Effective Task Assignment in Mobility Prediction-Aware Spatial Crowdsourcing

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Introduction

- **Task Assignment with Mobility Prediction**

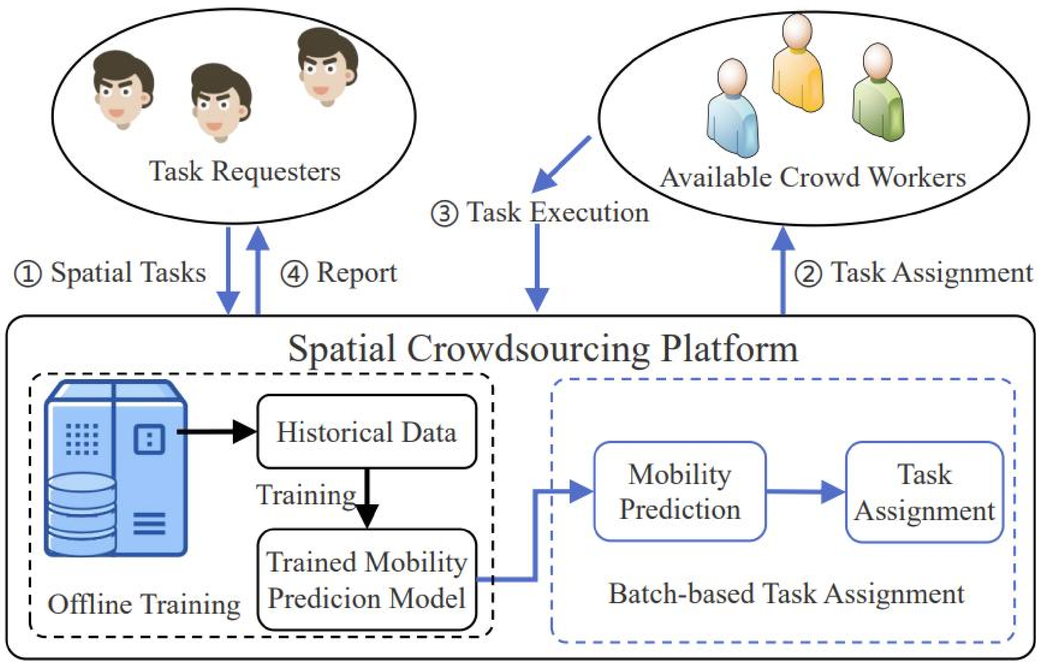
  Assign tasks to workers based on their predicted mobilities

- **Challenges**

  I. Pertains to the **dynamic mobility** patterns among workers.

  II. Addresses the **disconnect** between the objectives of mobility prediction models and task assignment.

  III. Involves the utilization of **uncertain predicted mobility**.

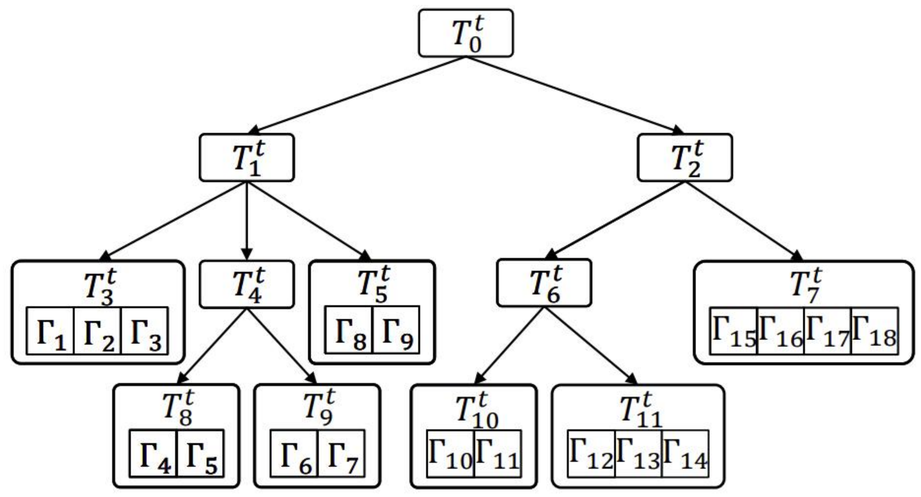


Methodology

- **Worker-Specific Mobility Prediction (Challenge I)**

  Game Theory-Based Task Adaptive Meta-Learning: train a set of **initialization parameters** for each learning task

  - Features: distribution, spatial (POI), learning path
  - Clustering learning tasks (modeled as a game)
  - Train a shared parameters for each cluster



- **Task-Oriented Loss Function (Challenge II)**

$$\mathcal{L}_T = \frac{1}{|r|}\sum_{i=1}^{|r|} f_w(l_i)\cdot(l_i - \hat{l}_i)^2$$

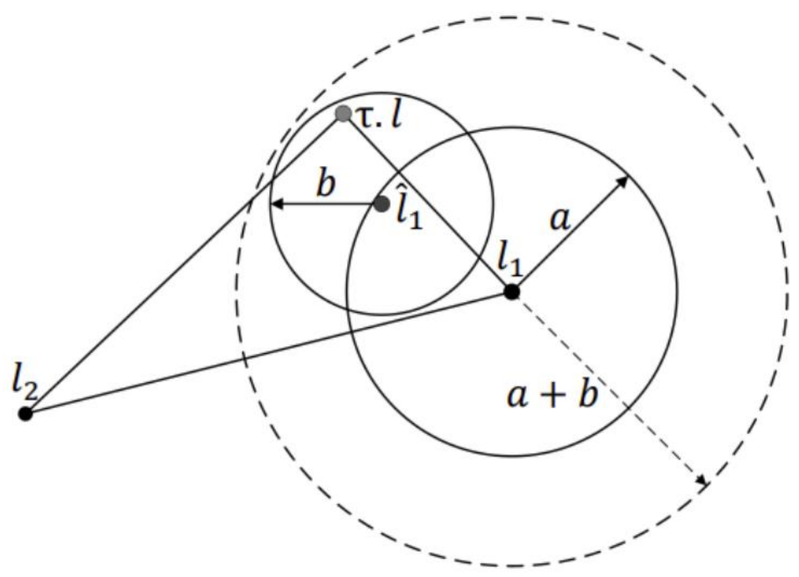
- **Prediction-Performance-Involved Assignment (Challenge III)**

  Matching Rate: $MR(r,\hat{r}) = \frac{1}{|r|}\sum_{i=1}^{|r|} match(l_i,\hat{l}_i)$

  - Converted to the probability of a worker completing the task without violating constraints

  General Idea of PPI:

  - Prioritize tasks with higher likelihood of completion



Experiments

- **Mobility Prediction**

seq_{in}	metric	MAML	CTML	GTTAML-GT	GTTAML
1	RMSE	1.0332	0.9664	0.9317	**0.9063**
	MAE	0.9210	0.8590	0.8044	**0.7793**
	MR	0.2997	0.3600	0.4234	**0.4396**
	TT	**1361.7**	1643.8	1424.1	2531.1
5	RMSE	0.9722	0.9437	0.9428	**0.8937**
	MAE	0.8697	0.8215	0.8369	**0.7711**
	MR	0.3621	0.3881	0.4020	**0.4446**
	TT	**2091.4**	2577.1	2277.2	3987.1
10	RMSE	0.9466	0.9216	0.8991	**0.8976**
	MAE	0.8436	0.7967	0.7805	**0.7723**
	MR	0.3858	0.4309	0.4325	**0.4338**
	TT	**2517.1**	3718.0	3255.4	5624.3

seq_{out}	metric	MAML	CTML	GTTAML-GT	GTTAML
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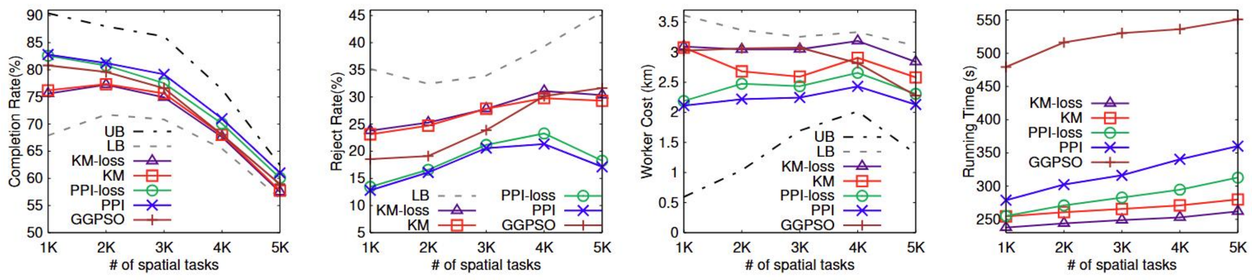
	MR	0.3621	0.3881	0.4020	**0.4446**
	TT	**2091.4**	2577.1	2277.2	3987.1
2	RMSE	1.1911	1.0517	1.1390	**1.0100**
	MAE	1.0422	0.9054	0.9557	**0.8691**
	MR	0.0936	0.3209	0.3358	**0.3431**
	TT	**2090.6**	2870.8	2620.4	4660.3
3	RMSE	1.1900	1.2082	1.1943	**1.1664**
	MAE	1.0162	1.0316	0.9818	**0.9646**
	MR	0.2129	0.2552	0.2815	**0.3051**
	TT	**2404.3**	3427.0	2984.3	5273.8

- GTTAML achieves the best performance in mobility prediction
  - RMSE and MAE decreased by 6% and 9% compared to CTML.
  - MR increased by **22%** against CTML.

- **Task Assignment**



(a) Completion Rate (b) Rejection Rate (c) Worker Cost (d) Running Time

- PPI vs. GGPSO
  - **41%** lower rejection rate.
  - **28%** lower worker cost.