2014-JP-01-EN Traveling upriver

0 ----	I: hard	II: medium	III: medium	IV: easy

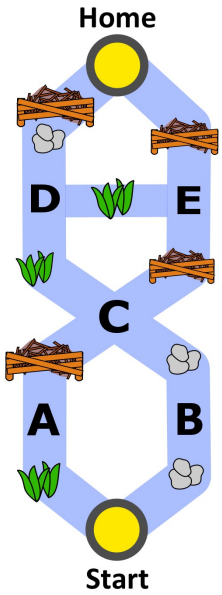
☒ ALG	☐ INF	☐ STRUC	☐ PUZ	☐ SOC	☐ USE

Answer Type: Multiple Choice Mandatory for: none

Body

To reach home, a beaver has to make a trip through a system of creeks.
To have energy for the trip the beaver eats 15 twigs.
On its trip, the beaver must get across some obstacles.
This consumes energy corresponding to the following amount of eaten twigs:

Obstacle	Consumes Energy
	2
	3
	5



On the right, you see the system of creeks and the locations of the obstacles.
The locations A, B, C, D, and E are used to describe routes through the creeks.

Question

Which of the following routes can the beaver take?
Remember it starts with an energy of 15 twigs.

Start → A → C → E → Home
Start → A → C → E → D → Home
Start → B → C → D → E → Home
Start → B → C → D → Home

Answer

Start → B → C → D → E → Home

Explanation

The different routes consume the following amounts of energy:
Start → A → C → E → Home : 2+5+5+5 = 17
Start → A → C → E → D → Home : 2+5+5+2+3+5 = 22
Start → B → C → D → E → Home : 3+3+2+2+5 = 15; this is the only route that does not consume more energy than the beaver has.
Start → B → C → D → Home: 3+3+2+3+5 = 16

It's informatics

The system of creeks is like a network, with the locations A to E plus Start and Home as nodes that are connected. The energy consumption of the obstacles on the connections can be regarded as a distance between connected nodes. Then, the beaver is looking for a shortest path from node „Start“ to node „Home“. In informatics, the mathematical construct „graph“ is often used to represent such networks with distances. Many algorithms have been developed for graphs. For the „shortest path problem“, several efficient algorithms have been invented, e.g. by Dijkstra and (together) by Floyd and Warshall. You may have seen the application of such algorithms already, for instance in route planning services like car navigation systems. So the next time you reach your goal thanks to computer software, you may think of Dijkstra and all the other computer scientists that have improved the finding of shortest paths.

Keywords

Graph, Shortest path problem, Dijkstra

Websites

http://en.wikipedia.org/wiki/Edsger_W._Dijkstra
http://en.wikipedia.org/wiki/Dijkstra%27s_algorithm

Internal Use

Wording

home
(system of) creeks: the „graph“
trip: going from start to home in general, independent of the route
route: a possible path through the graph
energy: corresponding to number of twigs eaten, consumed by getting across obstacles

Comments

Graphics

All figures are drawn by Maiko Shimabuku (shimabuku.m@gmail.com , Japan).
The figure is licensed under a Creative Commons Attribution-ShareAlike 2.1 Japan License (CC BY-SA 2.1 JP).
2014-06-04, Wolfgang Pohl: Exported dam, grass, and rocks into separate image files.
Françoise Tort, francoise.tort@ens-cachan.fr, 2014-06-03, I removed the circles around the letters because they looked like obstacles.

Files

All additional files for this task (graphics, scripts, etc.)
2014-JP-01-EN.odt (this file)
2014-JP-01-fig.svg
2014-JP-01-fig.png
2014-JP-01-fig-alt.svg
2014-JP-01-fig-alt.png
2014-JP-01-dam.png
2014-JP-01-grass.png

2014-JP-01-rocks.png

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