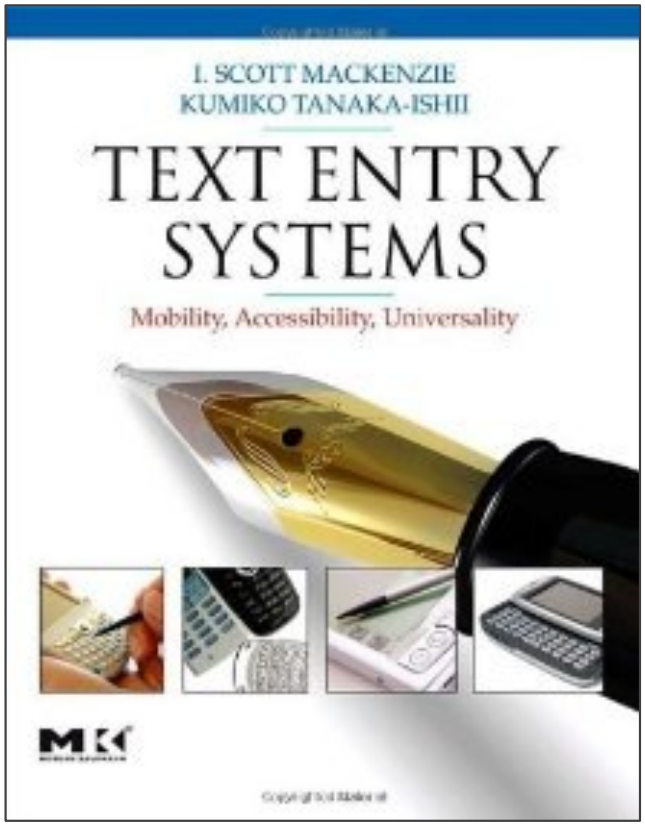
Text Entry

Gilles Bailly

TELECOM ParisTech

cnrs advancing the frontiers



→Scott MacKenzie

Text Entry (on Mobile Devices)

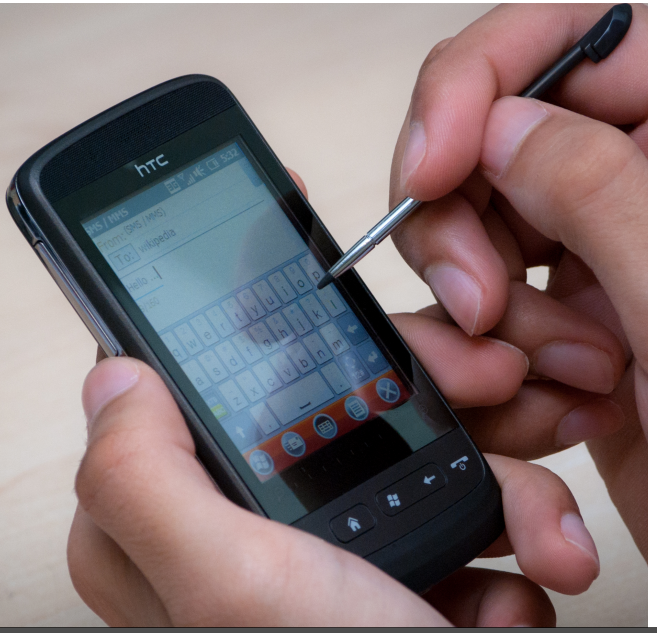
Mobile text entry

- SMS (>**1 billion** SMS messages sent each day)
- Email, calendars, etc.

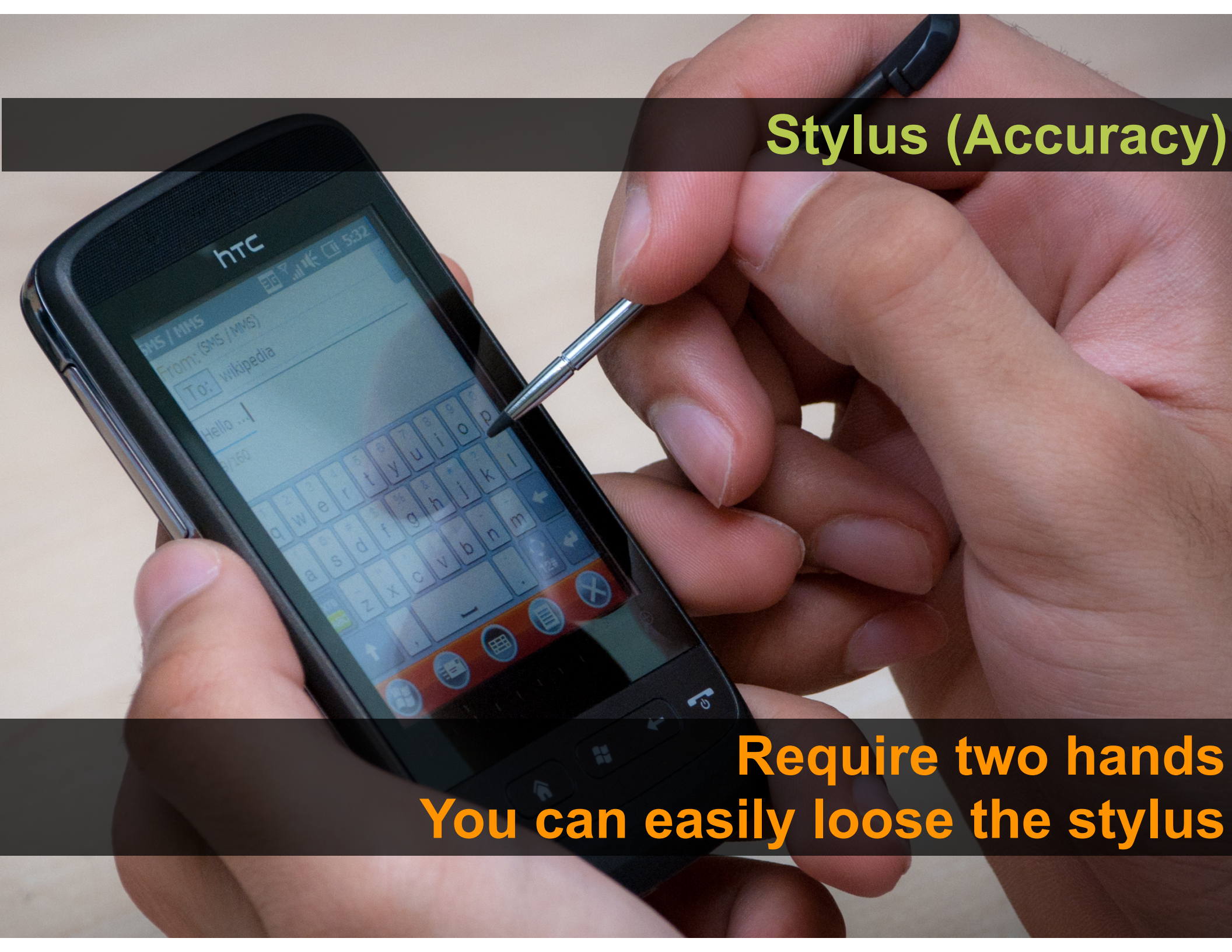
Companies are **ambitiously** searching for **improvements**

Pros & cons

Commercial Products



Brainstorming (30s)
Pro & con



Stylus (Accuracy)

Require two hands

You can easily loose the stylus

Haptic Feedback
Relative “large” keys
One-Handed interaction

Ambiguous
(1key => several characters)
Novice users?

Haptic Feedback
Unambiguous
(1 key => 1 character)

Small keys

Magnifier
(occlusion)
Flexibility

No Haptic feedback

Size of keys
Two-Handed Interaction

Small content area

What to measure?

Discoverable: users figure it out (without a tutorial?)

Efficient: allows performing tasks quickly

Robust: minimal error rates; help users recover

Pleasing/fun: high user satisfaction

–<others>

Speed & **Accuracy**

- Movement minimization
- Low attention demand
- Low cognitive demand

How to measure?

Usability **does not mean** you always have to design for **novices** (but know who you design for)

How to measure?

WPM: **W**ord **P**er **M**inute

Desktop touch typing: **60+ wpm**

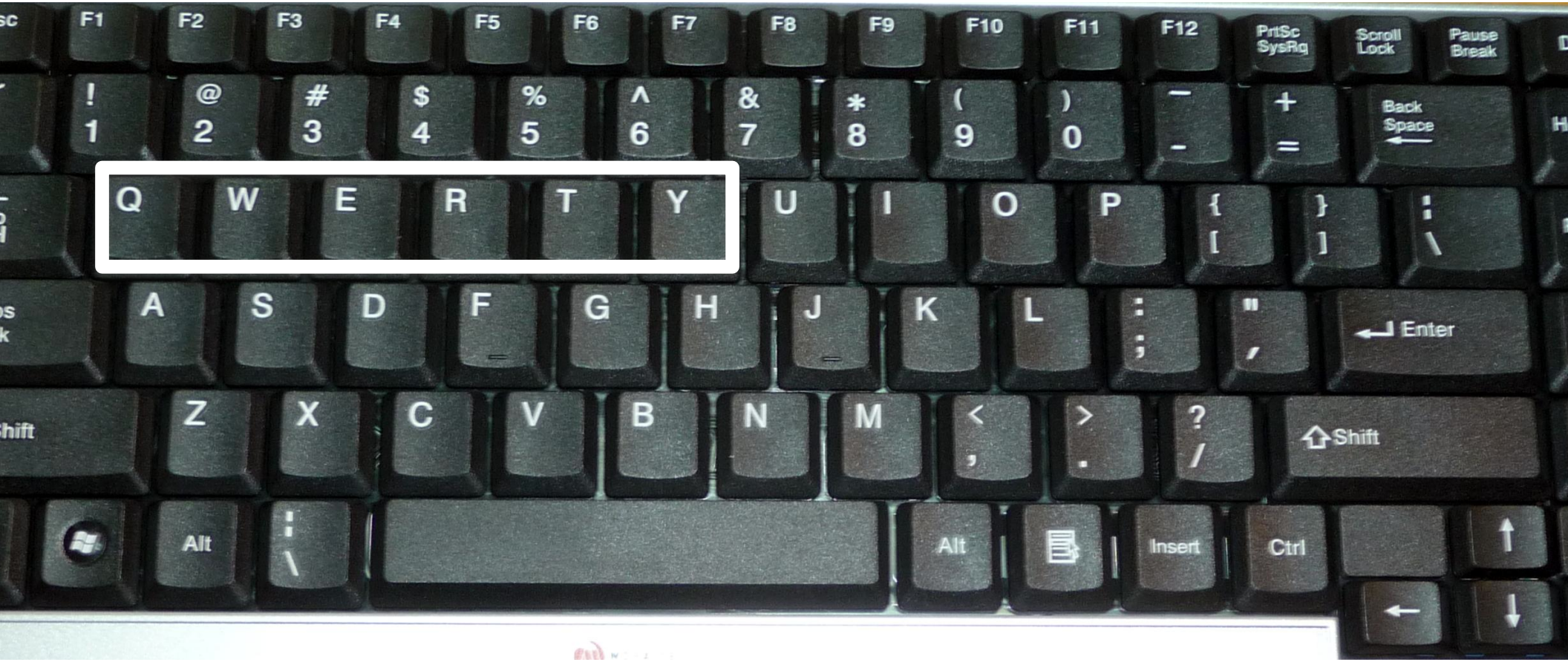
Soft keyboards:

- 40+ wpm after lots of practice,
- typically 18-28 wpm for qwerty,
- 5-7 wpm for unfamiliar layout

Handwriting speeds: **13-22 wpm**

Keyboard Layout

What is the name of this layout?



Good or Bad?

Why?

Prevent Clash and Jam

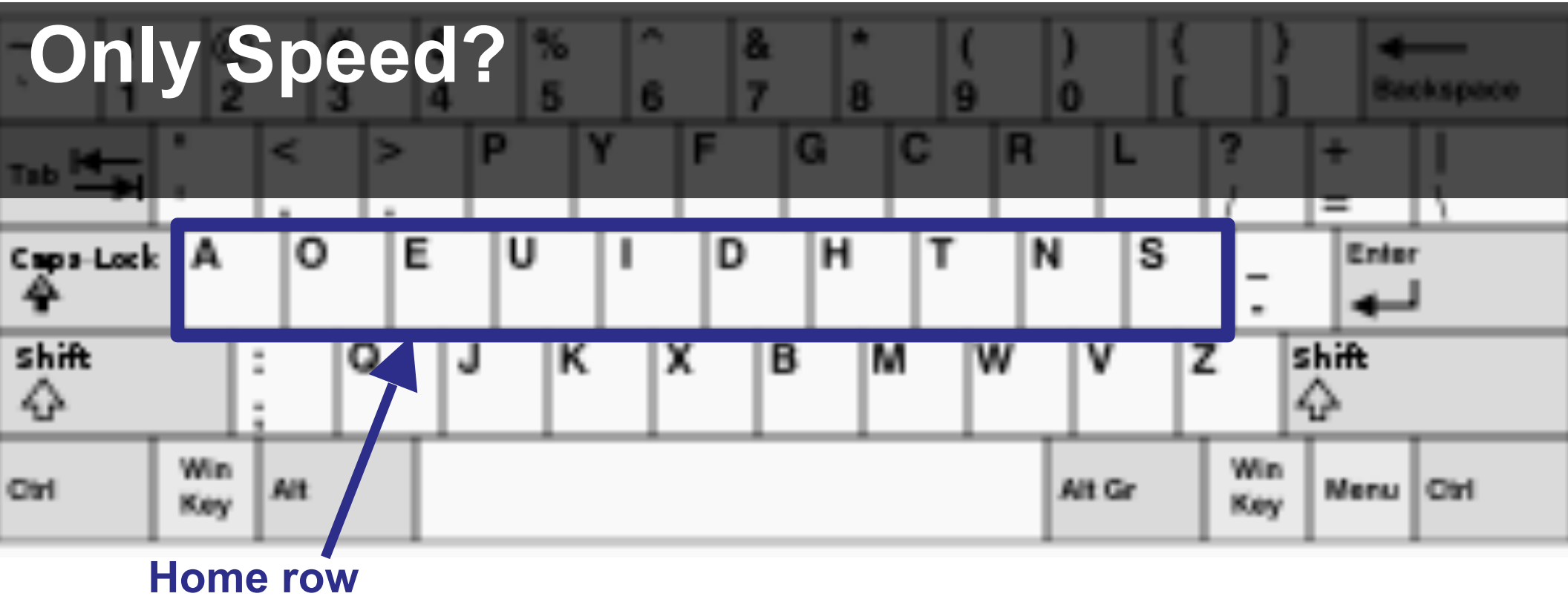
«Le système Qwerty est né de l'usage que l'on faisait des machines à écrire. Parmi les premiers utilisateurs on comptait des télégraphistes qui avaient besoin de transmettre rapidement des messages. Cependant, les ***télégraphistes*** *trouvaient que l'alignement alphabétique était confus et inefficace pour traduire des messages en* ***morse****.»*

Dvorak Keyboard

Speed typing by

- Maximizing home row (where fingers rest)
- Alternate hand typing

Most frequent letters and digraphs easiest to type



Dvorak Keyboard

Increase Speed and… Comfort

- reduce repetitive strain injuries
- carpal tunnel syndrome

Many common letter combinations

-require **awkward** finger motions.

-are typed with the **same** finger.

-require a finger to **jump** over the home row.

-are typed with **one hand** while the other sits idle.

Most typing is done with the left hand, which for most people is the weaker hand.

Many common letter combinations are typed by adjacent fingers, which is slower than using other fingers.

About 30% of typing is done on the lower row, which is the slowest and most difficult row to reach.

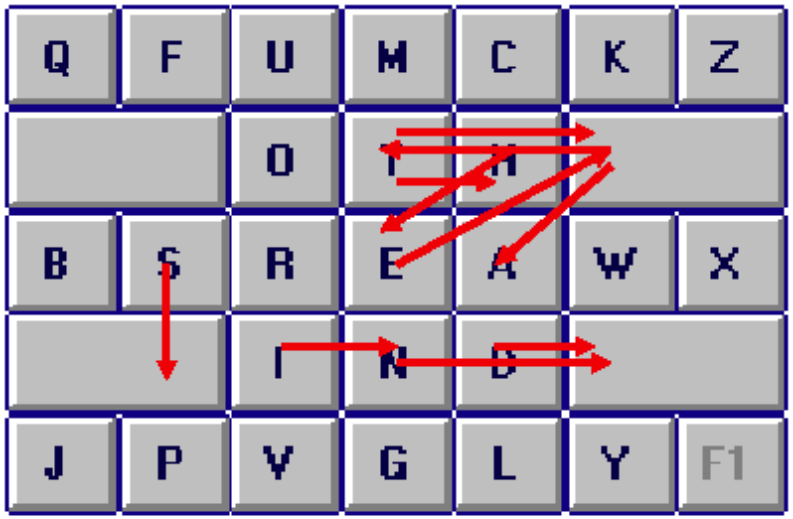
About 52% of keyboard strokes are done in the top row, requiring the fingers to travel away from the home row most of the time

Fitaly and Opti Keyboards

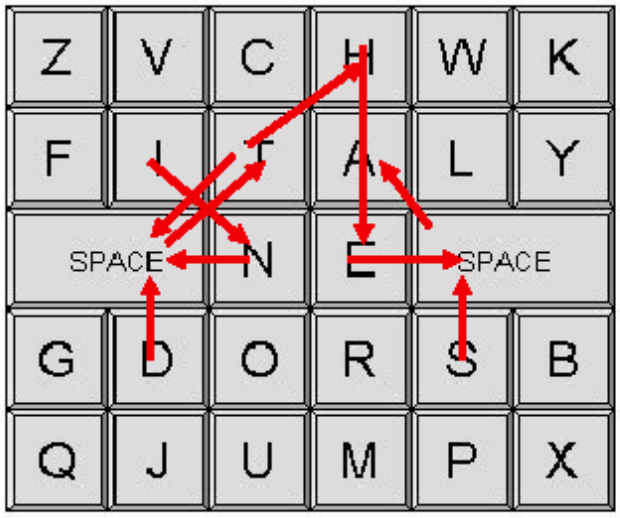
Frequent digrams

Top 10

Digram	Frequency
e_	14788053
_t	11565380
th	10301807
he	9436372
_a	8454634
s_	8359914
n_	6419069
t_	6336756
d_	6235838
in	5534329
...	...
uz	626
zl	626
mh	613
lh	584
cn	567
oq	547
aa	546
xq	543
wm	540
ij	536



Opti



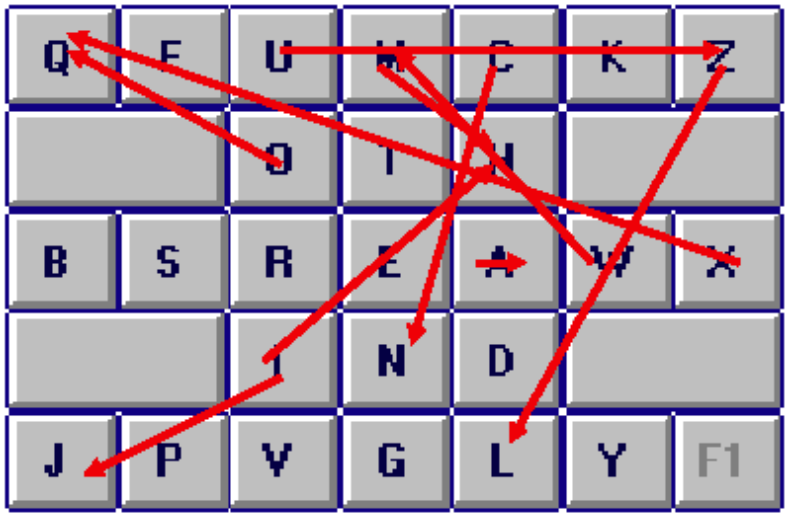
Fitaly

Fitaly and Opti Keyboards

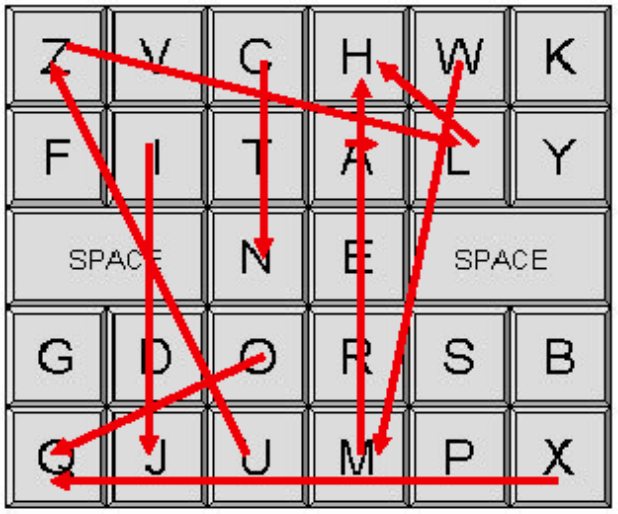
unfrequent digrams

Digram	Frequency
e_	14788053
_t	11565380
th	10301807
he	9436372
_a	8454634
s_	8359914
n_	6419069
t_	6336756
d_	6235838
in	5534329
...	...
uz	626
zl	626
mh	613
lh	584
cn	567
oq	547
aa	546
xq	543
wm	540
ij	536

Bottom 10

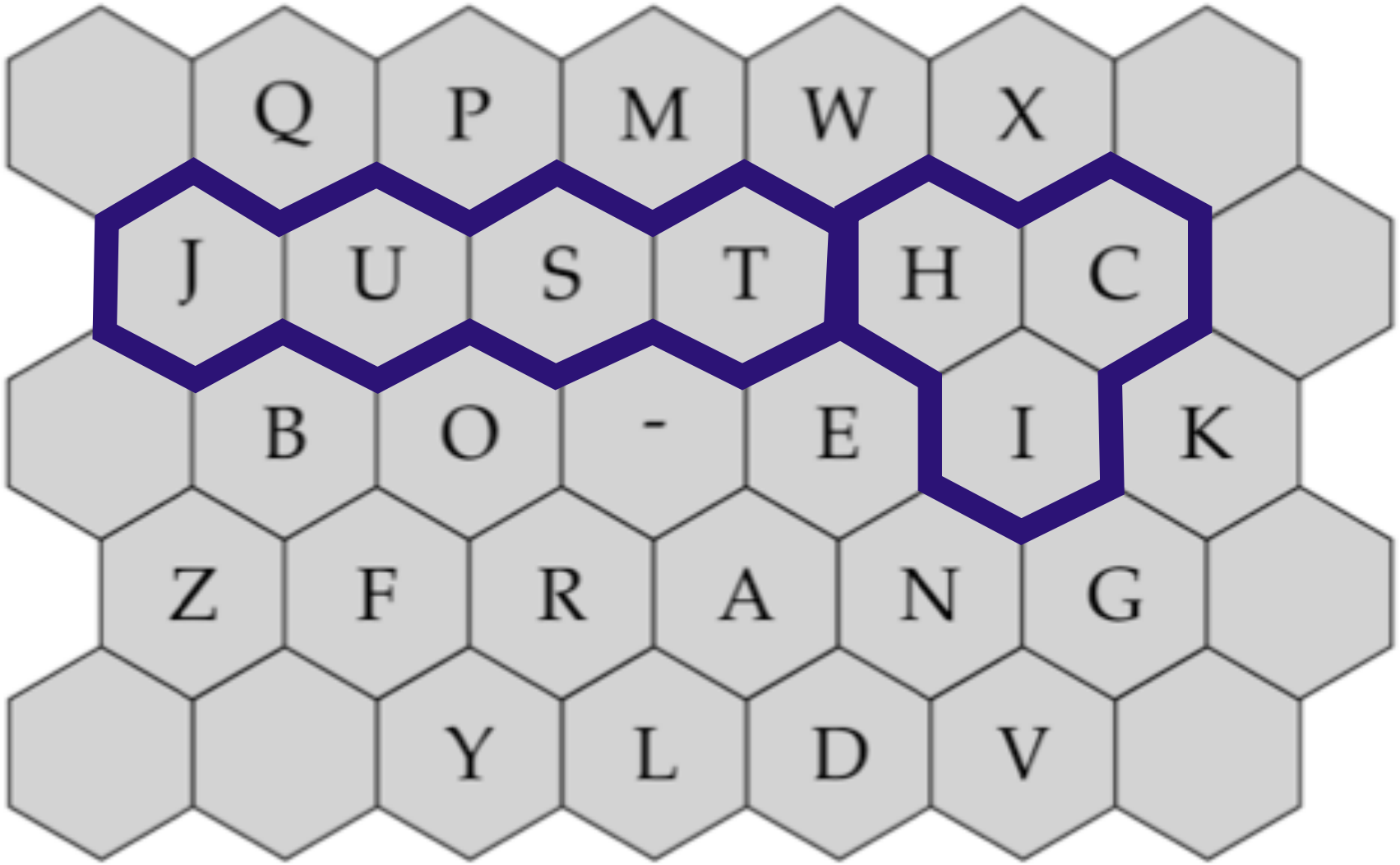


Opti



Fitaly


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

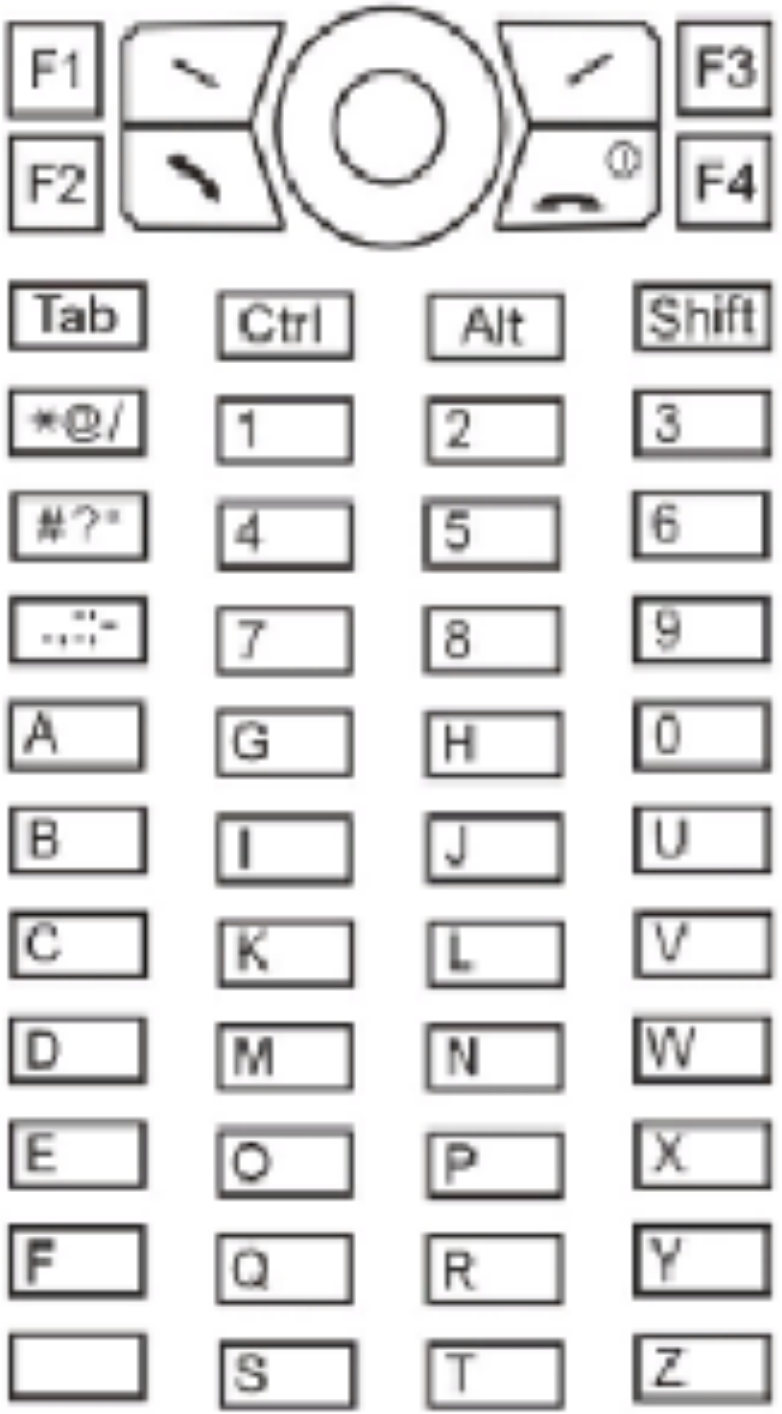

Q P M W X
J U S T H C
B O - E I K
Z F R A N G
Y L D V

ABC Keyboards

Familiar arrangement

Non-qwerty shape

a	b	c	d	e	f
g	h	i	j	k	l
m	n	o	p	q	r
s	t	u	v	w	x
z	y	space			



Number of keys & Ambiguity

1 key => 1 character (27 + 1 keys)

How many keys?
Which mapping?

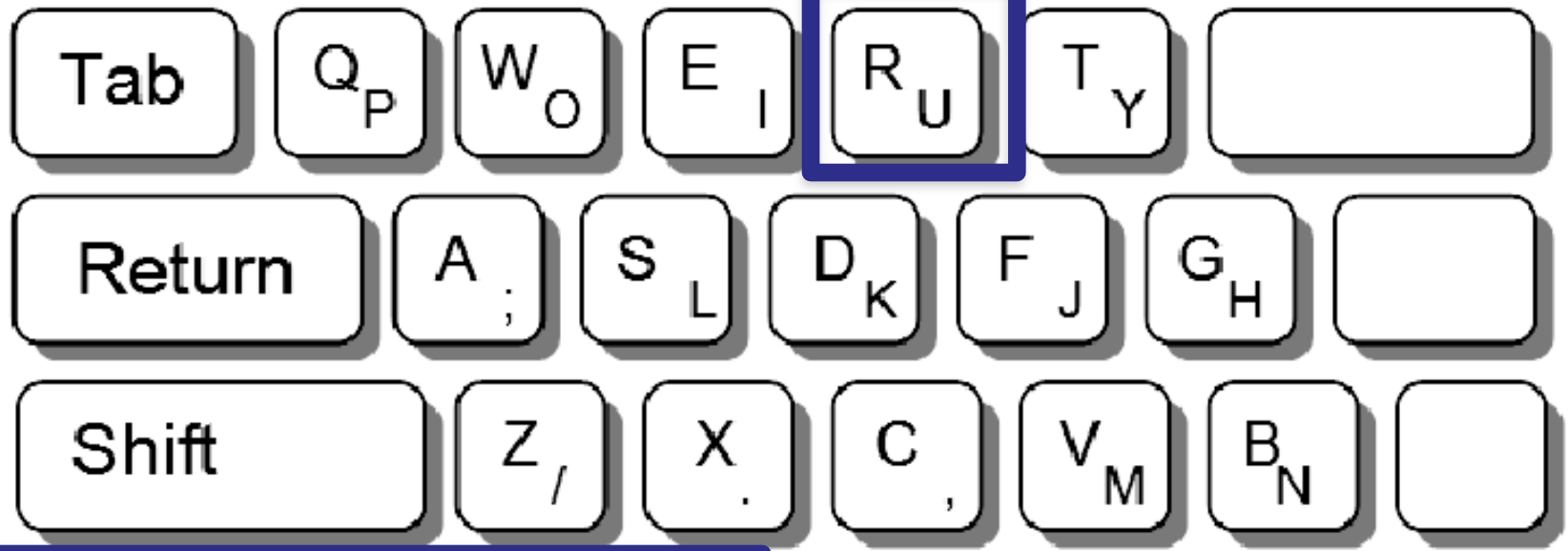
Half-Qwerty

One-handed operation

Reduce repetitive strain injuries

Ambiguous keyboards

One key, many characters



Disambiguation

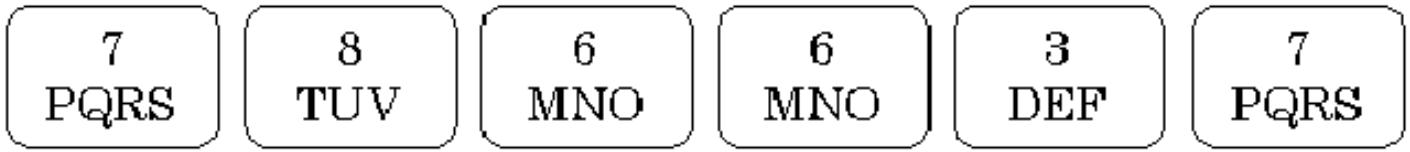
1 key => ~2 characters (16 + 1 keys)

Mobile phone

Nokia N73

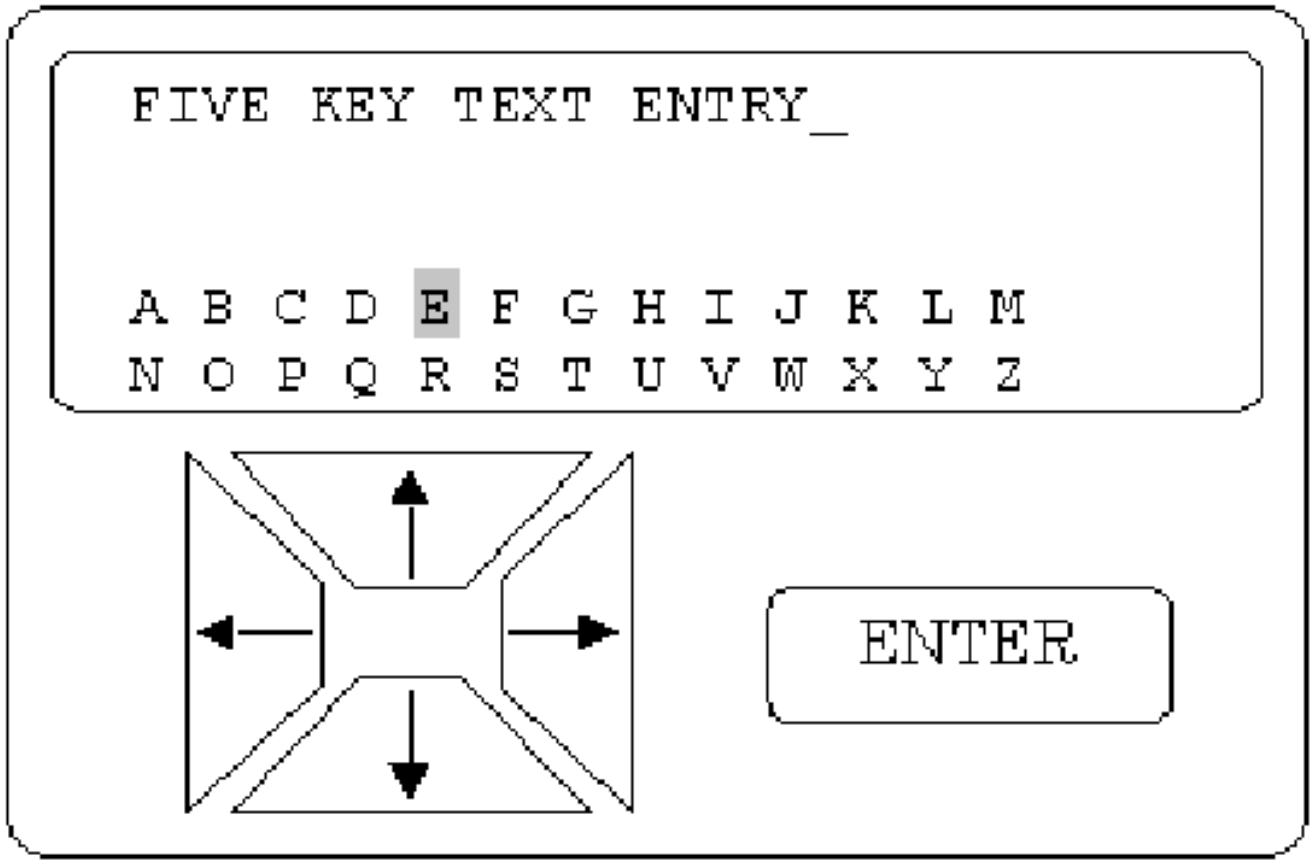
1 key => ~3 characters (10 + 1 keys)

Disambiguation by Multitap



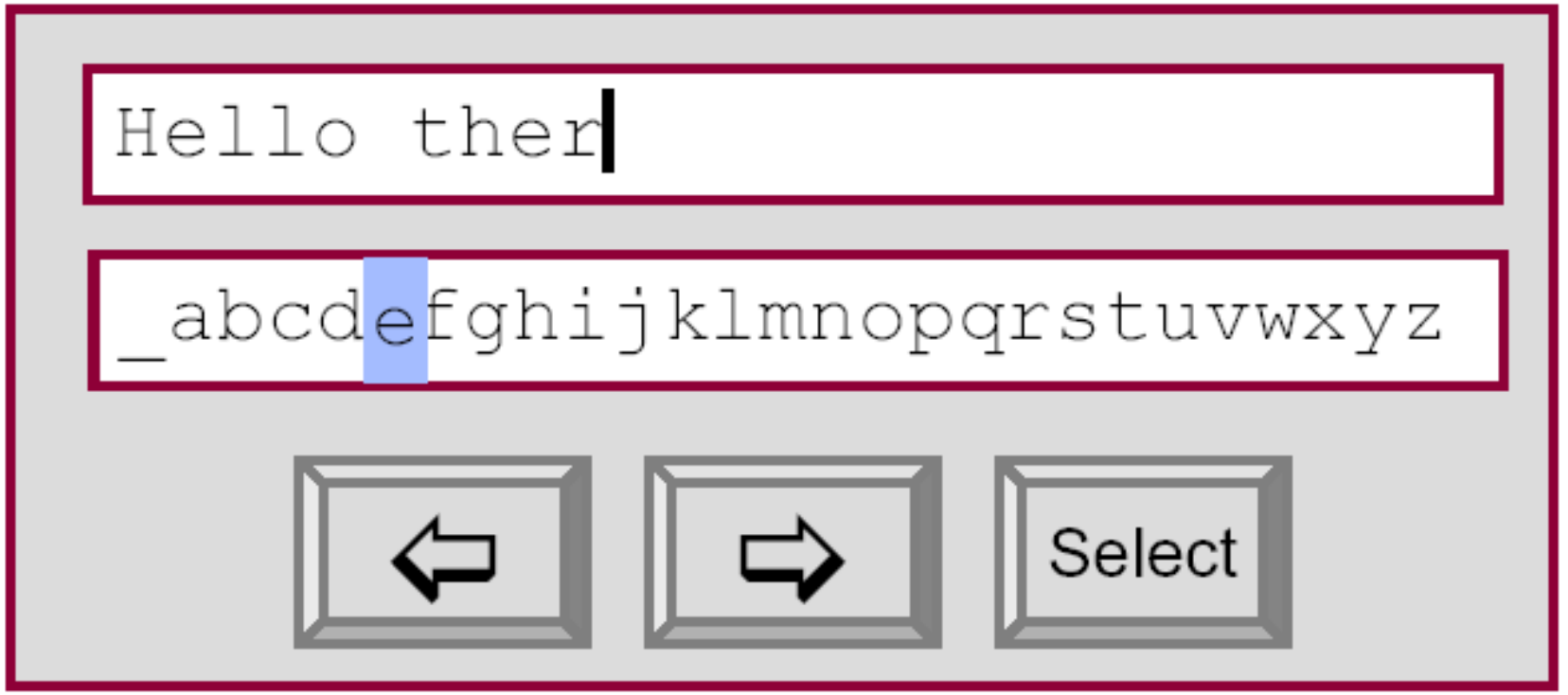

```
RUNNER = 7778866n6633777
         R U N  N E  R
```

Pager / Game controller



4 + 1 keys

Watch



2 + 1 keys

Intuition

We **decrease** the number of keys …

Can we improve that?

… we **increase** the number of actions for selecting one character

2 Observations

All characters do no have the same **frequency**

All character combinations are **not possible**

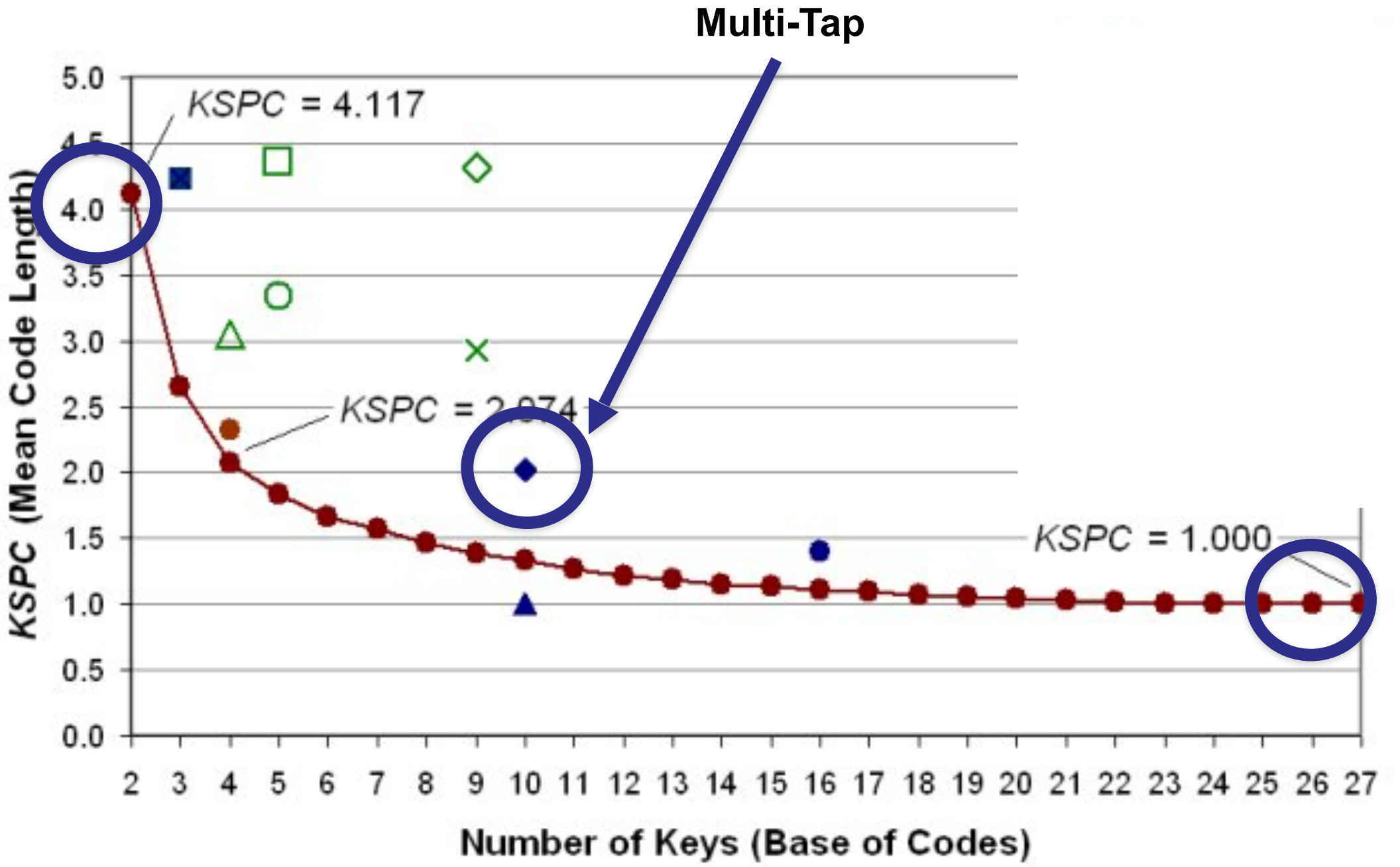
Symbol	Frequency	Huffman Code
[space]	67962112	111
e	37907119	010
t	28691274	1101
a	24373121	1011
o	23215532	1001
i	21820970	1000
n	21402466	0111

4 bits

In-Frequent symbols get **longer** codes

j	474021	1100001011
q	297237	11000010101
z	93172	11000010100

11 bits

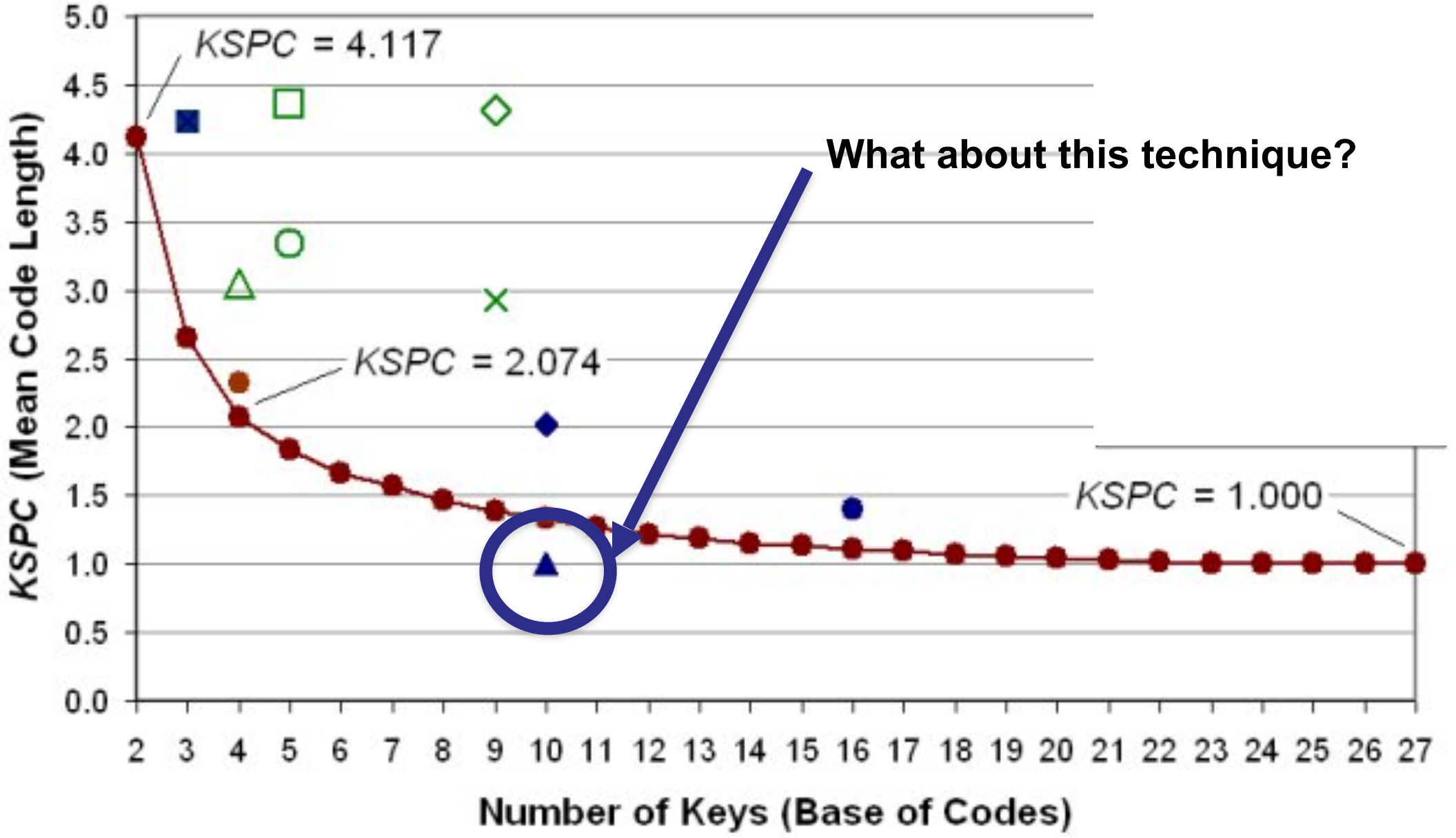

Multi-Tap
KSPC = 4.117
KSPC = 2.074
KSPC = 1.000
KSPC (Mean Code Length)
5.0
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Number of Keys (Base of Codes)

Symbol	Frequency	Huffman Code
[space]	67962112	111
e	37907119	010
t	28691274	1101
a	24373121	1011
o	23215532	1001
i	21820970	1000
n	21402466	0111

E: 2 key press
O: 3 key press
I: 3 key press

j	474021	1100001011
q	297237	11000010101
z	93172	11000010100

j: 1 key press


KSPC = 4.117
KSPC = 2.074
KSPC = 1.000
What about this technique?
KSPC (Mean Code Length)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
Number of Keys (Base of Codes)

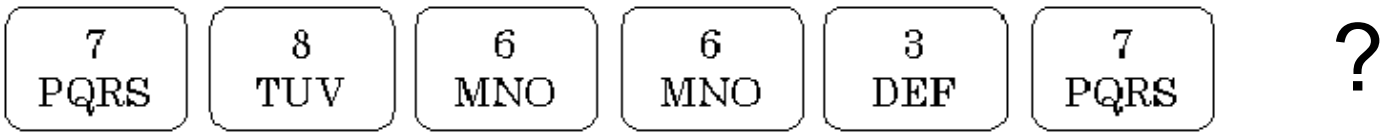
2 Observations

All characters do no have the same **frequency**

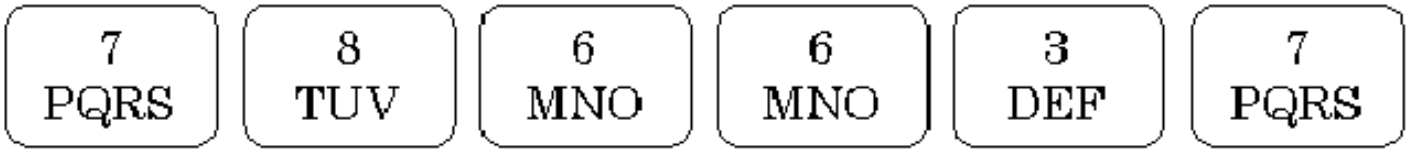
All character combinations are **not possible**

Disambiguation

Dictionary-Based Disambiguation



Dictionary-Based Disambiguation (T9)




```
RUNNER = 786637nn
         RUNNE  R

SUMMER = 786637
         SUMMER

STONES = 786637n
         STONE S
```

Some Limitations:

- The word is not in the dictionary
- Several alternatives for the same sequence

MultiModal text INput

TiltText (UIST 03)

TiltType

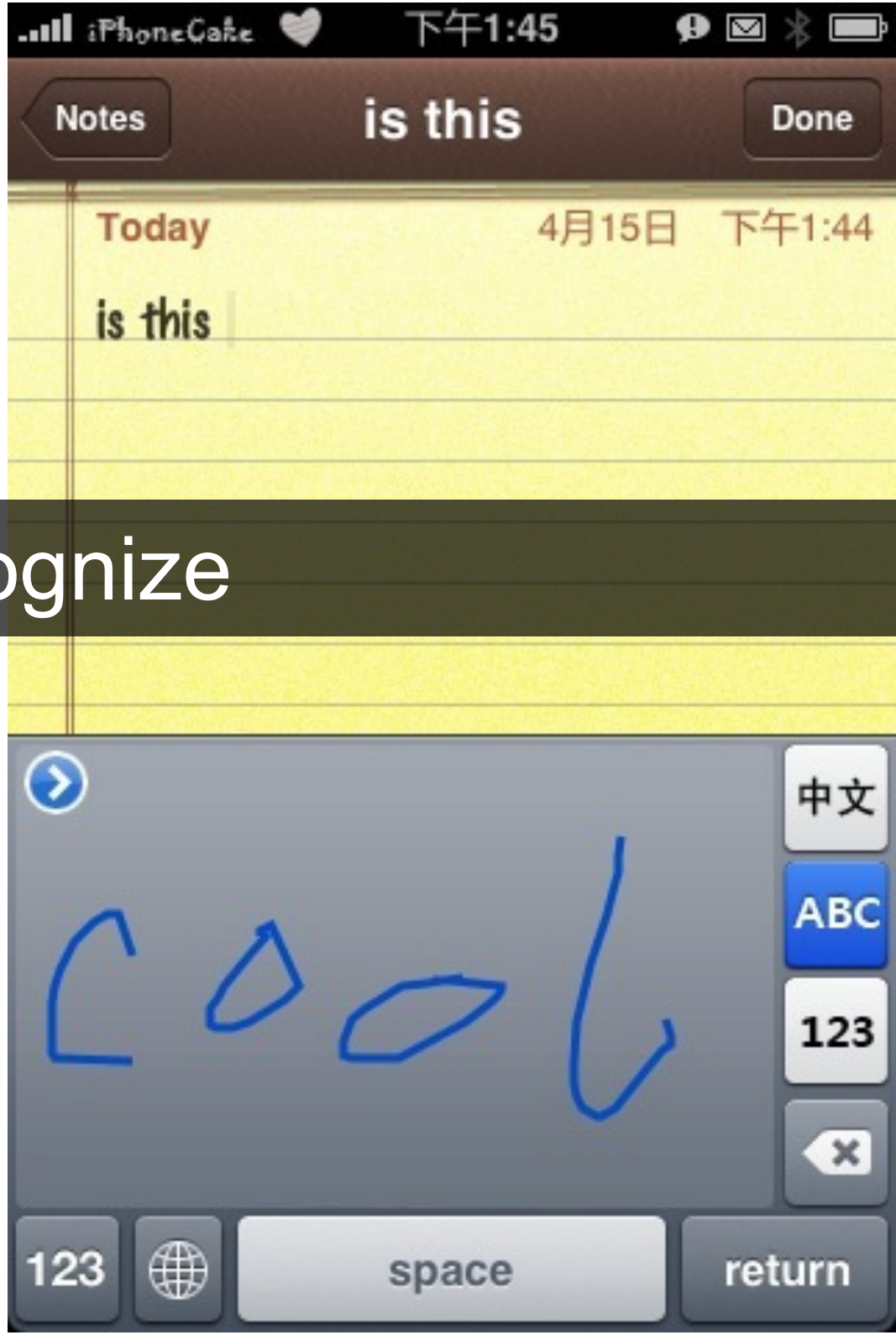
Press and hold button while tilting the device

portolano.cs.washington.edu/projects/tilttype

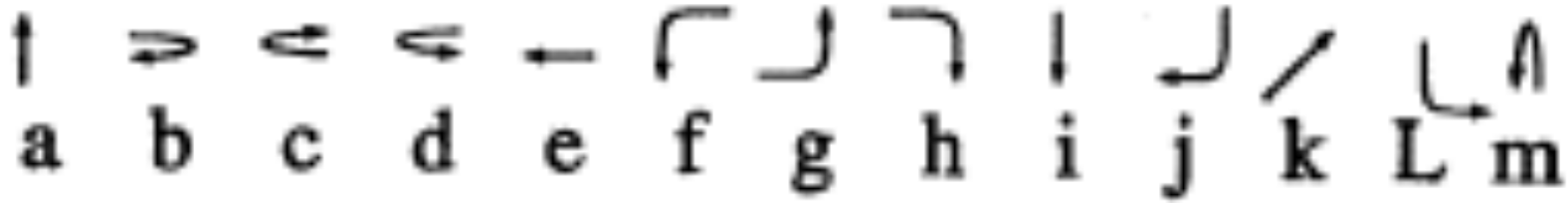
Gesture &
Text input

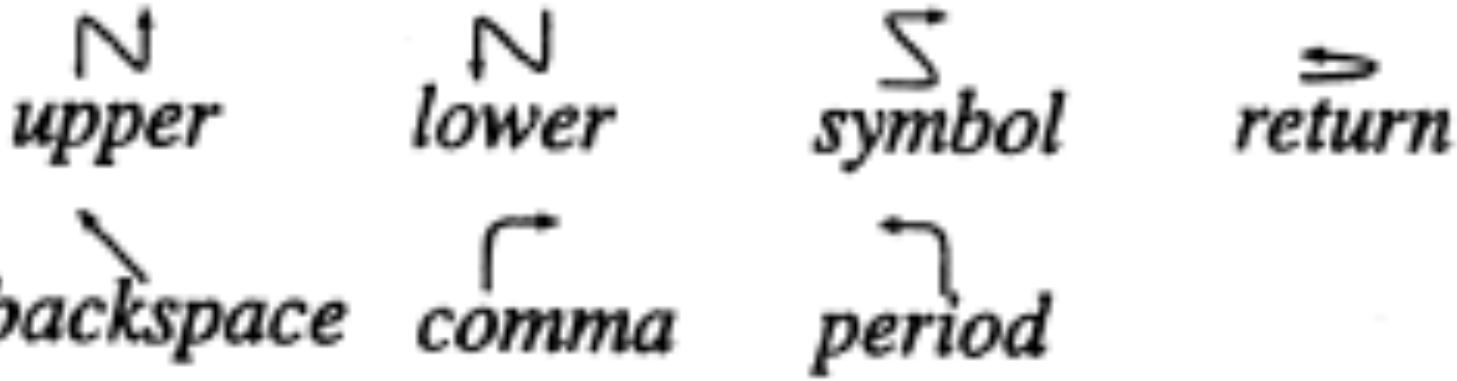
Hand writing Recognition

Can be difficult to recognize

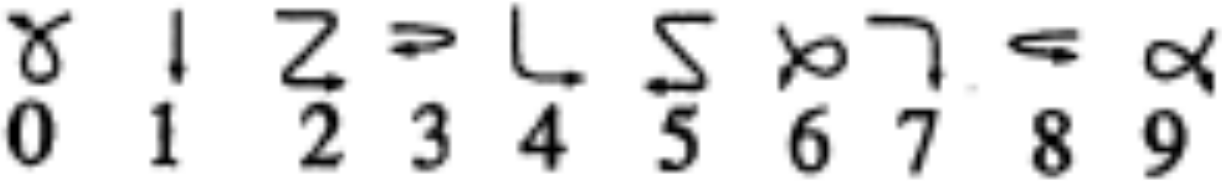


Unistroke



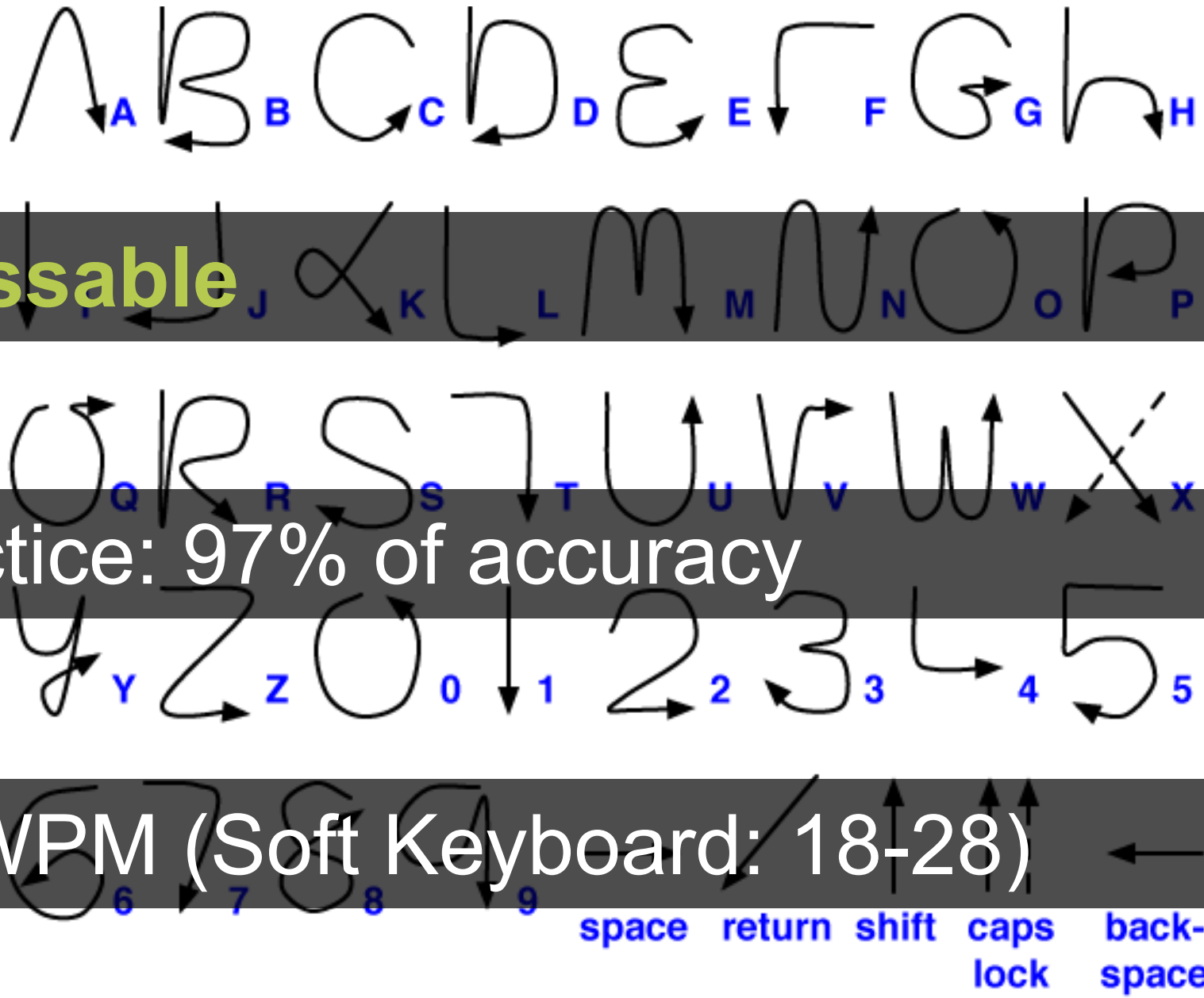


in symbol mode, the numbers are as follows:



[Goldberg]

Graphiti

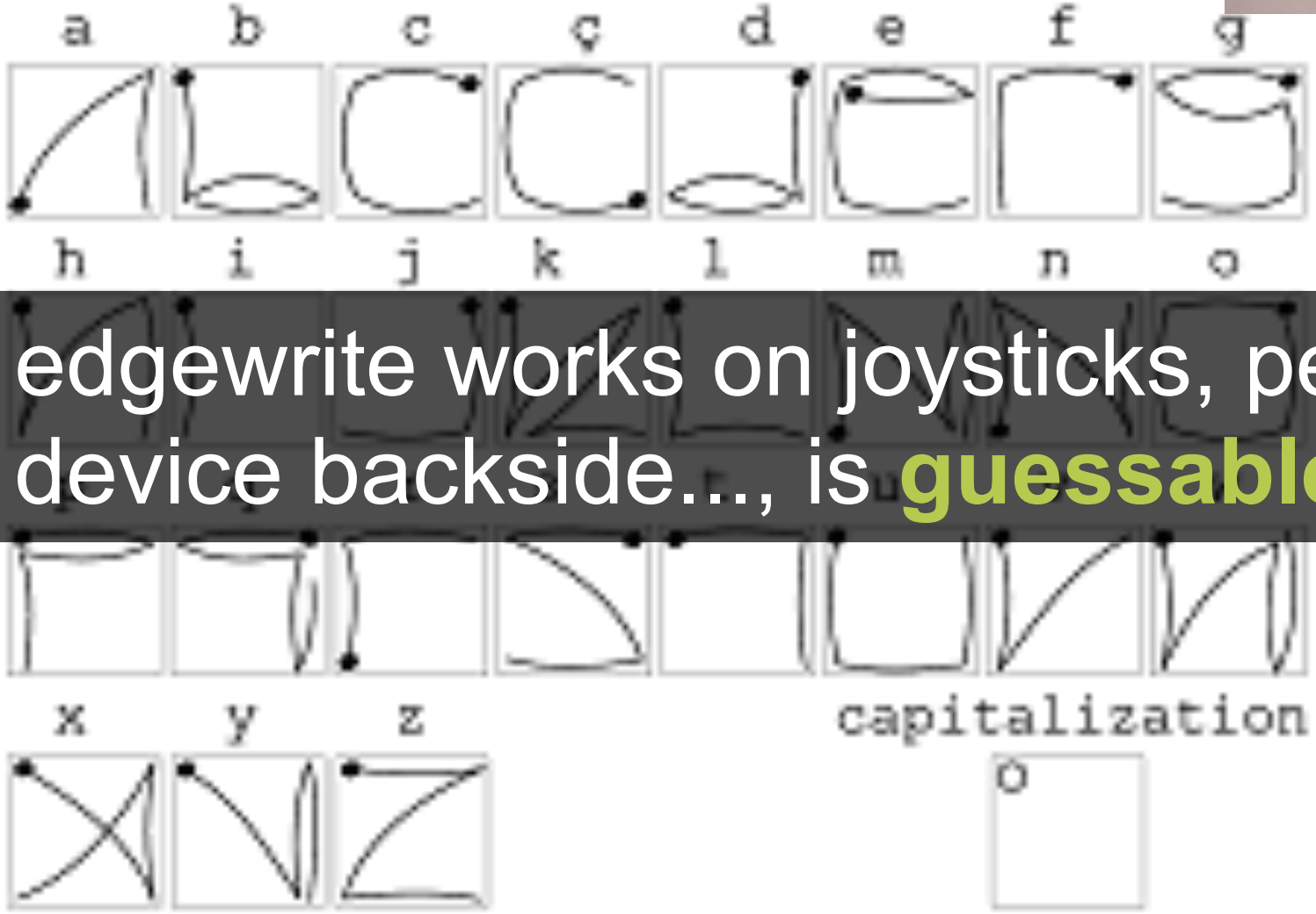


more **guessable**

5 min practice: 97% of accuracy

Slow:15 WPM (Soft Keyboard: 18-28)

EdgeWrite



edgewrite works on joysticks, pen, touch, device backside..., is **guessable**

[wobbrock]

EdgeWrite

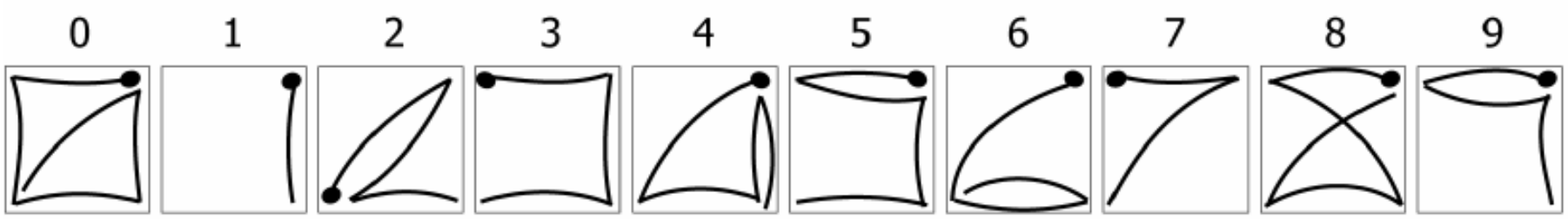
Physical constraints

Moving stylus along **edges** and diagonals of square input area

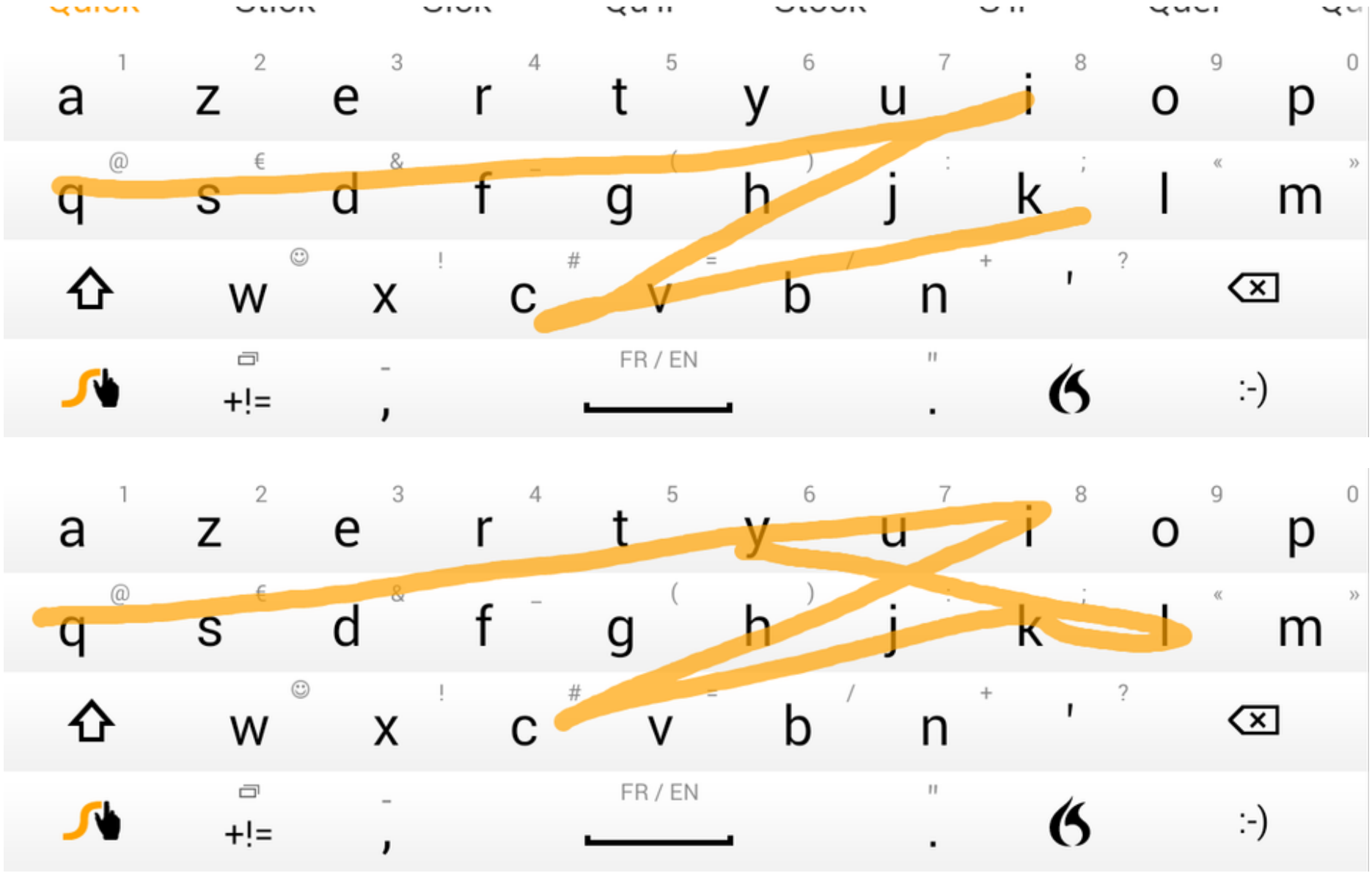
People with **motor impairments**

Input = Sequence of visited corners

Example: Digits



Wobbrock, Myers, Kembel: *EdgeWrite: a stylus-based text entry method designed for high accuracy and stability of motion*. UIST'03. http://depts.washington.edu/ewrite/


1 2 3 4 5 6 7 8 9 0
a z e r t y u i o p
@ € & _ ( ) : ; « »
q s d f g h j k l m
! # = / + ?
w x c v b n '
FR / EN
+!=
,
.
:-)
1 2 3 4 5 6 7 8 9 0
a z e r t y u i o p
@ € & _ ( ) : ; « »
q s d f g h j k l m
! # = / + ?
w x c v b n '
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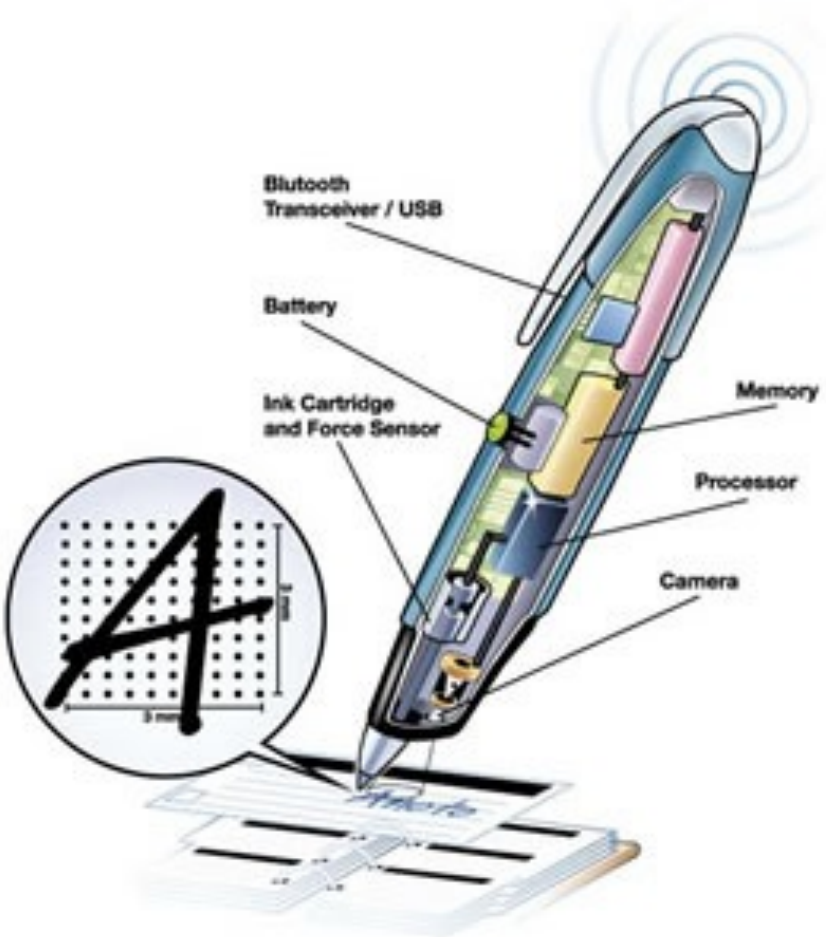
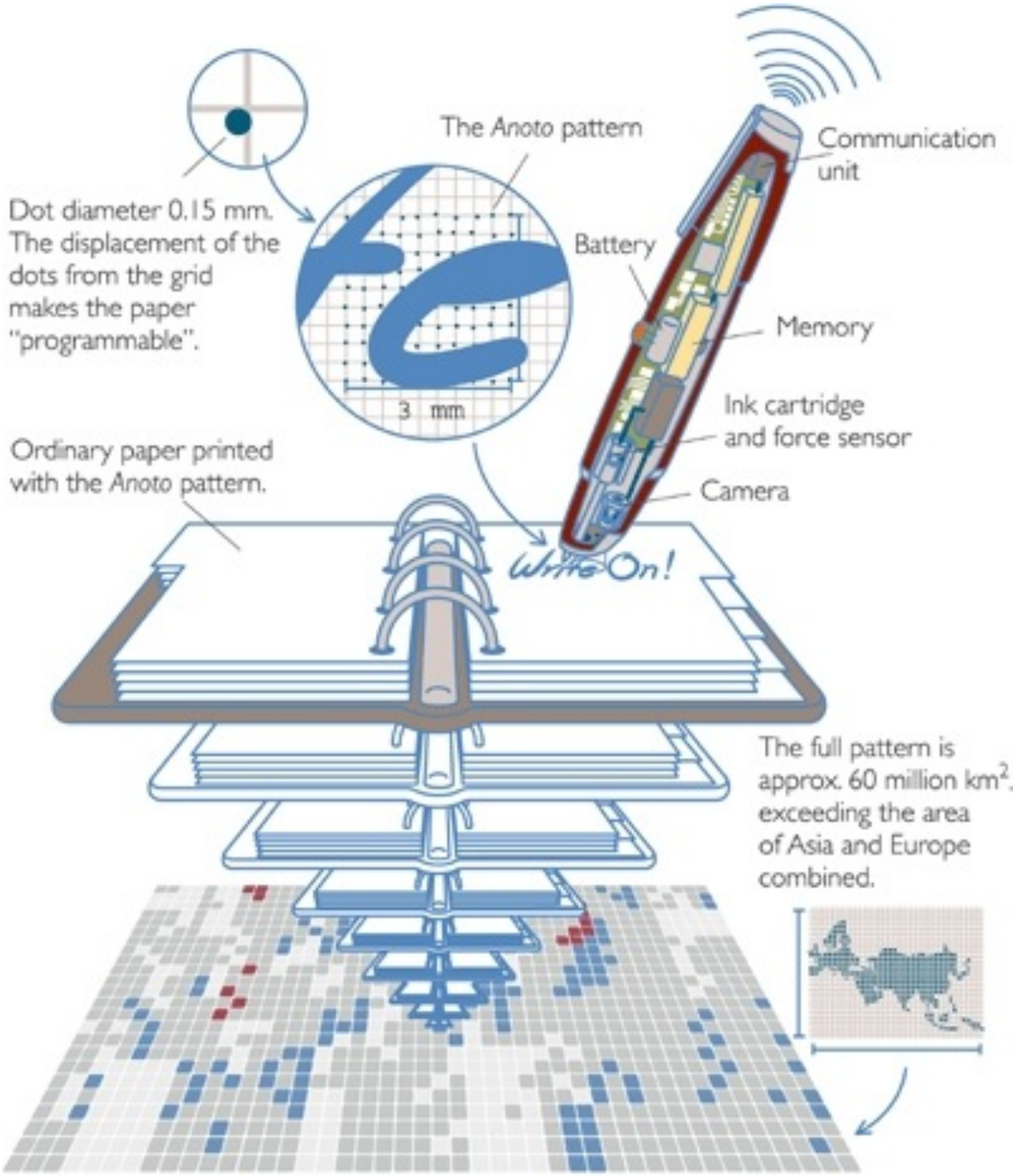
,
.
:-)

Anoto

Anoto


Blutooth
Transceiver / USB
Battery
Ink Cartridge
and Force Sensor
Memory
Processor
Camera


Dot diameter 0.15 mm.
The displacement of the
dots from the grid
makes the paper
"programmable".
The Anoto pattern
3 mm
Communication
unit
Battery
Memory
Ink cartridge
and force sensor
Camera
Ordinary paper printed
with the Anoto pattern.
Write On!
The full pattern is
approx. 60 million km²,
exceeding the area
of Asia and Europe
combined.

undo

Synchronize

Interactive Paper

Digital pen ~~technologies~~ bridge the paper-digital divide by enabling user actions on paper to be tracked. Handwritten notes and sketches can be digitally captured.
Active areas on paper can be defined that link to digital content and services and users activate them by simply ~~touching~~ selecting them with the pen. Possibilities abound for publishing new forms of interactive documents and providing paper-based interfaces to applications.
We have developed a platform and range of tools to support the rapid prototyping and production of all kinds of interactive paper applications.

iPaper

iPaper is a framework that supports the rapid development and deployment of interactive paper applications. Active areas can be defined on paper and linked to various forms of digital media and services. By providing an extensive library of active components, users can rapidly develop a wide range of applications without having to do any programming. iPaper was developed as a component of iServer, a general cross-media server, which means that active areas can be linked to and from a wide range of physical and digital media including web pages, images, video, flash animations, databases and RFID tags as well as application programs.

iGesture

iGesture is a general and extensible framework to support the development and deployment of gesture recognition algorithms. The API makes it simple for application developers to define their own gesture-based interfaces. It is device independent and can be used with a mouse, tablet or


livescribe