PSAT Week 7: Graph Algorithms I

Objectives: graphs, depth-first search, global vs. local view

Task 1 (5 min):
Find a path from the starting point to the target in the center of the maze

Graphs:

- A **graph** consists of **nodes** (also called vertices) and **edges**
- Each edge has two nodes called endpoints
- Modeling a maze: nodes for the start, the target, intersections, and dead ends
  edges represent direct passages
- A **path** is a sequence of nodes connected by edges
- In general, edges might have directions and weights
- We usually assume that nodes are referred to by unique IDs or numbers.

Graphs as versatile model:

- Road networks
- Social networks
- Images as grids of pixels
- ...

Depth-First-Search algorithm (for starting node x and target node t):

```
Mark x as 'visited'
If x is the target node t, report that the target has been found
Otherwise, scan through the edges that have x as one of their endpoints
and perform the following instructions for each such edge:
      If the other endpoint y of the edge is not marked yet, perform the
      DFS algorithm with starting node y
```

Task 2 (10 min):
Execute the depth-first search in the given maze.

Task 3 (15 mins)
Suppose you do not have a global view on the maze, but need find your way by walking inside using only *local* information. How can you apply the depth-first search strategy in this setting to find a path to the target? You may assume to be equipped with bread crumbs to leave marks.

Trémaux's algorithm:

```
Enter the maze at the start and always act according to the following rules
until the target is reached:
      If an intersection is reached:
            If no markers exist yet at this intersection:
                  Mark entrance of passage from which you came with two markers
                  Choose any of the other passages, mark it, and walk along it
            If markers already exist at this intersection:
                  If entry of passage from which you came is not marked:
```

```
                    Turn around and walk back along passage from which you
                    came
              If entry of passage from which you came is marked:
                    If there still is a passage whose entrance is not
                    marked:
                          Mark the entry of this passage and walk along it
                    If the entries of all passages are marked:
                          Walk back along passage whose entrance is marked
                          with two markers
If a dead end is reached:
      Turn around and walk back along passage
```