

Stored Program Machines

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Eric Roberts
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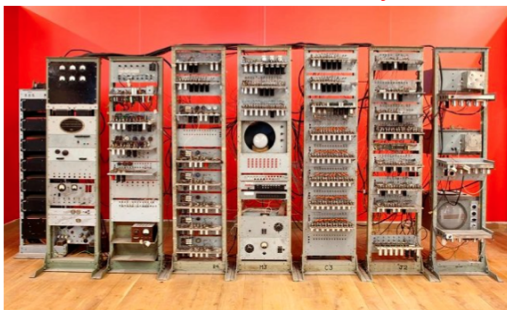
The von Neumann Architecture

- One of the foundational ideas of modern computing—traditionally attributed to John von Neumann although others can make valid claims to the idea—is that code is stored in the same memory as data. This concept is called the *stored programming model*.
- The next few slides introduce the Manchester Baby, which was the first stored-program computer. In the rest of today's class, I will describe the operation of a slightly more powerful machine that I've nicknamed Toddler.



John von Neumann and J. Robert Oppenheimer

The Manchester Baby



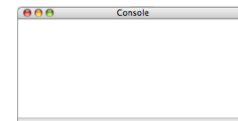
Structure of the Toddler Machine

	0x	1x	2x	3x	4x	5x	6x	7x	8x	9x
0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0
1	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0
2	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0
3	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0
4	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0
5	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0
6	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0
7	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0
8	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0
9	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0	+ 0 0 0

AC
+|0|0|0

PC
0|0

IR
+|0|0|0



The Toddler Instruction Set

1:xx	LOAD xx	Loads the value from address xx into the AC
2:xx	STORE xx	Stores the value from AC into address xx
3:xx	ADD xx	Adds the value at address xx to the AC
4:xx	SUB xx	Subtracts the value at address xx from AC
500	HALT	Halts the machine
5:xx	JUMP xx	Takes the next instruction from address xx
6:xx	JUMPZ xx	Jumps to xx if the AC is zero
7:xx	JUMPN xx	Jumps to xx if the AC is negative
8:xx	INPUT xx	Reads a value into address xx
9:xx	OUTPUT xx	Prints the value in address xx

Exercise: Multiply Two Numbers

- How would you write a Toddler program to multiply two nonnegative numbers, even though the machine has no multiply instruction?

