INTERACTION DESIGN. SESSION 2

Dept. Computer Science – UPC

OUTLINE

Session 1:

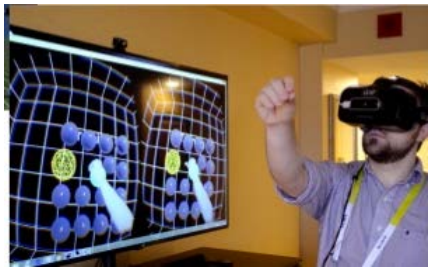
- *Understanding the fundamentals of basic interaction in UI*
  - *Background (Information Theory)*
  - *Hick-Hyman Law: Measuring Choice-Reaction Time*
  - *Fitts' Law: Measuring Pointing Time*
  - *Crossing and Steering Laws: Continuous Gestures*
- *Fitts' Law in UI Design*
  - *Applications in UI Design*
  - *Accelerating Target Acquisition*
- *Exercises*

Session 2:

- Pointing Devices
- Typing & Keyboards
- Mobile Interaction Design
- Exercises

POINTING DEVICES

- Direct-control devices:
  - Work directly on the surface of the screen
  - Direct "touch" in VR



- Indirect-control devices:
  - Work away from the surface
  - Mapping of the user movement to a pointing element (cursor/ray).

POINTING DEVICES

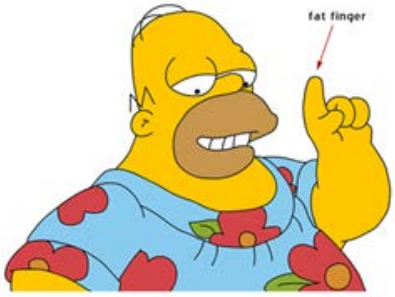
- **Direct-control devices**:
  - Old
    - Lightpen worked back in 1976
  - May produce fatigue:
    - Moving the lightpen on the screen required much effort
    - Should have a surface to rest the arm

POINTING DEVICES

- **Direct-control devices**. Issues:
  - Imprecision in pointing. Many factors:
    - *Quality of the screen:*

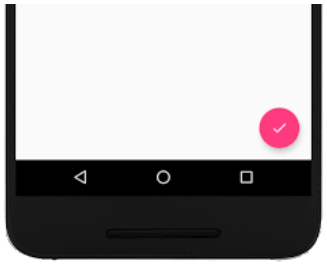
      Capacitive screens less precise than resistive
    - *Size of the pointer*

      Fat and *not-so-fat* fingers



POINTING DEVICES

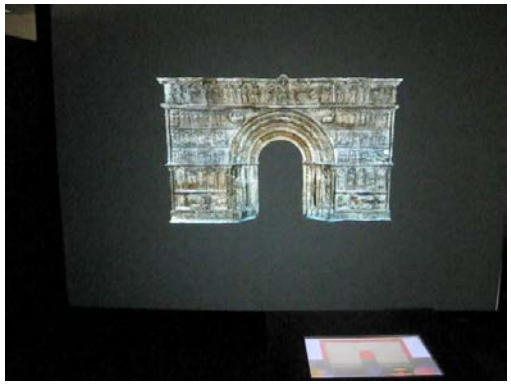
- **Direct-control devices**. Issues:
  - Land-on strategy:
    - Select on clicking point
    - Faster feedback
    - Prone to errors



  - Lift-off strategy:
    - Initial click creates "cursor", dragging used for precision pointing, lift-off selects
    - More time consuming

POINTING DEVICES

- **Direct-control devices**. Advantages:
  - Touch screens can be designed with no moving parts
    - Durable
    - Only device that has survived Walt Disney's theme parks
  - Multi-touch allows for complex data entry or manipulation
    - Pinch-to-zoom gestures



POINTING DEVICES

- **Direct-control devices.** Other issues:
  - Pens may be more suitable for some tasks
    - Reduce occlusion
    - Familiar to users
    - But require to be picked up and put down
    - Pens are more accurate than fingers
  - Fingers are less precise than wrist-based movement

POINTING DEVICES

- **Indirect-control devices.**
  - Examples:
    - Mouse, trackball, joystick, graphics tablets…
- Issues:
  - Alleviate hand fatigue
  - Eliminate screen occlusion
  - Mouse is the clear king
    - Cost-effective
    - Precise
    - Hand has a surface to rest on
    - Buttons easy to press
    - Long movements require to pick up mouse and replace
      - May be improved using accelerated moves

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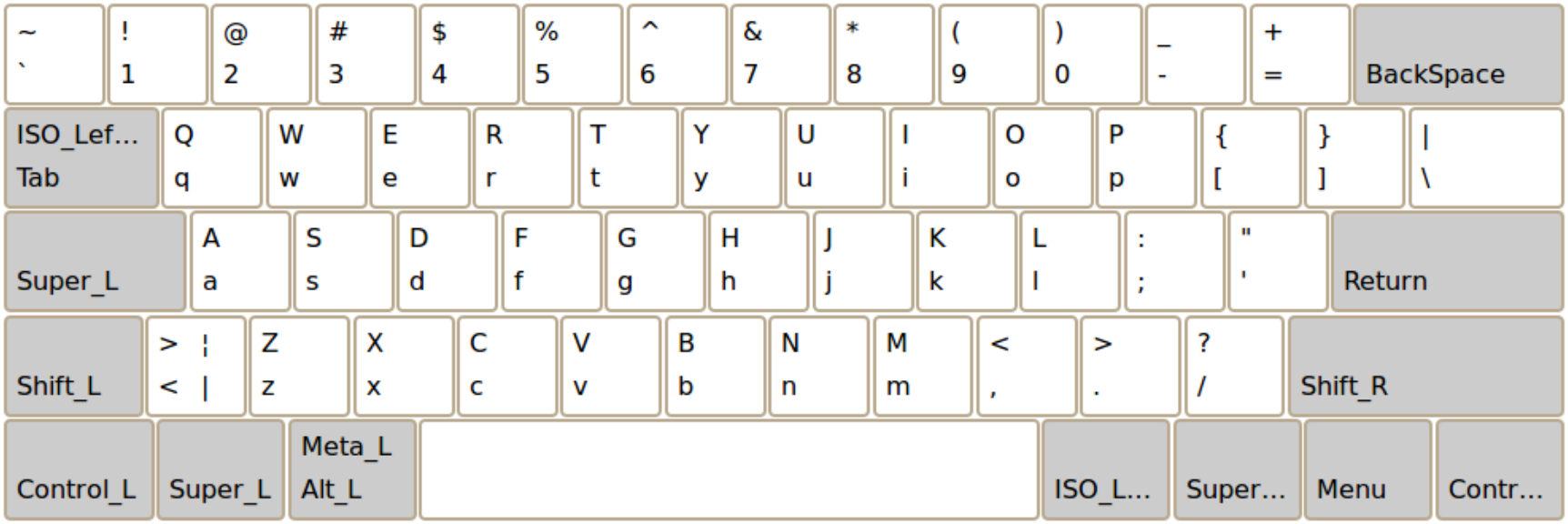
TYPING & KEYBOARDS. LAYOUTS

- **QWERTY keyboard layout**:
  - Design by Christopher Latham Shole.
  - The placement of the keys reduces key jams.
  - Keys commonly typed together are placed at large physical distance
    - In a typing machine
    - Changing hands
    - Assuming language is English
  - Does not make sense with computers
  - Not everybody writes in English

https://www.youtube.com/watch?time_continue=3&v=WEyCINkkR-Q&feature=emb_logo

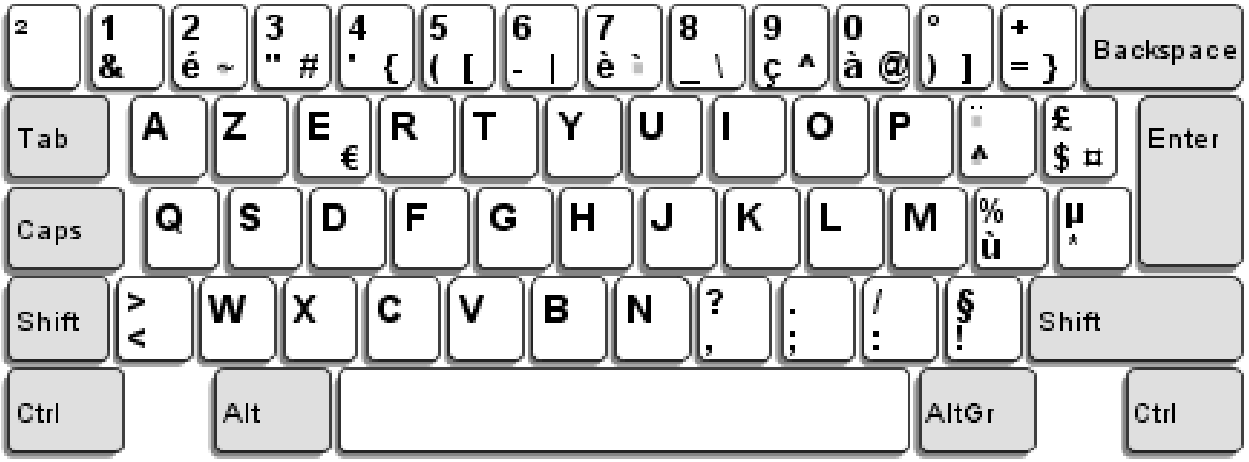
TYPING & KEYBOARDS. LAYOUTS

- QWERTY keyboard layout:



TYPING & KEYBOARDS. LAYOUTS

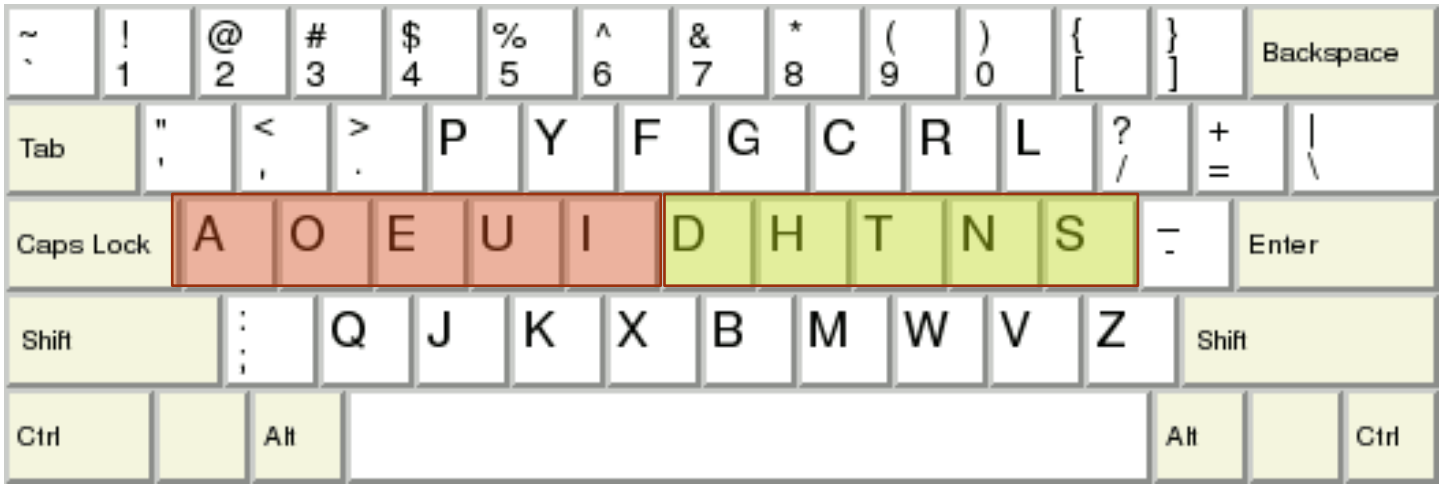
- Other ergonomic layouts: **AZERTY**



optimized for French

TYPING & KEYBOARDS. LAYOUTS

- **Dvorak layout:**
  - Vowels in one hand
    - Combinations with consonants impose hand change
  - Most common letters at the places the fingers rest on the keyboard

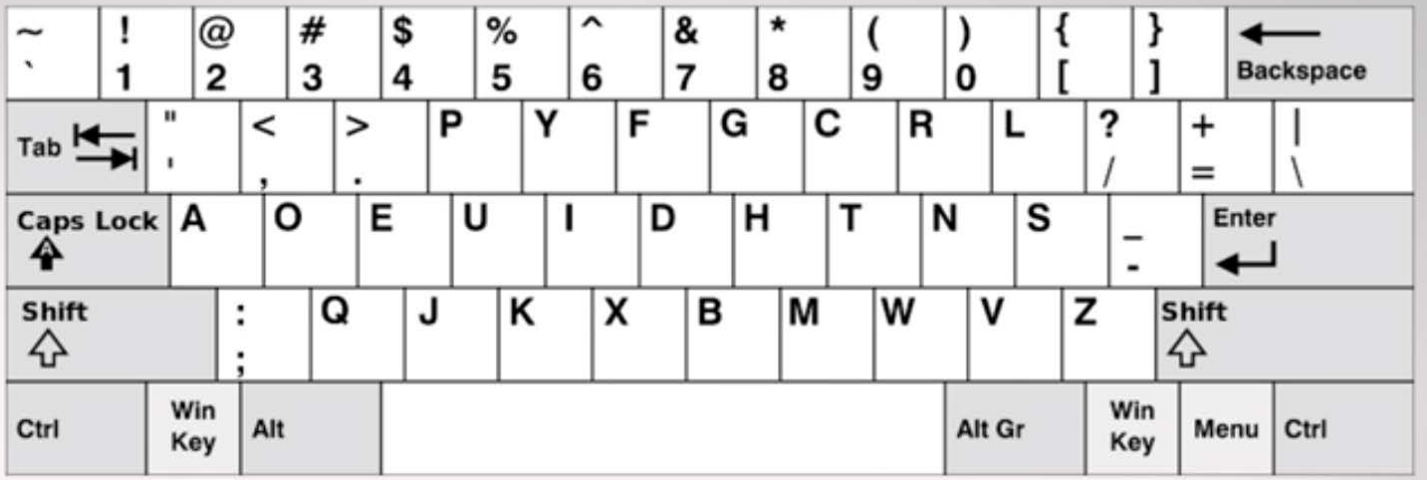


Dvorak

22%

70%

8%



QWERTY

52%

32%

16%

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TYPING & KEYBOARDS. LAYOUTS

- **Dvorak layout:**
  - Invented with the objective of reducing travel distances
    - 10-finger typing
  - Improvements of up to 30%
    - Other researchers say 5-10%
    - Typing Guinness world record held by a Barbara Blackburn with a DVORAK keyboard in a typewriter for many years
      - 150 wpm for 50 minutes
  - Less errors
  - Also optimized for English
  - Low level of acceptance

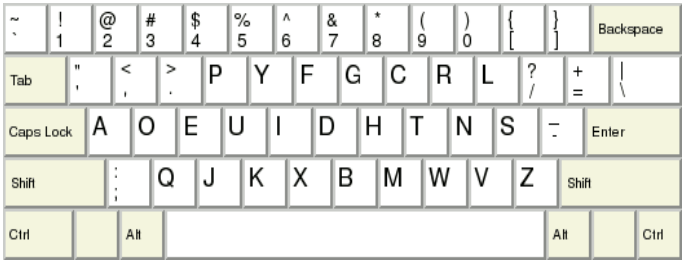
TYPING & KEYBOARDS. LAYOUTS

- Keyboard layouts
  - Improves posture and reduces tension
  - No proven advantage

TYPING & KEYBOARDS.

Keyboard arrangements should be designed so that:

1. Balance the loads on the right and left hands
2. Maximize the load on the home row
3. Maximize the frequency of alternating hand sequences
   - Alternating fingers avoids the need to wait for the end of the movement of the first finger before starting the second movement.
4. Minimizing the frequency of same finger typing



Especially good job: 1 & 2

Especially good job: 3

TYPING & KEYBOARDS. PRACTICAL ISSUES

- Experiment with keyboards layouts is difficult
  - Users get their proficiency for practice
  - It requires months of training in any layout
  - The same people would require to be training back to original arrangement for starting a new experiment

- It is commonly accepted formal results based as **predictive human performance model** rather than user testing for evaluation

TYPING & KEYBOARDS. PRACTICAL ISSUES

Source: http://minuum.com/

- Touchable layouts (some issues)
  - Size depends on screen size
  - Limited and occluded text
  - Require significant visual attention
    - No physical feedback. Sometimes sound
  - Distance from the keyboard to the insertion point
    - Especially on larger form factors
  - Errors: accidentally touching the screen
  - Touch and stylus based may be a good combined with stroke gestures or other ideas…

TYPING & KEYBOARDS. PRACTICAL ISSUES

- Expert typing model [Bi2013]:
  - Based on Fitts' Law
  - Time to move the tapping device with a single finger from one key (*i*) to another (*j*) depends on the distance and the width of the keys:

$$MT_{ij} = a + b \log_2 \left(\frac{D_{ij}}{W_{ij}} + 1 \right)$$

  - D_{ij} is the distance between keys *i* and *j*,
  - W_{ij} is the width of each key

  - Bi *et al.* also use the effective width

TYPING & KEYBOARDS. PRACTICAL ISSUES

Fitts Law accurately predicts pointing movement

- If improvement required, it can help us modify our UI
  - Change target width:
    - Increase size for faster reach
  - Change distance:
    - Move targets closer to reduce movement time
  - Change pointer movement:
    - Increase speed

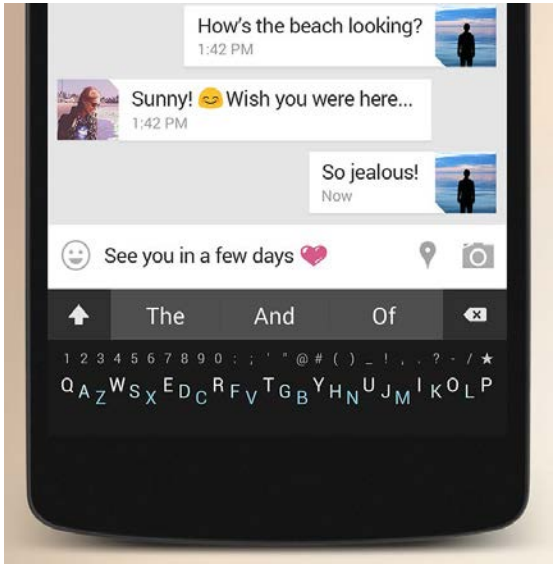
$$MT_{ij} = a + b \log_2 \left(\frac{D_{ij}}{W_{ij}} + 1 \right)$$

TYPING & KEYBOARDS. PRACTICAL ISSUES

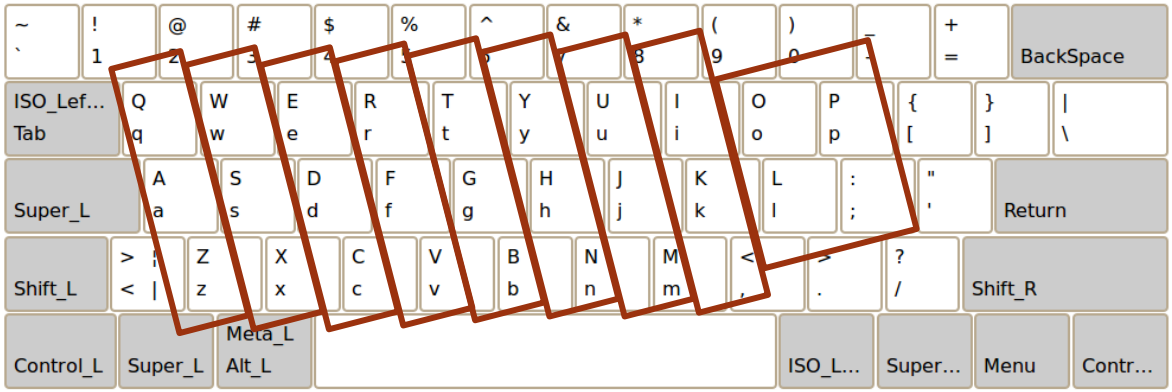
- Improving mobile layouts:
  - Different parameters to take into account:
    - 10-finger typing? As of tablets
    - 2-thumb typing? Mobiles/tablets.
    - 1-finger typing? Most commonly mobile
- Optimize for the number of fingers
  - Tactile screen form factor
  - Maybe hand positions too

TYPING & KEYBOARDS. MOBILE LAYOUTS

- Proposed mobile layouts. **Minuum**:
  - **Two or one finger typing**
  - Compressing the three key rows into one
    - Reduction of distances (in vertical)
    - Larger targets
      (the whole region of e. g. QAZ)
    - Proficient word prediction/correction is required
  - More room in your screen



A new (old) idea?



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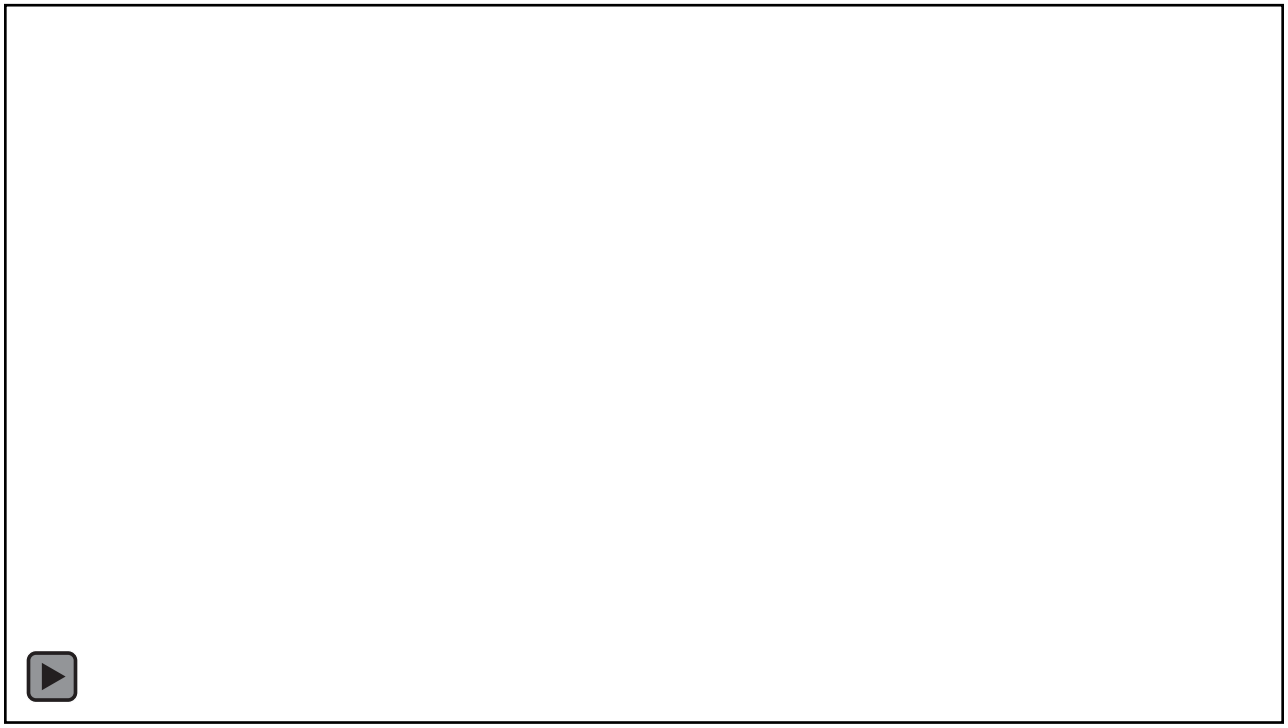
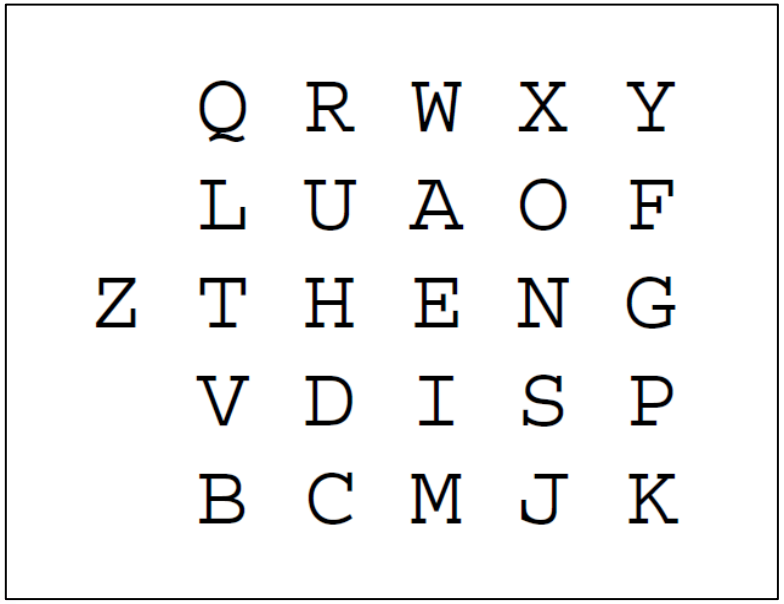
TYPING & KEYBOARDS. MOBILE LAYOUTS

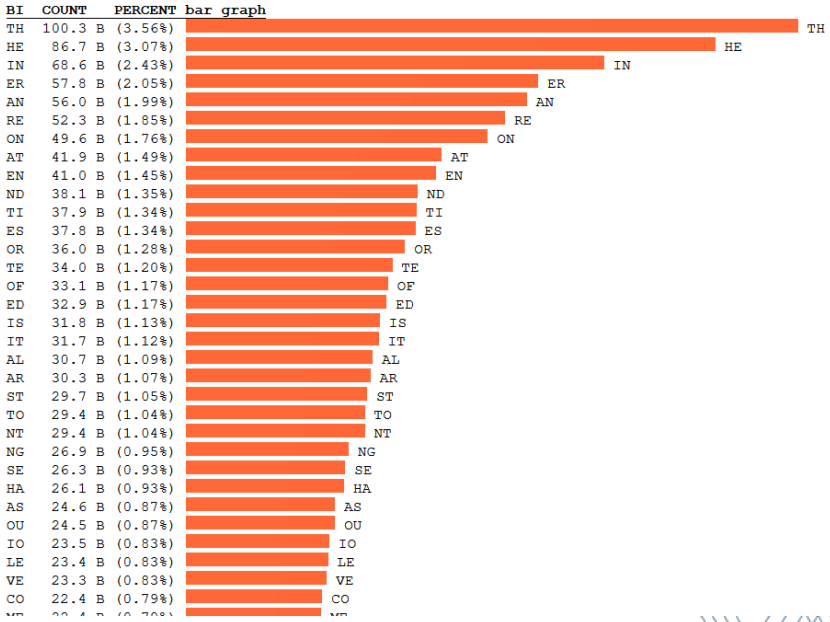
- Minuum is intended to type everywhere:



TYPING & KEYBOARDS. MOBILE LAYOUTS

- Diagram-based layout for **single-finger typing** [Lewis99]:
  - Optimized distances
  - Up to 25 wpm (over the typical 20 wpm on a complete QWERTY)





Source: norvig.com

TYPING & KEYBOARDS. MOBILE LAYOUTS

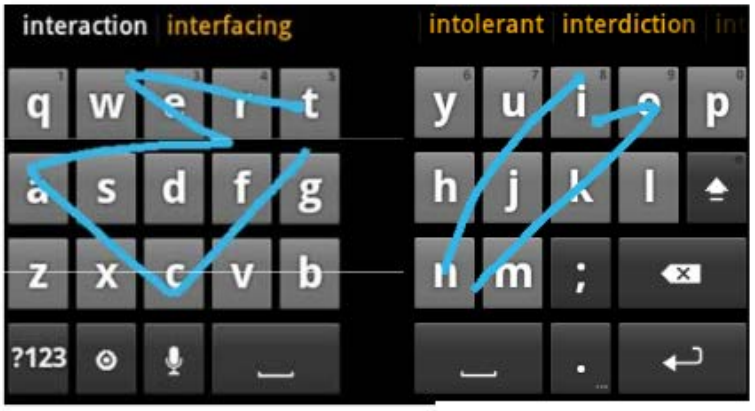
- **Single finger gesture typing** [Kristensson2012, Zhai2012]
  - The finger traverses all the letters of a word without lifting off the screen
  - More comfortable (subjective evaluation) in tablets [Nguyen2012]
  - Not faster than regular typing (objective evaluation) in tablets [Nguyen2012]. Not so negative

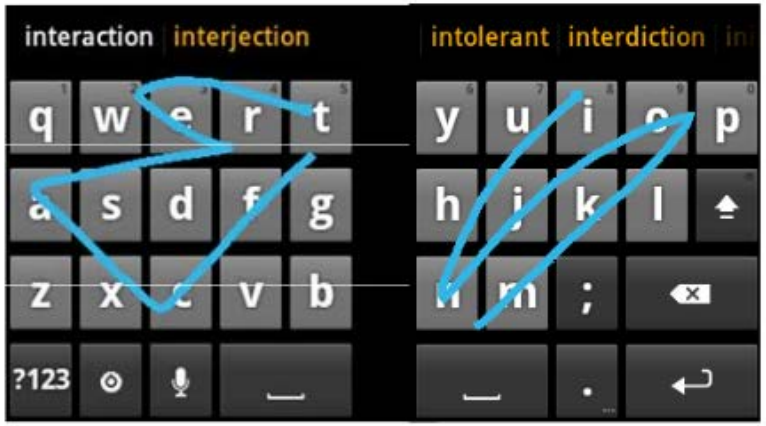
TYPING & KEYBOARDS. MOBILE LAYOUTS

- Proposed mobile layouts. **KALQ**:
  - Optimize layout for better **2 thumb typing**
  - Analyzed hand position, diagram frequency, tablet orientation…

TYPING & KEYBOARDS. MOBILE LAYOUTS

- **Two finger** gesture typing [Bi2012]
  - The two thumbs swipe to compose a word
    - Lifting the finger when a part of the word belongs to the other thumb
    - Or with a continuous trace
  - Finger traveling shortened by 50%
  - Speed does not increase over one finger entry (objective evaluation). Not so negative
  - High demand of attention (subjective evaluation)





TYPING & KEYBOARDS. PRACTICAL ISSUES

Designing virtual keyboards. Elements to consider for usability:

- Auto-correction
- Auto-capitalization
- Input data type & custom keyboards
- (Multiple-)Language support

TYPING & KEYBOARDS. PRACTICAL ISSUES

1. Auto-correction:

- Only suitable if proper dictionaries:
  - Commonly, users do not notice the corrections
  - Some data such as address very prone to wrong correction
  - 92% sites do it wrong
- Best practices:
  - Skip auto-correction for certain fields
  - Usually, it is safer to opt for a predictive approach and let the user to choose the best option.

TYPING & KEYBOARDS. PRACTICAL ISSUES

2. Auto-capitalization:

- In e-mail addresses, disable auto-capitalization
  - Even if correct, people tries to fix

TYPING & KEYBOARDS. PRACTICAL ISSUES

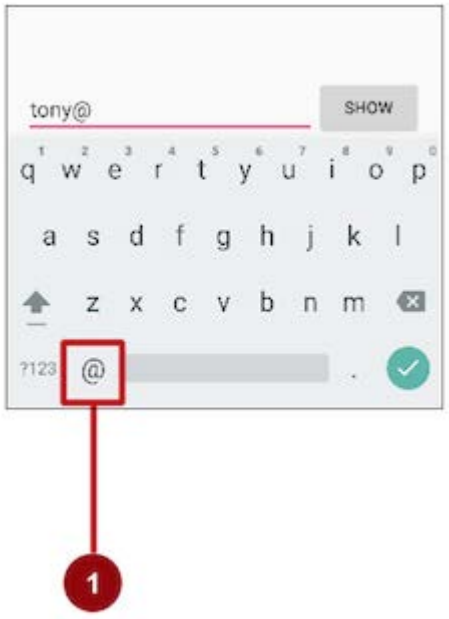
3. Appropriate layouts for the input data type:

- Virtual keyboards are small
  - An iPhone 4 character (portrait) measures 4 × 5.9 mm
    - Minimum recommended clickable size is 6.85 × 6.85 mm
  - Increase typos, validation errors…
  - 60% top mobile websites do it wrong
- **Dedicated keyboards may increase the size enough (phone numbers, ZIP codes, currency…)**
  - Invoke them, and **do it consistently**

TYPING & KEYBOARDS. PRACTICAL ISSUES

Dedicated keyboards examples (space gain):

Email address



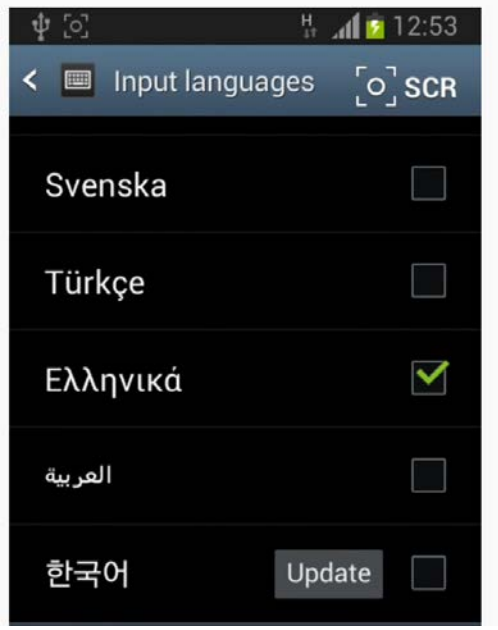
Phone number

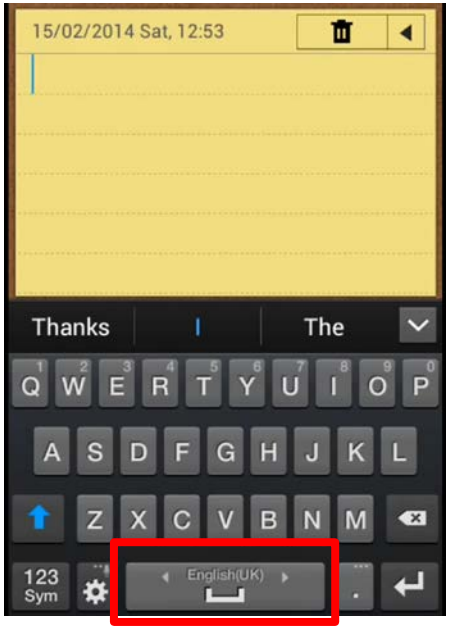
URL

TYPING & KEYBOARDS. PRACTICAL ISSUES

4. (Multiple-)Language support:

- Most custom keyboards provide the possibility of changing the language on demand
  - In many cases correctors or word predictions mix languages





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INTERACTION DESIGN AND EVALUATION. SESSION 1

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