CompSci.111

History of Computing

Assoc. Prof. Ian Watson

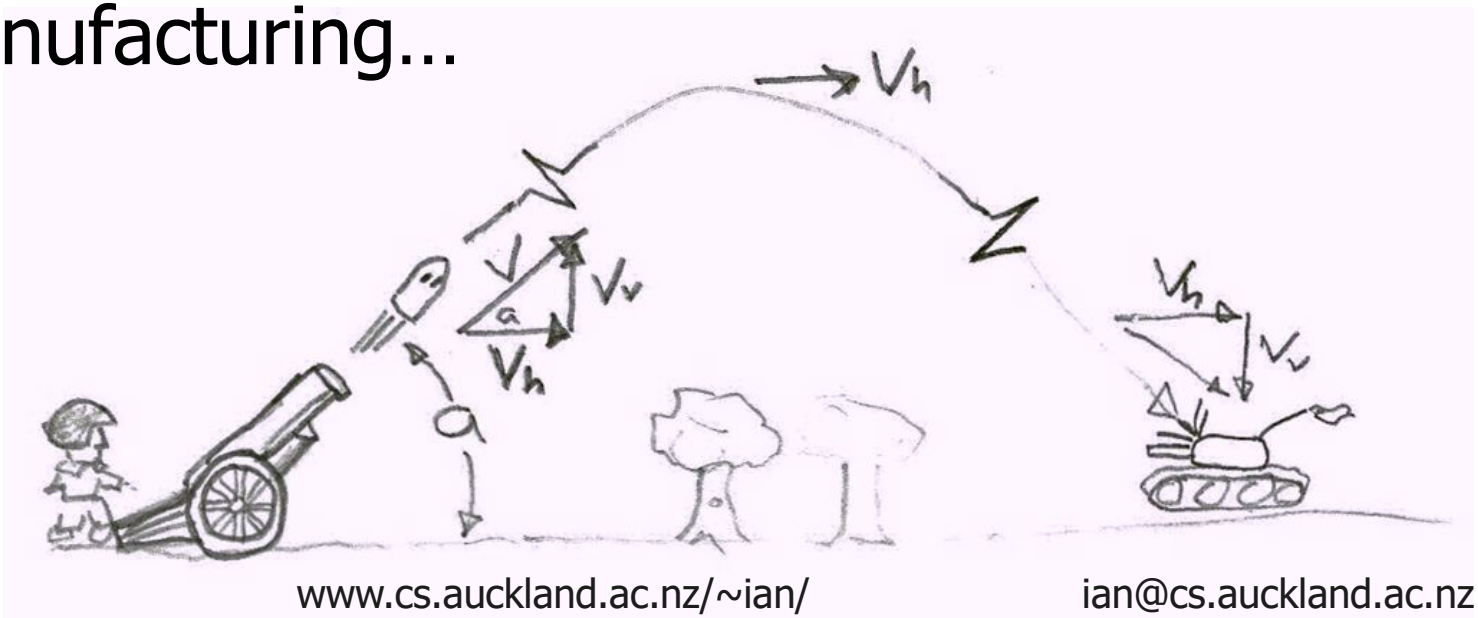
 www.cs.auckland.ac.nz/~ian/ ian@cs.auckland.ac.nz

Why?

- Computers are essential to modern life
- Many of the discoveries and decisions made by the pioneers still underpin modern computers
- As a CS student you should be familiar with CS history
- There are a lot of myths and misinformation about CS history

The need for computation

- Prior to the industrial revolution there was little need for computation
- Celestial navigation tables
- Artillery firing tables
- Engineering, architecture, insurance, science, manufacturing…



The University of Auckland

A celestial navigation table

	03	272 44.6	196 30.7	. . 59.5	196 04.2	. . 45.4	169 11.5	. . 04.7	199 17.9	. . 13.1	Adhara	255 19.7	S28 58.7
	04	287 47.1	211 29.9	23 59.9	211 04.8	45.6	184 13.5	04.6	214 20.1	13.2	Aldebaran	290 59.8	N16 30.8
	05	302 49.5	226 29.1	24 00.3	226 05.5	45.8	199 15.5	04.6	229 22.2	13.2			
	06	317 52.0	241 28.3	N24 00.6	241 06.1	N23 45.9	214 17.5	N23 04.5	244 24.3	N21 13.3	Alioth	166 27.8	N55 57.1
	07	332 54.4	256 27.5	01.0	256 06.8	46.1	229 19.4	04.5	259 26.5	13.3	Alkaid	153 05.2	N49 18.2
	08	347 56.9	271 26.6	01.4	271 07.4	46.3	244 21.4	04.5	274 28.6	13.3	Al Na'ir	27 54.7	S46 56.9
F	09	2 59.4	286 25.8	. . 01.8	286 08.1	. . 46.4	259 23.4	. . 04.4	289 30.8	. . 13.4	Alnilam	275 55.6	S 1 12.1
R	10	18 01.8	301 25.0	02.2	301 08.7	46.6	274 25.4	04.4	304 32.9	13.4	Alphard	218 04.7	S 8 40.2
I	11	33 04.3	316 24.2	02.5	316 09.4	46.8	289 27.4	04.4	319 35.0	13.5			
D	12	48 06.8	331 23.4	N24 02.9	331 10.0	N23 46.9	304 29.4	N23 04.3	334 37.2	N21 13.5	Alphecca	126 18.0	N26 42.4
A	13	63 09.2	346 22.6	03.3	346 10.7	47.1	319 31.4	04.3	349 39.3	13.5	Alpheratz	357 52.9	N29 05.9
Y	14	78 11.7	1 21.7	03.7	1 11.3	47.3	334 33.4	04.2	4 41.4	13.6	Altair	62 16.6	N 8 52.3
	15	93 14.2	16 20.9	. . 04.0	16 12.0	. . 47.4	349 35.4	. . 04.2	19 43.6	. . 13.6	Ankaa	353 24.6	S42 17.6
	16	108 16.6	31 20.1	04.4	31 12.6	47.6	4 37.4	04.2	34 45.7	13.7	Antares	112 36.7	S26 26.2
	17	123 19.1	46 19.3	04.8	46 13.3	47.7	19 39.4	04.1	49 47.9	13.7			
	18	138 21.5	61 18.5	N24 05.1	61 13.9	N23 47.9	34 41.3	N23 04.1	64 50.0	N21 13.7	Arcturus	146 03.4	N19 10.3
	19	153 24.0	76 17.6	05.5	76 14.6	48.1	49 43.3	04.1	79 52.1	13.8	Atria	107 46.0	S69 01.8
	20	168 26.5	91 16.8	05.9	91 15.2	48.2	64 45.3	04.0	94 54.3	13.8	Avior	234 21.9	S59 31.3
	21	183 28.9	106 16.0	. . 06.2	106 15.9	. . 48.4	79 47.3	. . 04.0	109 56.4	. . 13.9	Bellatrix	278 41.7	N 6 21.0
	22	198 31.4	121 15.2	06.6	121 16.5	48.6	94 49.3	03.9	124 58.6	13.9	Betelgeuse	271 11.1	N 7 24.4
	23	213 33.9	136 14.4	07.0	136 17.1	48.7	109 51.3	03.9	140 00.7	13.9			
11	00	228 36.3	151 13.5	N24 07.3	151 17.8	N23 48.9	124 53.3	N23 03.9	155 02.8	N21 14.0	Canopus	264 00.4	S52 42.0
	01	243 38.8	166 12.7	07.7	166 18.4	49.0	139 55.3	03.8	170 05.0	14.0	Capella	280 47.9	N46 00.1
	02	258 41.3	181 11.9	08.0	181 19.1	49.2	154 57.3	03.8	185 07.1	14.1	Deneb	49 37.4	N45 16.9
	03	273 43.7	196 11.1	. . 08.4	196 19.7	. . 49.4	169 59.3	. . 03.7	200 09.3	. . 14.1	Denebola	182 42.4	N14 33.6
	04	288 46.2	211 10.3	08.8	211 20.4	49.5	185 01.2	03.7	215 11.4	14.1	Diphda	349 04.9	S17 58.6
	05	303 48.7	226 09.4	09.1	226 21.0	49.7	200 03.2	03.7	230 13.5	14.2			
	06	318 51.1	241 08.6	N24 09.5	241 21.7	N23 49.8	215 05.2	N23 03.6	245 15.7	N21 14.2	Dubhe	194 01.9	N61 44.6
	07	333 53.6	256 07.8	09.8	256 22.3	50.0	230 07.2	03.6	260 17.8	14.3	Elnath	278 24.1	N28 36.6
S	08	348 56.0	271 07.0	10.2	271 23.0	50.1	245 09.2	03.6	275 19.9	14.3	Eltanin	90 49.8	N51 29.1
A	09	3 58.5	286 06.2	. . 10.5	286 23.6	. . 50.3	260 11.2	. . 03.5	290 22.1	. . 14.3	Enif	33 55.8	N 9 52.9
T	10	19 01.0	301 05.3	10.9	301 24.3	50.5	275 13.2	03.5	305 24.2	14.4	Fomalhaut	15 33.7	S29 36.6
U	11	34 03.4	316 04.5	11.2	316 24.9	50.6	290 15.2	03.4	320 26.4	14.4			
R	12	49 05.9	331 03.7	N24 11.6	331 25.6	N23 50.8	305 17.1	N23 03.4	335 28.5	N21 14.5	Gacrux	172 10.5	S57 07.7
D	13	64 08.4	346 02.9	11.9	346 26.2	50.9	320 19.1	03.4	350 30.6	14.5	Gienah	176 01.1	S17 33.3
A	14	79 10.8	1 02.0	12.3	1 26.9	51.1	335 21.1	03.3	5 32.8	14.5	Hadar	148 59.9	S60 23.1
Y	15	94 13.3	16 01.2	. . 12.6	16 27.5	. . 51.2	350 23.1	. . 03.3	20 34.9	. . 14.6	Hamal	328 11.1	N23 28.2
	16	109 15.8	31 00.4	12.9	31 28.2	51.4	5 25.1	03.2	35 37.1	14.6	Kaus Aust.	83 55.1	S34 23.0
	17	124 18.2	45 59.6	13.3	46 28.8	51.5	20 27.1	03.2	50 39.2	14.7			
	18	139 20.7	60 58.8	N24 13.6	61 29.5	N23 51.7	35 29.1	N23 03.2	65 41.3	N21 14.7	Kochab	137 18.2	N74 08.9
	19	154 23.1	75 57.9	14.0	76 30.1	51.9	50 31.1	03.1	80 43.5	14.7	Markab	13 47.2	N15 12.8
	20	169 25.6	90 57.1	14.3	91 30.8	52.0	65 33.0	03.1	95 45.6	14.8	Menkar	314 24.6	N 4 05.8
	21	184 28.1	105 56.3	. . 14.6	106 31.4	. . 52.2	80 35.0	. . 03.0	110 47.7	. . 14.8	Menkent	148 17.6	S36 22.9
	22	199 30.5	120 55.5	15.0	121 32.1	52.3	95 37.0	03.0	125 49.9	14.9	Miaplacidus	221 41.8	S69 43.8
	23	214 33.0	135 54.6	15.3	136 32.7	52.5	110 39.0	03.0	140 52.0	14.9			
12	00	229 35.5	150 53.8	N24 15.6	151 33.4	N23 52.6	125 41.0	N23 02.9	155 54.2	N21 14.9	Mirfak	308 53.5	N49 52.1
	01	244 37.9	165 53.0	16.0	166 34.0	52.8	140 43.0	02.9	170 56.3	15.0	Nunki	76 08.9	S26 17.6
	02	259 40.4	180 52.2	16.3	181 34.7	52.9	155 45.0	02.9	185 58.4	15.0	Peacock	53 32.7	S56 43.5
	03	274 42.9	195 51.3	. . 16.6	196 35.3	. . 53.1	170 46.9	. . 02.8	201 00.6	. . 15.0	Pollux	243 38.6	N28 01.4
	04	289 45.3	210 50.5	17.0	211 35.9	53.2	185 48.9	02.8	216 02.7	15.1	Procyon	245 09.1	N 5 13.1
	05	304 47.8	225 49.7	17.3	226 36.6	53.4	200 50.9	02.7	231 04.8	15.1			
	06	319 50.3	240 48.9	N24 17.6	241 37.2	N23 53.5	215 52.9	N23 02.7	246 07.0	N21 15.2	Rasalhague	96 14.3	N12 33.4
	07	334 52.7	255 48.0	17.9	256 37.9	53.7	230 54.9	02.7	261 09.1	15.2	Regulus	207 52.8	N11 57.4
	08	349 55.2	270 47.2	18.3	271 38.5	53.8	245 56.9	02.6	276 11.2	15.2	Rigel	281 20.8	S 8 12.0
S	09	4 57.6	285 46.4	. . 18.6	286 39.2	. . 54.0	260 58.8	. . 02.6	291 13.4	. . 15.3	Rigil Kent.	140 03.3	S60 50.7
U	10	20 00.1	300 45.5	18.9	301 39.8	54.1	276 00.8	02.5	306 15.5	15.3	Sabik	102 22.3	S15 43.7
N	11	35 02.6	315 44.7	19.2	316 40.5	54.3	291 02.8	02.5	321 17.7	15.4			
D	12	50 05.0	330 43.9	N24 19.5	331 41.1	N23 54.4	306 04.8	N23 02.5	336 19.8	N21 15.4	Schedar	349 51.2	N56 32.7
A	13	65 07.5	345 43.1	19.9	346 41.8	54.6	321 06.8	02.4	351 21.9	15.4	Shaula	96 33.5	S37 06.3
Y	14	80 10.0	0 42.2	20.2	1 42.4	54.7	336 08.8	02.4	6 24.1	15.5	Sirius	258 41.7	S16 43.3
	15	95 12.4	15 41.4	. . 20.5	16 43.1	. . 54.8	351 10.7	. . 02.3	21 26.2	. . 15.5	Spica	158 40.2	S11 10.4

	03	225 54.3	. . 32.9	249 42.0	16.0	5 03.2	12.5	54.4
	04	240 54.4	33.6	264 17.0	16.0	5 15.7	12.4	54.4
	05	255 54.4	34.3	278 52.0	16.0	5 28.1	12.5	54.4
	06	270 54.4	N17 34.9	293 27.0	15.9	N 5 40.6	12.4	54.5
	07	285 54.4	35.6	308 01.9	15.9	5 53.0	12.4	54.5
	08	300 54.5	36.2	322 36.8	15.8	6 05.4	12.4	54.5
F	09	315 54.5	. . 36.9	337 11.6	15.8	6 17.8	12.3	54.5
R	10	330 54.5	37.5	351 46.4	15.8	6 30.1	12.4	54.5
I	11	345 54.5	38.2	6 21.2	15.7	6 42.5	12.3	54.5
D	12	0 54.5	N17 38.8	20 55.9	15.7	N 6 54.8	12.3	54.5
A	13	15 54.6	39.5	35 30.6	15.7	7 07.1	12.3	54.5
Y	14	30 54.6	40.2	50 05.3	15.6	7 19.4	12.3	54.6
	15	45 54.6	. . 40.8	64 39.9	15.5	7 31.7	12.2	54.6
	16	60 54.6	41.5	79 14.4	15.6	7 43.9	12.3	54.6
	17	75 54.7	42.1	93 49.0	15.4	7 56.2	12.2	54.6
	18	90 54.7	N17 42.8	108 23.4	15.5	N 8 08.4	12.1	54.6
	19	105 54.7	43.4	122 57.9	15.4	8 20.5	12.2	54.6
	20	120 54.7	44.1	137 32.3	15.3	8 32.7	12.1	54.6
	21	135 54.7	. . 44.7	152 06.6	15.3	8 44.8	12.1	54.7
	22	150 54.8	45.4	166 40.9	15.3	8 56.9	12.1	54.7
	23	165 54.8	46.0	181 15.2	15.2	9 09.0	12.0	54.7
11	00	180 54.8	N17 46.6	195 49.4	15.2	N 9 21.0	12.0	54.7
	01	195 54.8	47.3	210 23.6	15.1	9 33.0	12.0	54.7
	02	210 54.8	47.9	224 57.7	15.0	9 45.0	11.9	54.7
	03	225 54.9	. . 48.6	239 31.7	15.0	9 56.9	11.9	54.7
	04	240 54.9	49.2	254 05.7	15.0	10 08.8	11.9	54.8
	05	255 54.9	49.9	268 39.7	14.9	10 20.7	11.8	54.8
	06	270 54.9	N17 50.5	283 13.6	14.9	N10 32.5	11.8	54.8
	07	285 54.9	51.2	297 47.5	14.8	10 44.3	11.8	54.8
S	08	300 54.9	51.8	312 21.3	14.7	10 56.1	11.7	54.8
A	09	315 55.0	. . 52.5	326 55.0	14.7	11 07.8	11.7	54.8
T	10	330 55.0	53.1	341 28.7	14.6	11 19.5	11.7	54.9
U	11	345 55.0	53.7	356 02.3	14.6	11 31.2	11.6	54.9
R	12	0 55.0	N17 54.4	10 35.9	14.5	N11 42.8	11.6	54.9
D	13	15 55.0	55.0	25 09.4	14.4	11 54.4	11.5	54.9
A	14	30 55.0	55.7	39 42.8	14.4	12 05.9	11.5	54.9
Y	15	45 55.0	. . 56.3	54 16.2	14.4	12 17.4	11.5	54.9
	16	60 55.1	56.9	68 49.6	14.2	12 28.9	11.4	54.9
	17	75 55.1	57.6	83 22.8	14.3	12 40.3	11.3	55.0
	18	90 55.1	N17 58.2	97 56.1	14.1	N12 51.6	11.3	55.0
	19	105 55.1	58.8	112 29.2	14.1	13 02.9	11.3	55.0
	20	120 55.1	17 59.5	127 02.3	14.0	13 14.2	11.2	55.0
	21	135 55.1	18 00.1	141 35.3	14.0	13 25.4	11.1	55.0
	22	150 55.1	00.8	156 08.3	13.9	13 36.5	11.2	55.0
	23	165 55.2	01.4	170 41.2	13.8	13 47.7	11.0	55.1
12	00	180 55.2	N18 02.0	185 14.0	13.7	N13 58.7	11.0	55.1
	01	195 55.2	02.7	199 46.7	13.7	14 09.7	11.0	55.1
	02	210 55.2	03.3	214 19.4	13.7	14 20.7	10.9	55.1
	03	225 55.2	. . 03.9	228 52.1	13.5	14 31.6	10.8	55.1
	04	240 55.2	04.6	243 24.6	13.5	14 42.4	10.8	55.2
	05	255 55.2	05.2	257 57.1	13.4	14 53.2	10.7	55.2
	06	270 55.2	N18 05.8	272 29.5	13.4	N15 03.9	10.7	55.2
	07	285 55.3	06.5	287 01.9	13.3	15 14.6	10.6	55.2
	08	300 55.3	07.1	301 34.2	13.2	15 25.2	10.5	55.2
S	09	315 55.3	. . 07.7	316 06.4	13.1	15 35.7	10.5	55.2
U	10	330 55.3	08.3	330 38.5	13.1	15 46.2	10.5	55.3
N	11	345 55.3	09.0	345 10.6	13.0	15 56.7	10.3	55.3
D	12	0 55.3	N18 09.6	359 42.6	12.9	N16 07.0	10.3	55.3
A	13	15 55.3	10.2	14 14.5	12.8	16 17.3	10.2	55.3
Y	14	30 55.3	10.9	28 46.3	12.8	16 27.5	10.2	55.3
	15	45 55.3	. . 11.5	43 18.1	12.7	16 37.7	10.1	55.3

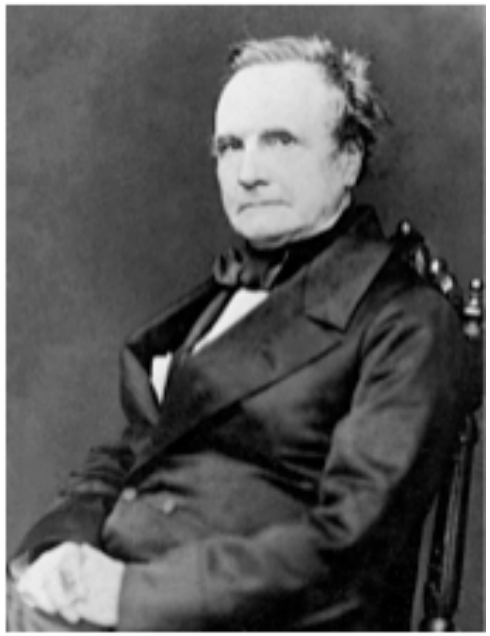
64	////	01 35	03 01	03 40	03 38	03 37	03 37
62	////	02 09	03 18	03 44	03 46	03 49	03 55
60	00 25	02 33	03 33	03 47	03 52	03 59	04 09
N 58	01 25	02 52	03 45	03 50	03 58	04 08	04 22
56	01 56	03 07	03 55	03 52	04 03	04 16	04 32
54	02 19	03 20	04 05	03 54	04 07	04 23	04 42
52	02 36	03 32	04 13	03 56	04 11	04 29	04 51
50	02 51	03 42	04 20	03 58	04 15	04 35	04 58
45	03 20	04 02	04 36	04 02	04 23	04 47	05 15
N 40	03 42	04 19	04 49	04 06	04 30	04 57	05 28
35	03 59	04 32	05 00	04 09	04 36	05 06	05 40
30	04 12	04 44	05 09	04 11	04 41	05 14	05 50
20	04 35	05 02	05 26	04 16	04 50	05 27	06 07
N 10	04 52	05 18	05 40	04 20	04 58	05 39	06 23
0	05 06	05 31	05 53	04 24	05 06	05 50	06 37
S 10	05 18	05 44	06 06	04 28	05 14	06 01	06 52
20	05 30	05 56	06 20	04 32	05 22	06 13	07 07
30	05 41	06 10	06 35	04 37	05 31	06 27	07 25
35	05 47	06 17	06 44	04 40	05 37	06 35	07 36
40	05 53	06 25	06 54	04 43	05 43	06 45	07 48
45	05 59	06 35	07 06	04 46	05 50	06 56	08 02
S 50	06 06	06 46	07 21	04 51	05 59	07 09	08 20
52	06 09	06 50	07 28	04 53	06 03	07 15	08 28
54	06 13	06 56	07 35	04 55	06 08	07 22	08 38
56	06 16	07 02	07 43	04 58	06 13	07 30	08 48
58	06 20	07 08	07 53	05 01	06 18	07 38	09 00
S 60	06 24	07 15	08 04	05 04	06 24	07 48	09 15

Lat.	Sunset	Twilight		Moonset			
		Civil	Naut.	10	11	12	13
°	h m	h m	h m	h m	h m	h m	h m
N 72	□	□	□	18 32	20 39	□	□
N 70	22 35	////	////	18 19	20 12	22 27	□
68	21 47	////	////	18 09	19 52	21 47	24 15
66	21 17	////	////	18 00	19 37	21 20	23 14
64	20 54	22 23	////	17 53	19 24	20 59	22 40
62	20 37	21 47	////	17 47	19 13	20 43	22 15
60	20 22	21 22	////	17 42	19 04	20 29	21 55
N 58	20 09	21 03	22 32	17 37	18 56	20 17	21 39
56	19 59	20 47	22 00	17 33	18 49	20 07	21 25
54	19 49	20 34	21 36	17 30	18 43	19 58	21 14
52	19 41	20 22	21 18	17 26	18 37	19 50	21 03
50	19 33	20 12	21 03	17 23	18 32	19 43	20 54
45	19 17	19 51	20 34	17 17	18 21	19 27	20 35
N 40	19 04	19 35	20 12	17 12	18 12	19 15	20 19
35	18 53	19 21	19 55	17 07	18 05	19 04	20 05
30	18 44	19 10	19 41	17 03	17 58	18 55	19 54
20	18 27	18 51	19 18	16 56	17 46	18 39	19 34
N 10	18 13	18 35	19 01	16 50	17 36	18 25	19 17
0	18 00	18 22	18 47	16 44	17 27	18 12	19 01
S 10	17 47	18 09	18 34	16 38	17 17	18 00	18 45
20	17 33	17 56	18 23	16 32	17 07	17 46	18 28
30	17 17	17 42	18 11	16 25	16 56	17 30	18 09
35	17 08	17 35	18 05	16 21	16 50	17 21	17 57
40	16 58	17 27	17 59	16 17	16 42	17 11	17 45
45	16 46	17 17	17 53	16 11	16 33	16 59	17 29
S 50	16 31	17 07	17 46	16 05	16 23	16 44	17 11
52	16 25	17 02	17 43	16 02	16 18	16 38	17 02
54	16 17	16 56	17 39	15 59	16 13	16 30	16 52
56	16 09	16 50	17 36	15 56	16 07	16 22	16 41

Preparing a table

- 2 *computers* perform the calculations
- A *comparator* checks their results
- If they agree the table is given to a printer
- The printer typesets the table and prints it
- The comparator checks the printed table against the hand made table

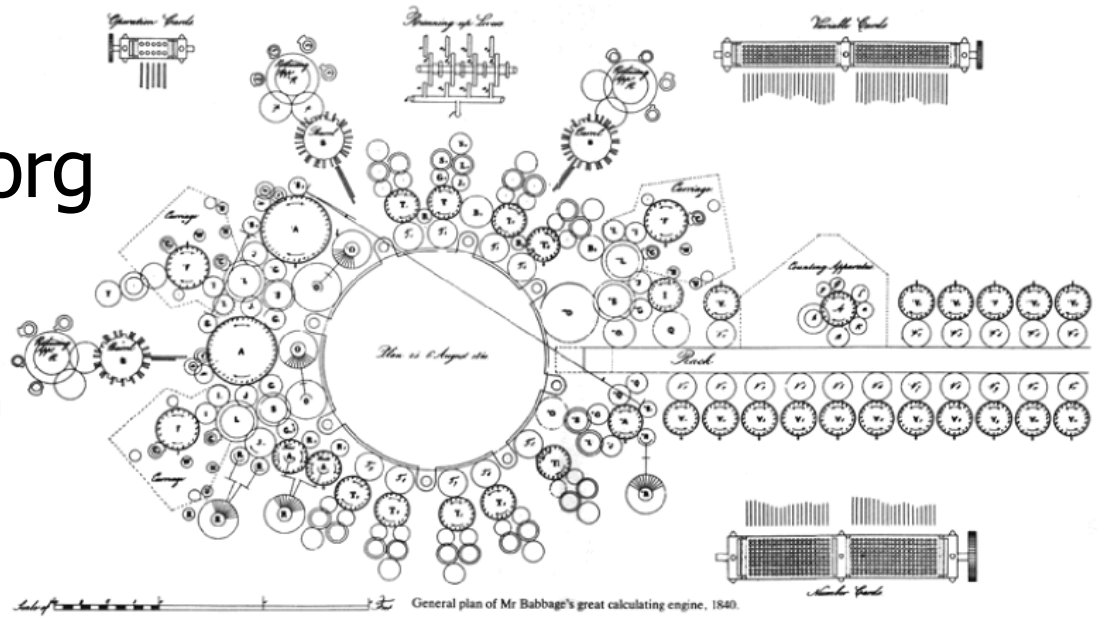
Charles Babbage



- Victorian mathematician and inventor
- "*by God, I wish these tables could be made by steam.*"
- Decide to build a calculating engine that would use the method of finite differences to solve polynomial equations

The Analytical Engine

- Architecture similar to a modern computer
- Could solve any problem, not just polynomials
- Could be programmed
- Supported branches, conditionals and loops
- Never built
- www.plan28.org



Ada Lovelace

- Lady Ada Lovelace hypothesised in 1842 that Charles Babbage's Analytical Engine could manipulate symbols other than numbers and hence perhaps could compose music or poems
- The programming language ADA is named after her
- But she did not believe the Engine could think for itself

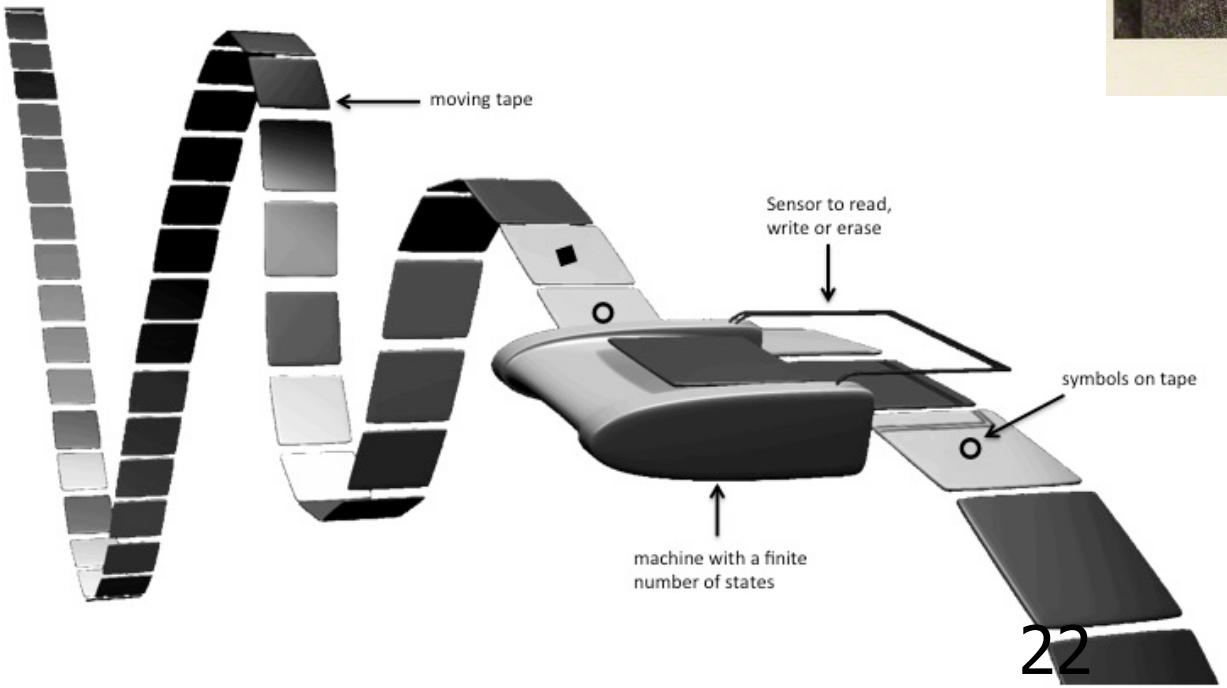
http://en.wikipedia.org/wiki/Ada_lovelace

The Universal Machine

- Not much happened until WWII
- BIGGER need for computation
- Artillery firing tables
- Aerospace design
- Cyptography
- …

The Turing Machine

- Alan Turing, 1936
- A simple (hypothetical) computing machine
- Could solve any problem for which a program could be written
- The basis of all modern computers



The Universal Machine

- An algorithm describes how to solve an individual decision problem
- At this time computers were people
- Turing imagined a hypothetical factory filled with floor upon floor, rows upon rows of hundreds upon hundreds of computers
- each using an algorithm to solve a particular decision problem
- Such a factory could in theory solve the decision problem for all conceivable problems
- This was the ***universal machine***

Watch the video: http://vimeo.com/33559758

Colossus

- 1943 First programmable digital computer - Colossus
- 10 machines built for Bletchley Park, England to crack German High Command's Lorenz code
- Designed by Tommy Flowers
- 1,500 valves (vacuum tubes)
- TOP SECRET until 1970's
- ENIAC in 1945 was publicised as the "first computer"

Lorenz machine

The Stored Program Computer

- 1943: Colossus Mark 1

The Stored Program Computer

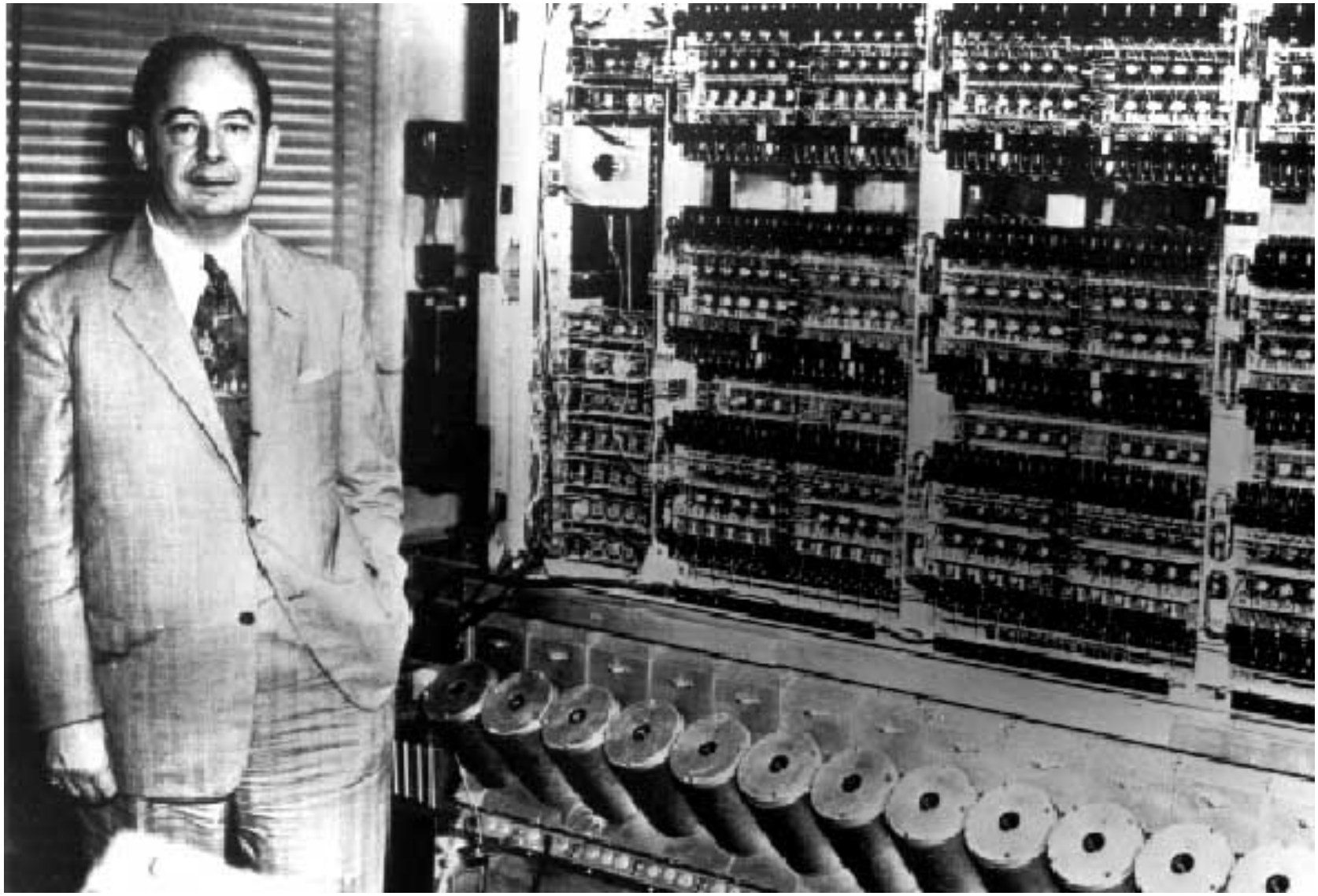
1945: John von Neumann

- Wrote a report called, *First Draft of a Report on EDVAC,* on the stored program concept,

The basic structure proposed in the draft became known as the "von Neumann machine" (or model)

- a ***memory***, containing instructions and data
- a ***processing unit***, for performing arithmetic and logical operations
- **a *control unit***, for interpreting instructions
- **input/output** (I/O) devices

The University of Auckland



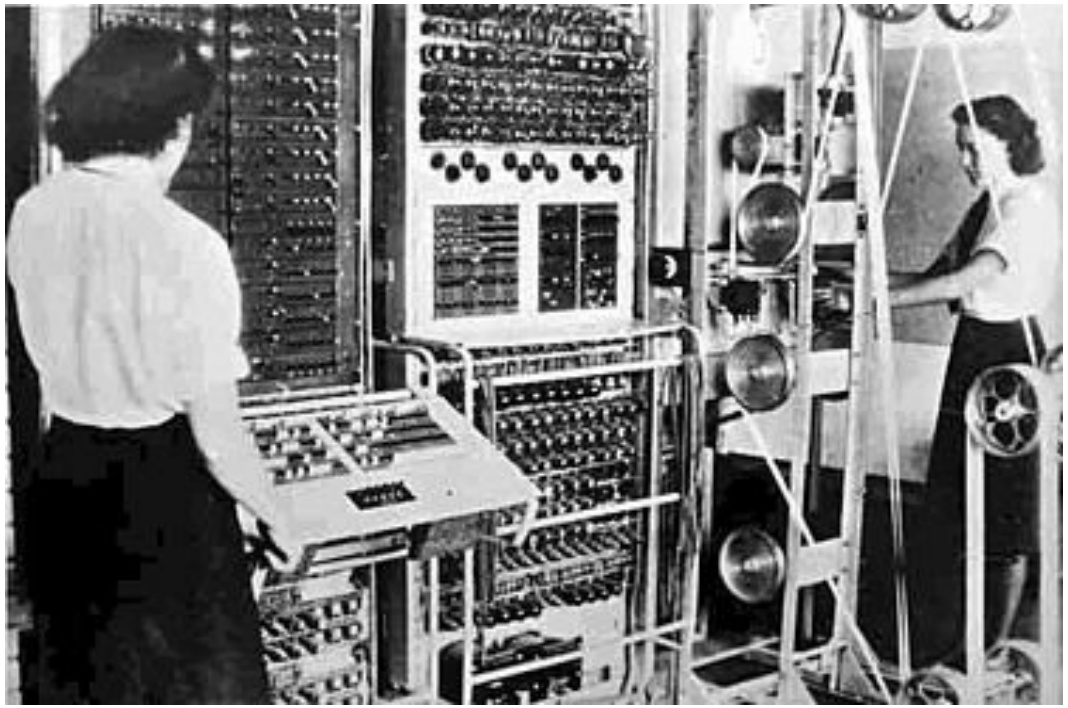
John von Neumann (1903-1957) with the ENIAC

Early Computers

- Babbage's Analytical Engine (1837)
  - Never built, decimal, mechanical, programmable via punch cards
- Universal Turing Machine (1936)
  - Theoretical, binary, programmable – the basis of all computers

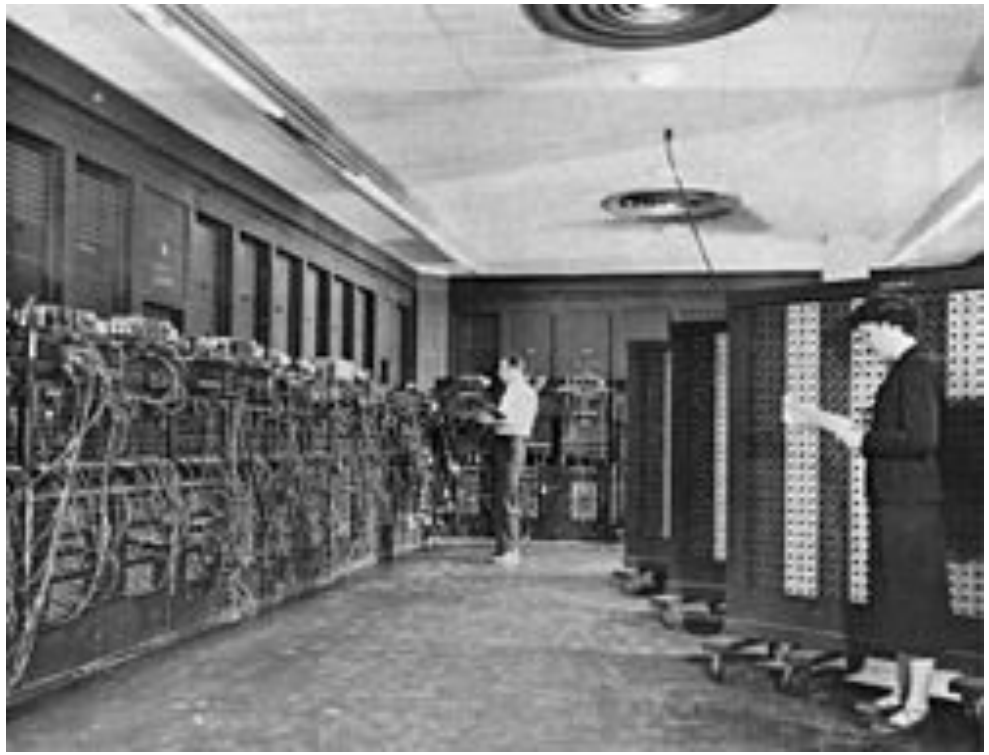
Early Computers

- Colossus (1943)
  - Binary, electronic, programmable patch cables and switches



Early Computers

- ENIAC (1946)
  - Decimal, electronic, programmable patch cables and switches



Claude Shannon

- engineering and maths graduate
- 1938 his MSc "A Symbolic Analysis of Relay and Switching Circuits" showed that electrical switches could implement boolean algebra and binary arithmetic
- The most influential MSc thesis in history!
- He invented digital logic, his method replaced the ad hoc methods used before
- Worked on cryptography during WWII
- Then pioneered the study of information theory

Watch the video: http://go.shr.lc/1oodYtP

The Mother of All Demos

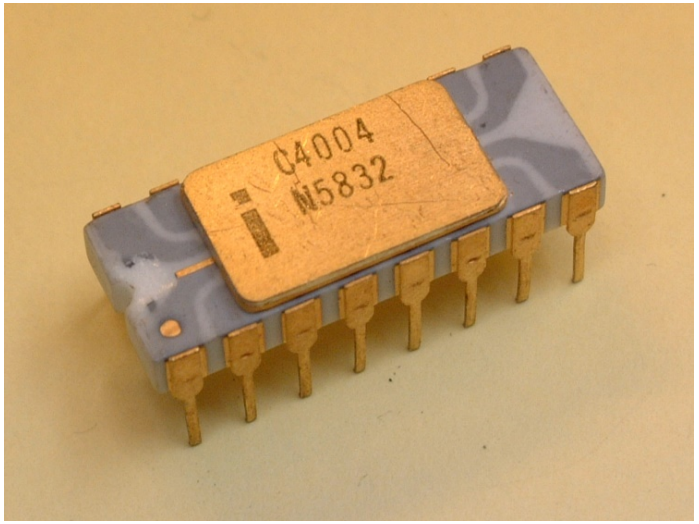
- Doug Englebart established the Augmentation Research Centre at SRI
- Invented the mouse, bit mapped graphical displays, a collaborative networking environment, video conferencing and hypertext (derived from Vannevar Bush's Memex)
- On Dec 9 1968 he gave "*The Mother of all Demos*" to an audience in San Francisco
- Watch the demo http://go.shr.lc/1nYcExL

The Stanford AI Lab

- John McCarthy founded SAIL in 1968
- He coined "Artificial Intelligence"
- Englebart wanted to "augment" human's McCarthy wanted to replace them
- McCarthy helped design UNIX at Bell Labs and believed computing power would become a utility like electricity
- People at SAIL developed A* used in your GPS satnav for route planning
- Other SAIL researchers pioneered robotics (Shakey)

The first microprocessor

- Intel
  - Formed 1968
  - Gordon Moore
  - C4004 released 1971
  - 8080 released in 1974
  - First micro processors
  - Entire CPU in a single chip

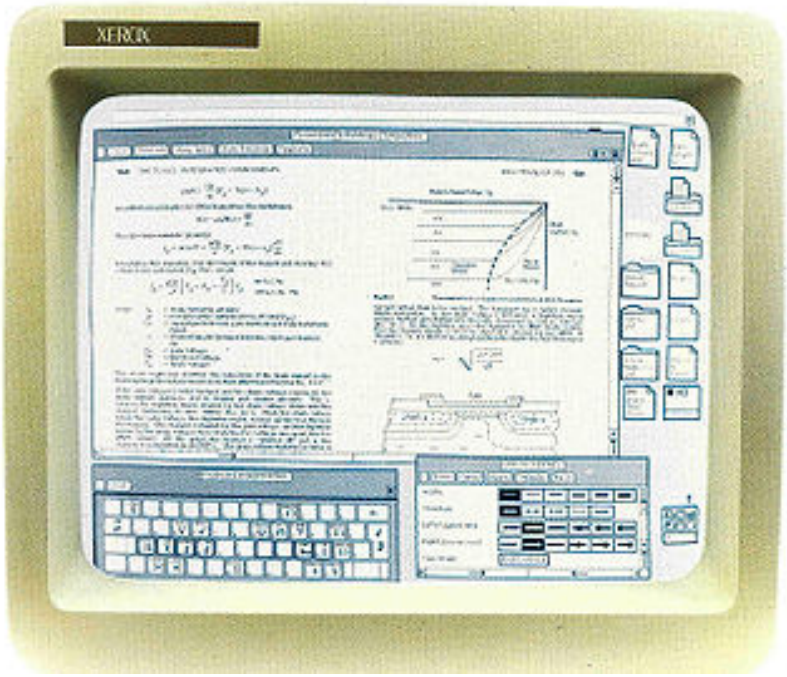


Intel C 4004
cpu-zone.com

- Moore's Law
  - Coined in 1965: Predicts number of components in integrated circuits will double every year
  - Revised in 1975: doubles every two years
  - Revised in 2010: doubles every 2 ½ years
  - Exercise: Compute your PC/laptop specs Moor's law

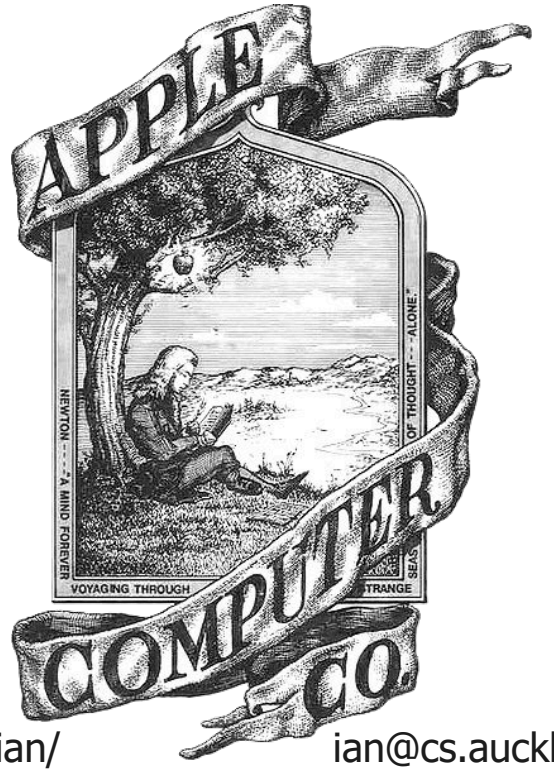
Xerox PARC

- Interested in the "office of the future"
- Opened a research centre on the US West Coast removed from head office
- They invented:
  - The GUI
  - WISWYG word processing
  - Ethernet
  - Postscript
  - The laser printer
  - Object oriented programming
  - The personal computer
- They commercialised none of it!!!

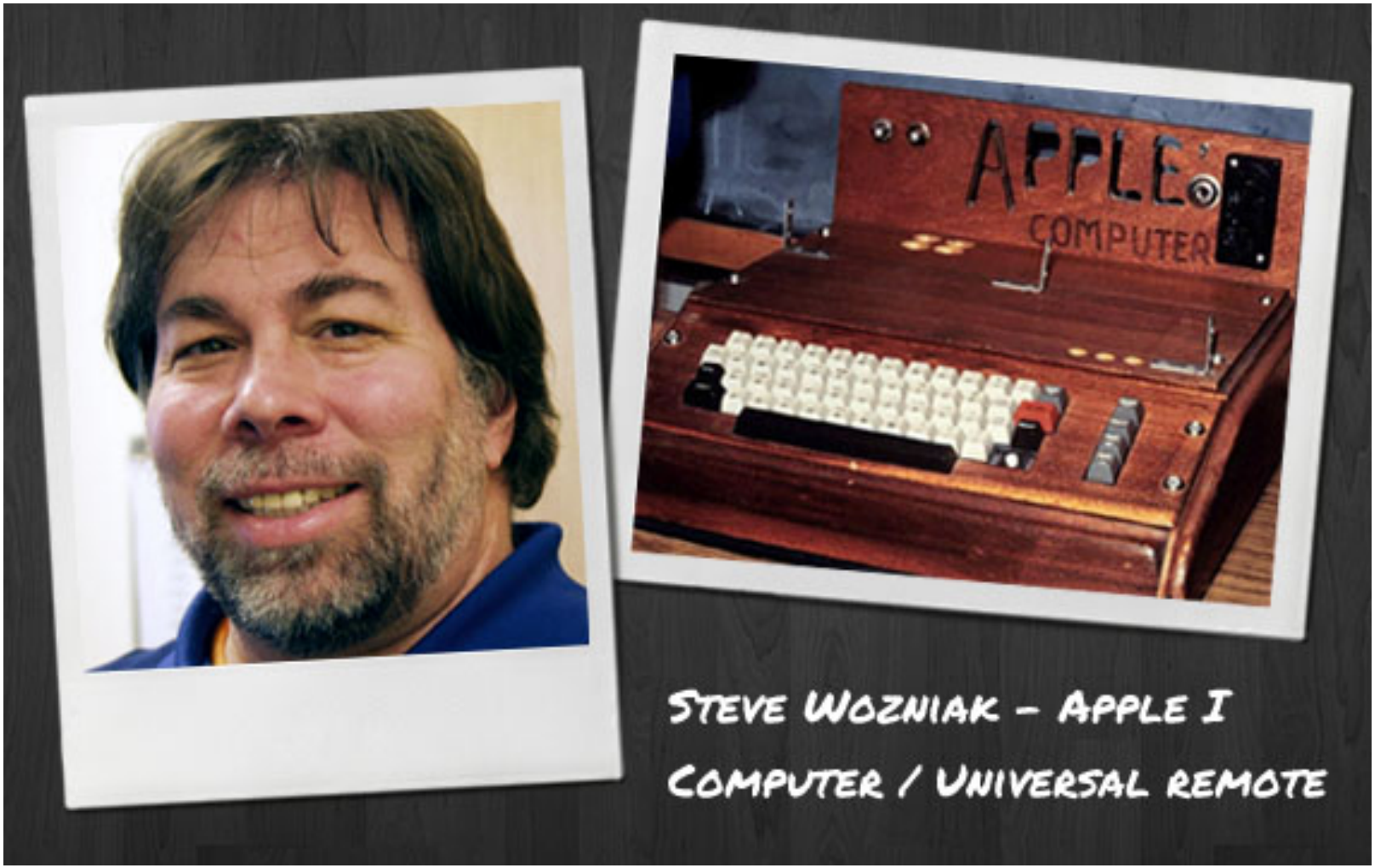


Apple

- Two friends Steve "Woz" Wozniak and Steve Jobs started by building a selling a device for phone phreaking (hacking)
- In 1976 Woz built the Apple I and they started selling them as a kit for $666.66
- BYO keyboard and home TV
- The Apple II was released in 1977
- Sold for 15 years!



The University of Auckland



Predicting the future?

So we went to Atari and said 'Hey, we've got this amazing thing, even built with some of your parts, and so what do you think about funding us? Or we'll give it to you. We just want to do it. Pay our salary and we'll come work for you.' And they said "No."

So then we went to Hewlett-Packard, and they said, "Hey, we don't need you. You haven't even made it through college yet."

Steve Jobs, talking about the Apple II

Visicalc

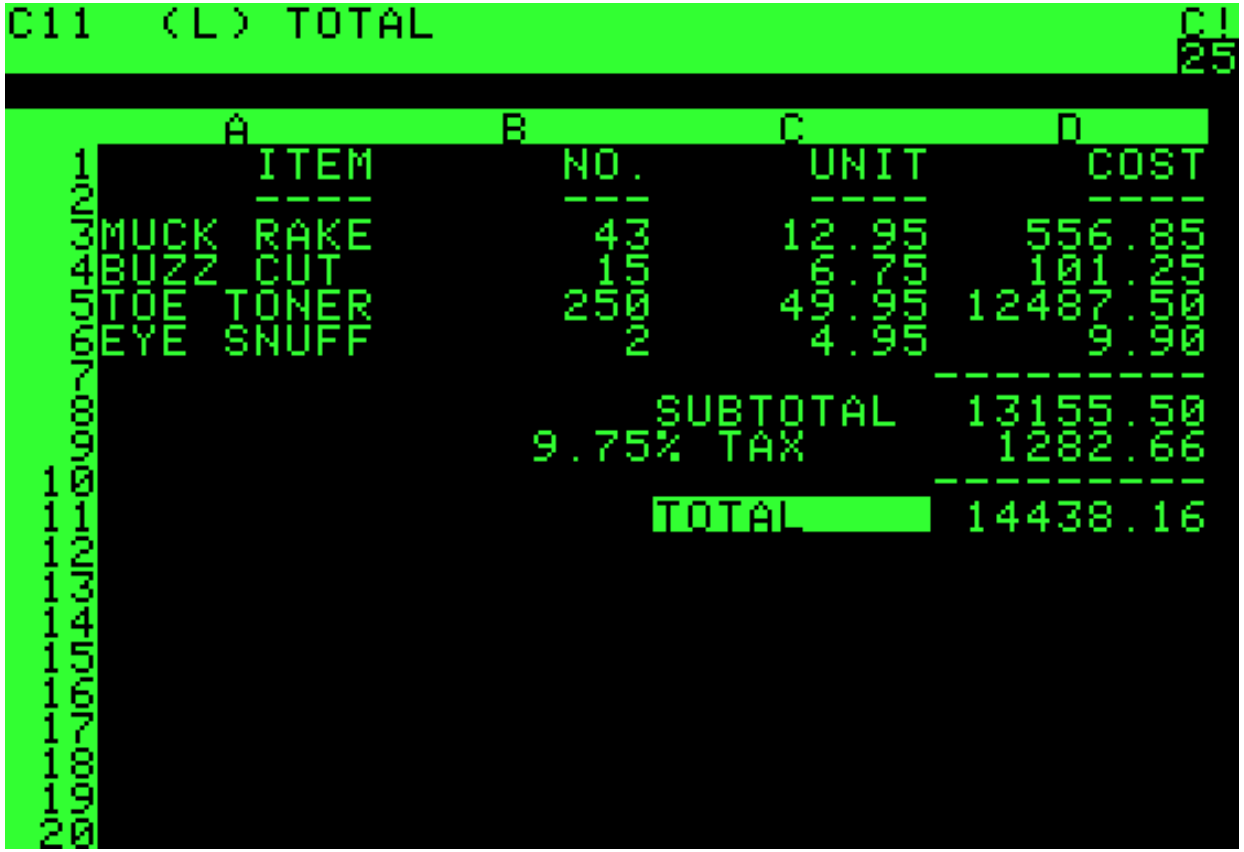
Dan Bricklin, Bob Frankston, 1979

1st Killer application

Spreadsheet

Proved necessity of owning an Apple II

Apple captured 50% of market by 1980



The IBM PC

- In 1981 IBM launched the PC to compete with the Apple II
- Invited Microsoft to make its operating system
- Licensed MSDOS from Microsoft
- IBM allowed others to "clone" the PCs hardware
- Compaq, HP and others quickly flooded the market

"*My own IBM computer. Imagine that!*"

The Macintosh

- Steve Jobs was working on the Lisa a successor to the Apple II
- He visited Zerox PARC and was shown the Star with its GUI
- Started working an a secret project that would become the Macintosh
- Released on January 1984
- 1st mass-market computer with a GUI and mouse