

NETS 213: CROWDSOURCING
AND HUMAN COMPUTATION

An Analytic Framework for Human Computation

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Classification System for Human Computation

- Motivation
- Quality Control
- Aggregation
- Human Skill
- Process Order
- Task-request Cardinality

Motivation

- How can we motivate people to participate?
- Even with a low barrier to entry (anyone with a computer can contribute) we still need to make a case **why** they should contribute.

Motivation: Pay

- Easiest way to recruit workers.
- Downside: provides incentive to cheat
- Problem might be exacerbated when the crowd workers are anonymous
- MTurk uses micropayments
- Online temping services provide higher wages: LiveOps, ODesk, etc
- CrowdFlower tried non-monetary payments (virtual goods and currencies, SwagBucks)

Motivation: Altruism

- People want to do good
- When Jim Gray went missing, volunteers searched 500k satellite images
- After the Haitian earthquake, diaspora translated 1000 messages per day

LAYERS

Haiti 4636 Volunteers

message count



Eske lekol kolej marie anne kraze?mesi	Was the College Marie Anne school destroyed? Thank you.
Nou pa ka anpeche moustik yo mo`de nou paske yo anpil.	We can't prevent the mosquitoes from biting because there are so many.
tanpri ke`m ap kase mwen pa ka pran nouvel manmanm.	Please heart is breaking because I have no news of my mother.
4636:OpitalMedesensanFwontie`delmas19I afe`men. Opital sen lwi gonzag nan delma 33 pran an chaj gratwit- man tout moun ki malad ou blese	4636: The Doctors without Borders Hospital in Delmas 19 is closed. The Saint Louis Gonzaga hospital in Delmas 33 is taking in sick and wounded people for free

Motivation: Reputation

- Sometimes people will contribute in order to build their profile within a community
- Example: stackoverflow

Users

reputation

new users

voters

editors

moderators

week

month

quarter

year

all

Type to find users: 

Gordon Linoff
New York, United States
1,260
sql, mysql, sql-server



Sotirios Delimanolis
1,020
java, spring, spring-mvc



Arun P Johny
Bangalore, India
960
jquery, javascript, html



CommonsWare
Over Here!
945
android, java, android-intent



Jon Skeet
Reading, United Kingdom
915
c#, java, .net



Hans Passant
Madison, WI
905
c#, .net, winforms



Martijn Pieters
Cambridge, United Kingdom
880
python, python-2.7, list



MarcinJuraszek
Radzionków, Poland
870
c#, linq, .net



alecx
Russia
870
python, django, scrapy



BalusC
Willemstad, Curaçao
855
java, jsf, jsf-2



dasblinkenlight
United States
825
c#, c++, java



konsolebox
825
bash, linux, shell



falsetru
Seoul, South Korea
800
python, regex, ruby



VonC
France
780
git, eclipse, java



arshajii
Boston, MA
777
java, python, string



Peter Lawrey
Surrey, UK
773
java, multithreading, performance



Marc Gravell ♦
Forest of Dean, UK
750
c#, .net, linq



No Idea For Name
Israel
745
c#, java, winforms



Darin Dimitrov
Sofia, Bulgaria
735
c#, asp.net-mvc, asp.net-mvc-



Roman Pekar
Moscow, Russia
720
sql, sql-server, tsql

Motivation: Enjoyment

- Games with a purpose is a strategy to try to make a task fun
- In the ESP game two players look at an image and try to guess what words the other is thinking
- In doing so they label images on the web

score
100

 **ESP Game**
Concentrate...

time
2:21

What do you see?

taboo words

peace

lay



guesses

sheeps...

sheep

+ submit

→ pass



Create a profile

Support

Choose your path!

Beginners start at Basics 1.
Advanced learners take a short test.



Basics 1

OR



Placement test



Spanish progress



1

2

0

XP

W

0 Words

Create a profile to save your
progress!

[Create a profile](#)[Log in](#)

Phrases 0/3

Basics 2 0/4



Food 0/5



Animals 0/4



Plurals 0/1



Follow Duolingo



90k



300k



g+ 70k



Luis Von Ahn

==

Tom Sawyer



Tom Sawyer (Whitewashing the Fence), 1936

Motivation: Implicit Work

- It is sometimes possible to make people do work alongside some other task

The Norwich line steamboat train, from New-London for Boston, this morning ran off the track seven miles north of New-London.

morning

morning overtook

Type the two words:



groups.google.com

11 matches < > Q staff Done

Google Search for members

Groups

NETS 213 Course ...

Please use this feature carefully. Only add people you know.

Enter email addresses to add as members

Yoni Nachmany <yoninachmany@gmail.com>, Jie Gao <jie.gao@seas.upenn.edu>

Separate email addresses with commas. Each person will immediately receive an invitation.

Write a welcome message

Welcome to the NETS 213 staff mailing list!

Email subscription options

No email: web-only participation

Abridged Email: one summary email

Digest Email: up to 25 full new messages per day

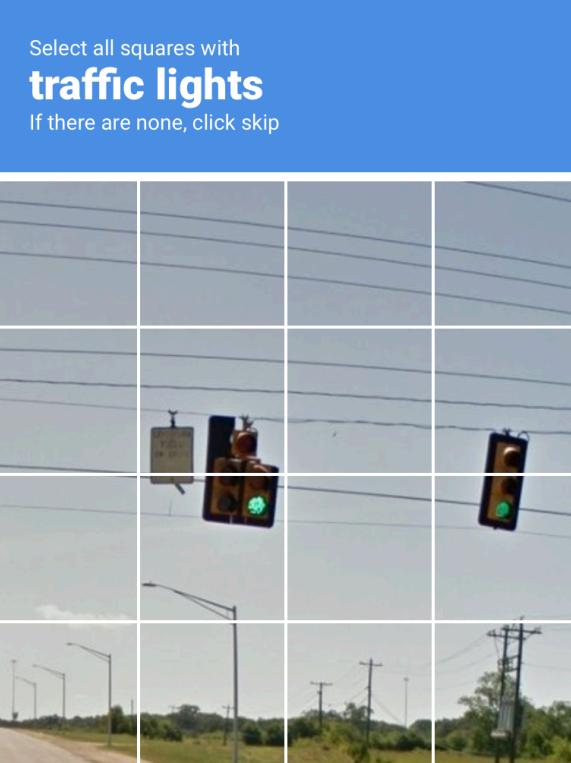
All Email: send each message as it arrives

Select all squares with traffic lights
If there are none, click skip

ma@seas.upenn.edu>

957 characters remaining

SKIP



groups.google.com

11 matches < > Q staff Done

Google Search for members

Groups Add

NETS 213 Course ...

Please use this feature carefully. Only add people you know.

Enter email addresses to add as members

Yoni Nachmany <yoninachmany@gmail.com>, Jie Gao <jie...

Separate email addresses with commas. Each person will immedi...

Write a welcome message

Welcome to the NETS 213 staff mailing list!

Select all squares with traffic lights

If there are none, click skip

Email subscription options

No email: web-only participation

Abridged Email: one summary email

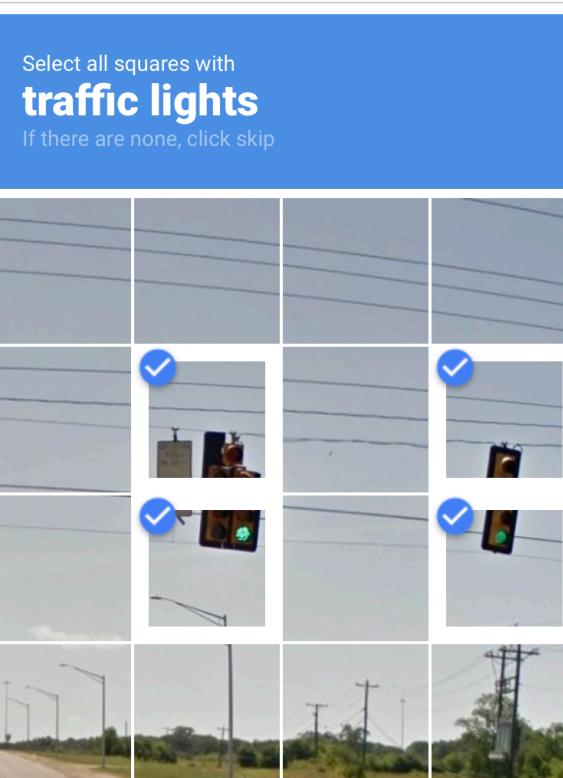
Digest Email: up to 25 full new messages

All Email: send each message as it arrives

Contin...

957 characters remaining

C N E i NEXT



ma@seas.upenn.edu>

groups.google.com

11 matches < > Q~ staff x Done

Google Search for members

Groups Add

NETS 213 Course ...

Please use this feature carefully. Only add people you know. Using this feature for sending unwanted email can result in account deactivation.

Enter email addresses to add as members

Yoni Nachmany <yoninachmany@gmail.com>, Jie Gao <jiegao@seas.upenn.edu>, Paul Zuo <pzuo@seas.upenn.edu>, Danni Ma <dannima@seas.upenn.edu>

Separate email addresses with commas. Each person will immediately become a member and can start receiving messages.

Write a welcome message

Welcome to the NETS 213 staff mailing list!

I'm not a robot

reCAPTCHA Privacy - Terms

Continue

957 characters remaining

Members

- All members
- Invite members
- Direct add memb...
- Outstanding invites
- Join requests

Messages

Settings

Permissions

Roles

Information

Motivation

- Pay
- Altruism
- Reputation
- Enjoyment
- Implicit Work
- **Can you think of others?**

Quality Control

Even if people are motivated to participate, how do we know that they are doing work conscientiously?

Can we trust them not to cheat or sabotage the system?

Even if they are acting in good faith, how do we know that they're doing things right?

Quality Control: Reputation Check

- Mechanical Turk uses a reputation system
- When a Turker submits poor work, Requesters reject it
- The Turker's approval rate is displayed to all other Requesters

QC: Agreement and Redundancy

- The ESP game uses the labels that two players independently agree on
- Similar technique is often used in MTurk, when each item is done independently
- Redundancy allows a voting on ambiguous answers / opinions
- It is also helpful for identifying workers who are consistently divergent

QC: Gold Standard

- In MTurk we commonly mix in questions with a known answer alongside new questions
- This is similar to agreement, but now we check agreement against experts or trusted workers
- For multiple choice questions, gold standard allows for automatic grading

QC: Second-pass review

- Do second-pass grading when gold standard don't allow automatic grading
- Often times the second-pass HIT can be automatically gradable
- This makes the whole pipeline fully automated and ensures high quality



Heather Locklear Arrested for driving under the influence of drugs



Heather Locklear
Photo by: Santa Barbara County Sheriff's Department

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A DULL LIFE

The actress Heather Locklear, Amanda of the popular series Melrose Place, was arrested this weekend in Santa Barbara (California) after driving under the influence of drugs. A witness viewed her performing inappropriate maneuvers while trying to take her car out from parking in Montecito, as revealed to People magazine by a spokesman for the California Highway Police. The witness stated that around 4.30pm on Saturday, Locklear "hit the accelerator violently, making excessive noise while trying to take her car out from the parking with abrupt and forth maneuvers. While reversing, she passed several times in front of his sunglasses." Shortly after, the witness, who for the first time, apparently had not recognized the actress, saw her



• Why was Heather Locklear arrested?

- ▶ She was arrested on suspicion of driving under the influence of drugs.

Driving under the influence

Driving while medicated

DUI

Driving while using drugs

Medikamentes

QC: Defensive task design

- Try to design tasks so that they are nearly as hard to cheat as they are to complete
- For my translation HITs, people frequently would paste text into Google Translate
- I converted the text into images, then people had to transcribe it.

QC: Statistical models

- Sometimes it is possible to have prior knowledge about what the range of expected answers should be
- Use your statistical knowledge to throw out outliers

QC: Economic incentives

- When money is the motivator, it may be possible to use different incentive structures to illicit better results
- Pay people more when they reach a certain level of mastery, or when their output passes second pass reviews
- CastingWords uses bonuses to do this

[All HITs](#) | [HITs Available To You](#) | [HITs Assigned To You](#)

Find **HITs** containing **castingwords** that pay at least \$ **0.00** for which you are qualified require Master Qualification **GO**

HITs containing 'castingwords'

1-10 of 47 Results

Sort by: Reward Amount (most first) **GO!**

Show all details | Hide all details

[1](#) [2](#) [3](#) [4](#) [5](#) > [Next](#) >> [Last](#)

Express Transcription: Frank King X-ray #159143 (195% premium) (avg rwd+bsn: \$7.60) [13:00 mmss]			Not Qualified to work on this HIT (Why?) View a HIT in this group	
Requester: CastingWords	HIT Expiration Date: Sep 11, 2013 (56 minutes 15 seconds)	Reward: \$3.80		
	Time Allotted: 4 hours 30 minutes	HITs Available: 1		
Express Transcription: Easy #159160 (avg rwd+bsn: \$6.3) [21:00 mmss]			Not Qualified to work on this HIT (Why?) View a HIT in this group	
Requester: CastingWords	HIT Expiration Date: Sep 11, 2013 (3 hours 58 minutes)	Reward: \$3.15		
	Time Allotted: 5 hours 30 minutes	HITs Available: 1		
Express Transcription: Frank King X-ray #159143 (195% premium) (avg rwd+bsn: \$4.68) [08:00 mmss]			Not Qualified to work on this HIT (Why?) View a HIT in this group	
Requester: CastingWords	HIT Expiration Date: Sep 11, 2013 (56 minutes 13 seconds)	Reward: \$2.34		
	Time Allotted: 4 hours	HITs Available: 1		
Express Transcription: Easy #159160 (avg rwd+bsn: \$3.9) [13:00 mmss]			Not Qualified to work on this HIT (Why?) View a HIT in this group	
Requester: CastingWords	HIT Expiration Date: Sep 11, 2013 (3 hours 58 minutes)	Reward: \$1.95		
	Time Allotted: 4 hours 30 minutes	HITs Available: 1		
Express Transcription: Easy #159160 (avg rwd+bsn: \$2.4) [08:00 mmss]			Not Qualified to work on this HIT (Why?) View a HIT in this group	
Requester: CastingWords	HIT Expiration Date: Sep 11, 2013 (3 hours 58 minutes)	Reward: \$1.20		
	Time Allotted: 4 hours	HITs Available: 1		
Express Transcription: Easy #159160 (avg rwd+bsn: \$1.5) [05:00 mmss]			Not Qualified to work on this HIT (Why?) View a HIT in this group	
Requester: CastingWords	HIT Expiration Date: Sep 11, 2013 (3 hours 58 minutes)	Reward: \$0.75		
	Time Allotted: 4 hours	HITs Available: 1		
Express Transcription: Frank King X-ray #159143 (195% premium) (avg rwd+bsn: \$1.16) [02:00 mmss]			Not Qualified to work on this HIT (Why?) View a HIT in this group	
Requester: CastingWords	HIT Expiration Date: Sep 11, 2013 (56 minutes 9 seconds)	Reward: \$0.58		
	Time Allotted: 3 hours 30 minutes	HITs Available: 1		

Quality Control

- Reputation check
- Agreement and redundancy
- Gold standard + automatic reviewing
- Multi-level review
- Defensive task design
- Statistical filtering
- Economic incentives
- Others?

Aggregation

- Part of the process of human computation is to combine all contributions to solve a global problem.
- The class of problem may determine what strategy is best.

Aggregation: Statistical Data Processing

- In *Wisdom of Crowds*, Surowiecki argues that aggregating answers from a decentralized, disorganized group of people, all thinking independently yields more accurate answers than from individuals.
- Individual errors need to be uniformly distributed, so individual judgments must be made independently.

Aggregation: Collection

- Voting
- Prediction markets

Aggregation: Collection

- Sometimes aggregation collects discrete facts in a knowledge base
- A contribution may
 - add a new fact
 - improve quality by correcting, refuting, or confirming existing facts

Status

I have 12 answers so far.

I am thinking of a sentence

True

False

Don't know

Doesn't make sense

Engines are typically located in storage sheds.

Score: 0

Questions Answered: 0

Because I think it might be true.

Aggregation: Search

- Some human computation paradigms are simply asking people to find something in a large number of images
- Stardust@home project - people looked through images of aerogel to find dust from comet's tail gathered by spacecraft



GET STARTED

STARDUST@HOME

ABOUT

NEWS

GET STARTED

COMMUNITY

CLASSROOM

HELP

1. Finding Stardust

2. Tutorial Session

► 3. Test & Register

4. Log In & Search

Tech FAQ

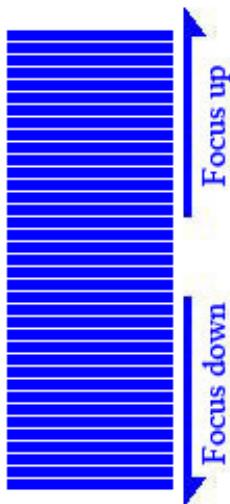
Stardust Search

Percent of images loaded: 
Images loaded for next movie: 



 100 microns

[Continue to the next movie](#) →



[Examples](#)



Aggregation: Iterative Refinement

- One person's output is shown to the next person, who is asked to improve upon it
- What would Surowiecki say? (WWSS?)

- Please transcribe as many words as you can.
- Put a * in front of words you are unsure about.

If a *festival . *two *me . *but *is

If . *two If .

*festival *festival .

Submit

Aggregation

- Wisdom of Crowds
- Collection
- Search
- Iterative improvement
- **Genetic algorithm**
- **None?**
- **Other?**

Human Skill

„Human Computation is a paradigm for utilizing human processing power to solve problems that computers cannot yet solve.“

– Luis von Ahn. Doctoral Thesis, 2005.

Human Skill

- What human skills have we seen so far?
- What others might be used for human computation tasks?

Process order

- Three roles in Human Computation: Requester, Worker, Computer
- **Requester** is the end user who benefits from the computation
- **Worker** is the person performing the task
- **Computer** only comes into play when it plays a role in solving the problem (not just aggregating results or being the information channel)

Process Order: CWR

- Computer → Worker → Requester
- In reCAPTCHA:
 - Computer first tries to perform OCR
 - Workers are presented with words that it fails to recognize
 - Their transcriptions are aggregated for the Requester (reader / library)

Process Order: WRC

- Worker → Requester → Computer
- In image labeling games:
 - Players (workers) provide labels
 - Web users (requesters) perform an image search
 - Computer searches the database of labels and presents matches

Process Order: CWRC

- Computer → Worker → Requester → Computer
 - Cyc system has inferred a lot of facts by analyzing text
 - Sends its guesses to FACTory where Workers confirm/correct facts
 - When a user (requester) queries Cyc
 - The Cyc system performs AI inference

Process Order: RW

- Requester → Worker
- Some tasks require no (non-human) computation
- Audio transcription or text dictation
- For small jobs, might not need any sophisticated computer-mediated QC

Task-Request Cardinality

- When a service is powered by human computation, many human workers may produce the result.
- Sometimes, just one or a few workers may suffice. The structure of the problem dictates the cardinality.

Task-Request Cardinality

- One-to-one: ChaCha question answering
- Many-to-many: Image labeling / search
- Many-to-one: Search for Jim Gray
- Few-to-one: VizWiz has a few people respond to each blind person's query

Opportunities for Growth in HComp

- Dimensions: Motivation, Quality Control, Aggregation, Human Skill, Process Order, Task-Request Cardinality
- Consider new pairings of dimensions
- Invent new values for dimensions
- Classify new work and consider variations