

# Collective Intelligence

Ariel Weingarten/Kandarp Khandwala

**wiki**

shared or group intelligence  
that emerges from the  
collaboration, collective efforts,  
and competition  
of many individuals

# goals

understand the challenges of equipping  
inconsistently skilled individuals

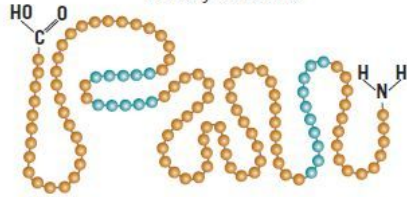
explore the difference between domain experts  
and the people recruited to help them

explore a future where games with a purpose  
and cheap, on-demand crowd work  
are a pervasive part of society

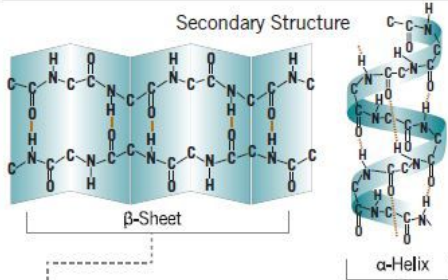
# Predicting protein structures with a multiplayer online game

## LEVELS OF PROTEIN STRUCTURE

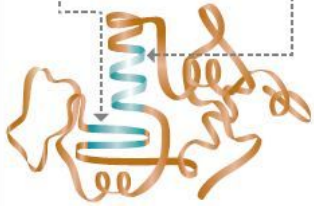
Primary Structure



Secondary Structure



Tertiary Structure



Quaternary Structure



Particle Sciences

predicting protein structure from  
amino acid sequence:

template-based modeling,  
ab initio (from the beginning)

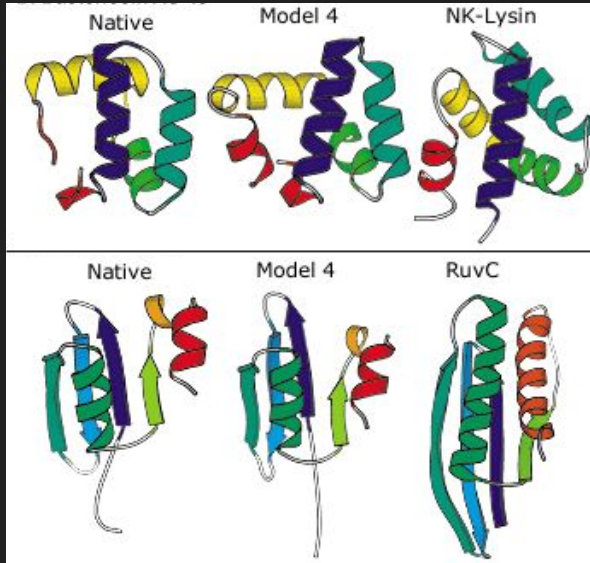
# rosetta methodology

*stochastic* algorithms:

fragment finding and assembly

deterministic:

energy minimization, structure perturbation and refinement



extent of free energy landscape  
order of 1000 dof,  
computationally-limited

## **hypothesis**

replace stochastic components with  
human decision making...



**how does it work?**

improper conformations: *puzzles*

leaderboard: *competition*

(players also collaborated in teams)

Pull Mode

Rank: 317 Score: 2534

Soloist Beginner Puzzle 8 (<150): Fruit Fly

No conditions

Group Competition

#	Group Name	Score
1	Rice Biochemistry	9174
2	Team Commonwealth	9168
3	Ukraine	9088
4	Team Canada	9085
5	Firebird BioChem	9073
6	SETL Germany	9030
7	Boncha	9001

Soloist Competition

#	Player Name	Current	Best
1	Mike Crunching For Physics	-	9242
2	weitzten	-	9235
3	ys719	-	9222
4	markc	-	9211
5	kevin_karplus	-	9186
6	JINXter	-	9185
7	eb.eric	-	9181

12

4

3

1

5

2

6

7

10

11

8

9

Shake Sidechains Wiggle All Wiggle Backbone Wiggle Sidechains Freeze Protein Remove Bands Disable Bands Align Guide Reset Structures Reset Puzzle Help Glossary

Chat - Group Chat - Puzzle Chat - Global Notifications

auto show auto show auto show auto show

What do you think about getting someone up to speed on this?

KILLED BY  
k1



EMBER SPIRIT

Crimson Guard of Prosperity

k1 (Ember Spirit) just pwned ! WANT KN3 RELEASE DATE (Skywrath Mage)'s head for 326 gold!  
A tower was destroyed by The Dire!



LEVEL UP +1

SKYWRATH MAGE



14 26/1500

Respawning in 48 seconds

103 38+3 28+3 74+13

2 420

Q 70 W 110 E 100 R 175



737 SHOP

Shift-click shop items to set Quick Buy

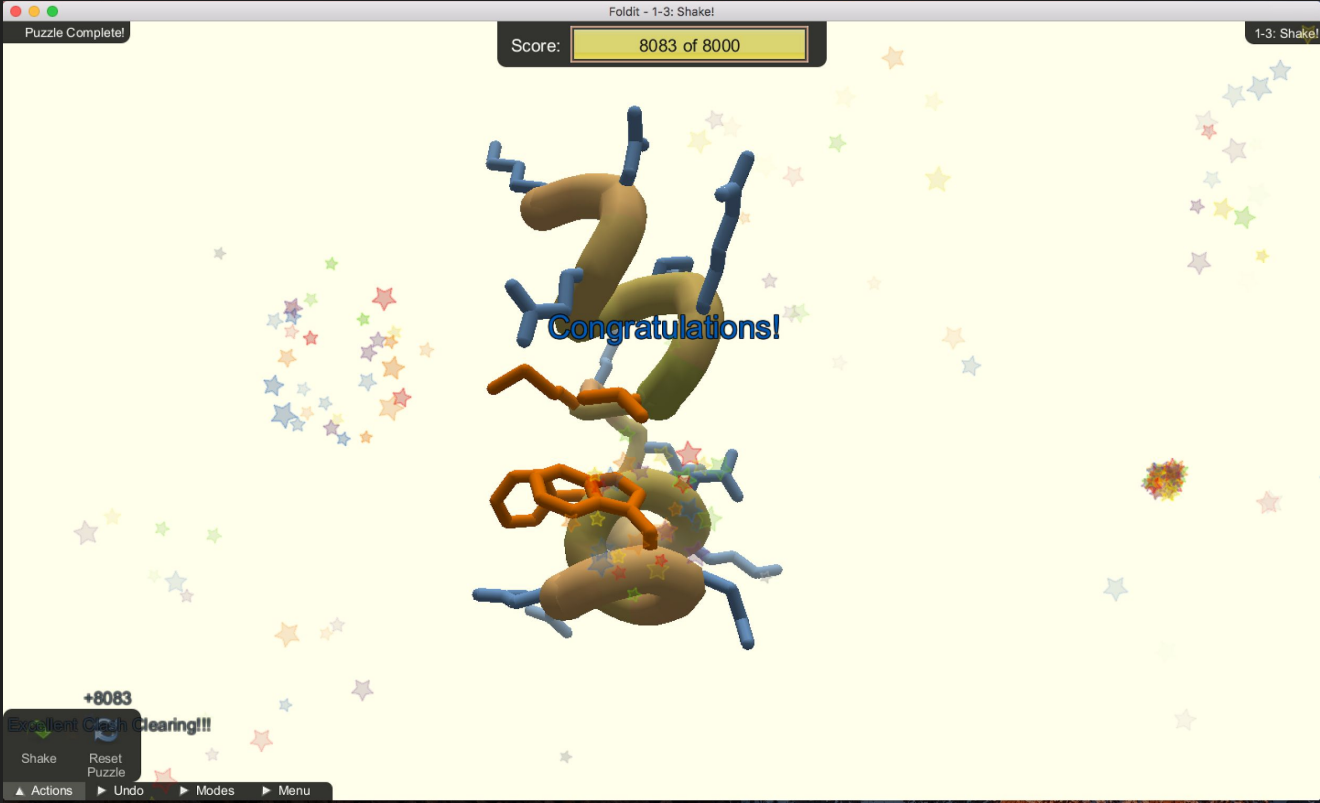
K/D/A 3/8/7  
LH/D 51/7



Thoughts about game playing  
mentality in empirical research...

(discuss with neighbor for 1 minute)

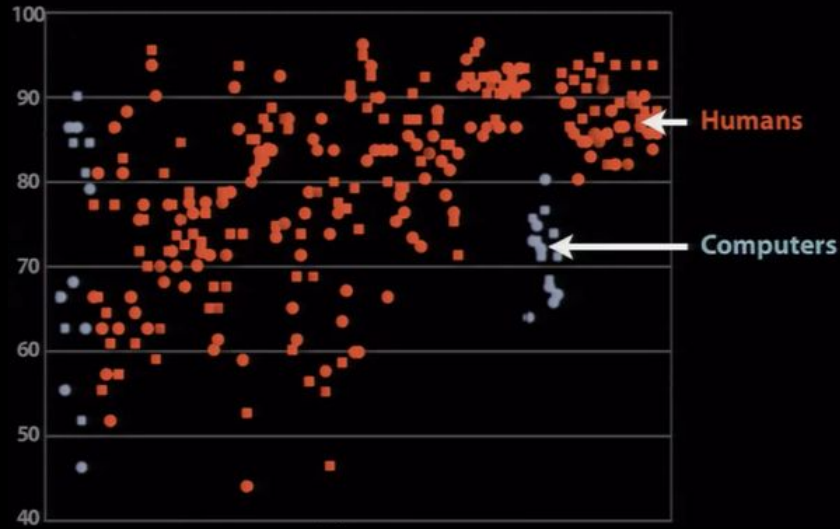
demo



experiment  
posed 10 “blind” puzzles  
compared similarity to native

**Table 1 | Blind data set**

Puzzle ID	Foldit C $\alpha$ r.m.s.d.	Rebuild and refine C $\alpha$ r.m.s.d.	Native	Method	Number of residues
986875	<b>1.4</b>	4.5	2kpo	NMR	99
986698	<b>1.8</b>	3.7	2kky	NMR	102
986836	<b>5.7</b>	6.6	3epu	X-ray	136
987088	<b>3.5</b>	4.3	2kpt	NMR	116
987162	<b>4.5</b>	5.2	3lur	X-ray	158
987076	3.3	3.5	2kpm	NMR	81
986629	3.5	3.3	2kk1	NMR	135
987145	2.6	2.3	3nuf	X-ray	105
986844	6.9	<b>5.8</b>	2ki0	NMR	36
986961	10.6	<b>5.7</b>	2knr	NMR	118



Are these games efficient if one were to consider the return on player time?



Are these games efficient if one were to consider the return on player time?

Gabriel: what happens when the novelty wears off?

Could one achieve the same result with paid experimenters?

Dorothy: who owns the intellectual property?

Francesco: some applications favor computers

Janet: does not seem to help learning

**how did we do?**

riskier steps (worse, then better)

more useful starting point

better at resolving incorrect features

Hundreds of thousands of people have come together to solve puzzles, making it a successful academic platform.  
What do you think the 'secret ingredient'?

Hundreds of thousands of people have come together to solve puzzles, making it a successful academic platform.

What do you think the 'secret ingredient'?

Stephanie: gamers want to appear smart

Eric: challenge drives people

Many of you: what about attrition?

**improvements**

iteration with player tools

social praise (forum)

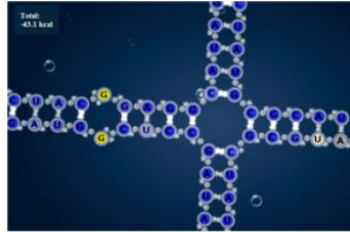
### A Design interface



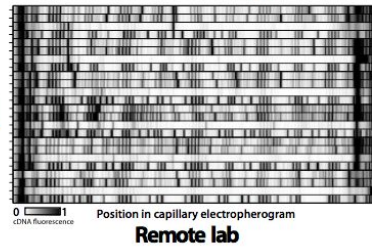
### B Voting interface

	5
Ding's Branches 1	G G A A A G G U
Branches	G G A A A G C U
Squid	G G A A A C U C
Mat - Branches V1	G G A A A G G C
Y oh Y	G G A A A G C A
Deck the Halls	G G A A A G C G
JP-11-4-18	G G A A A C C A
Chaen 202-	G G A A G C C U
Toad Hall	G G A A A G G U
Starry's Branches II	G G A A A G C C
Mat - Branches V1.1 (Submit..	G G A A A G G C

### D Results viewer



### C Synthesis results



### E Design rule collection

 aldo's Loops & Stacks	0.406 Ordering	40 length
 deivad's deivad's strategy	0.382 Ordering	60 length

# **Soylent: a Word Processor with a Crowd Insider**

#### 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).
4. Quinn, A.J. and Bederson, B.B. A Taxonomy of Distributed Human Computation.
5. 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.
6. Sala, M., Partridge, K., Jacobson, L., and Begole, J. An Exploration into Activity-Informed Physical Advertising Using PEST. *Pervasive '07*, Springer Berlin Heidelberg (2007).
7. Simon, I., Morris, D., and Basu, S. MySong: automatic accompaniment generation for vocal melodies. *Proc. CHI '08*, ACM Press (2008).
8. 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).
9. Sorokin, A. and Forsyth, D. Utility data annotation with Amazon Mechanical Turk. *CVPR '08*, (2008).
10. von Ahn, L. and Dabbish, L. Labeling images with a computer game. *CHI '04*, ACM Press (2004).

10

## Shortening A Paper to Ten Pages

- 1) Do it yourself
- 2) Use an AI
- 3) Ask colleagues





**REFERENCES**

1. Bernstein, M., Marcus, A., Berger, D.R., and Miller, R.C. Efficient Directed Graph Sharing on a Shared Memory Computer. *CHI '10*, ACM Press (2010).

2. Ross, J., Silberman, S., Zaldivar, J., et al. Who Are the Crowdworkers? Understanding Demographics in Amazon's Mechanical Turk. *CHI '10*, ACM Press (2010).

21. Quinn, A., and Bederson, E. A Taxonomy of Distributed Human-Computer Interaction. *CHI '10*, ACM Press (2010).

22. Ross, J., Silberman, S., Zaldivar, J., et al. Who Are the Crowdworkers? Understanding Demographics in Amazon's Mechanical Turk. *CHI '10*, ACM Press (2010).

23. ...

24. Simons, D., and Morris, S. MyScribe: Automatic transcription of speech. *CHI '08*, ACM Press (2008).

25. ...

26. Sorokin, A., and Forsyth, D. Image data annotation with Amazon's Mechanical Turk. *CHI '08*, ACM Press (2008).

27. von Ahn, S., and Dabbish, L. Labeling images with a computer game. *CHI '06*, ACM Press (2006).

24. Simons, D., and Morris, S. MyScribe: Automatic transcription of speech. *CHI '08*, ACM Press (2008).

25. ...

26. Sorokin, A., and Forsyth, D. Image data annotation with Amazon's Mechanical Turk. *CHI '08*, ACM Press (2008).

27. von Ahn, S., and Dabbish, L. Labeling images with a computer game. *CHI '06*, ACM Press (2006).

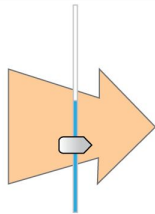
# Shortening A Paper to Ten Pages

## 4) Recruit a crowd

# Soylent is a word processing interface that uses crowd contributions to aid complex writing tasks.

**Shortn** and interaction patterns  
Shortn human contributions directly  
Shortn endeavors that span many levels of conceptual and  
Shortn pragic activity. Authoring tools offer help with prag-  
Shortn people. We thus present Soylent, a word processing  
Shortn duce the Find-Fix-Verify crowd programming pat-  
Shortn feasibility, cost, wait time, and work time for edits.

This paper introduces architectural and interactio  
plex endeavors that span many levels of concept  
other people. We thus present Soylent, a word pr  
we introduce the Find-Fix-Verify crowd program  
ability, cost, wait time, and work time for edits.




**Crowdproof** intuitive, but they didn't let people be able to control computers eff  
The masses can use the software develop  
if one who knows nothing about programming  
job everyday, the only thing she can do is simpl  
But if she happens to be a computer programm  
automate everything. Why is there only a little chance? In fact, each GUI application is a big black

'Be able to' is unnecessary.: let people be able...  
allow people to control  
Error Descriptions

**The Human Macro**

Write a request:  
Find Creative Commons figure for paragraph

This paper introduces architectural and interaction patterns for integrating crowd-sourced human contributions directly into the workflow of software development. We thus present Soylent, a word processing interface that uses crowd contributions to aid complex writing tasks. We introduce the Find-Fix-Verify crowd programming pattern, which reduces the time and cost of editing text. This paper introduces architectural and interaction patterns for integrating crowd-sourced human contributions directly into the workflow of software development. We thus present Soylent, a word processing interface that uses crowd contributions to aid complex writing tasks. We introduce the Find-Fix-Verify crowd programming pattern, which reduces the time and cost of editing text.



demo

“The Human Macro”: great idea or  
research paper gimmick?

(discuss with neighbor for 1 minute)

# Challenges in Programming Crowds

This project has interacted with  
~9000 Turkers on ~2000 different tasks

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

**30% Rule:**

~30% of the results  
from 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.*

# The Lazy Turker

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

# The Eager Beaver

Go beyond task requirements to be helpful,  
but introduce errors in the process

*The theme of loneliness features throughout many scenes in Of Mice and Men and is often the principal, significant, primary, preeminent, prevailing, foremost, essential, crucial, vital, critical, 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 comradeship. But in my opinion there is only one theme that is present from beginning to end, this theme is pursuit of dreams.*



# Find

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

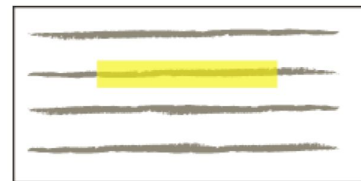


# Fix

# Verify

# Find

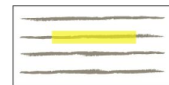
“Identify at least one area that can be shortened without changing the meaning of the paragraph.”



Independent agreement to identify patches

# Fix

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



Soylent, a prototype...

# Verify

# 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 ~~prototypetest~~...

# Verify

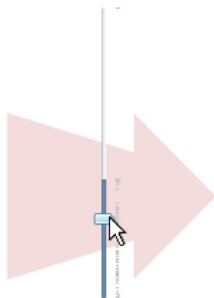
“Choose at least one rewrite that has style errors, and at least one rewrite that changes the meaning of the sentence.”

- 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.

What is one challenge that might arise from Find-Fix-Verify, and how would you address it by evolving the system?

Sean: the addition of a qualify phase that can test workers to identify ones that demonstrate sufficient knowledge to work on the task.

Michelle: I don't completely agree that crowdsourcing editing of high specialized or technical documents can be done to a satisfactory level.

Tushar: Another challenge that I can think of would be to handle multiple, conflicting edits over the same text.

What other applications could benefit from embedded crowd workers?

Danilo: Photoshop with "complex filters".

(discuss with your neighbours for 2 minutes)

Is Fix-Find-Verify only for  
guiding Turkers?

(discuss with your neighbours for 2 minutes)

# Ethical?

Jorge: Make use of the different currencies earn by different people in the world to profit from the least wealthy countries doing common and simple tasks is for me hard to digest.

Dorothy: I'm excited about the possibilities of crowdsourcing, but I'm worried that the rhetoric of innovation makes UX/ HCI designers blind to the human concerns.

(discuss with your neighbours for 2 minutes)



**Did you form groups yet?**