Flexible Online Task Assignment in Real-Time Spatial Data

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Introduction

• Real-time spatial data is ubiquitous.
  • Online platforms that facilitate spatial tasks to be assigned and performed by workers, e.g., O2O applications.

• Motivation
  • Most O2O applications need to do task assignment in real-time:
    - Real-Time Taxi-Calling Service.
    - Food Delivery Service.
  • The flexibility of workers has not been considered.

The FTOA Problem

• Given
  - A set of crowd workers W
    - Each w ∈ W: location Lw, arriving time Sw, deadline Dw.
  - A set of spatial tasks R
    - Each r ∈ R: location Lr, arriving time Sr, deadline Dr.
  - Find an online allocation M to maximize the assigned pairs MaxSum(M) = ∑maxw,r∈Mr I(w, r). I(w, r) = 1 if the following constraints are satisfied.
    - Deadline Constraint.
    - Worker’s decision Constraint.
    - Task’s decision Constraint.
    - Invariable Constraint: Once a task r is assigned to a worker w, the assigned pairs of (w, r) cannot be changed.

• Online Algorithm Evaluation: Competitive Ratio (CR)
  • IID Model (Stochastic case Analysis):
    • CRid = minw∈W, r∈R MaxSum(M) MaxSum(OPT)

Offline Guide Generation Algorithm

• Steps
  1. Construct the bipartite graph according to the prediction.
  2. Run the network algorithm to generate the guide.

Polar and Polar-OP Algorithm

• POLAR: CRid = 0.4
  1. When a new object arrives, occupy a node w(r) in the offline guide.
  2. Find the neighbor node r’(w) in the offline guide.
  3. Match the object who occupies the neighbor node r(w).

• POLAR-OP: CRid = 0.47
  1. When a new object arrives, associate the object to its corresponding node w(r) in the offline guide.
  2. Find the neighbor node r’(w) in the offline guide.
  3. Match the object associated to the neighbor node r(w).

Experimental Evaluation

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