# Modelling and analysis of a cyber-physical system
now with <u>monads</u>!
Practical assignment 2

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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.
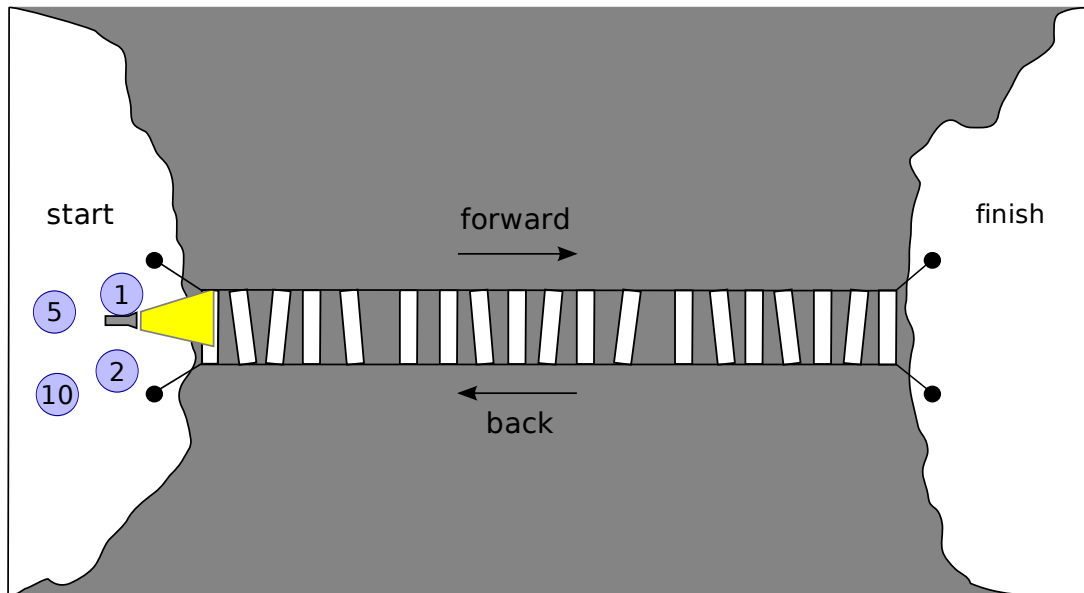
One of the adventurers claims that they cannot be all on the other side in less than 19 minutes. One companion disagrees and claims that it can be done in 17 minutes.

First task

Your first task is to verify these claims using HASKELL[1]. Specifically you will need to,

1. <u>model</u> the system above using what you learned about <u>monads</u>, in particular the duration and non-deterministic ones;

2. show that it is indeed <u>possible</u> for all adventurers to be on the other side in 17 minutes;

3. show that it is <u>impossible</u> for all adventurers to be on the other side in less than 17 minutes.

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

We require that you fulfill this task by completing the code in attachment (`Adventurers.hs`), i.e. by adding a definition to the functions that lack a definition, following the comments present in the code. Write a report that explains your code and the conclusions obtained.

Some hints to help you get started: Recall the duration monad from the slides and the HASKELL code that was previously provided. Analyse in detail the code concerning the Knight's quest and in particular the monad `LogList`.

Second task

Your second task is to compare both approaches (via UPPAAL and HASKELL) to the adventurer's problem. Specifically, you should provide strong and weak points of the two approaches: what are the (dis)advantages of UPPAAL for this problem? And what about HASKELL? You are also welcome to draw connections to other modules you were taught during the course.

Valorisation (*)

Add new functionalities to the code: for example present the sequence of states respective to the movements of the adventurers from the initial state to the final goal.

What to submit: A single report in PDF for tasks 1 and 2 **and** the completed source file (`Adventurers.hs`). Send by email (nevrenato@gmail.com) a unique zip file "`pcf2324-N1_N2.zip`", where `N1` and `N2` are your student numbers. The subject of the email should be "`pcf2324 N1 N2`"

Deadline: 03th June 2024 @ 23h59