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Programming Project Tips

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All Sections

Hey all,

Here are some tips for how to proceed with the programming project.

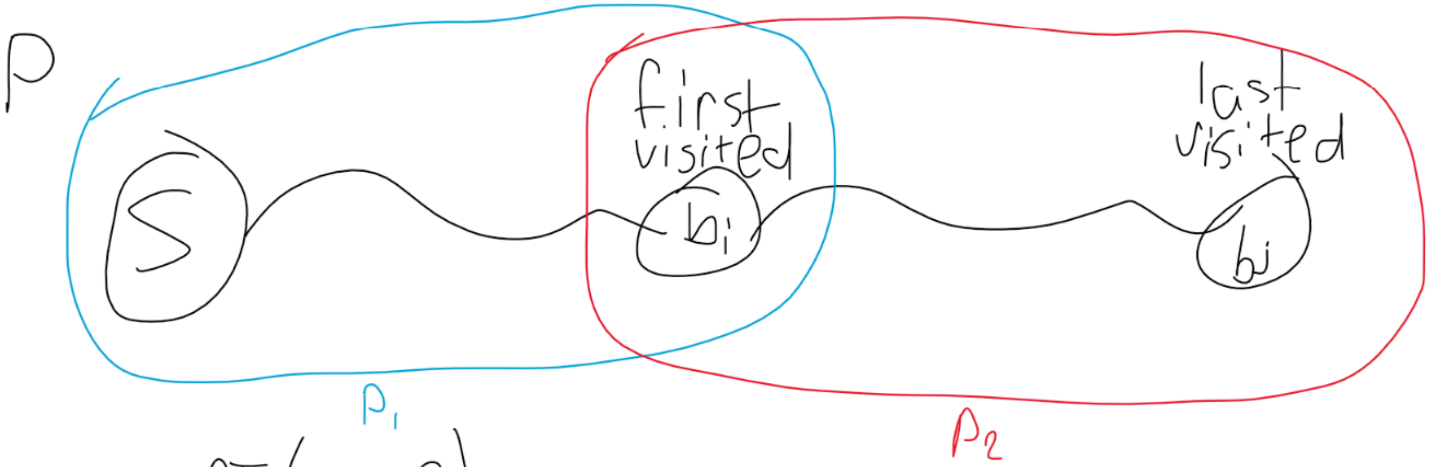
Step 1

Convert the input grid/heights into a weighted directed graph. Once you do this, you can forget about the grid and heights altogether.

Step 2

The intended solution is to use dynamic programming. Consider the following figure:

$$\text{source} = s, \quad B = \{b_1, \ldots, b_n\}$$



$$OPT(s,B) = \min_{b_i \in B} \{ |P_1| + |P_2| \}$$

We can define the OPT(s,B) = the length of any shortest path that starts from s and visits all nodes in B (your algorithm should output OPT(s,B). Let the drawn path P be such a shortest path and let bi be the first vertex in B along P starting from s. The length of P is the sum of the length of the blue path P1 and the red path P2. I have given you most of the recursive equation, you just need to fill in the lengths of these paths. The length of P1 can be computed using the Bellman-Ford-Moore algorithm. The length of P2 can be written in terms of a subproblem OPT. There is also the base case to consider.

Note that we are minimizing the sum of these paths over bi in B. This is because we do not know which node in B that we should visit first. The greedy algorithm does not work: you cannot just compute the shortest path from s to each node in B and then travel to the node in B closest to s.

Step 3

Once you figure out the recursive equation, you need to record answers in a table M (just like in Knapsack). M has 2 dimensions, since OPT has 2 parameters. The rows correspond to nodes and the columns correspond to subsets of B. You can index the nodes using numbers, so vertex 1 corresponds to row 1. How can we index a subset of B? We can identify a subset of B with a binary string. For example, if B = {b1, b2, b3}, then the binary string 101 corresponds to the subset {b1,b3}. In other words, a 1 indicates that an element is contained in the subset and a 0 indicates that t is not.

Summary

1. Convert the input into a directed weighted graph
2. Fill in the dynamic program equation above
3. Store answers is a 2-dimensional table indexed by (number, binary string)

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