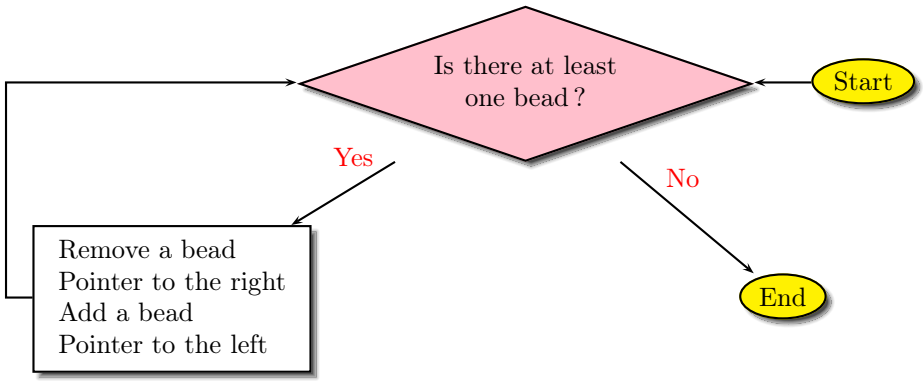
In 1936, Emil Post wrote a research article describing a machine which would allow to compute anything, see `https://www.wolframscience.com/prizes/tm23/images/Post.pdf`.

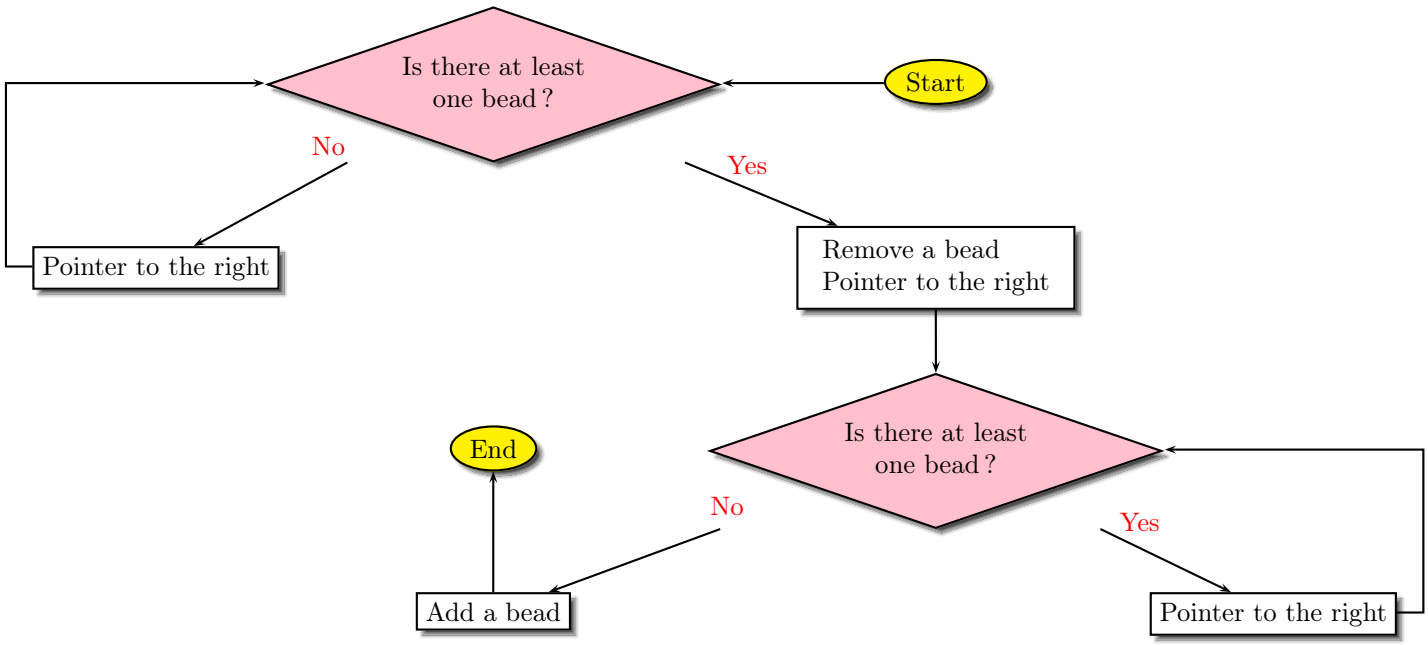
In this work, we will modify slightly his idea. We will manipulate a finite set of cells (9 cells, printed in 3d) that can contain small beads (we'll assume that we have an"infinite" supply of them, colors don't make any difference). All through the exercises, it is important to know which cell is currently "active" : we will represent this by a pointer (a small hand, also printed in 3d, whose index will show the active cell). You can print the cells and the pointer yourself thanks to the file :
`http://www.barsamian.am/2022-2023/S7ICTE/PointerAndTray.zip`.

This machine has to be updated manually : you'll have to make the manipulations described in each of the following flow charts, starting from an initial state which is described each time at the beginning. For each exercise, explain the state of the machine at the end of the flow chart (where is the pointer, and how many beads are in each cell). In those exercises, the cells are numbered from 1 (far left) to 9 (far right).

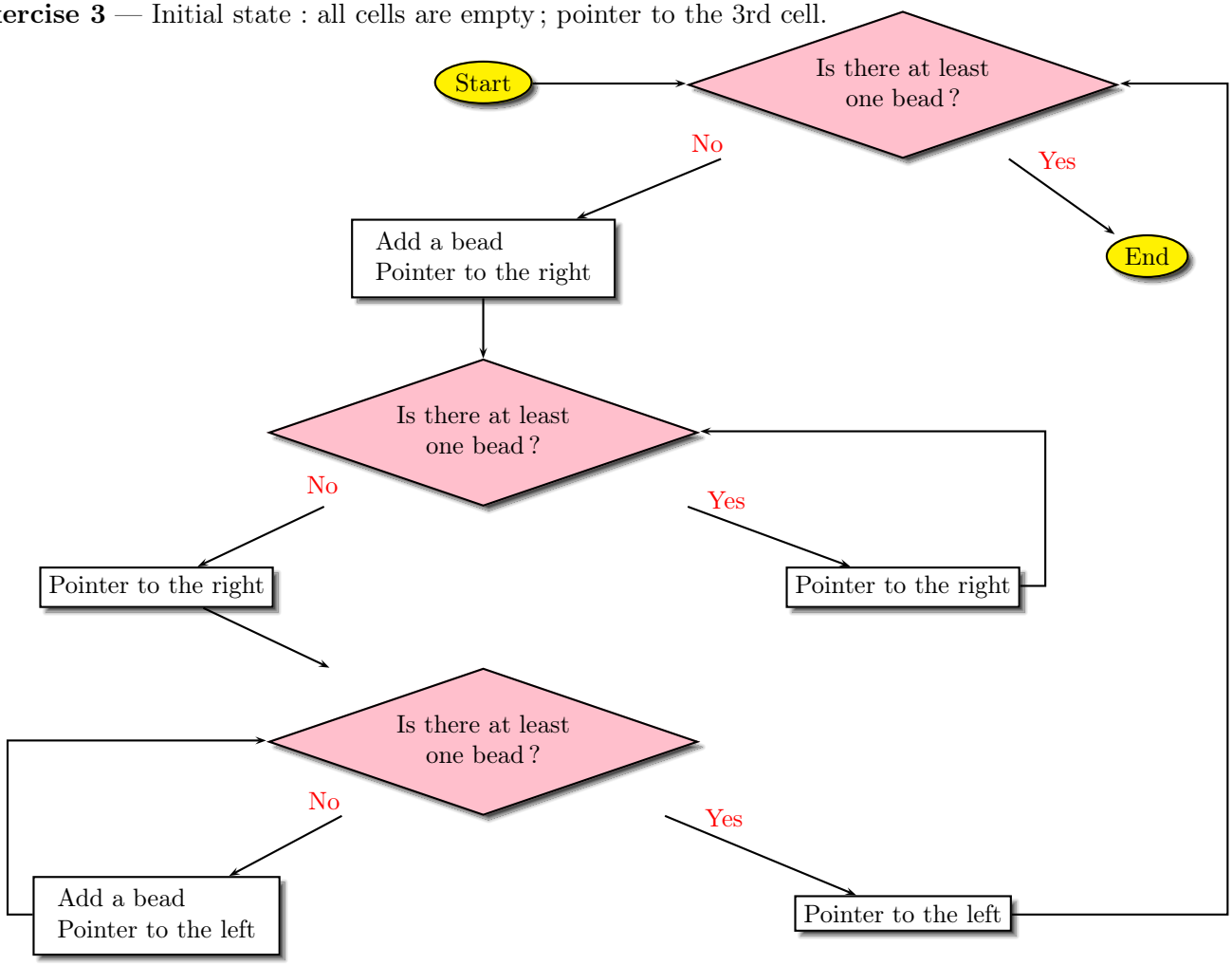
Exercise 1 — Initial state : 5 beads in the 1st cell and 3 in the 2nd ; pointer to the 1st cell.



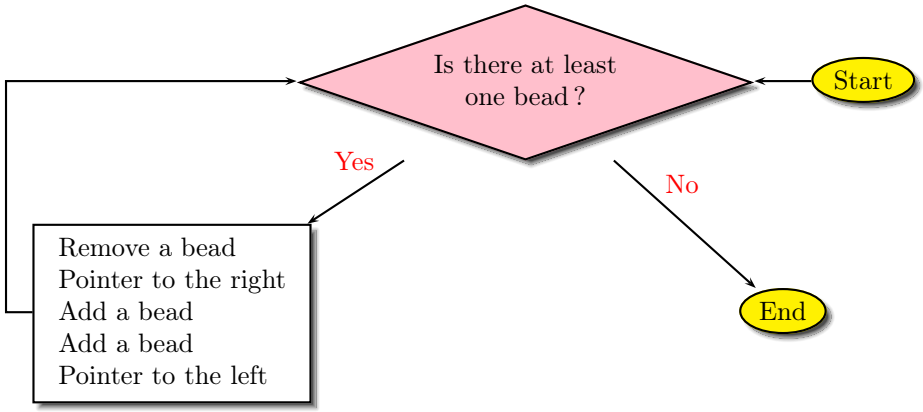
Exercise 2 — Initial state : 1 bead in each of the cells number 2, 3, 4, 5, 7, 8, 9 ; pointer to the 1st cell.



Exercise 3 — Initial state : all cells are empty ; pointer to the 3rd cell.



Exercise 4 — Initial state : 5 beads in the 4th cell ; pointer to the 4th cell.



Exercice 5 — Your own flow charts.

1. Starting from the same initial state, write a flow chart that gives the same final state as in exercise 3, but way easier. The only possible operations in the flow chart are the ones you encountered : add a bead, remove a bead, move the pointer to the left, move the pointer to the right, test if there is at least a bead in the cell.
2. With some help from the flow chart of exercise 1, draw a new flow chart that, given an initial state that has 2 cells with any number of beads, computes the associated subtraction. The only possible operations in the flow chart are the 5 same as in the previous question.