

# Incentives in Crowdsourcing Markets with Heterogeneous Tasks

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# Market Mechanisms for Crowdsourcing

Our model for a crowdsourcing market involves

- Heterogeneous Tasks
- Workers with different skill sets

## **Goal:**

Efficient assignment of Tasks to Workers

# A Real-World Experiment: Market Mechanisms for Crowdsourcing

## **The Wikipedia experiment:**

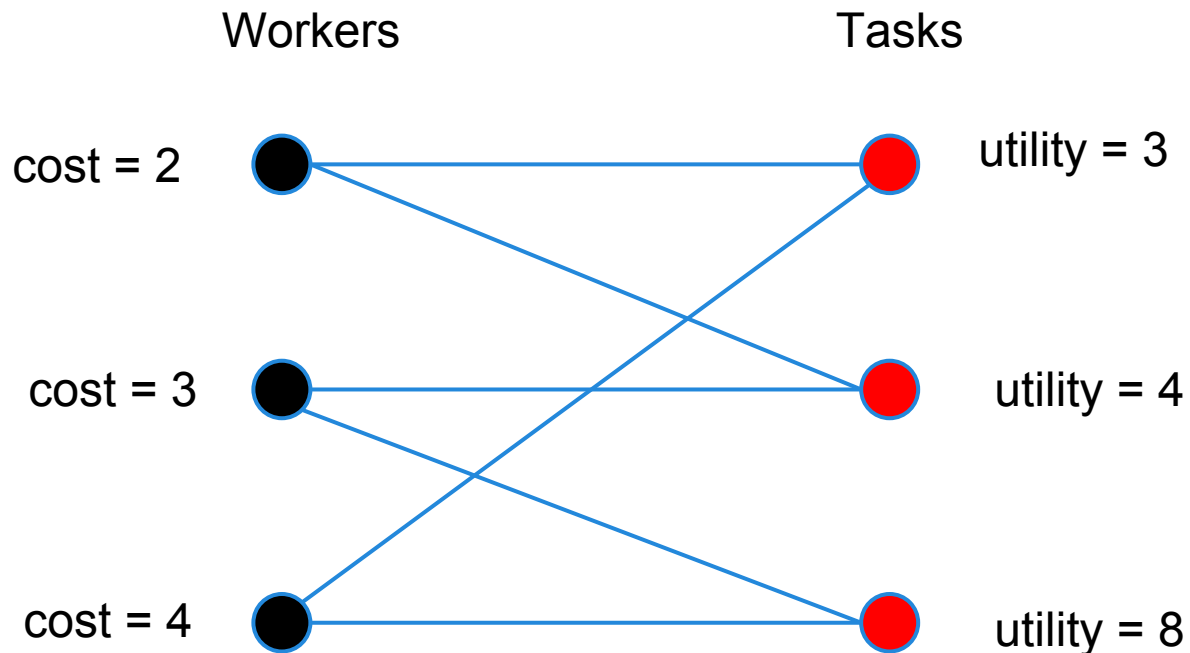
- Tasks: wiki page translations
- Workers: Translators
- A limited budget for hiring workers

## **Goal:**

Maximize total utility obtained from the pages that get translated

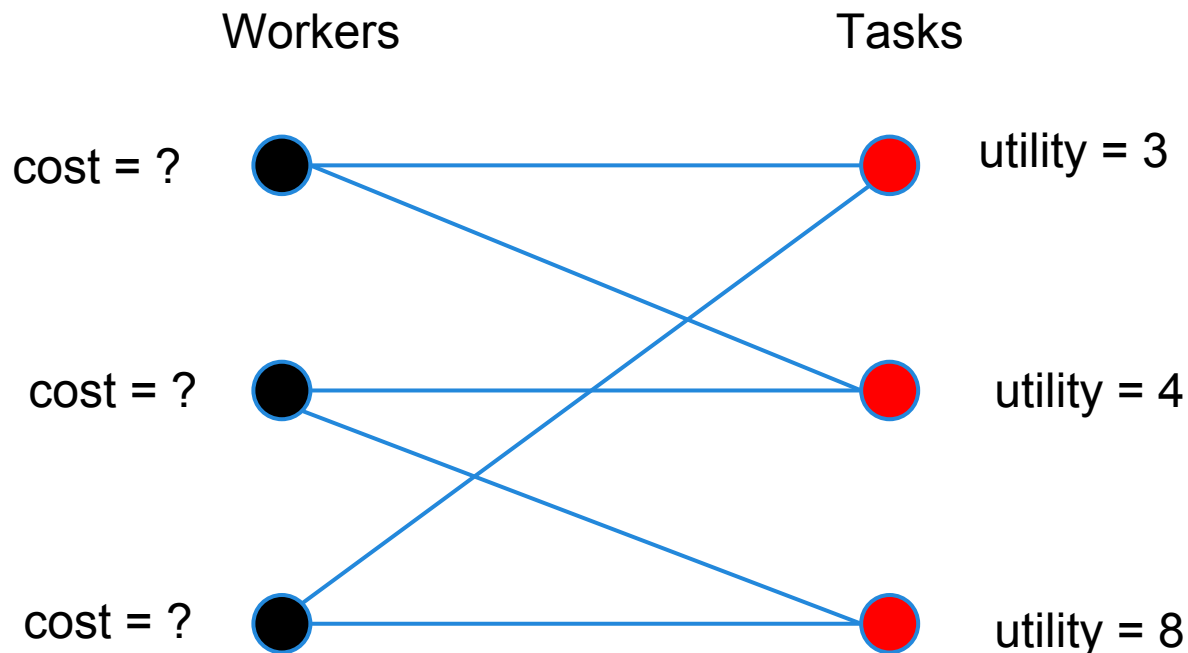
*In the end, we apply our solution on this market*

# Overview of the Model



- Each worker has a cost
- Each task has a utility
- A bipartite graph describes the skill sets of workers

# The Mechanism Design Problem: Example



- We do not assume that the workers' costs are known.
- Rather, we design a mechanism to which they report their costs.

# The Mechanism Design Problem

Given:

- Budget  $B$
- A bipartite graph  $G(W, T)$
- Each task has a publicly known **utility**
- Each worker has a **private cost**

Design a mechanism:

- Workers report their bid (costs) to the mechanism
- The mechanism assigns them to tasks

# The Mechanism Design Problem

The mechanism must be:

- Truthful
  - No worker has incentive to report a fake cost
- Efficient
  - Ratio of the collected utility to the optimal utility

# **Our Mechanism (a reverse auction)**



# Key Concept

- *buck-per-bang* rate  $r$ 
  - Pay  $r \cdot u$  to a worker for doing a task with utility  $u$

# Layout of the Mechanism

1. Fix a buck-per-bang rate  $r$
2. Prune the graph  $G$ 
  - remove an edge  $(w,t)$  if  $c_w > r u_t$
3. Generate an allocation in the new graph
4. Compute the prices (based on  $r$ )
5. Check for budget feasibility

# Basic Definitions

- Fix an ordering on the agents, namely  $\sigma$
- The tentative task assigned to  $i$  is  $T(i)$

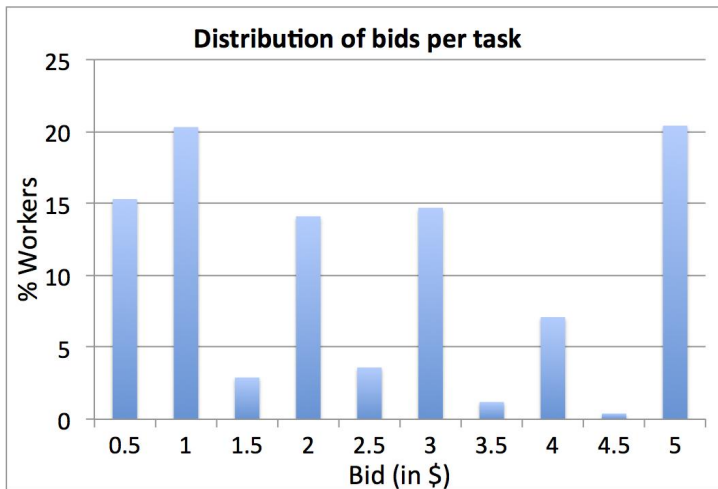
# The Mechanism

1.  $r \leftarrow \infty$
2. For  $i = 1$  to  $|W|$   
 $T(\sigma(i)) =$  task with the highest utility  
that is doable by  $\sigma(i)$
3. Payments are possible with rate  $r$  ?
  - a. **No:** decrease  $r$  and repeat
  - b. **Yes:** stop and pay.

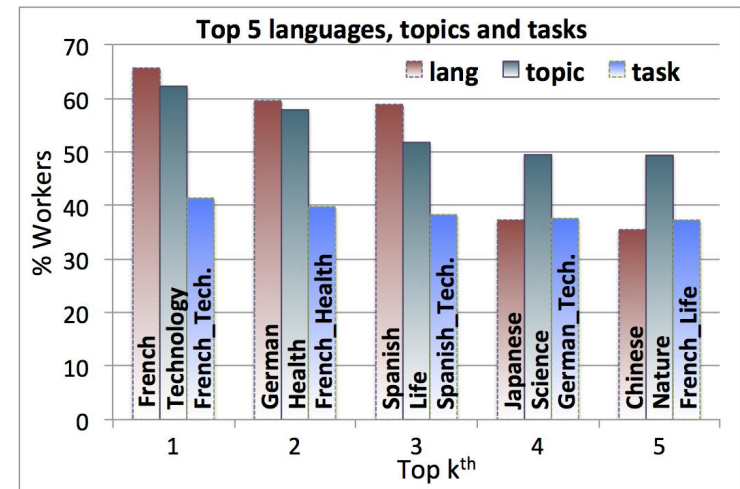
# Results

- The mechanism is *oneway-truthful*
- It is also truthful under a different payment rule
  - Pay each worker her *critical bid*
- It is Efficient
  - 3-approximation in **large markets**
- By choosing  $\sigma$  uniformly at random
  - The approximation ratio becomes  $\frac{2e - 1}{e - 1} \approx 2.58$
  - The mechanism is truthful in large markets

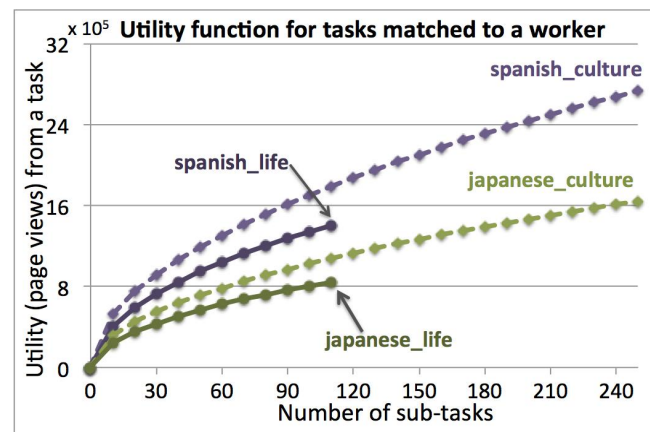
# Wikipedia translation project : MTurk Study



Distribution of bids

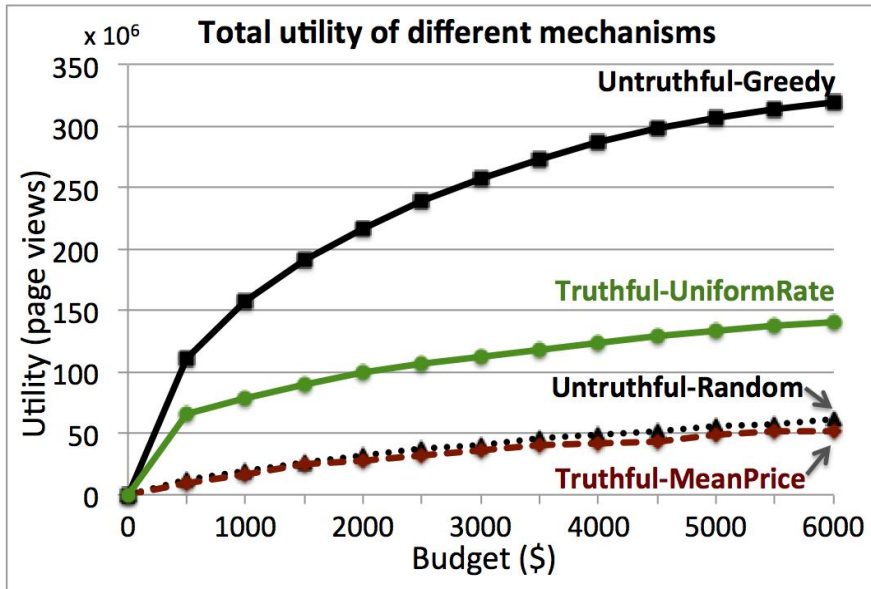


Top languages, topics and tasks

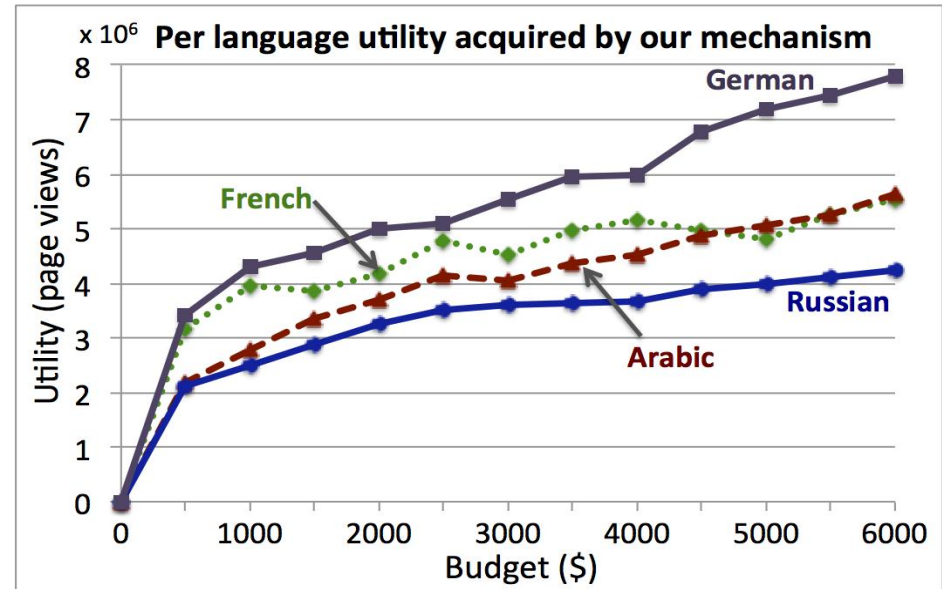


Worker's profile

# Wikipedia translation project : Results



Overall utility



Utility per language