Documentation

Placement of the sensors and semaphores

For our solution we use 16 sensors, one at each tracks end station so that the train can stop, wait and then turn and go back. A sensor is also placed before a critical section and before a switch so we can check if a critical section is occupied or not and if we need to change the switch. There is also a sensor after a critical section so we can release the semaphore that holds the critical section.

Each time a train activates a sensor the program checks what paths are available for the train to take or if it needs to stop and wait until the path ahead is clear. The event will also check if the train has exited a critical section or leaving a track that uses a semaphore so we can release the semaphore that the train left.

We chose to use six different semaphores for our solution, they are marked in blue and yellow on the picture. First of we chose the critical sections as semaphores, and after that we figured that if we use the tracks of the shortest path as semaphores, then we can always let the first train that acquires the semaphore take that path and redirect the second train if the shortest path is still occupied.

Choice of critical sections

We have chosen three different critical sections marked in yellow on the picture.
The "fourWay" was chosen because only one train can pass through at a time, so we needed placed a semaphore for that location to prevent a collision.
The second and third critical section is named "two" and "four", here we only have a single track so we need to avoid that two trains access this track at the same time. If two trains gets access to this section at the same time we will have either a frontal collision or that a faster train might catch up to a slower train and collide from behind.

Maximum train speed

The maximum speed a train can have without colliding is 16. If we would like the trains to be able to move faster, we would have to move the sensors since it would take longer for the trains to stop.

Testing of solution

We have tested in a few different ways. We used (5, 15) as standard speed through the lab since we thought it was a good idea to let them go at different speeds. When it all worked as expected, we tried to get the maximum speed. We ran the threads and let them run for about 20 minutes or until they failed. We tried 17 which lead to a crash, but 16 seemed to work in a few different combinations. We tried (1, 16), (5, 16), (10, 16) and (16, 16) which worked as it should. We also tried some other combinations to make sure it works at lower speeds as well.

Train track setup

Blue = Semaphores

Yellow = Critical Sections/Semaphores

Red = Sensors

Black = Sensors

Green = Switches