Programming Languages II

Unless otherwise stated, exercises should be submitted in electronic form, via the collaborative learning environment moodle.softlab.ntua.gr. Deadlines will be strict. You are allowed at most one late exercise.

Exercise 1   Virtual machines

Deadline: 15/12/2019

Implement a virtual machine for the language **Befunge-93**, an "esoteric" programming language with the following characteristics:

- The "program" is written in a two-dimensional grid, or more correctly a torus, and control flow moves in two dimensions.

- Program execution uses a stack.

- The program may read and modify itself (reflective).

The language specification can be found at the following link:

https://catseye.tc/view/befunge-93/doc/Befunge-93.markdown

We recommend that you use C/C++ as the implementation language and to take advantage of the GNU C Compiler extensions for the efficient implementation of VM interpreters, as mentioned in the slides of the lecture of 9/10/2019.

Input and output.   Your implementation will receive from the command line exactly one argument (argv[1]): the name of the file that contains the "program" to be executed by the virtual machine.

During the execution of this program, the virtual machine must read from the standard input and print to the standard output.

Example of execution.   The commands base64 and zcat come from some operating system that respects itself (e.g., Linux).

```
$ base64 -d << ___EOF___ | zcat > test.bf
H4sIAIhYyF0AA2WOUQ6DIAyG3zlFhy0Sq5mLOhY0bgcxsrftBDzt8KPoEpNB2tB8/B+0
Gowz9DaloU8+OjIkU64066iiLglJqsPUHEGbUSq7AT2pWWeEKY457Pa5htKw3MsmFsRW
ZJvyuH8me6AWCFPcHHs22REyZ3lS+pZgs8uS6Q56tKNloZJL505+h+CebEH7CLNa48k3
l2mp/ctxde2oh+Ucit6HWPimuvUBHwrD4utlhf81DwPX6FeP6gv3kl+BTQEAAA==
___EOF___

$ ./befunge93 test.bf


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