ICS Homework 5

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A1

`.END` pseudo-op is a sign to indicate that assembly process ends here. It is not an instruction. `HALT` is an instruction which is actually performed.

A2

A data structure following the FIFO rule, which means that if an element A gets in the queue before B, A also gets out of the queue before B.

A3

`LD` and `ST` instructions expect memory locations, not immediate values as the second operand.

Fix: use `LDI` and `STI` instead.

A4

There is a problem: the linker won't recognize that the `AGAIN` label in one module is intended to refer to the same entity as the `AGAIN` label in the other module.

A5

1. x0FFF

2. No. Data in R2 will be saved in memory location x3004.

3. Data in R2(i.e. x0FFF) will be performed as an operation, which is `BRnzp` `#-1`. Therefore the program will repeatedly perform this operation.

A6

.FILL initializes a memory location as its operand.

.BLKW sets aside N memory locations, where N is the operand.

.STRINGZ initializes $N + 1$ memory locations with a string and NULL, where N is the length of the string.

A7

a: NOT R2, R0

b: ADD R2, R2, #1

c: BRz DONE

d: ADD R0, R0, #1

A8

A9

1. AH

2. After PUSH F or PUSH G

3. Nothing

A10

```
1   PEEK:
2     LD   R1, TOP_OF_STACK   ; Load the top of the stack address into R1
3     ADD  R2, R1, #0         ; Copy the address to R2 for underflow checking
4
5     BRzp NO_UNDERFLOW        ; Branch if the stack is not empty
6
7     LEA  R0, UNDERFLOW_MSG  ; Load the address of the underflow error message
8     TRAP x22               ; Output the error message
9     TRAP x25               ; Halt
10
11  NO_UNDERFLOW:
12    LDR  R0, R1, #0         ; Load the value at the top of the stack into R0
13    RET
14
15  TOP_OF_STACK:   .FILL x3FFF
16  UNDERFLOW_MSG:  .STRINGZ "Stack underflow error"
```