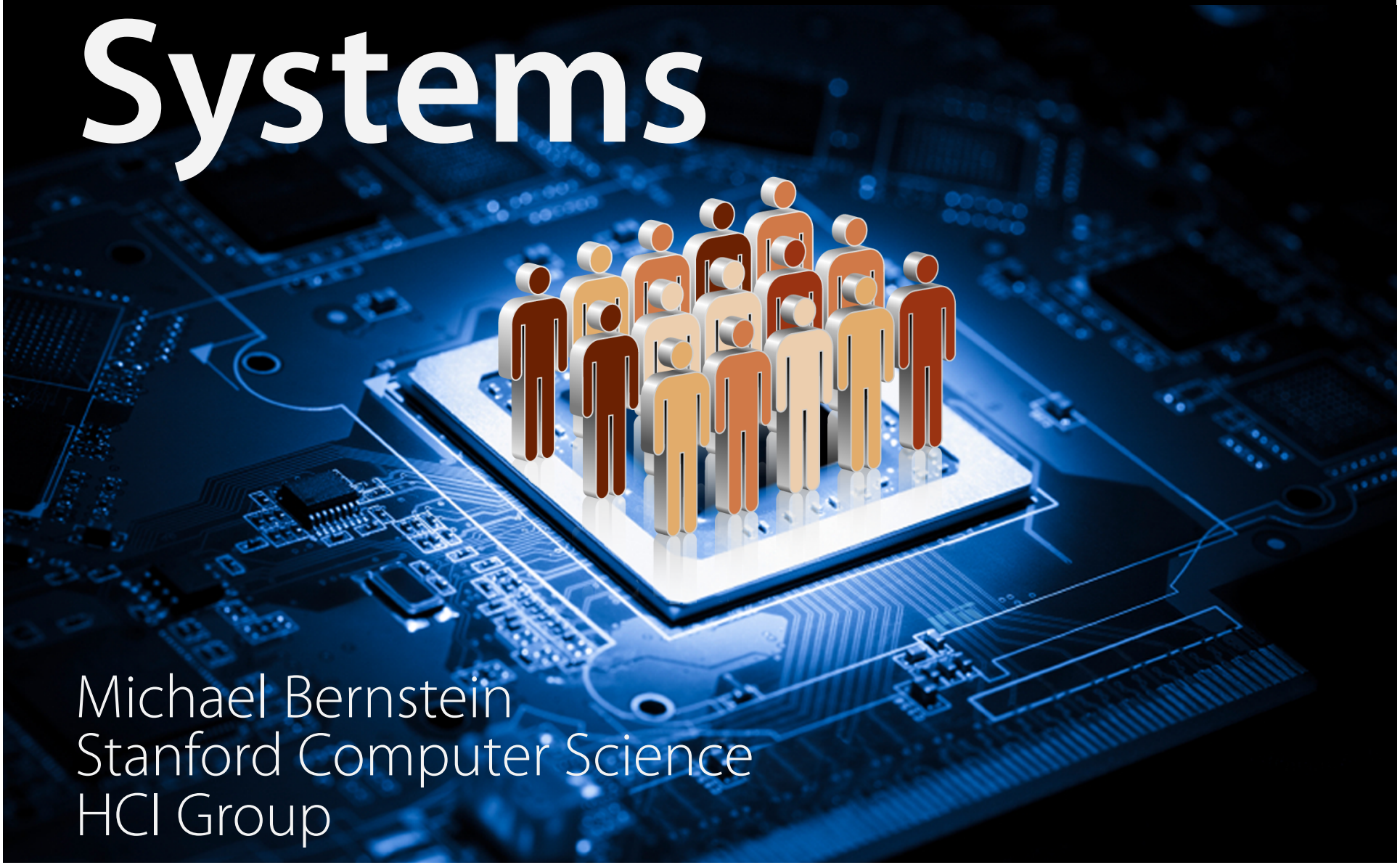
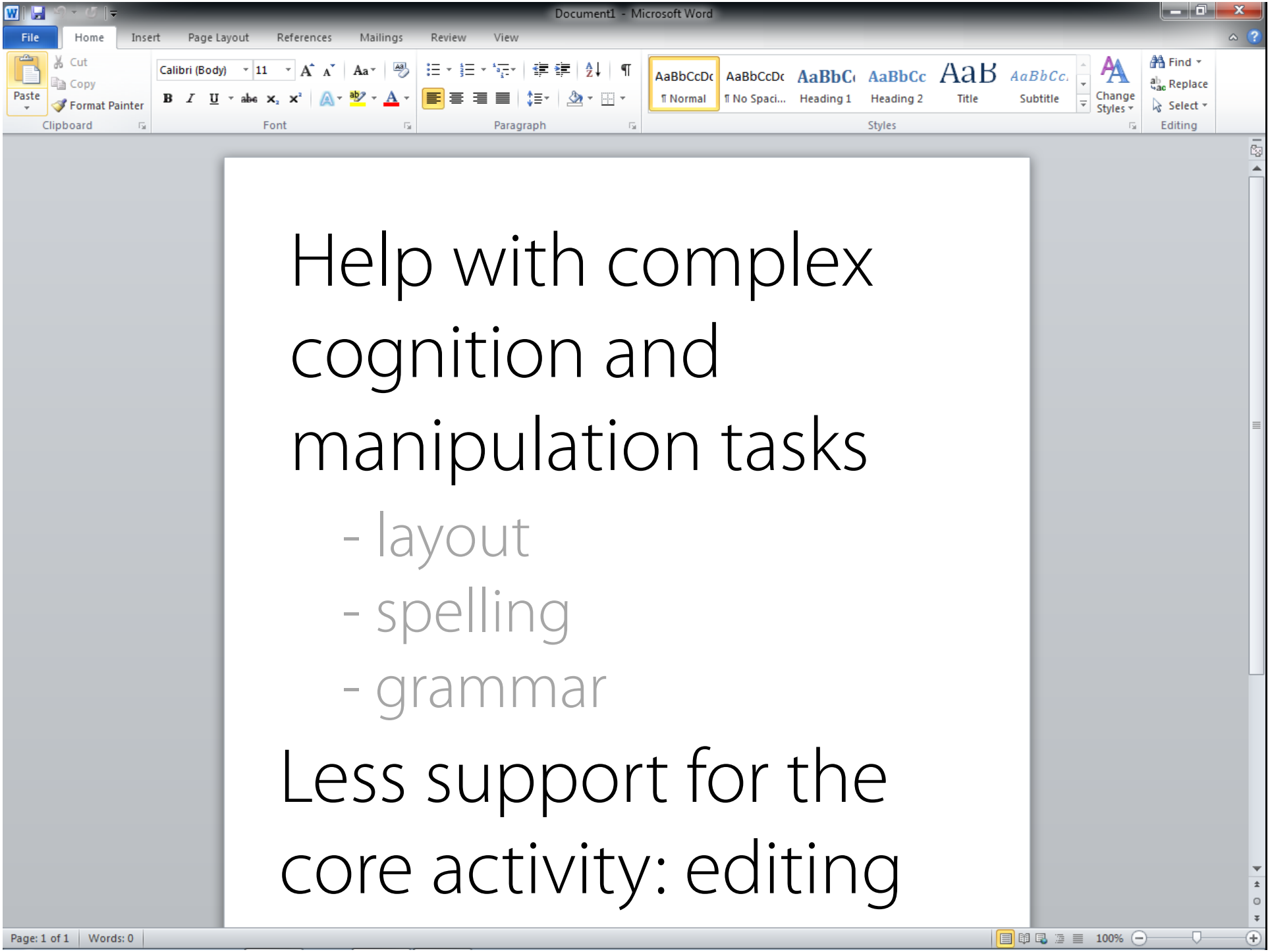
Crowd-Powered Systems



Michael Bernstein
Stanford Computer Science
HCI Group


Document1 - Microsoft Word
File
Home
Insert
Page Layout
References
Mailings
Review
View
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Copy
Format Painter
Paste
Clipboard
Calibri (Body)
11
Font
Paragraph
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¶ Normal
AaBbCcDc
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AaBbC
Heading 1
AaBbCc
Heading 2
AaB
Title
AaBbCc.
Subtitle
Change Styles
Styles
Find
Replace
Select
Editing
Help with complex cognition and manipulation tasks
- layout
- spelling
- grammar
Less support for the core activity: editing
Page: 1 of 1
Words: 0
100%

REFERENCES

1. Bernstein, M., Marcus, A., Karger, D.R., and Miller, R.C. Enhancing Directed Content Sharing on the Web. *CHI '10*, ACM Press (2010).
2. Bernstein, M., Tan, D., Smith, G., Czerwinski, M., et al. Collabio: A Game for Annotating People within Social Networks. *UIST '09*, ACM Press (2009), 177–180.
3. Bigham, J.P., Jayant, C., Ji, H., Little, G., et al. VizWiz: Nearly Real-time Answers to Visual Questions. *UIST '10*, ACM Press (2010).
21. Quinn, A.J. and Bederson, B.B. A Taxonomy of Distributed Human Computation.
22. Ross, J., Irani, L., Silberman, M.S., Zaldivar, A., et al. Who Are the Crowdworkers? Shifting Demographics in Amazon Mechanical Turk. *alt.chi '10*, ACM Press.
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24. Simon, I., Morris, D., and Basu, S. MySong: automatic accompaniment generation for vocal melodies. *Proc. CHI '08*, ACM Press (2008).
25. Snow, R., O'Connor, B., Jurafsky, D., and Ng, A.Y. Cheap and fast—but is it good?: evaluating non-expert annotations for natural language tasks. *ACL '08*, (2008).
26. Sorokin, A. and Forsyth, D. Utility data annotation with Amazon Mechanical Turk. *CVPR '08*, (2008).
27. von Ahn, L. and Dabbish, L. Labeling images with a computer game. *CHI '04*, ACM Press (2004).

Shortening a paper

Supported by human editors

Related Work

Crowdsourcing: A Batch Platform

Data collection, machine learning training, user studies, social science experiments
[Ipeirotis 2010, Heer et al. 2010, Kittur et al. 2008]

Games with a purpose
[von Ahn and Dabbish 2004, Cooper et al. 2011]

Collective action
[Wikipedia, Polymath Project, Search for Jim Gray]

Historical roots: distributed calculation of mathematical tables
[Grier 2007]

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1. Bernstein, M., Marcus, A., Karger, D.R., and Miller, R.C. Enhancing Directed Content Sharing on the Web. *CHI '10*, ACM Press (2010).
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21. Quinn, A.J. and Bederson, B.B. A Taxonomy of Distributed Human Computation.
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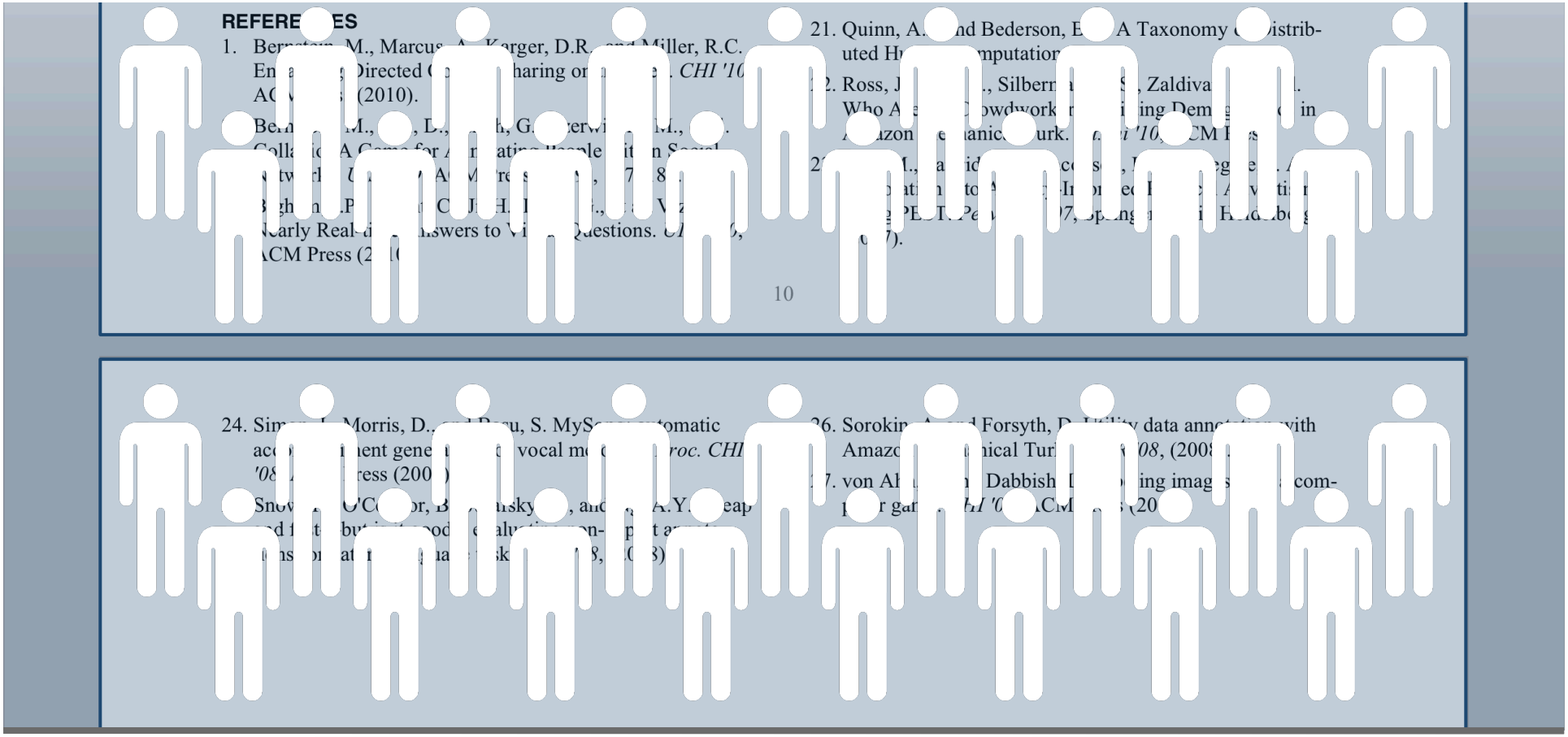
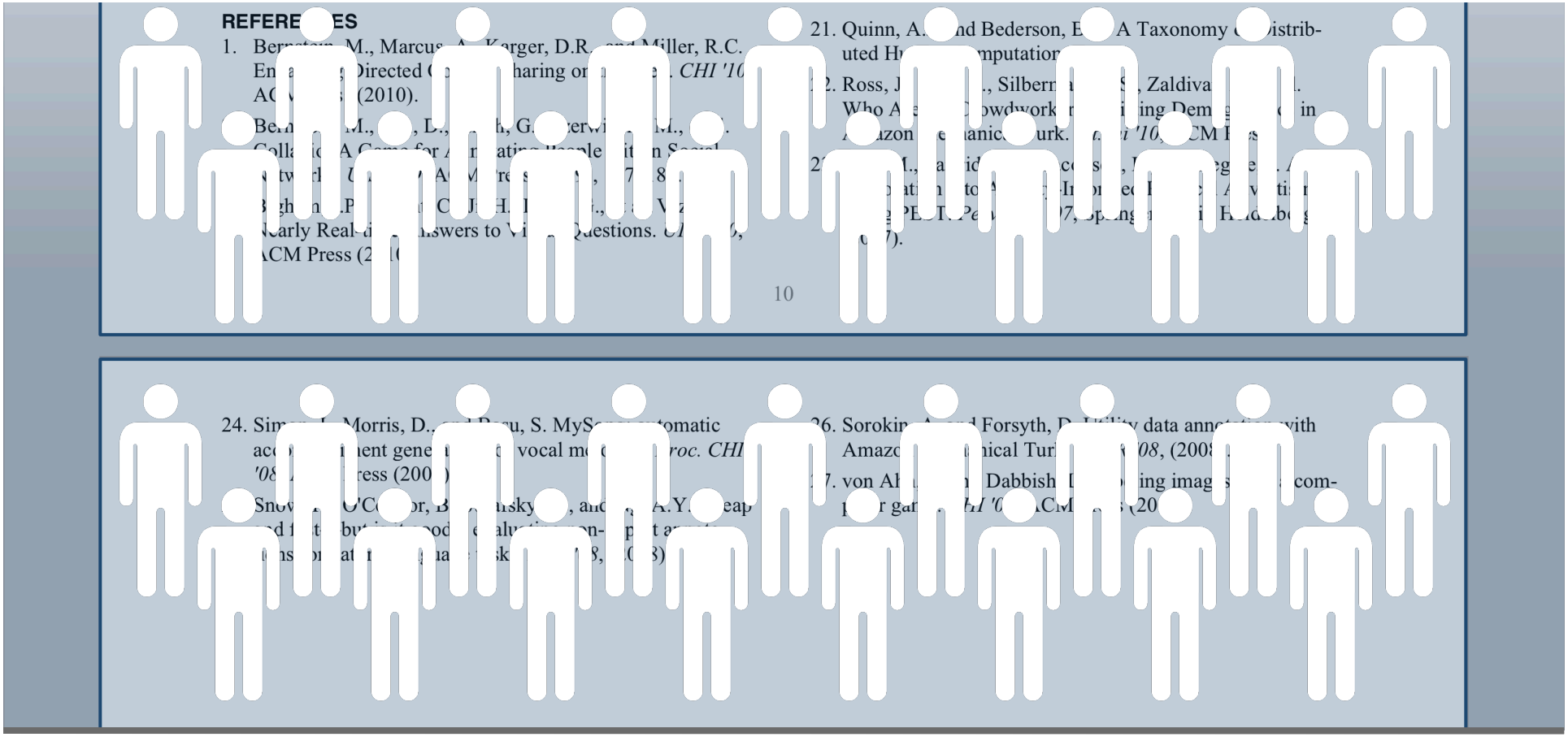
Shortening a paper

Supported by human editors



Shortening a paper

Supported by crowds

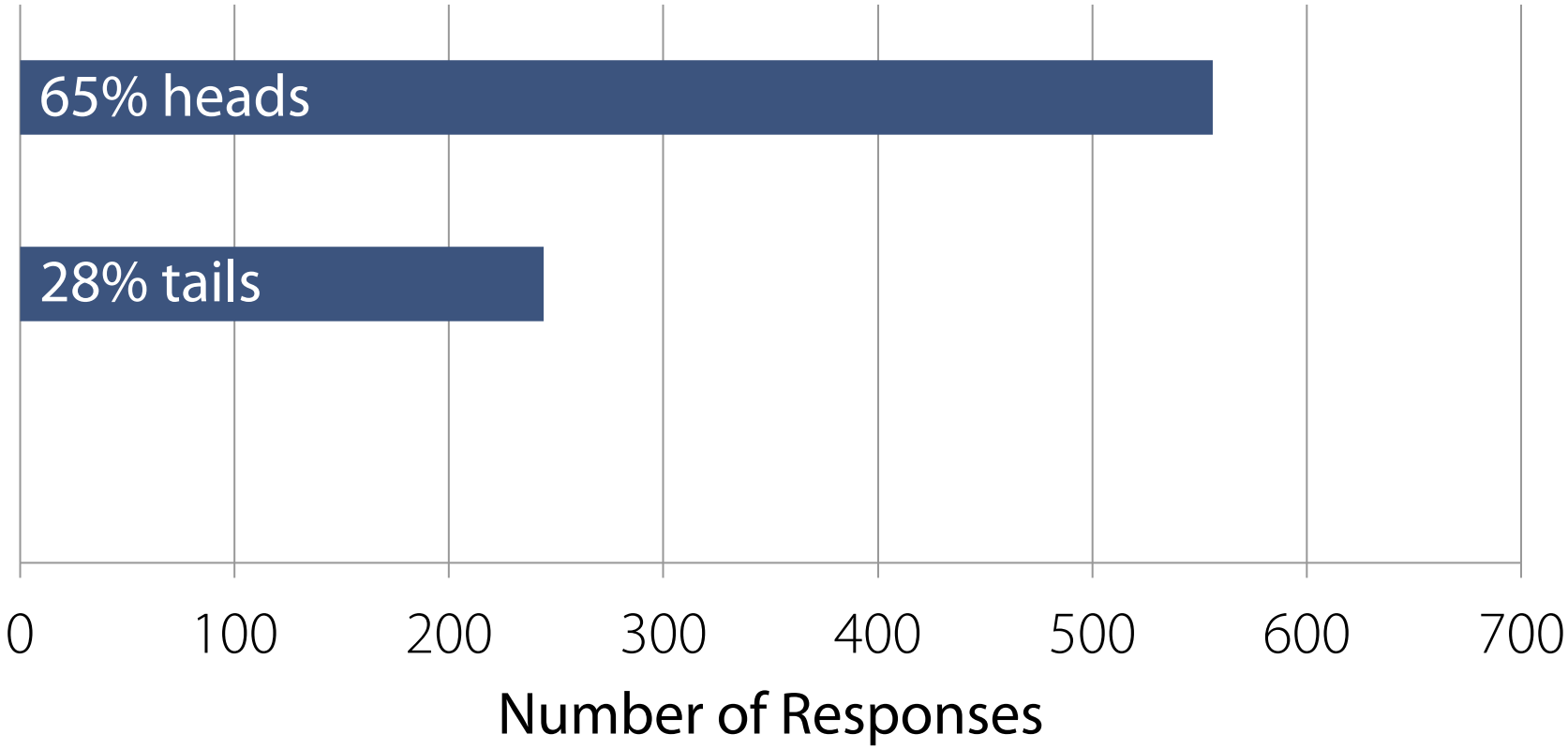


Crowd-powered system

Interactive computing system supported by human intelligence

Challenge: Quality

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



Challenge: Quality

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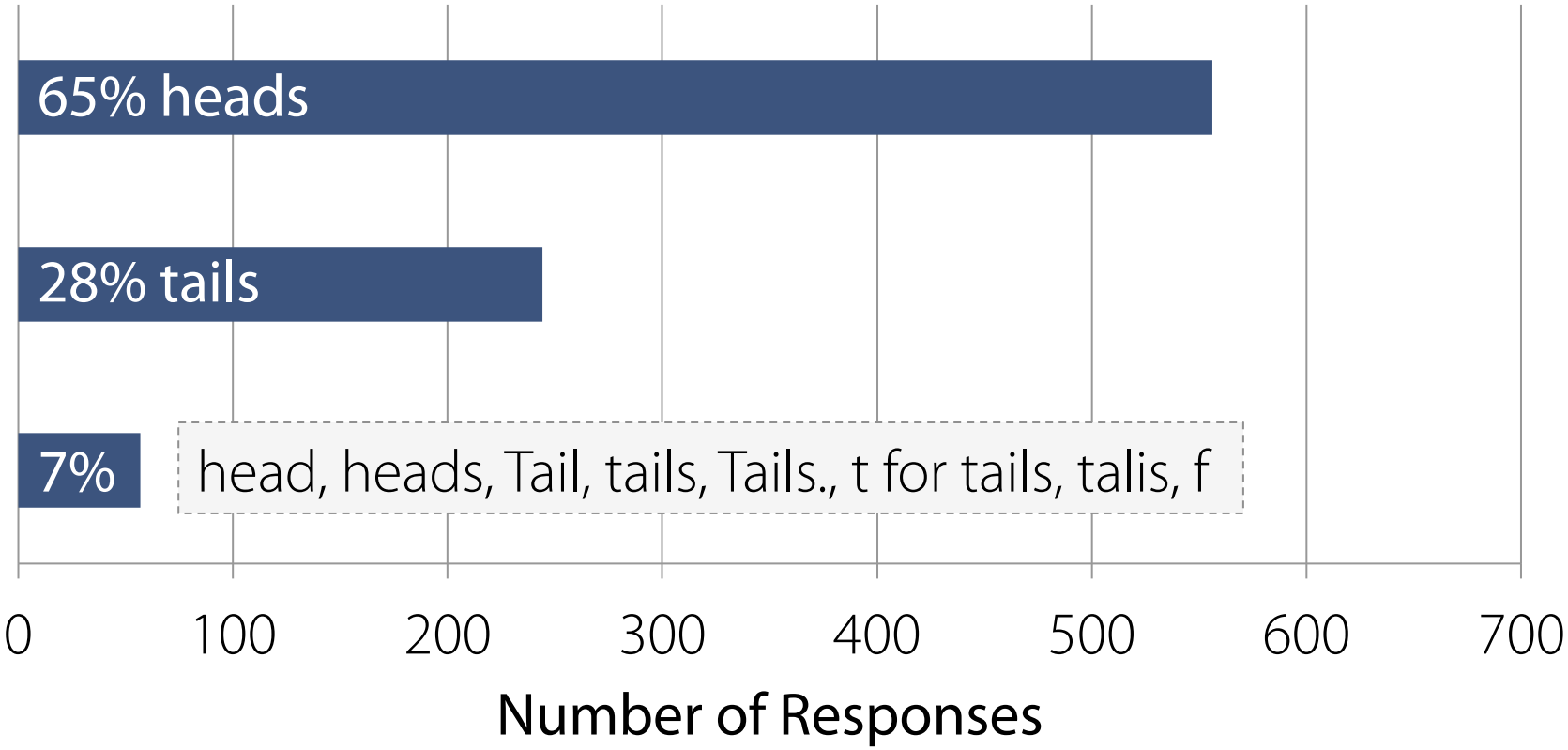


Challenge: Speed

Interactive applications need faster responses than crowds can provide

> "User response was extremely fast": 48 hours
> [Kittur et al. 2008]
>
> "Cheap and fast": 190 hours
> [Snow et al. 2008]

Half-life for 2.5¢ reward is 2 days,
Half-life for $1 reward is 12 hours
[Wang et al. 2011]

Interactive systems that embed crowd intelligence

Computational techniques that produce high-quality, fast results

Paid Crowdsourcing

Pay small amounts of money for short tasks

Amazon Mechanical Turk: Roughly five million tasks completed per year at 1-5¢ each [Ipeirotis 2010]

Label an image
Requester: Matt C.
Reward: $0.01

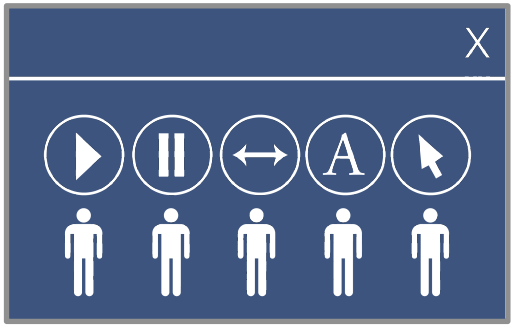
Transcribe short audio clip
Requester: Gordon L.
Reward: $0.04

Population: 40% U.S., 40% India, 20% elsewhere

Gender, education and income are close mirrors of overall population distributions [Ross 2010]

Outline

1 Soylent



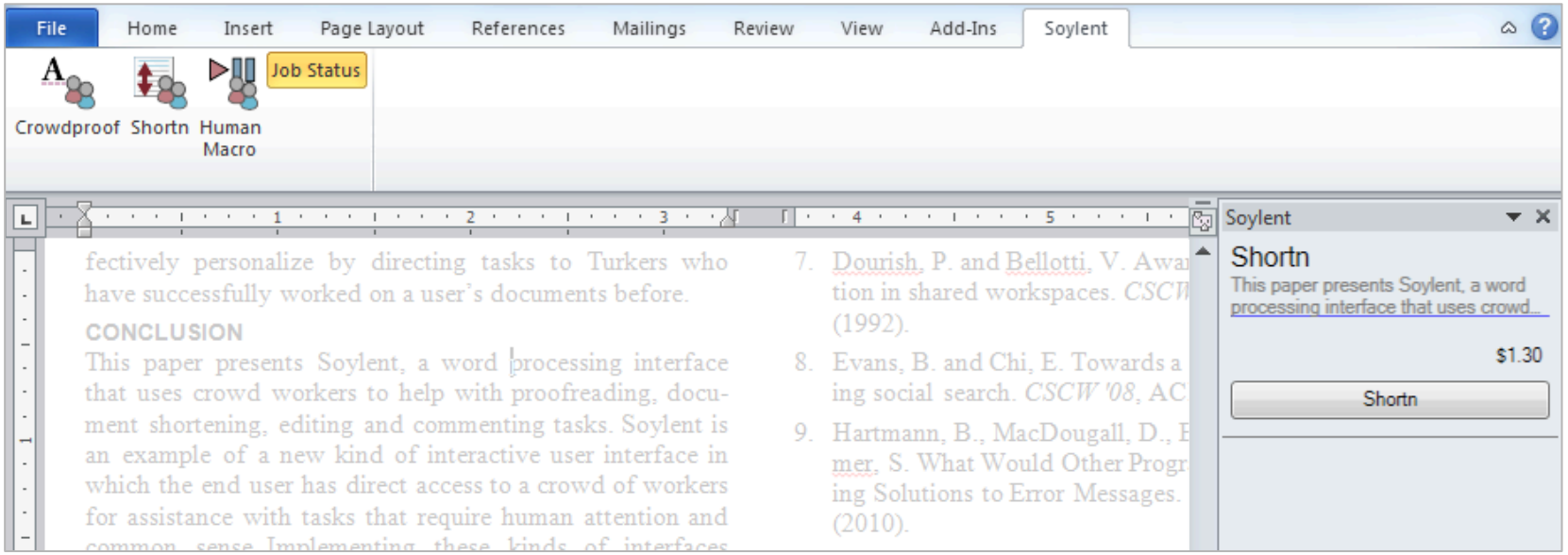
Word processor
with a crowd inside

2 Adrenaline

Realtime
crowdsourcing

Soylent

Word processor that recruits crowds to aid complex writing tasks



M. Bernstein et al. Soylent: A Word Processor with a Crowd Inside. UIST 2010.

Soylent

Word processor that recruits crowds to aid complex writing tasks

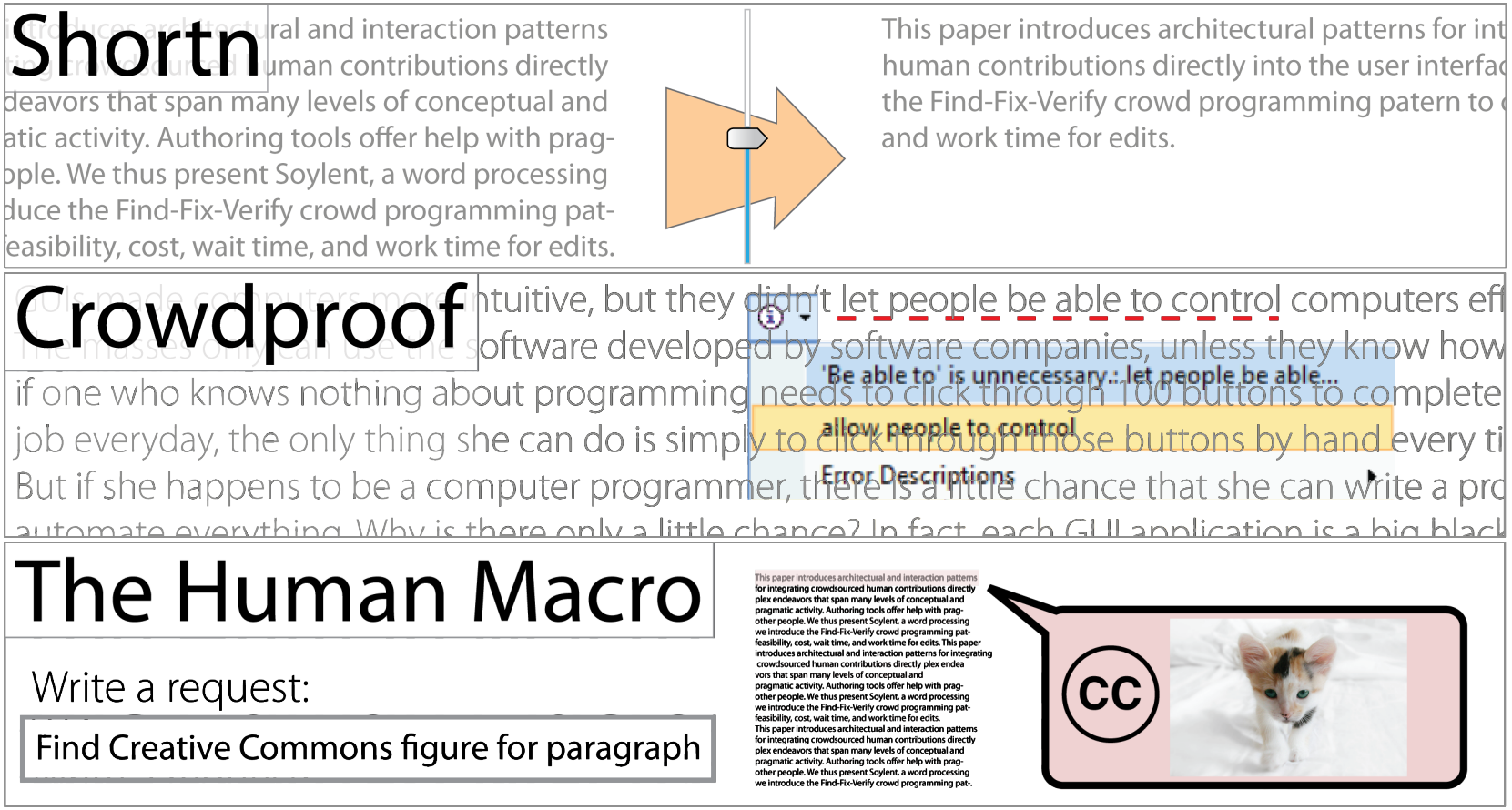
Embeds crowds as first-order building blocks in a software system

Decomposes open-ended tasks via a new design pattern

M. Bernstein et al. Soylent: A Word Processor with a Crowd Inside. UIST 2010.

demo

Soylent seeks out crowd contributions to enable new interactive systems.



Challenges in Programming Crowds

Soylent has interacted with ~10,000 workers on > 2000 different tasks

Key Problem: crowd workers often produce poor output on open-ended tasks

30% Rule

~30% of the results in open-ended tasks will be unsatisfactory

Two Personas — An Example

Proofread and correct the following paragraph:

The theme of loneliness features throughout many scenes in Of Mice and Men and is often the dominant theme of sections during this story. This theme occurs during many circumstances but is not present from start to finish. In my mind for a theme to be pervasive is must be present during every element of the story. There are many themes that are present most of the way through such as sacrifice, friendship and comradship. But in my opinion there is only one theme that is present from beginning to end, this theme is pursuit of dreams.

Two Personas — An Example

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Persona One: The Lazy Worker

Does as little work as necessary to be paid

The theme of loneliness features throughout many scenes in Of Mice and Men and is often the dominant theme of sections during this story. This theme occurs during many circumstances but is not present from start to finish. In my mind for a theme to be pervasive is must be present during every element of the story. There are many themes that are present most of the way through such as sacrifice, friendship and comradship. But in my opinion there is only one theme that is present from beginning to end, this theme is pursuit of dreams.

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Persona Two: The Eager Beaver

Goes beyond task requirements to be helpful, but introduces errors in the process

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Persona Two: The Eager Beaver

Goes beyond task requirements to be helpful, but introduces errors in the process

The theme of loneliness features throughout many scenes in Of Mice and Men and is often the dominant theme of sections of this story. \n

This theme occurs during many circumstances but is not present from start to finish. \n

In my mind, for a theme to be pervasive it must be present during every element of the story. \n

There are many themes that are present most of the way through such as sacrifice, friendship and comradeship.\n

But in my opinion there is only one theme that is present from beginning to end: this theme is pursuit of dreams.

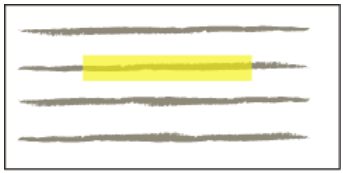
The Result: Low-quality Work

Programming with crowds today is haphazard: we lack design patterns

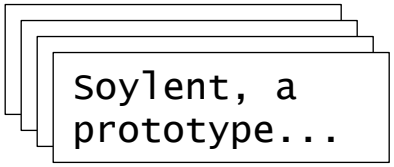
Solution: Find-Fix-Verify

Find-Fix-Verify is a design pattern for programming with crowds in open-ended tasks.

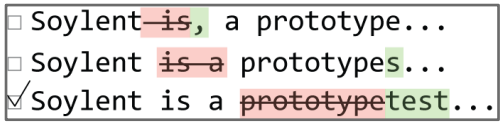
Find a problem



Fix the problem

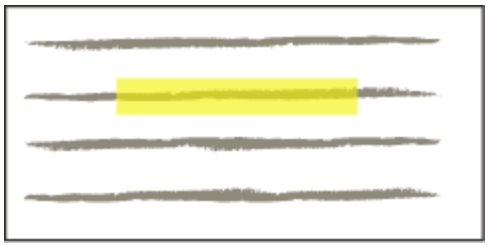


Verify the quality of each fix



Find

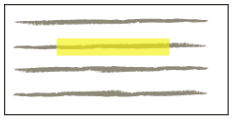
"Identify at least one area that can be shortened without changing the meaning of the paragraph."



Independent agreement to identify patches

Fix

"Edit the highlighted section to shorten its length without changing the meaning of the paragraph."



Soylent, a prototype...

Randomize order of suggestions

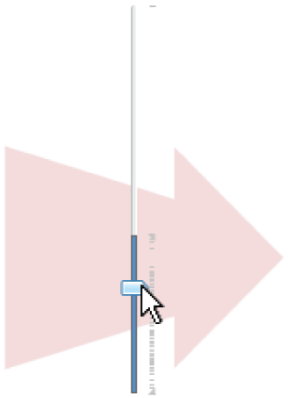
Verify

"Choose at least one rewrite that has style errors, and at least one rewrite that changes the meaning of the sentence."

☐ Soylent ~~is~~, a prototype...
☐ Soylent ~~is a~~ prototypes...
☑ Soylent is a ~~prototype~~test...

Keep suggestions that do not get voted out

Automatic clustering generally helps separate different kinds of records that need to be edited differently, but it isn't perfect. Sometimes it creates more clusters than needed, because the differences in structure aren't important to the user's particular editing task. For example, if the user only needs to edit near the end of each line, then differences at the start of the line are largely irrelevant, and it isn't necessary to split based on those differences. Conversely, sometimes the clustering isn't fine enough, leaving heterogeneous clusters that must be edited one line at a time. One solution to this problem would be to let the user rearrange the clustering manually, perhaps using drag-and-drop to merge and split clusters. Clustering and selection generalization would also be improved by recognizing common text structure like URLs, filenames, email addresses, dates, times, etc.



Automatic clustering generally helps separate different kinds of records that need to be edited differently, but it isn't perfect. Sometimes it creates more clusters than needed, because the differences in structure aren't relevant to a specific task. | Conversely, sometimes the clustering isn't fine enough, leaving heterogeneous clusters that must be edited one line at a time. One solution to this problem would be to let the user rearrange the clustering manually using drag-and-drop edits. Clustering and selection generalization would also be improved by recognizing common text structure like URLs, filenames, email addresses, dates, times, etc.

changes the meaning of the sentence."

Find-Fix-Verify Discussion

Why split Find and Fix?

- Focus Lazy Workers on a problem of our choice
- Group suggestions by core problem

Why add Verify?

- Quality rises when Turkers are in productive tension

Crowds and Algorithms

[Little et al. 2010, Kittur et al. 2011, Shahaf & Horvitz 2010, Franklin et al. 2011, Marcus et al. 2011, Dai et al. 2010, Parameswaran et al. 2011]

Evaluation Goals

Is Soylent's approach of crowdsourced interactive systems feasible?

1. How high is the quality?
2. How long is the delay?
3. How much does it cost?

Shortn

Blog

Print publishers are in a tizzy over Apple's new iPad because they hope to finally be able to charge for their digital editions. But in order to get people to pay for their magazine and newspaper apps, they are going to have to offer something different that readers cannot get at the newsstand or on the open Web.

Classic HCI Paper

The metaDESK effort is part of the larger Tangible Bits project. The Tangible Bits vision paper introduced the metaDESK along with two companion platforms, the transBOARD and ambientROOM.

Draft HCI Paper

In this paper we argue that it is possible and desirable to combine the easy input affordances of text with the powerful retrieval and visualization capabilities of graphical applications. We present WenSo, a tool that uses lightweight text input to capture richly structured information for later retrieval and navigation.

Technical Writing

Figure 3 shows the pseudocode that implements this design for Lookup. FAWN-DS extracts two fields from the 160-bit key: the i low order bits of the key (the index bits) and the next 15 low order bits (the key fragment).

Rambling E-mail

A previous board member, Steve Burleigh, created our web site last year and gave me alot of ideas. For this year, I found a web site called eTeamZ that hosts web sites for sports groups. Check out our new page: […]

Blog – 83%

Print publishers are in a tizzy over Apple's new iPad because they hope to ~~finally~~ be able to charge for their digital editions. But in order to get people to pay for their magazine and newspaper apps, they ~~are going to~~ have to offer something different that readers cannot get at the newsstand or on the open Web.

Classic HCI Paper – 87%

~~The metaDESK effort is part of the larger Tangible Bits project. The Tangible Bits vision~~

Cut 15% of original paragraph length on average.

graphical applications. We present WenSo, ~~a tool that~~which uses lightweight text input to capture richly structured information for later retrieval and navigation.

Technical Writing – 82%

Figure 3 shows the pseudocode that implements this design for Lookup. FAWN-DS extracts two fields from the 160-bit key: ~~the i low order bits of the key~~ (the index bits) and the next 15 low order bits ~~(the key fragment)~~.

Rambling E-mail – 78%

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Focus on unnecessarily wordy phrases

But in order to get people to pay for their magazine and newspaper apps, they ~~are going to~~ have to offer something different that readers cannot get at the newsstand or on the open Web.

S

Technical Writing – 82%

Figure 3 shows the pseudocode that implements this design for Lookup. FAWN-DS extracts two fields from the 160-bit key: ~~the i low order bits of the key~~ (the index bits) and the next 15 low order bits ~~(the key fragment)~~.

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Merge sentences when patches span sentence boundaries

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sports groups. Check out our new page: […]

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Classic HCI Paper – 87%

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Draft HCI Paper – 90%

~~In this paper we argue that~~ it is possible and desirable to combine the easy input

Introduced style errors when workers were not part of the community of practice

~~In this paper we argue that~~ it is possible and desirable to combine the easy input affordances of text with the powerful retrieval and visualization capabilities of graphical applications.

Blog – 83%

Print publishers are in a tizzy over Apple's new iPad because they hope to ~~finally~~ be able to charge for their digital editions. But in order to get people to pay for their

Parallelism can introduce inconsistent changes

FAWN-DS extracts two fields from the 160-bit key: ~~the i low order bits of the key~~ (the index bits) and the next 15 low order bits ~~(the key fragment)~~.

affordances of text with the powerful retrieval and visualization capabilities of graphical applications. We present WenSo, ~~a tool that~~which uses lightweight text input to capture richly structured information for later retrieval and navigation.

Technical Writing – 82%

Figure 3 shows the pseudocode that implements this design for Lookup. FAWN-DS extracts two fields from the 160-bit key: ~~the i low order bits of the key~~ (the index bits) and the next 15 low order bits ~~(the key fragment)~~.

Rambling E-mail – 78%

~~A previous board member,~~ Steve Burleigh~~,~~ created our web site last year and gave me alot of ideas. ~~For this year,~~ I found a web site called eTeamZ that hosts web sites for sports groups. Check out our new page: […]

Shortn

Blog – 83% 3 para., 158 people, $1.52/para

Print publishers are in a tizzy over Apple's new iPad because they hope to ~~finally~~ be able to charge for their digital editions. But in order to get people to pay for their magazine and newspaper apps, they ~~are going to~~ have to offer something different that readers cannot get at the newsstand or on the open Web.

Classic HCI Paper – 87% 7 para., 264 people, $1.06/para

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Draft HCI Paper – 90% 5 para., 284 people, $1.49/para

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Technical Writing – 82% 3 para., 188 people, $1.61/para

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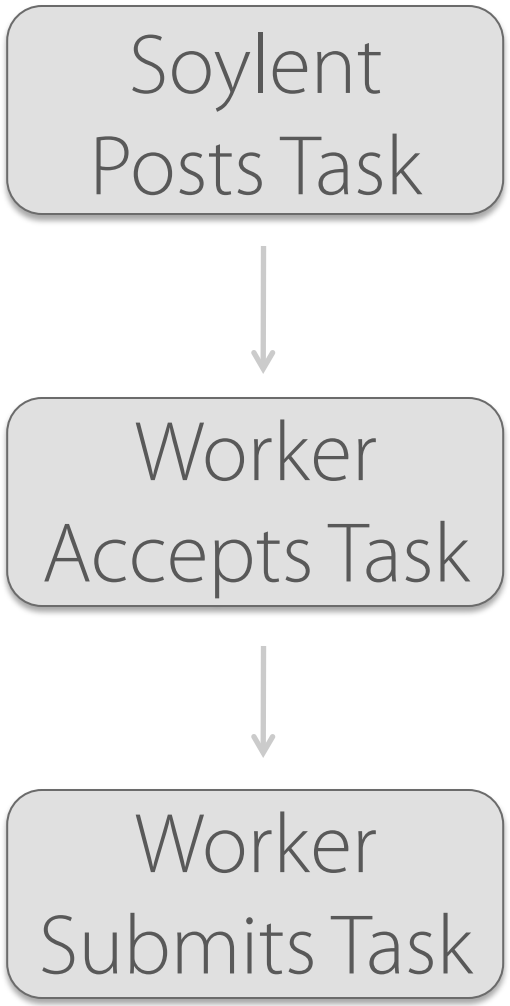
Rambling E-mail – 78% 6 para., 362 people, $1.62/para

~~A previous board member,~~ Steve Burleigh~~,~~ created our web site last year and gave me alot of ideas. ~~For this year,~~ I found a web site called eTeamZ that hosts web sites for sports groups. Check out our new page: […]

Results

How Fast Is Shortn?



Wait time is the longest:
Median 18.5 minutes

Summed medians across Find, Fix and Verify

Q_1=8.3 minutes, Q_3=41.6 minutes

Actual work time is shorter:
Median 2.0 minutes

Summed medians across Find, Fix and Verify

Q_1=60 seconds, Q_3=3.6 minutes

Crowdproof

ESL: English as a Second Language

However, while GUI made using computers be more intuitive and easier to learn, it didn't let people be able to control computers efficiently. Masses only can use the software developed by software companies.

Passes Word's Grammar Checker

Marketing are bad for brand big and small. You Know What I am Saying. It is no wondering that advertisings are bad for company in America, Chicago and Germany.

Wikipedia

Dandu Monara (Flying Peacock, Wooden Peacock), The Flying machine able to fly. The King Ravana (Sri Lanka) built it. Accorinding to hindu believes in Ramayanaya King Ravana used "Dandu Monara" for abduct queen Seetha from Rama. According to believes "Dandu Monara" landed at Werangatota.

Notes

Blah blah blah—argument about whether there should be a standard "nosql storage" API to protect developers storing their stuff in proprietary services in the cloud. Probably unrealistic.

Draft HCI Paper

Many of these problems vanish if we turn to a much older recording technology---text. When we enter text, each (pen or key) stroke is being used to record the actual information we care about---; none is wasted on application navigation or configuration.

Crowdproof

ESL: English as a Second Language

However, while GUI made using computers be more intuitive and easier to learn, it didn't allow people to ~~let people be able to~~ control computers efficiently. ~~Masses only can~~The masses can only use the software developed by software companies, unless they know how to write programs.

Word: found **30%** of errors

Crowdproof: found **67%** of errors

Combined: found **82%** of errors

Crowdproof fixed
88% of the errors it found.

Human Macro

Find BibTeX:

"Hi, please find the bibtex references for the 3 papers in brackets. You can located [sic] these by Google Scholar searches and clicking on bibtex."

Find Creative Commons Figures:

"Pick out keywords from the paragrah like Yosemite, rock, half dome, park. Go to a site which hsa CC licensed images [. . .]"

Blog Feedback:

"Please tell me how to make this paragraph communicate better. Say what's wrong, and what I can improve. Thanks!"

Tense Change:

"Please change text in document from past tense to present tense"

Find and Format Addresses:

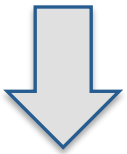
"Please complete the addresses below to include all informtion needed as in example below. [...]"

Human Macro

Find BibTeX:

"Hi, please find the bibtex references for the 3 papers in brackets. You can located [sic] these by Google Scholar searches and clicking on bibtex."

Duncan and Watts [Duncan and watts HCOMP 09 anchoring] found that Turkers will do more work, but quality is no higher.

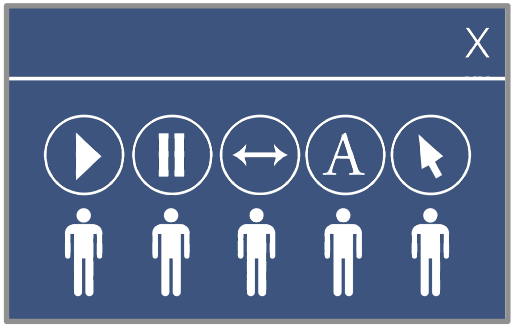


```
@conference {
   title={{Financial incentives [...]}},
   author={Mason, W. and Watts, D.J.},
   booktitle={HCOMP '09},
   [...]
}
```

The Human Macro executed requests perfectly **71%** of the time, and had the right intention **88%** of the time.

Outline

Soylent



Word processor
with a crowd inside

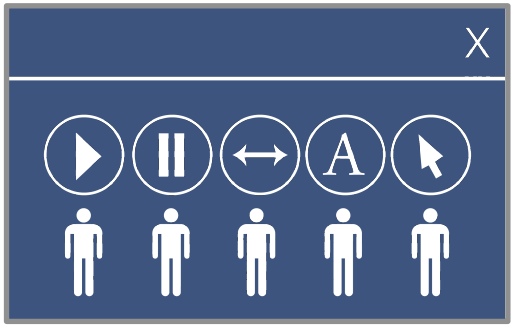
New class of paid, on-demand crowd-powered systems

Find-Fix-Verify design pattern

Lazy Worker and Eager Beaver

Outline

1 Soylent



Word processor
with a crowd inside

2 Adrenaline

Realtime
crowdsourcing

Applications are constrained by crowd latency.

Design [Yu and Nickerson 2011, Xu and Bailey 2011]
Health and nutrition [Noronha et al. 2011]
Open-world databases [Franklin et al. 2011, Marcus et al. 2010]
Crowd algorithms [Little et al. 2010, Parameswaran et al. 2011]
Assistive technology [Bigham et al. 2010]
Robotics [Sorokin et al. 2010, Lasecki et al. 2011]
Maps [Stranders et al. 2011]
Task decomposition [Kulkarni et al. 2012]
Machine vision [Rodriguez and Davis 2011, Yan et al. 2010]
Feedback and collaboration [Kittur 2010, Dow et al. 2012]

One unverified response
in 56 seconds
[Bigham et al. 2010]

— but —

The user loses focus
after 10 seconds
[Nielsen 1993, Card et al. 1991]

Our goal is on-demand, realtime crowds.

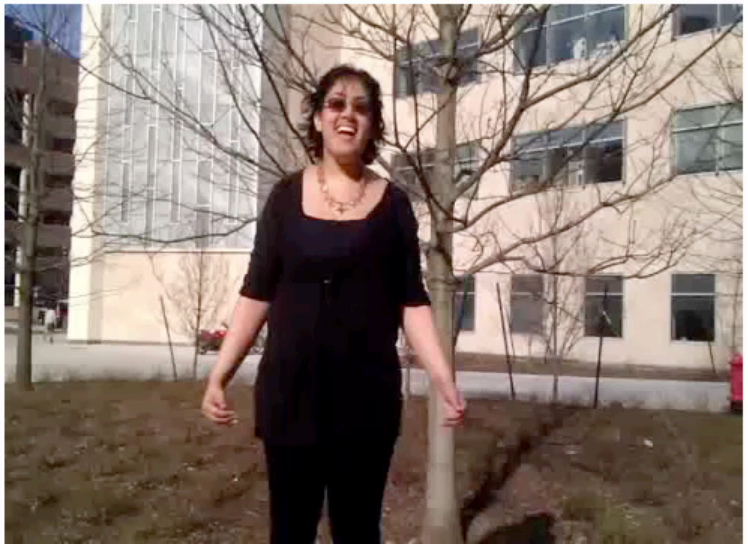
Adrenaline

Realtime crowd-powered camera

M. Bernstein, J. Brandt, R. Miller, and D. Karger. Crowds in Two Seconds: Enabling Realtime Crowd-Powered Interfaces. UIST 2011.


SONY



How do we recruit crowds quickly?

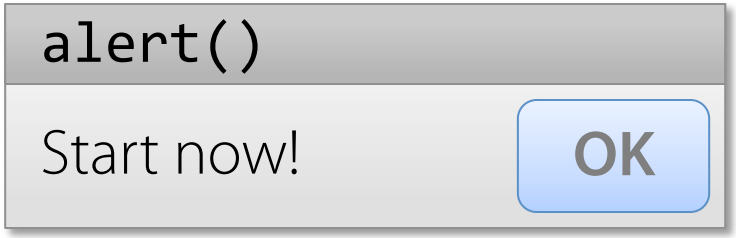
Approach: Retainer model

Retainer Model

Workers sign up in advance
Offer ½¢ per minute to remain on call
Alert when task is ready

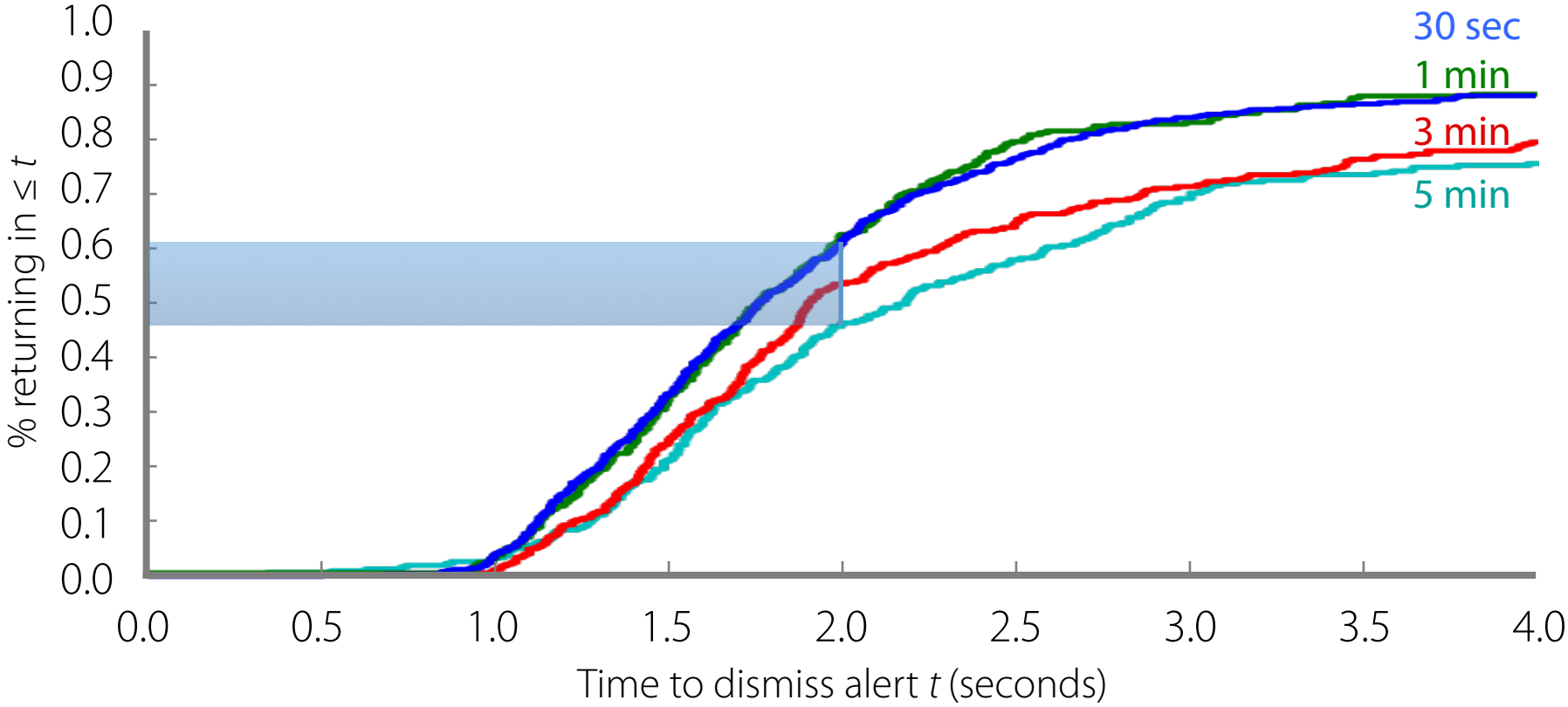
Task:
Move the playback head to find the best moment.

Wait at most:
5 minutes



Results: N=1545 tasks

How quickly do retainer workers return?

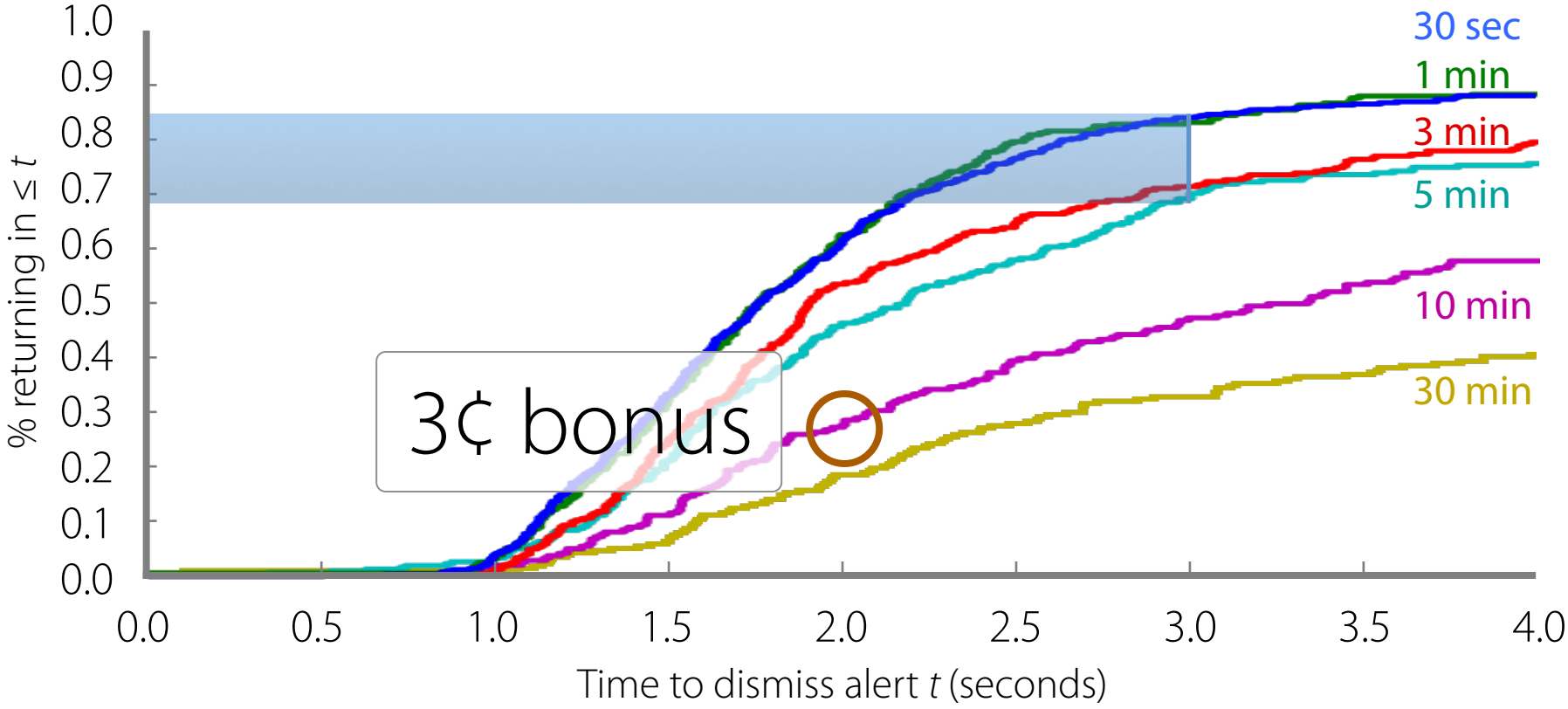


For retainer times under ten minutes,

46–61% within **2 seconds**.

Results: N=1545 tasks

How quickly do retainer workers return?

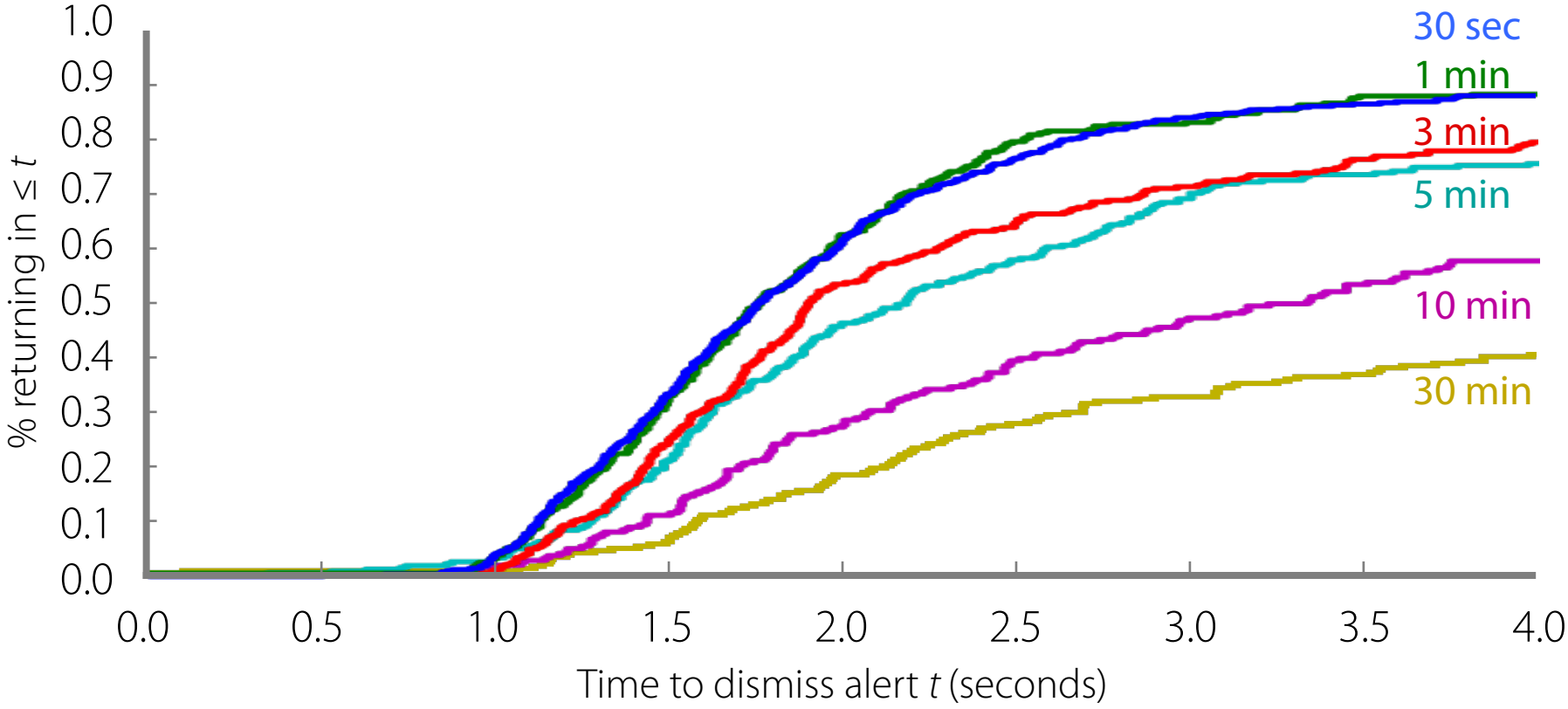


For retainer times under ten minutes,

69–84% within **3 seconds**.

Results: N=1545 tasks

How quickly do retainer workers return?



One worker on retainer costs **$0.30 / hour**.

A|B: Instant Votes

Five votes in five seconds:

"Which font should I use?"
"Which tie matches better?"
"Which blog headline is catchier?"

A|B: Instant Votes

Five votes in five seconds:

"Which font should I use?"
"Which tie matches better?"
"Which blog headline is catchier?"

The retainer model: crowds in two seconds and votes in five seconds.

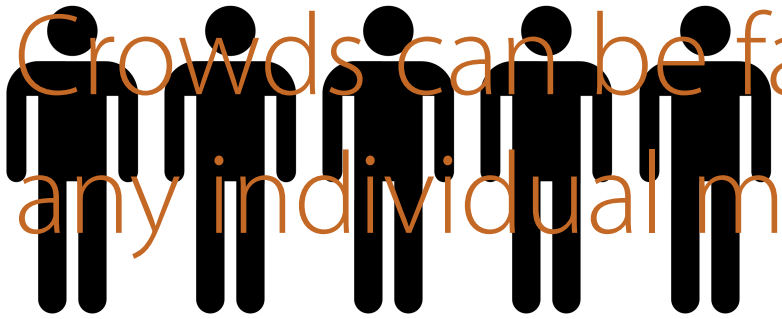

Work time is slow.

How do we overcome slow work times?

How do we overcome slow work times?

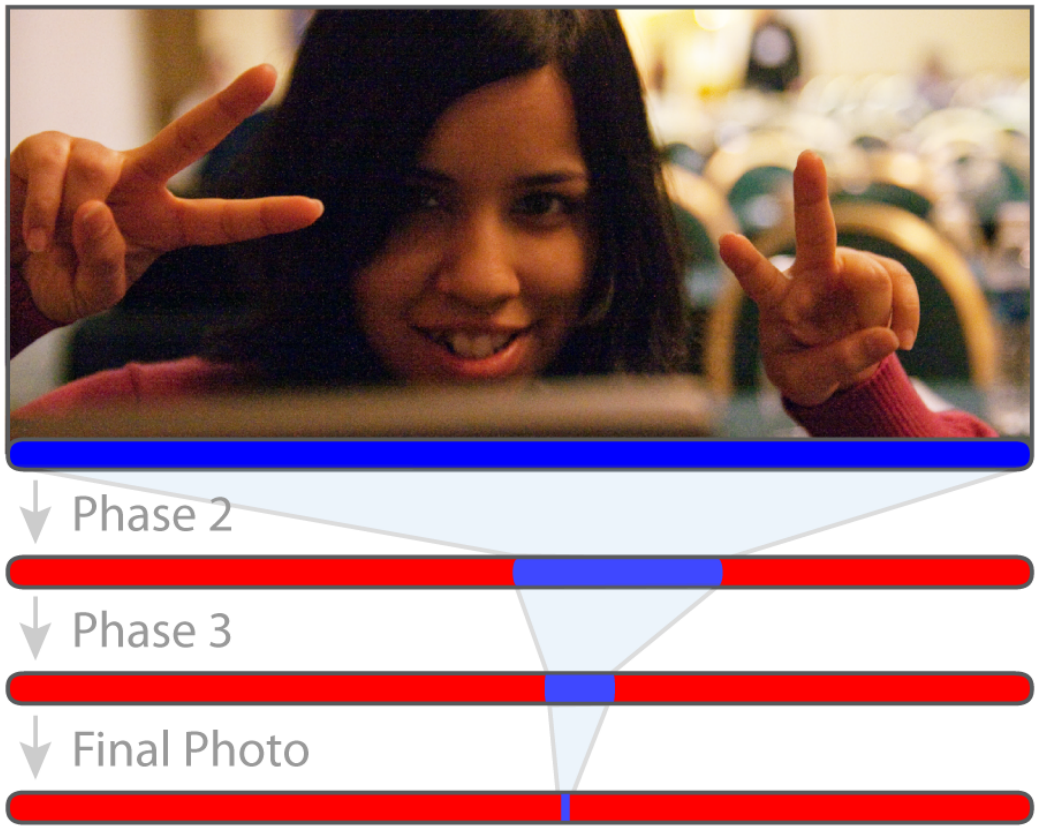
Synchronous crowds

Crowds can be faster than any individual member



Rapid Refinement

Recognize potential agreement early, then use it to reduce a continuous search space quickly.



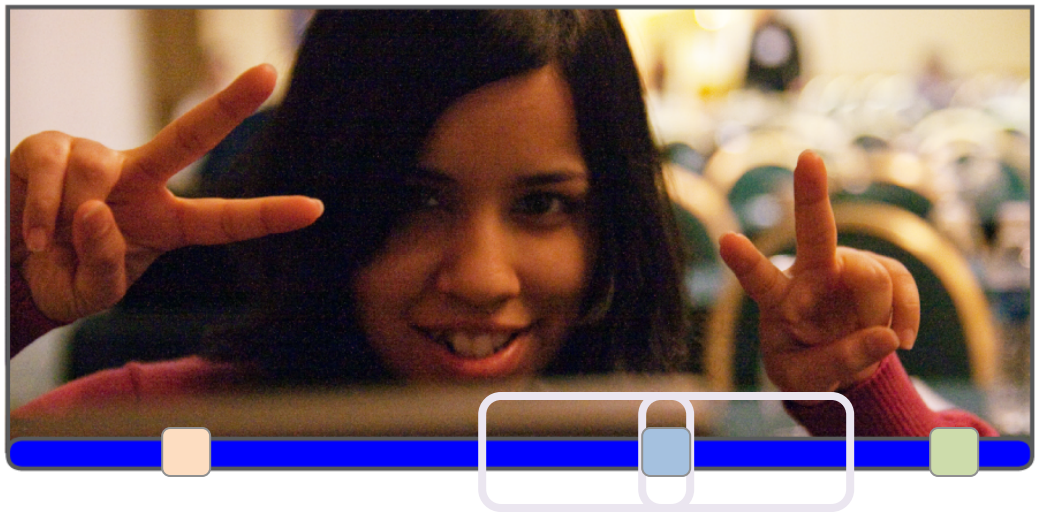
Rapid Refinement

Worker 1

Worker 2

Worker 3

Rapid Refinement

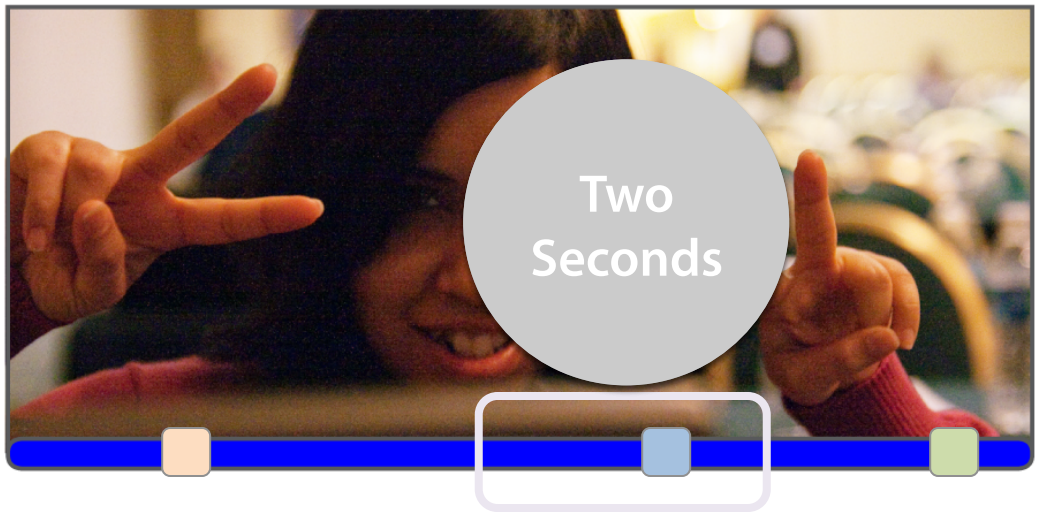


Worker 1

Worker 2

Worker 3

Rapid Refinement



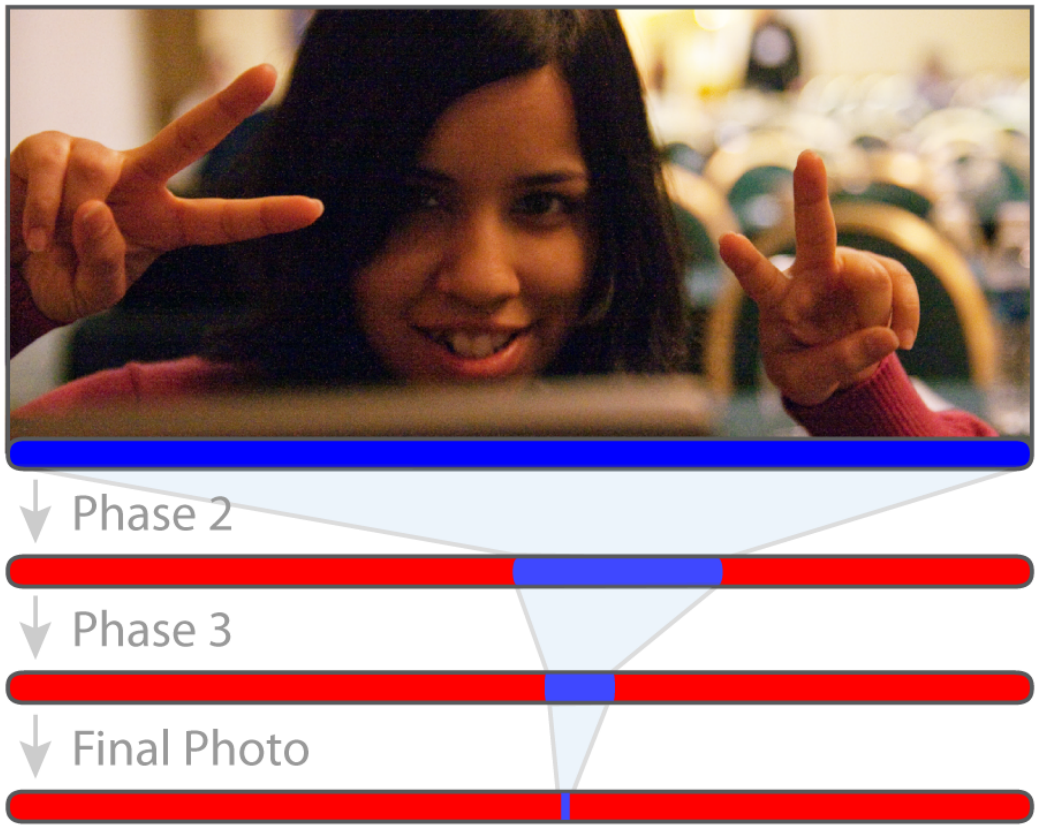

```
while (searchArea.size > 1):
  a = calculateAgreement(workerPositions,
                         searchArea,
                         refinementRatio)

  if (a.percent >= 0.66):
```

Worker 1

Worker 2

Worker 3

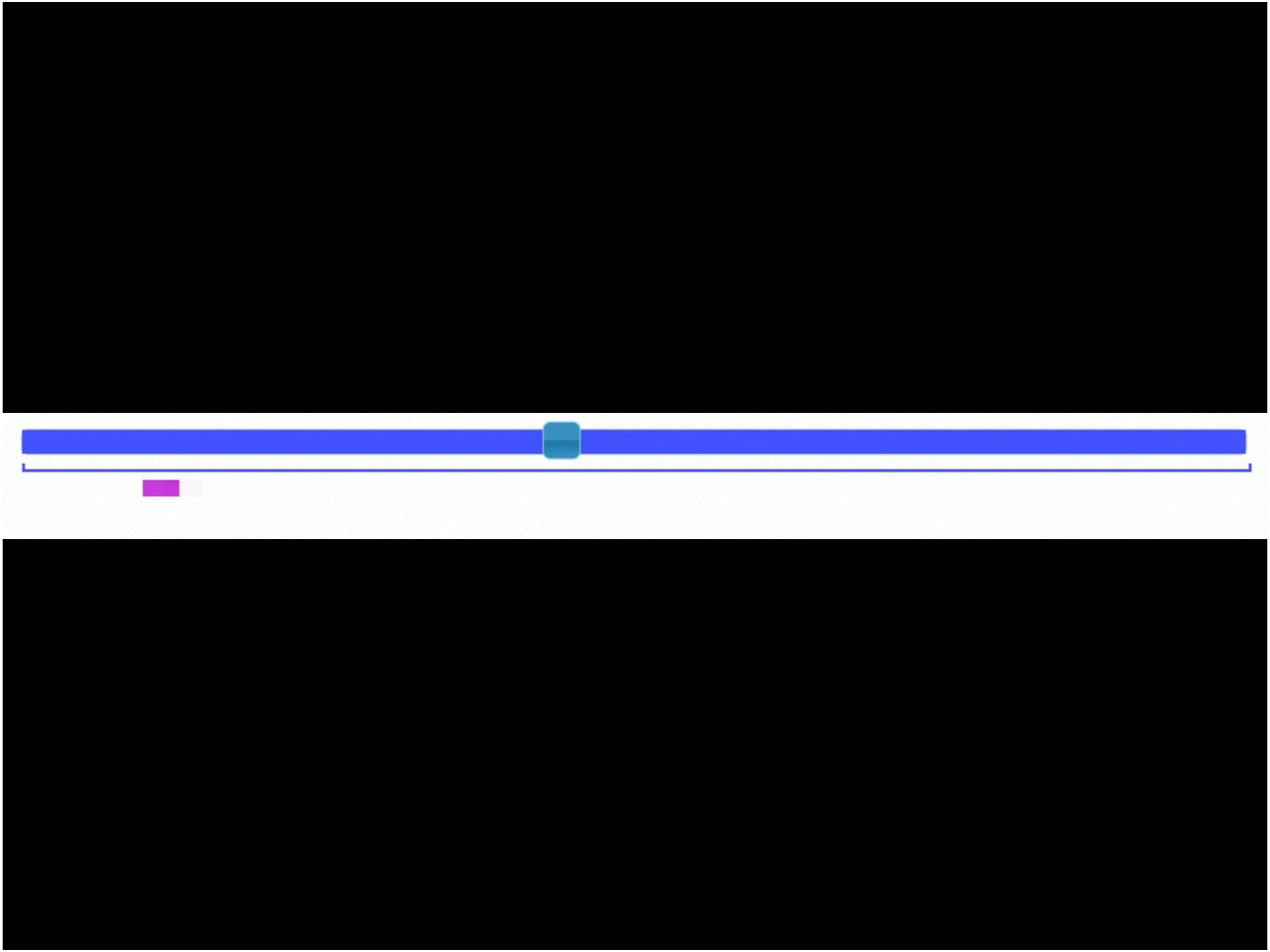
Rapid Refinement



Worker 1

Worker 2

Worker 3



Evaluation

Do the retainer model and rapid refinement produce realtime results?

Crowdsourcing approaches:

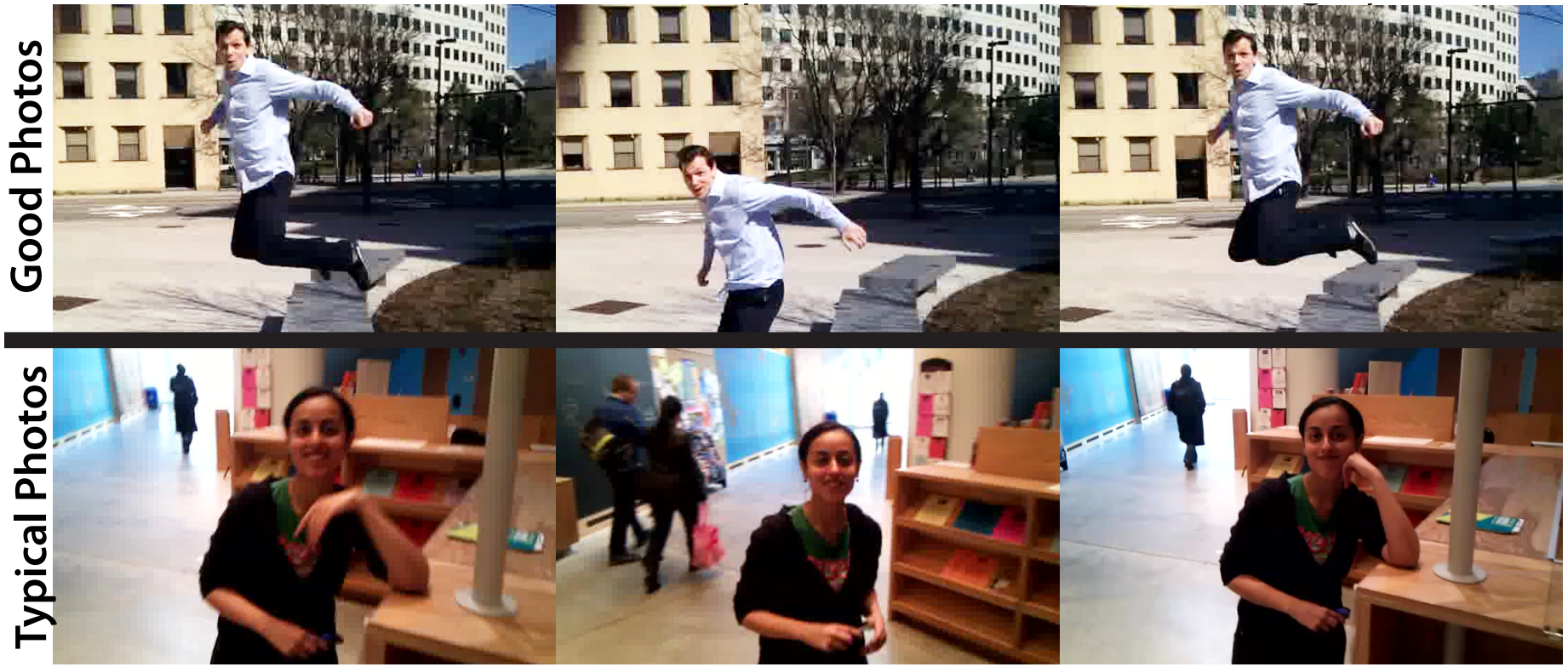
1. Rapid Refinement
2. Generate-and-Vote
3. Generate-One

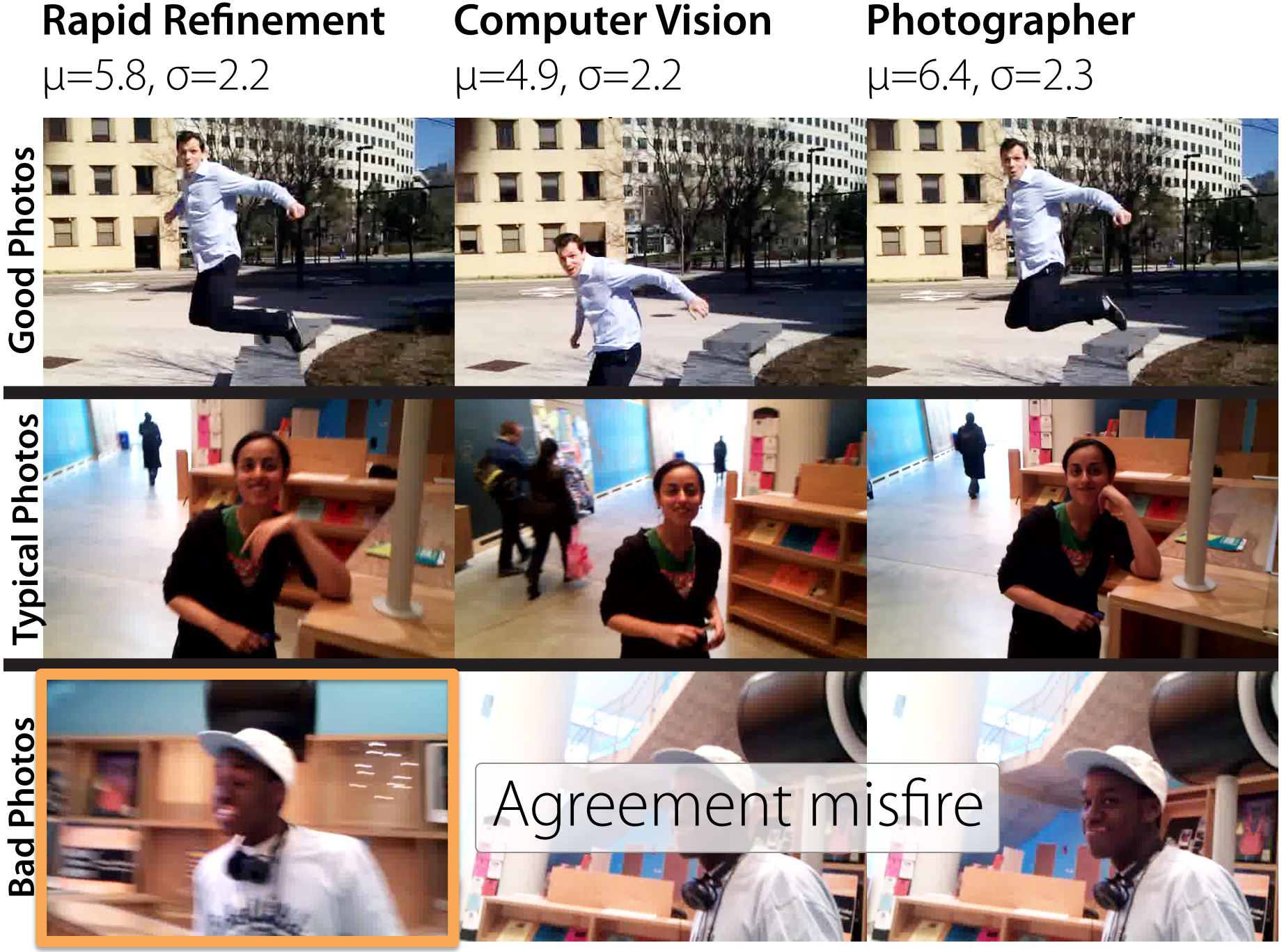
Rapid Refinement
μ=5.8, σ=2.2

Computer Vision
μ=4.9, σ=2.2

Photographer
μ=6.4, σ=2.3

9 point Likert scale on self-rated quality
ANOVA $p < .001$


Rapid Refinement
μ=5.8, σ=2.2
Computer Vision
μ=4.9, σ=2.2
Photographer
μ=6.4, σ=2.3
Good Photos
Typical Photos


Rapid Refinement
μ=5.8, σ=2.2
Computer Vision
μ=4.9, σ=2.2
Photographer
μ=6.4, σ=2.3
Good Photos
Typical Photos
Bad Photos
Agreement misfire

Results

Rapid Refinement Fastest, with Smallest Time Variance

Algorithm	Histogram of Execution Times N=72 photos
Rapid Refinement	 μ=12.6 sec, σ=2.2 sec 22¢
Generate One	 μ=16.3 sec, σ=9.8 sec 22¢
Generate and Vote	 μ=45.3 sec, σ=14.0 sec 53¢

ANOVA with pairwise posthoc tests $p < .05$

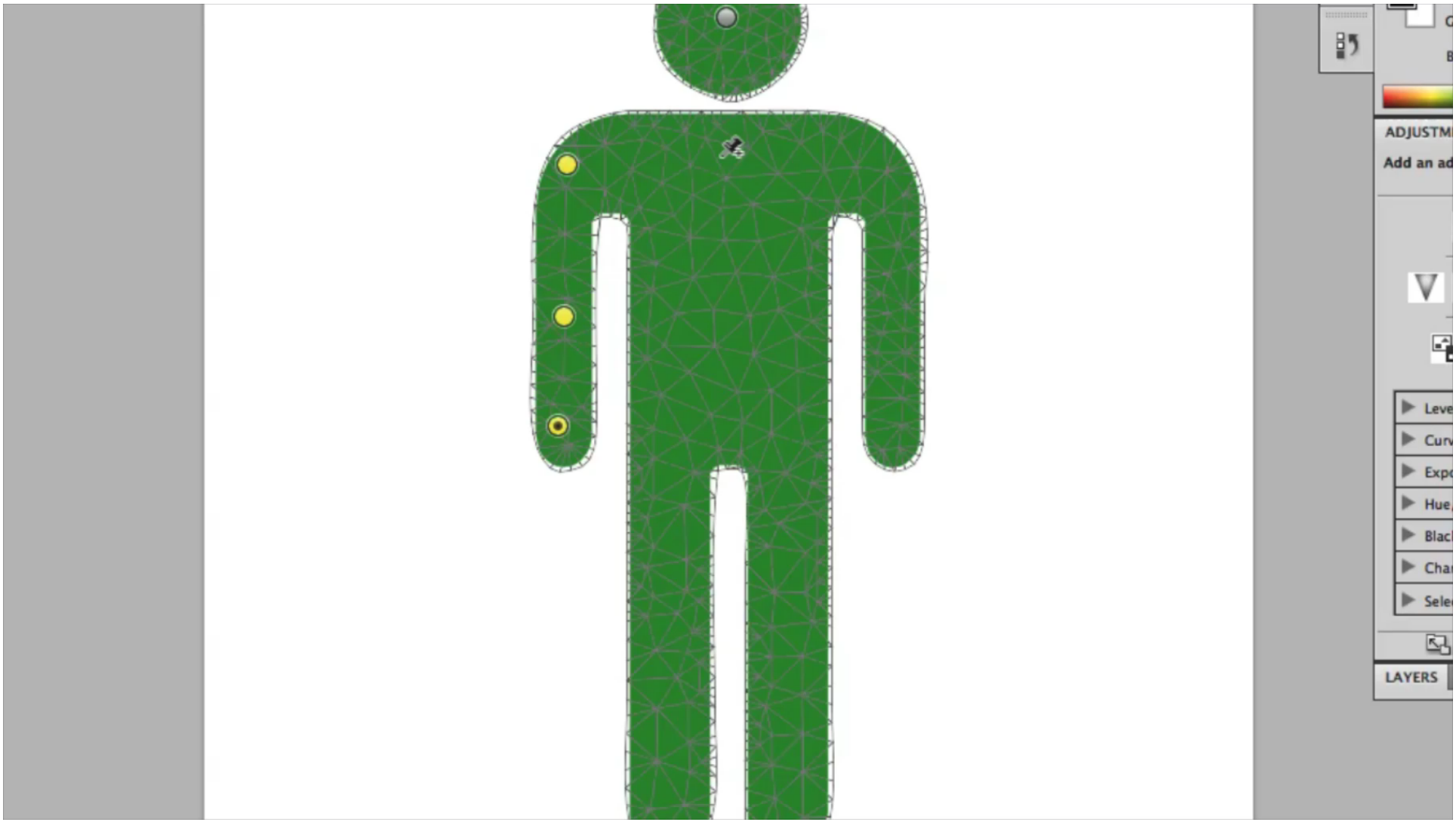
Tradeoffs in Rapid Refinement

Strengths:
- Quick preliminary results (10 sec)
- Combines work and verification

Weaknesses:
- Sacrifices quality for speed
- Stifles individual creativity

Generalizability:
- Any continuous search space
  (*e.g.*, parameter tuning)

The retainer model and rapid refinement execute large searches in roughly ten seconds.


ADJUSTM
Add an ad
LAYERS


With eight workers on retainer:
- First movement: 2.1 seconds
- First figure complete: 25.0 seconds
- New figure completed: every 3.3 seconds

Mathematical modeling to optimize realtime crowdsourcing

M. Bernstein et al. Analytic Methods for Optimizing Realtime Crowdsourcing. Collective Intelligence 2012.

Queueing Theory Model

Cast the retainer model as an *M/M/c/c* queue

Formal framework for understanding arrival and service processes with *c* servers and Poisson arrival rates

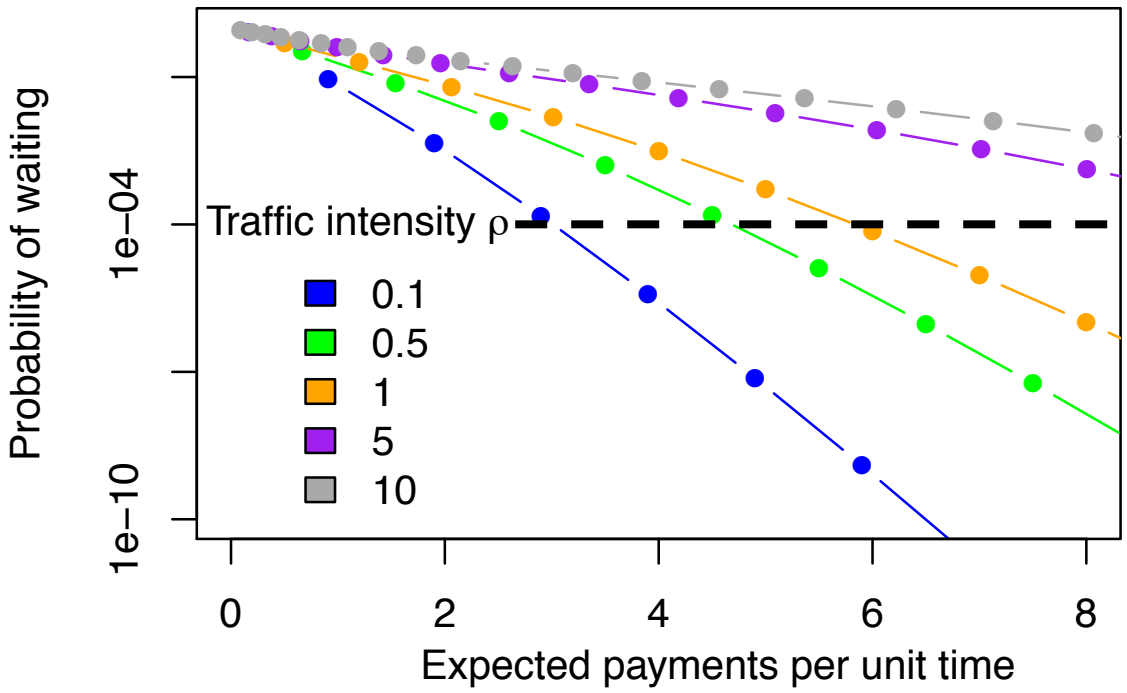
Worker recruitment rate λ, task arrival rate μ, traffic intensity $\rho = \lambda / \mu$

Probability of non-realtime service with c workers on retainer, $\pi(c)$

$$\pi(c) = \frac{\rho^c / c!}{\sum_{i=0}^{c} \rho^i / i!} \qquad \text{Cost} = c - \rho(1 - \pi(c))$$

Queueing Theory

Optimizing Realtime Crowdsourcing



Minimize c such that $\pi(c) \leq p_{max}$

Median feedback in 0.50 seconds (3x improvement)

Other benefits: globally shared retainer pool, task routing, predictive recruitment

Outline

Adrenaline

Realtime crowdsourcing

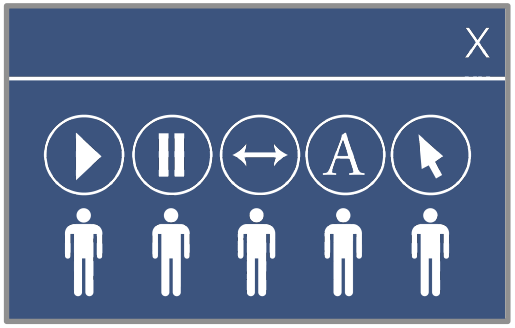
Enabling interactive crowd-powered systems

Techniques for fast, synchronous crowds:

1. Retainer Model
2. Rapid Refinement

Outline

1 Soylent



Word processor
with a crowd inside

2 Adrenaline

Realtime
crowdsourcing

Interactive systems that embed crowd intelligence

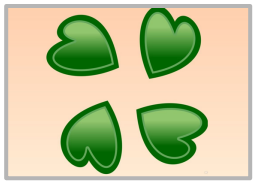
Computational techniques that produce high-quality, fast results

Social Computing Approaches

1. Pay crowds
   Microtask markets
2. Create new crowds
   Design of social computing systems
3. Mine past crowd activity
   Interactive crowd data

Designing Social Computing Systems

Friendsourcing
UIST 2009
TOCHI 2010



Anonymity & archives
ICWSM 2011
Best Paper

Social filtering
CHI 2010

Microblog rating
CSCW 2012
Best Short Paper
Honorable Mention

Create and understand new kinds of social interactions

Gather crowds that can collect information unknown to most people

Friendsourcing

Designing social applications to collect information known only to members of a social network

Collabio gathered over 29,000 tags on thousands of people

FeedMe built user models by helping route news to friends

Friendsourcing

Designing social applications to collect information known only to members of a social network

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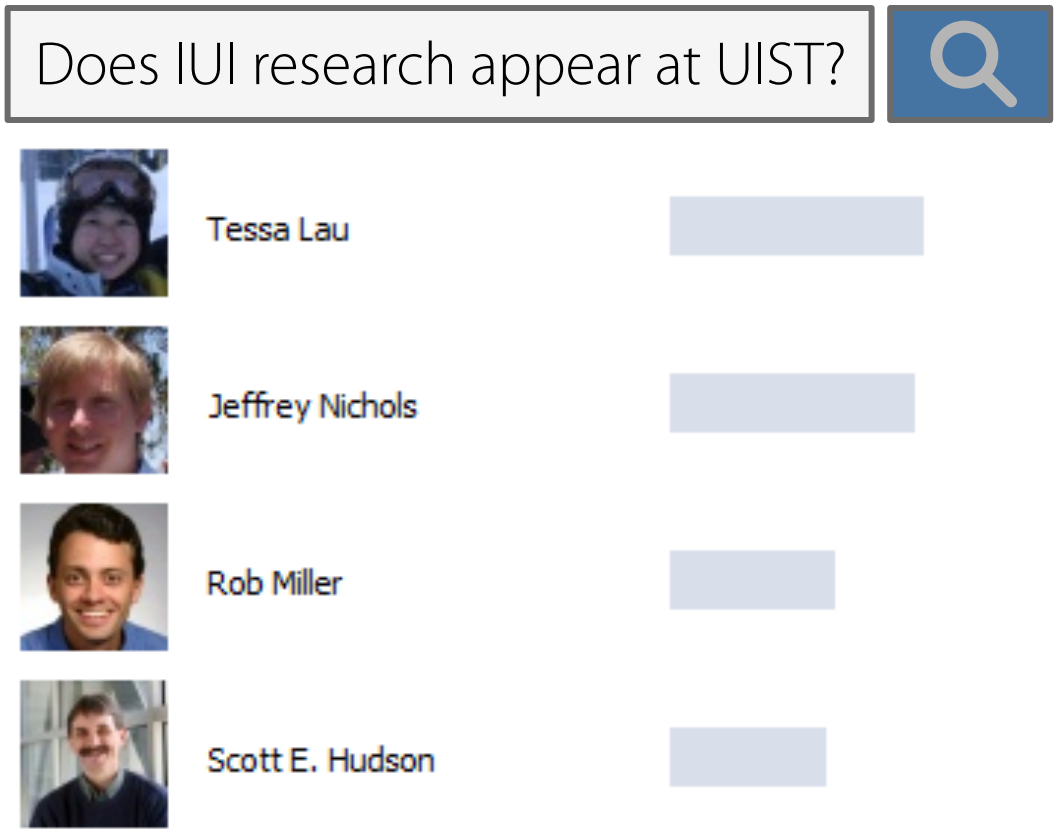


Online Anonymity and Ephemerality

4chan /b/ online community

Anonymity and ephemerality support
community dynamics that drive internet culture.

Study of 5.5 million posts

Median thread: 5 seconds on the first page
5 minutes on the entire site

Over 90% of posts are completely anonymous

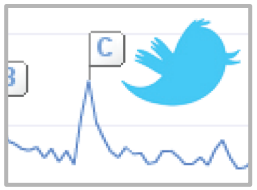
Social Computing Approaches

1. Pay crowds
   Microtask markets
2. Create new crowds
   Design of social computing systems
3. Mine past crowd activity
   Interactive crowd data

Interactive Crowd Data

Tail answers
CHI 2012
Best Paper
Honorable Mention

Microblog topic browsing
UIST 2010



Microblog timelines
CHI 2011

Crowd-powered entertainment
ACE 2011

Integrate crowd activity traces into user experiences

Aid exploration of social data

Answers: Direct Search Results

Manually constructed for popular queries

weather boston

Weather for **Boston, MA**

28°F | °C

Overcast

Wind: S at 14 mph

Humidity: 41%

Mon	Tue	Wed	Thu
			
32° 29°	47° 34°	36° 14°	31° 25°

Detailed forecast: The Weather Channel - Weather Underground - AccuWeather

Boston, MA **weather | Boston**.com

www.**boston**.com/**weather**/

Complete **weather** for **Boston**, Massachusetts, and the world.

Extended forecast for Boston - Late-season storm has a wallop - Blizzard of '78? - 10

Boston Weather Forecast and Conditions

www.**weather**.com/**weather**/today/**Boston**+MA+USMA0046

Boston weather forecast and **weather** conditions. Today's **Boston weather** plus a 36

Prevalence of Unpopular Searches

Limited resources mean that search engines cannot directly answer:

molasses substitutes 

increase volume windows xp 

dissolvable stitches speed 

dog body temperature 

CHI 2013 deadline 

•
•
•

Tail Answers

Direct results for queries in the long tail

molasses substitutes

Substitute for molasses

Replace one cup of molasses with one of the following: 1 cup dark corn syrup, honey or maple syrup; 3/4 cup firmly packed brown sugar or 3/4 cup granulated sugar, plus 1/4 cup water.

Source: http://frugalliving.about.com/od/makeyour/qt/Molasses/Sub.htm

Molasses Substitute Recipe

frugalliving.about.com/od/.../qt/**Molasses**_Sub.htm

Note: These **substitutions** may alter the taste of your recipe a bit. If the **molasses** flavor is vital to the success of your recipe, try the brown sugar **substitute**.

Molasses Substitutions, Measures, Tips and Cooking Hints

homecooking.about.com/od/specificfood/a/**molasses**tips.htm

Green Apple Calories

There are approximately 35 calories in a green apple.

Source: http://www.livestrong.com/thedailyplate/nutrition-

Inventor of First Light Bulb

The first electric light was made in 1800 by Humphry Davy, an English scientist. He experimented with electricity and invented an electric battery. When he connected wires to his battery and a piece of carbon, the carbon glowed, producing light. This is called an electric arc.

Source: http://www.enchantedlearning.com/inventors/edison/lightbulb.shtml

Substitute for molasses

Replace one cup of molasses with one of the following: 1 cup dark corn syrup, honey or maple syrup; 3/4 cup firmly packed brown sugar or 3/4 cup granulated sugar, plus 1/4 cup water.

Source: http://frugalliving.about.com/od/makeyour/qt/Molasses/Sub.htm

Disovalble Stitches

It typically takes at minimum one week for the suture to dissolve, i.e. be absorbed by the body.

Source: http://answers.yahoo.com/question/index?

How to Mute Audio on Windows Movie Maker

On the Audio or Audio/Music track of the timeline, click the audio clip that you want to mute. To select multiple clips, press and hold down the CTRL key as you click clips. Click Clip, point to Audio, and then click Mute.

Source: http://windows.microsoft.com/en-US/windows-vista/Adjusting-audio-

IRS Milage

The IRS allows reimbursement for business miles driven at a rate of for 51 cents per mile.

Source: http://www.irs.gov/newsroom/article/0,,id=232017,00.html

How to Turn Up Volume on Your Computer

Start>All Programs>Accessories>Entertainment>Volume Control>Wave Setting. Increse it and the Volume should go higher.

Source: http://answers.yahoo.com/question/index?

Fish Frying Temperature

350 degrees for 3 minutes is the ticket! Also, make sure to put just enough fillets in the basket to cover the bottom of it.

Source: http://www.walleyecentral.com/forums/showthread.php?t=146552

Area Code 407

Area code 407 is the area code for the Orlando metro area including all of Orange, Osceola, and Seminole counties, as well as small portions of Volusia and Lake counties.

Source: http://en.wikipedia.org/wiki/Area_code_407

Ireland Currency

Euro (EUR)

Source: http://wwp.greenwichmeantime.com/time-zone/europe/european-

New York City Sales Tax 2010

New York City sales tax rate is 8.875%

Source: http://ny.rand.org/stats/govtfin/salestax.html

Crowd Data in Tail Answers

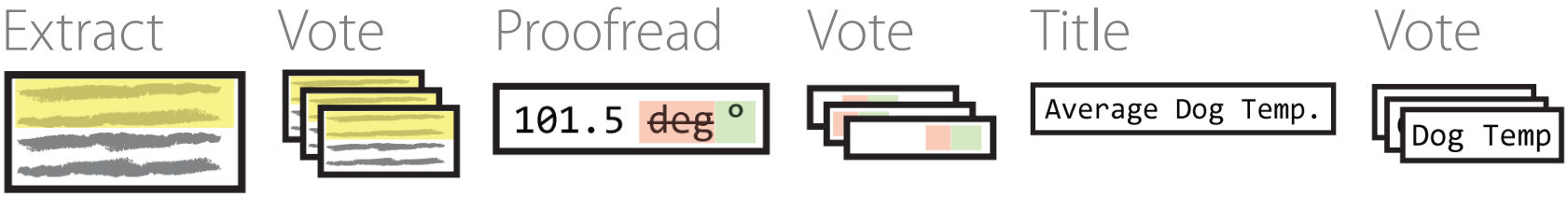
75 million search trails, 13 million URLs

Destination probability

P(URL ends trail | URL in trail)

Question word queries

Paid crowds for extraction and authoring



Social Computing Approaches

1. Pay crowds
   Microtask markets
2. Create new crowds
   Design of social computing systems
3. Mine past crowd activity
   Interactive crowd data

Integrate social and crowd intelligence as core parts of interaction, software, and computation.

Research Agenda

Crowds training machine learning systems, machine learning systems aiding crowds

Combine machine and social intelligence to complete complex, high-level tasks

The Future of Crowd Work

Cyber-Taylorism and the crowd worker as API call

- Embed human-human contract ethics
- Expected wages and living wages

Future of education, reputation, and promotion

- Would you be proud of your own child if they decided to do full-time crowd work?

How would you design a crowd work platform?

N. Kittur, J. Nickerson, M. Bernstein, et al. The Future of Crowd Work. CSCW 2013.

Meanwhile…

Adoption of Find-Fix-Verify

Image segmentation [Noronha et al. 2011]
Map labeling [Stranders et al. 2011]
Formal crowd languages [Minder et al. 2011]

The rise of crowd-powered systems

VizWiz, Legion, Turkomatic, MonoTrans, CrowdDB, Qurk, Deco, Appsheet, Shepherd, TaskGenie, Platemate, CollabMap, CrowdSight

Crowd-powered systems enable experiences that neither crowd nor machine intelligence can support alone.

Computation will be critical to the wisdom of crowds.

Collaborators

Faculty and researchers

Rob Miller and David Karger

Björn Hartmann, Desney Tan, Eric Horvitz, Greg Little, Joel Brandt, Katrina Panovich, Mark Ackerman, Mary Czerwinski

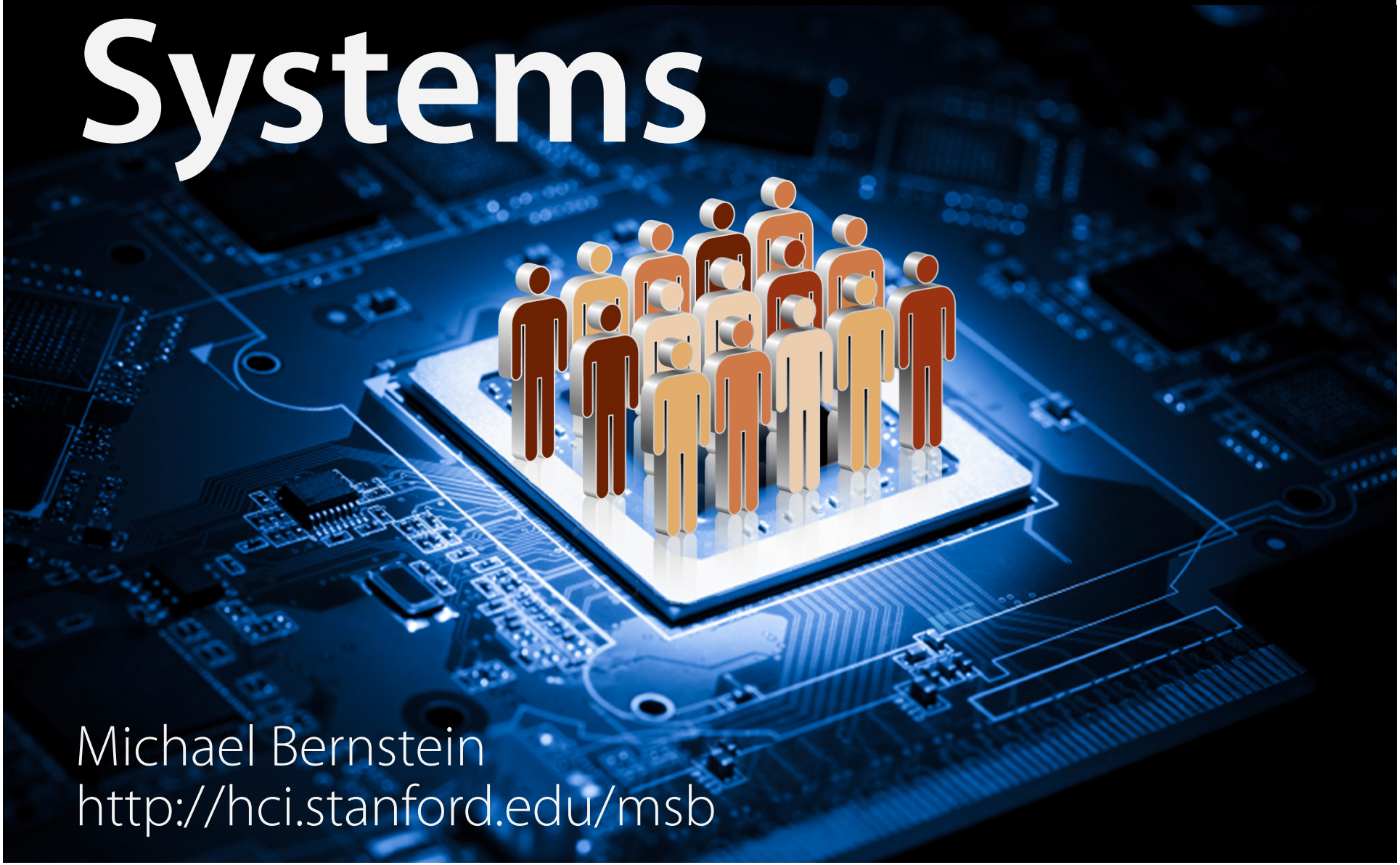
Students

Nicolas Kokkalis, David Crowell, Kavya Joshi

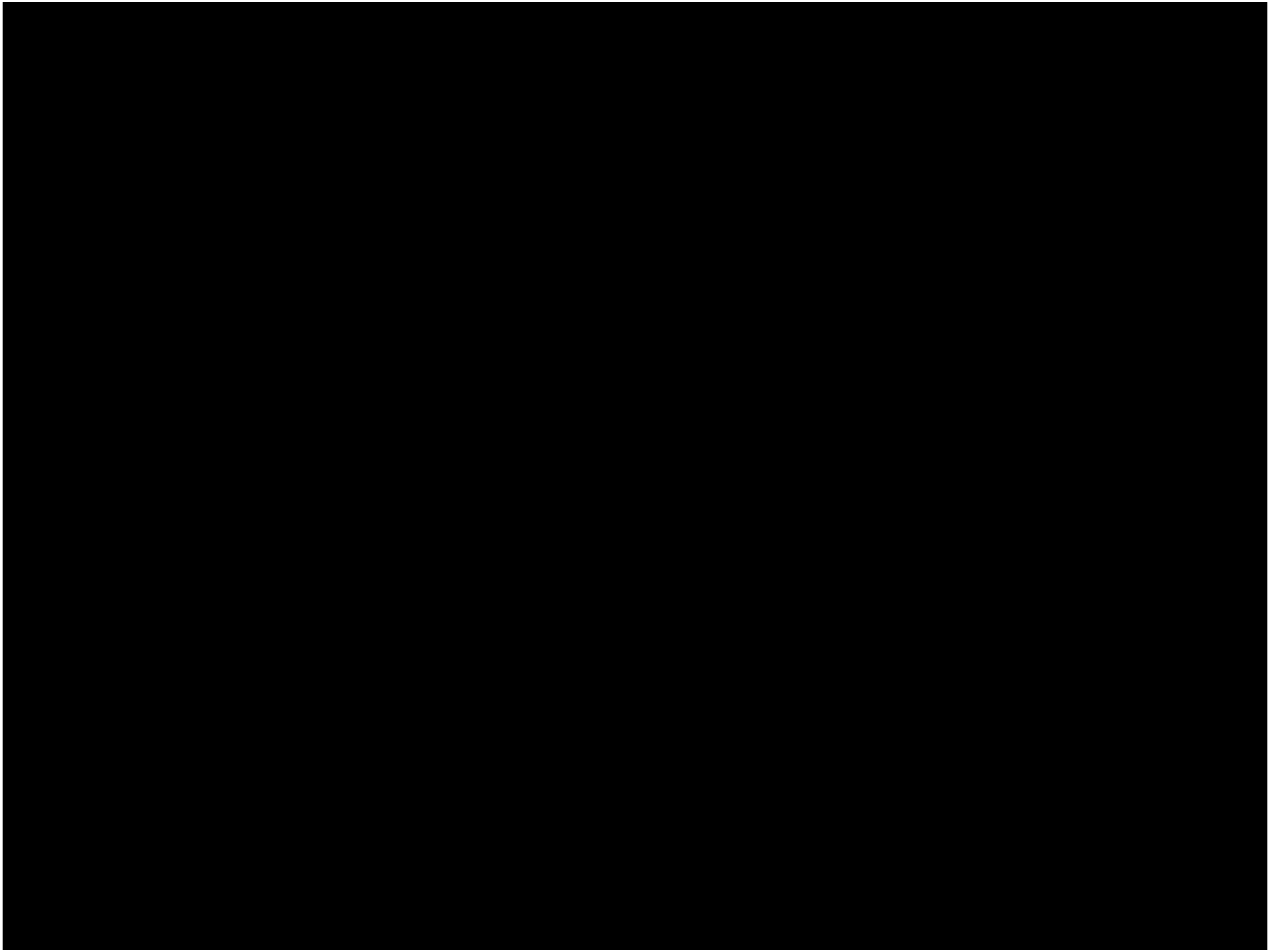
Image Credit

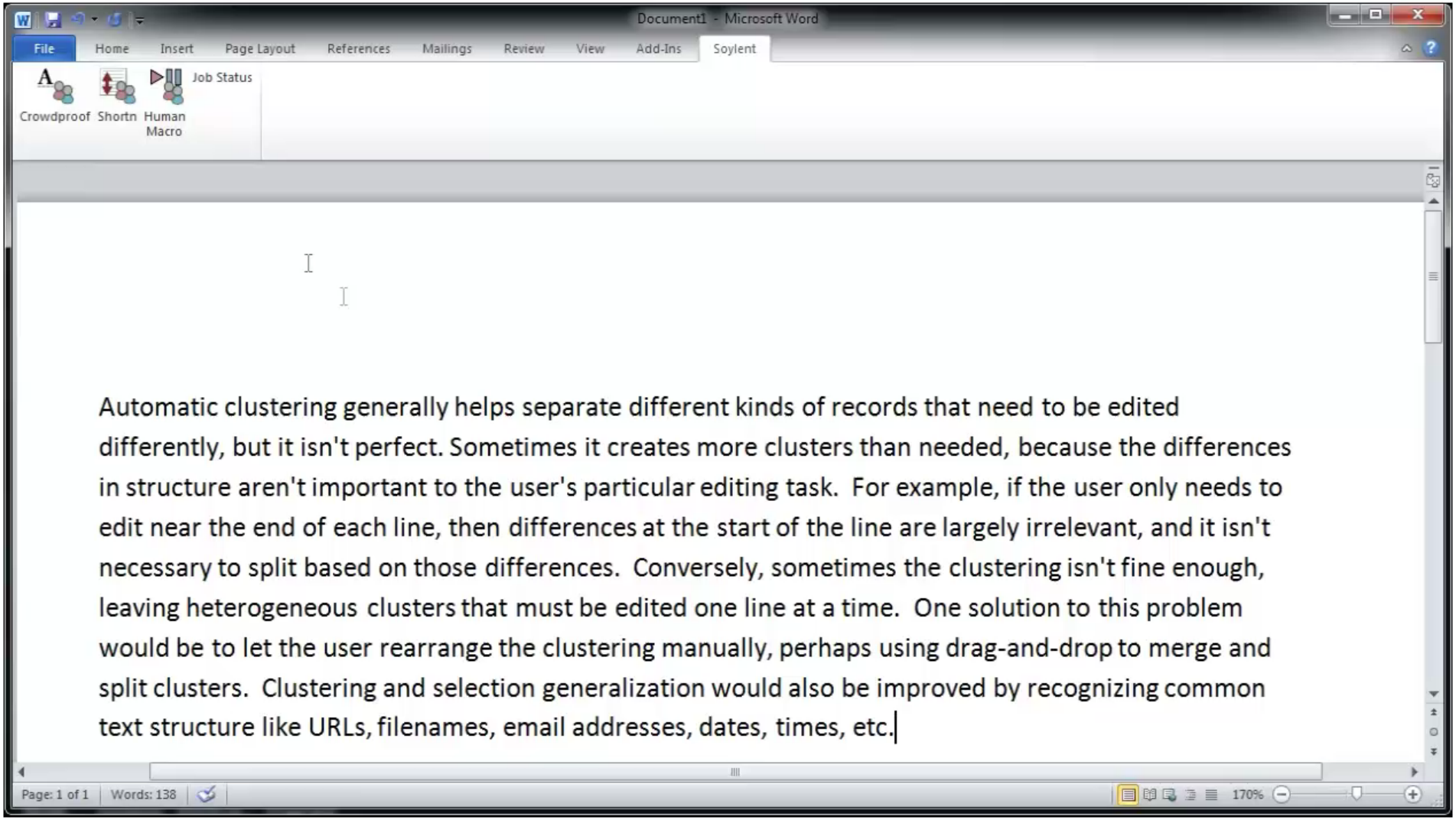
Christine Daniloff (MIT News Office), Creative Commons: auntiep, jeffwilcox, jmpk, ebriel, jwl, takuhitosotome, d!zzy

Crowd-Powered Systems

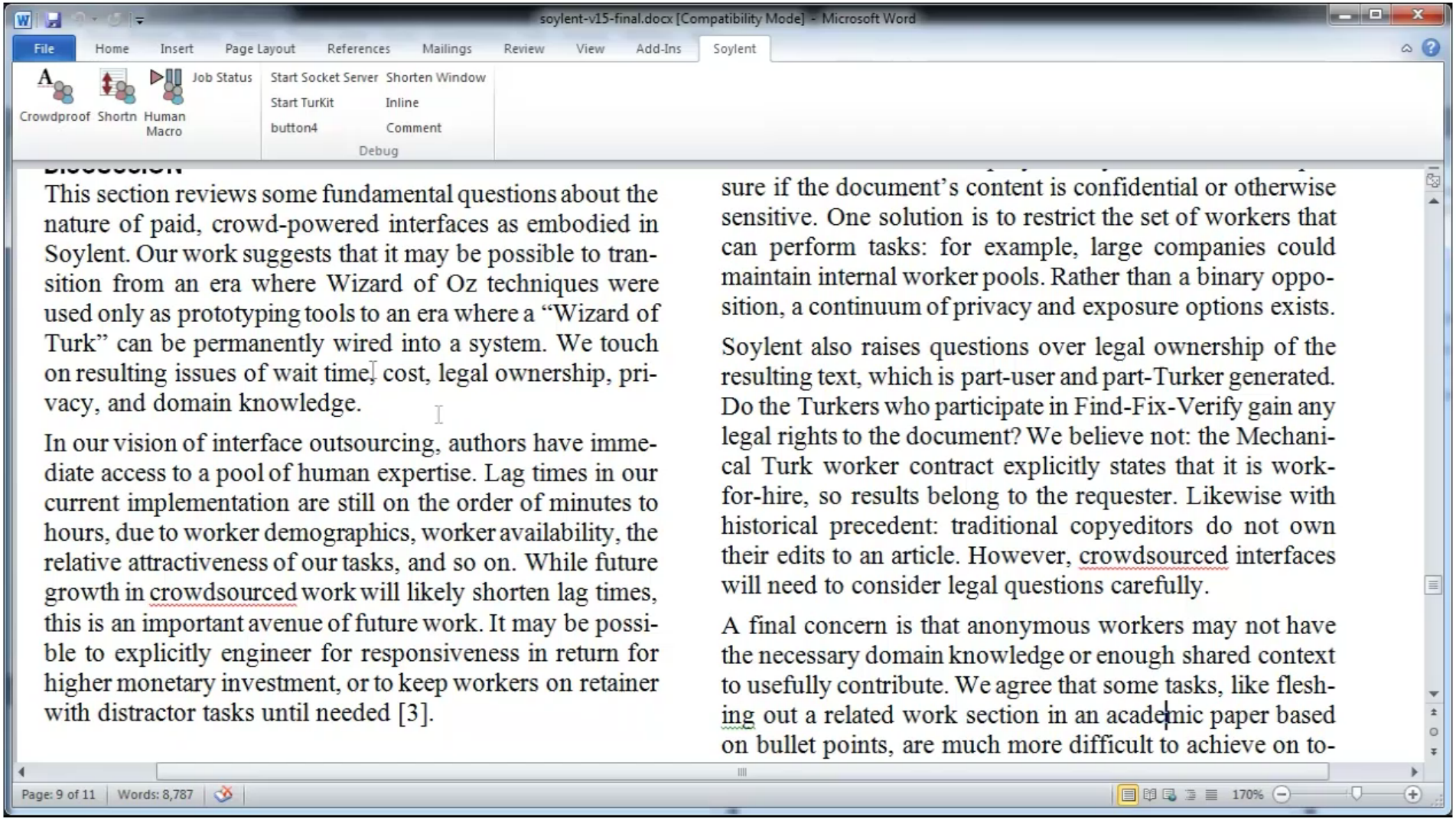


Michael Bernstein
http://hci.stanford.edu/msb



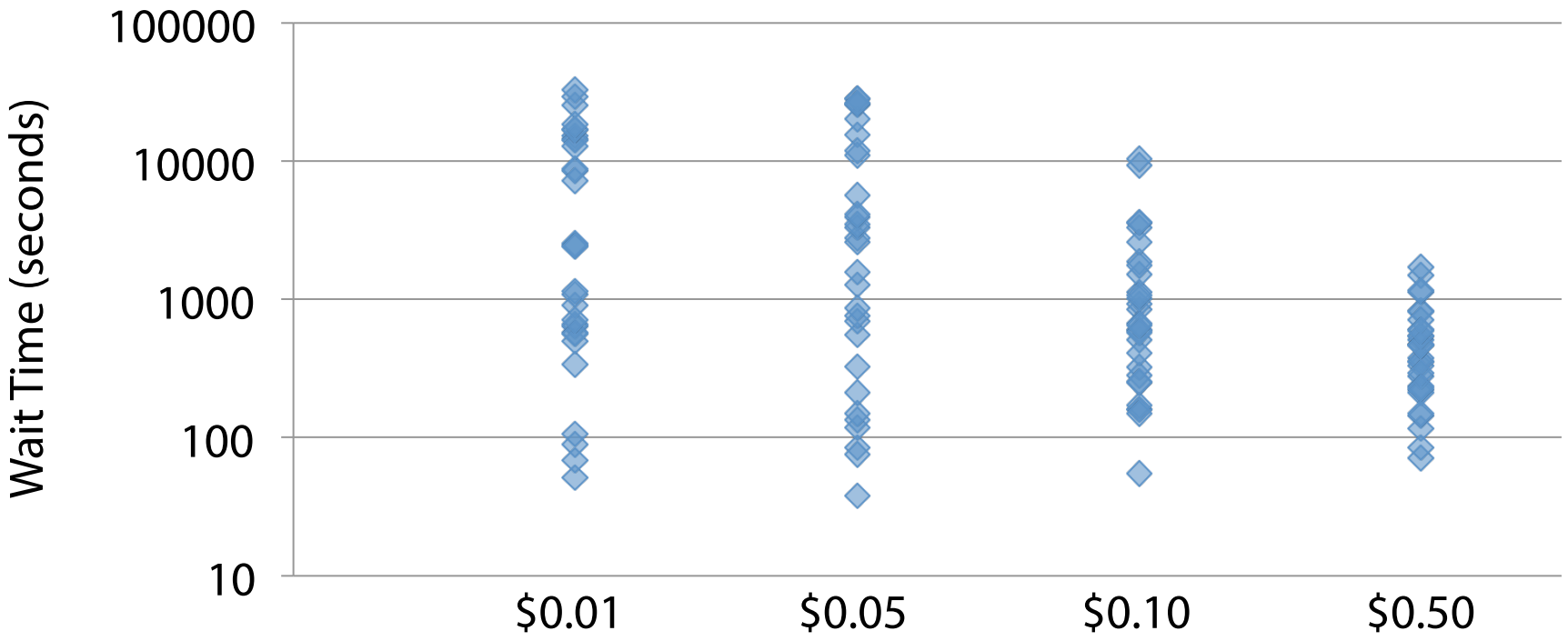

Document1 - Microsoft Word
File
Home
Insert
Page Layout
References
Mailings
Review
View
Add-Ins
Soylent
Crowdproof
Shortn
Human Macro
Job Status
Automatic clustering generally helps separate different kinds of records that need to be edited differently, but it isn't perfect. Sometimes it creates more clusters than needed, because the differences in structure aren't important to the user's particular editing task. For example, if the user only needs to edit near the end of each line, then differences at the start of the line are largely irrelevant, and it isn't necessary to split based on those differences. Conversely, sometimes the clustering isn't fine enough, leaving heterogeneous clusters that must be edited one line at a time. One solution to this problem would be to let the user rearrange the clustering manually, perhaps using drag-and-drop to merge and split clusters. Clustering and selection generalization would also be improved by recognizing common text structure like URLs, filenames, email addresses, dates, times, etc.
Page: 1 of 1
Words: 138
170%

e GUIs made using computers be more intuitive and easier to learn, it didn't let
computers efficiently. Masses only can use the software developed by softwa
ess they know how to write programs. In other words, if one who knows noth
eeds to click through 100 buttons to complete her job everyday, the only thing
click through those buttons by hand every time. But if she happens to be a cor
here is a little chance that she can write a program to automate everything. W
nce? In fact, each GUI application is a big black box, which usually have no out


soylent-v15-final.docx [Compatibility Mode] - Microsoft Word
File
Home
Insert
Page Layout
References
Mailings
Review
View
Add-Ins
Soylent
Crowdproof
Shortn
Human Macro
Job Status
Start Socket Server
Start TurKit
button4
Shorten Window
Inline
Comment
Debug
DISCUSSION
This section reviews some fundamental questions about the nature of paid, crowd-powered interfaces as embodied in Soylent. Our work suggests that it may be possible to transition from an era where Wizard of Oz techniques were used only as prototyping tools to an era where a "Wizard of Turk" can be permanently wired into a system. We touch on resulting issues of wait time, cost, legal ownership, privacy, and domain knowledge.
In our vision of interface outsourcing, authors have immediate access to a pool of human expertise. Lag times in our current implementation are still on the order of minutes to hours, due to worker demographics, worker availability, the relative attractiveness of our tasks, and so on. While future growth in crowdsourced work will likely shorten lag times, this is an important avenue of future work. It may be possible to explicitly engineer for responsiveness in return for higher monetary investment, or to keep workers on retainer with distractor tasks until needed [3].
sure if the document's content is confidential or otherwise sensitive. One solution is to restrict the set of workers that can perform tasks: for example, large companies could maintain internal worker pools. Rather than a binary opposition, a continuum of privacy and exposure options exists.
Soylent also raises questions over legal ownership of the resulting text, which is part-user and part-Turker generated. Do the Turkers who participate in Find-Fix-Verify gain any legal rights to the document? We believe not: the Mechanical Turk worker contract explicitly states that it is work-for-hire, so results belong to the requester. Likewise with historical precedent: traditional copyeditors do not own their edits to an article. However, crowdsourced interfaces will need to consider legal questions carefully.
A final concern is that anonymous workers may not have the necessary domain knowledge or enough shared context to usefully contribute. We agree that some tasks, like fleshing out a related work section in an academic paper based on bullet points, are much more difficult to achieve on to-
Page: 9 of 11
Words: 8,787
170%

Effect of Price on Wait Time

Paying more had no effect on early arrivals,
but sped up the latecomers



Results: Cost

$0.08 per Find, $0.05 per Fix, and $0.04 per Verify

Average paragraph cost $1.41 to Shortn:

- $0.55 to Find an average of two patches
- $0.48 to Fix each patch
- $0.38 to Verify each patch

Lower bound with $0.01 per task:

- $0.30 per paragraph

Retainer Experiment

1545 tasks from 280 workers

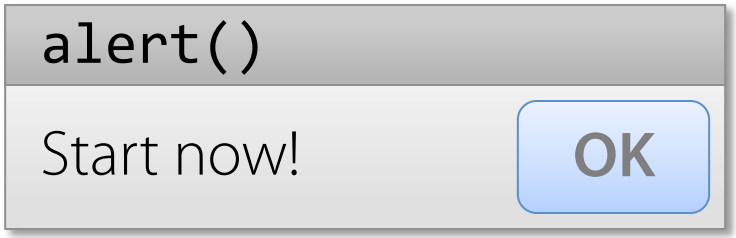
He leapt the fence and dashed toward the door.

Manipulate retainer time:

{0.5, 1, 2, 5, 10, 30} minutes

Sample wait time from [0, retainer time]

Measure: time to dismiss the alert



Retainer Design Experiment

Four designs:

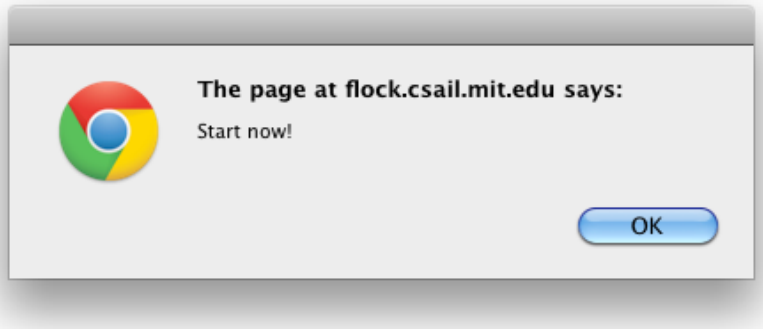
1 Baseline
(no alert)

Retainer Design Experiment

Four designs:

1. Baseline (no alert)
2. Alert

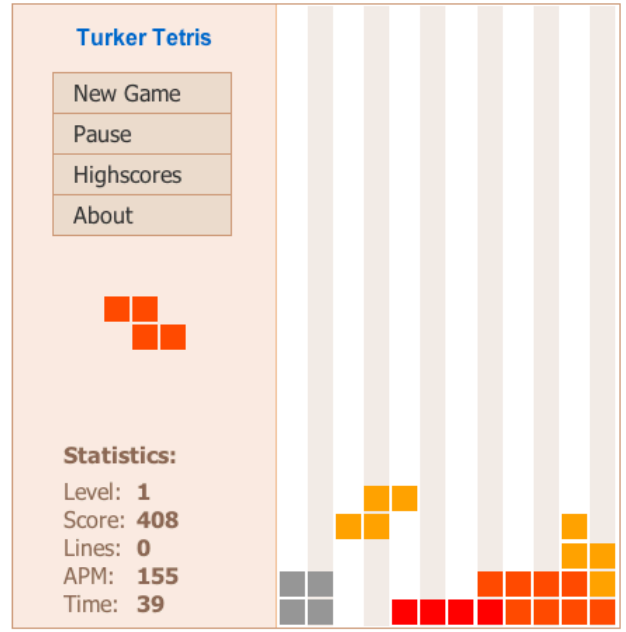
```
playAudio("alert_chime.mp3");
alert("Start now!");
```

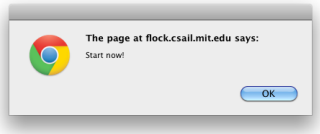


Retainer Design Experiment

Four designs:

1. Baseline (no alert)
2. Alert
3. Game



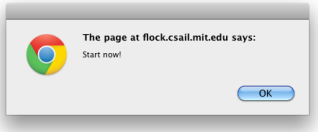


Retainer Design Experiment

Four designs:

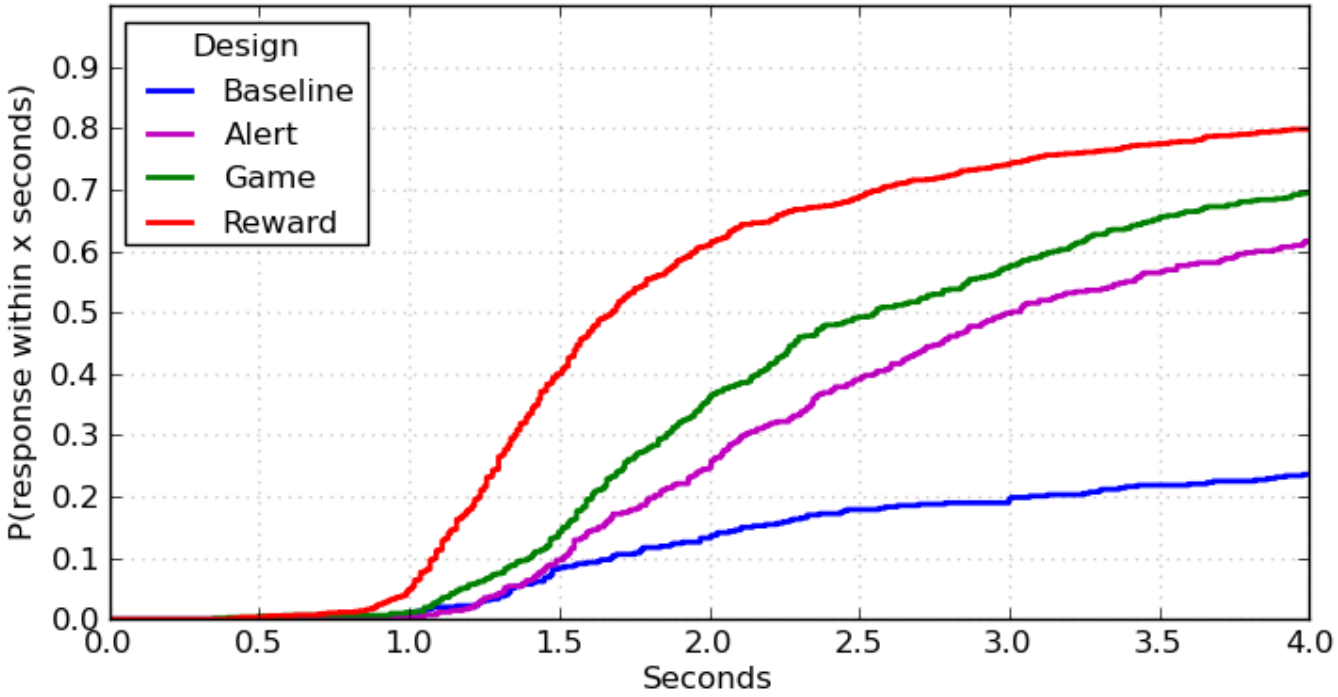
1. Baseline (no alert)
2. Alert
3. Game
4. Reward

3¢ bonus for dismissing the alert within 2 seconds



Between subjects, N=1913 tasks

Retainer Time Results



Results: Quality

Rapid Refinement had lower variance
than Generate-One.
(σ=2.2 vs. σ=2.6 on a 9-point Likert scale)

Generate-and-Vote matches the professional
photographer.
(μ=6.6 vs. μ=6.4)

Cost:
- Rapid Refinement and Generate-One: 22¢
- Generate-and-Vote: 53¢

Results: Delay