**Evergreen Line Skytrain  
CoreASM Specification**

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# 1. Overview of Functional Requirements

The functional requirements for the Evergreen Line are as follows:

1. After the train halts at a station, the doors should open within 2 seconds (liveness requirement)
2. Doors shall stay open for 10-12 seconds
3. After the 10-12 second period, the doors shall close if it is safe to do so
4. Doors must be closed for at least 2 seconds before the train departs from a station (safety requirement)

Requirements A, B, and D are independent of the environment; they are actions the Skytrain must perform under any conditions. Consequently, we have strictly programmed (i.e. hard-coded) the Skytrain to exhibit a constant behaviour that satisfies these three requirements. Requirement C is dependent on the environment and the Skytrain will need to respond accordingly depending on the situation. To fulfill requirement C we have added a “door sensor” to determine whether the doors are safe to close. We also use the door sensor to handle the exceptional case where the doors are safe to close, but while the doors are closing it has become unsafe.

There is one unknown requirement in the specification – the amount of time the train takes to leave a station. This requirement is important because it determines the time needed before it is safe for the next train to arrive. We have set the requirement as follows:

1. When the train departs, it is completely clear of the station within 10 seconds

This requirement allows a new train to arrive as early as 10 seconds after the previous train has departed.

# 2. ASM Specification Components

In our ASM model, both the Westbound line and Eastbound line contain the following agents:

* A track controller
* A door controller and door sensor
* Environment
* Observer

Each agent is covered in more detail in the sections below.

## 2.1. Track Controller

The track controller is a sensor that maintains the current status of the track. We have assigned the following statuses for this state machine: empty, arriving, stopped, preparing to leave, and leaving. The track controller manages the arrival and departure of the trains. The track controller’s behaviour is the following:

* When it detects a train is approaching a station, tell the Skytrain to slow down and stop
* Determine when the train has fully stopped then give a signal to the door controller
* Wait for a return signal from the door controller
* Prepare the Skytrain for leaving by waiting for 2 seconds (requirement D)
* Tell the Skytrain to leave the station

## 2.2 Door Controller with Door Sensor

The door controller controls the opening and closing of the train doors. The doors have the following statuses: opening, open, closing, closed. The door controller and sensor requires information from the track controller to perform its actions. The door controller behavioural cycle is the following:

* Wait for a signal from the track controller indicating the train has stopped
* Open the doors within 2 seconds after the train has stopped (requirement A)
* Keep the doors open for 10 seconds (requirement B)
* Attempt to close the doors
  + If the door sensor has detected that the doorway was obstructed, open the doors again and wait 2 seconds (Requirement C)
  + Attempt to close the doors again; if doorway is still obstructed, repeat above
* When doors are closed, give a signal to the track controller indicating the train is ready to depart

## 2.3 Environment

The environment agent is responsible for creating events for the simulation. In order to test our door sensor that we used to fulfill requirement C, we simulated passengers boarding and exiting the Skytrain which would cause the doorway to be blocked. We introduced a variable “business factor” which determines how likely a doorway will be blocked. The business factor value grows when the track is empty as more people will queue up in the station for the next train. Business factor decays when a train has arrived, because the amount of people waiting at a station decreases.

The environment agent is also responsible for keeping the Skytrains a safe distance from each other. After the previous Skytrain has departed at least 10 seconds ago (requirement E), the environment will generate a new Skytrain approaching the station.

## 2.4 Observer

The observer agent in the simulation model is responsible for outputting the current time, status of the track, status of the doors, and status of the door sensor for verification.