



Crowdsourcing & Crowd-AI Systems

**Dr. Ting-Hao (Kenneth) Huang
Pennsylvania State University
Guest Lecture**

February 2023



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[We are hiring at all levels! Come work with us!](#)

I combine AI with crowdsourcing to create systems that are usable, robust, and intelligent.

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Today We're Going to Talk About

1. Overview of **Crowdsourcing**
2. **High-Quality Data & How to Get Them**
3. **Crowd-AI Systems**

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What is crowdsourcing?

Crowdsourcing

From Wikipedia, the free encyclopedia

Crowdsourcing is a [sourcing model](#) in which individuals or organizations obtain [goods and services](#), including ideas and finances, from a large, relatively open and often rapidly-evolving group of [internet users](#); it [divides work between participants](#) to achieve a [cumulative result](#). The word crowdsourcing itself is a portmanteau of [crowd](#) and [outsourcing](#), and was coined in 2005.^{[1][2][3][4]} As a mode of sourcing, crowdsourcing existed prior to the digital age (i.e. "offline").^[5]

divides work



(Wikipedia@2018/02/18)

Definition of CROWDSOURCING

: the practice of [obtaining needed services, ideas, or content by soliciting contributions from a large group of people](#) and especially [from the online community](#) rather than from traditional employees or suppliers



online

(Merriam-Webster@2018/02/18)

Crowdsourcing Platforms

- **General Crowd**

- Amazon Mechanical Turk, Toloka, appen



- **Expert Crowd**

- UpWork



- **Physical Task**

- Task Rabbit



- **Citizen Science**

- Galaxy Zoo



- **Game with Purpose**

- ESP Game, Foldit



- **Wikipedia**



WIKIPEDIA
The Free Encyclopedia

Micro-task Platforms

Post Tasks



Requester



HIT Groups (1-20 of 1193)					
Requester	Title	HITS	Reward	Created	Actions
Raucous Data	Review websites for physical activity (WARNING: This HIT may contain adult conte...	30,107	\$0.02	In 6s	Preview <button>Accept & Work</button>
Scoutt	Extract purchased items from a shopping receipt	19,498	\$0.08	2m ago	Preview <button>Accept & Work</button>
ITES HI	Find products on Amazon.es	18,686	\$0.03	5d ago	Preview <button>Accept & Work</button>
Scoutt	Extract purchased items from a shopping receipt (3-5 items)	17,178	\$0.03	12m ago	Preview <button>Accept & Work</button>
Scoutt	Extract purchased items from a shopping receipt (1-2 items)	15,636	\$0.01	14m ago	Preview <button>Accept & Work</button>
Spiridon Systems	Two tasks, one ask!	12,422	\$0.02	2d ago	Preview <button>Accept & Work</button>
Scoutt	Extract purchased items from a shopping receipt (6-10 items)	10,627	\$0.06	10m ago	Preview <button>Accept & Work</button>
EX Research	Find the correct LinkedIn profile of an Attorney	7,746	\$0.01	13d ago	Preview <button>Accept & Work</button>
Crowdsurf Support	Transcribe up to 35 Seconds of Media to Text - Earn up to \$0.17 per HIT!!	7,648	\$0.05	In 1s	Preview <button>Accept & Work</button>
svcl_planckton	Locate Head/Tail in a image of object	7,452	\$0.05	1d ago	Preview <button>Accept & Work</button>
Scoutt	Extract purchased items from a shopping receipt	6,965	\$0.08	1h ago	Preview <button>Accept & Work</button>
Venkatesh Madhava	Rate Little Girls Dresses Based On Your Taste	4,319	\$0.01	5h ago	Preview <button>Accept & Work</button>
Scoutt	Extract purchased items from a shopping receipt (3-5 items)	4,186	\$0.03	36m ago	Preview <button>Accept & Work</button>
Scoutt	Extract purchased items from a shopping receipt (1-2 items)	3,935	\$0.01	2h ago	Preview <button>Accept & Work</button>
Venkatesh	Rate Little Girls Dresses	3,405	\$0.01	1d ago	Preview <button>Accept & Work</button>
turk_3pmx	Collect data from a Website	3,350	\$0.18	7d ago	Preview <button>Accept & Work</button>

Take Tasks



Workers



Amazon Mechanical Turk (MTurk)

amazon mturk <small>beta Worker</small>		HITs	Dashboard	Qualifications	Search All HITs		Filter		
All HITs	Your HITs Queue								
HIT Groups (1-20 of 1193)						Show Details	Hide Details	Items Per Page:	20
Requester	Title	HITs	Reward	Created	Actions				
+ Raucous Data	Review websites for physical activity (WARNING: This HIT may contain adult conte...	30,107	\$0.02	in 6s	Preview	Accept & Work			
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MTurk Workers' Interface

amazon mturk beta
Worker

HIT Details Auto-accept next HIT Reward: \$0.20 Time Remaining: 02:59:24 Return

Is Cooking in this video?

Samples Progress:
0/10

Description >

Instructions >



Yes

No

Unsure

Playback Rate - x0.5 +

How big is MTurk?

of the underlying population. We also demonstrate how to model and account for the inherent selection biases in such surveys. Our results indicate that there are more than 100K workers available in Amazon's crowdsourcing platform, the participation of the workers in the platform follows a heavy-tailed distribution, and at any given time there are more than 2K active workers. We also show that the half-life of a worker on the platform is around 12-18 months and that the rate of arrival of new workers balances the rate of

I heard that MTurk's data quality is pretty bad...?

Political Science Research and Methods (2020), 8, 614–629
doi:10.1017/psrm.2020.6



ORIGINAL ARTICLE

The shape of and solutions to the MTurk quality crisis

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³Computational Social Science, University of Chicago, Chicago, USA and ⁴Department of Politics, University of Virginia, Charlottesville, VA, USA

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Abstract

Amazon's Mechanical Turk is widely used for data collection; however, data quality may be declining due to the use of virtual private servers to fraudulently gain access to studies. Unfortunately, we know little about the scale and consequence of this fraud, and tools for social scientists to detect and prevent this fraud are underdeveloped. We first analyze 38 studies and show that this fraud is not new, but has

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Crowdsourcing: A Fish Market Story

Crowdsourcing: A Fish Market Story



Goal: Find (A Lot of) **Fresh Fish**



Can I hire **people** to identify fresh fish?



- **People on the street.**
- They will give you their **10 minutes** in exchange for \$10.
- You can screen the candidates, but **you only know a little about them.**

Can **people** tell if a fish is fresh?



Can people tell if a fish is fresh?

BHG.COM | RECIPES AND COOKING | FISH RECIPES | FISH BASICS

How to Tell if Fish is Fresh

Here's how to spot the freshest fish at your market.

June 09, 2015



Always be very picky when selecting fish from the store.

There are definite signs that fish is fresh. Fresh fish should have a mild scent and moist flesh, and appear freshly cut. Don't purchase fish that has a strong, fishy odor. Whole fish should have bright, bulging eyes and bright red or pink gills. Frozen fish should meet the fresh-smell test and have taut packaging with no evidence of ice or blood. Fresh fish is best used right away. Or, you can store it for up to two days in the coldest part of the refrigerator. Frozen fish will keep in its original wrapping, frozen at 0 degrees or lower, for up to 3 months.

With some **instruction**, maybe?

7 Secrets to Finding the Freshest Fish



Kim Bussing

Updated: Mar. 20, 2019

When it comes to choosing the right salmon, trout or tilapia, it's hard to know what to look for. Here's how to tell if fish is fresh!

1 / 7



With concrete and clear **instruction**, yes?



Ingredients

How to tell if a fish is fresh

Method

Choosing a good fish is about using your senses! Sight, smell and touch are the ready reckoners for what is fresh, use them and you won't go wrong.

1. Check the eyes for clarity

Before you handle the fish, check the eyes. They should be clear, plump and shiny, not sunken or cloudy. If the eyes look good, you can be pretty sure that the fish is fresh and healthy. Some fish eyes can have a slightly cloudy appearance even when they are spanking fresh (like Barramundi, Kingfish and Mackerel) mostly due to them being quickly chilled in ice after harvest, so when checking their eyes look for plump, wet and shiny!

2. Smell the fish

A fresh fish should smell like mineral water or even cucumbers – it certainly shouldn't smell like swamp water or have strong earthy, ammonia or 'fishy' odours. Cooking won't remove these, more likely it'll actually enhance them.

3. Touch the flesh

If the fish monger allows it, give the fish a little poke... when pressed, the flesh should be resilient to the touch, it should spring back immediately like you were pressing on your own flesh. The outside of the fish should be covered in a clean, translucent slime and should look like a clean sheen. Scales should be completely covering the skin, if they are loose or missing this is an indication of age or temperature abuse.

4. Check the gills

Fish gills are an excellent indicator of quality. When first caught, the gills are bright red but slowly darken over time so the brighter the colour, the fresher the fish. Like the flesh of the fish, the gills should also feel clean and cold, not slimy.

I prefer buying a whole fish over fillets as you can use the techniques above to ensure that what you're buying is the best possible quality. If you prefer a fillet, be sure to ask your fishmonger to 'Dry Fillet' your fish, that is to fillet the fish without using or immersing the fish in fresh water. This might require you to gently wipe the flesh with damp cloth (ideally dipped in salt water) before using it but will guarantee maximum flavour!

“Hey, go find some fresh fish for me!”

Not going to work well (even when you show them instruction.)



What **type** of fish are we looking for?



How will the fish be **displayed**?



Which fish store should I go to?



A Lot More!

- How should you **compare** two fish?
- How much **time** do you have to make each decision?
- Can you see the **whole** fish? Or just a **portion**?
- How close can we see the fish? Is the environment dark?
- Does the store owner speak English?
- What is the best time to go?

Key: Reduce the Effort and Confusion



Do Not Ask Crowd Workers to Define Your Research Question

“What do you mean by _____?”

- If a task is **easy to understand**, it is more likely to be done correctly.
- If a task **avoids unnecessary work**, it is more likely to be done efficiently
- A **usable task** is more likely to be done at all.

Pretty vs. Ugly User Interface

A 

Answer 10 captchas, earn \$0.01
You will be paid in a \$0.01 bonus after finishing all 10.
Correct, just 9 captchas left

This is a research study. We are not spammers.
The prices and tasks change over time, so try again later if you do not like this task or price.
Optional hit feedback:

B 

Answer 10 captchas, earn \$0.01
You will be paid in a \$0.01 bonus after finishing all 10.

ALERT

FREE* SCREENSAVERS!

Britney Spears

Screen savers: Angelina Jolie, Britney Spears, Paris Hilton, Jessica Alba, Jessica Simpson

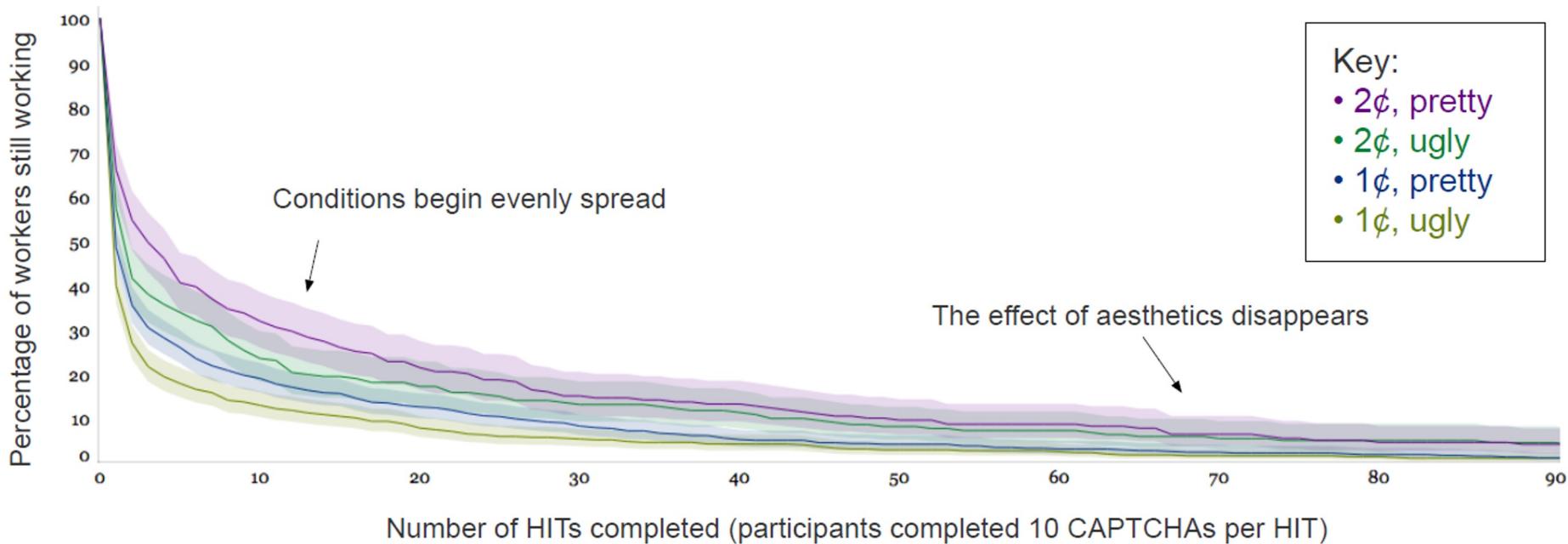
Preview Settings

Click the "OK" button now to get

The timer and task details are identical to the pretty version, but the visual elements are much more distracting.

Animated GIF shakes left and right. Very annoying.

Pretty vs. Ugly User Interface (Cont.)



In April 2020,
we annotated

~11,000

COVID-19 Paper Abstracts

Using MTurk Workers
Within 10 Days

CODA-19: Reliably Annotating Research Aspects on 10,000+ CORD-19 Abstracts Using a Non-Expert Crowd

Ting-Hao (Kenneth) Huang (PSU)

Chieh-Yang Huang (PSU)

Chien-Kuang Cornelia Ding (UCSF)

Yen-Chia Hsu (CMU)

C. Lee Giles (PSU)



PennState

Carnegie
Mellon
University

UCSF

University of California
San Francisco

For successful infection, viruses must recognize their respective host cells. A common mechanism of host recognition by viruses is to utilize a portion of the host cell as a receptor. Bacteriophage Sf6, which infects *Shigella flexneri*, uses lipopolysaccharide as a primary receptor and then requires interaction with a secondary receptor, a role that can be fulfilled by either outer membrane proteins (Omp) A or C. Our previous work showed that specific residues in the loops of OmpA mediate Sf6 infection. To better understand Sf6 interactions with OmpA loop variants, we determined the kinetics of these interactions through the use of biolayer interferometry, an optical biosensing technique that yields data similar to surface plasmon resonance. Here, we successfully tethered whole Sf6 virions, determined the binding constant of Sf6 to OmpA to be 36 nM. Additionally, we showed that Sf6 bound to five variant OmpAs and the resulting kinetic parameters varied only slightly. Based on these data, we propose a model in which Sf6: Omp receptor recognition is not solely based on kinetics, but likely also on the ability of an Omp to induce a conformational change that results in productive infection. All rights reserved. No reuse allowed without permission.

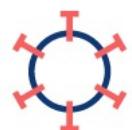


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CORD-19

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Get Started

Download

CORD-19

COVID-19 Open Research Dataset

The Semantic Scholar team at the Allen Institute for AI has partnered with leading research groups to provide CORD-19, a free resource of more than 280,000 scholarly articles about the novel coronavirus for use by the global

280,000 s

Research Aspects

- Annotation Scheme
 - Background
 - Purpose
 - Method
 - Finding/Contribution
 - Other

But... who will do it?

- **Machines / NLP**

- Need human-annotated data
- In-domain data preferred

- **Experts**

- Paper Authors
- Researchers
- Students



Large-Scale Sentence-Level Annotation for Academic Papers is Hard...

	Corpus	Document type	Instance type	# of documents	# of sentence	Annotator type	# of classes	Public?
Liakata et al.	ART†	paper	sentence	225	35,040	expert	18	yes
Ravenscroft et al.	MCCRA†	paper	sentence	50	8,501	expert	18	yes
Teufel and Moens	CONF	paper	sentence	80	12,188	expert	7	no
Kim et al.	MEDLINE	abstract	sentence	1,000	10,379	expert	6	no
Contractor et al.	PubMed	paper	sentence	50	8,569	expert	8	no
Morid et al.	UpToDate+PubMed	mixed	sentence	158	5,896	expert	8	no
Banerjee et al.	CONF+arXiv	paper	sentence	450	4,165	expert	3	no
Huang and Chen	NTHU database	abstract	sentence	597	3,394	expert	5	no
Agarwal and Yu	BioMed Central	paper	sentence	148	2,960	expert	5	no
Hara and Matsumoto	MEDLINE	abstract	sentence	200	2,390	expert	5	no
Zhao et al.	JOUR	mixed	sentence	...	2,000	expert	5	no
McKnight and Srinivasan	MEDLINE	abstract	sentence	204	1,532	...	4	no
Chung	PubMed	abstract	sentence	318	829	expert	4	no
Wu et al.	CiteSeer	abstract	sentence	106	709	expert	5	no
Dasigi et al.	PubMed	section	clause	75	<4,497*	expert	7	no
Ruch et al.	PubMed	abstract	sentence	100	4	no
Lin et al.	PubMed	abstract	sentence	49	...	expert	4	no

MTurk Workers Can Help!

	Corpus	Document type	Instance type	# of documents	# of sentence	Annotator type	# of classes	Public?
This work	CORD-19	abstract	clause	10,966	103,978	crowd	5	yes
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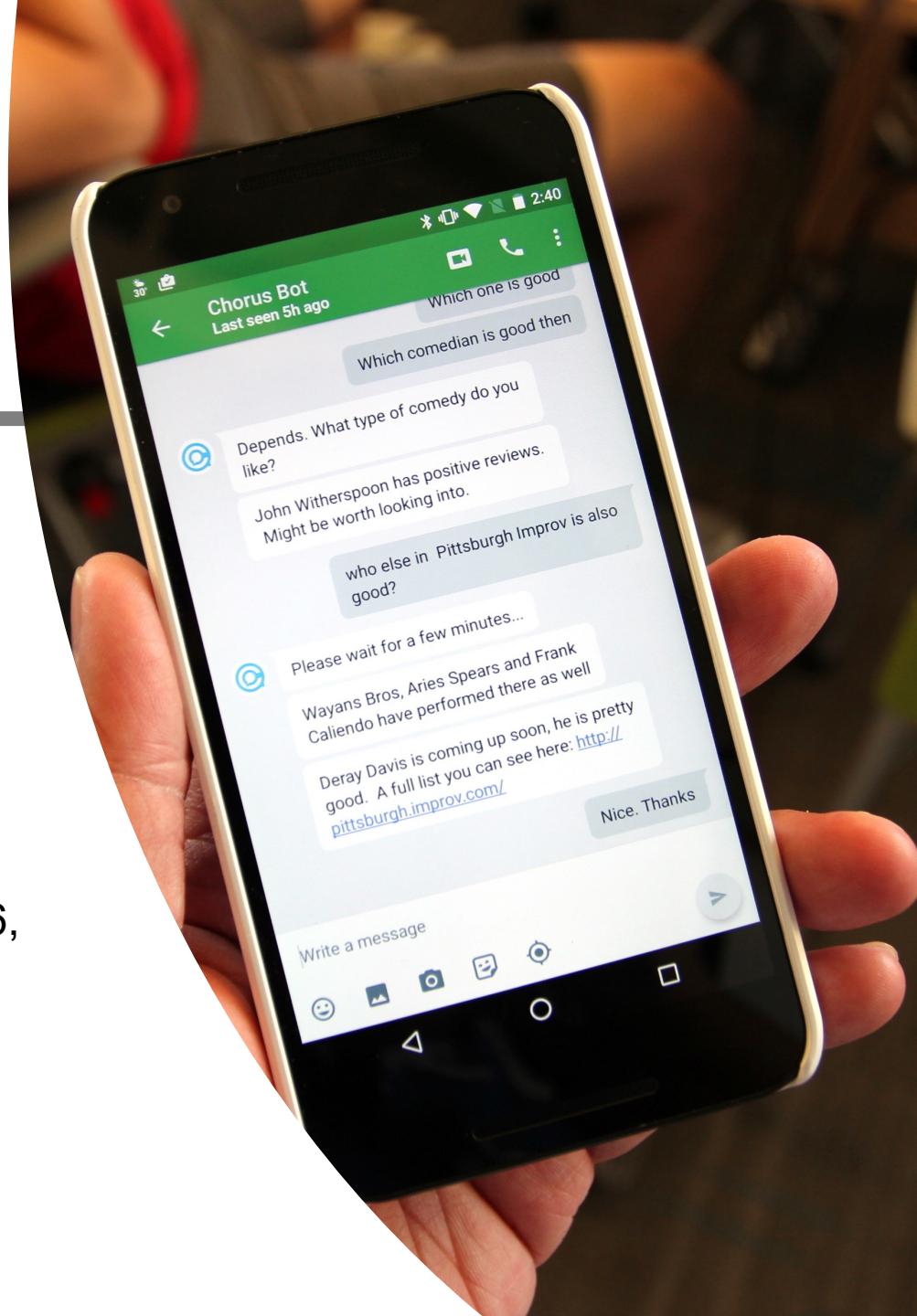
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A Crowd-Powered Conversation Assistant

- CHI'18 ♂, CHI LBW'16 ♂
- UIST'17, UIST Poster'17
- HCOMP'17, '16, '15, HCOMP DC'16, HCOMP WIP'14
- CI'17
- CSCW Workshop'17





Chorus Bot

Active 4h ago



Hi



What can I help you with? I'll be able to chat in a few minutes.

I'm at CHI 2018 conference now

9:44 AM

I'll have two free day on Friday and Saturday here

What should I do



That;s great.

Are you interested in watching movies?

Not really. I want to do something local or some sightseeing

Not really. I want to do something local or some sightseeing



Okay. Give me a minute.

Have you visited the Botanical Garden?

No. What is that



Declared a National Historic Site of Canada in 2008, the gardens attract nearly 700,000 visitors each year and boast vast collections and impressive facilities. They are one of four nature attractions under the city of Montreal's Space for Life (Espace Pour la Vie) umbrella, the others being the Biodome, the Rio Tinto Alcan Planetarium and the Insectarium.

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Oh wow

So this is the top recommendation?

Is it indoor or outdoor? What's the weather like on Fri and Sat?



Notre-Dame Basilica is also worth checking out

Its Outdoor.

Its Outdoor.

I've visited Notre-Dame Basilica...
So what's the weather on
Fri and Sat

Will it rain? If it's outdoor...



There's a slight chance of raining.

How about temperature?



~8 degrees

Well that's not too bad

I'm from Pittsburgh hahaha

I think that is good for me now

Thanks

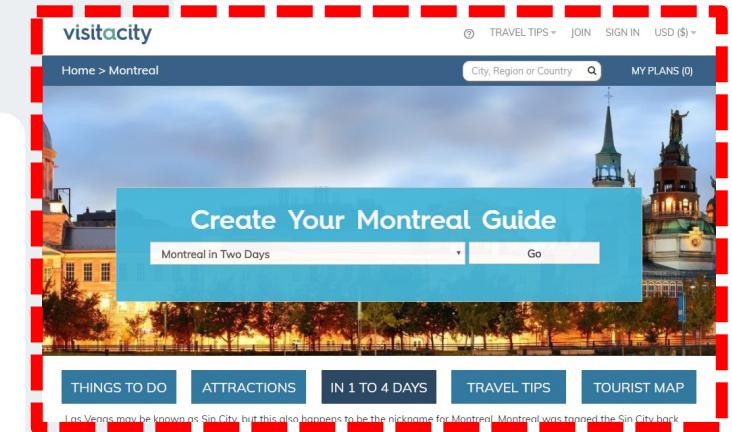
I think that is good for me now

Thanks



You're welcome.

You can check out this: https://www.visitacity.com/en/montreal?campaignid=358308965&gclid=EA1alQobChMlkP7clYbT2gIVCh4rCh0uoAC1EAAYASAAEgKsBD_BwE



Is there anything else you'd like to ask?

No that's it I think

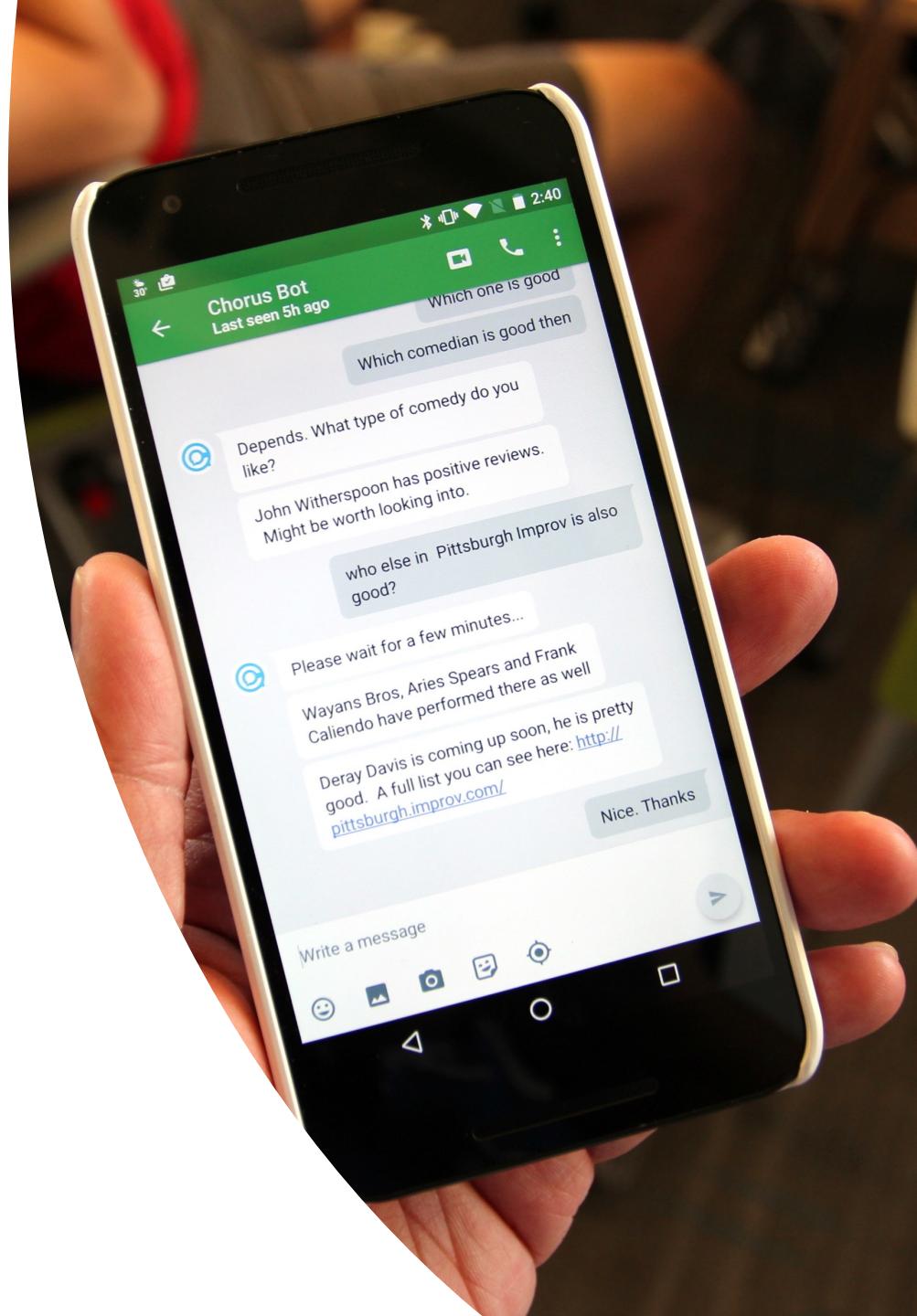
Thanks!



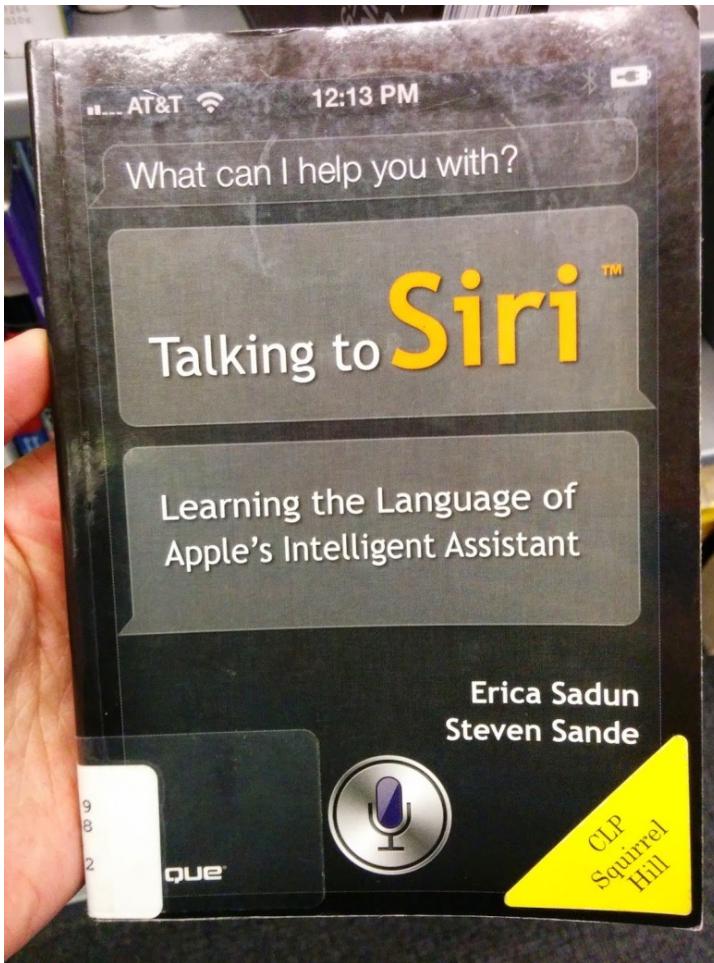
Goodbye. Have a wonderful time!

What just happened?

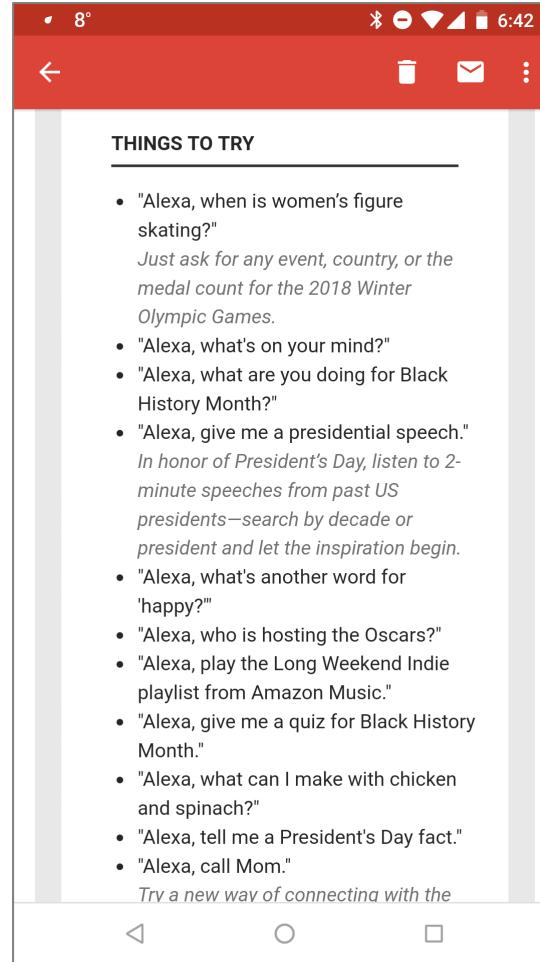
- Open Conversation
 - Multi-turn interaction
 - Multiple domains
 - Personalized
 - Coherent dialog
 - Mix of task-oriented and social conversation



Today's Conversational Assistants...



“Talking to Siri”



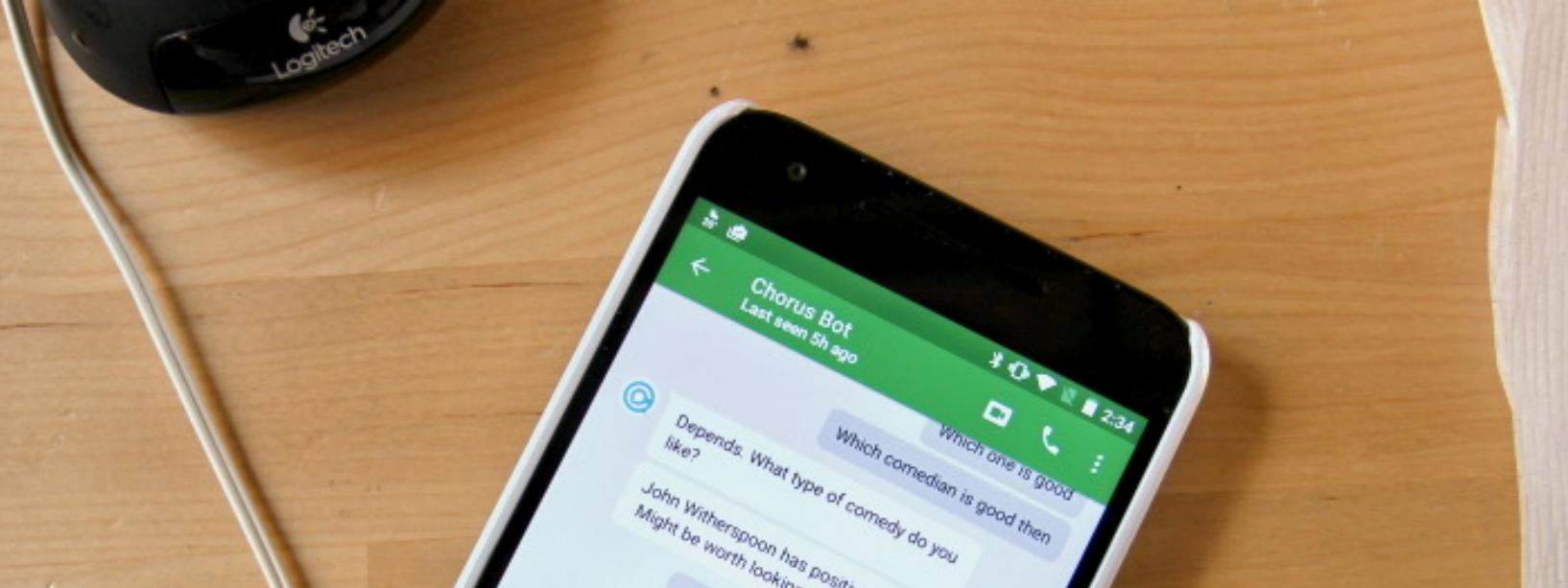
**Weekly Newsletter on
How to Talk to Alexa**

Existing Approaches to Open Conversation

- Combining **multiple task-oriented dialog systems**
 - DialPort (Zhao, *et al.*, 2016)
- **End-to-end** framework for dialogue systems
 - Serban, *et al.* 2016; Li, *et al.* 2017
- **Adapting** a model to many other domains
 - Walker, *et al.*, 2007; Sun, *et al.*, 2016
- **Chit-chat** systems (social bot)
 - Hold social conversations (Banchs, *et al.*, 2012)
- **Still a very hard problem...**

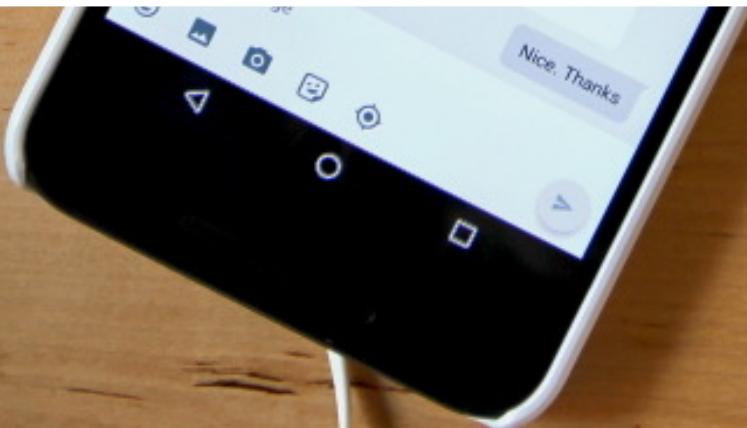
The Alexa Prize

A \$500,000 prize will be awarded to the team selected for creating the best socialbot. The second- and third-place teams will receive prizes of \$100,000 and \$50,000, respectively. Additionally, a **\$1 million** research grant will be awarded to the winning team's university if their socialbot achieves the grand challenge of **conversing coherently and engagingly with humans for 20 minutes** with a 4.0 or higher rating.



Chorus: A Crowd-Powered Conversation Assistant

[HCOMP'16, HCOMP'17]

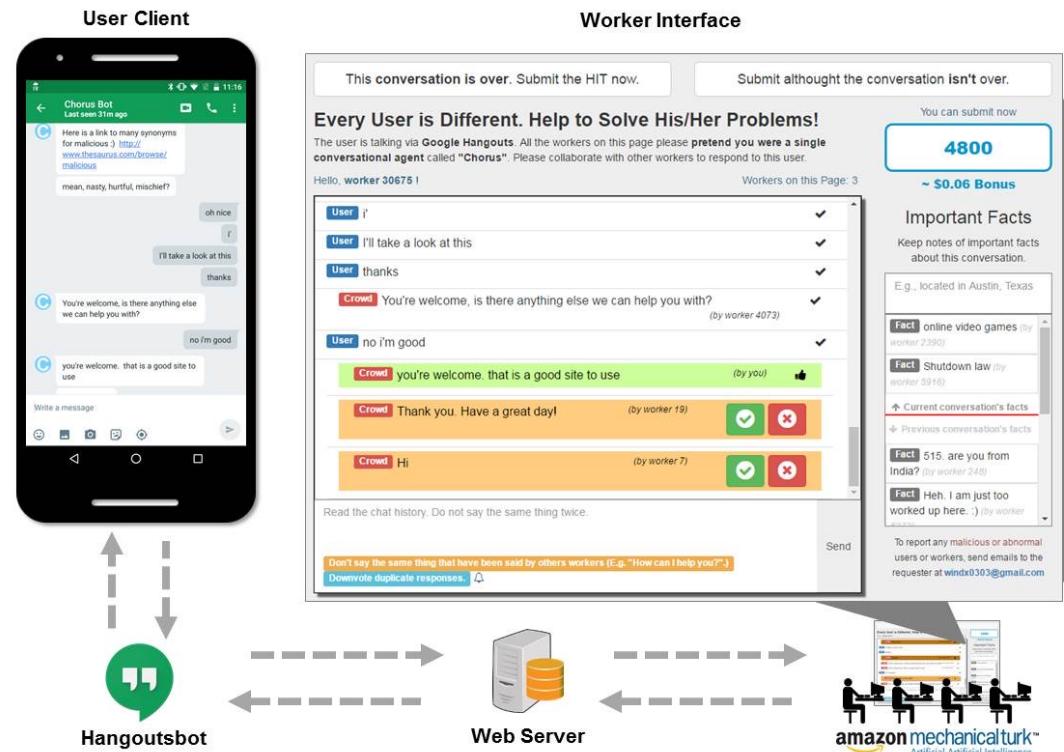


Chorus: A Crowd-Powered Conversation Assistant

- Crowd workers collectively hold a conversation by:

- Propose Responses
- Vote Responses
- Take Notes

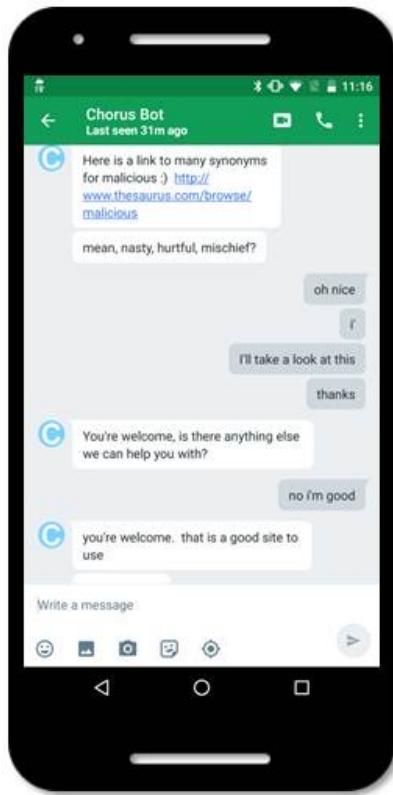
Reward points for each action



"Is there anything else I can help you with?": Challenges in Deploying an On-Demand Crowd-Powered Conversational Agent. Huang, et al. HCOMP 2016.

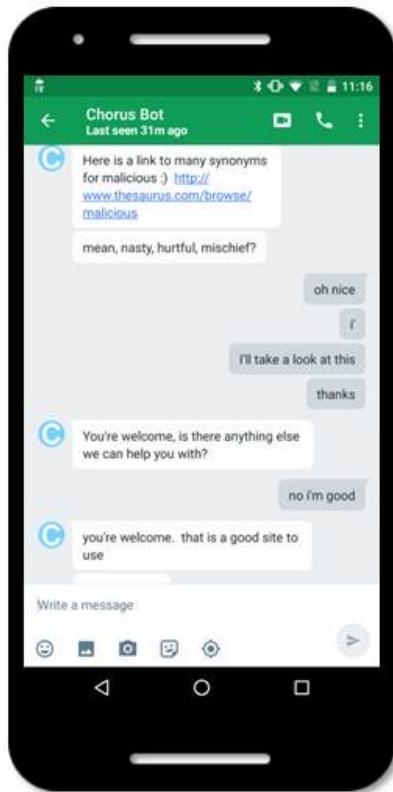
User Interface

User Client



User & Worker Interface

User Client



Worker Interface

This conversation is over. Submit the HIT now. Submit although the conversation isn't over.

You can submit now

4800

~ \$0.06 Bonus

Every User is Different. Help to Solve His/Her Problems!

The user is talking via Google Hangouts. All the workers on this page please pretend you were a single conversational agent called "Chorus". Please collaborate with other workers to respond to this user.

Hello, worker 30675 !

Workers on this Page: 3

User i'
User I'll take a look at this
User thanks
Crowd You're welcome, is there anything else we can help you with? (by worker 4073)
User no i'm good
Crowd you're welcome. that is a good site to use (by you)
Crowd Thank you. Have a great day! (by worker 19)
Crowd Hi (by worker 7)

Read the chat history. Do not say the same thing twice.

Don't say the same thing that have been said by others workers (E.g. "How can I help you?")
[Downvote duplicate responses.](#)

Send

Important Facts

Keep notes of important facts about this conversation.

E.g., located in Austin, Texas

Fact online video games (by worker 2390)
Fact Shutdown law (by worker 5916)

[↑ Current conversation's facts](#)

[↓ Previous conversation's facts](#)

Fact 515. are you from India? (by worker 248)

Fact Heh. I am just too worked up here.. :) (by worker 2390)

To report any malicious or abnormal users or workers, send emails to the requester at windex0303@gmail.com

Hangoutsbot

Web Server



Is this conversation over? Click here if the conversation is over.

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The user is talking via **Google Hangouts**. All the workers on this page please **pretend you were a single conversational agent** called "**Chorus**". Please collaborate with other workers to respond to this user.

Hello, worker 144664 !

Workers on this Page: 2

Reach 4000 points to submit

1312

~ \$0.016 Bonus

Crowd Is there anything else I can answer for you? (by worker 139809) ✓

User That's it ✓

User Thanks ✓

Crowd Have a nice day! (by worker 139809) ✓

Crowd I hope you have a nice day as well! (by worker 144680) ✓

User Hi ✓

↑ Previous conversation of this user.

↓ Current conversation starts here.

User Hi ✓

Auto Reply hello (by bot 131971) ✓

Crowd Do you have any questions? (by worker 139809) ✓

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Pretend you are a **single chatbot** called Chorus.

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↑ Current conversation's facts

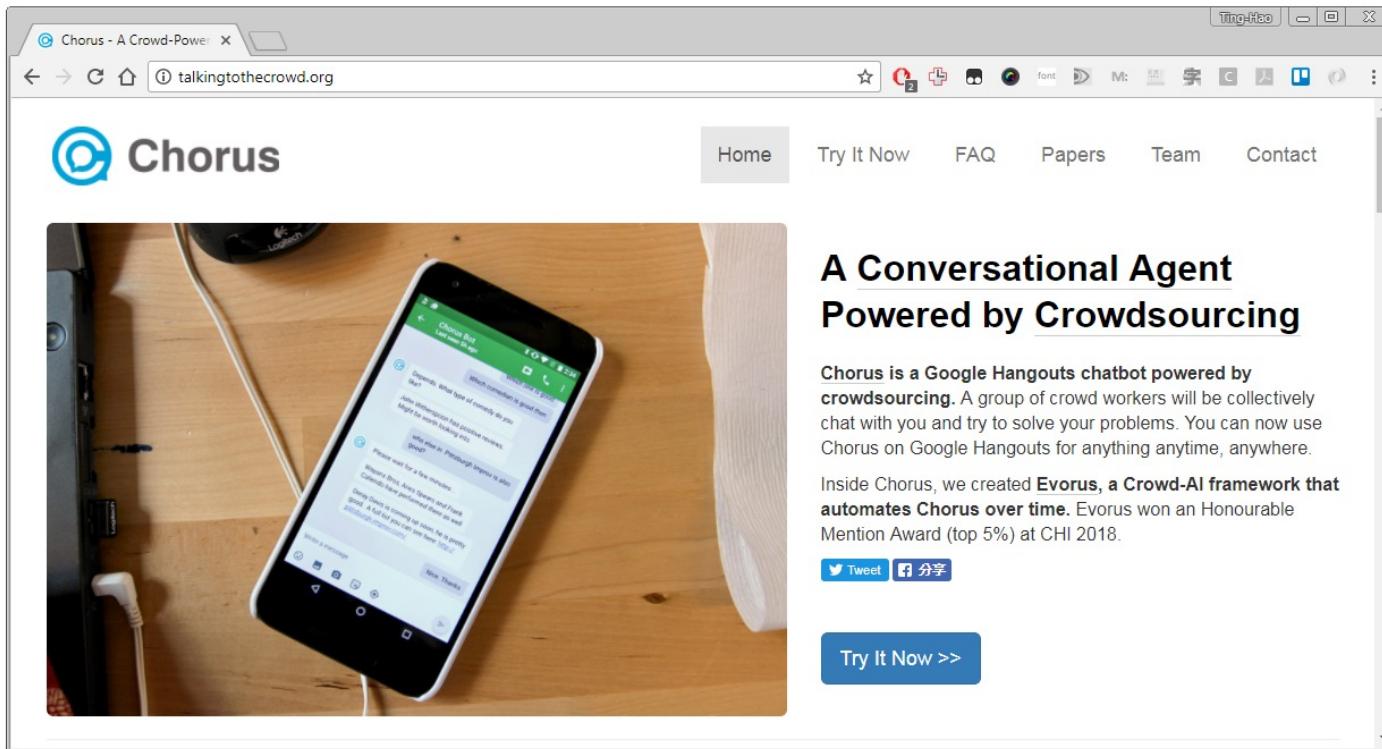
↓ Previous conversation's facts

Fact User wants to know the weather in Pittsburgh. (by worker 139809)

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We Deployed Chorus

- Launched on May 20th, 2016
 - On Google Hangouts
 - **2200+** conversations, **420+** users
- [TalkingToTheCrowd.org](http://talkingtothecrowd.org)



The screenshot shows a web browser window with the URL talkingtothecrowd.org. The page features a header with the Chorus logo and navigation links for Home, Try It Now, FAQ, Papers, Team, and Contact. Below the header is a large image of a smartphone lying on a wooden desk. The phone's screen displays the Chorus mobile application, showing a conversation with a conversational agent named "Chorus Bot". The text in the conversation includes questions like "Which instrument is good for a beginner?" and "Depends, what type of comedy do you like?". The right side of the page has a section titled "A Conversational Agent Powered by Crowdsourcing" with descriptive text and social sharing buttons for Twitter and Facebook. A "Try It Now >>" button is located at the bottom.

A Conversational Agent
Powered by Crowdsourcing

Chorus is a Google Hangouts chatbot powered by crowdsourcing. A group of crowd workers will be collectively chat with you and try to solve your problems. You can now use Chorus on Google Hangouts for anything anytime, anywhere.

Inside Chorus, we created **Evorus**, a Crowd-AI framework that automates Chorus over time. Evorus won an Honourable Mention Award (top 5%) at CHI 2018.

[Tweet](#) [分享](#)

[Try It Now >>](#)

Gift Suggestion



Can you suggest some birthday present for one of my friend?

female, computer science PhD student in Texas



Sure! What types of things does your friend like?

we're going to visit her this weekend from Pittsburgh

She's in Austin



Does she have any favorite TV shows, movies, or video games?



Travel Planning



How many suitcases can I take on a flight from the US to Israel?



Let me check

Can I ask you from where are you planning to board the flight?

Pittsburgh



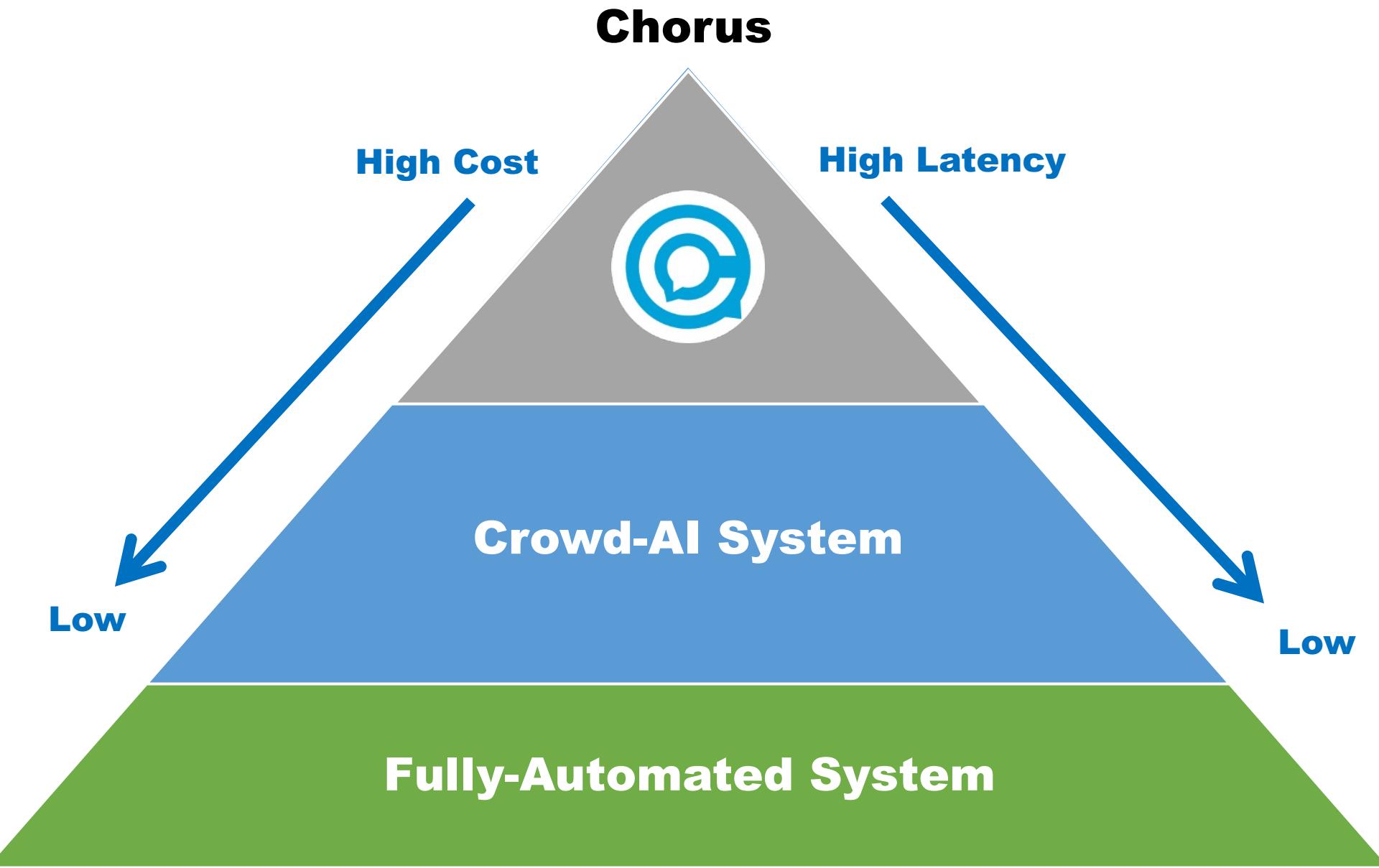
with which company are you flying?

and which air services are you using?

What did we learn?

- **Challenges Identified**
 - **Malicious** workers & users
 - Identifying **the end of a conversation**
 - When workers' consensus is not enough...
- **Basic Statistics**
 - Avg session duration = 10.49 min
 - Avg #message per session = 17.88

A Top-Down Approach



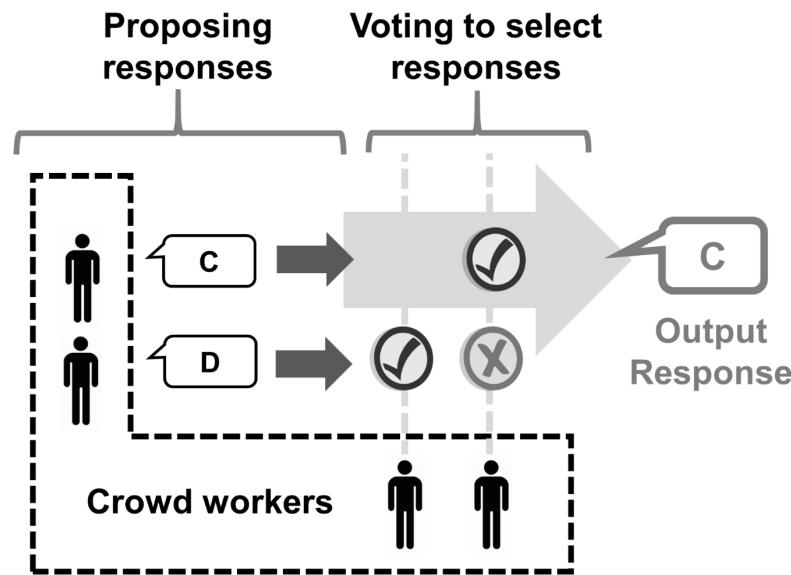


Evorus: A Crowd-Powered Conversational Assistant Built to Automate Itself Over Time

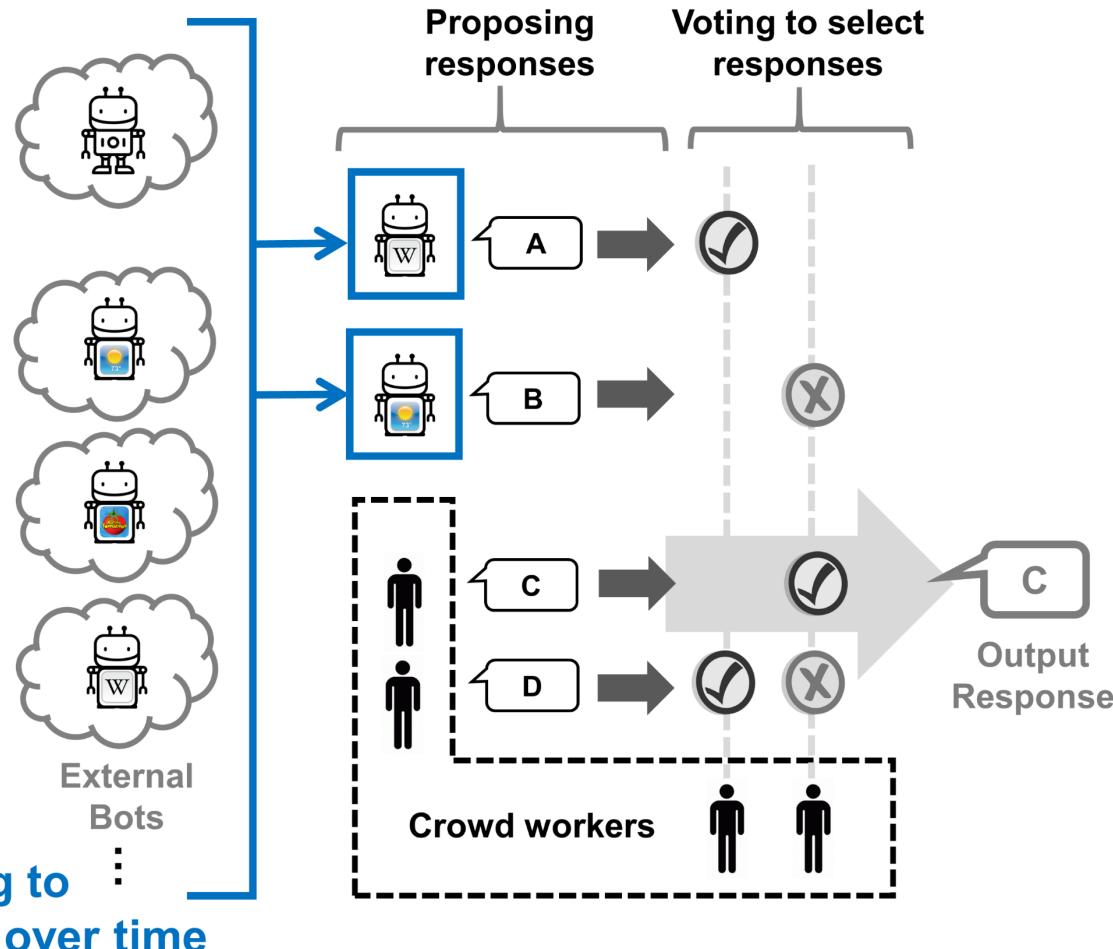
[UIST Poster'17, CHI'18 ]



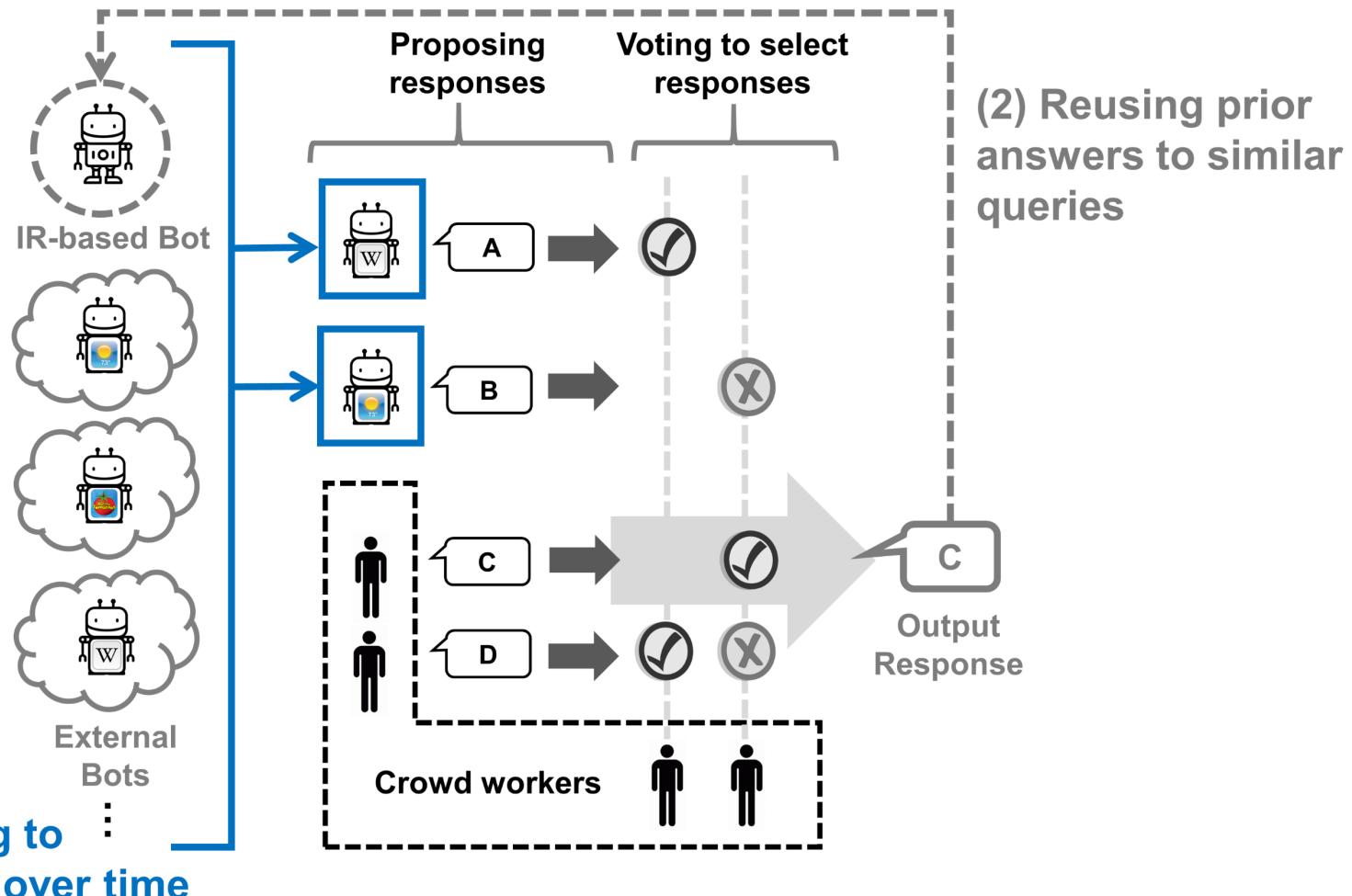
Automating Chorus Over Time



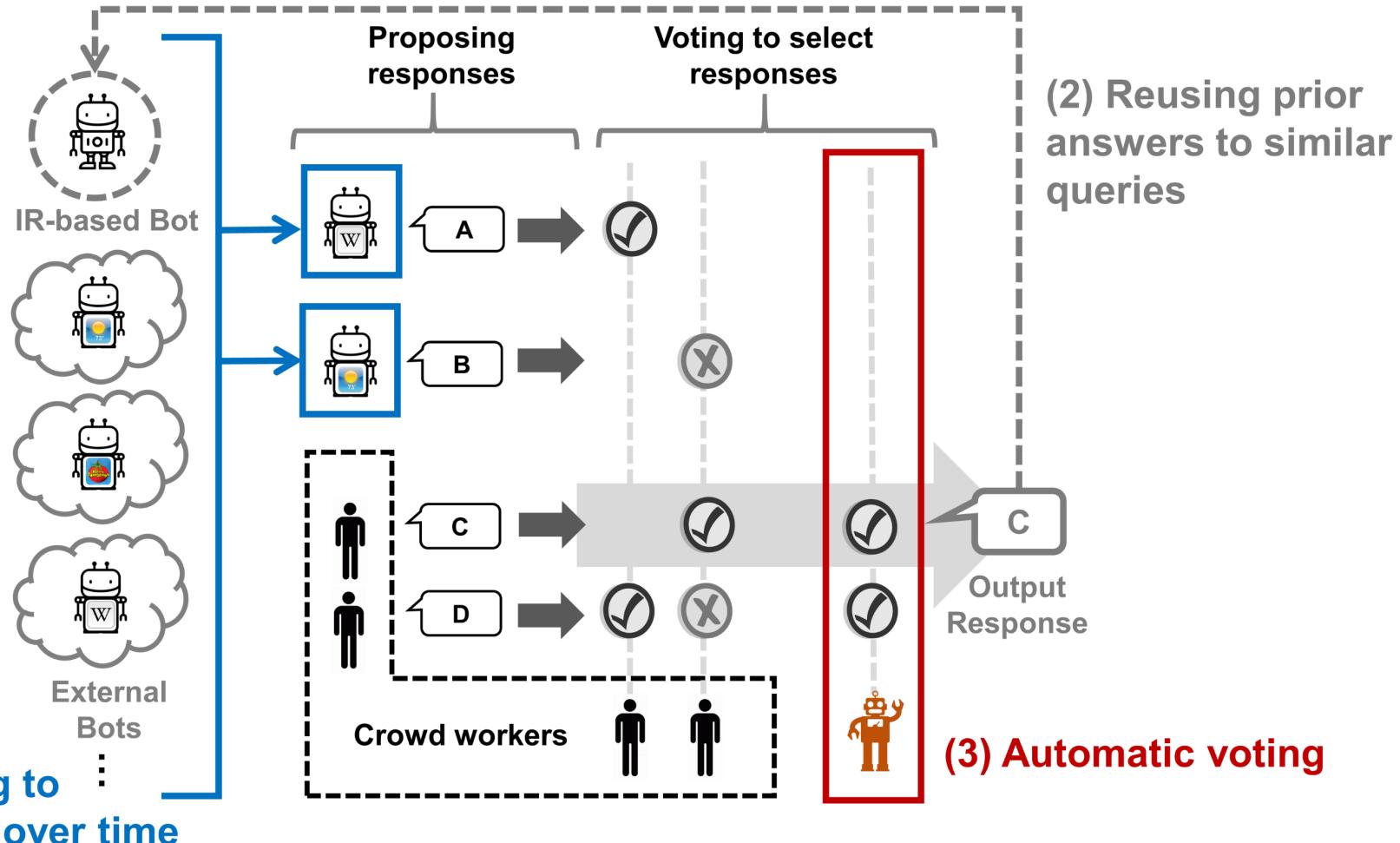
Automating Chorus Over Time



Automating Chorus Over Time



Automating Chorus Over Time



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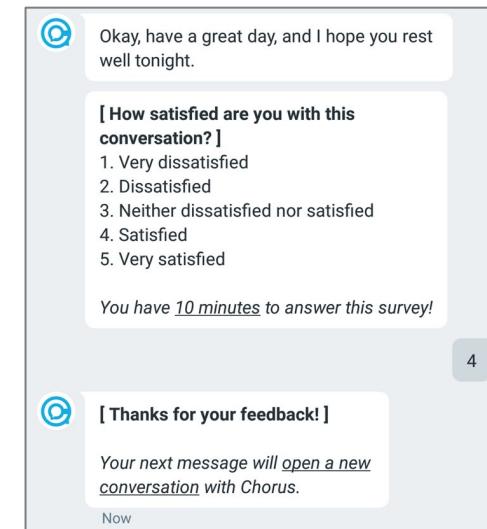
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Automating Open Conversations

- **Setup**
 - A 5-month-long deployment, 80 Users
 - 4 chatbots + 1 voting bot
- **Result**
 - Automated responses were chosen **12.44%** of the time.
 - Human upvotes were reduced by **13.81%**.
 - The cost of each message is reduced by **32.76%**.
- **Conversation quality and user satisfaction level remains.**
 - Conversation Quality: Satisfaction, Clarity, Responsiveness, Comfort
(Liu, et al., 2010)



Today We're Going to Talk About

1. Overview of **Crowdsourcing**
2. **High-Quality Data & How to Get Them**
3. **Crowd-AI Systems**





Crowdsourcing & Crowd-AI Systems

**Dr. Ting-Hao (Kenneth) Huang
Pennsylvania State University
Guest Lecture**

February 2023