

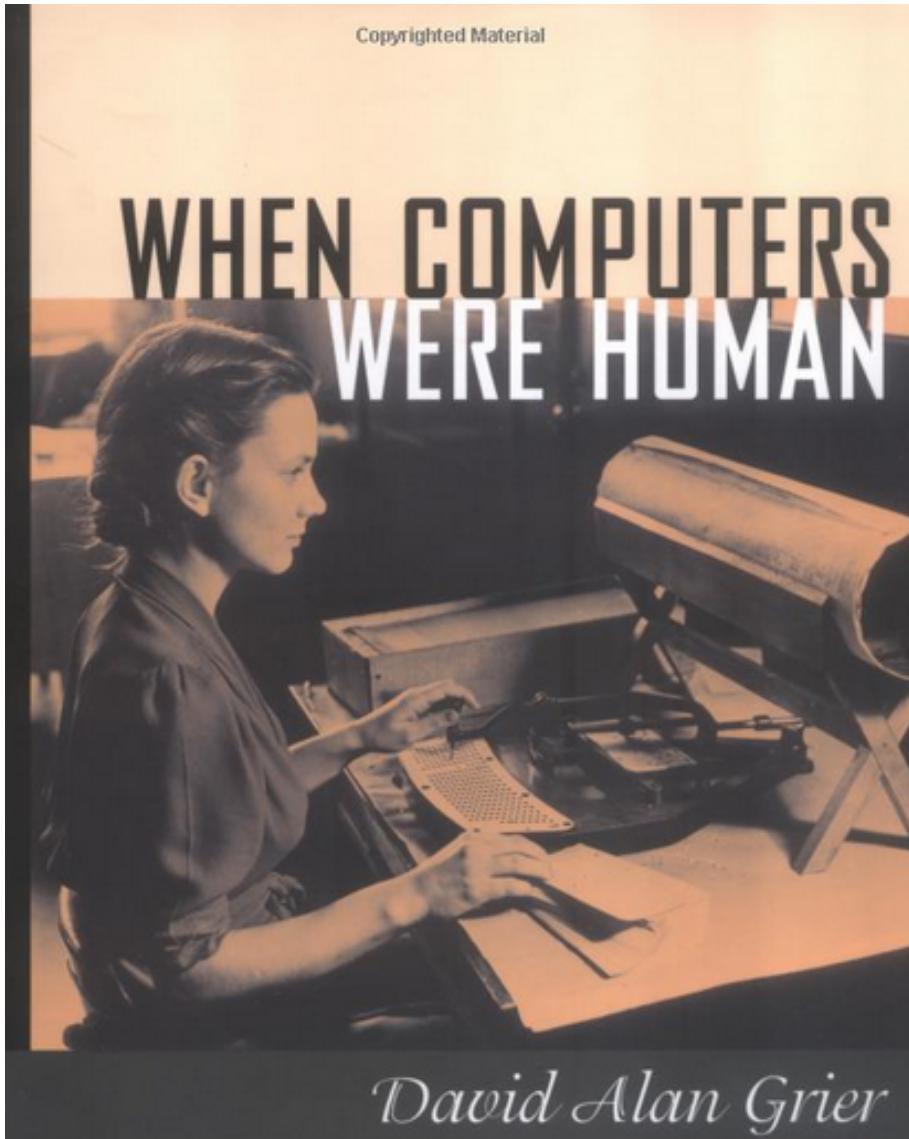
Human and Social Computation

Research at Politecnico di Milano

Definition

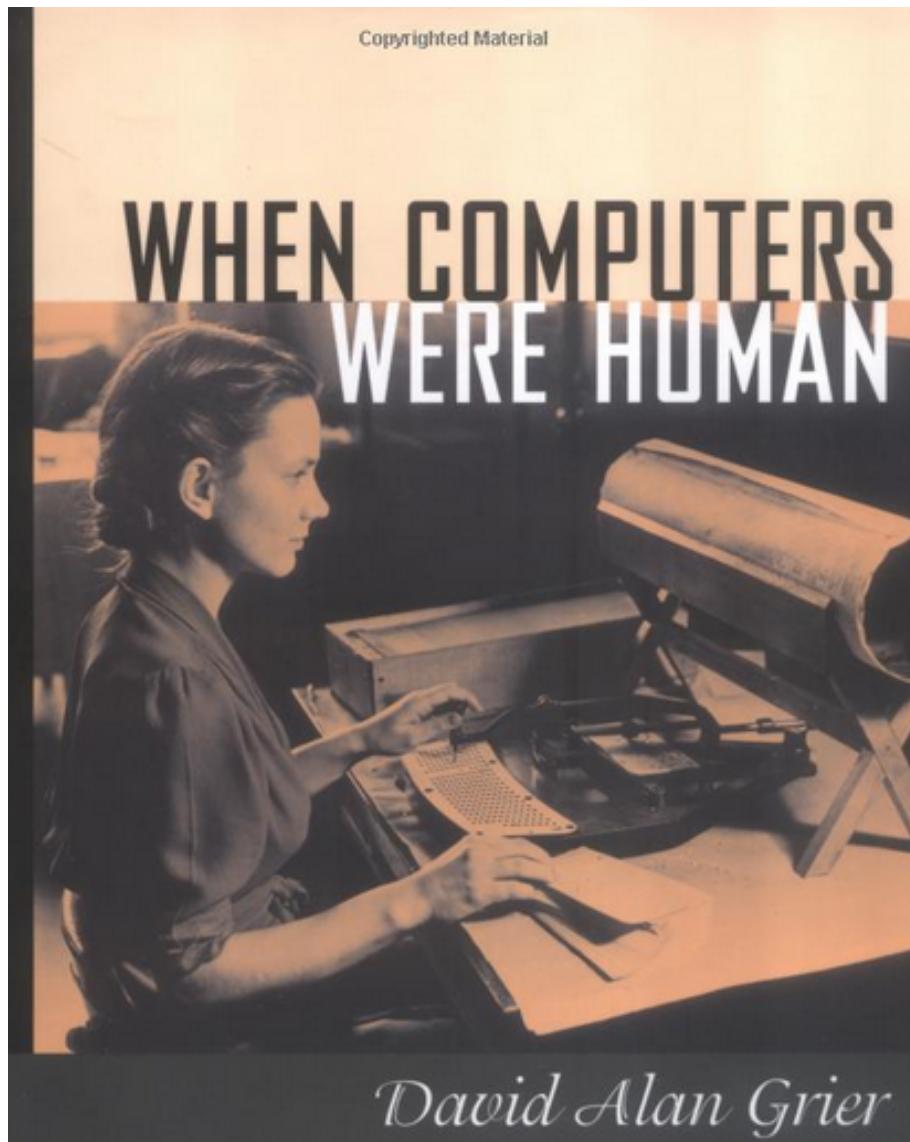
- According to Von Ahn
- Combine humans and computers to solve large-scale problems that neither can solve alone taking advantage of the human cycles
- According to Wikipedia:
- **Human-based computation** is a [computer science](#) technique in which a computational process performs its function by [outsourcing](#) certain steps to humans. This approach uses differences in abilities and alternative costs between humans and computer agents to achieve symbiotic human-computer interaction.

Human Computation, Round 1



- Humans were the first “computers,” used for math computations
- **Organized** computation:
 - Clairaut, astronomy, 1758: Computed the Halley’s comet orbit (three-body problem) **dividing the labor** of numeric computations across 3 astronomers

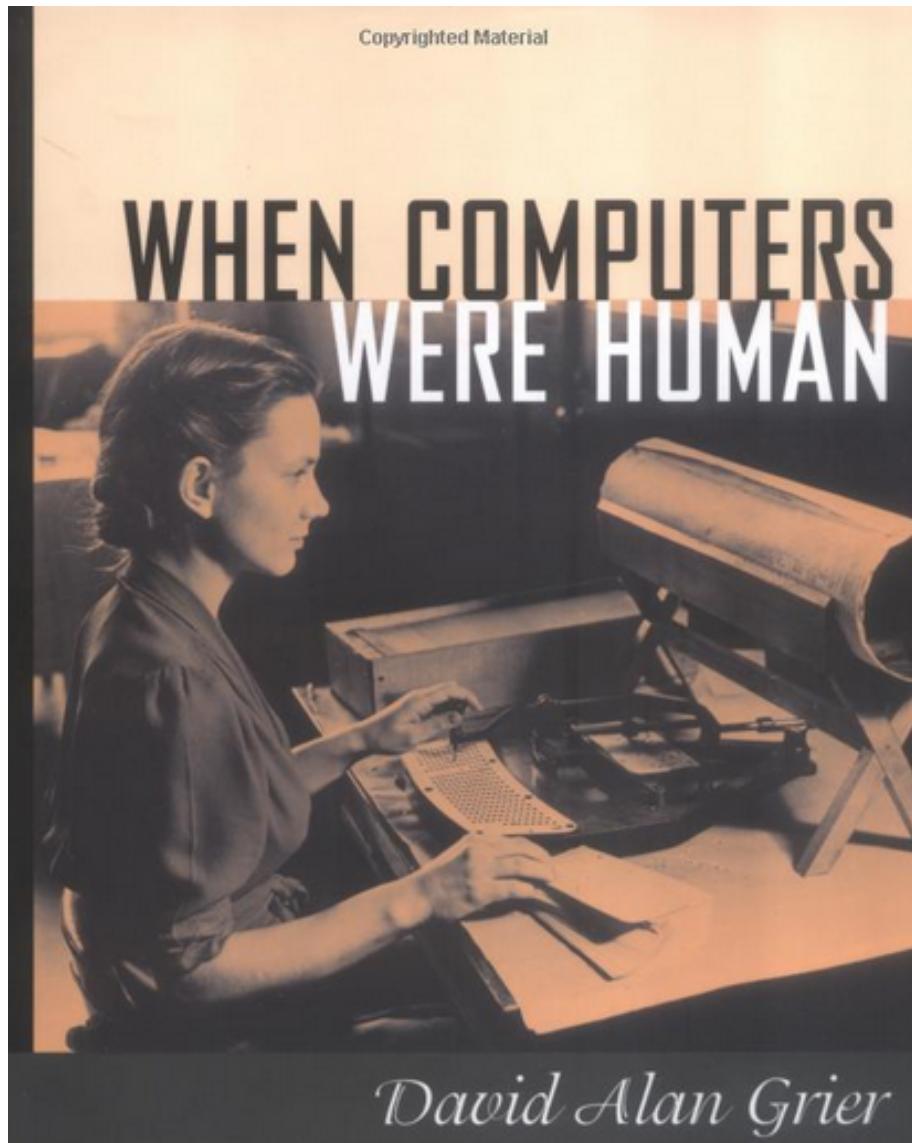
Human Computation, Round 1



- **Organized computation:**
 - Maskelyne, astronomical almanac with moon positions, used for navigation, 1760. **Quality assurance** by doing calculations twice and compared by third verifier.
 - De Prony, 1794, hires hairdressers (unemployed after French revolution; knew only addition and subtraction) to create logarithmic and trigonometric tables. He **managed the process** by splitting the work into very detailed workflows. (Hairdressers better than mathematicians in arithmetic!)

Grier, When computers were human,
Grier, IEEE Annals

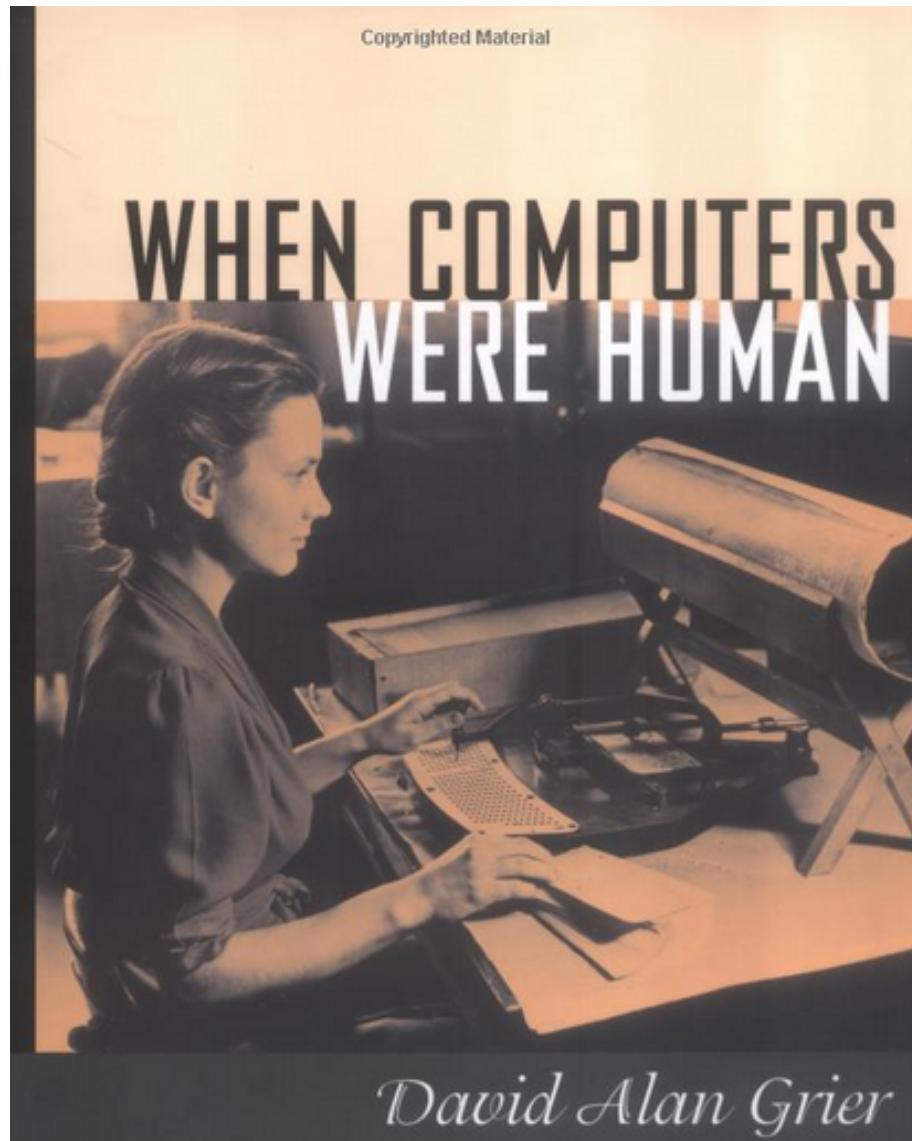
Human Computation, Round 1



- **Organized** computation:
 - Clairaut, astronomy, 1758
 - Maskelyne, 1760
 - De Prony, log/trig tables, 1794
 - Galton, biology, 1893
 - Pearson, biology, 1899
 - ...
 - Cowles, stock market, 1929
 - Math Tables Project, unskilled labor, 1938

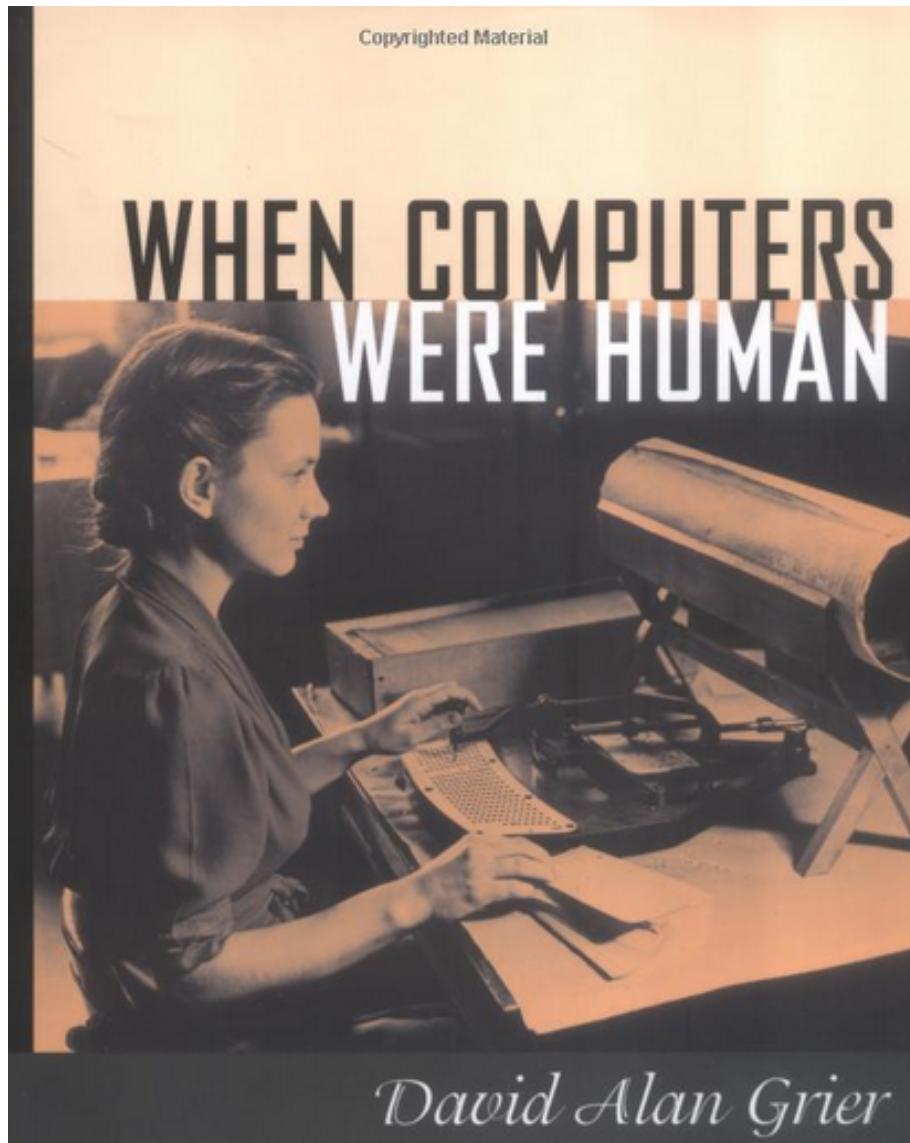
Grier, When computers were human,
Grier, IEEE Annals

Human Computation, Round 1



- Patterns emerging
 - Division of labor
 - Mass production
 - Professional managers
- Then we got the “automatic computers”

Human Computation, **Round 2**



- Now we need humans again for the “AI-complete” tasks
 - Tag images [ESP Game: voh Ahn and Dabbish 2004, ImageNet]
 - Determine if page relevant [Alonso et al., 2011]
 - Determine song genre
 - Check page for offensive content
 - ...

ImageNet: <http://www.image-net.org/about-publicatio>

CAPTCHA

A PROGRAM THAT CAN GENERATE AND GRADE TESTS
THAT:

- A. MOST HUMANS CAN PASS
- B. CURRENT COMPUTER
PROGRAMS CANNOT PASS

EXAMPLE

PICKS RANDOM STRING OF LETTERS

oamg

RENDERS IT INTO A DISTORTED IMAGE



Forms of Human Computation

- **Crowdsourcing** is a distributed model that assigns tasks traditionally undertaken by employees or contractors to an undefined crowd



- Split the task into microtasks
- Assign them to performers in the crowd
- Collect partial results into the final one

...for your large-scale data needs.

1 million on-demand workers
85.04 million tasks completed
8.60 million tasks completed last month



Paid Crowdsourcing: Amazon Mechanical Turk

All HITs

1-10 of 1984 Results

Sort by: HITs Available (most first) ▾ **GO!**

Show all details | Hide all details

1 2 3 4 5 > [Next](#) » [Last](#)

Find the email address for the company and website	View a HIT in this group
Requester: Sam GONZALES	HIT Expiration Date: Dec 13, 2010 (1 week 2 days) Reward: \$0.01
	Time Allotted: 30 minutes HITs Available: 39172
Identify Arabic Dialect in Text	View a HIT in this group
Requester: Chris Callison-Burch	HIT Expiration Date: Dec 31, 2010 (3 weeks 6 days) Reward: \$0.05
	Time Allotted: 15 minutes HITs Available: 14240
POI Verification for USA Cities	View a HIT in this group
Requester: nutella42	HIT Expiration Date: Dec 17, 2010 (2 weeks) Reward: \$0.08
	Time Allotted: 30 minutes HITs Available: 2446
Preference Judgements between Search Engine Results	View a HIT in this group
Requester: jaime arquello	HIT Expiration Date: Dec 10, 2010 (7 days) Reward: \$0.03
	Time Allotted: 5 minutes HITs Available: 1952
Keyword Category Verification	View a HIT in this group
Requester: Andy K	HIT Expiration Date: Dec 9, 2010 (6 days 2 hours) Reward: \$0.03
	Time Allotted: 60 minutes HITs Available: 1949

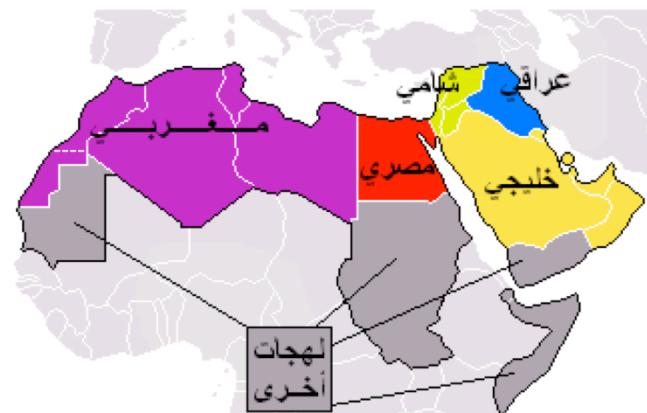
Help Classify Arabic into Dialects!

This task is for Arabic speakers who understand the different local Arabic dialects (اللهجات العامية، أو الـ)، and can distinguish them from *Fusha* Arabic (الفصحي)، (الدارجة).

Below, you will see several Arabic sentences. For each sentence:

1. Tell us how much dialect (عامية) is in the sentence, and then
 2. Tell us which Arabic dialect the writer intends.

This following map explains the dialects:



First, please answer these questions about your language abilities:
(You don't have to answer these questions in every HIT; one time is enough.)

Is Arabic your native language?

How many years have you spoken Arabic? (If native speaker, just enter ✓)

Which Arabic dialect do you understand best?

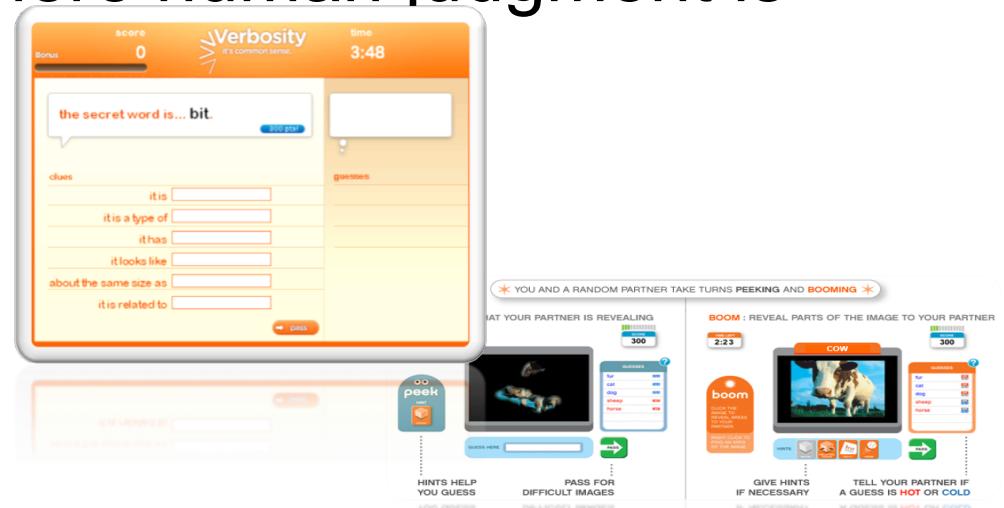
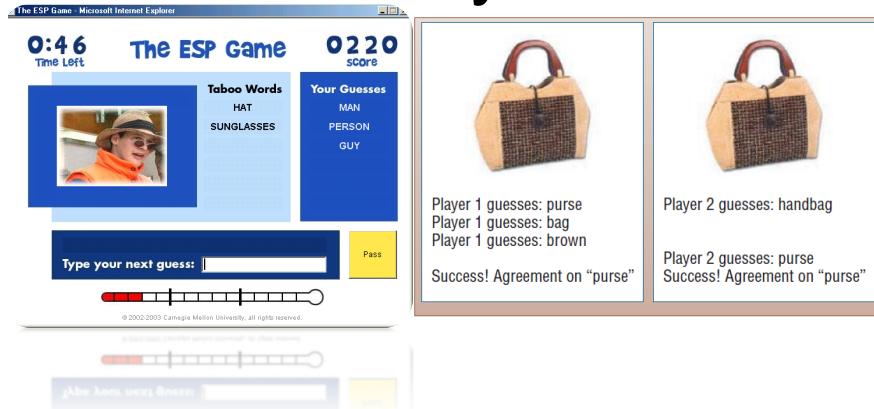
What country do you currently live in?

Choose dialect... ▾

Which Dialect? أية لهجة عامية؟	Dialect Level كمية اللهجة العامية	Sentence الجملة
Choose level first	Choose level...	..خليه براحته يا جماعة الخير .. #1
Choose level first	Choose level...	لله الله يا هلال #2
Choose level first	Choose level...	سبحان الله !! !!! واتعجب #3

Forms of Human Computation

- ***Games with a Purpose (GWAPs)***
 - Exploiting the billions of hours that people spend online playing with computer games to solve complex problems that involve human intelligence [vA06,LvA09].
 - Games with a purpose exploit gamers' time to perform useful tasks where human judgment is necessary



Types of Games

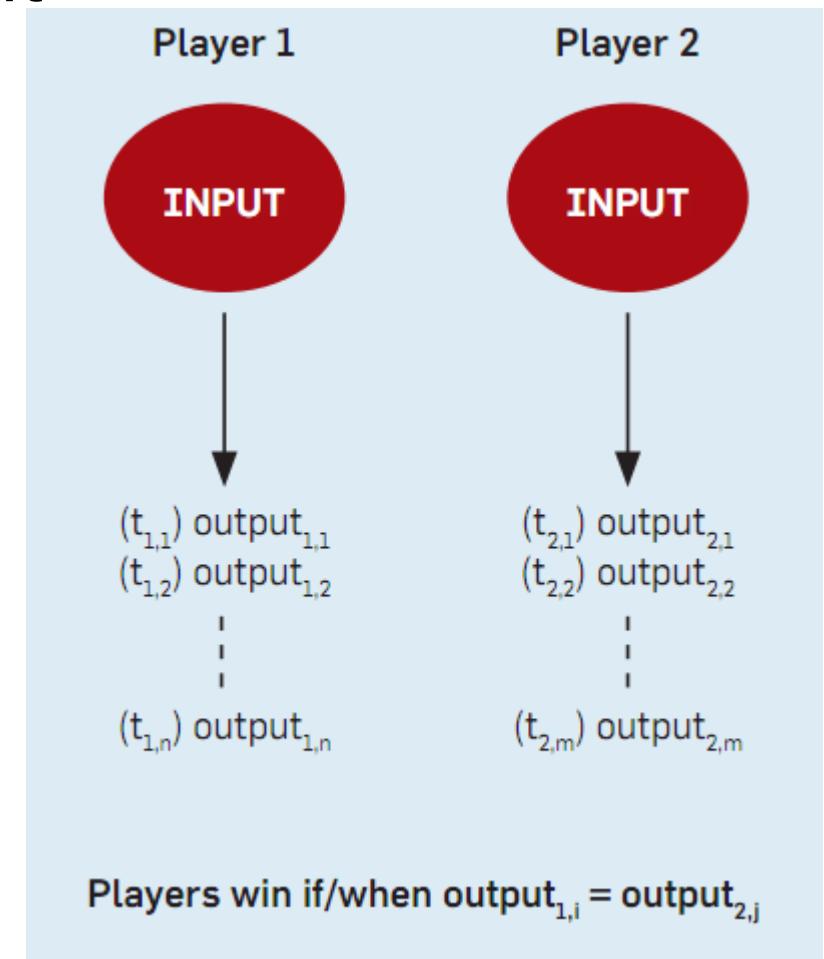
[Luis von Ahn and Laura Dabbish, CACM 2008]

Three generic game structures

- **Output agreement:**
 - Type same output
- **Input agreement:**
 - Decide if having same input
- **Inversion problem:**
 - P1 generates output from input
 - P2 looks at P1-output and guesses P1-input

Output Agreement: **ESP Game**

- Players look at common input
- Need to agree on output



Improvements

- Game-theoretic analysis indicates that players will converge to easy words [Jain and Parkes]
- **Solution 1:** Add “Taboo words” to prevent guessing easy words
- **Solution 2:** KissKissBan, third player tries to guess (and block) agreement

Input Agreement: TagATune

- Sometimes difficult to type identical output (e.g., “describe this song”)
- Show same or different input, let users describe, ask players if they have same input

Describe the tune ...

0:10

your descriptions

fast drums

only drums over and over
same beat

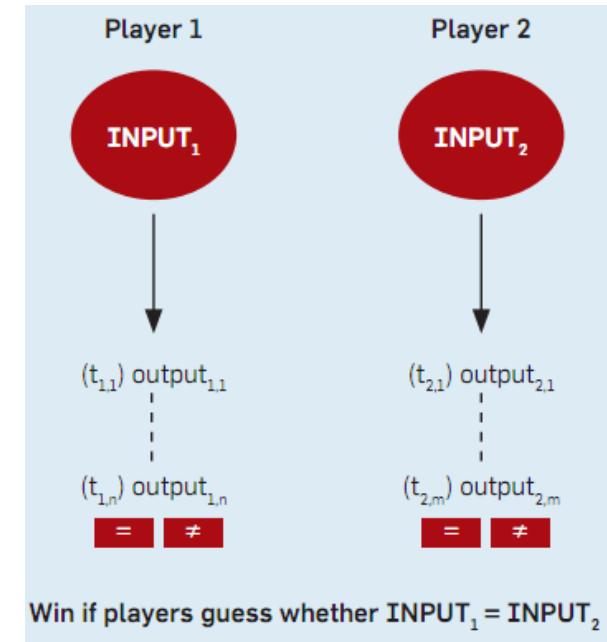
your partner's descriptions

fast drums

only drums over and over
same beat

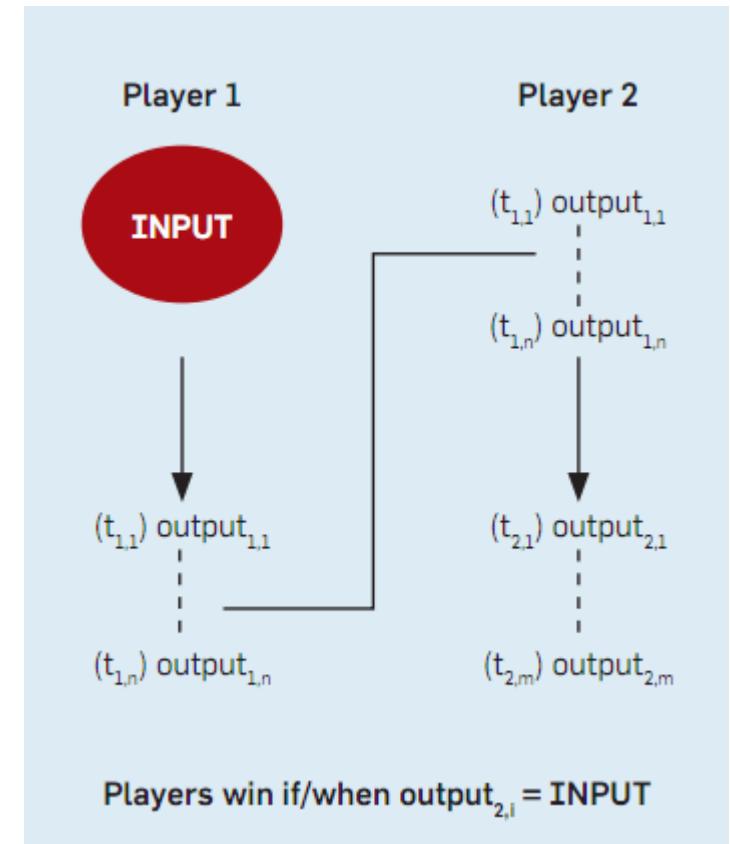
fast drums

+ submit pass



Inversion Problem: Peekaboom

- Non-symmetric players
- Input: Image with word
- Player 1 slowly reveals pic
- Player 2 tries to guess word



Peekaboom





HINT





HINT





HINT





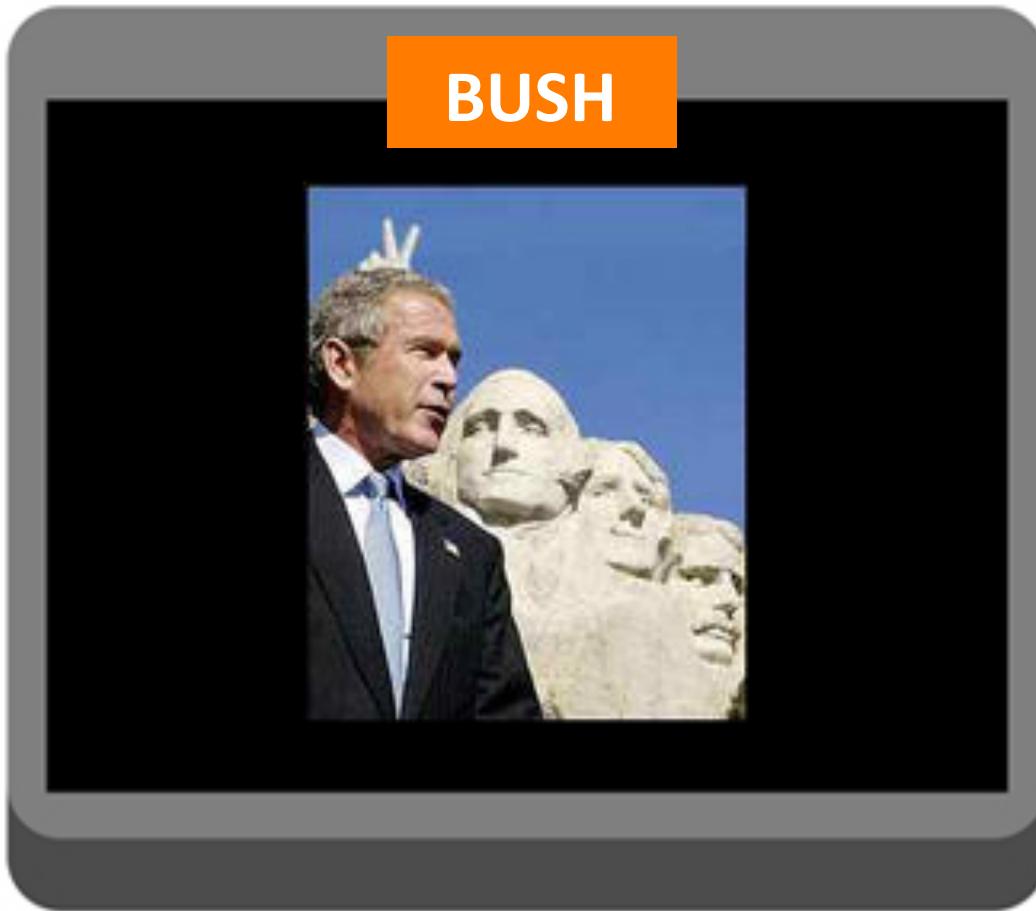
HINT





BUSH

HINT



Protein folding

- **Protein folding**: Proteins fold from long chains into small balls, each in a very specific shape
- Shape is the **lower-energy setting**, which is the most stable
- Fold shape is very important to **understand interactions** with other molecules
- **Extremely expensive computationally!** (too many degrees of freedom)

FoldIt Game

- Humans are very good at reducing the search space
- Humans try to fold the protein into a minimal energy state.
- Can leave protein unfinished and let others try from there...

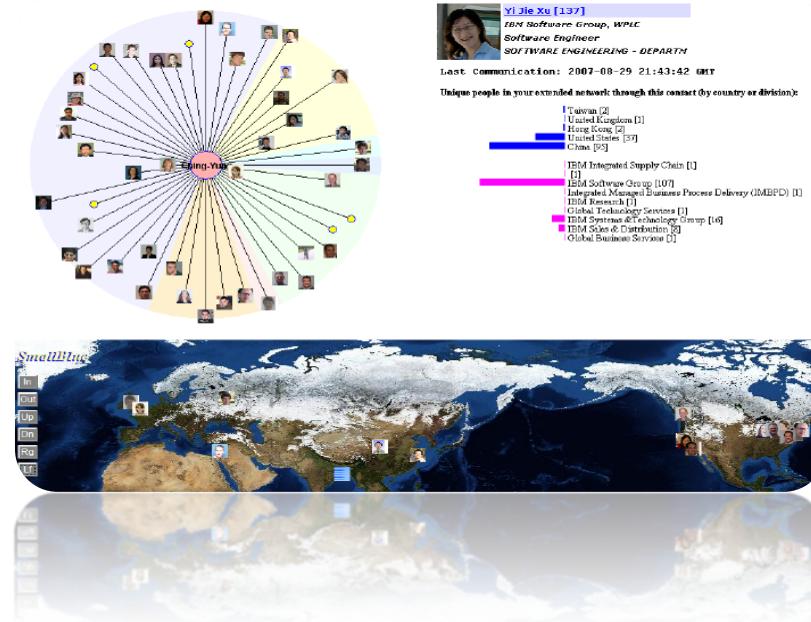
Other forms of Human Computation

- ***Social Mobilization***
 - It addresses problems with time constraints, where the efficiency of task spreading and of solution finding is essential.
 - An example of the problem and of the techniques employed to face it is the Darpa Network Challenge [PRP+10]

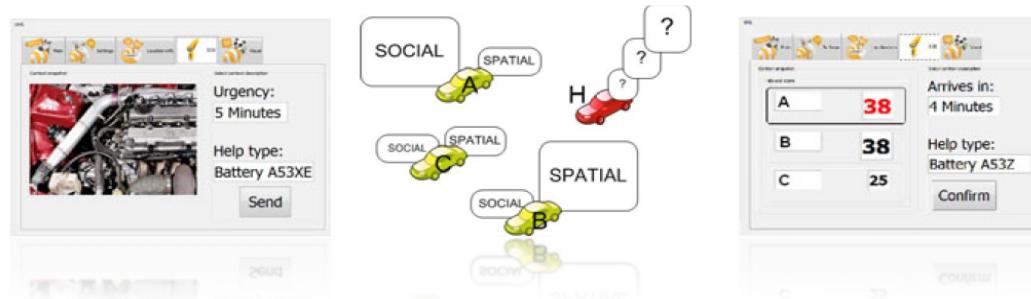


Open problems

- **Search for expertise**
 - Social paths
 - Expertise contexts



- **Geo-social interaction**



Open problems

- *Task “execution-time” optimization*
- *Truth verification*
 - Users might cheat
 - Data quality, e.g.
 - Distinguishing correct balloon sightings from misleading claims



Open problems

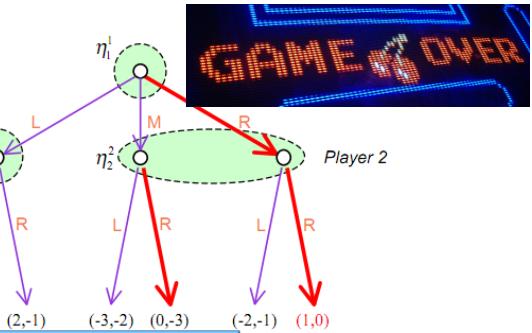
- **Social tagging**
- Descriptive tags within a social network for: individuals, objects, images
- Find people skills
- It has been used for:
 - Support collaboration in software development
 - Folksonomy in task museums
 - Collabio (biography using friends tags)



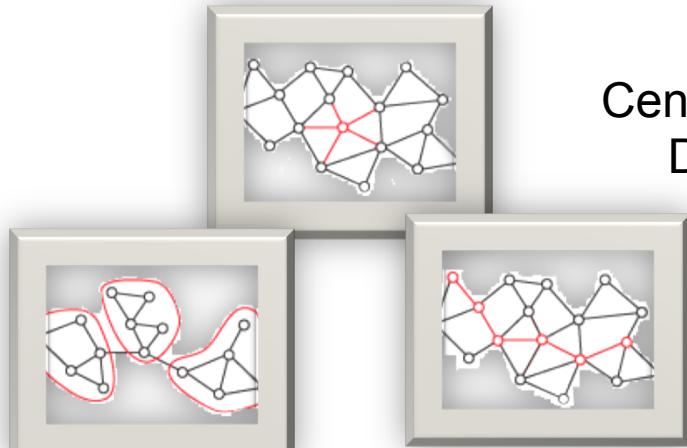
Techniques

Symmetric verification
...
Input-Output agreement

Game Theory



- Data Uncertainty management



Social Network Analysis

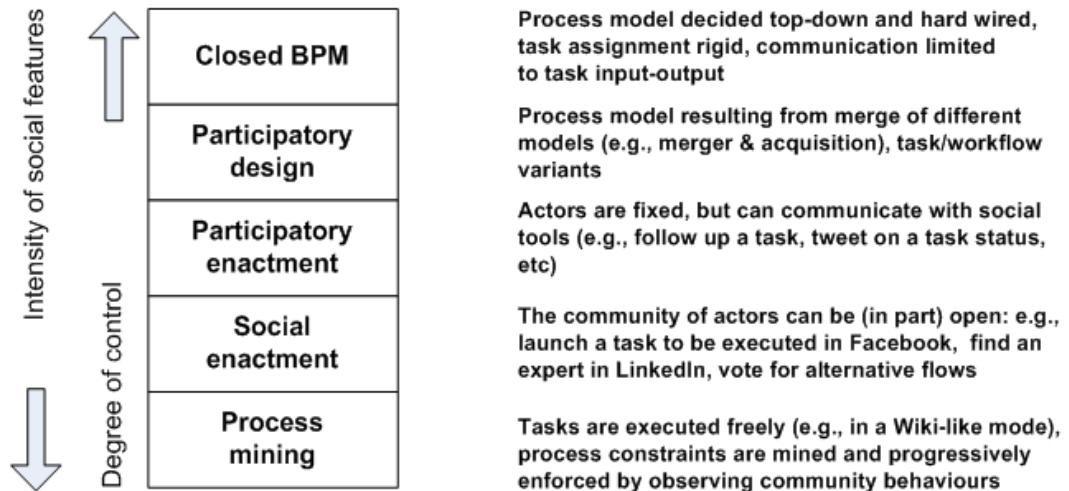
Incentives to participation: reciprocity, money, etc

Interaction modes
Noise management /
Social Validation

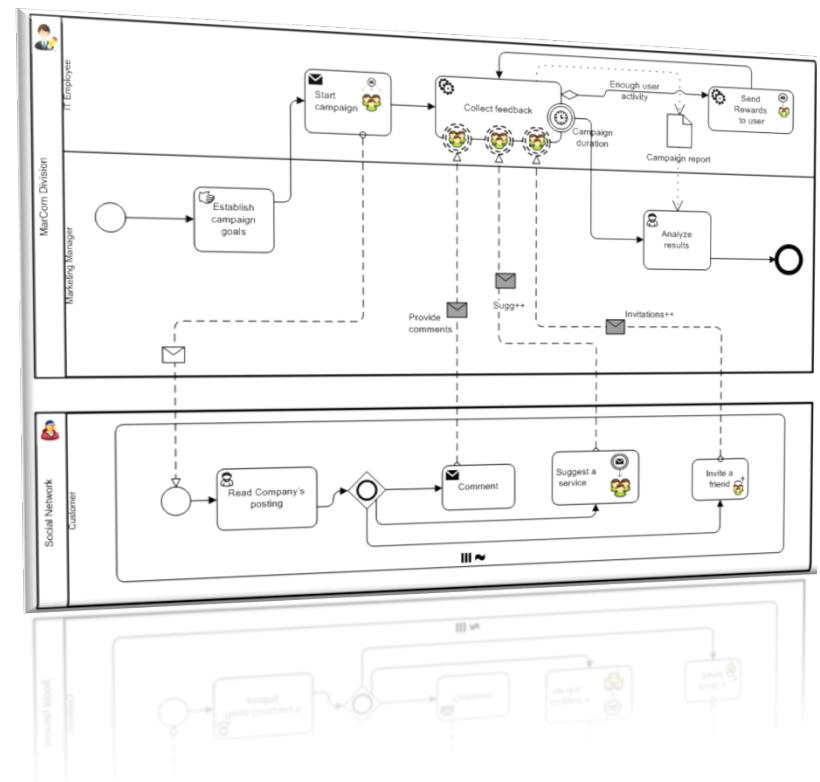
Social graph analysis

Projects (applications of Social and Human Computation)

- **BPM4People**: social business process management



- Difference with classic BPM
 - Community task assignment
 - Controlled task visibility



Projects (applications of Social and Human Computation)

- Social dimensions of a process
 - Level of Social Participation: inform, comment, produce data
 - Actor type: internal performer, internal/external observer

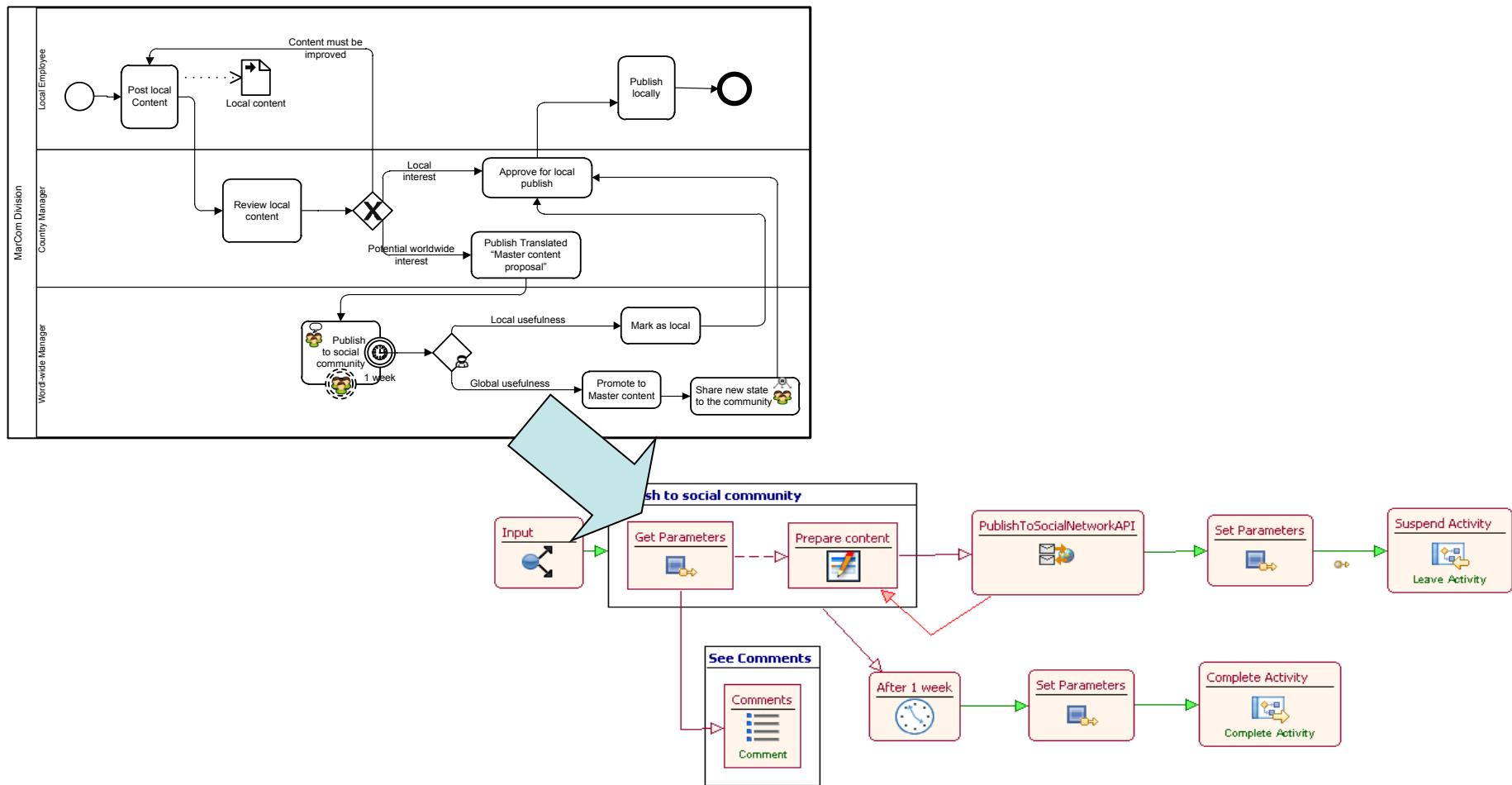
Requirement	BPMN notation	Comment
Task Type: Social broadcast	Annotation of task 	Data flow to a community pool
Task Type: Social posting	Annotation of task 	Data flow to a single user in a community pool
Task Type: Invitation to activity	Annotation of task 	Dynamic enrollment to a task in the process case
Task Type: Commenting	Annotation of task 	Submission of comments about the activity
Task Type: Voting	Annotation of task 	Voting (y/n) on an activity, either within a social network platform or directly in the BPM system

make the world a better place by making it easier to work together

Requirement	BPMN notation	Comment
Actor category and community pool		Annotation in the pool/lane header, respectively for: Internal performer, internal observer, external observer. The last two categories characterize community pools
Activity inheritance	Hierarchical definition of user roles	To avoid duplication of activities, hierarchies of roles with inheritance of task execution can be defined
Community executed activity	<i>Ad hoc</i> Activity within a community pool 	A sub-process or a task delegated to a community of observer users. Ad hoc mark denotes complex / non-structured interactions
User vs. Automatic Gateways		The execution of the choice is performed by a human or by an automatic procedure /rule

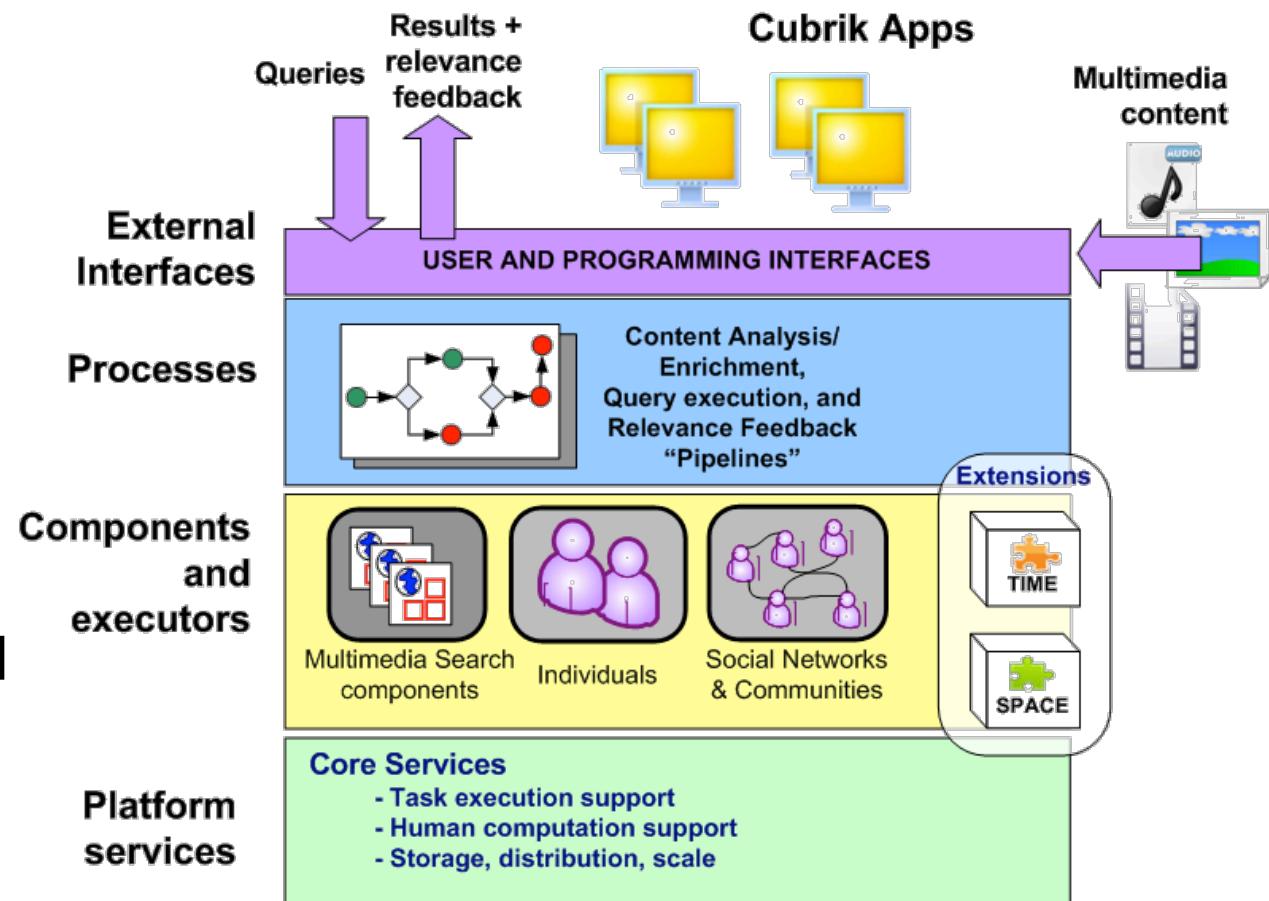
Automatic code generation

- From social BPM specs to Social WebML design to Java EE app



Projects (applications of Social and Human Computation)

- **Cubrik:** human-enhanced multimedia search
- CUBRIK **will use GWAP-based content tagging** to complement component-based feature extraction and high level annotation



References

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