CSC104 fall 2013

Computational thinking

week 3

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Text: Picturing Programs

In media res

racing with Alice

Representing even simple information is hard. Let's race through this table:

b_7 →				0	0	0	0	1	1	1	1
b_6 →				0	0	1	1	0	0	1	1
b_5 →				0	1	0	1	0	1	0	1
Bits	b_4 ↓	b_3 ↓	b_2 ↓	b_1 ↓	Row ↓ / Column →	0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	SP	0	@	P	`	p
	0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC2	"	2	B	R	b	r
	0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
	0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
	0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
	0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
	0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
	1	0	0	0	8	BS	CAN	(	8	H	X	h	x
	1	0	0	1	9	HT	EM	)	9	I	Y	i	y
	1	0	1	0	10	LF	SUB	*	:	J	Z	j	z
	1	0	1	1	11	VT	ESC	+	;	K	[	k	{
	1	1	0	0	12	FF	FC	,	<	L	\	l	|
	1	1	0	1	13	CR	GS	-	=	M	]	m	}
	1	1	1	0	14	SO	RS	.	>	N	^	n	~
	1	1	1	1	15	SI	US	/	?	O	_	o	DEL

0010101 → NAK

1000001 → A

"Alice was..."

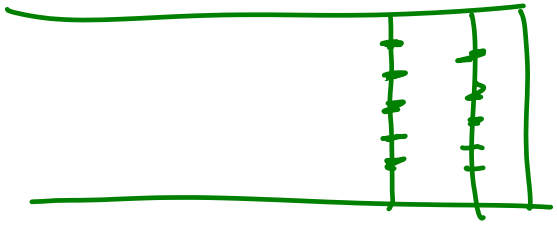
Early devices

tally systems

Clay tablets, read-only when baked,
read/write when sundried,
havebeen in use for at least 5,000 years.

4000?

Abacuses, or abaci, have been
in use for nearly as long



more beads
to count,
add, subtract

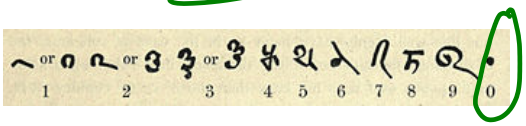
Number systems and gears

ancient world

Roman numerals

XXIII
XII

23
12
46
230
276



Hindu-Arabic numbers: positional notation, and zero over 2000 years ago

slick algorithms, e.g. long multiplication

Antikythera mechanism make us re-think ancient technical skills

Navigation important

Very precise metal-working

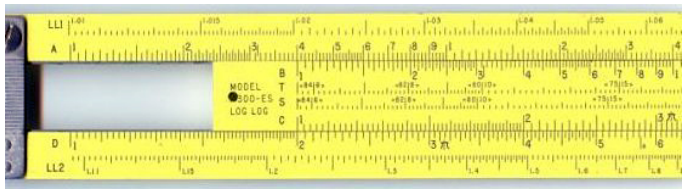
Gears and rules

machine age

$2 \times 2 \times 2 = 2^3$

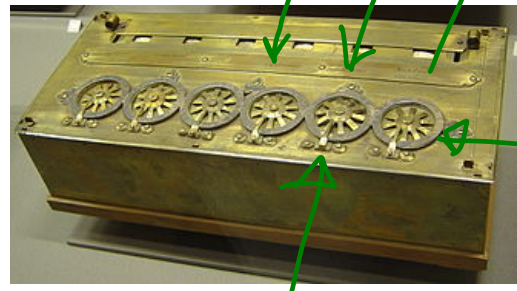
$2 \times 2 \times 2 \times 2 \times 2 = 2^5$

$2^3 \cdot 2^5 = 2^{3+5}$



Add powers (logs) to multiply quickly, extract roots

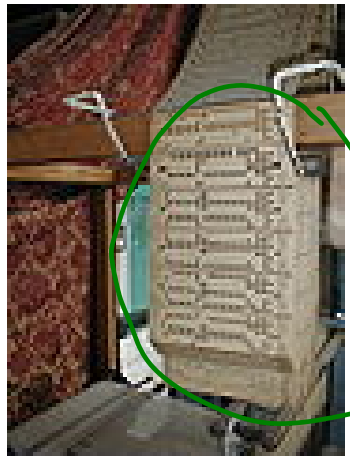
Read the gears to extract taxes — Pascaline



1
1 1
1 2 1
1 3 3 1

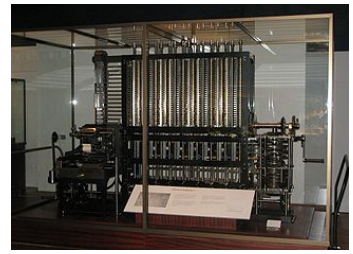
Looms and engines

industrial revolution



Jacquard loom combined
steam and punch cards
for automatic patterns

punched cards



Babbages difference engine
would have evaluated
polynomials like $3x^3 + 5x^2 - 7x + 9$

gears, pins, and electricity

digital and analog before tubes

data stored in punched cards
manipulated by pins and
electricity last for decades

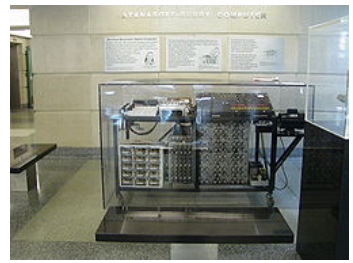
analog computers model world
using smoothly-varying quantities
such as water

programmable or electronic...

...but not both?

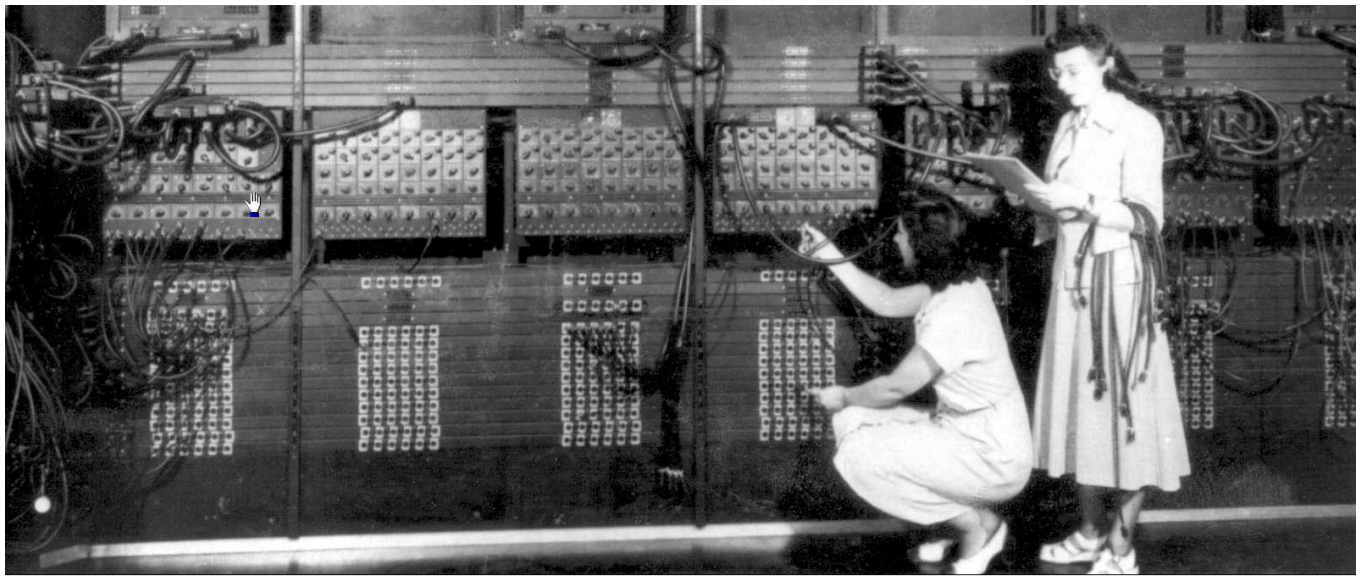
"programmable" (cards) but
not electronic (relays)
the Zuse Z1

electronic but not programmable
dedicated to one calculation
the Atanosoff-Berry



when computers were women

for a while



Eniac's first programmers were women

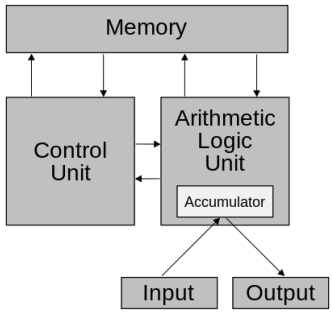
known for clear-thinking, manual dexterity, and speed

. . . human labour was cheaper than computer cycles

dozens of cubic metres, programmed by connecting pins

stored programs, faster switches

getting modern

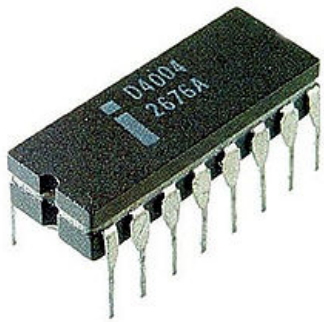


the same memory for data
and programs is now
the typical design

tubes were big, hot, slow
compared to transistors
. . . which just keep shrinking

your (grand)parent's computer

smaller, faster ...



perhaps thanks to sputnik
the computing power of eniac
fits in your hand by 1970

mass-produced desktops
landed with a clunk
by 1980s

Notes