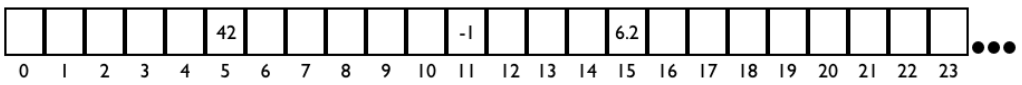
AMath Tea Time — Puzzle #6

12 May 2015

Problem

(This puzzle takes just a little bit of explaining...)

A computer is constructed with a simple memory layout. It has an unlimited amount of memory and each memory location is numbered so that a program can refer to it. Each memory location can store a single number or be uninitialized. In the following diagram the memory locations that are blank are uninitialized and some other memory locations have numbers in them.

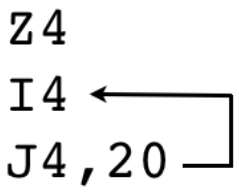


The computer's CPU only has three instructions **Z**, **I** and **J** as follows:

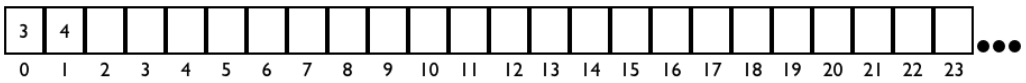
- **Z** (Zero) This instruction zeroes a memory location. For example, **Z**2 sets memory location 2 to 0 and **Z**42 sets memory location 42 to 0.
- **I** (Increment) This instruction adds one to the contents of a memory location. For example, **I**3 adds 1 to whatever is currently stored in location 3.
- **J** (Jump) This instruction examines the contents of two memory locations and branches if the contents are different. For example **J**18,19 would compare the contents of memory locations 18 and 19, if they are the same the program continues with the next instruction, if different it branches. The branch destination is just specified by drawing an arrow to the instruction you want to go to.

When there are no more instructions the program stops.

For example, here's a loop that keeps adding one to memory location 4 until it equals memory location 20.



Question #1: The operator of the machine places two numbers (one each) in memory locations 0 and 1. Here, for example, the operator has put 3 in location 0 and 4 in location 1. Write a program using the **Z**, **I** and **J** instructions to add those (arbitrary) numbers together and put the result in memory location 2.



Question #2: Under what circumstances does this program fail?

Hints

If you have any puzzles to share then send them my way at `cswiercz@uw.edu`*!*