Fundamentals of Flatland

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1 Introduction

The goal is to translate the elements of the flatland environment into ASP facts that can be solved by Clingo.

2 Problem definitions

2.1 Grid environment

The Flatland environment is a rectangular grid of width w and height h. It is composed of cells, each of which is classified as one of eight track types and may hold no more than one agent at any time step. Each track type may be rotated or flipped. The combination of track type, rotation, and flip is known as its arrangement.

Let G be a Flatland grid environment of width w and height h. The cells in the environment can be represented by C a set of five-tuples (x, y, t, Ω, ϕ), such that:

- $0 \leq x < w$
- $0 \leq y < h$
- $t \in \{0, 1, 2, 3, 4, 5, 6, 7\}$
- $\Omega \in \{N, E, S, W\}$
- $\phi \in \{0, 1\}$

Each (x, y) coordinate corresponds to a single cell in the environment, whereas t denotes the track type, Ω denotes the orientation of the track, and ϕ denotes whether a track is flipped.

2.2 Agents

Each agent is assigned a starting cell. Each agent has an orientation at every time step, which corresponds to the cardinal direction it is facing. Agents can traverse the environment at a rate of one cell per time step according to transition functions, which are based on track arrangement and agent location and orientation at given time steps.

Let A be a set of n agents. Each agent a can be represented by the following tuple (). *At this point, I'm not really sure whether the starting and ending positions should be properties of the agents themselves, or rather characteristics of the specific problem which are then executed using the agents.*

Below this line are personal notes and unfinished definitions and descriptions.

We can represent the trains as a set of n agents $\{a_0, a_1, \ldots, a_n\}$. Each agent a has a starting point s, a goal g, and an initial direction d.

We can represent our problem with the tuple (x_d, y_d, t, s, g, A), where

- x_d and y_d constitute
- t represents the track type
- s represents a set of starting points
- g represents a set of goals
- A represents a set of agents

2.3 Environment

We can represent any Flatland grid environment with a directed graph $G = (V, E)$, where V is a set of vertices and E is a set of edges. A mapping function $f(x, y) = (V, E)$ is defined, such that for each coordinate (x, y) in the Flatland environment, we assign a vertex $v \in V$. We assign the edges by examining the track type in each cell of the Flatland environment and determining which of its two neighboring cells are connected to each other via the current cell. This results in a hypergraph of order 3.