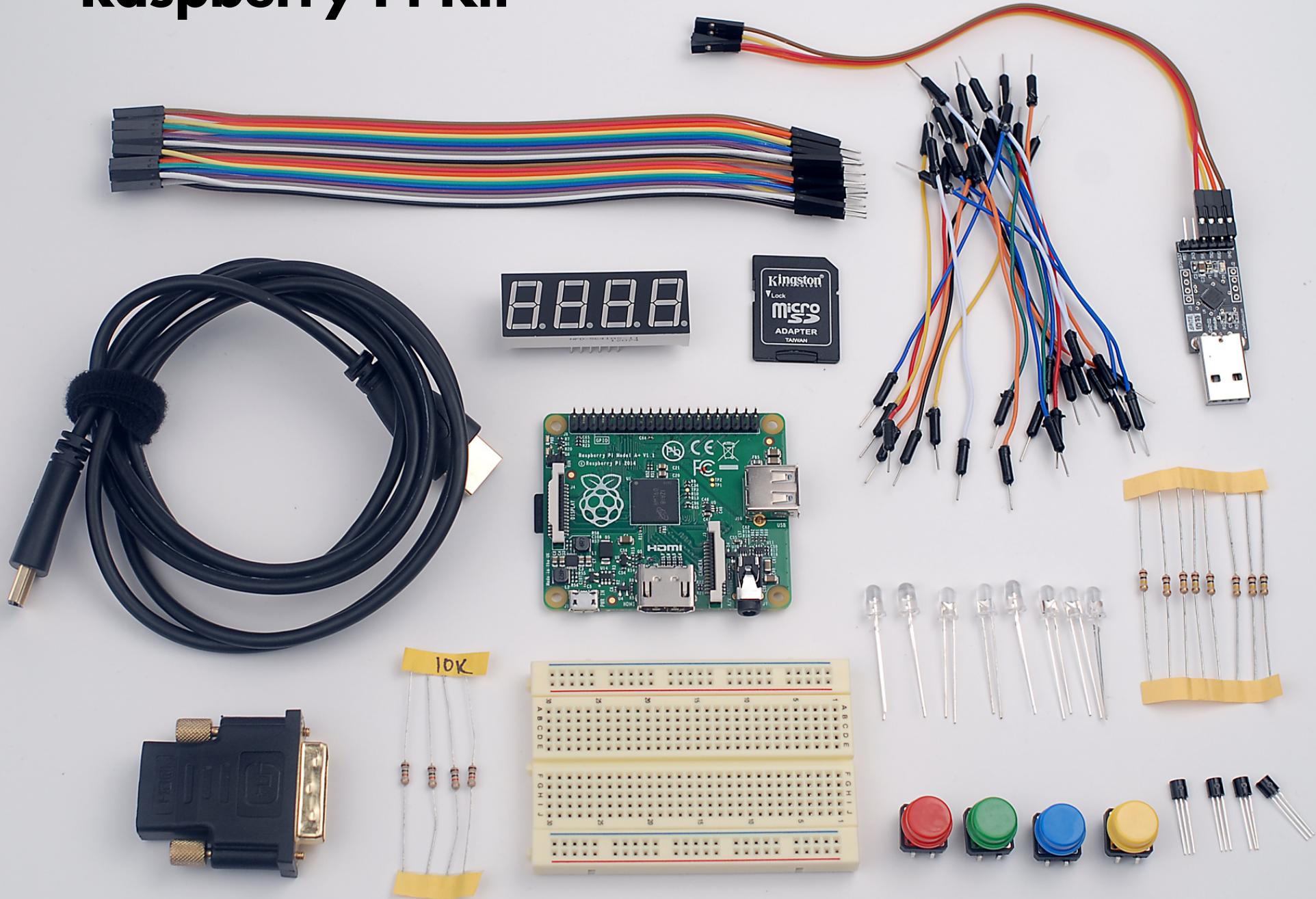


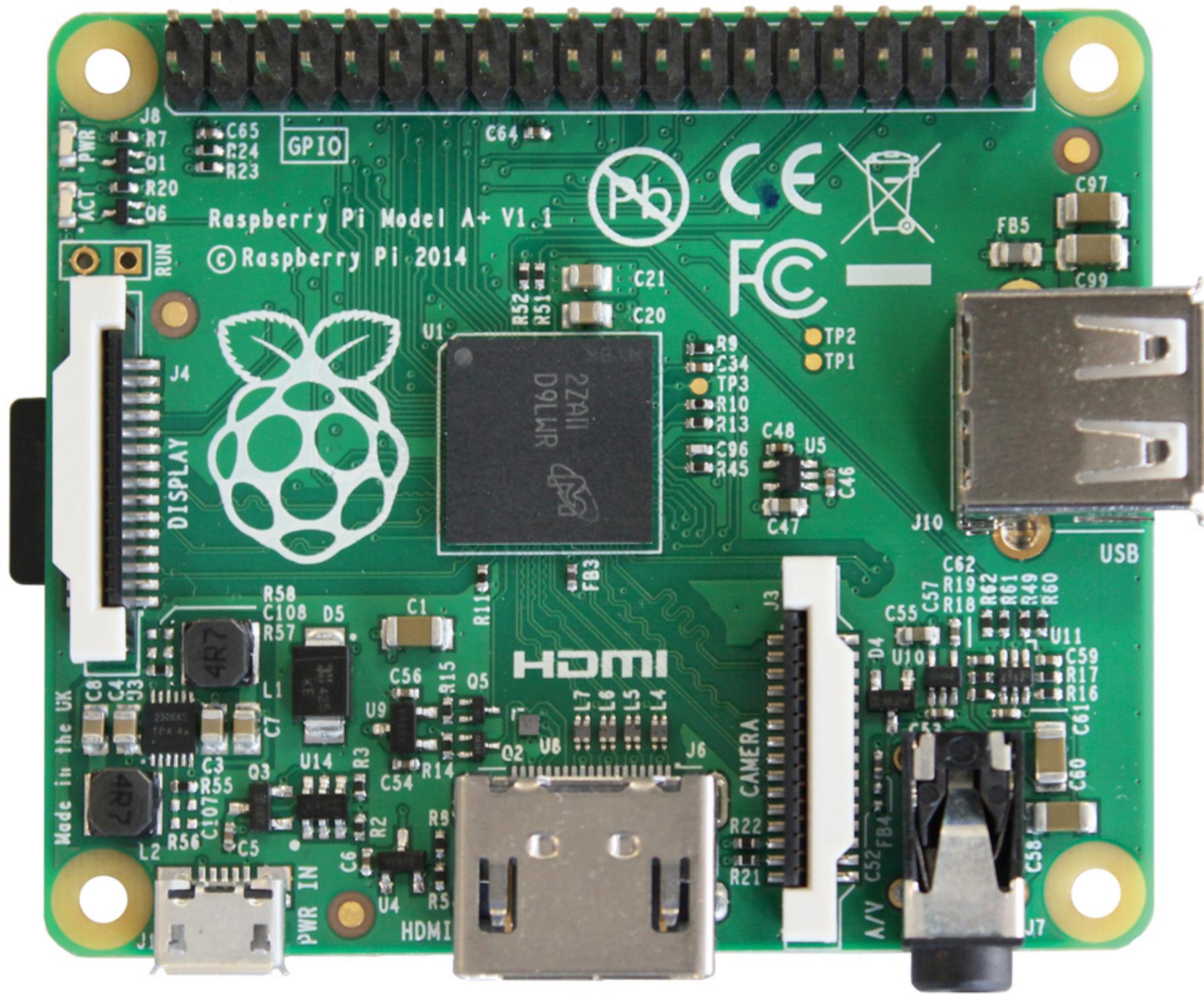
CS107e
Computer Systems from
the Ground Up

Winter 2022
<https://cs107e.github.io/>



Raspberry Pi Kit

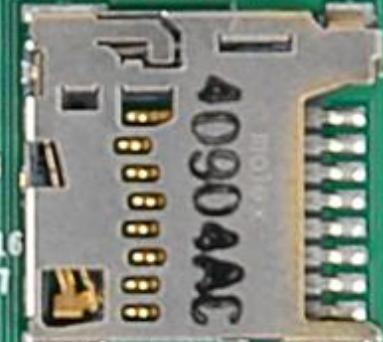




ARUKCE MC1
V-OF3
1439 1-6



MICRO SD CARD



J9

C66

R12	C10	C17	C36	C69	C37	R25
C50	C9	F8	C49	C18	C12	C35
C51	C9	F8	C49	C14	C12	C30
C52	C9	F8	C49	C13	C12	C31
C45	C29					

PP21 C23 C28 L3
R31 C26 C42 C3
C19 C41 C43 C67
C44 C16 C10 C32
C25 C27 C37 C15
C10 X1 C11 C38
C24 C15 PP15
C11 PP14 PP10
C19 PP16 PP17
PP5

J551 N
PP31 J5
PP32 TDI
PP30 TDO
PP38 THS
PP39 TCK
PP30 GND
PP32 PP29 PP34
PP33 PP31



C24 R1m b
PP8 PP4
F1 3k02
PP7 PP1
PP2
PP3

PP22

PP35

PP23

PP27

PP26

PP12

PP25

PP24

PP40

PP39

PP38

PP37

PP30

PP31

J5

C66

C66

PP9

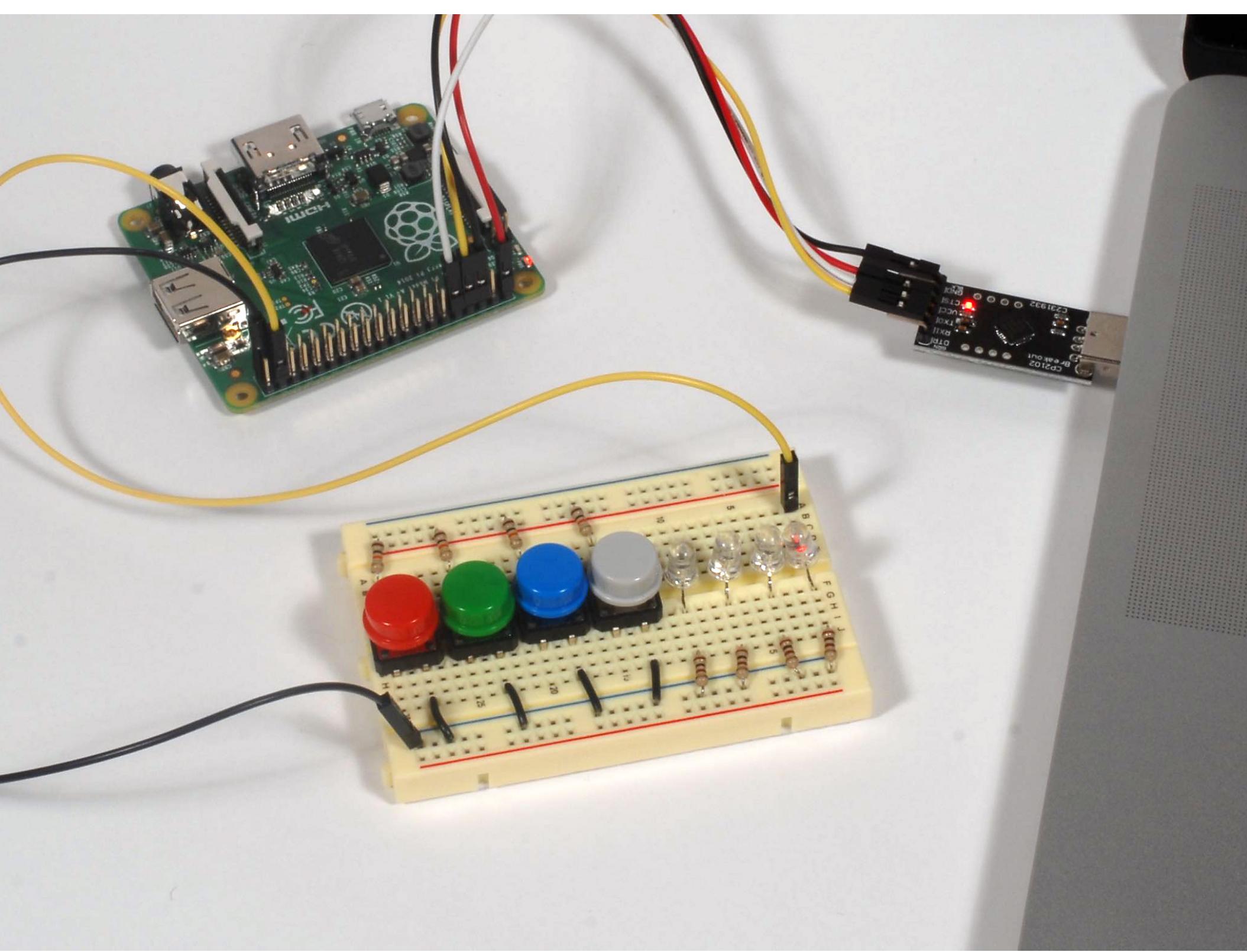
PP4

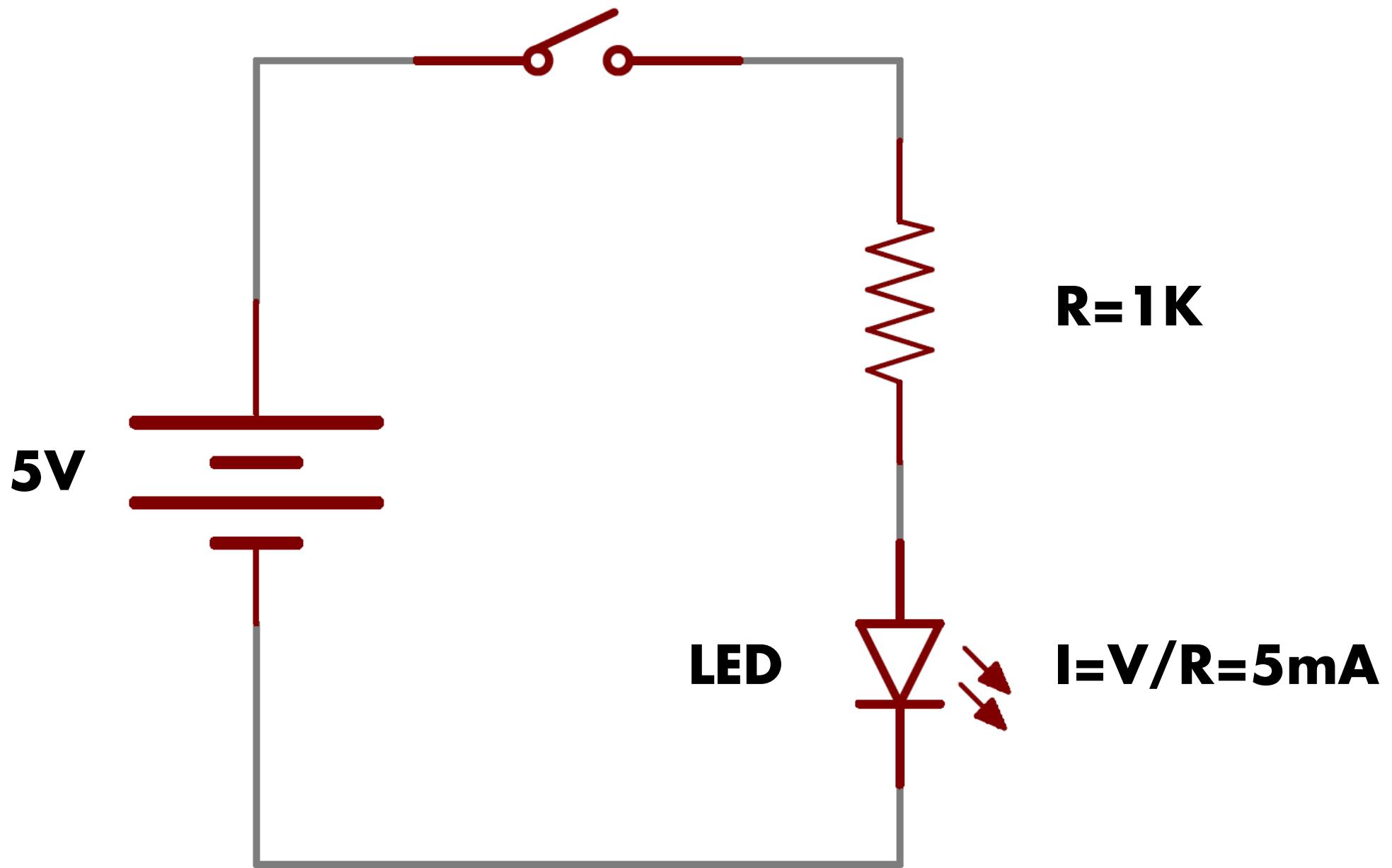
PP7

PP1

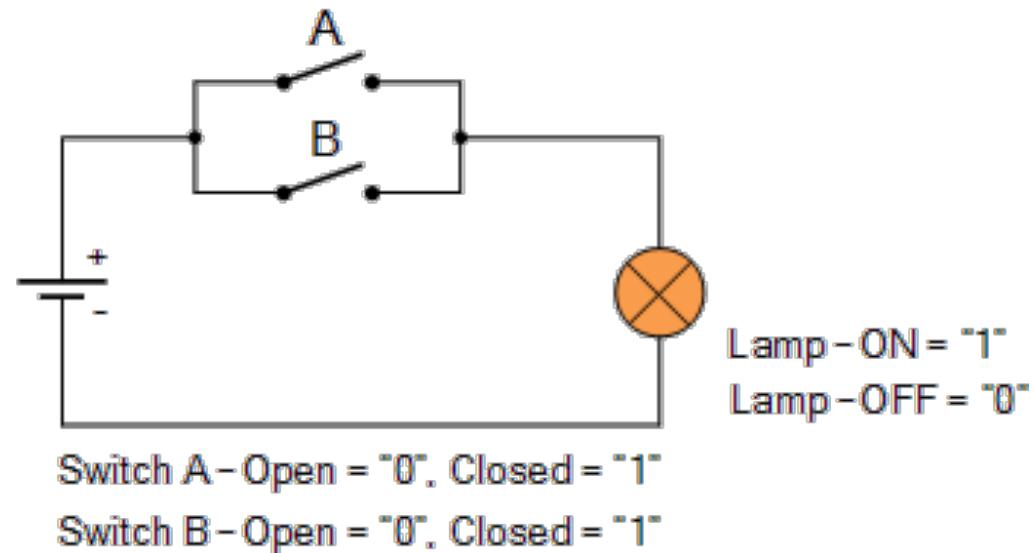
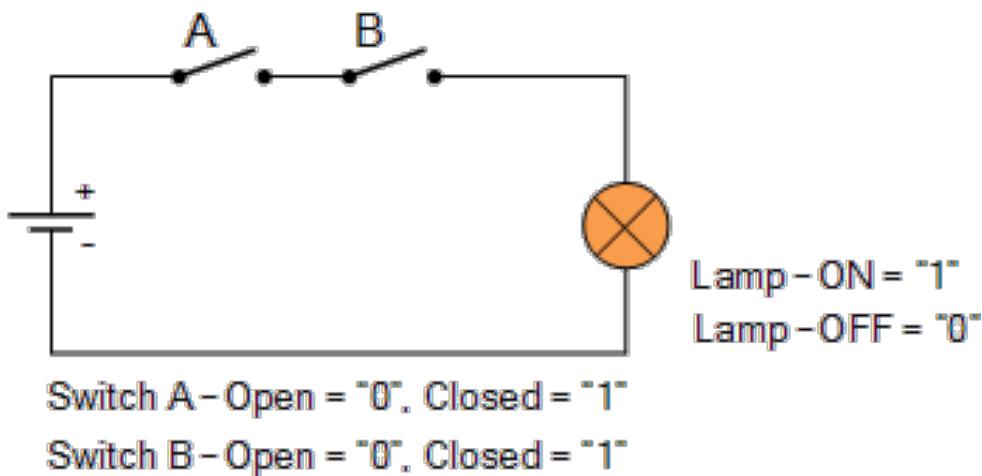
PP2

PP3



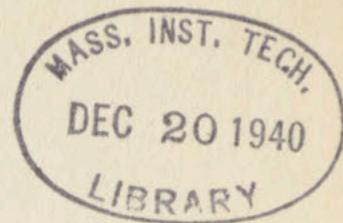


Switching Logic



AND

OR



A SYMBOLIC ANALYSIS
OF
RELAY AND SWITCHING CIRCUITS

by

Claude Elwood Shannon

B.S., University of Michigan

1936

Submitted in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

from the

Massachusetts Institute of Technology

1940

Logic / Boolean Algebra

Name	NOT	AND	NAND	OR																																																			
Alg. Expr.	\bar{A}	AB	\overline{AB}	$A + B$																																																			
Symbol																																																							
Truth Table	<table border="1"> <thead> <tr> <th>A</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> </tr> </tbody> </table>	A	X	0	1	1	0	<table border="1"> <thead> <tr> <th>B</th> <th>A</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>	B	A	X	0	0	0	0	1	0	1	0	0	1	1	1	<table border="1"> <thead> <tr> <th>B</th> <th>A</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	B	A	X	0	0	1	0	1	1	1	0	1	1	1	0	<table border="1"> <thead> <tr> <th>B</th> <th>A</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>	B	A	X	0	0	0	0	1	1	1	0	1	1	1	1
A	X																																																						
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C syntax

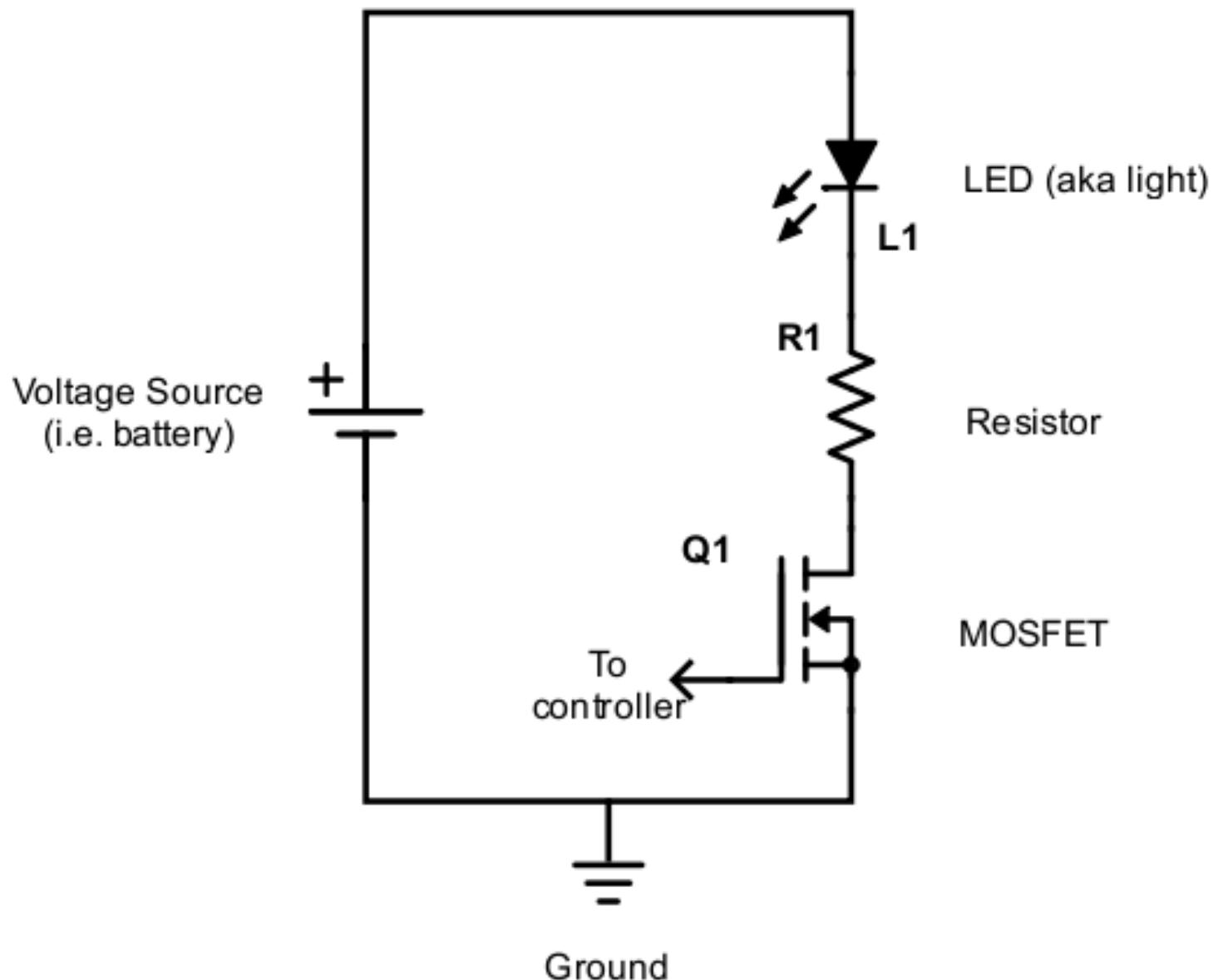
$\sim A$

$A \& B$

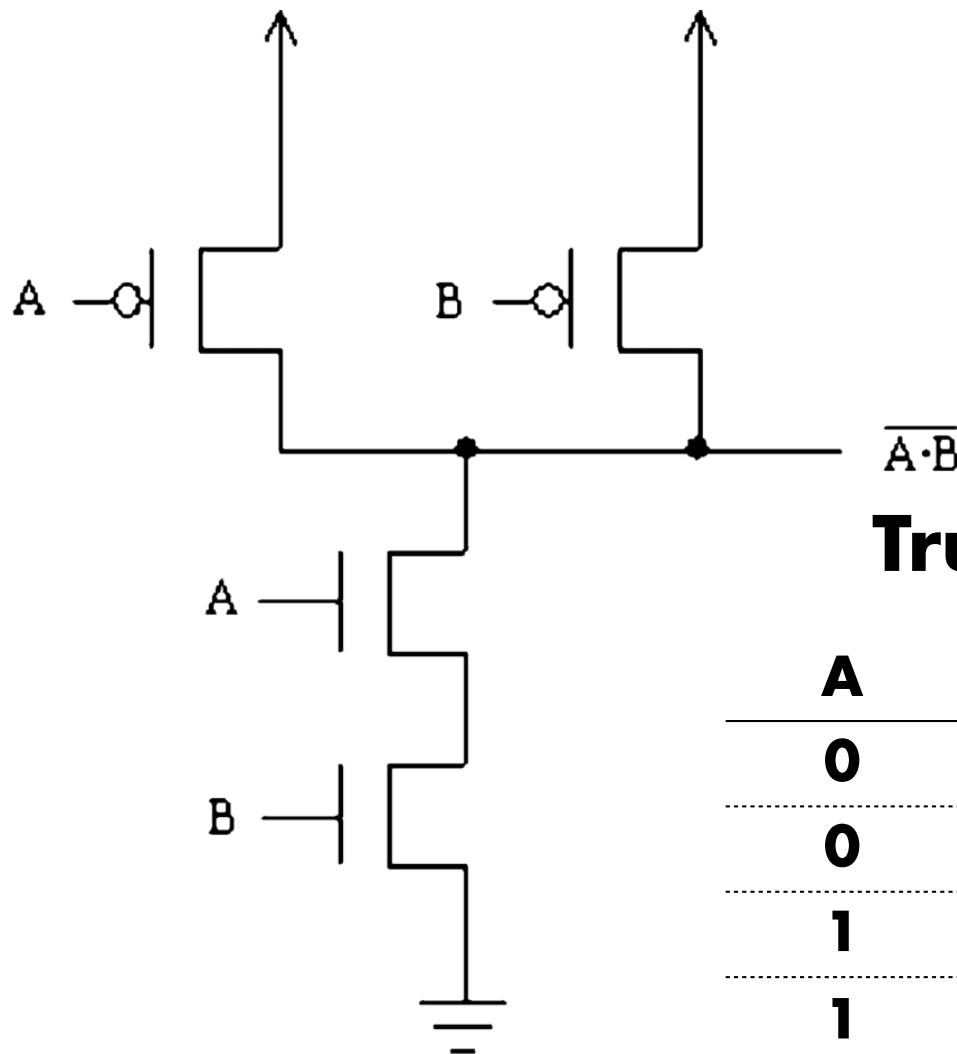
$\sim(A \& B)$

$A | B$

Transistor as a Switch



CMOS NAND Gate

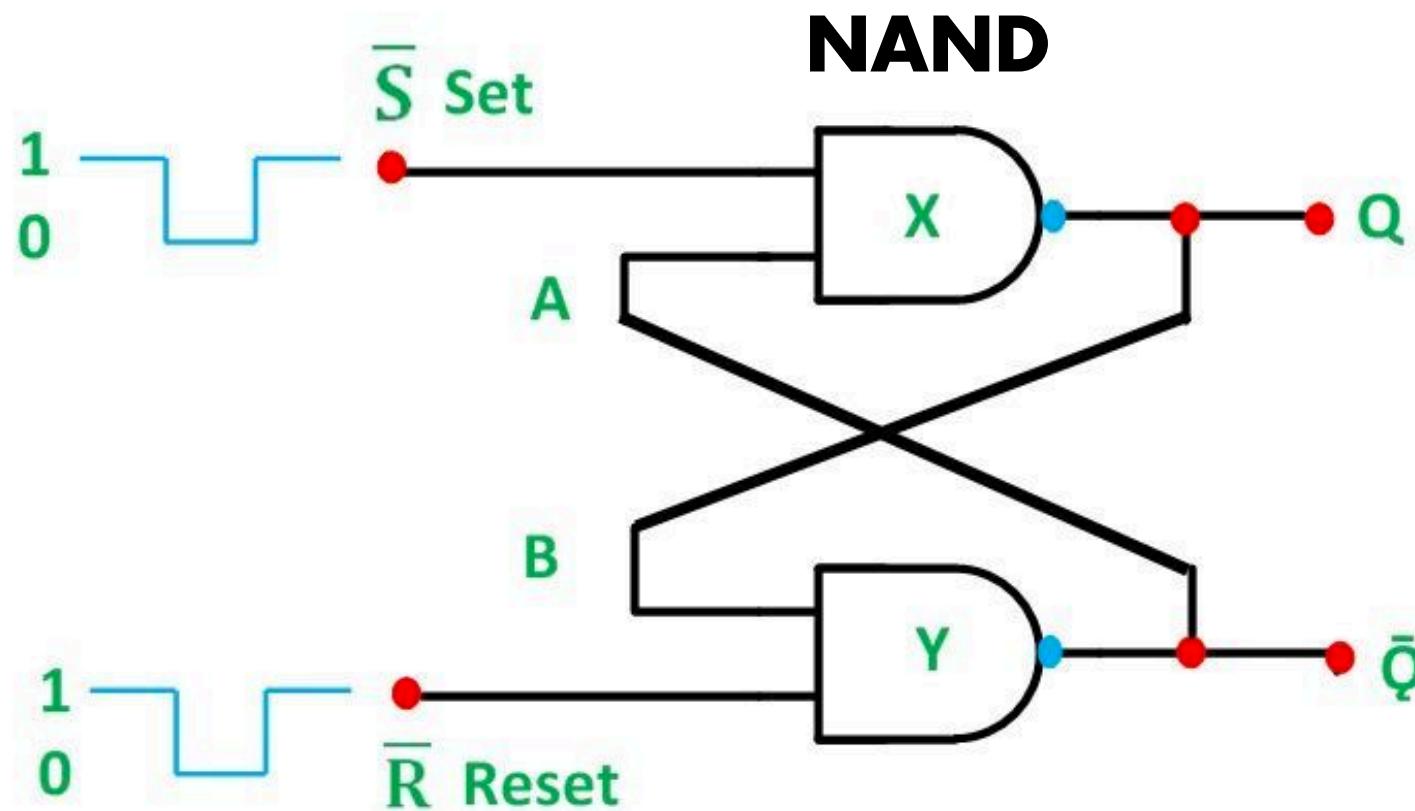


Truth Table

A	B	$\sim(A \cdot B)$
0	0	1
0	1	1
1	0	1
1	1	0

AND, OR, NOT can be built from NAND

RS Flip Flop



Circuit Globe

1-Bit Register/Memory

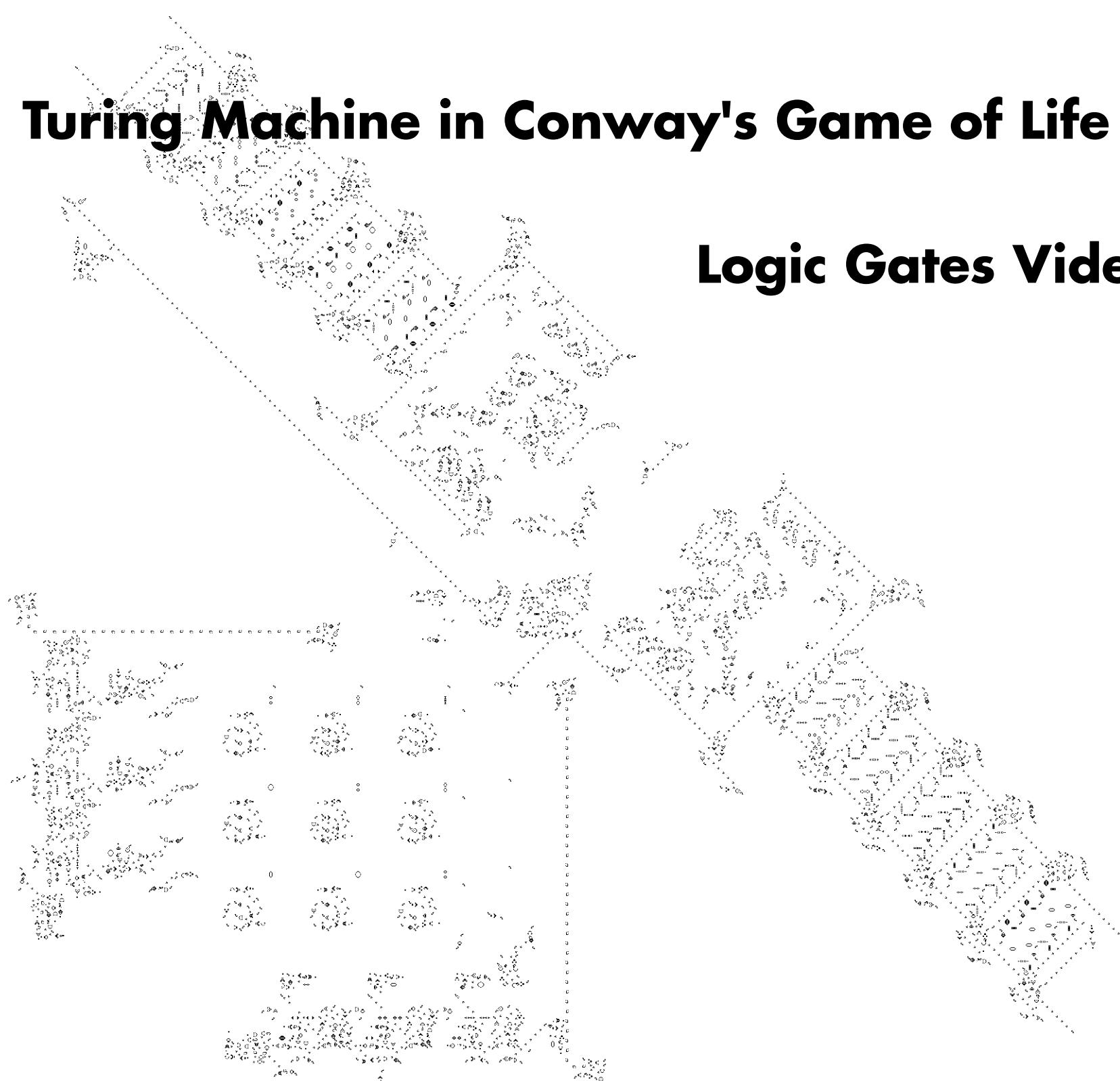
NAND and Flip-Flop

are all

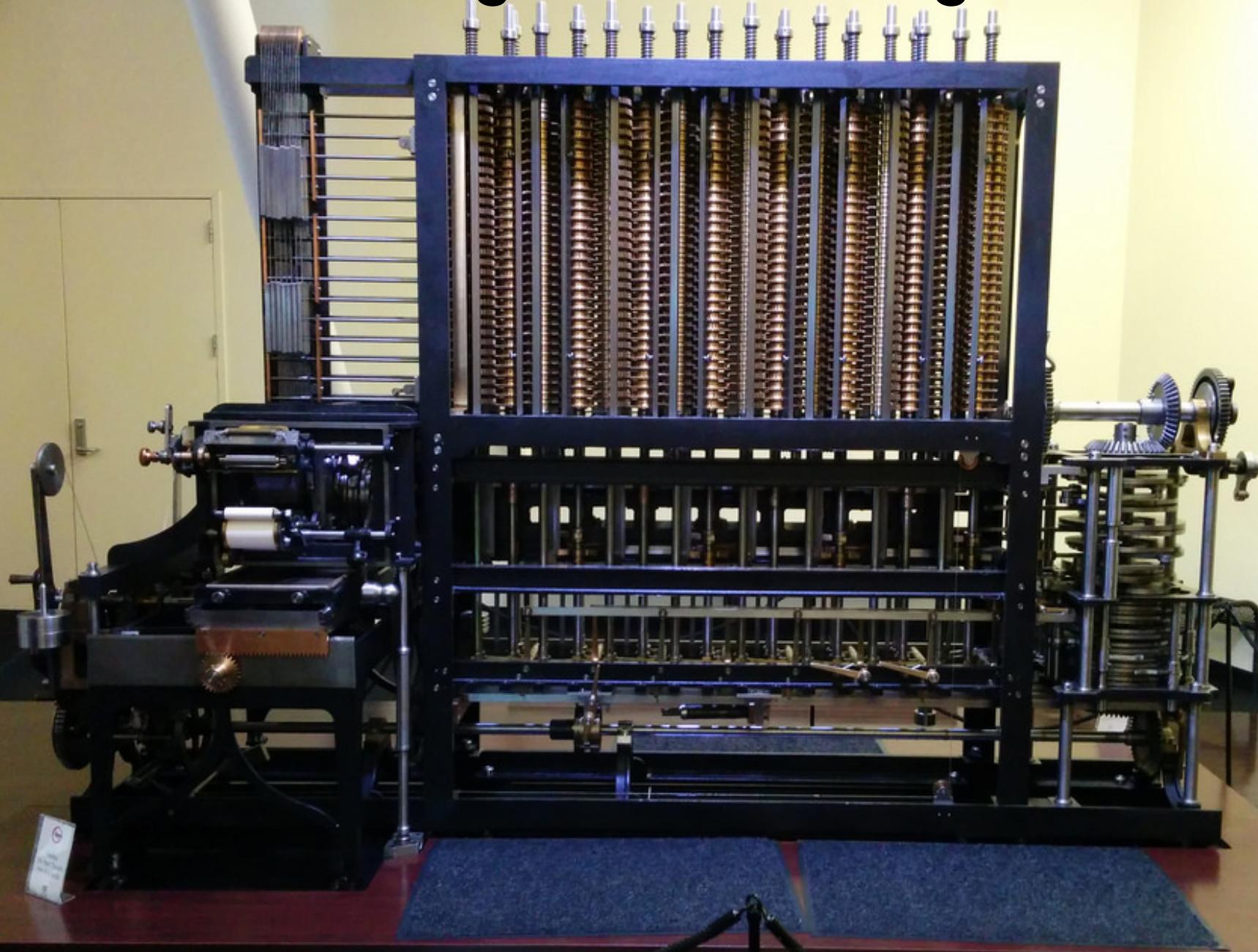
you need to build a computer!

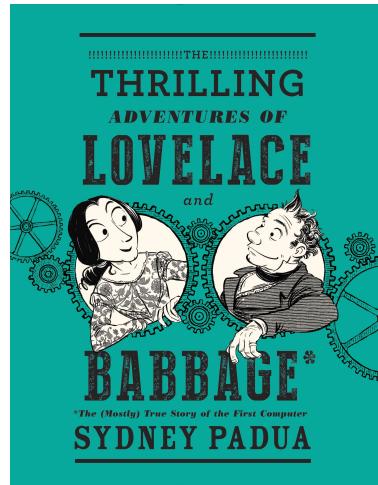
Turing Machine in Conway's Game of Life

Logic Gates Video

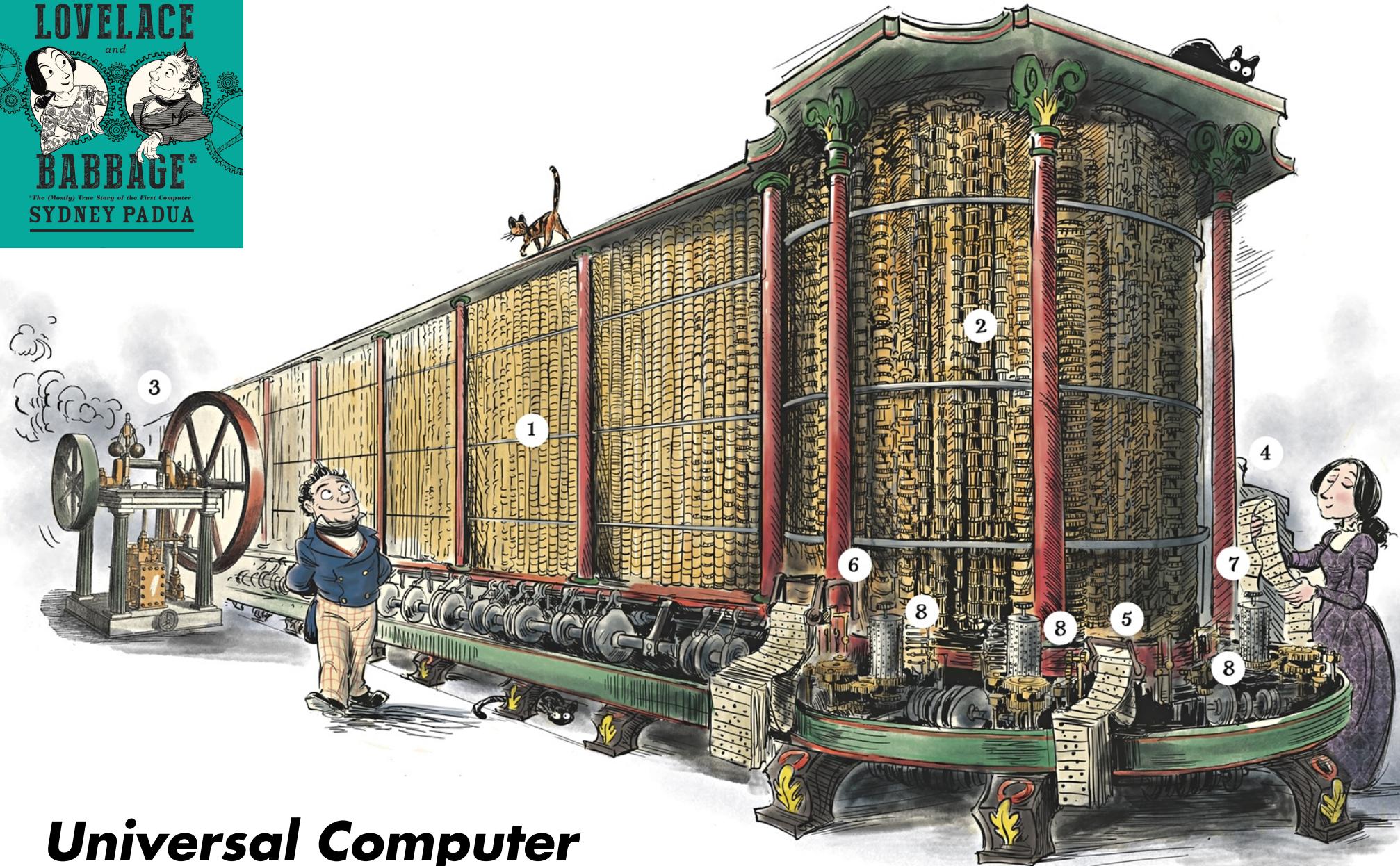


Babbage Difference Engine



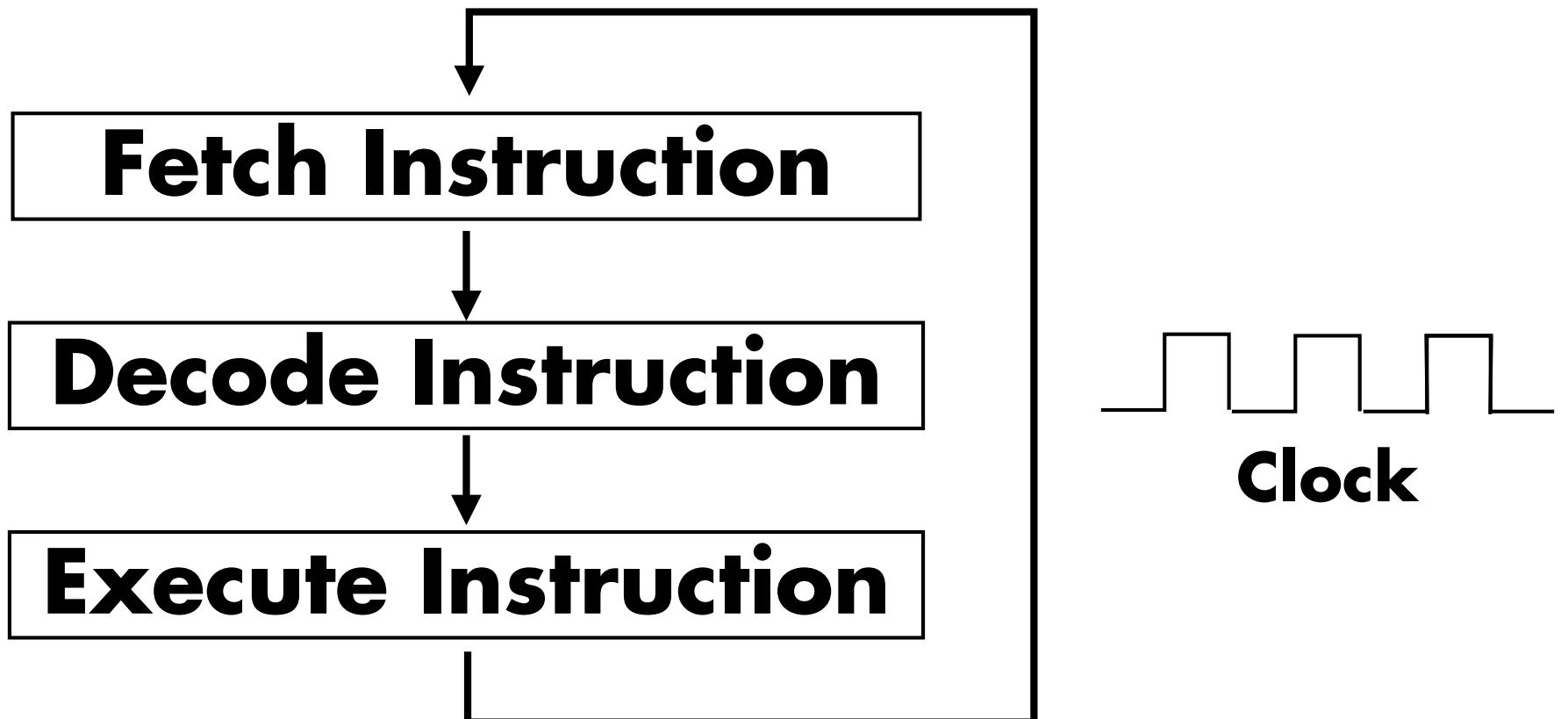


Analytical Engine



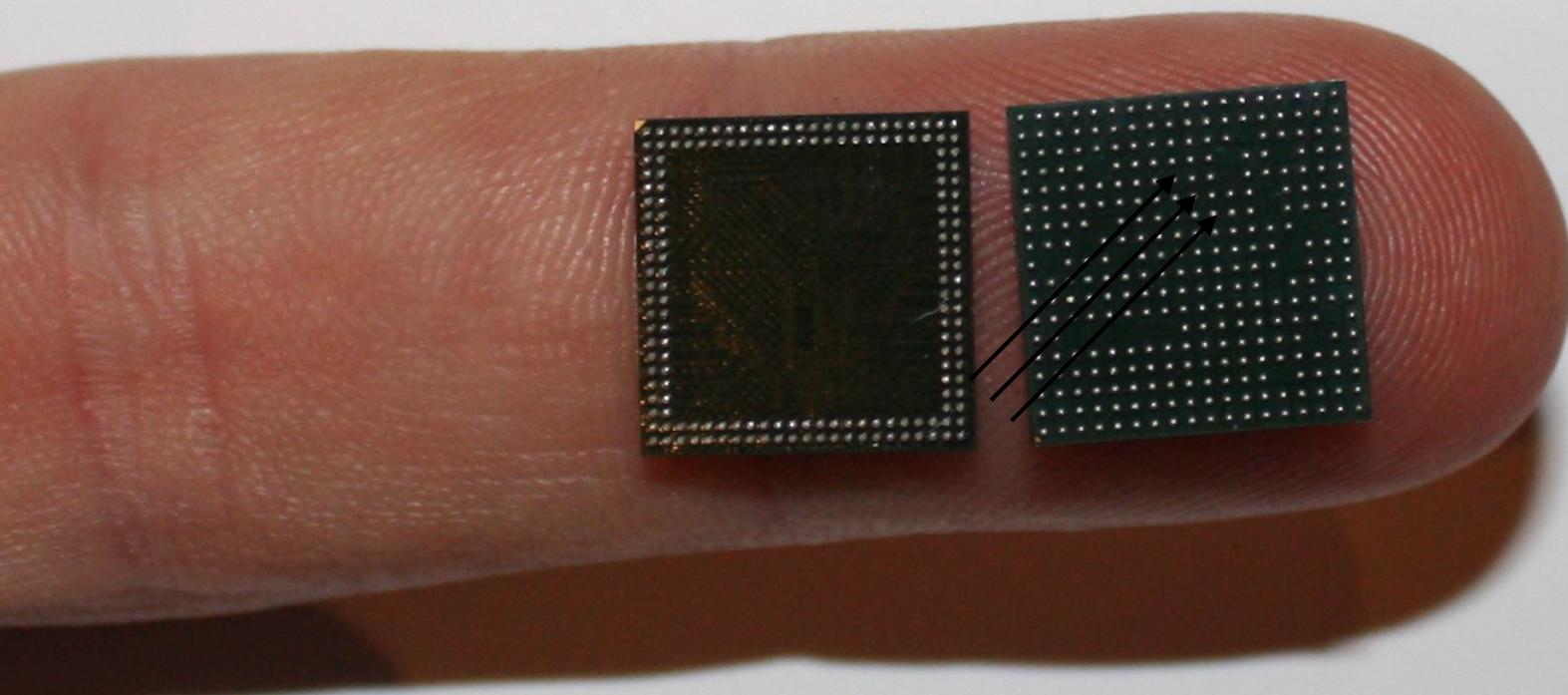
Universal Computer

Running a Program



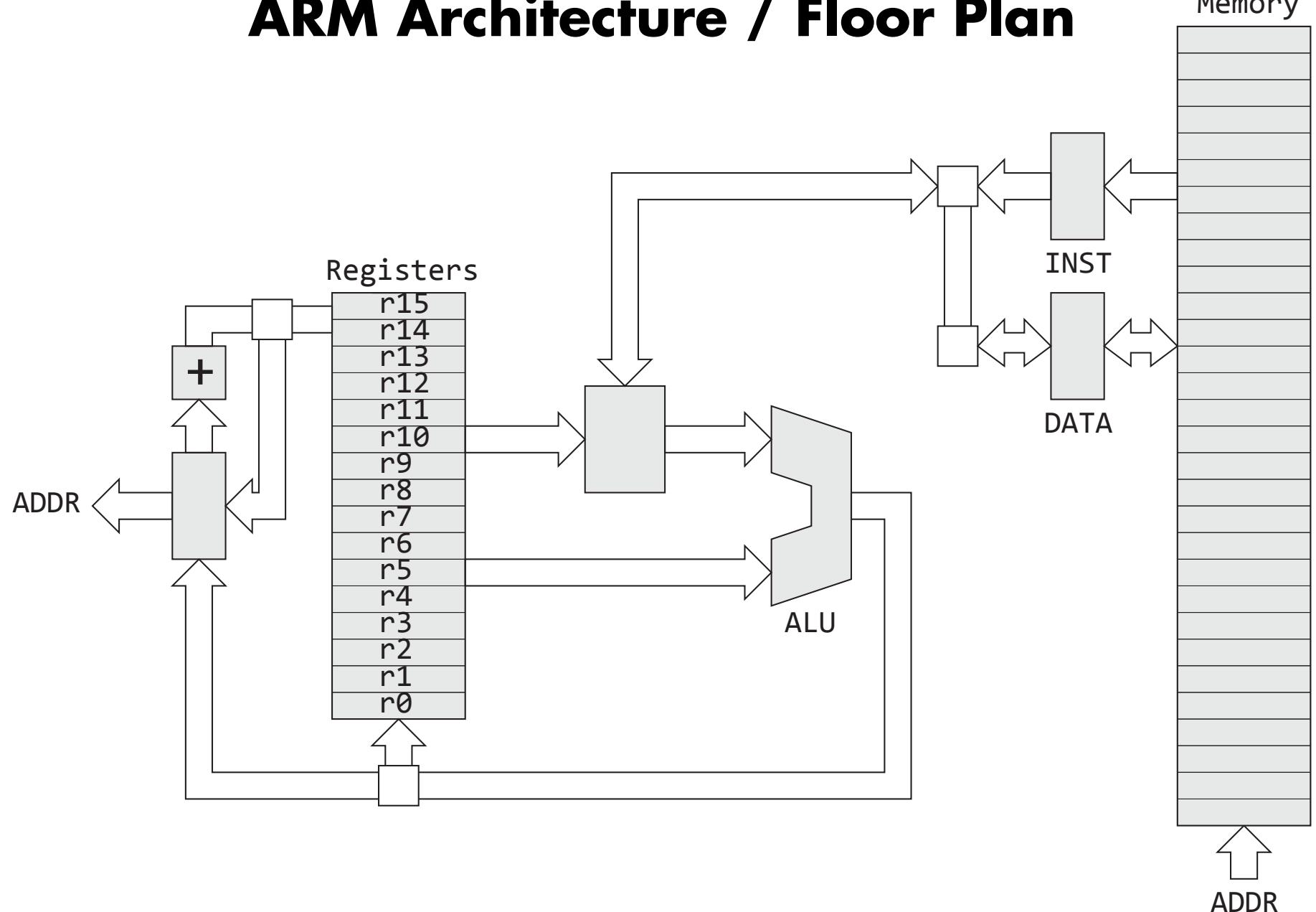
Package on Package

Broadcom 2865 ARM Processor



Samsung 4Gb (gigabit) SDRAM

ARM Architecture / Floor Plan



First Week

Lab 0 on Wed

Pre-lab:

- **Install your development environment (follow steps in install guide <http://cs107e.github.io/guides/install>)**
- **Read and understand our guides on background topics (electricity, numbers, unix)**

During lab:

- **Establish comfort with background topics**
- **Practice with environment/tools, habits for productivity**
- **Meet one another!**

Number Representations

Binary representation

Hexadecimal

Bit operators

Guide: <https://cs107e.github.io/guides/numbers/>

Basic Electricity

Voltage and current

Ohms Law : $V = I R$

Power : $P = I V$

Driving an LED

Transistor switches

Breadboarding

Guide: <https://cs107e.github.io/guides/electricity/>

Unix Command Line

Moving around the file system

Creating, moving, and deleting files

Compiling and running programs

Profiles and paths

Guide: <https://cs107e.github.io/guides/unix/>

Note: Watch cs107 UNIX videos!

Essential Tools

git

- **git add/commit/push/pull**

editor

- **vim, emacs, sublime, ...**