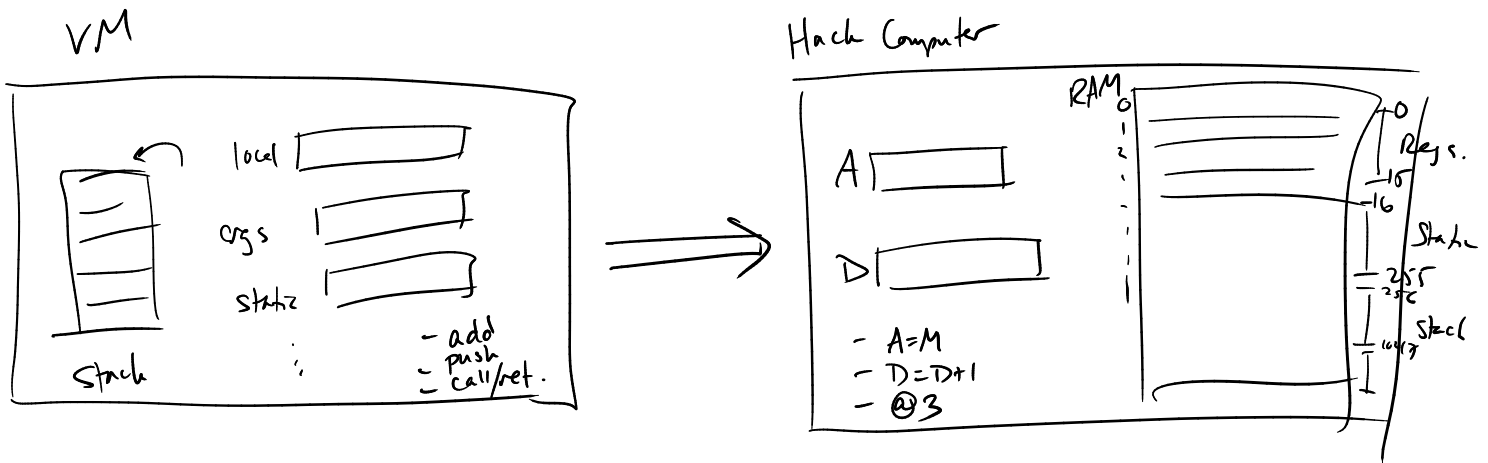


Virtual Machine → Hack mapping



Standard mapping VM memory → RAM:

Hex	Dec	Description	Similar	Register	Description
0x0 - 0xf	0 - 15	Virtual registers	Similar indirect addr. pointer seg.	0	SP - Stack pointer.
0x10 - 0xff	16 - 255	Static variables.		1	LCL - location of local segment.
0x100 - 0x7ff	256 - 1047	Stack.		2	ARG - " " arguments.
0x800 - 0x3fff	1048 - 16383	Heap.		3	THIS - " " this seg.
0x4000 - ...	16484 - ...	Screen, kbd.	direct addr.	4	THAT - " " that seg.
				5-12	temp segment. - temp. storage for compiler.
				13-15	scratch - temp. storage for VM translator.

VM translator: hints

- Similar to assembler!
 - Reading a file full of instructions.
 - Ignoring blank lines, comments.
 - Scan through + translate as we go.
- Different:
 - 1 VM instruction → many assembly instructions
 - (Proj. 8) Multiple input .vm files → single .asm file.

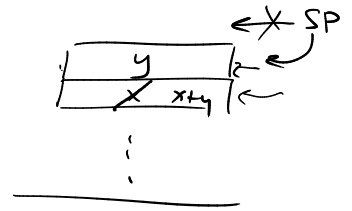
push local 3

- Get address of local segment $\left[\begin{array}{l} @LCL \\ D = M \end{array} \right.$
- Add 3 to it $\left[\begin{array}{l} @3 \\ A = D + A \end{array} \right.$
- Read value from that address $\left[\begin{array}{l} D = M \end{array} \right.$
- Get address of top of stack $\left[\begin{array}{l} @SP \\ A = M \end{array} \right.$
- Store value to top of stack $\left[\begin{array}{l} M = D \end{array} \right.$
- Increment stack pointer. $\left[\begin{array}{l} @SP \\ M = M + 1 \end{array} \right.$

same as push constant 3 example. —
Make into a function!

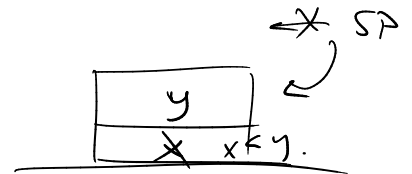
add

- Decrement stack ptr. $\left[\begin{array}{l} @SP \\ AM = M - 1 \end{array} \right.$
- Read value (y) from SP address $\left[\begin{array}{l} D = M \\ \downarrow \\ \text{to } D \end{array} \right.$
- Compute address SP - 1 $\left[\begin{array}{l} A = A - 1 \end{array} \right.$
- [Add value @ that address] $\left[\begin{array}{l} M = D + M \end{array} \right.$
- [Store result to SP - 1.]



lt

- Decrement SP
- Read y value
- Read x from SP - 1
- Compute x - y.
- if result is < 0, jump to LT
- push 0 on stack
- jump to END
- (LT 1) \leftarrow use counter to generate unique labels.
- push -1 on stack



(END 2)