Today

- Human computation and crowdsourcing (Intro)
- Crowdsourcing platforms
Definitions

(warning: terms not always well-defined)
What is “Human Computation”?

- Integrating people into computational process

- People fill a well-defined **functional** role
  - In contrast to most human endeavors which is not well defined
  - Allows automated systems to work with human input

- Often structured output, but not always
  - Labels, confidence values, image boundaries, ordered text
  - Design feedback,

- “Human Computation”
  - Luis von Ahn, PhD thesis title, CMU
Why Human Computation?

- Artificial Intelligence (AI) cannot currently solve everything

- Even problems that are automatable are not always solved

- Example: ESP Game
  - von Ahn et al., CHI 2004
  - Label images with pairs of people
How Does this Differ from HCI?

- HCI trades off user interaction complexity with system complexity
  - No fixed way for the person to address their task

- Here, we have a “computational process” for human effort

- Can start to abstract processes (workflows) and optimize them
Historical Examples of Human Computation

- Human computation is not “new”
  - “When Computers Were Human” — David Alan Grier
  - Works Progress Administration
  - Needed to give people jobs, and find ways to make it useful
  - Used non-expert to compute canonical mathematical tables
Aside: UM connection

1. Calculus class, University of Michigan, 1921. Author’s grandmother is right-most woman
What is “Crowdsourcing”? 

- An open call to a group of people

- “Crowdsourcing”
  - “Crowdsourcing is the act of taking a job traditionally performed by a designated agent ... and outsourcing it to...a large group of people in the form of an open call.”
  - [Jeff Howe, Wired]

- Books
  - Jeff Howe: Crowdsourcing
  - James Surowiecki: The Wisdom of Crowds
Why Crowdsourcing?

- No one worker will *always* be available

- Open call allows for more available human intelligence
  - Allow for the creation of on-demand systems
  - Even real-time becomes possible — 1s responses or less with multiplexing

- Any individual has a chance of error
  - With groups of workers, we might be able to reduce this error rate
  - Especially for ephemeral workers

- Collectively, we can get pieces that work together in parallel
Types of Crowds (At a Glance)

- **User crowds**
  - User/community generated content, interaction traces
  - Social media, online forums
  - Game players (e.g., GWAP)

- **Paid crowds**
  - Amazon Mechanical Turk
  - Focus groups
  - Contracting platforms (expert)

- **Volunteer crowds**
  - Community-sourcing
  - Activism / demonstrations

- ...
Historical Examples of Crowdsourcing

- Crowdsourcing is not “new”
  - Generalization: collective intelligence
  - Not restricted to people: emergent behaviors

- Guessing the weight of an Ox [James Surowiecki]
  - Average of a group was within 1% of the correct answer
  - Group performs better than any expert
Wait, what’s the difference?

[Quinn & Bederson, CHI 2011]
Wait, what’s the difference?

“Crowdsourcing is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call.” [24]

[Quinn & Bederson, CHI 2011]
Wait, what’s the difference?

“...a technique that makes use of human abilities for computation to solve problems.” [8,74]

“A computational process that involves humans in certain steps...” [73]
Wait, what’s the difference?

“... applications and services that facilitate collective action and social interaction online with rich exchange of multimedia information and evolution of aggregate knowledge...” [48]

“... the interplay between persons' social behaviors and their interactions with computing technologies” [15]
Wait, what’s the difference?

Groups that collectively act with intelligence (including phenomena like emergent behavior)

[Quinn & Bederson, CHI 2011]
Wait, what’s the difference?

Find insight into large sets of data, such as datasets generated by collective systems.

[Quinn & Bederson, CHI 2011]
Wait, what’s the difference?

[Quinn & Bederson, CHI 2011]
Connections: Computer Science

- Human-Computer Interaction (HCI)
- Social Computing
- Artificial Intelligence (AI) / Machine Learning (ML)
- Multi-Agent Systems
  - Economics / [Algorithmic] Game Theory / Incentive Mechanism Design
- Parallel Computing
- [[ what else? ]]
Connections: Models of Work

- Firms
  - Management science
  - “Value of a firm” ⇒ efficiency of organization

- Work processes
  - Adam Smith: division of labor
  - Assembly lines, unit productions
  - Taylorism: ‘scientific management’ of workers
  - Modern evidence-based process management

- Group dynamics
  - Team structure / cools
  - Organizational behavior/psychology
Connections: Consensus-Finding

- Voting theory / election systems
  - Find collective answers
  - Avoid / leverage manipulation

- Collaboration in teams
  - Structures
  - Workflows / organization

- Collective intelligence
  - Emergent behavior
Connection: Social Sciences

- Social networks / communities

- Cognitive science
  - Individual and group cognition

- Psychology
  - Interpersonal behaviors
  - Biases
  - Incentives (esp. intrinsic)

- Political science
What is possible?

- **Previous:**
  - Processes for creating knowledge bases / producing answers

- **Now:**
  - Systems to label images/audio/etc. — often, output can train AI
  - Real-time / on-demand systems (few-second response latency, no down time)
  - Groups of non-experts can outperform experts
  - Less-restricted, more creative tasks

- **Future:**
  - Complex open-ended tasks that result in computationally usable answers
  - Millisecond-level latency even with human assistance
  - Online training of AI/ML systems
  - ... You tell me.
Dangers of these models?

“Magnus, Robot Fighter #1” (Feb. 1, 1963)
Promise of These Models

Flexible work

Scalable human processes

On-demand support for anything and everything you need (fluid economy)

Fair compensation, enforced by an unbiased party (the system)

...?
Choosing a Crowd
Importance of Crowd + Incentive Selection

- Asking a good question to the wrong person isn’t good
  - Medical advice from a gas station attendant
  - Medical advice from a lawyer
  - Programming advice from an M.D.

- Asking the right person with the wrong incentives leads to problems too
  - Classic “paid by the hour” comments
  - Opposite: fixed-pay
  - How do we design incentives?
    - Discussed more next class

- Not all worker-crowds may be incentivized by the same things in all cases
  - True of people in general (they care about different things)
Dimensions of a Crowd

- Reliability
- Expertise
- Availability
- Location
- Motivation
Dimensions of a Crowd

- Reliability
- Expertise
- Availability
- Location
- Motivation

(first Google image search result for ‘realm’)
Reliability

- How confident are we that the system will always work?

- Answer accuracy
  - Does the task require skill or knowledge?
  - Also depends on expertise

- Commitment
  - Will the crowd always contribute?
  - Will they do the minimum or push for completion / improvement
  - Also depends on motivation
Expertise

- What skills are needed / available?
- Specific knowledge (e.g., botany, ornithology)
- Training in a particular skill (e.g., touch-typing, writing)
- Familiarity with an interface or task (e.g., Photoshop, FoldIt)
- Familiarity with a platform (e.g., MTurk)
Expertise: Platform Considerations

- Visibility of experience / skills
- Evidence for skills
- Other feedback
Availability

- How responsive can we expect the system to be?
- Collective availability
  - Can it be “Always on”?
- Per-worker time-on-task
- Online times for a specific worker (length of engagement)
- Recruiting and routing latency
  - How fast can a worker get to the task after selection?
Availability: Platform Considerations

- How are tasks posted?
  - What details can be included easily (e.g., about pay rate and incentives)

- Posting latency
  - How long does it take for the task to appear in front of workers?

- Posting / hiring interaction (e.g., API or interview)
  - Depends on platform functionality as well as culture

- How long is a ‘typical’ task?
  - Defined by functionality and culture
Location

- Where are workers recruited and working from?

- In person versus online
  - And if in person, where? If online, what platform / page?
  - Much like any advertising, positioning matters

- Location-based knowledge
  - What do people in a particular place know that others don’t?
  - Relates to expertise
Location: Platform Considerations

- Location of post (e.g., in-person or online; where online?)

- Does post location predict work location?
  - Example: if we post a flier in a campus quad, we’ll probably get students [on campus]

- Does post location predict expertise?
  - Example: Heimerl et al., vending machine — post a question-answering vending machine in a hospital break room to get expert medical opinions (without interviewing or filtering).
Motivation

- Why are workers participating? What incentives are at play?
  - For-pay (large part of system-supporting crowds)
    - Extrinsic benefit
  - Volunteers (want to help others/community)
    - Intrinsic benefit
  - Users (help contribute for the resulting benefit)
    - Often combined benefit
  - Enjoyment (e.g., games with a purpose)
    - Intrinsic benefit

- How visible are rewards?
  - People need to be able to understand what the result of their actions are
  - Otherwise, even the perfect reward scheme won’t have the desired effect
Motivation: Platform Considerations

- Types of payments and feedback
  - Money
  - Points / leader-boards
  - ‘Barn Stars’ (Wikipedia)
  - Result feedback (e.g., “your contributions helped 15 people!”)
  - Notoriety (discrete rewards / ‘winners’)
  - [[ what else? ]]

- Incentive mechanisms supported
  - Not all mechanisms can be implemented on all platforms
  - For example, without bonuses, MTurk could not support time-based incentives
Example Platforms
Amazon Mechanical Turk

Make Money by working on HITs

HITs - Human Intelligence Tasks - are individual tasks that you work on. Find HITs now.

As a Mechanical Turk Worker you:
- Can work from home
- Choose your own work hours
- Get paid for doing good work

Get Results from Mechanical Turk Workers

Ask workers to complete HITs - Human Intelligence Tasks - and get results using Mechanical Turk. Get Started.

As a Mechanical Turk Requester you:
- Have access to a global, on-demand, 24 x 7 workforce
- Get thousands of HITs completed in minutes
- Pay only when you're satisfied with the results
Amazon Mechanical Turk

<table>
<thead>
<tr>
<th>All HITs</th>
<th>1-10 of 1633 Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sort by:</td>
<td>Show details</td>
</tr>
<tr>
<td>Find HITs containing:</td>
<td>for which you are qualified</td>
</tr>
</tbody>
</table>

Extract purchased items from a shopping receipt
- **Requester:** Jon Breig
- **HIT Expiration Date:** Sep 16, 2015 (6 days 23 hours)
- **Time Allotted:** 2 hours
- **Reward:** $0.08

Classify Receipt
- **Requester:** Jon Breig
- **HIT Expiration Date:** Sep 16, 2015 (6 days 23 hours)
- **Time Allotted:** 20 minutes
- **Reward:** $0.02

Type the text from the images, carefully. Productivity and bonuses guaranteed.
- **Requester:** CopyText Inc.
- **HIT Expiration Date:** Sep 16, 2015 (6 days 23 hours)
- **Time Allotted:** 10 minutes
- **Reward:** $0.01

Extract purchased items from a shopping receipt (1-2 items)
- **Requester:** Jon Breig
- **HIT Expiration Date:** Sep 16, 2015 (6 days 23 hours)
- **Time Allotted:** 2 hours
- **Reward:** $0.01

Answer a brief survey about a few social media posts
- **Requester:** Consumer & Business Intelligence at Hill Holliday
- **HIT Expiration Date:** Sep 16, 2015 (6 days 22 hours)
- **Time Allotted:** 60 minutes
- **Reward:** $0.03

What-a-mole by Gazel! Play a 1 min eye tracking game in the web browser! 0909
Amazon Mechanical Turk: Hiring/Tasks

**Extract purchased items from a shopping receipt** (1-2 items)

Hit Reward: $0.01 for first 2 items + Bonus: $0.01 for every 4 items.

**Real readable original receipt**

<table>
<thead>
<tr>
<th>#</th>
<th>Type</th>
<th>Qty</th>
<th>Item Description</th>
<th>Price</th>
<th>Per Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Item</td>
<td>1</td>
<td>EXAMPLE DESCRIPTION</td>
<td>26.97</td>
<td>8.99</td>
</tr>
</tbody>
</table>

**What is the transaction date & time on the receipt?**

06/24/2015 HH MM

**SubTotal:**

**Sales Tax:**

**Total:**

3.92

If total not captured in image, mark receipt above as
"Not Readable or Not Receipt"

**Submit**
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As a Mechanical Turk Requester you:
- Have access to a global, on-demand, 24 x 7 workforce
- Get thousands of HITs completed in minutes
- Pay only when you're satisfied with the results
WORKING AT SAMASOURCE
We are a dynamic team passionate about changing the world

OUR TEAM
Samasource

Our Impact

6794 Workers
20993 Dependents
27787 Lives Transformed

*See how we calculate this*
Over 92% of our incoming workers are unemployed or underemployed. On average, our workers increase previous income by 114% after six months of Samasource employment, and 89% of workers pursue additional means of formal employment and/or education after working for Samasource.

114% INCREASE IN INCOME

Households become more secure

Our workers spend a significant amount of their earnings on things to improve their families’ quality of life including safer housing, healthier food, and education for their children.

- Safer housing: $21 → $48
- Healthier food: $20 → $40
- Education for children: $14 → $24
Upwork (formerly oDesk)

Where will great work take you?

Find freelancers to tackle any job, any size, any time

How It Works
Upwork: Hiring

sam steele

Windows Automation Consultant - PowerShell, SCCM
Warilla, Australia

1:46am local time - 14 hrs ahead

Microsoft SCCM  Windows PowerShell  VBScript  Operating Systems Development  VMware Administration

Overview

12 years Windows administration with strong skills in:
* SOE design (XP and Windows 7)
* Scripting - vbscript and powershell
* SCCM 2007 and SCCM 2012
* Altiris Deployment Server and Notification
* Software packaging - MSI (using install shield) and AppV
* SCOM 2012
* Orchestrator 2012
* SQL administration and basic SQL query skills
* Vsphere 4 and 5

In the last 2 years, I have been responsible for implementing SCCM in a large enterprise environment covering multiple sites. This role also include the SOE design for Windows 7 and software packaging.

I have excellent automation skills using vbscript, powershell, powercli and SQL.

Flag as inappropriate

Contact

Save

Work History

5.00 ★★★★★
136 hours worked
3 jobs

Availability

Available
More than 30 hrs/week

Languages

English: Fluent
Self-Assessed
Upwork: Hiring

Work History and Feedback

Jan 2013 - Present

Windows 2012 System Engineer unattended set-up

Job in progress

Mar 2014 - Jun 2014

LDAP/User monitoring

⭐⭐⭐⭐⭐ 5.00

Sam was a great resource who finished the work on time, within budget, and more features than originally requested.

Tests

<table>
<thead>
<tr>
<th>Name</th>
<th>Score (out of 5)</th>
<th>Time to Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows Server 2008 Test</td>
<td>4.00</td>
<td>40 mins</td>
</tr>
</tbody>
</table>
eLance

Hire a great freelancer.

Post Your Job (it's free)

Grow your business faster.
Simply post your job or search for freelancers to get the job done.

384,818 Available

View

Post Your Job

IT, Web & Mobile
Data Science
Design & Multimedia

Marketing & Sales
Customer Service

Engineering and Arch.

Finance & Mgmt.

Legal

Office & Admins
Project Management
Games Example: FoldIt
Quality Control
The world’s largest community of biased coins collectors…

1,000 participants on Amazon Mechanical Turk flip a coin and report “h” (heads) or “t” (tails)

- 65% heads
- 28% tails
The world’s largest community of biased coins collectors...

1,000 participants on Amazon Mechanical Turk flip a coin and report “h” (heads) or “t” (tails)

65% heads

28% tails

7% head, heads, Tail, tails, Tails, t for tails, talis, f
How many M&Ms do you think are in this Pittsburgh Penguins container?

A green one is shown next to the container to help with scale. They're Peanut M&Ms.

It's for science. Thanks!
How many M&Ms do you think are in this Pittsburgh Penguins container?

A green one is shown next to the container to help with scale. They're Peanut M&Ms.

It's for science. Thanks!
Celine Latulipe Why is the bottle so dark? What's the weird red stuff at the top? The other objects in the picture are distracting me.... squirrel!
Yesterday at 10:04pm · Like · 1

Kurt Luther 1000
Yesterday at 10:54pm · Like

Beki Grinter not enough to get me through the semester... just saying
Yesterday at 10:56pm · Like · 2

Daniel Lowd 3.
Yesterday at 11:01pm · Like

Juho Kim This didn't go well in 6.813 as well during my guest lecture 😄
23 hours ago via mobile · Like

Reid Priedhorsky 100,003
23 hours ago via mobile · Like

Sanjay Kairam My guess: 1189
22 hours ago · Like

Aaron Parker–Fasel 422
18 hours ago via mobile · Like

Aaron Parker–Fasel But I don't think science would approve of this since we can see the other responses.
18 hours ago via mobile · Like

Aaron Parker–Fasel Also, ONE DOLLAR!!
18 hours ago via mobile · Like

Walter Lasecki 515
18 hours ago · Like

Brian Keegan 4,718,410,528,053,753,149,052.64681820
15 hours ago via mobile · Edited · Like

KD Helfert I could help you count them as I eat them
14 hours ago · Like

Emerson Murphy–Hill 350
14 hours ago · Like

Jennifer Mankoff 600
14 hours ago · Like

Lisa Glebatis Perks 653
10 hours ago · Like

Matthew George Roberts 65,536
10 hours ago · Like

Preet Singh 1072
10 hours ago · Like

Karyn Insler 632
9 hours ago · Like

Max 'Electronic' Van Kleek 180
3 hours ago · Edited · Like

William Patrick 700
4 hours ago · Like

Michael Insler Too lazy to strategize my guess in relation to those above me. So let's go with 650.
3 hours ago · Like

Lisa Glebatis Perks Back off, Inslers! I claim the mid 600s. Oh, wait. We don't even know if we will find out the answer or if the winner gets a prize. Aggressive comment retracted.
2 hours ago · Like · 2

Matthew George Roberts Yessss, Lisa, yessssss.... Channel that competitive fire and rage. Bottle it up until the first women's RKR race. Then unleash the fury and destroy your competition!!!
Task Creation

- How can you find the most accurate answer?
- What makes this hard?