Introduction to Human-computation

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ESP Game

(von Ahn and Dabbish, 2004)
ESP Game

What do you see?

Grass
White
Sheep

Sheep's
Sheep

+10
ESP Game

New image tag: Sheep
ESP Game

• Image tags are useful (E.g. web search)
• Image tags are difficult to predict with a computer program
• Image are easily identified by humans
• Ask human to do the job :
  “Human-computation”
• Embed the task in a game :
  “game with a purpose”
What is human-computation?

• Human can do some tasks better than computers,
• Gather human to achieve significant results,
• Applications in : Image processing, sound processing, data collection, NP-hard problems…
Timeline

1750
- Nautical almanac 1770
- Halley comet 1758

1792
- Telegraph

1850
- Coastal Weather

1876
- Telephone

1900
- Audubon society project

1930
- Math tables

1960
- Internet

1990
- WWW

2004
- ESP game

2006
- Startdust

2008
- Phylo

2007
- GalaxyZoo

2010
- Foldit

This class
A New Era

The Web changed everything!

Crowdsourcing
Crowdsourcing is everywhere!
Amazon Mechanical Turk

[Image of the Amazon Mechanical Turk website with various HITs listed, including:
- Image Tagging - Answer questions about one image.
- Find Restaurant Web Addresses.
- Product Search Relevance.
- Verify Restaurant Websites.
- Find Business Web Addresses.]
Games with a purpose

(E. Law et al., 2007)
Citizen Science

eBird | Gulf Coast Oil Spill Bird Tracker
Hundreds of bird species could be impacted by the Gulf Coast oil spill, including species shown here.

Brown Pelican
Recently removed from the endangered species list, the rebounding population nests on coastal islands throughout the impact zone.

Explore interactive sightings map

Zooniverse
REAL SCIENCE ONLINE

THE MILKY WAY PROJECT

planethunters.org

GALAXY ZOO HUBBLE

SOLAR STORMWATCH

MOON ZOO

fppt.com
Scientific games

The Scientist, January 2013
Related concepts

• **Crowdsourcing**: A process that involves outsourcing tasks to a distributed group of people.

• **Collective intelligence**: A shared or group intelligence that emerges from the collaboration and competition of many individuals and appears in consensus decision making in animals, and computer networks.

• **Social computing**: Technology for supporting any sort of social behavior in or through computational systems (E.g. blogs, email, wiki, social networks, etc.).
Volunteer computing

Share your computing resources
3 central aspects

What operations to perform

To whom are assigned the operations

How to perform the operations

Human-computer system
What

• What tasks can be performed by machines? Can human & computers collaborate?
• How do we decompose the tasks?
• How do we aggregate noisy & complex output?
Who

- What are the best interfaces?
- How do we model the expertise of workers (over time)?
- How do we allocate tasks to workers?
- How to manage cultural aspects and language barrier?
How

- How do we motivate people on short & long-term?
- How do we design mechanisms that prevent cheating?
- What are interaction structures for defining how workers interact?
“Given a computational problem from a requester, design a solution using both automated computers and human computers.”
Computational problems

• Multiplication: two numbers ➔ product
• Sorting: set of objects ➔ set of objects sorted
• Medical diagnosis: x-ray, lab tests ➔ diagnosis
• Object recognition: image ➔ tag
• Translation: source sentence ➔ target sentence
• Editing: text ➔ corrected text
• Planning: goal, constraints ➔ sequence of actions
What is an algorithm?

“A finite set of rules which gives a sequence of operations for solving a specific type of problem” such that:

- **Input:** One or more inputs
- **Output:** One or more outputs which have a specific relation to the input(s)
- **Finiteness:** It must terminate after a finite number of steps.
- **Effectiveness:** Each operation needs to be basic
- **Definiteness:** Each step must be well defined and unambiguous.

(Knuth, 1973)
Reference

Human Computation
Edith Law, Luis von Ahn
Morgan & Claypool Publishers