Real-time Spatial Task Assignment for Weather Crowdsourcing

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1. Weather Crowdsourcing (WC)
With the ubiquity of smart phones, every person with a mobile phone can report weather conditions, e.g., precipitation, air quality. The reported data, often in real-time, offer a valuable addition to the satellite remote sensing and radar detections technologies.

Applications
- Environmental sensing
- Disaster response
- Transportation decision making

Fig. 1 WC apps

Task Assignment
1. Requester issues tasks to server
2. Server assigns tasks to nearby workers
3. Server sends tasks to assigned workers

Fig. 2 WC framework

2. Challenges
Distinctions from crowdsourcing paradigms:
1. Reported observation is near (within) task’s location (duration)
2. Server maximizes task coverage with worker budget constraint
3. Dynamic arrivals of tasks/workers

Fig. 3 WC example

Select workers that maximize task coverage (MTC)

Fig. 4 Graphical example of worker-task coverage (2 time instances)

3. Fixed Budget

Off-line Scenario
MTC is NP-hard by reduction from the maximum coverage problem with group budget constraint problem
Greedy algorithm gives 0.5-approximation ratio.

On-line Scenario
Heuristics to MTC time instance: Basic, Spatial, Temporal

4. Dynamic Budget

Off-line Scenario
MTC is NP-hard by reduction from the maximum coverage problem
Greedy algorithm gives 0.63-approximation ratio

On-line Scenario
Adapt allocates budget to time instances based on contextual bandits
i.e., balances budget status and coverage gain
Improve Adapt by leveraging workers’ activity patterns

Fig. 5 Work-flow for adaptive budget allocation based on contextual bandits

5. Performance Evaluations

Real Datasets
- Synthetic Datasets

Fig. 6 Gowalla, CA

Fig. 7 Foursquare PA

Fig. 8 Spatial distributions

Fig. 9 Temporal distributions

6. Discussions
- Worker overload to avoid repetitive activations of the same worker
- Profit for each task to represent the importance of tasks
- Utility of tasks as a function of spatial/temporal distance to worker
- Activation cost of workers is not uniform

Fig. 10 Performance evaluation