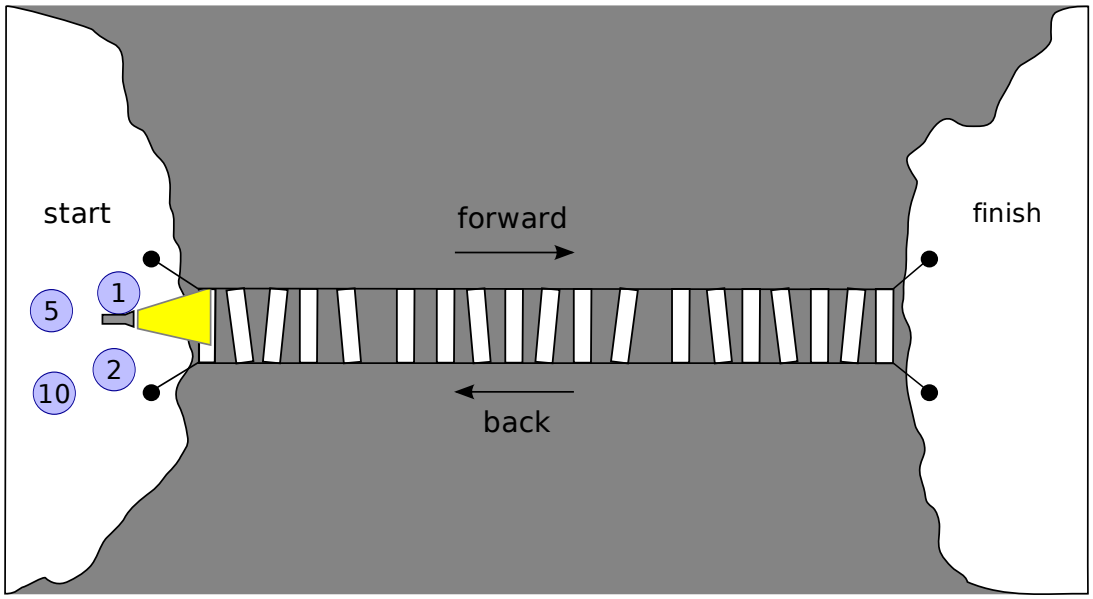
Assignment 1: Modelling and analysis of real-time systems

Renato Neves and José Proença
Arquitectura e Cálculo – 2019/2020

In the middle of the night, four adventurers encounter a shabby rope-bridge spanning a deep ravine. For safety reasons, they decide that no more than 2 people should cross the bridge at the same time and that a flashlight needs to be carried by one of them in every crossing. They have only one flashlight. The 4 adventurers are not equally skilled: crossing the bridge takes them 1, 2, 5, and 10 minutes, respectively. A pair of adventurers crosses the bridge in an amount of time equal to that of the slowest of the two adventurers.



One of the adventurers claims that they cannot be all on the other side in less than 19 minutes. One companion disagrees and claims that it can be done in 17 minutes. Your task it to verify these claims in UPPAAL[1]. Specfically, your task is to,

1. model the system above using what you learned about timed automata;
2. express in CTL that it is possible for all adventurers to be on the other side in 17 minutes;
3. express in CTL that it is impossible for all adventurers to be on the other side in less than 17 minutes;
4. test these formulae in UPPAAL;
5. write a report that explains your model, your formulae, and the conclusions obtained (about 1-2 pages excluding images).

[1] An animated description of the problem is available here.

What to submit: The report in PDF **and** the Uppaal model that you developed. Send by email (nevrenato@gmail.com) a unique zip file "`ac1920-N1_N2.zip`", where `N1` and `N2` are your student numbers. The subject of the email should be "`ac1920 N1 N2`"

Deadline: 12 May 2020 @ 23h59

Some hints to help you get started: the fact that only one person can carry the flashlight is a mutual exclusion problem. Recall from the slides the details of this kind of problem.

Do not try to model the whole system with just one timed automaton. Instead, use what you learned about parallel composition. We suggest one time automaton for the flashlight and one timed automaton for each person.

As an approximation, try first to design a model of the 'rope-bridge system' that neglects the timing constraints. Note that in this simplified form, the system is similar to the famous '*wolf, goat, cabbage*' problem.