XMP 2012 Assignment 1 (programming)

Bean machine

The Bean machine [1] was designed by Sir Galton to visualize the central limit theorem. In this exercise we will build a simulator of the bean-machine using CSP.

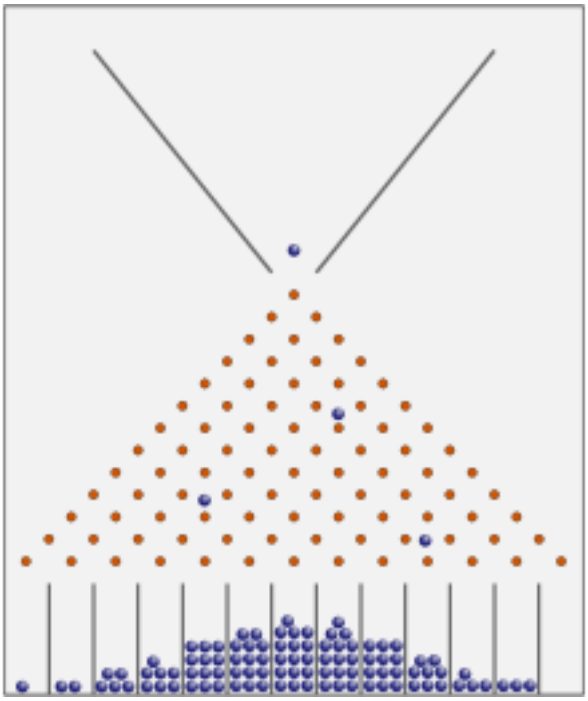

Figure 1, a simulated bean-machine from [2] note that the bottom layer of the pyramid is misaligned wrt. the counting bins.

You should implement each 'pin' in the triangle as a process, which may receive balls from any of it two upper neighbors and passes it to any of the two neighbors below. The bottom level sends to a counting bin. In the original form the pins should be fair, i.e. equal chance of going left and right.

Note that you will need additional processes in your simulation, for bean/ball injection and bin-counting.

Problem 1.

Write a bean-machine with 2 layers, i.e. 3 bins, in the pin-pyramid.

Problem 2.

Write a bean-machine that accepts an arbitrary number of levels in the pyramid. Set it up to run 10 layers of pins, i.e. 11 bins. Setup the simulator to terminate after a number of balls are either

a) Put into the simulation
b) Received in the counting bins

Run the 50 layer simulation to count 1000 balls/beans with both termination options (i.e. injected balls and counted balls), note that in both cases the number of counted balls should be exactly 1000.

Problem 3.

Extend the bean-machine from problem 2 with a bias, i.e. if the beans were iron balls we could apply a weak magnetic field to skew the probability to one side or the other. Add a process that includes an oscillator that sends bias-values in the range [0:0.5] with increment/decrement of 0.01 at the injection of each new bean/ball, to the bean-machine bias. Rerun the 1000 ball experiments from problem 2.

You may implement the assignment in any language that supports CSP (Java-CSP, C++CSP, Haskell-CSP, Occam, and PyCSP), however practical issues with getting your CSP library in only provided for PyCSP, thus it is strongly recommended that you choose PyCSP. Your report should describe your overall design, including (a) figure(s) that show your process network. Remember to describe how the simulation is initiated and terminated. The report, including a figure but not source code, should be kept at a maximum of two pages. A PDF version of the two page report plus a listing of the source-code as a single PDF file and the source-code (as a ZIP file) should be submitted ***as two separate files*** *to Absalon.*

References:

Note: even though I use Wikipedia for referencing the basic background for the assignment it is important to remember that Wikipedia is not a valid reference for scientific knowledge and as thus you as students should never use Wikipedia for your computer science references!

[1] http://en.wikipedia.org/wiki/Bean_machine
[2] http://simple.wikipedia.org/wiki/Bean_machine