Knowledge Graph and Crowdsroucing

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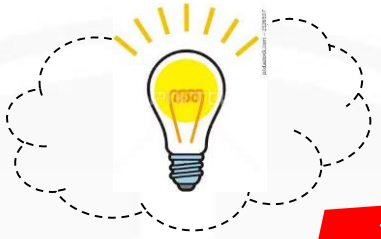
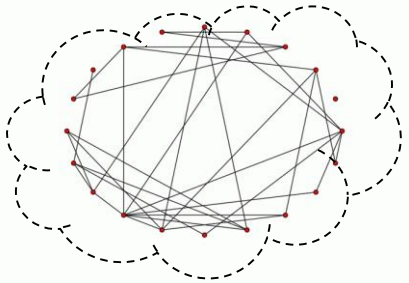
Human Brain and AI

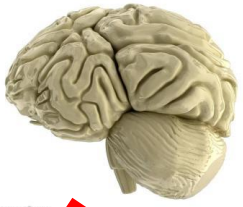


Creativity

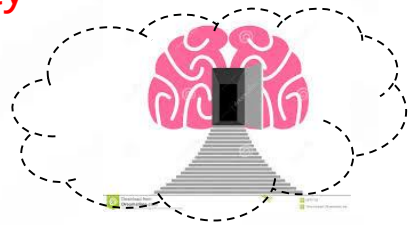
Normalization



Complexity



Repeatability



Openness

Scalability

- Human brains may help AI

How can human help AI?

- Facilitating machine learning
  - Supervised learning
  - Semi-supervised learning
  - Active learning
- Knowledge extraction
  - Ontology construction
  - Knowledge graph crafting

AI + Brain

Low

AI + AI

High

Brain + Brain

Cost

Cost

Quality

Crowdsourcing

- What’s crowdsouring?
- Crowdsourcing Vs. Outsourcing
- Successful applications

Crowdsourcing

- Characteristic of these applications
  - Task is simple (low diversity)
  - Potential workers are huge.
- Challenges
  - Task assignment
  - User experience

Knowledge-Intensive Crowdsourcing (KIC)

- A branch of crowdsourcing
- To achieve some knowledge-intensive task
- To bridge the gap between AI and human brain

Knowledge-Intensive Crowdsourcing

- Successful applications

CAPTCHAs

ImageNet Labeling

amazon
beta
mechanical turk

Amazon MTurk

WIKIPEDIA

Challenge of KIC

- High diversity on the tasks
- High diversity on the workers
- Qualities of the results are important

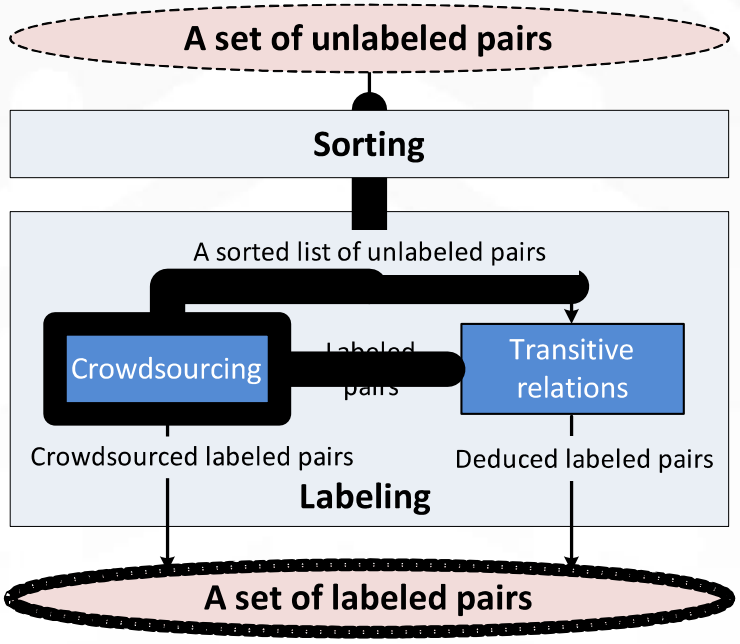
Issues on KIC

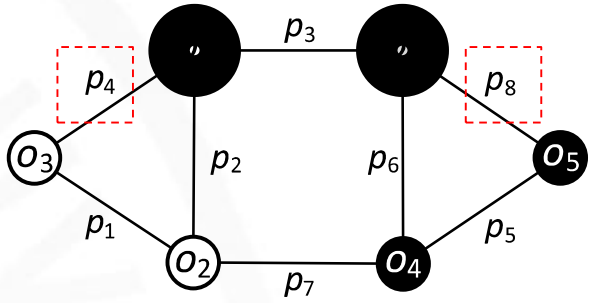
- What
  - to crowdsource?
- Whom
  - to crowdsource ?
- How
  - to devise question?
  - to incentivize worker?
  - to control quality?
  - to utilize the crowdsourcing result

What

- Task selection
  - To save monetary and time cost
  - Select the most important task
  - Select the task the human is good at but the computer is not
- Existing work
  - Entity resolution[SIGMOD13] [ICDE15]
  - Schema matching[VLDB13]
  - Sort and Join[VLDB11]

Entity Resolution [SIGMOD13]

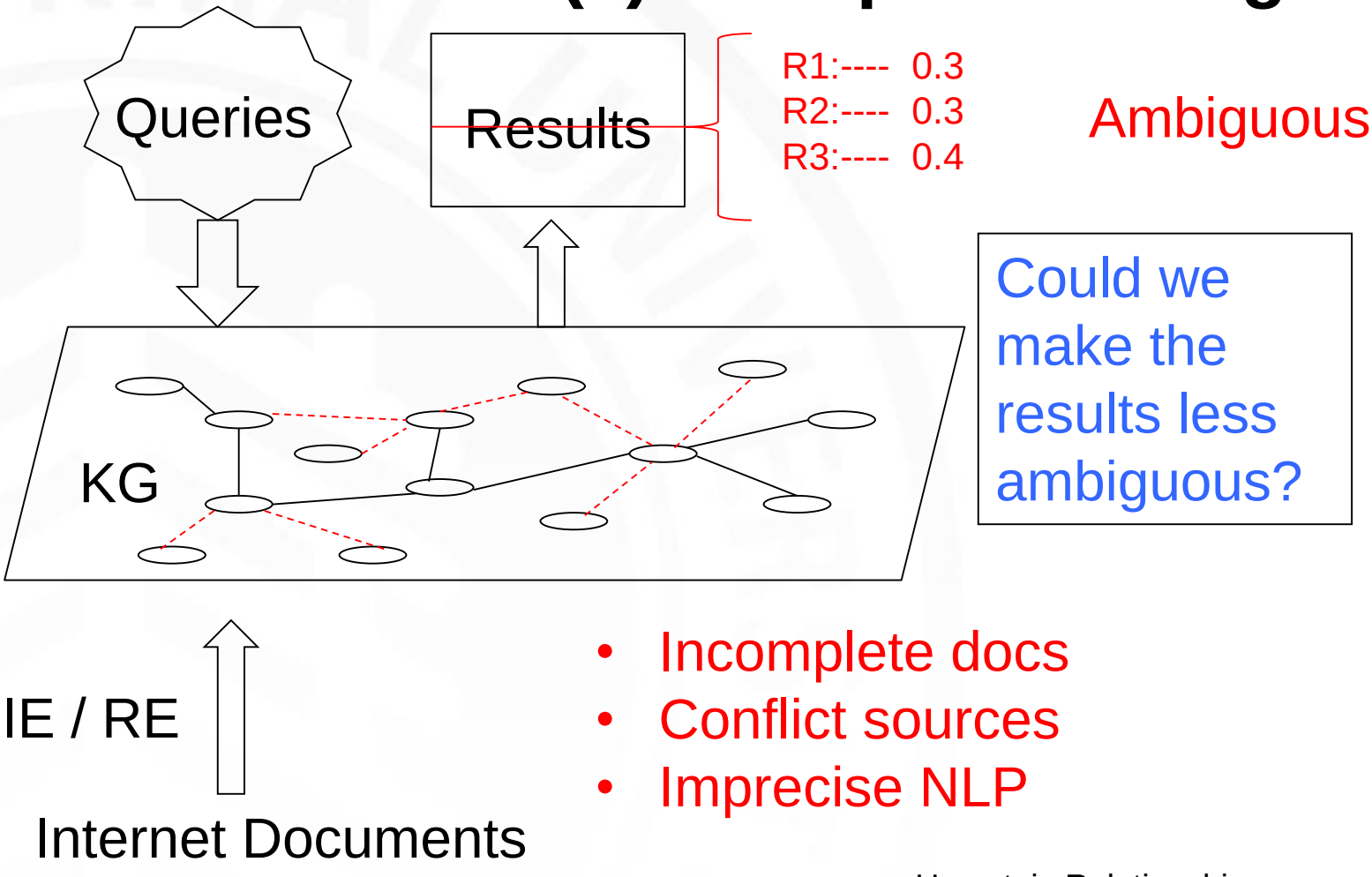




ID	Object
o_1	iPhone 2nd Gen
o_2	iPhone Two
o_3	iPhone 2
o_4	iPad Two
o_5	iPad 2
o_6	iPad 3rd Gen

ID	Object Pairs	Likelihood
p_1	(o_2, o_3)	0.85
p_2	(o_1, o_2)	0.75
p_3	(o_1, o_6)	0.72
p_4	(o_1, o_3)	0.65
p_5	(o_4, o_5)	0.55
p_6	(o_4, o_6)	0.48
p_7	(o_2, o_4)	0.45
p_8	(o_5, o_6)	0.42

What——Our work (1)：Graph Cleaning



X.Lin, et.al, *Human-Powered Data Cleaning for Probabilistic Reachability Queries on Uncertain Graphs*, TKDE, 2017.

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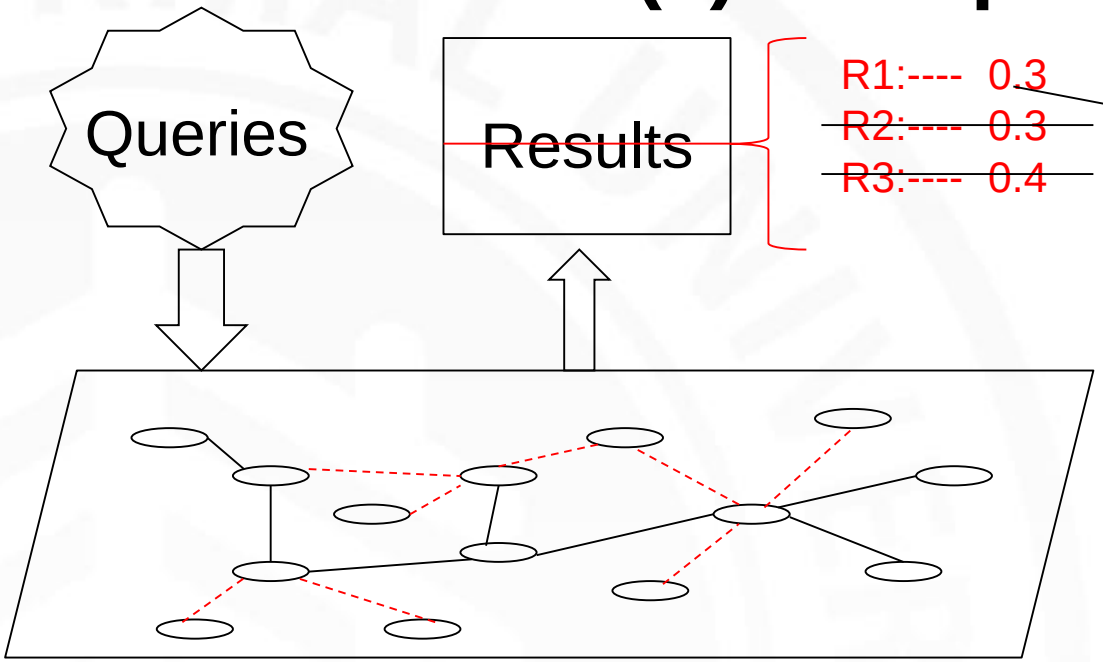
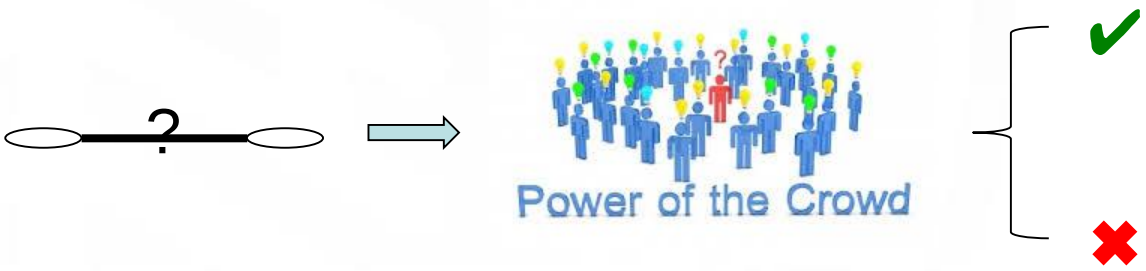
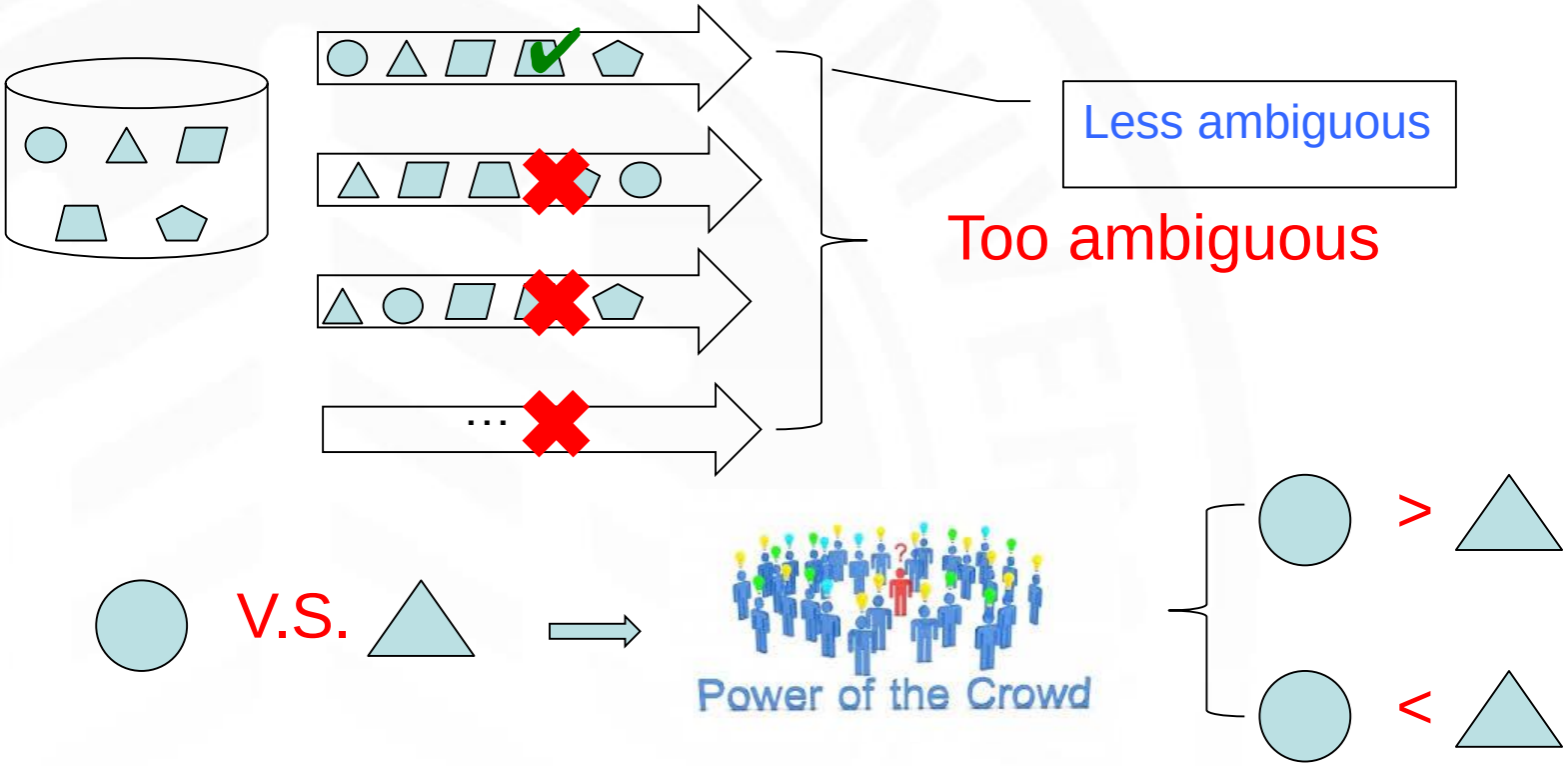




X.Lin, et.al, *Human-Powered Data Cleaning for Probabilistic Reachability Queries on Uncertain Graphs*, TKDE, 2017.

What——Our work(2) : Pairwise Top-k cleaning



X.Lin, et.al, *Reducing Uncertainty of Probabilistic Top-k Ranking via Pairwise Crowdsourcing*, TKDE, 2017.

Summaries of issue “what”

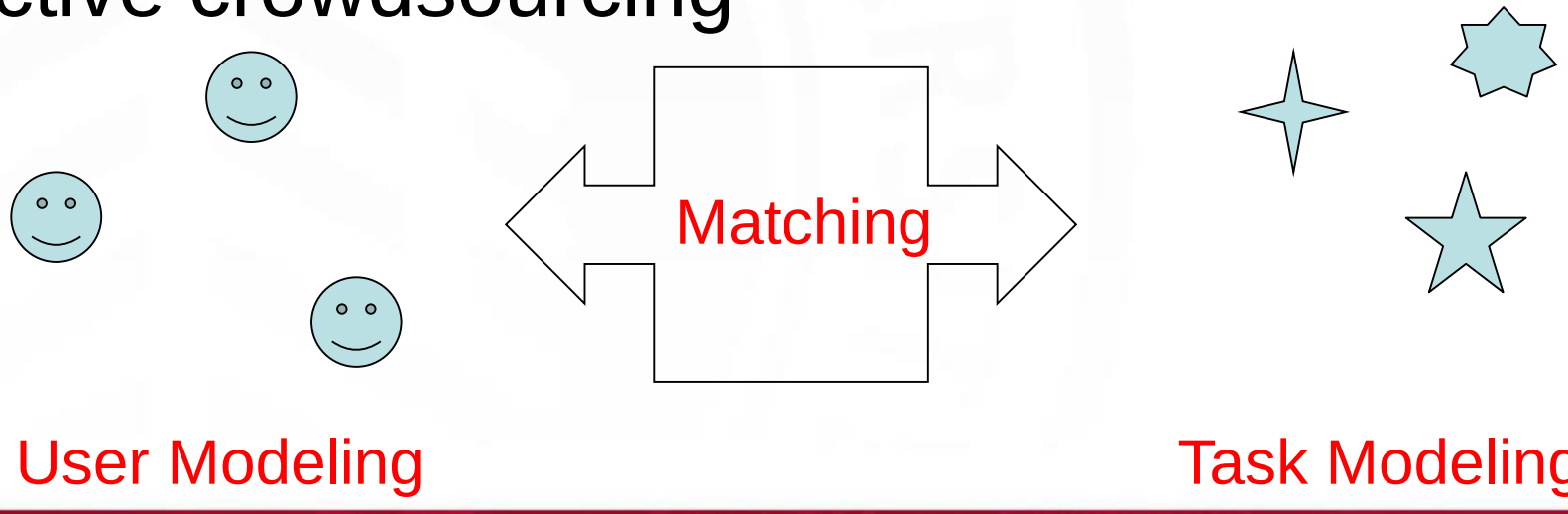
- Local refinement will promote the global quality
- Quantifying the influence is the key issue
- Task independent

Issues on KIC

- What
  - to crowdsource?
- Whom
  - to crowdsource ?
- How
  - to devise question?
  - to incentivize worker?
  - to control quality?
  - to utilize the crowdsourcing result

Whom

- Passive crowdsourcing
  - All tasks are *picked up* by the workers
  - Workers are qualified by some golden tasks.
- Active crowdsourcing



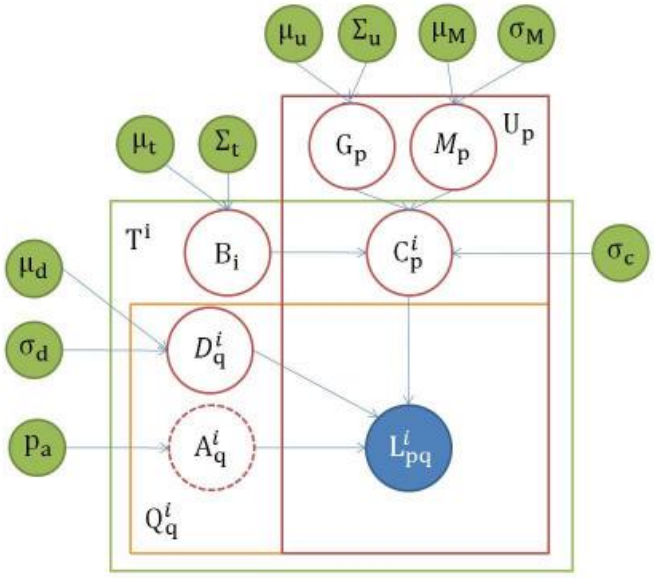
Whom: Active crowdsourcing

- User Modeling
  - Task-history-based modeling
  - Cold start problem
    - Golden task
    - Transfer learning [KDD13b]
- Matching
  - Keyword based
  - Tree based [WWW 16]
  - Vector based [VLDB 16]

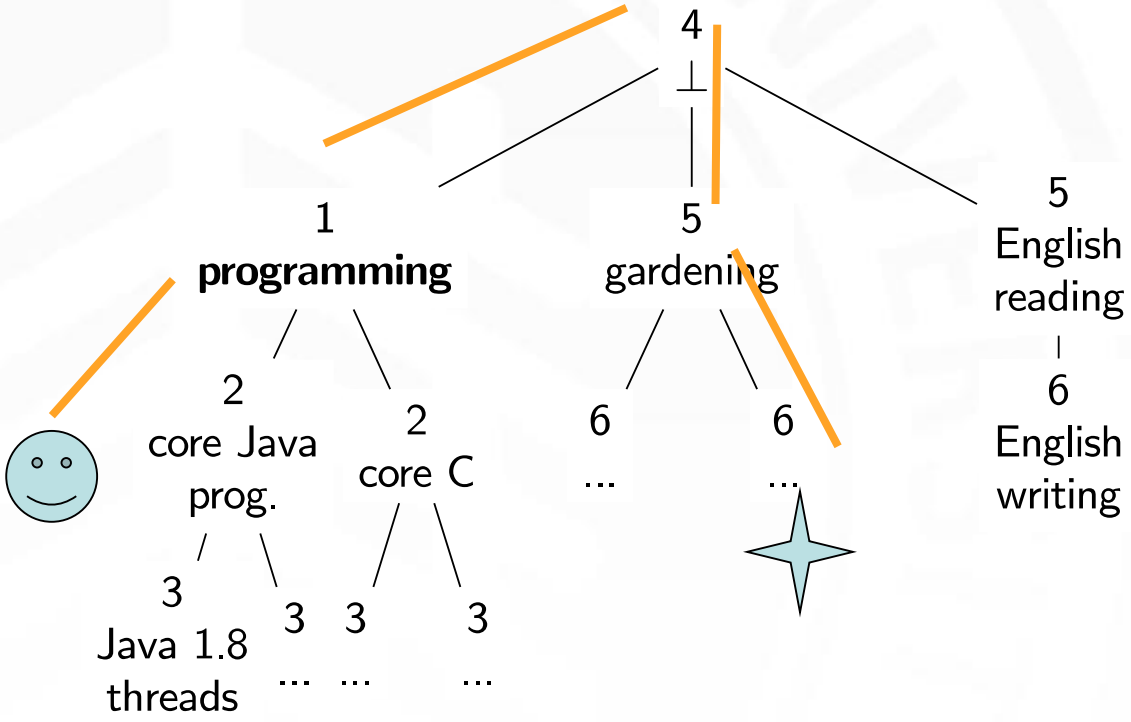
Whom: Active crowdsourcing

- **Task Assignment**
  - Randomly selected
  - Consider other factors (time, worker's quality,etc)
    - Assign the k most uncertain tasks[ICDE 12]
    - Choose the k highest quality workers[SIGMOD 15a]
    - Choose the highest improvement in quality [SIGMOD 15a]
    - …

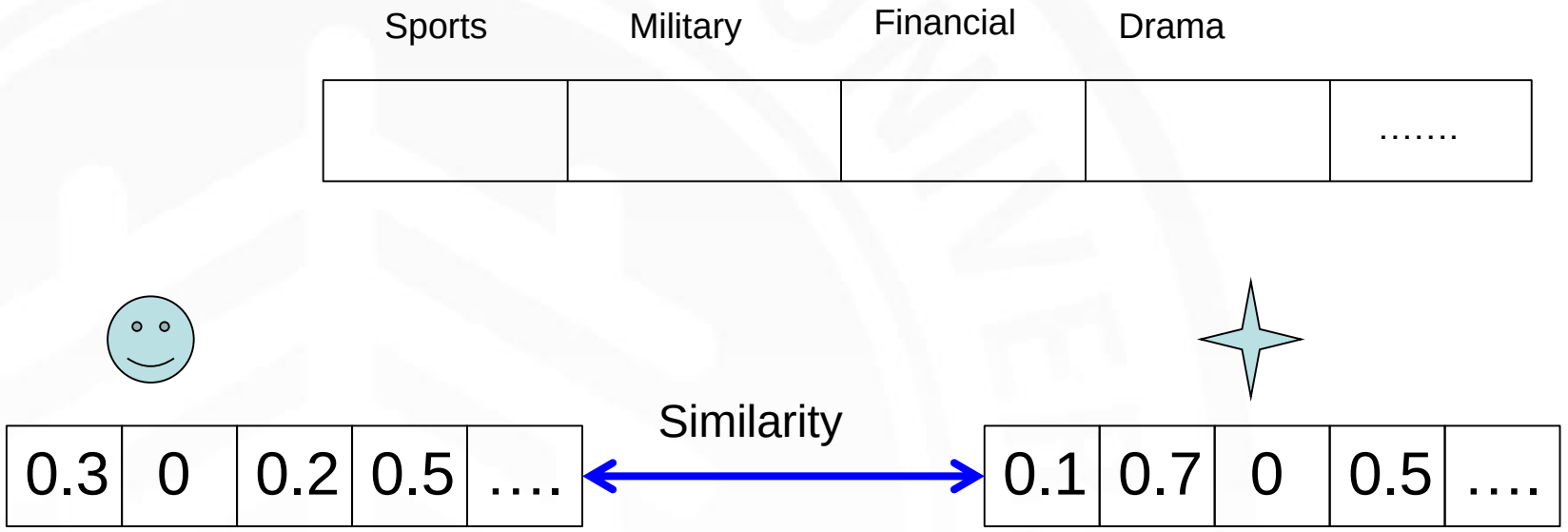
Transfer Learning in Worker Modeling [KDD2013]



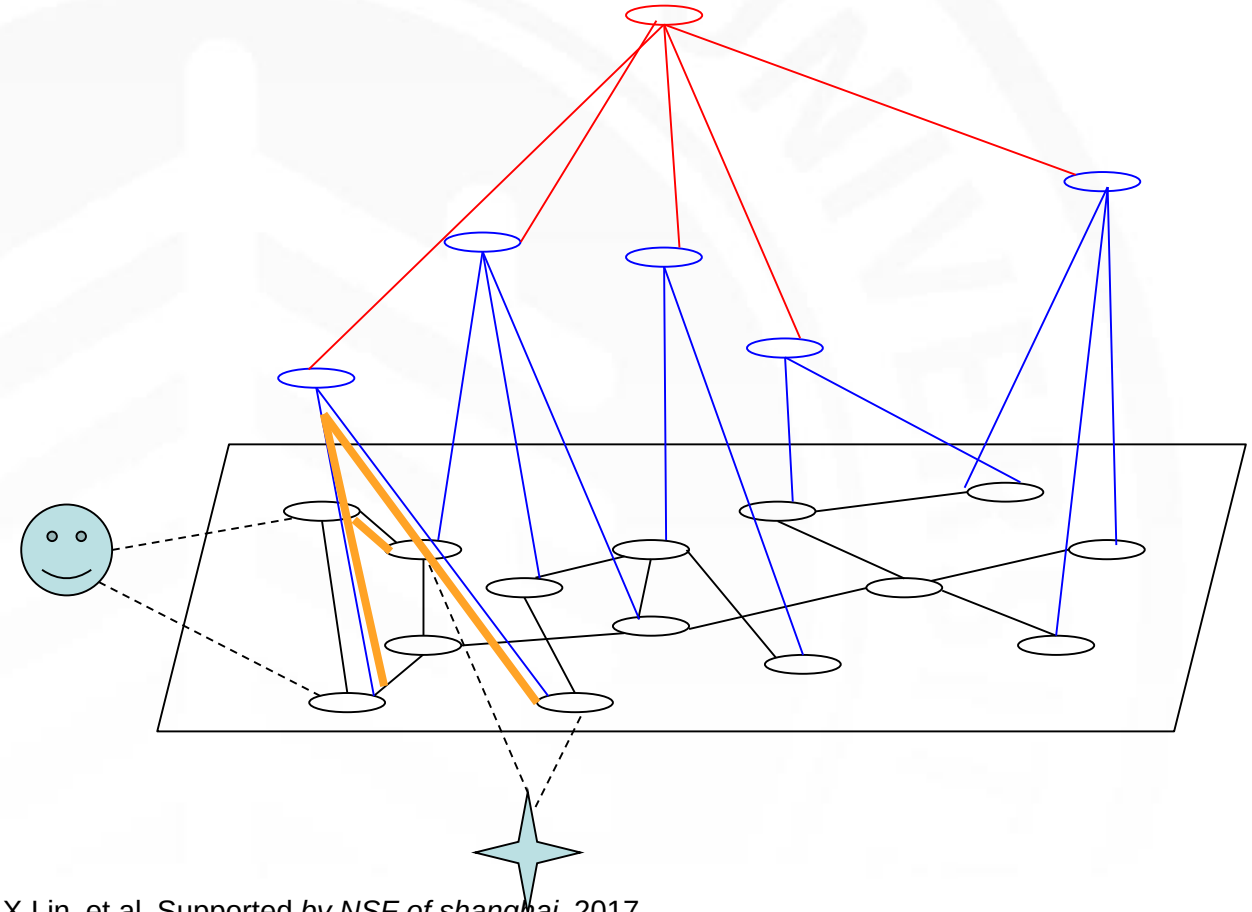
Tree-based matching [WWW16]



Domain-based matching [VLDB2016]



Whom—Our work: Graph+Tree-based



X.Lin, et.al, Supported *by NSF of shanghai*, 2017.

Issues on KIC

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How to devise question?

- Explicit crowdsourcing

- Implicit crowdsourcing

Devise questions

- Explicit crowdsourcing
  - Traditional guidelines:
    - 1. Small piece of task is preferred
    - 2. Yes-or-No > Choice >Blank filling
    - 3. Less cooperation is preferred
    - 4. Good UI is preferred
  - New research points:
    - Should tradeoff the cost and accuracy
      - Mix multi-choice and Yes-or-no [SIGMOD 17]
    - Should devise the workflow of Crowdsourcing

Devise questions

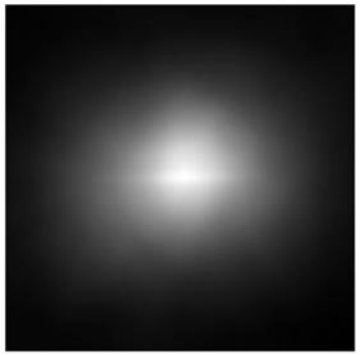
- Implicit crowdsourcing
  - **Gamification**
    - Common sense knowledge acquisition[CHI06]
    - Spatial Positions[AIIDE 14]
  - **Collecting Secretly**
    - CAPTCHAS
    - WAZE/ Google Map/ Baidu Map…
    - Auto Image Annotation [MTA 14]
    - Visual Focus [TMM14]
  - **Make Use of Psychological Characteristic**
    - Curiosity[CHI16]
    - Micro-diversions[CSCW 15]

Common knowledge acquisition

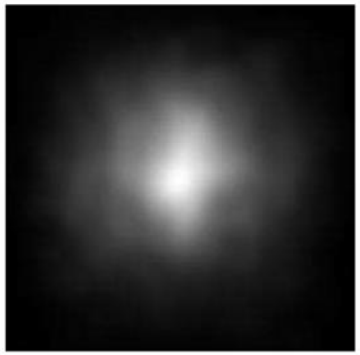
Templates:

- ___ is a kind of ___.
- ___ is used for ___.
- ___ is typically near/in/on ___ .
- ___ is the opposite of ___ / ___ is related to ___ .

Touch Saliency & Visual Focus

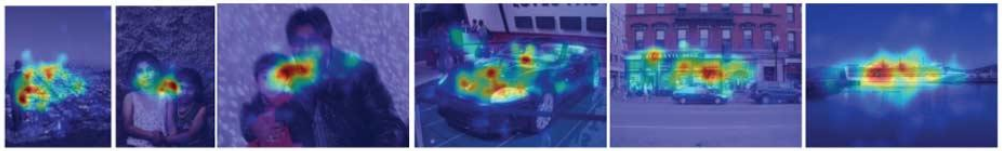


Touch



Visual

Heat Map
Touch



Heat Map
Visual

Implicit crowdsourcing

- Guidance of implicit crowdsourcing
  - Provide the task unconsciously
  - Workers are Users
  - First purpose should match user's demands, while second purpose should match the crowdsourced task.
  - First purpose is always the most important.
  - Motivate the crowds with Curiosity

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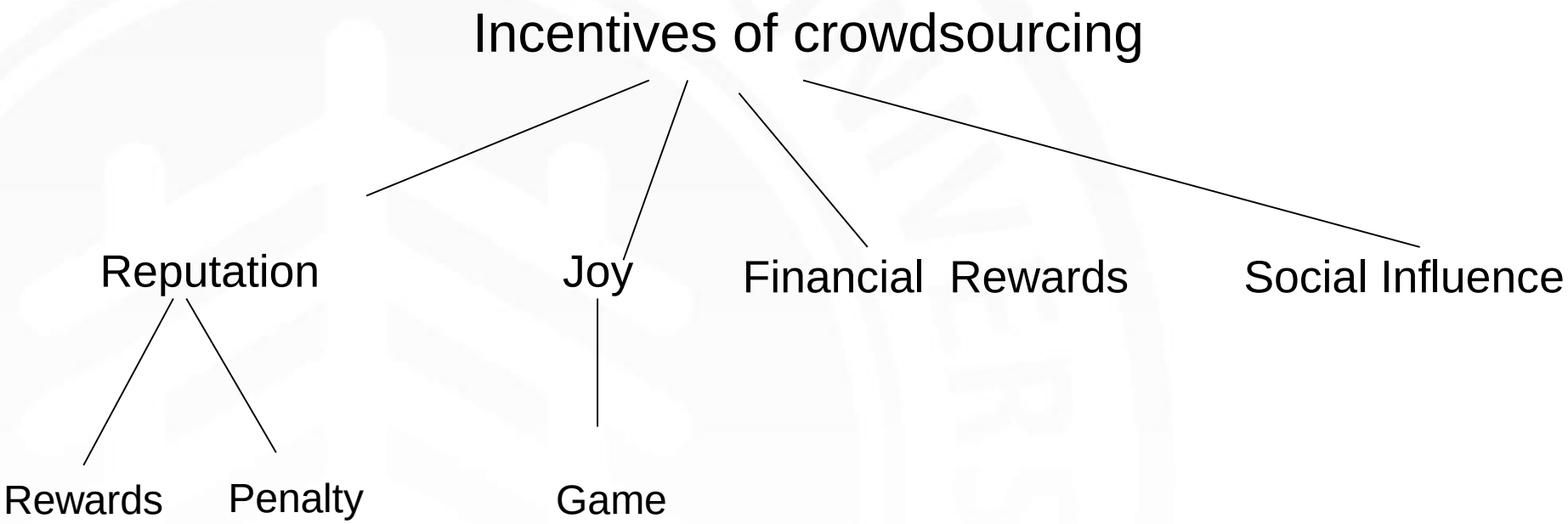
Taxonomy of incentives



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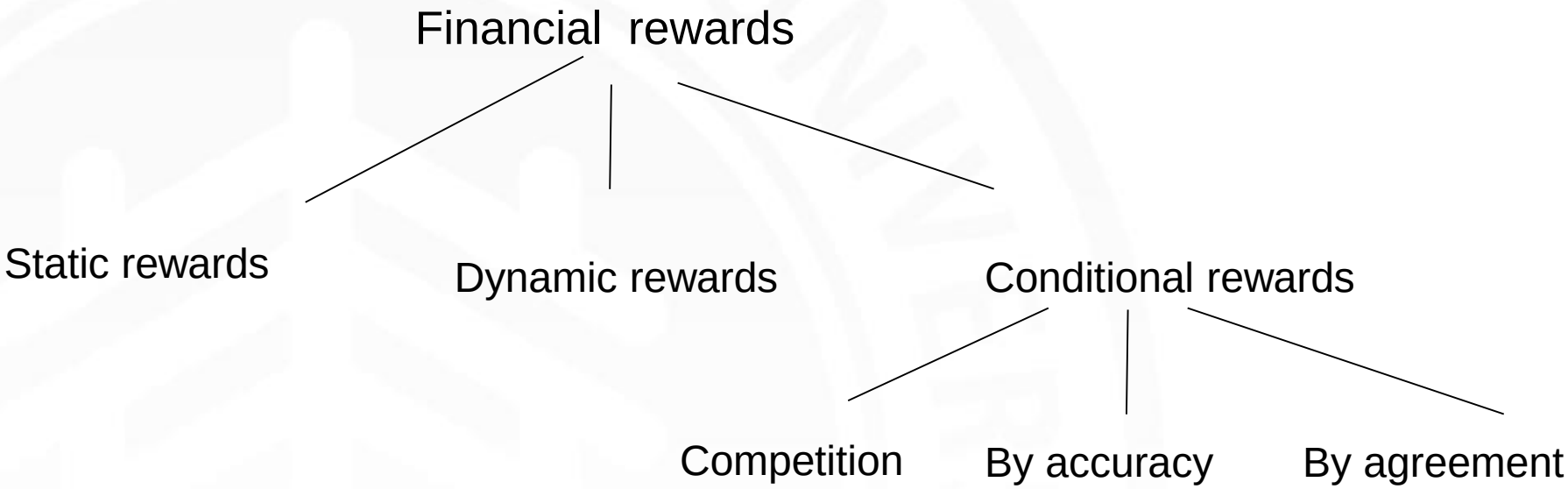

Taxonomy of incentives

Social Influence

Strong connection

Weak connection

Our works

- 1. Weak connection performance better than strong connection for short-term tasks
- 2. Hybrid incentive in different phrases

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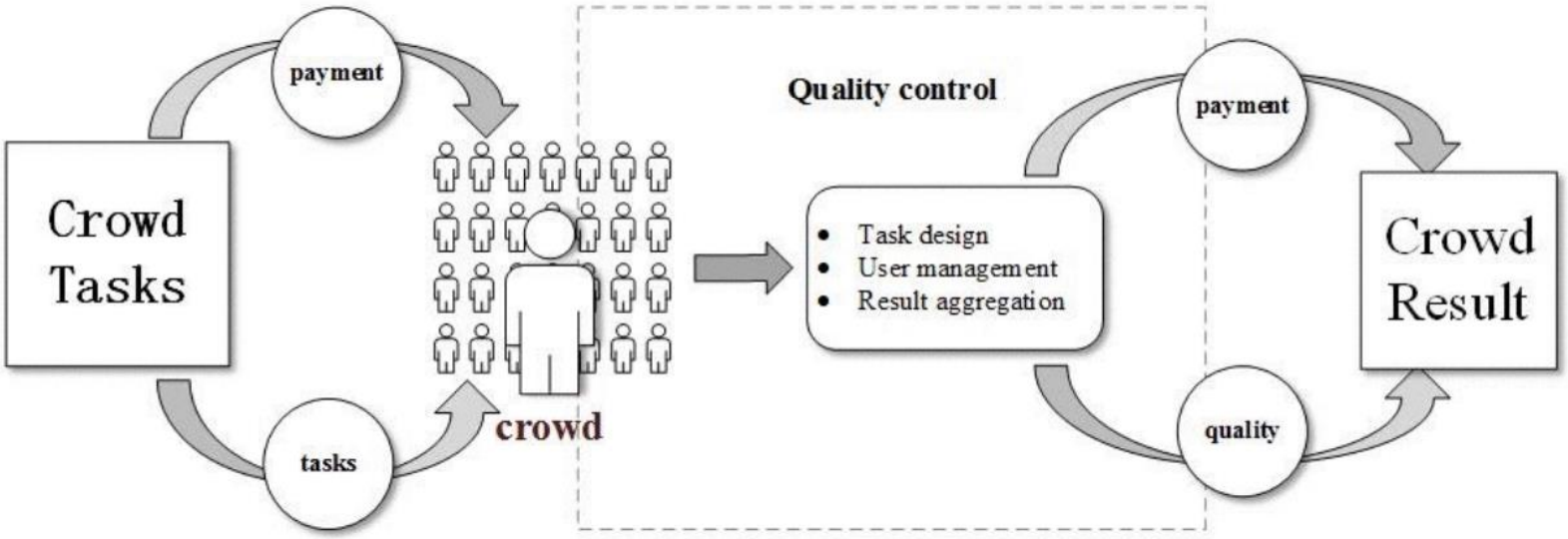
Quality Control

Overview



- Task Design
- Worker Organization Model
- Result aggregation

Quality Control

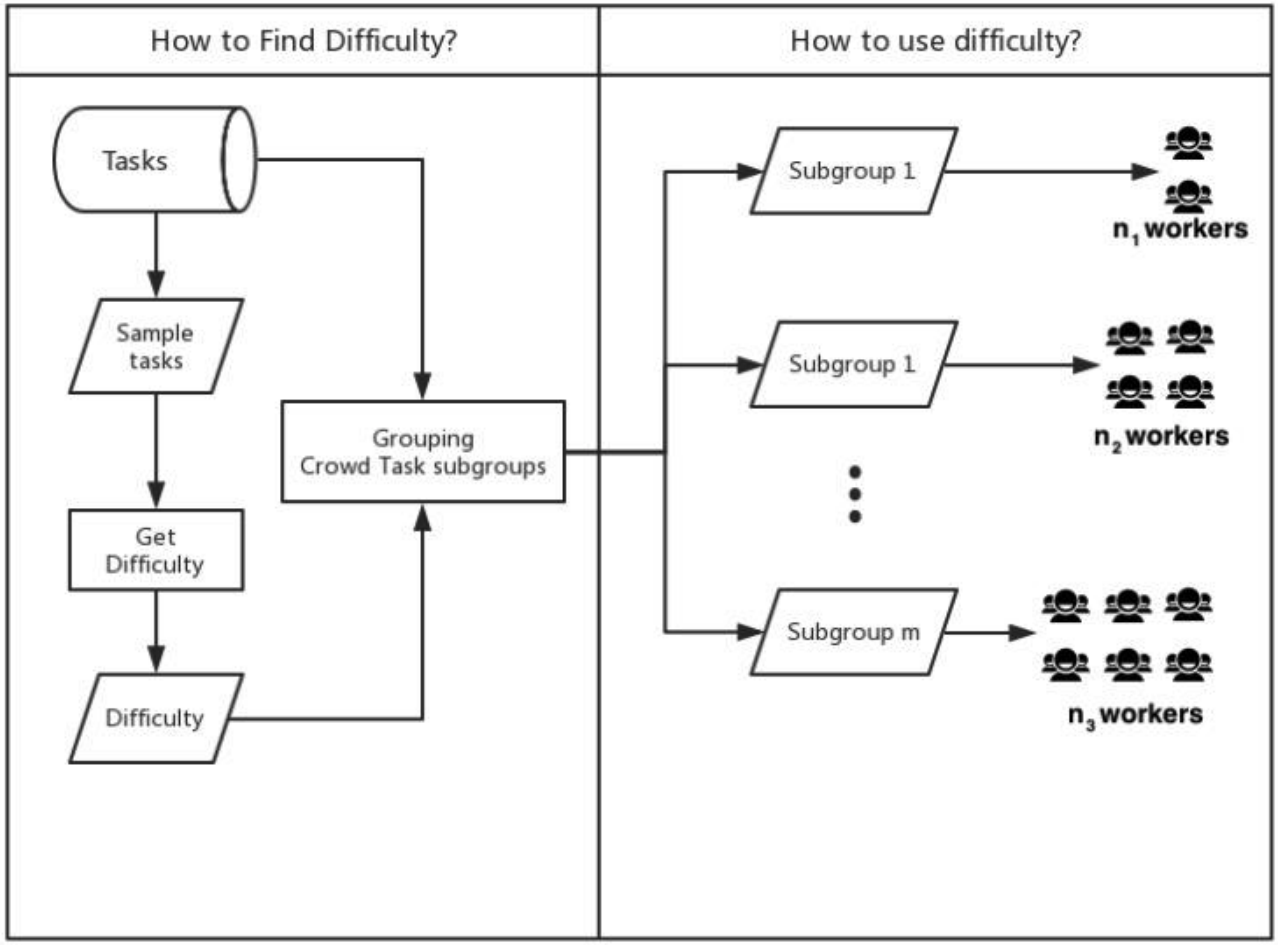
- Task design
  - Anti-malicious strategy [CHI15]
  - Add feedback mechanism[CSCW14]
- User management
  - Similar to the company management model

Quality Control

- Result Aggregation
  - Golden standard datasets
    - Dynamically insert golden tasks
    - Using golden tasks to test users
  - Redundancy-based strategy
    - Basic Majority Voting
    - Weighted Voting
  - Two-Stage strategy [KDD13a]

Our Work

- Difficulty-based task assignment



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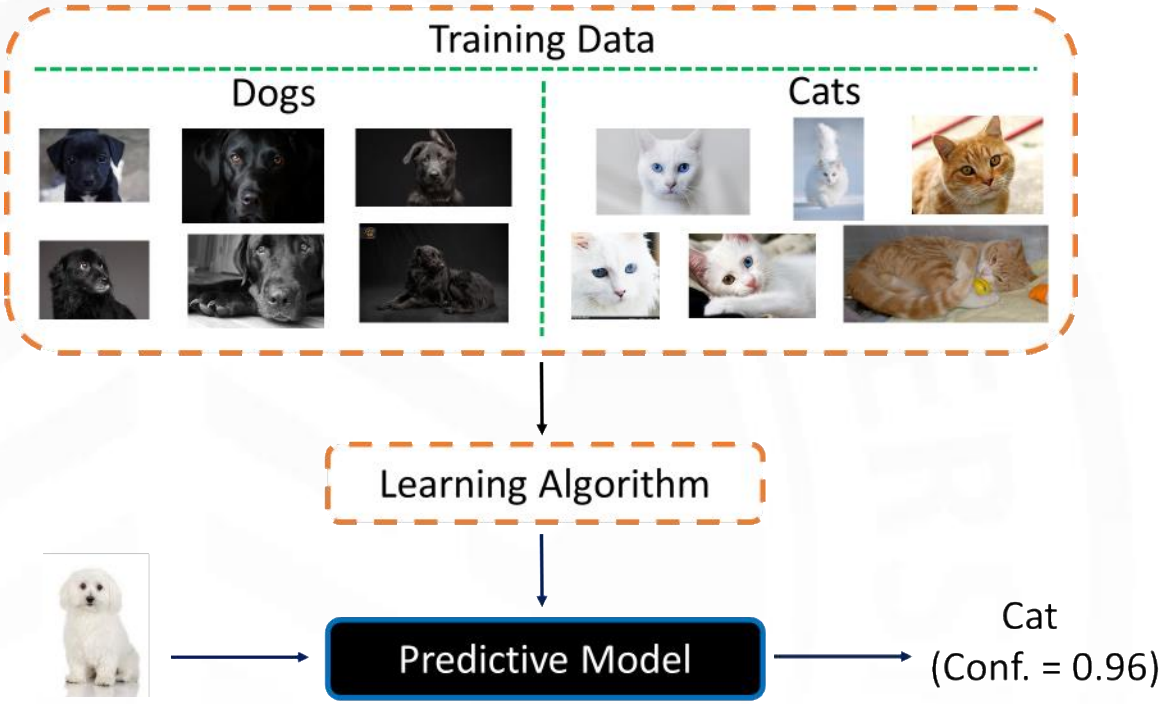
Our work (1): Finding unknown unknowns



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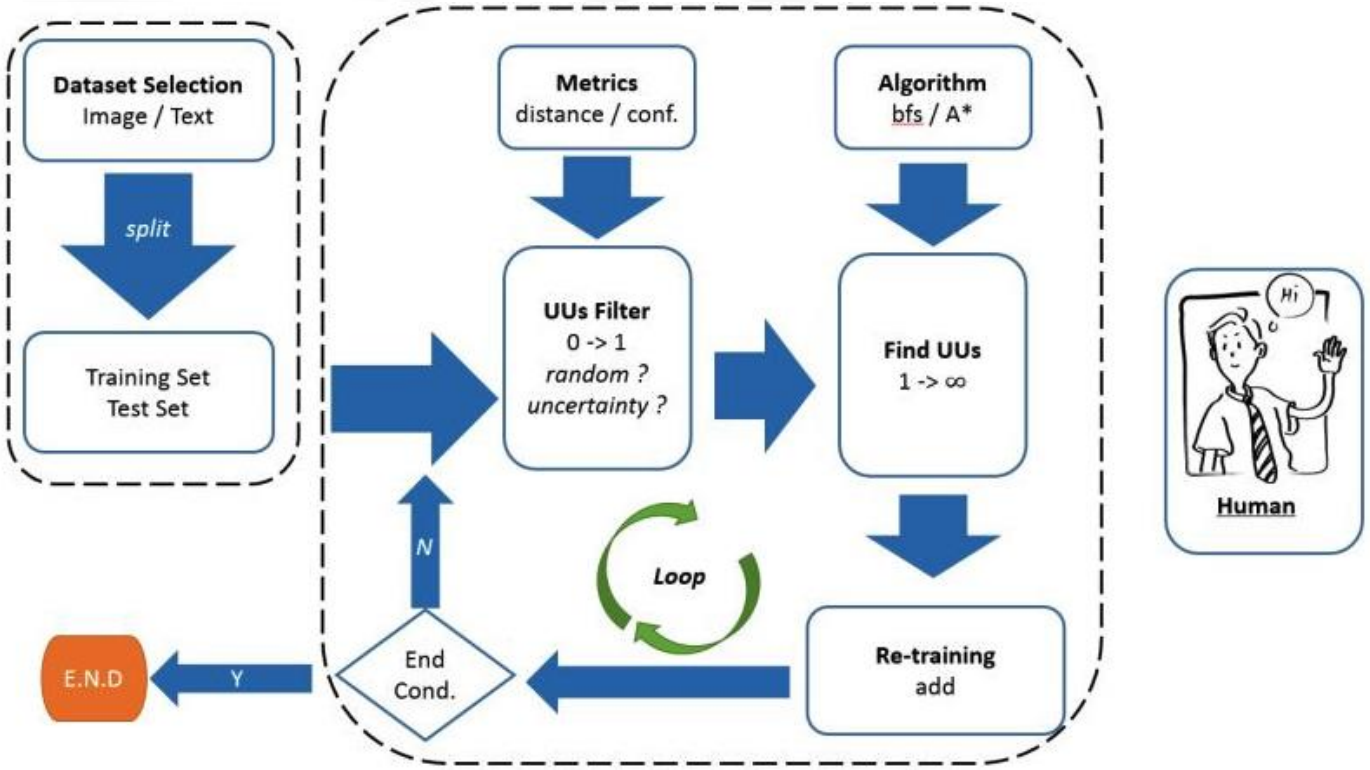
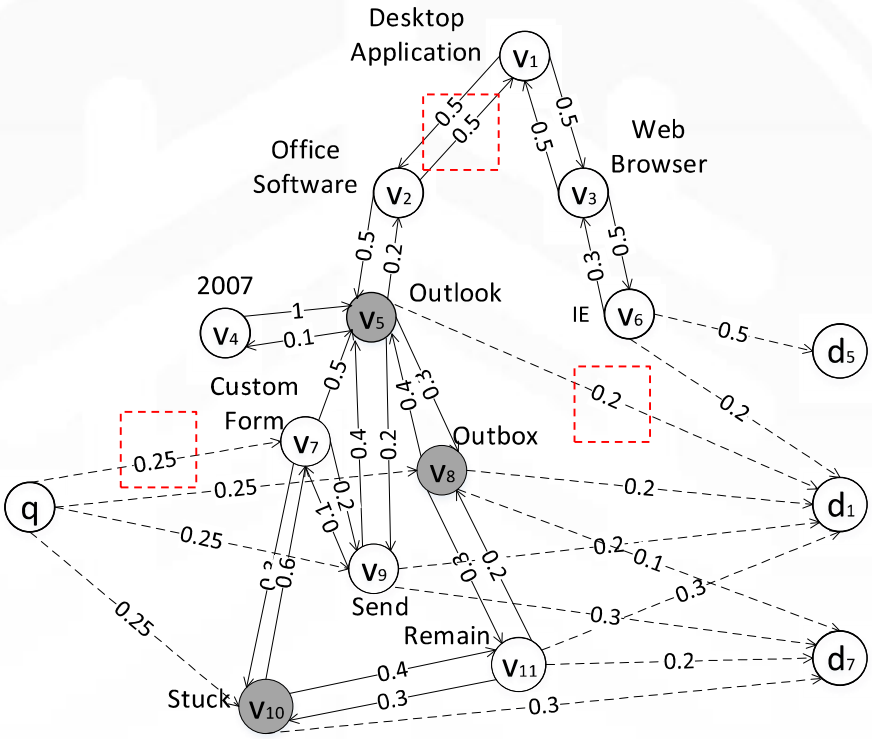
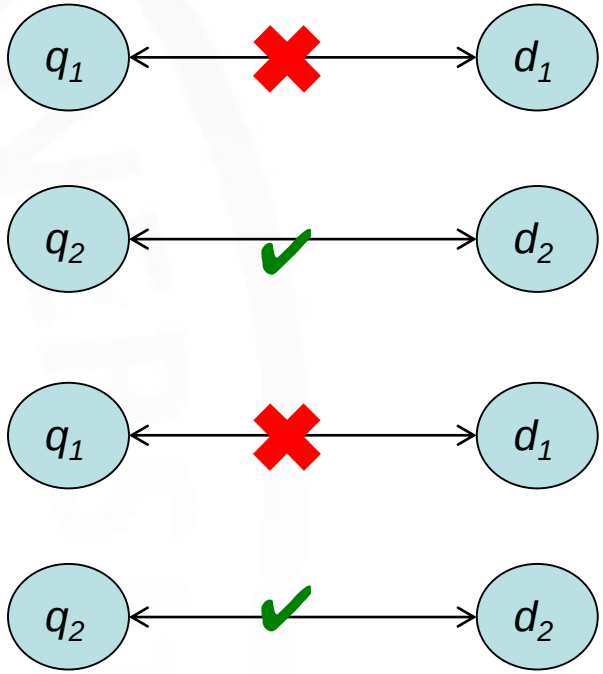


Our work (2): Crafting KG via QA complains





Thank you!

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