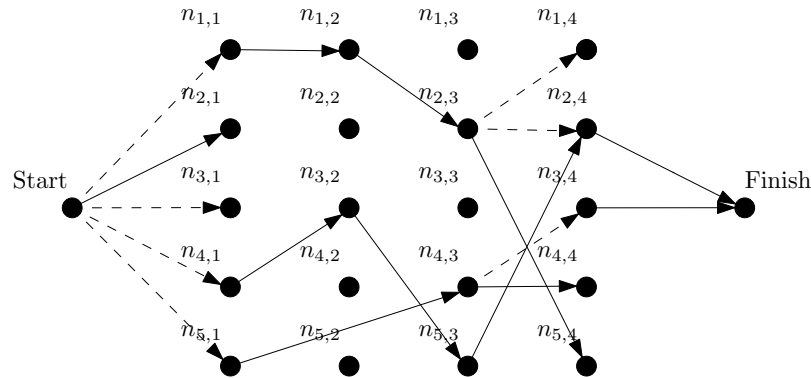


1 Artificial Intelligence (sbh11)

Evil Robot has decided to toy with his victims by placing them in a puzzle maze. Victims are initially at the **Start** node and need to navigate to the **Finish** node. Other nodes $n_{i,j}$ are laid out on a grid and connected by two kinds of edge. Fixed one-way edges (single-source, solid lines) allow a victim to pass from one node to another, left to right. For example, $n_{5,1}$ to $n_{4,3}$ in the diagram. Switched edges (single-source, solid and dotted lines) can be moved among destinations. For example, $n_{2,3}$ is currently connected to $n_{5,4}$ but can be moved to connect to $n_{1,4}$ or $n_{2,4}$ instead.



A victim can set the switched edges as desired, but only if they have reached the switch's source node. Their aim is to cross the maze successfully.

- (a) The victim decides to solve this problem by representing it as a planning problem using the *state-variable* representation. Give an example of how each of the following elements might appear in the representation.
 - (i) A *domain*. [1 mark]
 - (ii) A *rigid relation*. [2 marks]
 - (iii) A *function*, including a *state variable*, representing the destination of a switched edge. [3 marks]
 - (iv) A *goal*. [1 mark]
- (b) Explain in detail how actions allowing (1) the victim to move around the grid, and (2) the destination of a switched edge to be altered, might be implemented in the state-variable representation. [6 marks]
- (c) The victim now wishes to solve their planning problem by converting it to a *constraint satisfaction problem (CSP)*. Explain in detail, giving examples based on the diagram above and your earlier answers, the steps necessary to perform the conversion. [7 marks]