

Startup Tycoon

Algorithms with a Purpose

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1 Introduction

Welcome, entrepreneurs, to the Startup Tycoon. According to your trustworthy news source on X Combinator, there has recently been a growing demand for widgets in San Franhattan. And so, like the street-smart businessperson you are, you've decided to capitalize on (and hopefully monopolize) the nascent market by strategically taking on orders and expanding Tuber, your widget business. You aren't the only one with this objective, of course—you are joined by others who have their eyes on the prize as well. So, get out there and lead Tuber on to be great, and make Andrews Carnegie and Mellon proud!

2 Terminology

player	a single entity in a game, representing a team of up to 4 humans
game	an iteration of a set of orders and turns on a distinct map
turn	a single time step of a game during which an order may appear and a player may take an action
action	creating a station and/or responding to orders
order	a request for a widget originating from a home on the map
home	a node on the map that can generate orders for widgets
station	a node on the map that can respond to orders for widgets
map	the map on which orders appear and actions occur, consisting of a collection of nodes, some of which are connected

3 Rules

1. Every node can be reached from another through some path through the map. Nodes are connected with neighbors by **unweighted, undirected** edges.
2. Each station will be located at a **player-determined** node. The player may choose when to build their stations (including the first station), provided that they have enough capital.
3. Each turn will be capped at 0.5 seconds. Each game will end after **400** turns (a little over three minutes at most).

4. Orders will appear at certain time steps, with probabilities following a **Uniform Random Distribution**. An order contains the following:
 - A destination node
 - A bounty for the request
5. You can respond to the request whenever you choose after receiving it (including the time step it was received) by returning a **set of nodes** from the station to the destination including the station and destination. Of course, once an order has timed out, you may no longer respond to it. The actual bounty received is a function of how long it takes for the widget to reach its destination (see Section 4: Scoring).
6. For a number of time steps equal to the length of the path returned, the edges on the path **cannot be used** for other requests. (Imagine your widget traveling through one edge per time step, during which the entire path is occupied while during transit.)
7. A **new station** can be built on any turn instantaneously and can begin serving on the same turn it is created as long as the order of the commands is correct. Stations can be built on any node in the map, including homes. The cost of each successive station will be higher than the previous one.
8. You can respond to more than one order on each turn if you wish.

4 Scoring

The scoring function for each game is the money earned by fulfilling orders, minus the cost of the stations built:

$$\sum_{n \in N} (s_n - t_n \times d) - \sum_{b \in B} c_b$$

N = set of fulfilled orders

s_n = initial bounty of order n

t_n = time steps elapsed in fulfilling order n

d = decay factor (constant)

B = set of stations built

c_b = cost of building station b

The value of each order will decline linearly over time, and scores will reflect the time taken to deliver each fulfilled order. Note that continually unfulfilled orders will eventually time out upon reaching a value of 0.

5 Tournament

- The competition will take place in multiple rounds wherein each player's score is computed individually (i.e., there will not be multiple players competing simultaneously on the same map).

- The same map layout will be used for all players throughout a given round; however, a different map will be used for each successive round.
- The top 50% of players will advance from the end of each round into the following round.
- Scores will reset to 0 at the start of a round.
- The tournament winners shall be the top three players from the final round.

6 Tips

- The practice maps will not be the same as the tournament maps, but maps will always be connected, unweighted, and undirected.
- As each map is a connected, unweighted, and undirected graph, graph algorithms — search and shortest-path in particular — will probably come in handy.
- You may also find it useful to look into and take ideas from various **streaming algorithms**. Wikipedia is a good place to start: https://en.wikipedia.org/wiki/Streaming_algorithm