Human Computation Tasks with Global Constraints

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a day in San Francisco

amazing cafes
cool artsy things
somewhere to read
...

San Francisco map
a day in San Francisco

amazing cafes
cool artsy things
somewhere to read
...

1 2 3 4 5
a day in San Francisco

amazing cafes
cool artsy things
somewhere to read
...

[Map and social media icons]
a day in San Francisco

amazing cafes
cool artsy things
somewhere to read...

[Map of San Francisco with numbered locations]
human computation with global constraints

many small contributions    difficult to decompose
human computation algorithms

[Little et al., UIST 2010]

[Bernstein et al., UIST 2010]

[Kittur et al., UIST 2011]

[Noronha et al., UIST 2011]
Mobi
<table>
<thead>
<tr>
<th>Going to San Francisco</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saturday, 11am to 10pm</td>
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</table>

**What I am looking for:**
I am going to San Francisco for a conference and have a day to explore the city before the conference starts. I’d love to go to some amazing cafes, check out some cool artsy things, and also just to relax and read a little.

**Specific requirements:**
- have at least 2 cool artsy things activities.
- have at least 1 place to read activity.
- have at least 1 amazing coffee/cafe activity.
- spend at least 3 hours on fresh local foods.
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### Going to San Francisco
Saturday, 11am to 10pm

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>arrive at Hyatt Regency</td>
<td>(11:00am)</td>
</tr>
<tr>
<td>Cool cafe + People watching</td>
<td>(11:15am–11:45am)</td>
</tr>
<tr>
<td>place to read</td>
<td>(11:55am–12:25pm)</td>
</tr>
<tr>
<td>Ferry Plaza Farmers Market</td>
<td>(12:35pm–2:05pm)</td>
</tr>
<tr>
<td>San Fran Museum of Modern Art</td>
<td>(2:20pm–4:20pm)</td>
</tr>
<tr>
<td>Art at Grace Cathedral</td>
<td>(4:35pm–5:05pm)</td>
</tr>
<tr>
<td>Stop at Philz Coffee</td>
<td>(5:25pm–6:10pm)</td>
</tr>
<tr>
<td>balmy alley murals</td>
<td>(6:40pm–7:10pm)</td>
</tr>
<tr>
<td>Local food at unique Localvore restaurant</td>
<td>(7:25pm–8:55pm)</td>
</tr>
<tr>
<td>Westin St. Francis glass elevators</td>
<td>(9:15pm–9:45pm)</td>
</tr>
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</tbody>
</table>
visiting san francisco, ca

Our Brainstream
#fresh local food restaurants  #cool artsy things  #people watch  #amazing coffee/cafes  #somewhere to read  #todo  #activity  #note

Search or add an idea, or click on one below  Add

Our Brainstream
Add more things to the itinerary
There is still 5 hours and 3 minutes left empty in the itinerary. The trip can go till 10:00pm.
#todo  #time

Add more 'amazing coffee/cafes' to the itinerary
We need at least 2 amazing coffee/cafes activities. The current itinerary contains 1 amazing coffee/cafes activities. [...]  #todo  #amazing coffee/cafes

Add more 'cool artsy things' to the itinerary
We need at least 2 cool artsy things activities. The current itinerary contains 1 cool artsy things activities. The [...]  #todo  #cool artsy things

Cool cafe + People watching
Check out this North Beach cafe for great coffee and even better people watching!
#activity  #people watch  #amazing coffee/cafes

Art at Grace Cathedral
See the triptych created by world famous artist Keith Haring, marvel at the murals and the beautiful stained glass [...]  #activity  #cool artsy things

Starbucks for coffee
get some coffee  #activity  #amazing coffee/cafes

Ferry Plaza Farmers Market
Fresh local food. The back walkway, which has views of the bay and the coming and going of the ferries, is also a great [...]  #activity  #fresh local food restaurants  #people watch  #somewhere to read

Map
Trip time: 5 hours and 57 minutes

Itinerary

- arrive at Hyatt Regency (11:00am)
- Cool cafe + People watching (11:05am-11:35am)
- place to read (11:45am-12:15pm)
- Ferry Plaza Farmers Market (12:25pm-1:55pm)
- balmy alley murals (2:05pm-2:35pm)
- Local food at unique Localvore restaurant (2:40pm-4:10pm)
- Westin St. Francis glass elevators (4:25pm-4:55pm)
- arrive at Hyatt Regency (5:00pm)
Our brainstream
#fresh local food restaurants  #cool artsy things
#people watch  #amazing coffee/cafes
#somewhere to read  #todo  #activity  #note

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Mobi
crowdware

(a) the crowd contributes opportunistically
given the current solution context

(b) the system indirectly coordinates the
problem solving effort
Groupware
[Ellis et al., CACM 1991]

Wikipedia
[Cosley et al., IUI ’07]
[Hoffman et al., CHI ‘09]
Our brainstream
#shopping #lunch #non-touristy #museum #campus must-sees #todo #activity #note
search or add an idea, or click on one below Add
Add to the itinerary or spend more time on existing activities
There is still 2 hours and 49 minutes left empty in the itinerary. The trip can go till 4:30pm.
#todo #time
Add more 'shopping' to the itinerary
We need at least 1 hour of shopping. The current itinerary contains no shopping.
#todo #shopping
Add more 'campus must-sees' to the itinerary
We need at least 2 hours of campus must-sees. The current itinerary contains 45 minutes of campus [...] #todo #campus must-sees
Check out Glass Flowers
the glass flowers #activity #museum
Cambridge 1
the potato pizza is delicious #activity #lunch

Our brainstream
#shopping #lunch #non-touristy #museum #campus must-sees #todo #activity #note
search or add an idea, or click on one below Add
Check out Glass Flowers
the glass flowers #activity #museum
Cambridge 1
the potato pizza is delicious #activity #lunch
Take a pic where Good Will Hunting was born!
Matt Damon and Ben Affleck wrote their movie here. How you like them apples? #activity
Walk by the river
Might be a little cold... #activity #non-touristy
Bartley's burgers
Have any of their burgers. It's great. #activity #lunch
Sneak into Annenburg
Don't get caught #activity #campus must-sees
Visit the geological museum
glass flower exhibit

TODO

Mechanical Turk workers
paid $0.15 for any micro-contribution
TODO condition resolves quantitative constraints quicker

[*] the notodo condition never satisfied all the constraints
Chicago

TODO

NO TODO

- breakfast (=1)
- lunch (=1)
- architecture (≥1)
- kid-friendly (≥6h)
- dinner (=1)
- break (≥4)
- total time (∼12h)
end-to-end user study

Study: 10 subjects enter missions into Mobi

Result: All 10 subjects find crowd itineraries satisfy their mission, and would use it in real life.
Partner’s birthday

NYC with family

SeaWorld with pregnant wife
My partner’s birthday

What I am looking for:

There are 2 of us (33-year-old man and woman) and it’s my partner's birthday so I want to do something fun and different. We will have a car and are happy to drive out of the city to do something fun. We love hiking, the beach, the woods, and other outdoor things. We like seeing/experiencing things that are novel and uniquely that area. We don't like tourist-y things but can put up with some tourists if the situation is neat. The more off-the-beaten-path though, the better. We'd also be open to leaving on Friday and camping somewhere if there's a good option. Or be interested in exploring things that are out in the water. I always see these island off the coast whenever I get in a plane and I always wonder what they're about. Are there fun things that might involve a boat? Or visiting little islands off the coast? We've never done that and I have no idea what's out there... Heck, we've never tried kayaking or any water-based activities around Boston and that might be neat, especially if we can get to fun places for like a picnic or something?

We also love eating yummy food (from quirky street vendors to Michelin starred restaurants). We'll probably want a nice meal (probably dinner). We love Japanese and French and Italian. We've been to many of the fanciest places in Boston, but don't know anything about the Italian places in the North End. (We don't want an old stuffy person's restaurant... young, hip is much better. Funkified non-traditional food is best. So think more like Uni and less like Clio in terms of Boston restaurants.)
hidden constraints

“I just happen to be afraid of bungee jumping because it seems so unsafe”

“I am under age so the wine thing would not be great for me but everything else sounds great.”

“I was not expecting to travel so much uptown/downtown in one day.”
conclusion

crowdware enables the crowd to tackle complex tasks with global constraints
Thanks!

Please ask a question.
We'd appreciate some questions, currently no questions has been asked.
#todo

Get in touch with me.
My email is hq@eecs.harvard.edu
#todo

Help us improve mobi.
Please share your thoughts; all comments are welcomed.
#todo