Utility-Aware Social Event-Participant Planning

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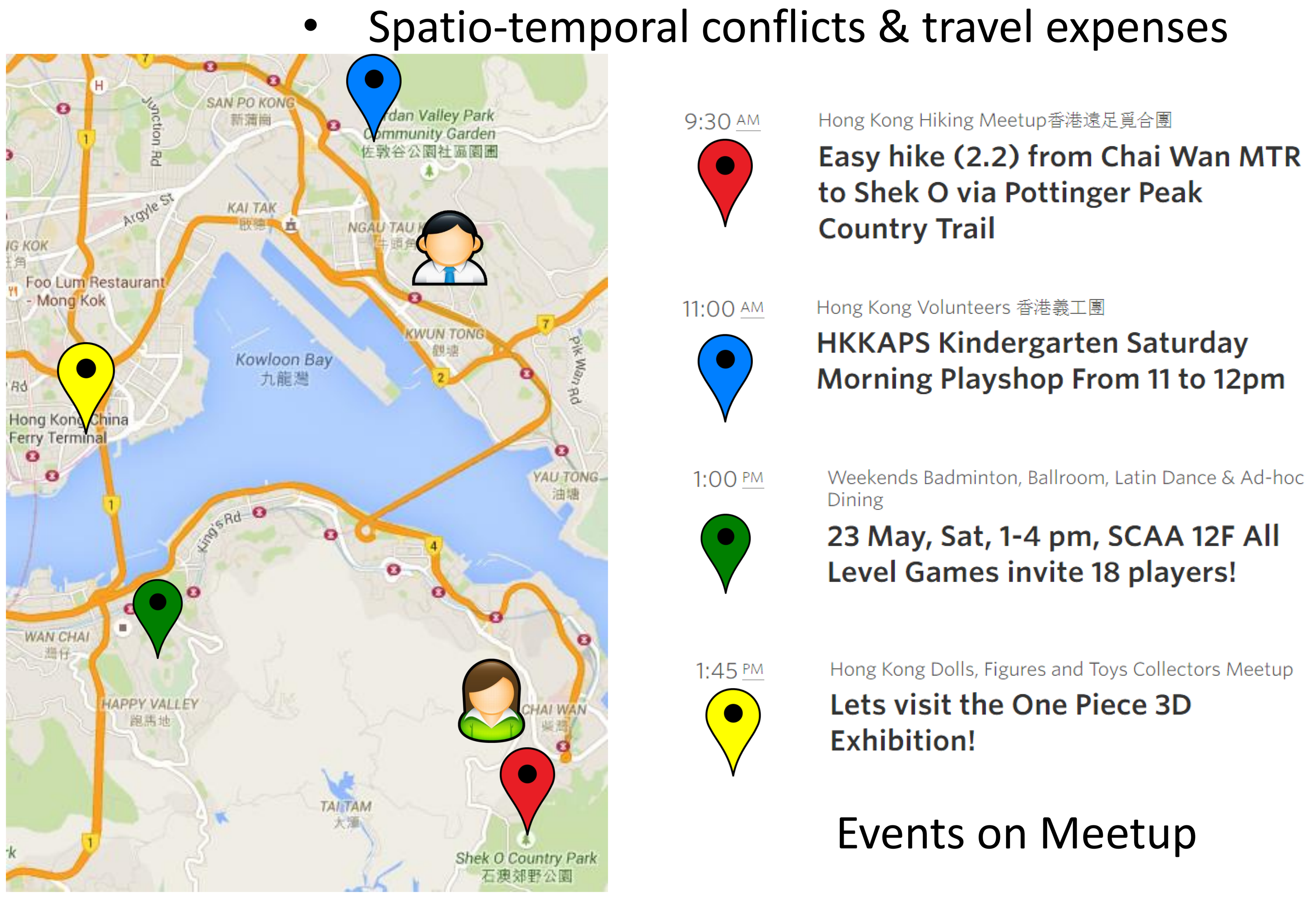
Introduction

- Event-Based Social Networks (EBSNs)
  - Online platforms that facilitate offline event organization and participation, e.g. Meetup and Plancast
- Motivation
  - Arrange proper social events to interested users
  - Existing works: either assume user attends one event or ignore location information
    - Spatio-temporal conflicts & travel expenses

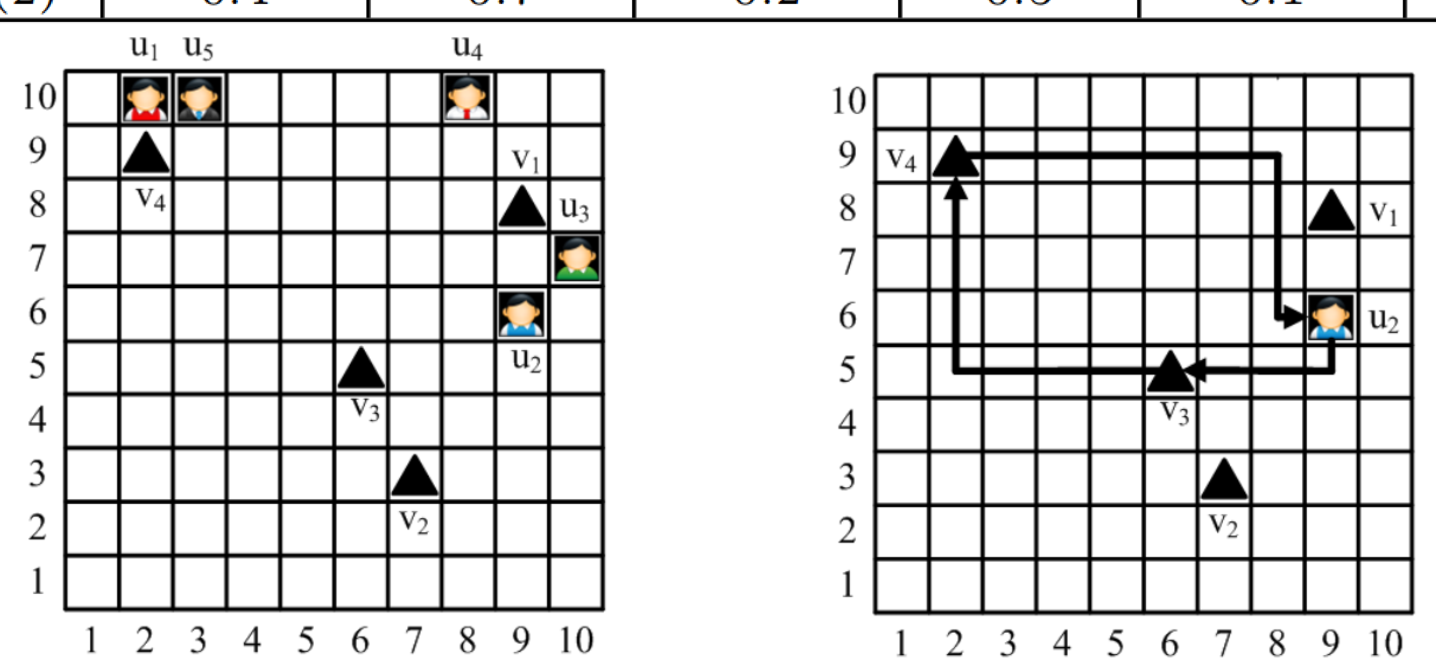


Events on Meetup

The USEP Problem

- Given
  - A set of events V
    - Each $v \in V$: capacity c_v, location l_v, time interval $[t_1^v, t_2^v]$
  - A set of users U
    - Each $u \in U$: location l_u, travel budget b_u
  - Travel cost $\{cost(u,v)\}, \{cost(v_i, v_j)\}$
  - Utility value $\{\mu(v,u)\}$
- Find a planning of schedules $A = \cup_u \{S_u\}$
  - Maximize $\Omega(A) = \sum_u \sum_{u \in S_u} \mu(v,u)$
  - Capacities of events are not exceeded
  - No schedule has time conflicts
  - $\mu(v,u) > 0, \forall v \in S_u, \forall u$
  - Travel budgets of users are not exceeded
- The USEP problem is NP-hard

	u_1 (59)	u_2 (29)	u_3 (51)	u_4 (9)	u_5 (33)	Time
v_1(1)	0.2	0.6	0.7	0.3	0.6	1-4p.m.
v_2(3)	0.5	0.1	0.3	0.9	0.5	3-6p.m.
v_3(4)	0.6	0.2	0.9	0.4	0.5	1-2p.m.
v_4(2)	0.4	0.7	0.2	0.5	0.1	6-7p.m.



Greedy-Based Solution: RatioGreedy

- Maintain a heap, pop a pair with largest $ratio$ value each time
  - $ratio(v,u) = \frac{\mu(v,u)}{inc\_cost(v,u)}$

	u_1	u_2	u_3	u_4	u_5
v_1	0.011(18)	0.15(4)	0.175(4)	0.05(6)	0.0375(16)

	States of H
After Initialization	(v_4,u_1) : 0.2(2), (v_1,u_3) : 0.175(4), (v_1,u_2) : 0.15(4), (v_3,u_3) : 0.075(12), (v_1,u_4) : 0.05(6), (v_1,u_5) : 0.0375(16), (v_2,u_5) : 0.023(22)
After 1st Iteration	(v_1,u_3) : 0.175(4), (v_1,u_2) : 0.15(4), (v_3,u_3) : 0.075(12), (v_1,u_4) : 0.05(6), (v_1,u_5) : 0.0375(16), (v_3,u_1) : 0.0375(16), (v_4,u_2) : 0.035(20), (v_2,u_5) : 0.023(22)

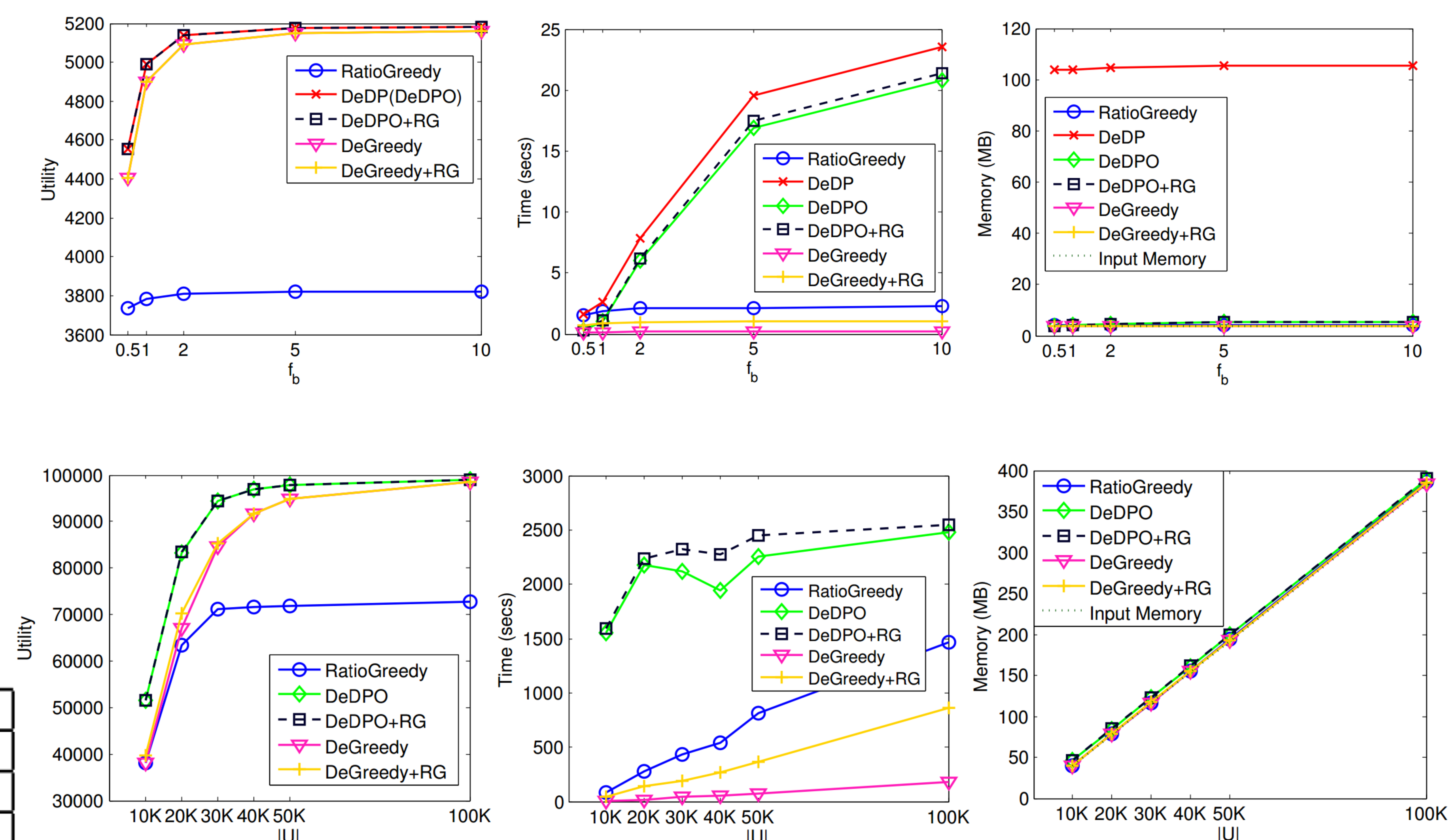
Two-Step Approximation Solution: DeDP

- Decomposed into $|U|$ problems
  - Find a schedule for each u with a dynamic programming algorithm
  - Combine the result of each u
- Optimization
  - Optimize space & speed with a proved property
  - Optimize utility with RatioGreedy
- Approximation ratio: 1/2
- Speed up by replacing DP with a greedy strategy

	$\hat{v}_1$	$\hat{v}_2$	$\hat{v}_3$	$\hat{v}_4$
u_1	$v_{1,1}$(0.2)	$v_{2,1}$(0.5)	$v_{3,1}$(0.6)	$v_{4,1}$(0.4)
u_2	$v_{1,1}$(0.6)	$v_{2,2}$(0.1)	$v_{3,2}$(0.2)	$v_{4,1}$(0.7)
u_3	$v_{1,1}$(0.1)	$v_{2,2}$(0.3)	$v_{3,2}$(0.9)	$v_{4,2}$(0.2)
u_4	$v_{1,1}$(-0.3)	$v_{2,3}$(0.9)	$v_{3,3}$(0.4)	$v_{4,2}$(0.5)
u_5	$v_{1,1}$(0)	$v_{2,3}$(0.5)	$v_{3,3}$(0.5)	$v_{4,2}$(0.1)

User	V'_r
u_1	$\mathbf{v_{3,1}}$, $v_{1,1}$, $\mathbf{v_{2,1}}$, $v_{4,1}$
u_2	$v_{3,2}$, $\mathbf{v_{1,1}}$, $v_{2,2}$, $\mathbf{v_{4,1}}$
u_3	$\mathbf{v_{3,2}}$, $v_{1,1}$, $\mathbf{v_{2,2}}$, $v_{4,2}$
u_4	$\emptyset$
u_5	$\mathbf{v_{3,3}}$, $\mathbf{v_{2,3}}$, $v_{4,2}$

Evaluation



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