

# Information and Society-E2

## Crowdsourcing and Human Computation

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# Human Computation

# Introduction

- Some **problems** are still **hard** for computers, e.g.:
  - Visual perception  
(e.g. Object recognition)
  - Natural language analysis  
(e.g. Sentiment analysis)
  - Planning and reasoning  
(e.g. Which route to take? What should you see in Paris?)

# Introduction

- Developing ***AI algorithms*** to solve these problems can be **difficult** or/and **needs time**
  - However, ***humans*** are able to perform these tasks much better and require little effort
  - In general, ***understanding (making sense of something)*** is more difficult for computers but relatively easier for humans
- Instead of spending time and effort developing new and sophisticated algorithms, it might be easier to ***mobilise a large number of people*** to help you perform these tasks

# Human Computation

## What is Human Computation?

**Firstly, we have to ask ourselves: what is computation?**

- *The process of receiving some data input, processing it, and producing some output*

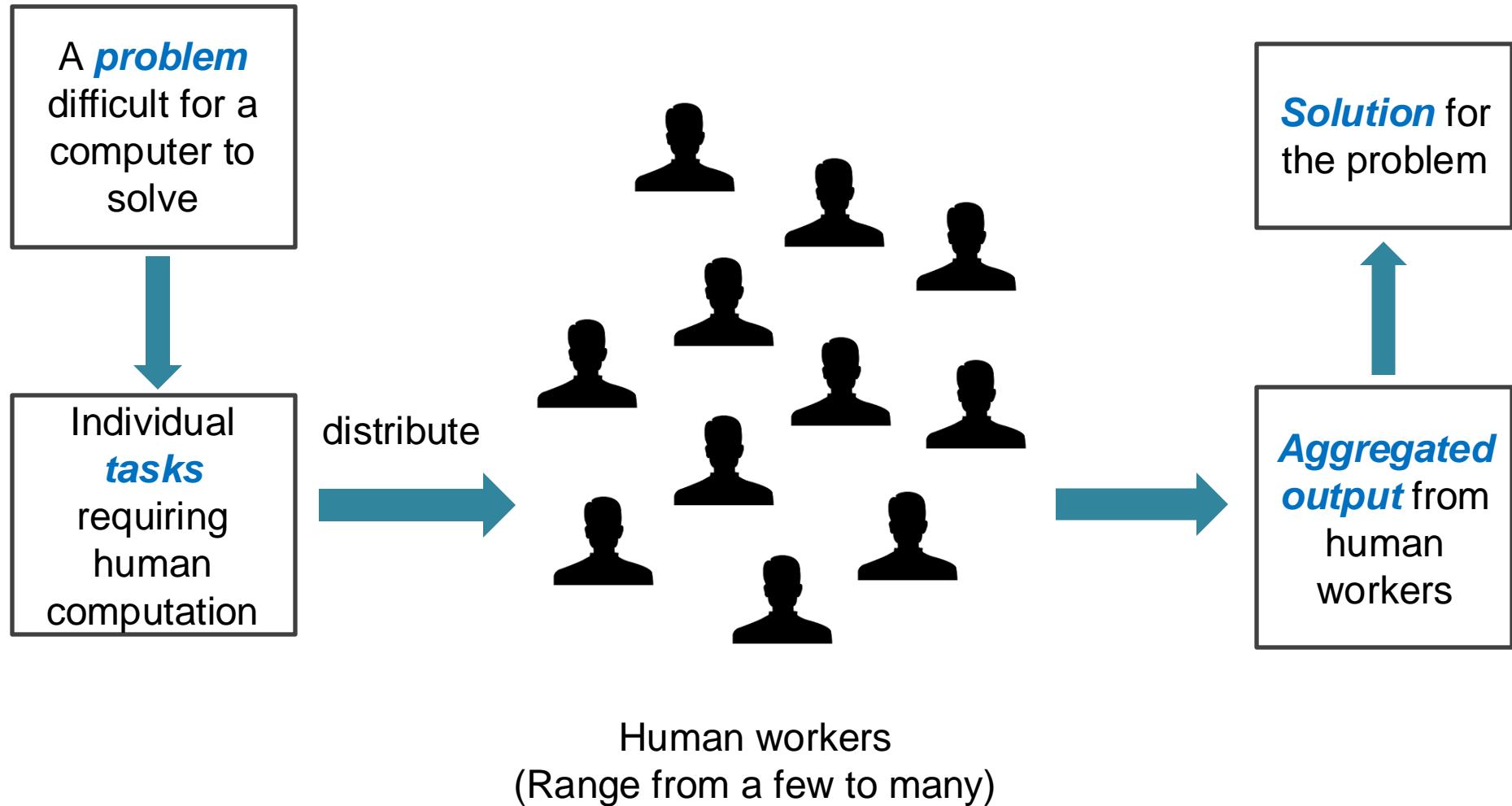
## Human Computation

- Computation carried out by human beings

→ A new research area, continuously evolving

# Human Computation

**What does a human computation system look like?**



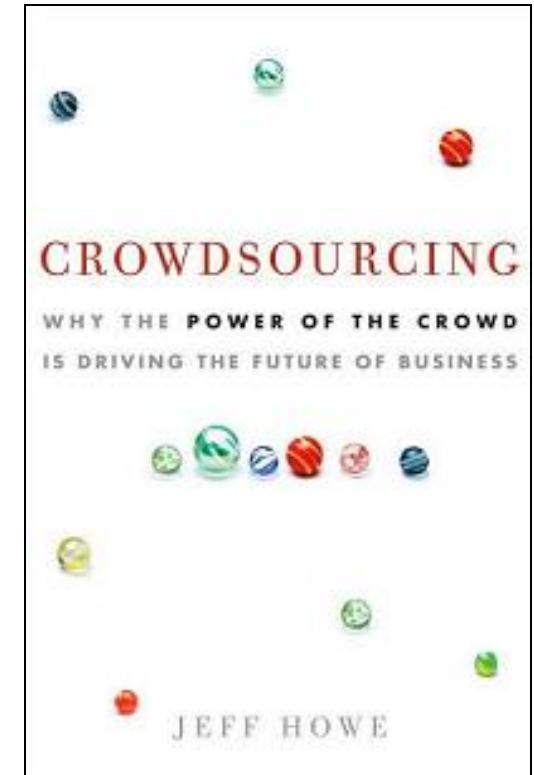
# Crowd-sourcing

# Crowd-sourcing

- What is **crowd-sourcing**? (ref. out-sourcing?)
- To obtain solutions, ideas, services, etc., by soliciting input from a large number of people

*“Crowdsourcing is the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call.”*

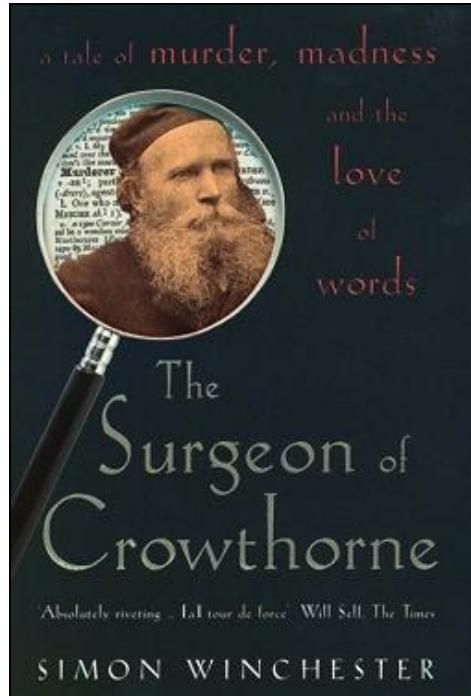
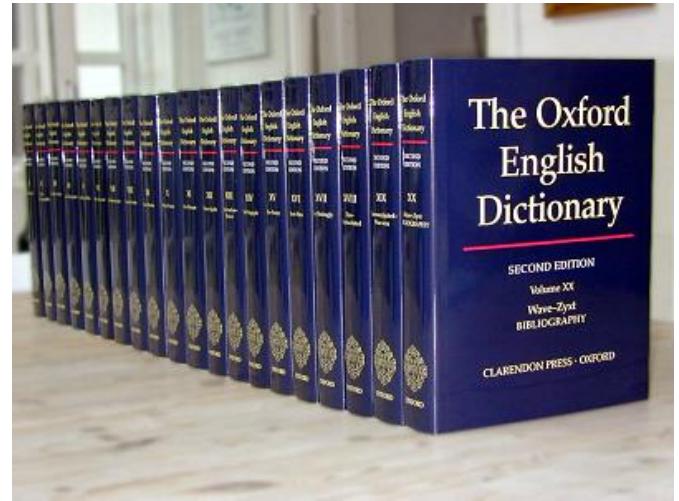
Jeff Howe (Contributing Editor of Wired Magazine)  
[\(http://crowdsourcing.typepad.com/\)](http://crowdsourcing.typepad.com/)



# Crowd-sourcing Examples

## The Oxford English Dictionary (OED)

- The dictionary asked people to ***contribute words in the English language and their examples***
- Over 70 years, they received more than ***6 million submissions***



# Crowd-sourcing Examples

## Waze: Crowd-sourced navigation and traffic information

The Waze website homepage features a large smartphone icon on the left displaying a map with a route to the Golden Gate Bridge. The text "Get the best route, every day, with real-time help from other drivers." is prominently displayed in the center. Below this is a "Download" button with "FREE" and links to the App Store and Google Play. A descriptive paragraph explains that Waze is a community-based traffic and navigation app that saves time and gas money. Navigation links at the bottom include "Guided tour" and "What's new?".

waze OUTSMARTING TRAFFIC, TOGETHER.

Live Map My Dashboard Community Support Blog

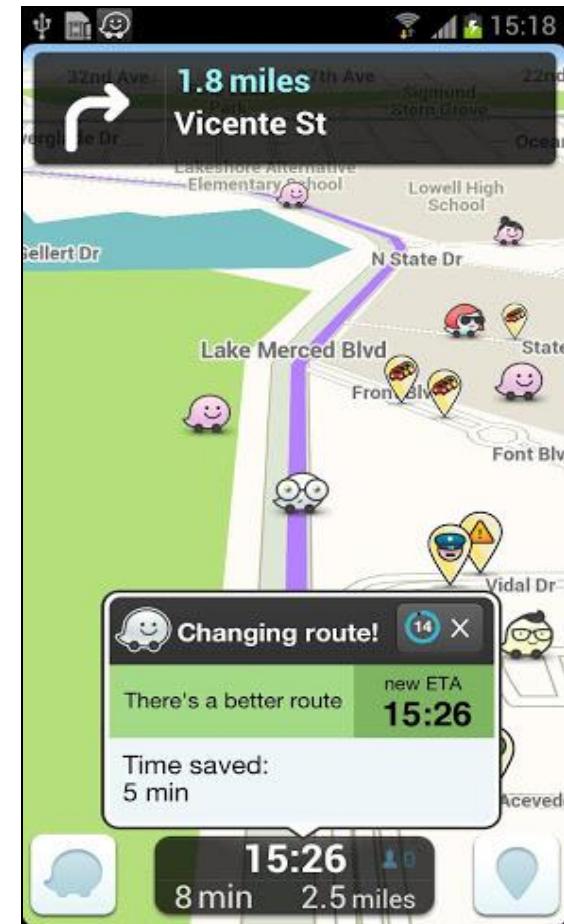
Get the best route, every day, with real-time help from other drivers.

Download FREE

Available on the App Store Get it on Google play

Waze is the world's fastest-growing community-based traffic and navigation app. Join other drivers in your area who share real-time traffic and road info, saving everyone time and gas money on their daily commute.

Guided tour What's new?



# Citizen Science

- Public participation in *scientific research*
- New technologies such as **mobile devices**, **mobile apps**, and **mobile broadband Internet**, allow people to *collect data* easily
- **Activities:**
  - Gather scientific data for experiments
  - Gather and share information
  - Carry out labour-intensive tasks to speed up scientific research

# Citizen Science

- Project Noah “Networked Organisms And Habitats”  
(<http://www.projectnoah.org/>)

The screenshot shows the Project Noah homepage. At the top, there is a brown navigation bar with links for Home, Organisms, Blog, Missions, Education, and Sign in. Below the navigation bar is the Project Noah logo, which includes the word "project" in lowercase and "noah" in a larger, stylized font with a green leaf icon above the letter "o". To the right of the logo is a descriptive text block: "Project Noah is a tool to explore and document wildlife and a platform to harness the power of citizen scientists everywhere." To the right of this text is a green button with the text "Join Project Noah Today". Below the main content area is a horizontal banner featuring various nature icons (leaves, cactus, monkey, bird, dragonfly, mushroom, frog, fish, cat, star) followed by a row of images showing a colorful bird, an orange caterpillar, a golden eagle, two puffins, a transparent butterfly, a fox, and a close-up of a hand holding a small insect. At the bottom of the page are three call-to-action boxes: "Discover thousands of organisms from around the world.", "Document nature with your mobile phone.", and "Help scientists with ongoing research." Each box contains an icon related to its function.

Home      Organisms      Blog      Missions      Education      Sign in

project noah

Project Noah is a tool to explore and document wildlife and a platform to harness the power of citizen scientists everywhere.

Join Project Noah Today

Discover thousands of organisms from around the world.

Document nature with your mobile phone.

Help scientists with ongoing research.

# Citizen Science

- iNaturalist (<http://www.inaturalist.org/>)



**Explore!**  
Your World!



**Learn!**  
About Life!



**Record!**  
Add Observations!

Welcome! to **iNaturalist.org**, where you can **record** what you see in nature, **meet** other nature lovers, and **learn** about the natural world.

[Learn More »](#) [Sign Up!](#)

**Recent additions**

**A** Plants  
Observer: finatic  
Date: Apr 6, 2013  
Date added: Apr. 10, 2013  
[ID Please!](#) [View »](#)



[3 photos »](#)

**B** mustard  
Observer: finatic  
Date: Apr 6, 2013  
Date added: Apr. 10, 2013  
[View »](#)

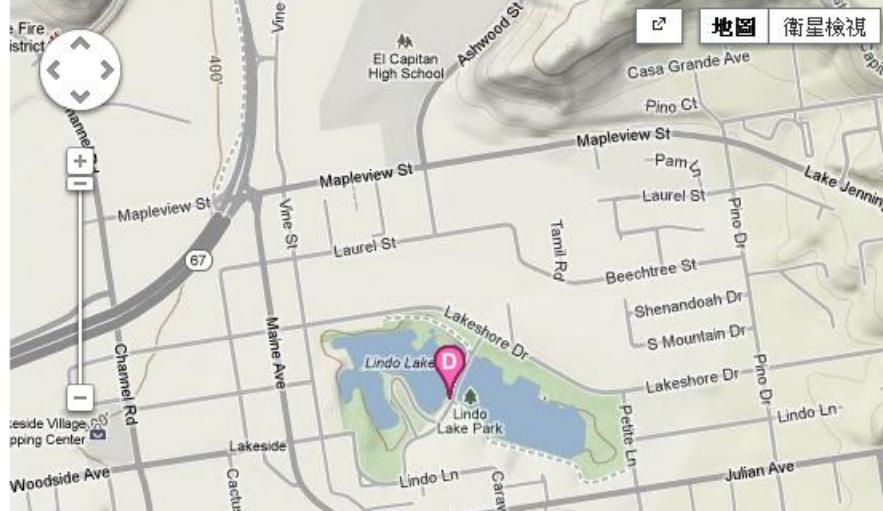


[2 photos »](#)

**C** wild radish  
Observer: finatic  
Date: Apr 6, 2013  
[View »](#)



[Date: Apr 6, 2013](#)



# Citizen Science

- Galaxy Zoo (<http://www.galaxyzoo.org/>)



# reCAPTCHA

## Problem 1:

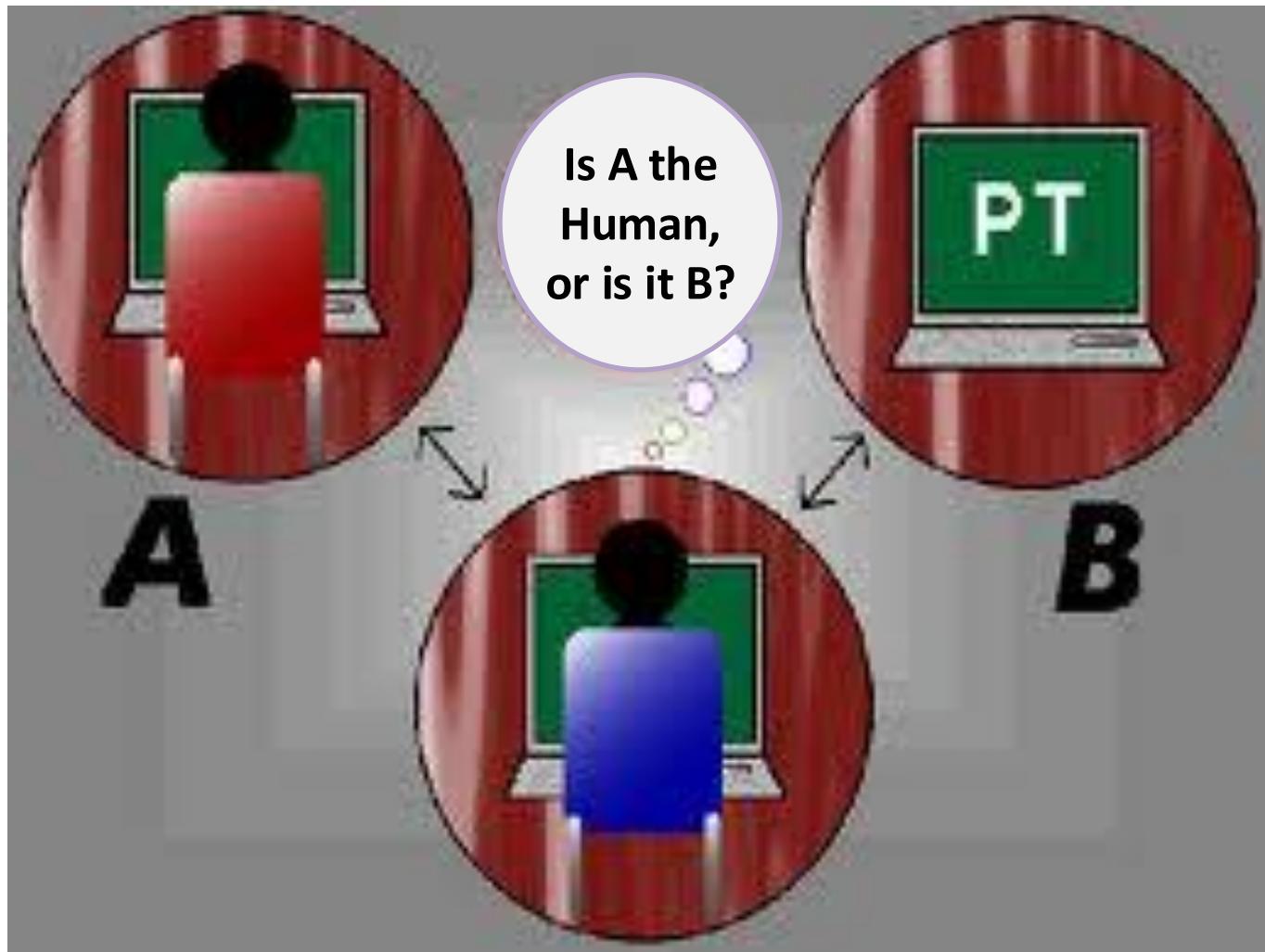
- Online forms (e.g. registrations, applications) can be filled in ***programmatically*** (using some automatic programs or scripts)
- ***Spamming*** becomes a severe problem for online forms on Websites
- How can we ***verify that it is a human*** that is filling in the form?



vs.

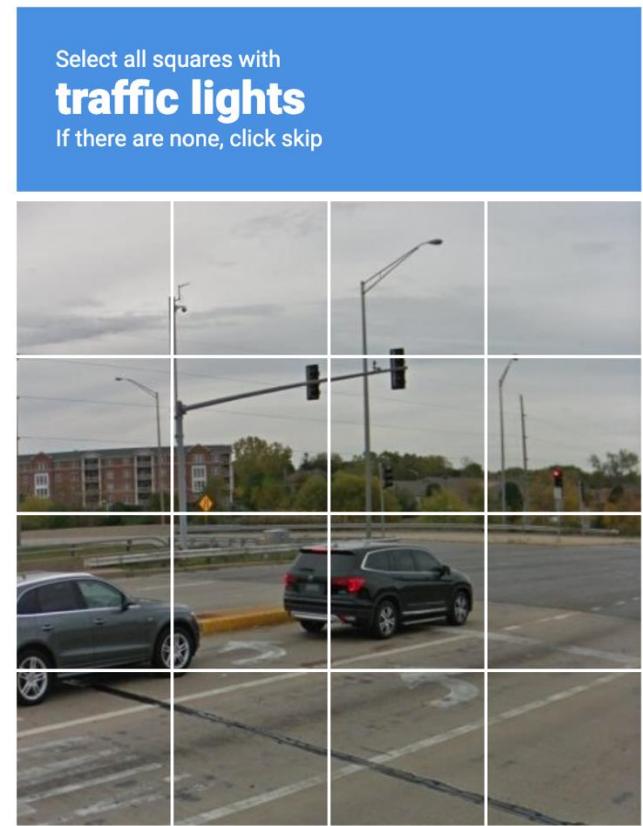
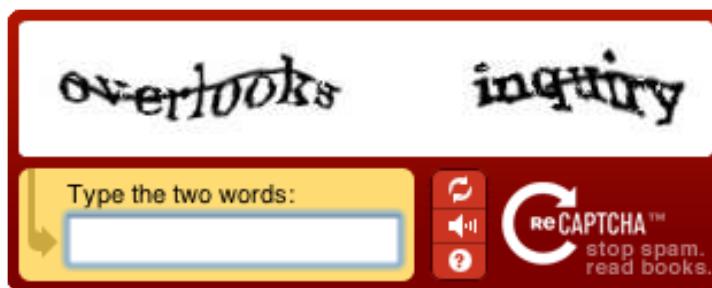
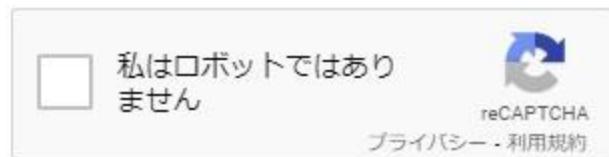


# Turing Test and Reverse Turing Test



# reCAPTCHA

## What is this?



SKIP

# reCAPTCHA

## Problem 2:

- We are motivated to **digitize old documents** (e.g. newspapers, magazines, books) for various reasons:
  - To preserve the content
  - To search the content digitally



- However, old texts are printed using **different fonts**, paper in a book may have **deteriorated**, printing **may not be clear**
- Difficult for **OCR programs** to achieve high accuracy (< 70%)

# reCAPTCHA

## Source Document (Medium Quality)

The Breckinridge and Lane Democrats, having taken courage at the recent eastern advices, are organizing energetically for the campaign. Several prominent Democrats who at first favored DOUGLAS, are coming out for the other side, apparently under the pressure of Federal influence. An address to the National Democracy of California, urging the party to support BRECKINRIDGE, has recently been published, which manifestly has strengthened that side of the question. It is signed by 65 Democrats, many of whom occupy respectable and prominent positions in the party, 22 of them are Federal office-holders, eight more are recipients of Federal patronage, and the others represent a mass of politicians giving the document most weight. The Douglas Democrats are also active. The Irish and German vote will mostly go with that branch of the party, but it is difficult to estimate which wing is the stronger. Thus far 17 Democratic newspapers have declared for DOUGLAS, 13 for BRECKINRIDGE, and 9 remain non-committal, with even chances of going either way. Under these circumstances the Republicans entertain not unjustifiable hopes that the Democratic divisions may be so equally balanced as to give the State to LINCOLN. Some very respectable Bell and Everett meetings have been held in different parts of the State, but thus far that party does not exhibit much rank and file strength.

Source Document  
(Scanned Image)

## OCR Transcription

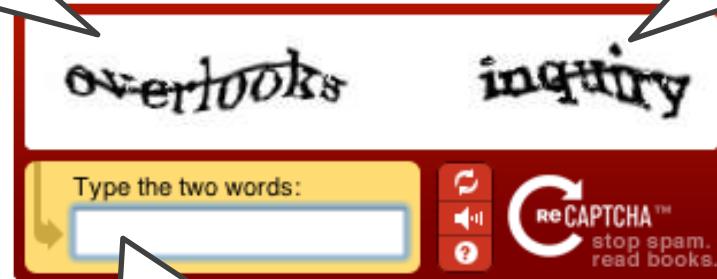
The Breckinridge and Lane Democrats, having taken courage at the recent eastern advises, are [xxxxxxxxx] energetically for the campaign: Several prominent Democrats who at first favored DonoLea, are coming out for the other aide, apparently under the [xxxxxxx] of Federal [xxxxxxx]. An address to the National Democracy of ,ifornia, urging the party to support HaeeslipsIDas, has recently been published, which manifestly has strengthened that aide of the [xxxxxxx]: It is signed by 65 Democrats, many of whom occupy respectable and prominent positions in the party, 22 of them are Federal office-holders, [xxxx] more are recipients of Federal patronage, and the others represent a mass of politicians giving the document [xxx] [xxxxx] mTheDcu8las Democrats are also active The Irish and German vote will mostly go with ths# branch of the party, but it is [xxxxxxx] to [xxxxxxx] [xxxx] [xxx] [xx] the stronger. Thus far 17 IT newspapers have declared for DonGres, 13 for Base\$- laaIDGS and 9 remain non-committal, with even chances of going either way. Under these circumstances the Republicans entertain not unjustifiable hopes that the Democratic divisions may be so equal,- ly balanced as to give the State [xx] LiaCOLV. Same very [xxxxx] Bell and Everett meetings have been held in different parts of the State, bat thus far that party does not exhibit much rank sad ale air en.

OCR Output  
(Text)

# reCAPTCHA

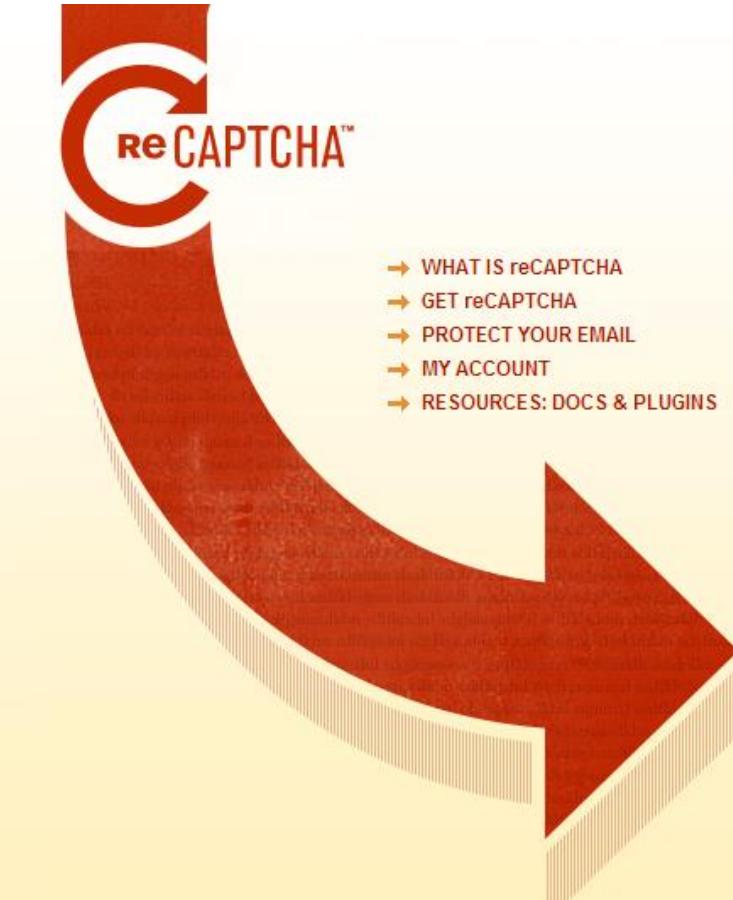
A word selected from the database, the correct answer of which is known (**control word**)

A word from the output of OCR on some old texts.  
**Human verification** needed.



It is difficult to design a computer program/algorithm to do this task, while a human being is able to do so rather easily.

# reCAPTCHA



**reCAPTCHA™**

- WHAT IS reCAPTCHA
- GET reCAPTCHA
- PROTECT YOUR EMAIL
- MY ACCOUNT
- RESOURCES: DOCS & PLUGINS

reCAPTCHA IS A FREE ANTI-BOT SERVICE THAT HELPS DIGITIZE BOOKS.

steamboat train, from New this morning ran off the track New-London. Four cars plunged

*morning upon*

Type the two words:

→ LEARN HOW reCAPTCHA WORKS

USE reCAPTCHA ON YOUR SITE

- 🔒 STRONG SECURITY
- ➡ ACCESSIBLE TO BLIND USERS
- ➡ 30+ MILLION SERVED DAILY

**NEW** See how accurate reCAPTCHA is at digitizing content!

[Blog](#) | [About Us](#) | [Contact](#) | [FAQs](#) | [Terms](#)  
© 2013 Google, all rights reserved.

<http://www.google.com/recaptcha>

# reCAPTCHA

**CAPTCHA** = “**C**ompletely **A**utomated **P**ublic **T**uring test to tell **C**omputers and **H**umans **A**part”

## Past statistics

- Over 100 million CAPTCHAs are displayed everyday
- 750 million people (**10 % of humanity**) have helped digitize at least one word
- Current transcription rate / day: > 160 books

Try if you have a Website:

<https://developers.google.com/recaptcha/>

# Games with a Purpose (GWAP)

- People like to play *games*
- What if we incorporate human computation elements into a game?
- Players are made *to solve some computational tasks* that are difficult for computers, while they are playing the game

# Games with a Purpose (GWAP)

The screenshot shows the homepage of the gwap website. At the top, there is a navigation bar with links: gwap, ESP Game, Tag a Tune, Verbosity, Squigl, Matchin, Flipit, and PopVideo. Below the navigation bar, there is a login form with fields for email and password, a 'Sign In' button, a 'remember me' checkbox, and links for 'forgot password?' and 'We have partially resumed operations, this message will disappear when all services are online.' On the left side, there is a large call-to-action banner with the text 'Play the Games, Change the Web.' and a subtext 'When you play a game at Gwap, you aren't just having fun.' It features three large buttons: 'Gender Guesser' (blue), 'Prizes' (orange), and 'Best Images' (blue). On the right side, there is a preview of the 'ESP Game' interface, which asks 'What do you see in an image? Do you have ESP?' with a sample image of a tree and a pink 'PLAY NOW' button. At the bottom, there is a 'Top 10' scoreboard with the following data:

Rank	User	Score
1	Today's	
2	All Time	
3	Top 10	10
4	guest243271	9,900
5	skuppins	8,225
6	rosie	7,875
7	Lottie	7,850
8	guest243248	7,650

At the very bottom, there are links for 'Blog', 'About', and 'Contact'.

# GWAP Examples

## Object Recognition

- In computer vision research, object recognition is an important task
- While developing new algorithms, training data with ***ground truth (annotations)*** are usually needed



Ferrari, Sports Car, Red Car



A380, Airbus, Aeroplane

# The ESP Game

- Two users are shown the same image
- When they come up with the same word for describing the image, they can proceed to the next stage



# The ESP Game



'sheep' is a label  
for this image.

# Other Social Computing Examples: Community QA (CQA) Sites, Wikipedia, etc.

The screenshot shows the Yahoo! Answers homepage. At the top, there's a purple navigation bar with links for 'トップ' (Top), 'カテゴリ' (Category), '回答ひろば' (Answering Room), a search bar, and a button to 'Q 質問する' (Ask a question). Below the bar, the 'YAHOO! ANSWERS' logo is prominently displayed. The main area features three main sections: 'Ask' (with a question mark icon), 'Answer' (with a smiley face icon), and 'Discover' (with a exclamation mark icon). Each section has a brief description and a 'Continue' or 'Browse Open Questions' button. A large search bar at the bottom is labeled 'What are you looking for?' and 'Search Answers'.

Answers.com® | 📚 WikiAnswers®  
The world's leading Q&A site

The screenshot shows the Answers.com homepage. It features a green header with 'Ask' and 'Answer' buttons. A central search bar is labeled 'Enter question or phrase...' with a 'Go' button. Below the search bar is a link to 'Unanswered questions'. The top navigation bar includes 'Search' and options for 'All sources', 'Community Q&A', and 'Reference topics'.

The screenshot shows the answerbag homepage. The header features the 'answerbag' logo with the tagline 'Every Question Deserves a Great Answer'. To the right is a search bar labeled 'Find your answer' with a 'Custom Search' field and a 'Search' button. Below the search bar is a link to 'Ask a new question or post a poll.' The main navigation menu at the bottom includes 'HOME', 'CATEGORIES', 'TOPICS', 'QUESTIONS', 'POLL'S', 'DEBATES', 'FORUMS', 'Connect', and 'Login / Register'. A large 'Ask a question' input field is located at the bottom center.

# Crowd-sourcing Market Places

# Amazon Mechanical Turk

## Amazon Mechanical Turk

<https://www.mturk.com/mturk/>

### Make Money by working on HITs

HITs - *Human Intelligence Tasks* - are individual tasks that you work on. [Find HITs now.](#)

As a Mechanical Turk Worker you:

- Can work from home
- Choose your own work hours
- Get paid for doing good work



### Get Results from Mechanical Turk Workers

Ask workers to complete HITs - *Human Intelligence Tasks* - and get results using Mechanical Turk. [Get started.](#)

As a Mechanical Turk Requester you:

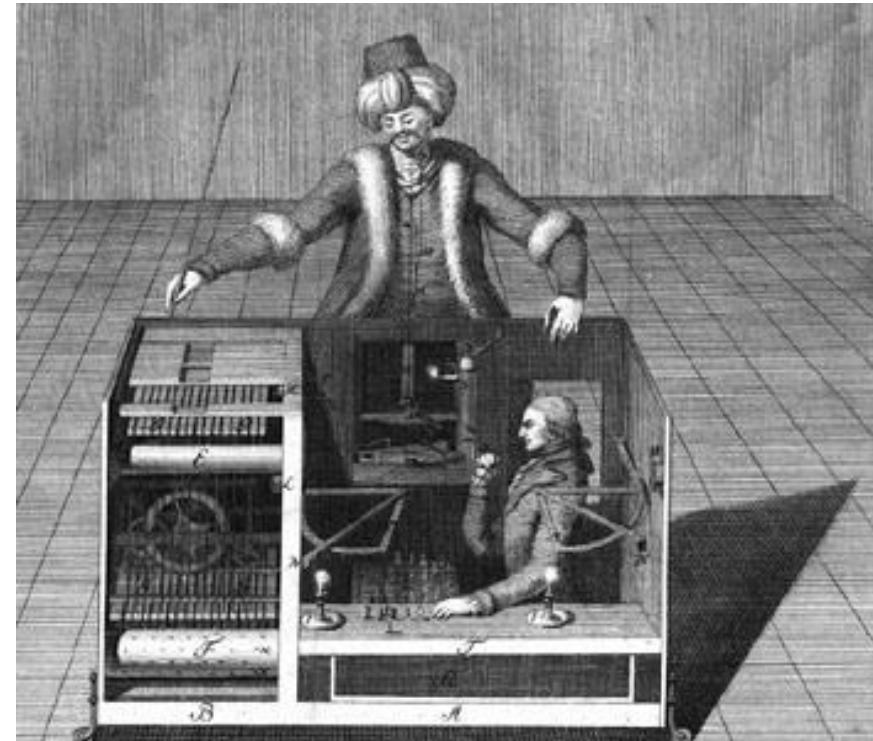
- Have access to a global, on-demand, 24 x 7 workforce
- Get thousands of HITs completed in minutes
- Pay only when you're satisfied with the results



# Amazon Mechanical Turk

## What is ‘the Mechanical Turk’?

- A fake chess-playing machine constructed in the late 18th century.
- A human chess player hiding inside the machine was actually playing the game
- More at:  
[http://en.wikipedia.org/wiki/Mechanical\\_Turk](http://en.wikipedia.org/wiki/Mechanical_Turk)



# Amazon Mechanical Turk

- An online platform established by Amazon, where:
  - You can create a human computation / crowd sourcing task
  - Other people can come to work on the task and get paid
- Tasks are called **HITS ‘Human Intelligence Tasks’**
- 90% of the HITS have rewards < US\$0.10

# Amazon Mechanical Turk

## What kind of tasks are created on AMT?

### Created by researchers for their research projects

- Does the tweet involve **positive** or **negative** emotion?
- What is the person **doing** in the image?
- Extract person **names** mentioned in a **text** document

**Predict Home City of a Tweet User**

**Instructions**

Your task is to select **one** candidate cities that is **most likely to be** or **closest to** the home city reading a list of tweets from that user.

Please pay attention to the *locations, events, activities, organizations, businesses*, mentioned in the tweets. These hints can give hint about the location of a user.

Here are an example.

**Example 1:**

User tweets:

- Who has the best ceviche in Miami? (**hint:**The user mentioned a location name Miami.)
- I wish Graziano's Market in the Gables was open past 7 p.m. (**hint:**Graziano's Market is located in FL which is close to Miami, FL)
- I love it, it was a great move for me. You still doing the makeup?
- I think I need to move to Orlando, the Miami scene is a bit lame when it comes to meet up. Orlando, Miami are mentioned. From the context, the user doesn't seem to live in Orlando.
- The Heat play the Philadelphia 76ers. (**hint:**The Heat is a professional basketball team located in a team from Philadelphia, PA. Combined the hints above, the user is more likely from N.J. than from Miami.)

# Amazon Mechanical Turk

## What kind of tasks are created on AMT?

### Routine tasks

- Transcription (e.g. audio to text)
- Simple translations
- Copying information (e.g. from business card to text)
- Etc.

Please select/crop company logo or image from the business card above.  
Click + Drag to select the company logo.

[Click to Zoom & Rotate Image](#)

Name

Title  Company

Email  Website

Address:   
Address Line 1

[add line](#)

City  State  Zip Code

Phone: [click here if not a U.S. phone number](#) ?  
Work  Ext.

Mobile

Fax

[add phone](#)

# Problems in Human Computation & Crowd-sourcing

# Problems

- Incentive model
- Behaviourial & cognitive aspects of the users
- Decomposition of a task
- Quality assurance
- Method of aggregation
- Task routing

# Problems - Incentives

## How to motivate people to do the work?

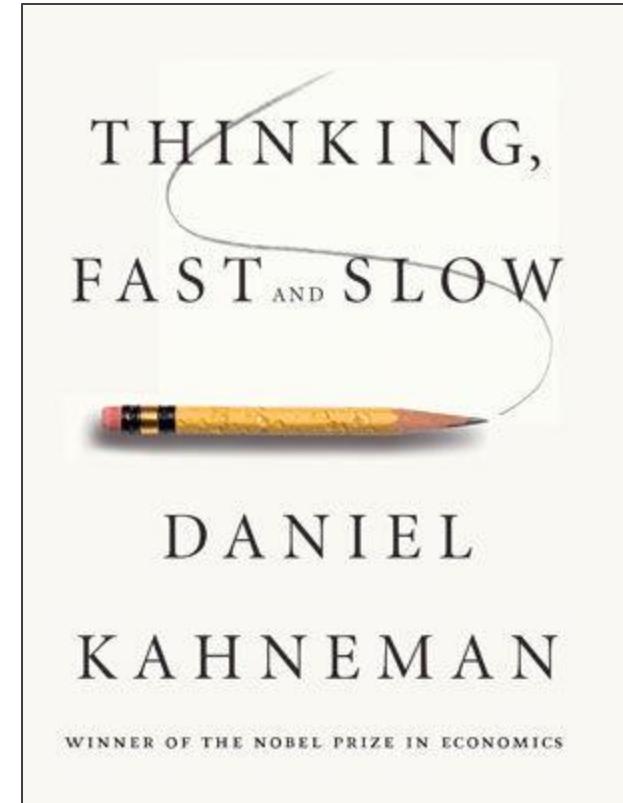
- Human computation and crowd-sourcing tasks usually have a **good and meaningful** purpose
- However, people do not work for nothing
- How can we **motivate** or **incentivise** people to take up the work?
  - **Money \$\$\$**
  - **Entertainment (games, e.g. ESP Game, Tag-a-tune)**
  - **Educational (something to learn, e.g., Duolingo)**
  - **Credits**
  - **Altruism (e.g., free food)**

# Problems – Human Errors/Biases

- Computers do not make mistakes if a program or an algorithm is designed and implemented correctly
- However, **humans** make **mistakes**
- Output of human computation can be **noisy** and **inaccurate**, even if they are legitimate workers (not spammers)

# Problems – Human Errors/Biases

- Many psychology experiments show that human can be ***systematically biased*** by how a question is presented and what information is included
- ***Cognitive Biases:***
  - Anchoring
  - Priming
  - Sequential context biases
  - Intensities of answers are connected



# Problems – Human Errors/Biases

## Anchoring (cognitive bias)

E.g. What is your best guess of the percentage of African nations in the UN?

- Participants are asked to spin a wheel, and write down the number they see
- People's guesses:
  - Mean answer = 25% for those who wrote down 10
  - Mean answer = 45% for those who wrote down 65



# Problems – Human Errors/Biases

## Anchoring (cognitive bias)

Students shown "1 x 2 x 3 x 4 x 5 x 6 x 7 x 8" made a median estimate of 512, while students shown "8 x 7 x 6 x 5 x 4 x 3 x 2 x 1" made a median estimate of 2,250

- 40,320 being the correct answer

# Problems – Human Errors/Biases

## Priming (psychology)

- According to a study at the New York University, what people read can affect their walking speed
- People are divided into two groups, one group is asked to manipulate words about the **elderly** (e.g. *wrinkle, forgetful, bald, gray, Florida, ...*)
- People in the above group walk down the corridor more **slowly** than the others.

Other examples include place of a voting booth, priming people with money-related objects, ...

# Problems – Quality Assurance

- Humans do not only make mistakes, but some may intentionally create ‘*spams*’ (e.g. just to earn the money)
- How can we ***maintain quality*** of the output in crowd-sourcing?
- **Common approaches:**
  1. **Verification** (insert tests with ground truth occasionally, ref. reCAPTCHA )
  2. **Voting** (send the same tasks to multiple workers and obtain majority votes)
  3. **Filtering** (remove worst or outlier answers)
  4. **Track user's reputation** (user ranking, black lists)

# Problems – Quality Assurance

## Inter-rater/Inter-annotator Agreement

- Let's say you are working on a ***classification task***, trying to classify datapoints into 'Yes' and 'No'
- You need some ***ground truth data***, so you ask two of your friends to label some data for you
- It is possible that they give you ***different*** answers, for example:
  - Friend A: 001=Yes, 002=No, 003=Yes, ...
  - Friend B: 001=No, 002=No, 003=Yes, ...
- At the end, how do you judge the ***quality of this labelling?***

# Problems – Quality Assurance

## Inter-rater/Inter-annotator Agreement

- We can use a statistical measure called [Cohen's Kappa](#)

$$\kappa = \frac{p(a) - p(e)}{1 - p(e)}$$

$p(a)$  is the proportion of agreement among two raters

$p(e)$  is the hypothetical probability of chance agreement

- The measure  $\kappa$  quantifies the agreement between 2 raters who each classify  $N$  items into  $C$  mutually exclusive categories
  - Complete agreement yields  $\kappa = 1$ , else 0

# Problems – Quality Assurance

## Inter-rater/Inter-annotator Agreement - Example

- Let's say you asked each of them to *label N=50 data points*:
- $P(a) = (18 + 20) / 50 = 0.76$
- $P(A \text{ says 'Yes'}) = (18 + 5) / 50 = 0.46$   
 $P(B \text{ says 'Yes'}) = (18 + 7) / 50 = 0.50$
- Therefore,  
 $P(e)$   
 $= P(\text{Both say 'Yes'}) + P(\text{Both say 'No'})$   
 $= (0.46 \times 0.50) + (0.54 \times 0.50) = 0.5$
- Kappa = 0.52

		B	
		Yes	No
A	Yes	18	5
	No	7	20

$$\kappa = \frac{p(a) - p(e)}{1 - p(e)}$$

# Problems – Quality Assurance

## Inter-rater/Inter-annotator Agreement

- Cohen's Kappa is applicable when there are 2 raters
- When there are more raters, use Fleiss' Kappa  
([http://en.wikipedia.org/wiki/Fleiss%27\\_kappa](http://en.wikipedia.org/wiki/Fleiss%27_kappa))

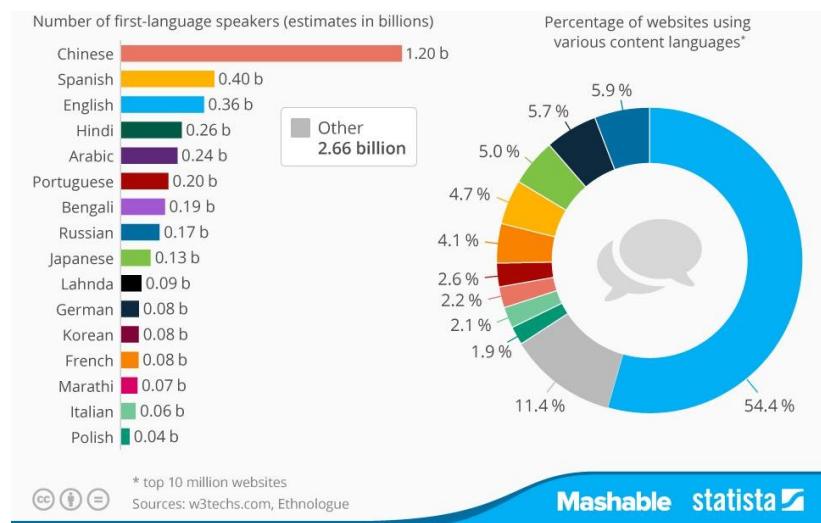
Luis von Ahn: Massive-scale Online Collaboration

<https://www.youtube.com/watch?v=-Ht4qiDRZE8>

# Summary

# Information Policy and Ethics

- ICT infrastructure
- Japan's ICT policy
- Ethical issues of ICT
- Information security and cyber crimes



consultations will focus on how the World Bank position its lending, investment, and advisory services in order to help developing countries (and respective public and private sectors) harness the next wave of opportunities presented by ICT.

# Information Education

- e-learning
- OpenCourseWare (OCW) and MOOC
- Information literacy
- Etc.

The screenshot shows the homepage of MIT OpenCourseWare. It features a large banner at the top with the text "Support the Online Learning Revolution" and several raised fists. Below the banner, there are sections for "Courses", "About", "Donate", and "Featured Sites". A "DONATE NOW" button is prominently displayed. The main content area shows "FEATURED COURSES" with thumbnail images for subjects like "Introduction to Psychology", "Teaching College-Level Mathematics", "Water Resources Engineering", and "Finance Theory". At the bottom, there are sections for "OCW NEWS" and "MEET OUR INSTRUCTORS".



The screenshot shows the homepage of Kyoto-U OpenCourseWare. The header includes the university's name and a search bar. The main content area features a "Recent lecture note" section with a thumbnail of a person speaking, followed by a "Welcome to Kyoto-U OCW" message and a "Welcome to KYOTO-U's OpenCourseWare" message. On the right side, there is a sidebar with a portrait of President Jiro Yamagishi and links to various OCW-related pages and social media links.

# Information Law

- Intellectual property rights and patents, university and patents
- Copyrights
- Personal information protection
- Etc.

- Can be implemented industrially?
- Is it new or not?
- Could it have been thought of simply?
- Has it been previously applied for?
- Is it not an anti-social invention?
- Are the contents of the invention adequately explained in the specifications document?

Industrial usability, usefulness

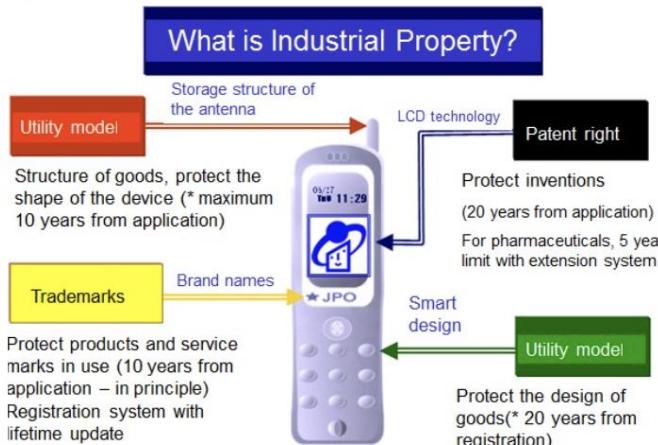
Novelty

Non-obviousness, progressivity

Previously applied principle

Sociability ?

Feasibility



## Intellectual Property Rights

### Industrial Property Rights

Patents

Utility Models

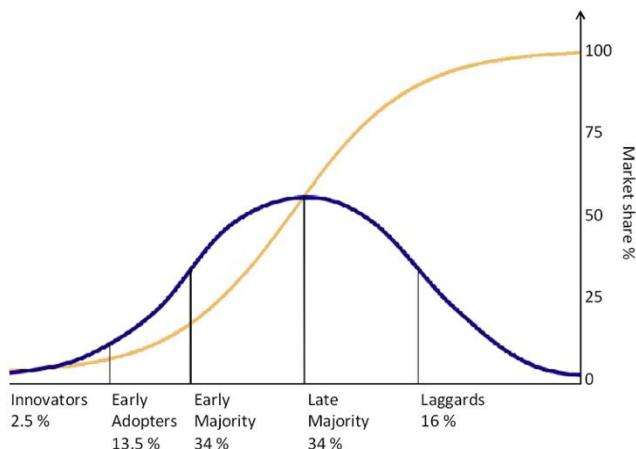
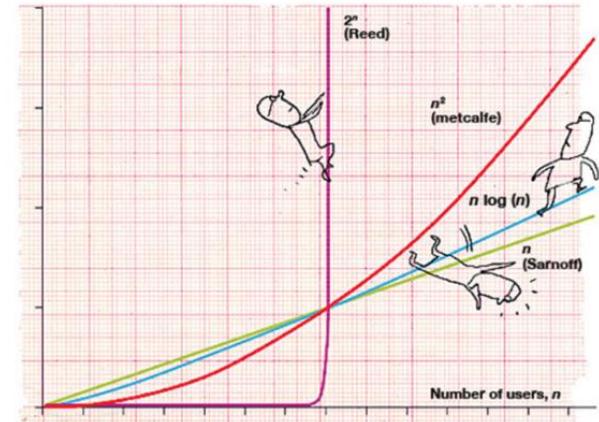
Design

Trademarks

Copyright

# Information Economy

- Impact of Internet on economy
- Externality, network externality
- Consumer search theory
- Information asymmetry
- Online advertising



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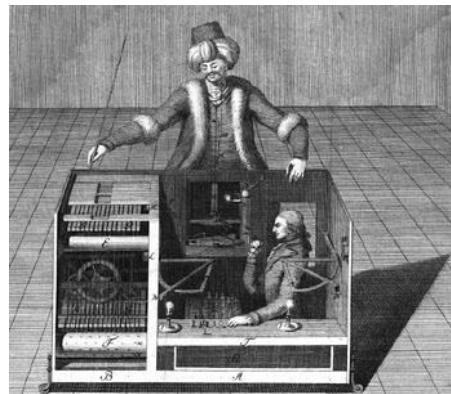
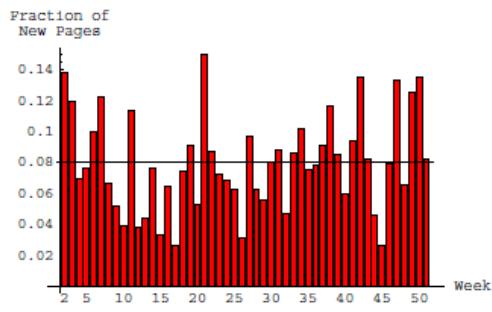
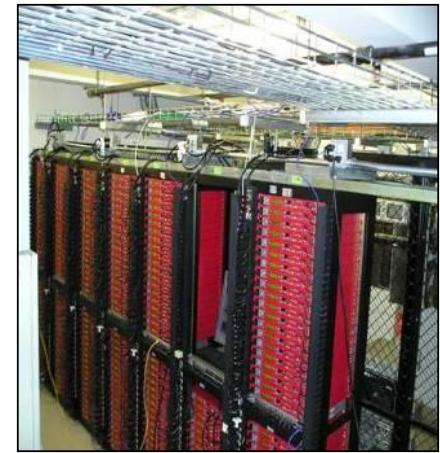
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# Other Topics

- Evolution of information society
- Information archiving
- Social media analysis
- Cloud computing
- Crowdsourcing and Human computation



# Class Questionnaire

- “Questionnaire System” in “Common Portal for All Students  
<https://student.iimc.kyoto-u.ac.jp/index.html>
- Period: July 3 (Monday) to **August 22 (Tuesday)**

# Feedback

- No specified class for feedback
- Feel free to email the instructor if you would like to discuss any of the topics of the lecture

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Kyoto University

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