fine-dining restaurants, Marque and Pei Modern, both in Sydney, but veteran Australian chef Mark Best says that his days of being a chef-restaurateur are far from over.
- Get a sex change, and start to dress like Alice. Steal her ID card and waltz on in like a boss.
- Get in as guest with current approved employee
- bribe another employee to acquire the item for him
- use vrius (sic)



In-house vs Crowd Sourced

Original	AMT
A. Convince an authorized employee to remove the USB stick and give it to Mark. (correct)	A. Convince an authorized employee to remove the USB stick and give it to Mark. (correct)
B. Compromise the facility's network and add Mark as an authorized guest.	B. Steal an ID card and use this ID to gain access to the facility. (new)
C. Unlock electronically-locked doors using malware.	C. Refuse to take the job as security is too strong. (new)
D. Climb over the perimeter fence at night and sneak into Alice's workspace.	D. Write malicious code to read the data from the USB. (new)
E. Fabricate a fake ID to fool the guards at the security checkpoint.	E. Get hired as an employee of the facility. (new)

Experiment Conclusion

Crowdsourcing platforms such as Mechanical Turk offer a viable and cost effective alternative to creating concept inventories by committee. While there is no way to effectively select subjects and you must still filter and polish the responses, Mechanical Turk is still a promising tool for distractor generation

What questions do you have?

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https://youtu.be/wN68EHiZkn0 - Take the CCA