



Lecture 2

The cargo cult of mobile
phones
(and a cure)

Small differences in a big world

Bad interfaces “kill people”

Small improvements are worthwhile

Mobile market

400 million mobiles sold this year

16 million will have cameras

1 billion mobile users worldwide

Paid \$100 billion for 3G

In the UK...

In UK, more mobiles than PCs

More people use a mobile than are watching TV

Usability is a big deal

History of communication

c1084 BC — The fall of Troy

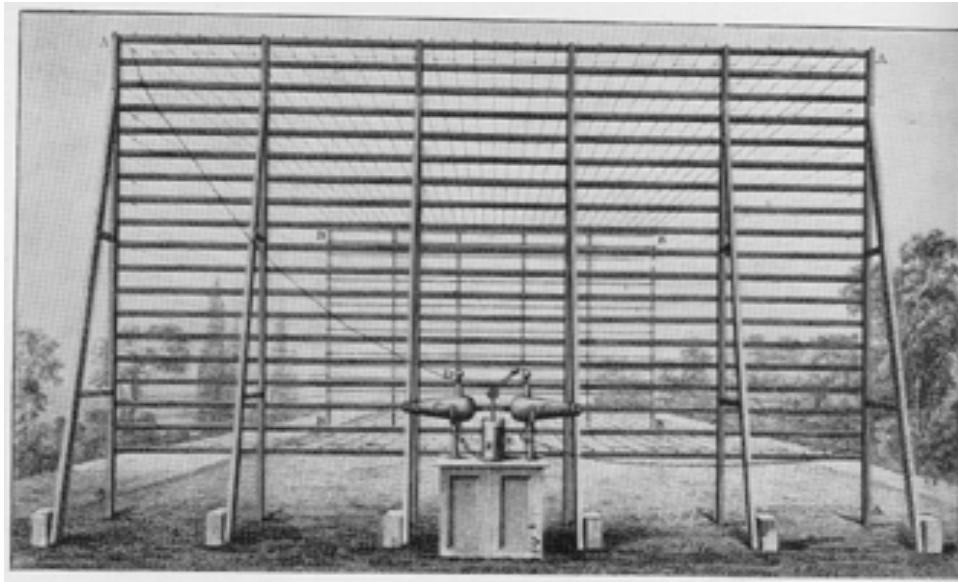
500 miles

Beacon fires

Medieval tap codes

	1	2	3	4	5
1	A	B	C	D	E
2	F	G	H	I	J
3	KQ	L	M	N	O
4	P	R	S	T	U
5	V	W	X	Y	Z

Francis Ronalds 8 miles of wire



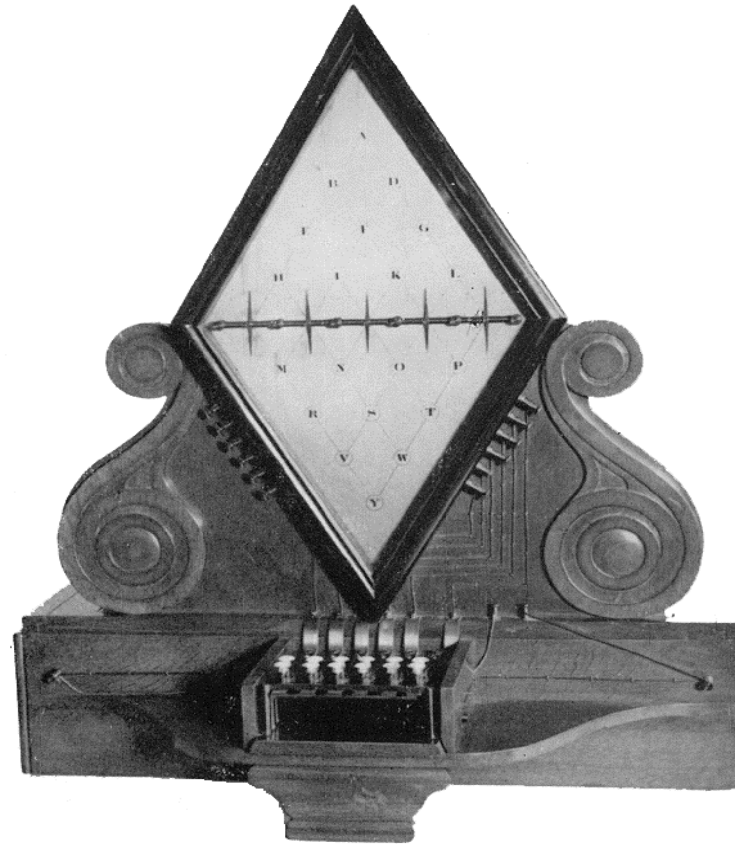
1823

Charles Wheatstone



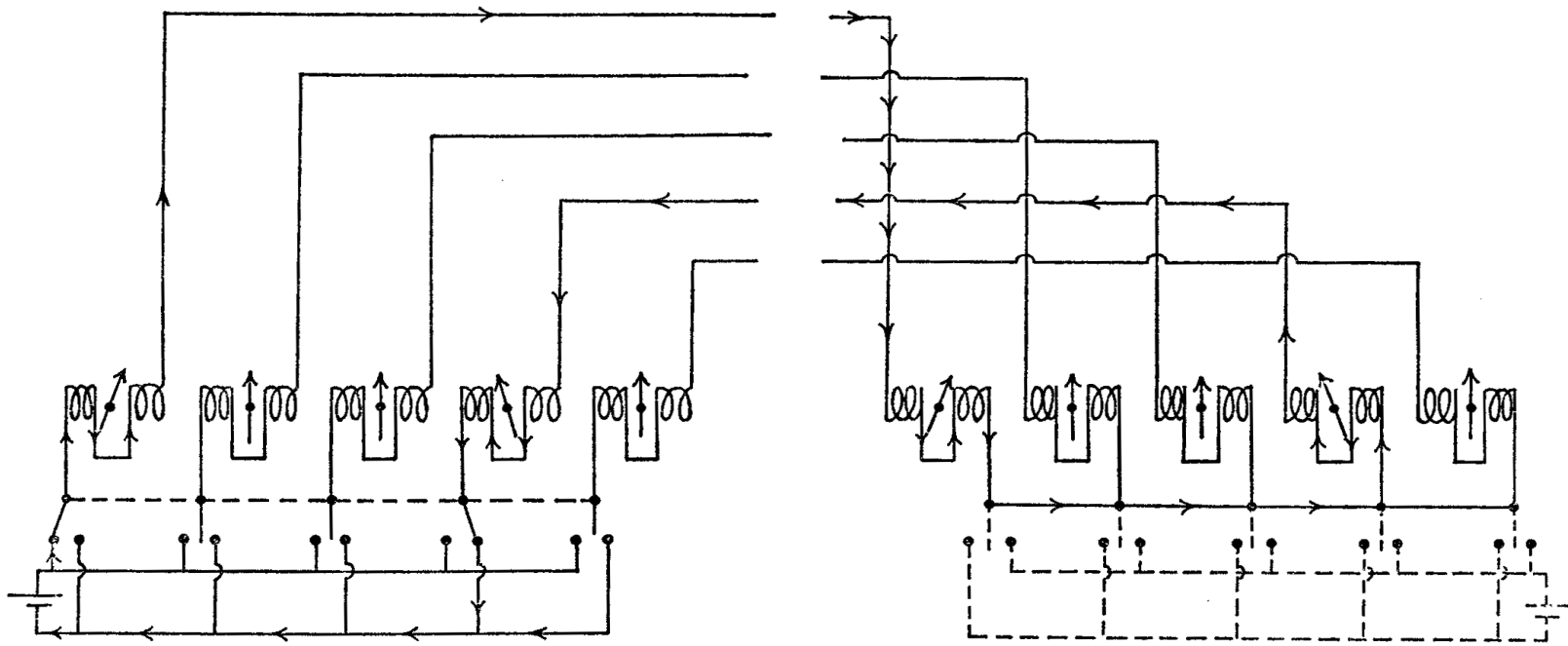
1837

Wheatstone's needle telegraph



Around 1837

Only 5 wires



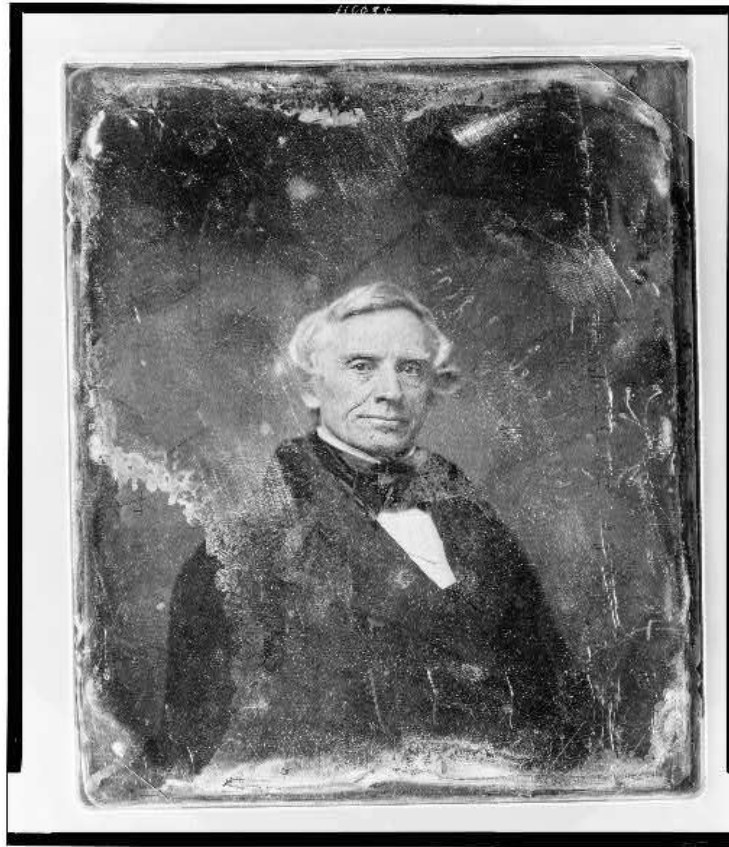
This is 1837. Incandescent light bulb c1870

Murder !

New Year's Day 1845

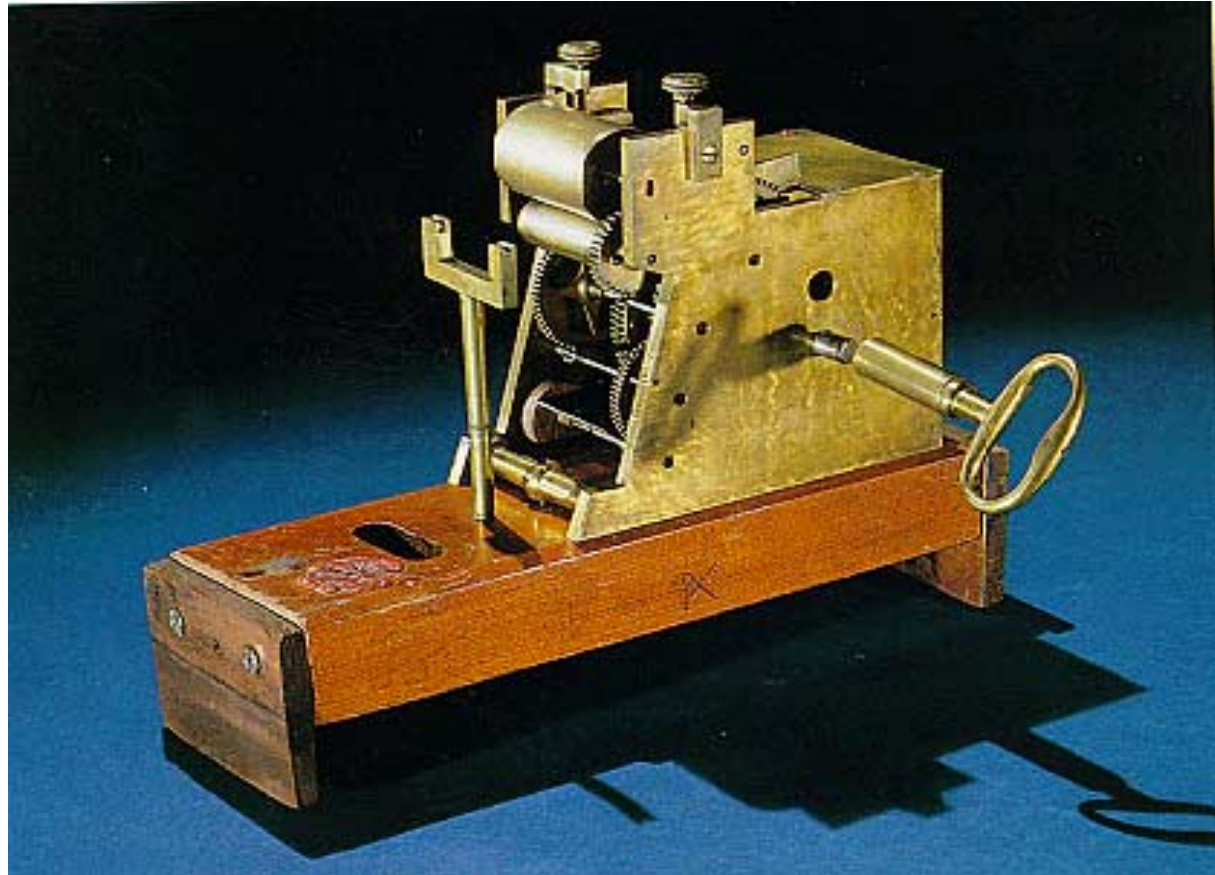
A MURDER HAS JUST BEEN COMMITTED AT SALT HILL AND THE SUSPECTED MURDERER WAS SEEN TO TAKE A FIRST CLASS TICKET FOR LONDON BY THE TRAIN WHICH LEFT SLOUGH AT 7H 42M PM HE IS IN THE GARB OF A KWAKER WITH A GREAT COAT ON WHICH REACHES NEARLY DOWN TO HIS FEET HE IS IN THE LAST COMPARTMENT OF THE SECOND FIRST CLASS CARRIAGE

Samuel P Morse



1840s

1 wire Morse tape machine



Wheatstone v Morse

Wheatstone

- Easy to use
- 3 operators
- Costly — lots of wires
- Unreliable

Morse

- Fast
- 2 operators
- Cheap — one wire
- Reliable

SOS

S





























O



S



Morse code

																									
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

Morse code *by* time

•		••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••
E	T	I	S	N	A	U	R	M	H	D	W	V	L	K	G	F	B	Z	X	P	O	C	Y	Q	J	

Length of messages

“What has God wrought” (1844)

Everything coded like Q: 233 dots





















Everything coded in real Morse: 133 dots

Everything coded like E: 29 dots

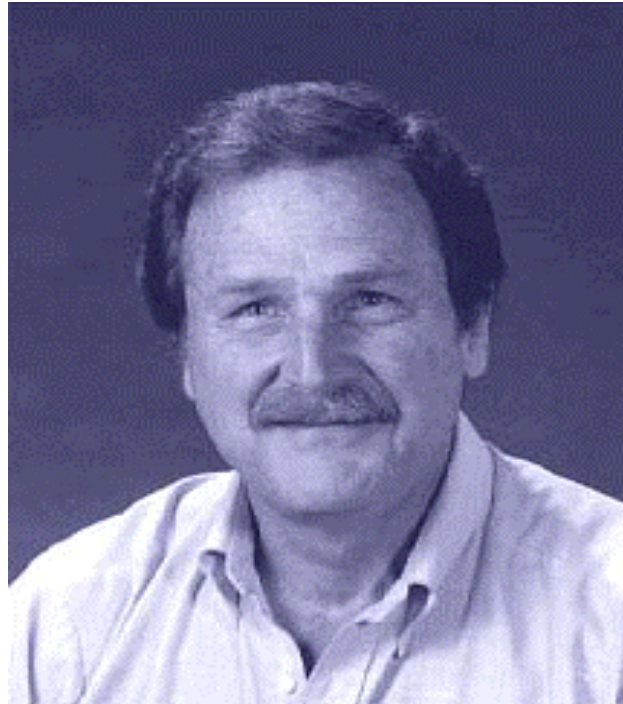
Morse code
by British National
Corpus

E T A O I N S R H L D C U M F P G W Y B V K X J Q Z

Morse code by Welsh

																			
A	Y	N	D	R	E	I	L	O	G	H	W	T	F	U	S	C	M	B	P

David Huffman



A Huffman code

E	011	L	11111	Y	101001
T	001	D	11110	B	101000
A	1110	C	01011	V	000010
O	1101	U	01010	K	0000111
I	1100	M	00011	X	000011011
N	1011	F	00010	J	000011010
S	1001	P	00000	Q	000011001
R	1000	G	101011	Z	000011000
H	0100	W	101010		

Decoding 011

{ABCDEFGHIJKLMNOPQRSTUVWXYZ}

0 → so must be in {CEFHKMPQTUVXZ}

1 → so must be in {CEHU}

1 → so must be in {E}

Decoding 000011001

0000110 could mean any of {J, Q, X, Z}

0000110 0 could mean any of {J, X}

0000110 01 means {X}

Building a Huffman code

Find the two least likely letters (Z, Q)

They will have the longest code ...0 and ...1

Call this a 'letter' {Z, Q}

Find next two least likely letters (J, X), code as ...0 and ...1

Carrying on...

Next two happen to be {Z, Q} and {J, X}
Code these pairs of letters as ...0 and ...1

So:

- Z is ...00
- Q is ...01
- J is ...10
- X is ...11

And so on...

Fax machines



QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

...The point...

Theory of communication

Thing-**2**-thing

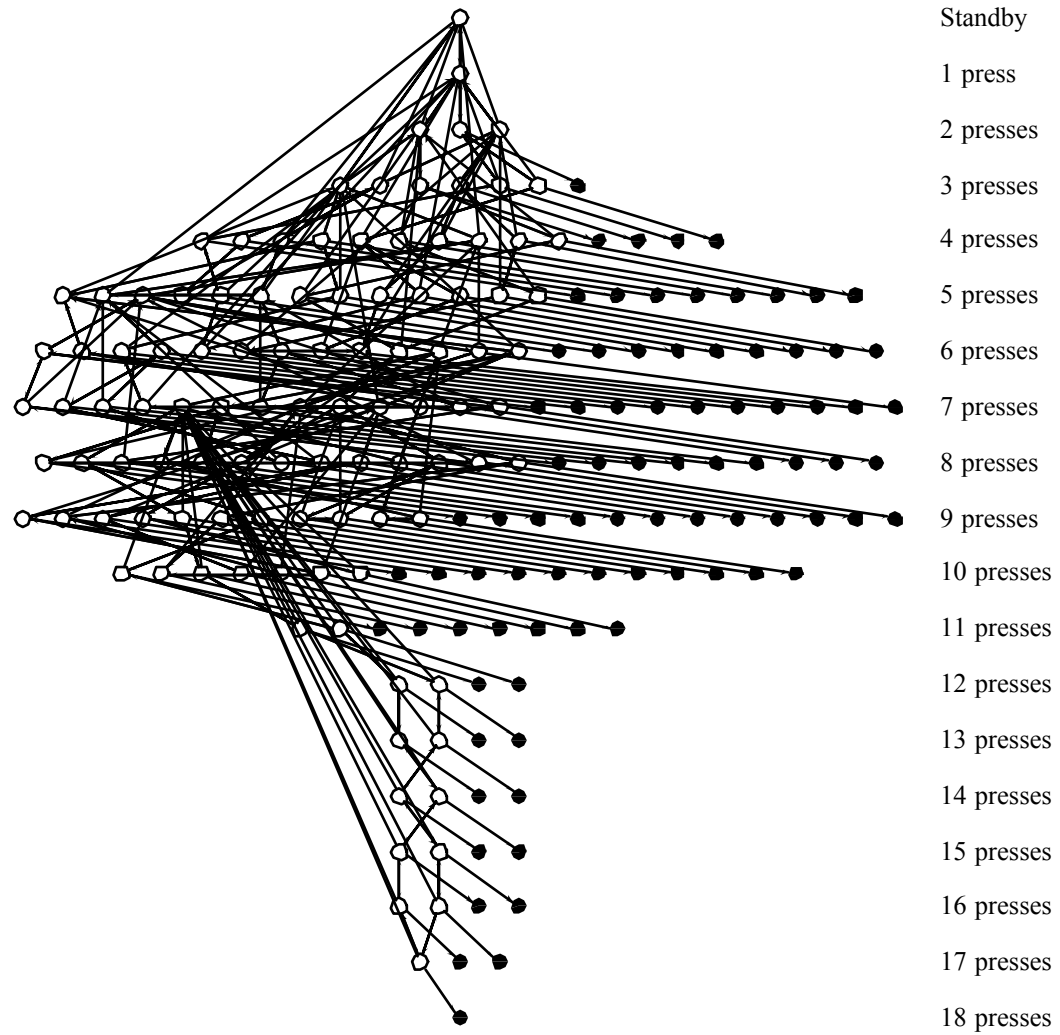
Could be humans to phones

Nokia 5110 function menu

Phone book, Navi-1,

- Search, Navi-1-1,
- Service nos, Navi-1-2,
- Add entry, Navi-1-3,
- Erase, Navi-1-4,
- Edit, Navi-1-5,
- Send entry, Navi-1-6,
- Options, Navi-1-7,
 - Type of view, Navi-1-7-1,
 - Memory status, Navi-1-7-2,
- Speed dials, Navi-1-8

Etc Etc Etc Etc Etc...



Function probabilities

Function	Presses	Rank	Assumed probability
Search	3	1	0.0613
Incoming call	4	2	0.0306
Inbox	4	2	0.0306
Speed dials	4	2	0.0306
Service nos	4	2	0.0306
...
Português	16	14	0.00438
Svenska	16	14	0.00438
Español	17	15	0.00408
Norsk	17	15	0.00408
Suomi	18	16	0.00383

Summary of results

Design	Best case	Worst case	Average
Original Nokia	3	18	7.15
Huffman, 3 key	3	5	4.04
Nokia shortcuts	2	5	3.39
Unallocated Huffman	2	4	3.09
10 digit Huffman	2	4	2.98
Shortest	2	3	2.69

Shared shortcuts menu

Phone book -1

- Search -1-1
- Service nos -1-2
- Add entry -1-3
- Erase -1-4
- Edit -1-5
- Send entry -1-6
- Options -1-7
 - Type of view -1-7-1 -6-9
 - Memory status -1-7-2 -7-0
- Speed dials -1-8

What about:

- Binary search?
- Hashing?

Binary alphabetic comparisons

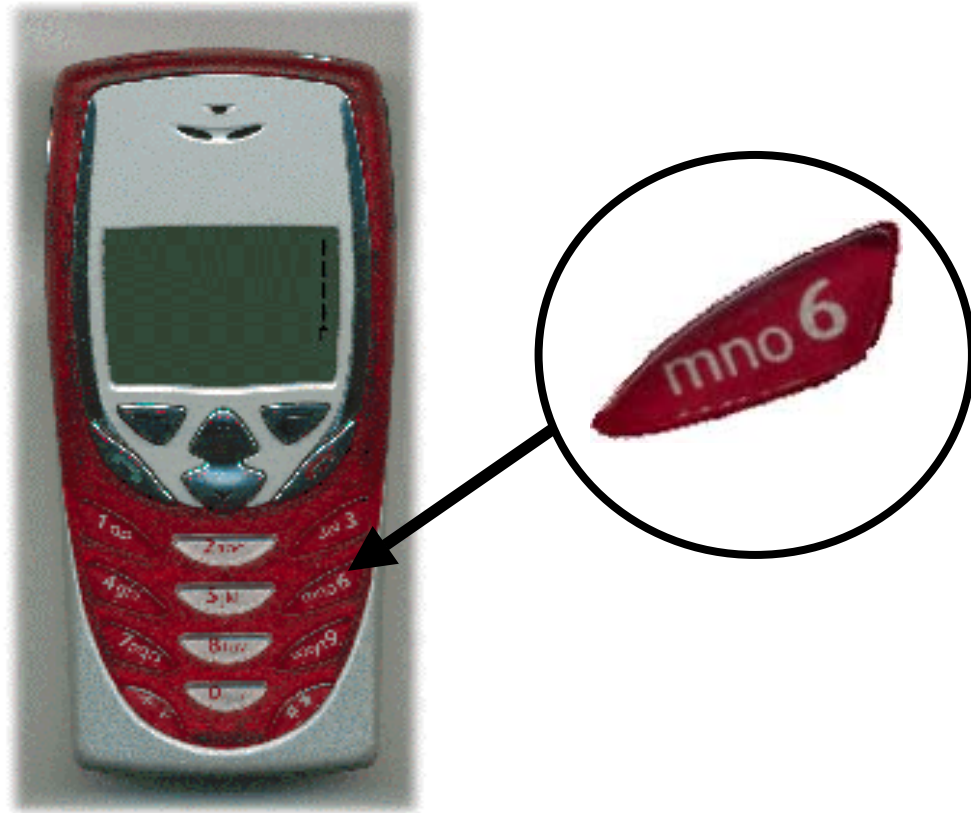
Original Nokia

- Full search 110
- Average search 8.2

Binary alphabetic

- Full search 74
- Average search 5.4

Hashed Nokia



[2] [2] [3]

AAD, AAE, AAF, ABD, ABE, ABF,
ACD, **ACE**, ACF, **BAD**, BAE, BAF,
BBD, BBE, BBF, BCD, BCE, BCF,
CAD, CAE, CAF, CBD, CBE, CBF,
CCD, CCE *or* CCF

[2] = A B C

[3] = D E F

Demo

...demo...

Design comparisons

Confused by having to enter the Nokia menu

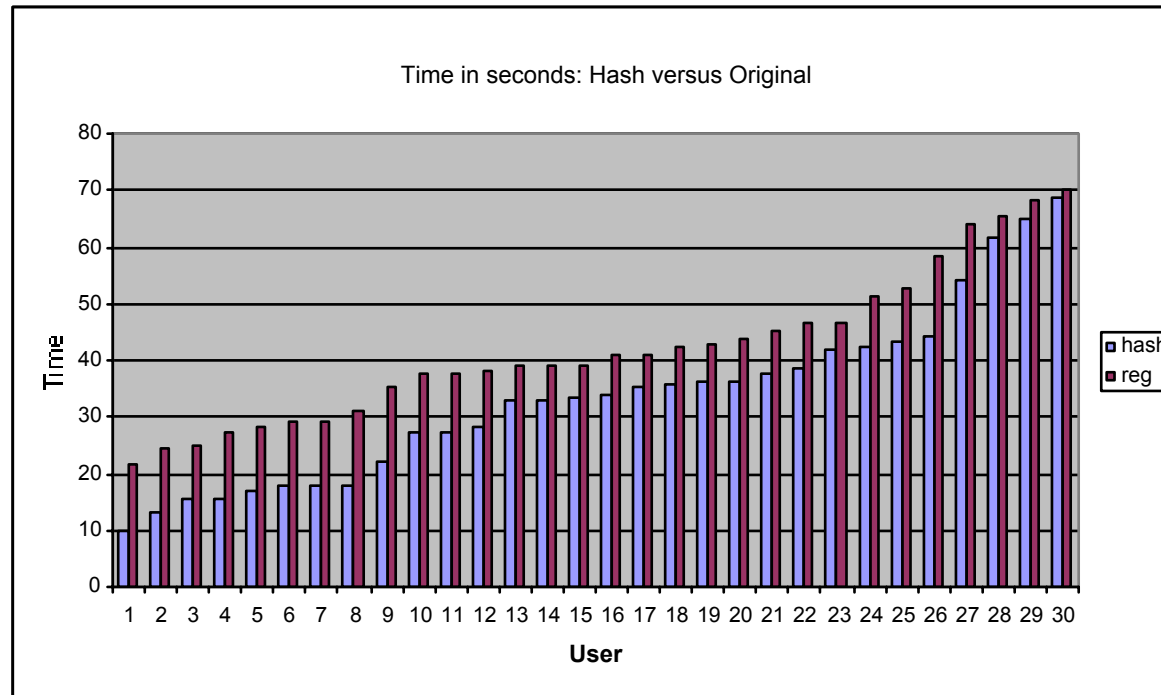
- Quite often users start to scroll without pressing Navi — frustrated when they did not see menu options
- The **modeless** new design avoids these Nokia problems

Concessions to Nokia

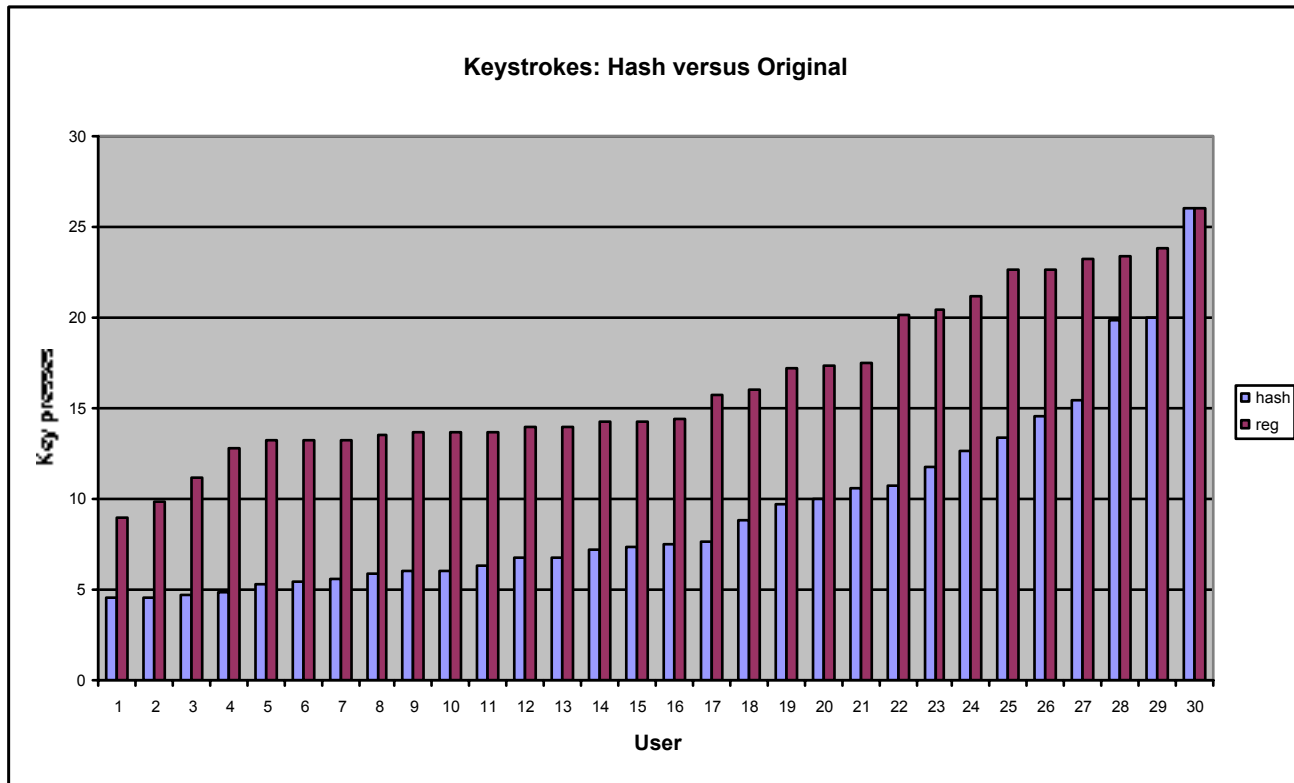
Eliminated data from users
who were stuck on the Nokia

Could have renamed the Nokia functions
to favour new approach

Experiments: time



Experiments: keystrokes



User opinions 1

Almost every subject preferred new design

- “I was able to see all the items in the list — nothing was hidden.”

Frustrated with standard design

- could not memorize, or visualize, menu
- some caught in menu cycles

User opinions 2

Scrolling was popular

- a “safer” way to find the function needed
- some users sacrificed speed to improve likelihood of finding the functions
- this method of accessing functions is not possible on most current mobiles

Computer Science



Easier



Quicker



Preferred

Take home points

Mobile phones are suboptimal!

Good computer science is for people too!

Next lecture...



Coming next...

bring
your
own
along

