Crowd Design

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Crowdsourcing

• “Crowdsourcing” is the act of taking a task traditionally performed by a designated agent (such as an employee or a contractor) and outsourcing it by making an open call to an undefined but large group of people.

[Howe 2008]
Potential benefits

• Wisdom of the crowd
• Reduced time to market
• Generating alternative solutions
• Democratization of participation
• Employing freelance specialists
• Learning through work
Example platforms

Mob4Hire Labs

With strong roots in project based mobile software testing using crowd services, Mob4Hire partners companies, enabling them with access to a wide range of devices, languages and networks for faster, scaleable, and cost effective QA.

- **Data Lab:** Confirm delivery of application (UI) messages on networks all over the world.
- **User Group Lab:** Maximize acceptance with user experience feedback and surveys.
- **Compatibility Lab:** Reduce costs with automated testing on the latest devices, global networks and languages.

Company | Contact | Privacy Policy | Member Terms | AF Terms of Use | Our Technology | Includes as a Platform | Why We Are | Software Testing | Services | Software Testing Services
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Topcoder awards over $25,000 a day.

Every day is a brand new challenge.

Socata

Socata*

Where will great work take you?

Find freelancers to tackle any job, any code, any time

Work with someone perfect for your team

Post a bounty. Get Code.

Get tough testing help! Post a task with a reward. 10-25% to incentivize your fellow testers.

1. Post a bounty
2. Verify solutions
3. Pick a winner

**Bounties**

- $250
- $100
- $50
- $25
- $10
- $5
- $2
- $1
- $0.50
- $0.25
- $0.10
- $0.05
- $0.01

*10% is the service fee. Payment is made via PayPal and is shown as a deduction on your final invoice.

**Get Started**
What we know today

- Various software engineering tasks *can* and *are* crowdsourced through a range of platforms

- Higher quality and less expensive code [Lakhani, Garvin, Lonstein 2010]

- Crowds are much smaller than anticipated; using crowds contributes to quality and creativity [Wu, Tasi & Li 2013]

- Waterfall model; best for less complex and stand-alone tasks; development costs much greater than expected; overhead much greater; quality issues pushed later in the life cycle [Stol & Fitzgerald 2014]
Two challenges

• Is it possible to crowdsource the more complex aspects of software development?

• Is it possible to crowdsource software development at massive scale?
Two challenges

• Is it possible to crowdsource the more complex aspects of software development?

• Is it possible to crowdsource software development at massive scale?

design
“Essential” workflow design considerations

- **size of crowd**
  - small
  - large

- **task length**
  - minutes
  - weeks

- **expertise demand**
  - minimal
  - extensive

- **locus of control**
  - client
  - workers

[LaToza & van der Hoek 2016]
“Accidental” workflow design considerations

- **Incentives**: intrinsic to extrinsic
- **Task Interdependence**: low to high
- **Task Context**: none to extensive
- **Replication**: none to many

[LaToza & van der Hoek 2016]
Competition

- size of crowd: small to large
- task length: minutes to weeks
- expertise demand: minimal to extensive
- locus of control: client to workers
- incentives: intrinsic to extrinsic
- task interdependence: low to high
- task context: none to extensive
- replication: none to many
Collaborative community

- small vs. large
- minutes vs. weeks
- minimal vs. extensive
- client vs. workers
- intrinsic vs. extrinsic
- low vs. high
- none vs. many

- size of crowd
- task length
- expertise demand
- locus of control
- incentives
- task interdependence
- task context
- replication
Microtasking

- **Small** to **Large**: size of crowd
- **Minutes** to **Weeks**: task length
- **Minimal** to **Extensive**: expertise demand
- **Client** to **Workers**: locus of control
- **Intrinsic** to **Extrinsic**: incentives
- **Low** to **High**: task interdependence
- **None** to **Extensive**: task context
- **None** to **Many**: replication
A first trial: two-phase competition

[LaToza, Chen, Jiang, Zhao & van der Hoek – ICSE 2015]
Second attempt: microtasking
## Morphological chart

<table>
<thead>
<tr>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
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<tbody>
<tr>
<td>Vegetable picking device</td>
<td>Vegetable placing device</td>
<td>Dirt sifting device</td>
<td>Packaging device</td>
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<td>Packaging device</td>
</tr>
</tbody>
</table>

### Vegetables picking device
- Triangular plow
- Tubular grabber
- Mechanical picker

### Vegetables placing device
- Conveyor belt
- Rake
- Rotating mover
- Force from vegetable accumulation

### Dirt sifting device
- Square mesh
- Water from well
- Slits in plow or carrier

### Packaging device
- Track system
- Sled

### Method of transportation
- Hand pushed
- Horse drawn
- Wind blown
- Pedal driven
# Microtasking a morphological chart

<table>
<thead>
<tr>
<th></th>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
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<td>Dirt sifting device</td>
<td>Square mesh</td>
<td>Water from well</td>
<td>Slits in plow or carrier</td>
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<td>Rake</td>
<td>Force from vegetable</td>
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Can a crowd identify key decision points?  
Can a crowd identify solution alternatives?  
Can a crowd identify a complete design?
Microtasking a morphological chart

Can a crowd identify key decision points?
Can a crowd identify solution alternatives?
Can a crowd identify a complete design?
Task:
Design an interface mechanism through which users build maps with roads and intersections.

Sketch solutions that cover the following requirements:
- The user can create a simple visual map of roads on an empty, rectangular canvas.
- The user can create a map that supports at least 6 intersections.
- Roads may only lead to 4-way intersections (3-way intersections are not allowed).
- The user can create a map that allows roads of varying lengths, with different arrangements of intersections.

Tips:
- You don’t need to support very complex maps. Try to focus on the different user interactions your solutions need to have to satisfy the requirements.

Reminder:
We are not looking for one perfect design but are interested in a variety of designs that each can have their own pro’s and con’s.

Name your first solution
Explain your first solution
Two experimental conditions

- User interface design versus internal code design
- Workers work in isolation versus workers see the completed work of others
## Participation

<table>
<thead>
<tr>
<th>Event</th>
<th>User Interface (UI)</th>
<th>UI with examples</th>
<th>Internal Design (ID)</th>
<th>ID with examples</th>
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</thead>
<tbody>
<tr>
<td>Signed consent form</td>
<td>1069</td>
<td>875</td>
<td>1474</td>
<td>836</td>
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<tr>
<td>Quit before taking qualification test</td>
<td>205 (19%)</td>
<td>191 (22%)</td>
<td>375 (25%)</td>
<td>229 (27%)</td>
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<td>Failed the test</td>
<td>580 (54%)</td>
<td>431 (49%)</td>
<td>886 (60%)</td>
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<td>Passed the test</td>
<td>284 (27%)</td>
<td>253 (29%)</td>
<td>232 (16%)</td>
<td>151 (18%)</td>
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<td>Entered the platform</td>
<td>282 (26%)</td>
<td>225 (26%)</td>
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<td>Submitted completion code</td>
<td>88 (8%)</td>
<td>87 (10%)</td>
<td>94 (6%)</td>
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<tr>
<td>Accepted work</td>
<td>78 (7%)</td>
<td>80 (9%)</td>
<td>76 (5%)</td>
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<td><strong>Total solutions</strong></td>
<td>181 solutions</td>
<td>187 solutions</td>
<td>158 solutions</td>
<td>115 solutions</td>
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</tbody>
</table>
Example solution alternative

name: Graphical representation of traffic at 6 traffic lights

explanation: I decided that the user has to see what is going on in order to make a decision about what to do with the traffic light timings. So, I decided to graphically represent it in a way that would make it easier to see what was happening.

time spent: 42m

time spent name: 0s

time spent explain: 0s

workerId: SNktPPM3GkPX573K3
Example solution alternative

name: Graphical Traffic Flow Editor

explanation: I goofed and drew a 3x3 grid with 4 intersections instead of a 3x4 grid with 6, but the principles should hold up the same regardless of map size or shape. (1) - Toolbar (2) - Map editing area (3) - Tool for placing entrances and exits, possibly left-click to place entrance, right-click to place exits or something to that effect (4) - Typical object select tool (5) - Tool for placing roads. I waand&k27; t sure, though, this interface is intended to be able to construct maps or simply change the traffic flows on existing maps, so functionality of this tool won't be expanded on much. Maybe a simple line tool type mechanism, where you click to place two nodes or select existing intersection nodes and a road is created between them (6) - Green arrows represent placed entrances and yellow arrows represent exits (7) - Intersection nodes. Should be automatically defined wherever two roads intersect. Maybe there could be a tool to manually place them as well? Not sure what impact or use that could have, except the possibility to create &quot;garages&quot; in areas between intersections, which I think I&rsquo;ve gone over later (8) - Marker representing a segment of road. Dashed lines in this sketch represent 2-way streets, lines with arrows are one-way (9) - When an entrance is selected, a slider appears allowing for adjustment of the amount of traffic that will enter through that entrance. Maybe it also makes the arrow grow bigger &rarr; the higher the factor so that it&rsquo;s easy to tell at a glance the relative traffic of all entrances without having to select each one and check (10) - When an intersection is selected, arrows appear from each oncoming traffic direction (that one on the left side isn&rsquo;t actually valid because it&rsquo;s a one-way street. It probably wouldn&rsquo;t be a bad idea for the system to detect this, but it shouldn&rsquo;t do any harm if it doesn&rsquo;t since that arrow will simply affect the Zero cars coming that way. When you select an arrow, a UI element appears that allows you to adjust the probability that approaching cars will head in a certain direction. In this case if the slider is moved to one of the points of the triangle, that means a 100% chance cars will move in that direction, while leaving it in the middle of the right face of the triangle means an equal probability of any direction. This could be expanded for an N-way intersection to be any (N-1)-gon, but that could get messy and unintuitive pretty quick. Then again, anything more than a 5-way intersection is pretty unlikely in a realistic road map. Turn probability should NOT override one-way streets however, unless a goal of the program is to model reckless/law-breaking drivers as well. (11) - When a road segment is selected, you can click and drag parallel to the road to make it a one-way street. A one-way street can be made two-way again by dragging in the opposite direction. Alternatively there could actually be two UI arrows with a dot in between. Possibility for more traffic flow control here, but most of what I can think of is already covered by entrances and intersections. (Other than vehicle speed, maybe? That&rsquo;s something I didn&rsquo;t consider at all until just now, hmm...) (12) - As with most editing programs, the option to look at and manually edit the actual values of whatever you&rsquo;re adjusting would be provided too, so you can be more precise with your flow settings if you like. -- Not shown in the sketch, but there could be a possibility of adding entrances and exits in between intersections as well, essentially garages on the blocks in between. These would simply be placed with the entrance/exit tool by clicking on the desired spot. Entrances would have the same entrance rate control slider, but in addition both entrances and exits could have an intersection-like probability controller that determines which way cars will turn when coming out of entrances, and the likelihood that passing cars will turn to take an exit they pass by. -- The ability to place entrances and exits and one-way streets so freely certainly presents the possibility of the user inducing conflict, but that might not be such a bad thing - if the map breaks somewhere, you should wind up seeing where it breaks sooner or later. But there could also be some kind of conflict handler, that&rsquo;s not really the part I&rsquo;m meant to be worrying about here anyway. -- This interface might not be the most precise but it should be fairly approachable and intuitive to use. Theoretically there shouldn&rsquo;t be any major issues with non-square-grid-based road systems either, and curved roads should be handled in the same way as straight road segmentas far as directions, intersections, etc.

time spent: 17m
time spent name: 6s
time spent explain: 6s

workerid: QsEyqY3uK4eeEv9jP
Quality

- UI design
- Internal Code design
- UI Design
- Internal Code design

Frequency

Scores: 1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7

# Req met: 0, 1, 2, 3, 4

UI Design with Examples
- Internal Code design with Examples

Scores: 1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7

# Req met: 0, 1, 2, 3, 4

SDCL - Software Design and Collaboration Laboratory
Department of Informatics, UC Irvine
sdcl.ics.uci.edu
# Diversity

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<thead>
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<th>User Interface Design</th>
<th>Internal Code Design</th>
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# Overall diversity versus individual diversity

## Decision Point Description

<table>
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<th>Decision Point</th>
<th>Description</th>
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<td>Map creation</td>
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<td>dp 2</td>
<td>Setting of traffic light timings</td>
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<td>dp 3</td>
<td>Determining the flow of traffic</td>
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<td>dp 4</td>
<td>Visualization of the state of the simulation</td>
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## Worker ID and Category

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<tr>
<th>Worker ID</th>
<th>Category</th>
<th>Block Type</th>
<th>Build as you go</th>
<th>Pencil-like (Drag)</th>
<th>GPS</th>
<th>Assisted Drawing</th>
<th>Click and drag</th>
<th>Nodes</th>
<th>Map Only</th>
<th>UI layout and extra features</th>
<th>Extra Features</th>
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<td>Worker MB21</td>
<td>Build as you go</td>
<td>Blocks</td>
<td>Pencil-like (Draw)</td>
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Quality across categories

Average quality score per category
(Map creation)
Conclusions

• It is feasible for a crowd to generate a diverse range of solution alternatives

• Solution alternatives, however, vary strongly in quality, with only a moderate number that are of sufficient quality

• It is important for diversity to involve multiple workers; individual workers do not create diverse sets of solution alternatives

• Displaying examples has a negative effect: diversity goes down slightly and quality goes down significantly
Future work

• Repeat the experiment, only displaying examples of sufficient quality (done)

• Repeat the experiment, with a different crowd (Topcoder)

• Address research question #1: generating decision points with a crowd

• Explore hybrid models