

C Reload

Simple Computer

Shin Hong

Programming Environment

- Linux

- <http://peace.handong.edu:8000/register/>

- Mac

- Download and install Xcode from the Mac App store

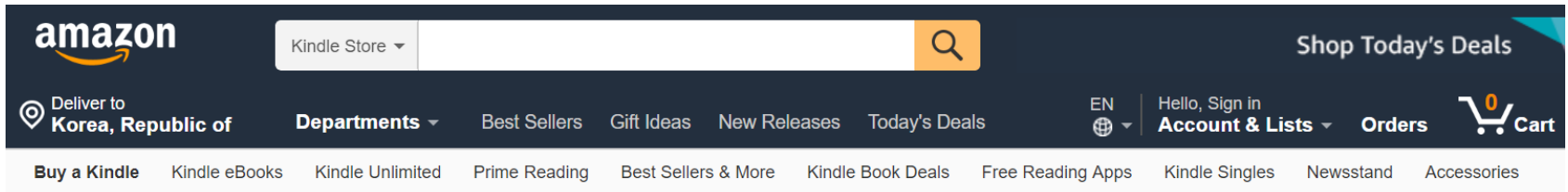
- Windows

- MinGW <http://www.codebind.com/cprogramming/install-mingw-windows-10-gcc/>

- Download and install Ubuntu 16.04 LTS from the MS app store

Textbook

- The C Programming Language, 2/e, by Brian Kernighan and Dennis Ritchie



Where automation meets job creation

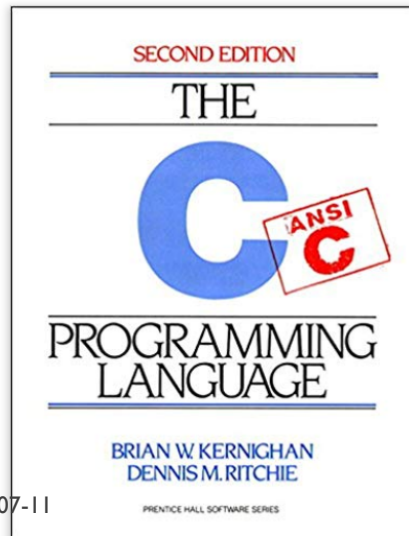
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C Programming Language: C PROGRAMMING LANG _p2 2nd Edition, Kindle Edition

by [Brian W. Kernighan](#) (Author), [Dennis Ritchie](#) (Author)

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What is computing?

- What is programming?

George Boole



Formulate a calculus of reasoning

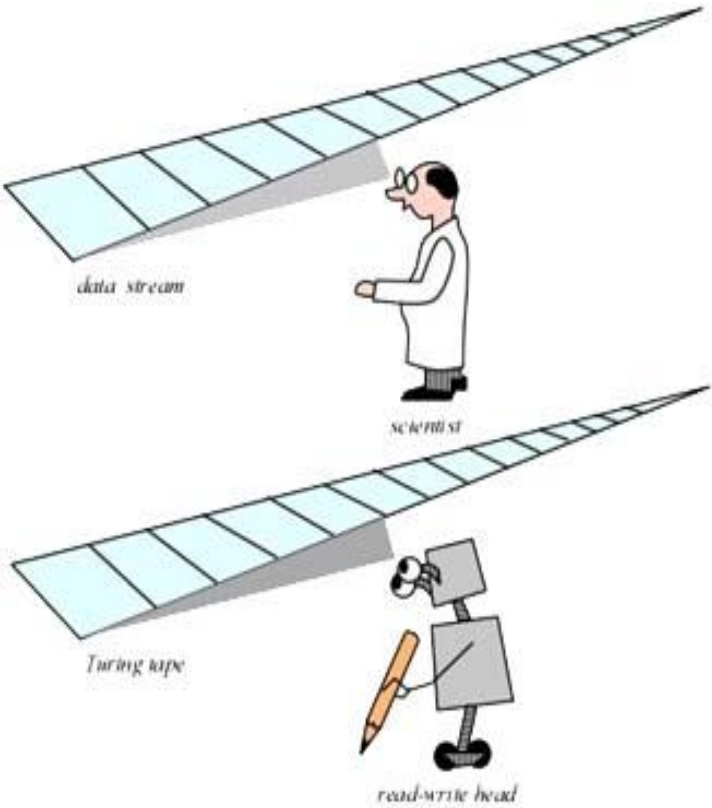
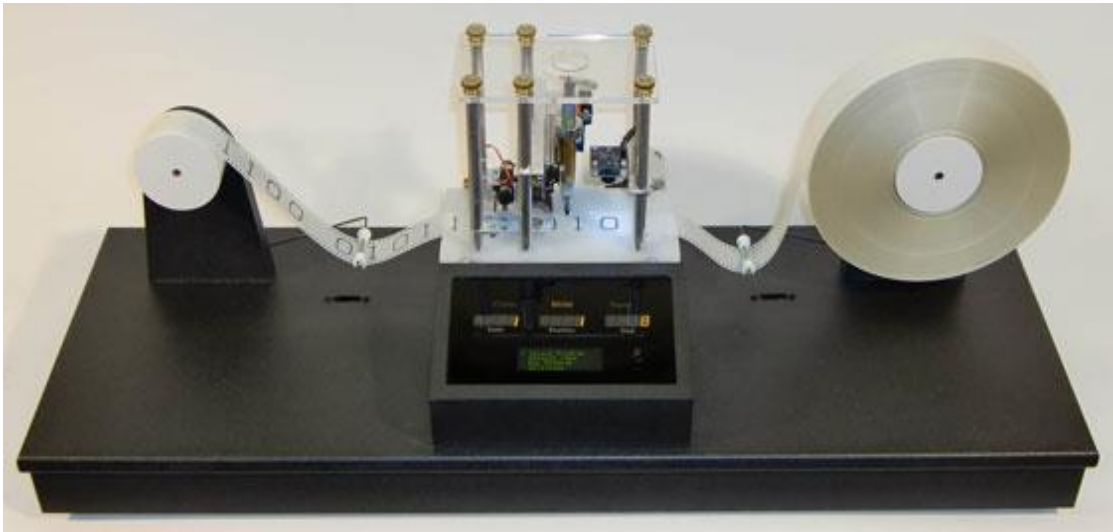
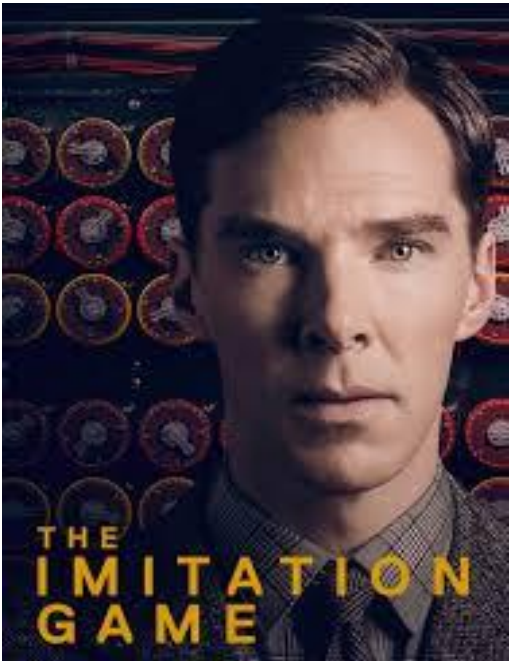
- Claim that logic should be considered as a branch of math, rather than a part of philosophy
- Argue that there are math laws to express the operation of human mind
- Showed that Aristotle's syllogistic logic could be rendered as algebraic equitation

A Brief History of Computing by G. O'Regan

Charles Babbage

Program for the computation by the Engine of the Tables of Bernoulli. See Plate CL (page 44 of 49)

Line of Operation	Description of Operation	Number of Operations	Working Positions												
			1	2	3	4	5	6	7	8	9	10			
1	$B_0 = 1$	1													
2	$B_1 = \frac{1}{2}$	1													
3	$B_2 = \frac{1}{4}$	1													
4	$B_3 = \frac{1}{8}$	1													
5	$B_4 = \frac{1}{16}$	1													
6	$B_5 = \frac{1}{32}$	1													
7	$B_6 = \frac{1}{64}$	1													
8	$B_7 = \frac{1}{128}$	1													
9	$B_8 = \frac{1}{256}$	1													
10	$B_9 = \frac{1}{512}$	1													
11	$B_{10} = \frac{1}{1024}$	1													
12	$B_{11} = \frac{1}{2048}$	1													
13	$B_{12} = \frac{1}{4096}$	1													
14	$B_{13} = \frac{1}{8192}$	1													
15	$B_{14} = \frac{1}{16384}$	1													
16	$B_{15} = \frac{1}{32768}$	1													
17	$B_{16} = \frac{1}{65536}$	1													
18	$B_{17} = \frac{1}{131072}$	1													
19	$B_{18} = \frac{1}{262144}$	1													
20	$B_{19} = \frac{1}{524288}$	1													
21	$B_{20} = \frac{1}{1048576}$	1													
22	$B_{21} = \frac{1}{2097152}$	1													
23	$B_{22} = \frac{1}{4194304}$	1													
24	$B_{23} = \frac{1}{8388608}$	1													
25	$B_{24} = \frac{1}{16777216}$	1													
26	$B_{25} = \frac{1}{33554432}$	1													
27	$B_{26} = \frac{1}{67108864}$	1													
28	$B_{27} = \frac{1}{134217728}$	1													
29	$B_{28} = \frac{1}{268435456}$	1													
30	$B_{29} = \frac{1}{536870912}$	1													
31	$B_{30} = \frac{1}{1073741824}$	1													
32	$B_{31} = \frac{1}{2147483648}$	1													
33	$B_{32} = \frac{1}{4294967296}$	1													
34	$B_{33} = \frac{1}{8589934592}$	1													
35	$B_{34} = \frac{1}{17179869184}$	1													
36	$B_{35} = \frac{1}{34359738368}$	1													
37	$B_{36} = \frac{1}{68719476736}$	1													
38	$B_{37} = \frac{1}{137438953472}$	1													
39	$B_{38} = \frac{1}{274877906944}$	1													
40	$B_{39} = \frac{1}{549755813888}$	1													
41	$B_{40} = \frac{1}{1099511627776}$	1													
42	$B_{41} = \frac{1}{2199023255552}$	1													
43	$B_{42} = \frac{1}{4398046511104}$	1													
44	$B_{43} = \frac{1}{8796093022208}$	1													
45	$B_{44} = \frac{1}{17592186044416}$	1													
46	$B_{45} = \frac{1}{35184372088832}$	1													
47	$B_{46} = \frac{1}{70368744177664}$	1													
48	$B_{47} = \frac{1}{140737488355328}$	1													
49	$B_{48} = \frac{1}{281474976710656}$	1													
50	$B_{49} = \frac{1}{562949953421312}$	1													
51	$B_{50} = \frac{1}{1125899906842624}$	1													
52	$B_{51} = \frac{1}{2251799813685248}$	1													
53	$B_{52} = \frac{1}{4503599627370496}$	1													
54	$B_{53} = \frac{1}{9007199254740992}$	1													
55	$B_{54} = \frac{1}{18014398509481984}$	1													
56	$B_{55} = \frac{1}{36028797018963968}$	1													
57	$B_{56} = \frac{1}{72057594037927936}$	1													
58	$B_{57} = \frac{1}{144115188075855872}$	1													
59	$B_{58} = \frac{1}{288230376151711744}$	1													
60	$B_{59} = \frac{1}{576460752303423488}$	1													
61	$B_{60} = \frac{1}{1152921504606846976}$	1													
62	$B_{61} = \frac{1}{2305843009213693952}$	1													
63	$B_{62} = \frac{1}{4611686018427387904}$	1													
64	$B_{63} = \frac{1}{9223372036854775808}$	1													
65	$B_{64} = \frac{1}{18446744073709551616}$	1													
66	$B_{65} = \frac{1}{36893488147419103232}$	1													
67	$B_{66} = \frac{1}{73786976294838206464}$	1													
68	$B_{67} = \frac{1}{147573952589676412928}$	1													
69	$B_{68} = \frac{1}{295147905179352825856}$	1													
70	$B_{69} = \frac{1}{590295810358705651712}$	1													
71	$B_{70} = \frac{1}{1180591620717411303424}$	1													
72	$B_{71} = \frac{1}{2361183241434822606848}$	1													
73	$B_{72} = \frac{1}{4722366482869645213696}$	1													
74	$B_{73} = \frac{1}{9444732965739290427392}$	1													
75	$B_{74} = \frac{1}{18889465931478580854784}$	1													
76	$B_{75} = \frac{1}{37778931862957161709568}$	1													
77	$B_{76} = \frac{1}{75557863725914323419136}$	1													
78	$B_{77} = \frac{1}{151115727451828646838272}$	1													
79	$B_{78} = \frac{1}{302231454903657293676544}$	1													
80	$B_{79} = \frac{1}{604462909807314587353088}$	1													
81	$B_{80} = \frac{1}{1208925819614629174706176}$	1													
82	$B_{81} = \frac{1}{2417851639229258349412352}$	1													
83	$B_{82} = \frac{1}{4835703278458516698824704}$	1													
84	$B_{83} = \frac{1}{9671406556917033397649408}$	1													
85	$B_{84} = \frac{1}{19342813113834066795298816}$	1													
86	$B_{85} = \frac{1}{38685626227668133590597632}$	1													
87	$B_{86} = \frac{1}{77371252455336267181195264}$	1													
88	$B_{87} = \frac{1}{154742504910672534362390528}$	1													
89	$B_{88} = \frac{1}{309485009821345068724781056}$	1													
90	$B_{89} = \frac{1}{618970019642690137449562112}$	1													
91	$B_{90} = \frac{1}{1237940039285380274899124224}$	1													
92	$B_{91} = \frac{1}{2475880078570760549798248448}$	1													
93	$B_{92} = \frac{1}{4951760157141521099596496896}$	1													
94	$B_{93} = \frac{1}{9903520314283042199192993792}$	1													
95	$B_{94} = \frac{1}{19807040628566084398385987584}$	1													
96	$B_{95} = \frac{1}{39614081257132168796771975168}$	1													
97	$B_{96} = \frac{1}{79228162514264337593543950336}$	1													
98	$B_{97} = \frac{1}{158456325028528675187087900672}$	1													
99	$B_{98} = \frac{1}{316912650057057350374175801344}$	1													
100	$B_{99} = \frac{1}{633825300114114700748351602688}$														



Computer Model



- Memory is a map from addresses to values
- A memory address is a non-negative integer
- A value is either a number or instruction
 - number: 0 to 255
 - instruction
 - receive an input
 - produce an output
 - evaluate an expression over memory addresses
 - assign a value to a memory address
 - jump to a memory address
 - finish
- A processor loads and executes instructions from address 0

Simple Computer Example

- Memory addresses: 0, 1, ..., 29
- Instruction
 - READ [m] Receive a new input and write it on address m
 - WRITE [m] Print out the number at address m
 - ASSIGN [m] [c] Put a number c to address m
 - MOVE [md] [ms] Put the value at address ms to address md
 - ADD [md] [mx] [my] Put the add of values in memory addresses mx and my to md
 - MINUS [md] [mx] [my] Put the minus of values in memory addresses mx and my to md
 - MOD [md] [mx] [my] Put the modulo of values in memory addresses mx and my to md
 - EQ [md] [mx] [my] Put 1 to md if the value at mx is equivalent to the value at my.
Otherwise, put 0 to md.
 - LESS [md] [mx] [my] Put 1 to md if the value at mx is less than the value at my.
Otherwise, put 0 to md.
 - JUMP [m] [c] Jump to address m if the value at c is not zero
 - TERM Finish the program execution

Exercise 1. Prime Number

- Write a program for the simple computer model that checks whether or not a given positive number is prime
 - Construct a map/table of the 30 memory addresses
 - Ex. check whether a given number is even

0: READ 21	...
1: EQ 23 21 22	20: "1"
2: JUMP 23 10	21:
3: JUMP 24 7	22: "0"
4: ASSIGN 24 20	23:
5: MINUS 21 21 20	24: "1"
6: JUMP 1	
7: ASSIGN 24 22	
8: MINUS 21 21 20	
9: JUMP 1 20	
10: PRINT 24	
11: TERM	