The human computer
Role-sheet: Program counter

You're the program counter, a special memory that keeps track of which location in memory the next instruction is to be read from.

The program counter is a quintessential aspect of the "stored program" architecture: it is a memory which stores the address of an instruction stored in memory. It is the program counter that enables the computer to know where the program is in memory.

The program counter is used by another part of the computer, the control unit, which reads from it and writes into it. Every now and then, the control unit reads the program counter to see which instruction of the program it should process next. Typically, the control unit then adds1 to the program counter, which causes the next instruction to be read from a place 1 location further down in the memory. In the case of certain instructions however (e.g. JMPs), the control unit will write a new value in the program counter, corresponding to the address of an instruction which is not contiguous to the current instruction.

The program counter is distinct from the main memory area: it is a special type of memory called a register, that can be read and written to much more rapidly. There are typically between two and one hundred registers depending on the type of CPU. Registers are used for the most frequently needed data items to avoid having to access main memory every time data is needed. Since data is constantly being worked on, reducing the need to access main memory (which is often slow compared to the control unit) greatly increases the computer's speed. The current program counter could theoretically be stored in the computer's main memory, but this would be very inefficient.

Preparation:

- Initial value: the initial value of the program counter is the memory address "1111 1010". Write down this number as a hexadecimal number on a piece of paper.

- Modifications will be made in the program counter by other parts of the computer. For instance, the above address will be incremented to point to the next instruction in the program. The person role-playing the program counter is responsible to keep track of her/his own value. Write your

current value on a piece of paper, and be ready to erase it and replace by a new value at any time.

- Every value manipulated in the computer is hexadecimal. In particular (in the case of our simplified computer), memory addresses stored in the program counter are encoded on 1 byte, i.e. 2 hexadecimal digits, starting with a “F” (i.e. binary value 1111).