Fischer's Mutual Exclusion Protocol (MEX)

\[ P_1 \]

\[ P_2 \]

\[ P_i : \]

- repeat
  - repeat
    - \text{await} \ k = 0
    - \ k := i \ ; \ \text{delay} \ b
  - until \ k = i

\textbf{Critical section}

\[ k := 0 \]

\textbf{forever}

<table>
<thead>
<tr>
<th>8b &gt; 11a</th>
<th>Number of locations</th>
<th>Number of transitions</th>
<th>CPU time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutual exclusion (two processes are never in the critical section at the same time).</td>
<td>16</td>
<td>81</td>
<td>3.8 sec.</td>
</tr>
</tbody>
</table>
Railroad Crossing: Train, Controller, and Gate

**Train**
- $x \geq 2000$
- $x \geq 1000$
- $z \in [-50, -40]$
- $z = 1000$
- $z \geq 0$
- $z \in [-50, -30]$
- $x = 100 \rightarrow z := [2000, \infty)$
- Exit
- $x \leq 100$
- $z \in [30, 50]$

**Gate**
- Up
  - $g \leq 90$
  - $\dot{g} = 9$
  - Raise
- Open
  - $g = 90$
  - $\dot{g} = 0$
- Down
  - $g \geq 0$
  - $\dot{g} = -9$
  - Lower
- Closed
  - $g = 0$
  - $\dot{g} = 0$

**Controller**
- About to lower
  - $t \leq \alpha$
  - $t = 0$
  - Lower
  - $t := 0$
  - Exit
- Idle
  - $t = 0$
  - Exit
  - $t := 0$
  - Raise
  - $t := 0$
  - App

**Table**

<table>
<thead>
<tr>
<th>$\alpha &lt; 49/5$</th>
<th>Number of locations</th>
<th>Number of transitions</th>
<th>CPU time</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the train is within 10 meters to the gate, the gate is always fully closed.</td>
<td>36</td>
<td>90</td>
<td>0.2 sec.</td>
</tr>
</tbody>
</table>