

Lecture 1

Gestural Interaction

Baptiste Caramiaux

Admin

Course structure:

- Fridays 1:30pm - 4:30pm
- “Exam”: February 1st, 2019

Online ressources:

- <https://github.com/bcaramiaux/GMI>
- Slides, bibliography, code

Main contact: baptiste.caramiaux@iri.fr

Outline

1. Brief history and examples
2. Gesture: definitions, functions
3. Gestures in interaction

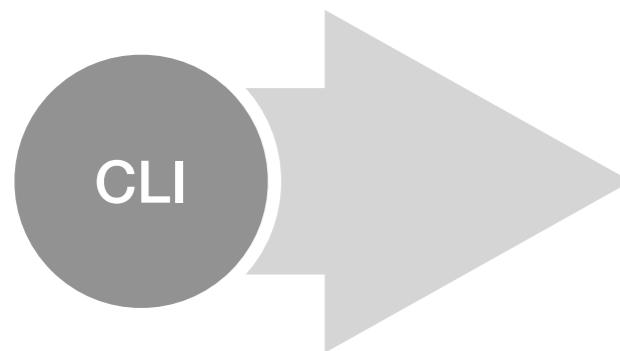
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Brief history

Command Line Interface

Codified, Strict



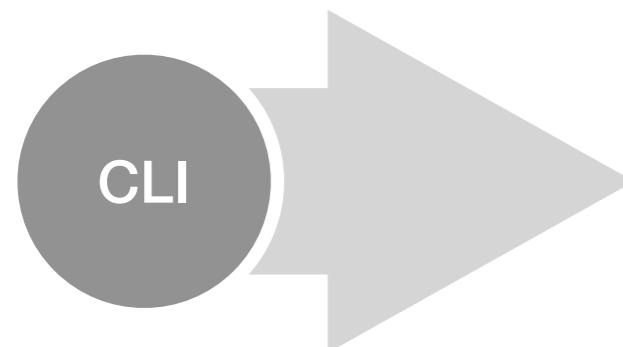
60's

> Brief history and examples

Brief history

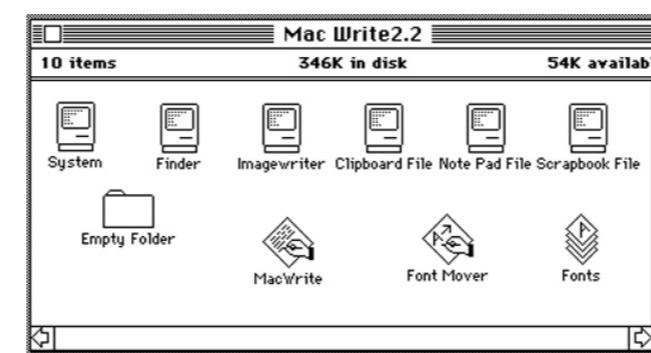
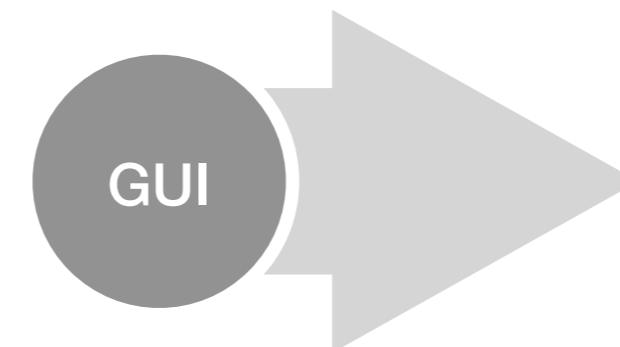
Command Line Interface

Codified, Strict



Graphical User Interface

Metaphor, exploratory



60's

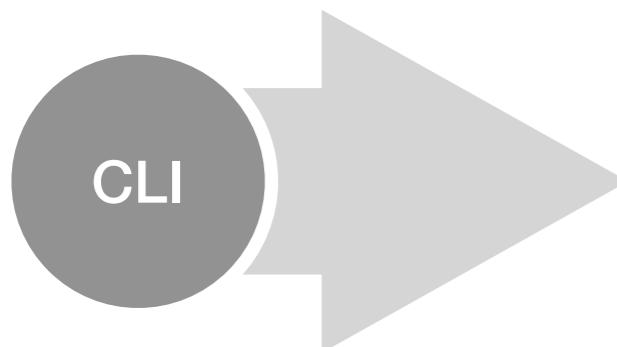
80's

> Brief history and examples

Brief history

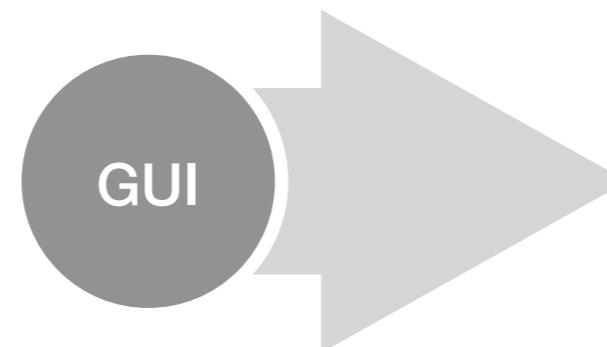
Command Line Interface

Codified, Strict



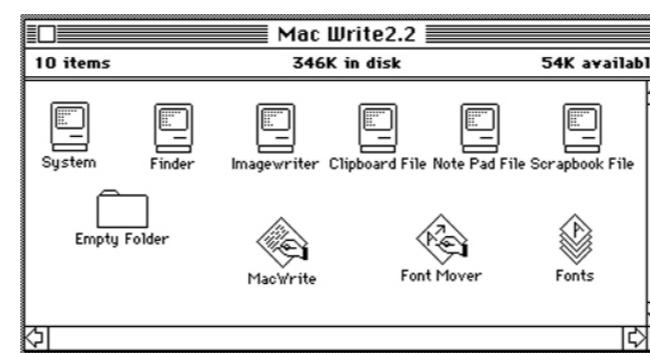
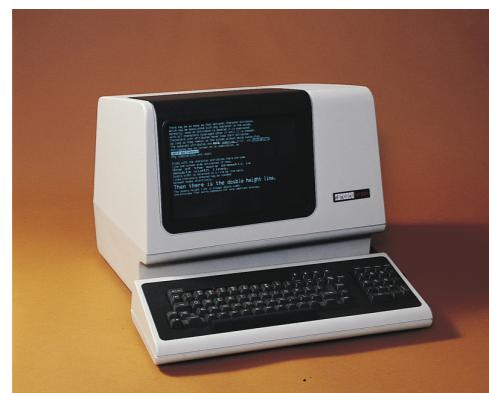
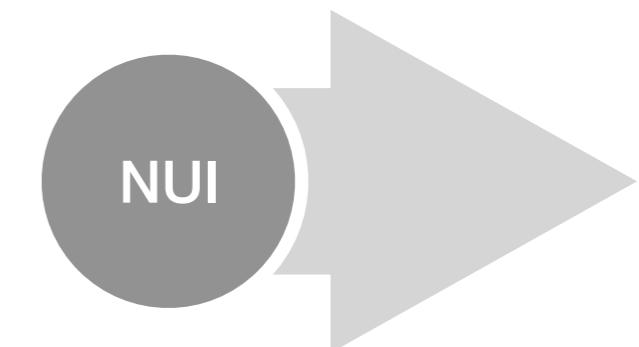
Graphical User Interface

Metaphor, exploratory



Natural User Interface

Direct, intuitive



60's

80's

00's

“Natural” interaction

Natural interaction is usually used for invisible interfaces, independently of the level of expertise (Terminology not widely accepted)

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Natural interaction is usually used for invisible interfaces, independently of the level of expertise (Terminology not widely accepted)

Gesture can be seen as a “natural” medium for interaction



Background in cognitive science

Embodied cognition

- “Cognition is embodied when it is deeply dependent upon features of the physical body of an agent, that is, when aspects of the agent's body beyond the brain play a significant causal or physically constitutive role in cognitive processing.”

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Examples motivating embodied cognition:

- Gesturing when we speak (McNeill 1992)
- Vision is often action-guiding (O'Regan and Noë 2001)
- Mirror neurons (Rizzolatti and Craighero 2004)

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Examples motivating embodied cognition:

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See: entry “Embodied Cognition” from the Stanford Encyclopedia of Philosophy (<https://plato.stanford.edu/entries/embodied-cognition/>)

Applications

Gestural interaction
with mobile systems

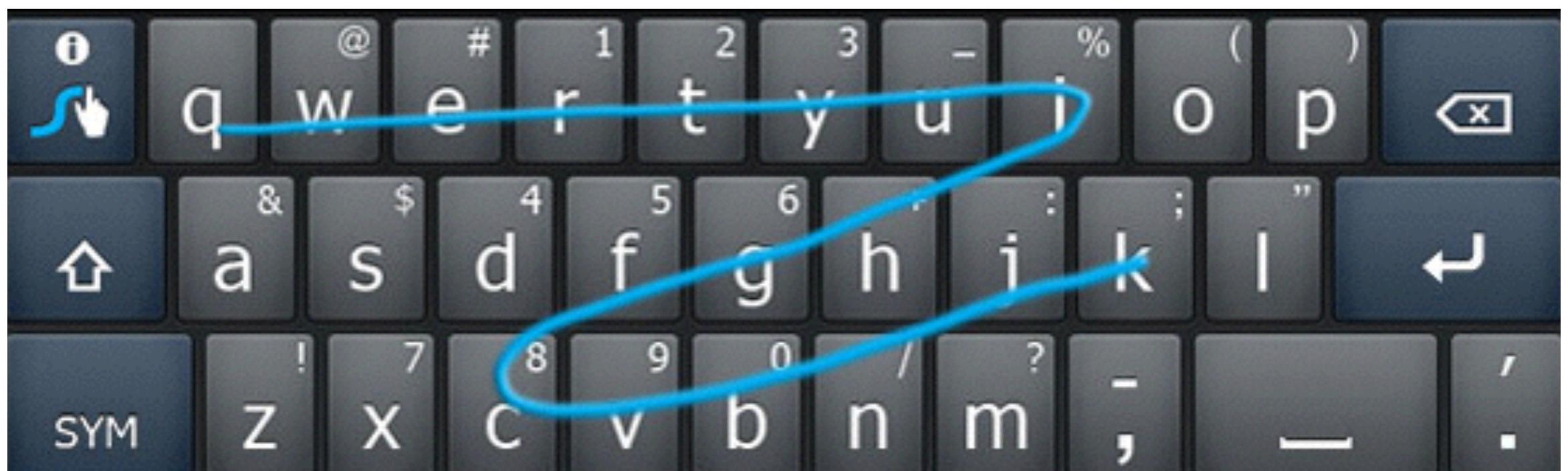
Somehow more
“natural” than writing
text



(NB: first iPhone released in 2007)

Applications

Shape Writer



“Quick”

Kristensson, P.O. and Zhai, S. SHARK²: A Large Vocabulary Shorthand Writing System for Pen-Based Computers. *UIST’04*

> Brief history and examples

Applications

Video games



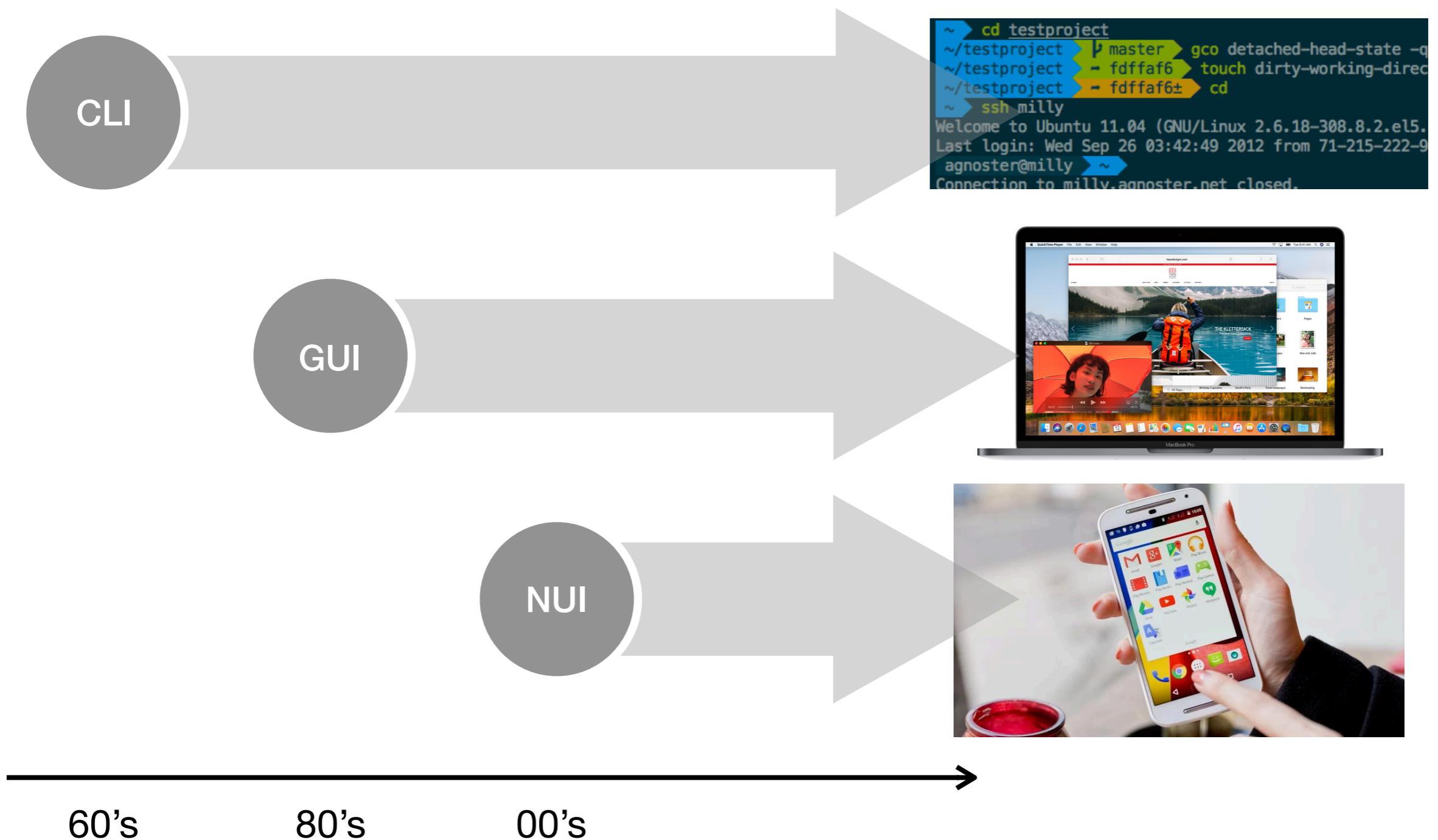
> Brief history and examples

Applications



> Brief history and examples

Parallel evolution



> Brief history and examples

Science Fiction



Outline

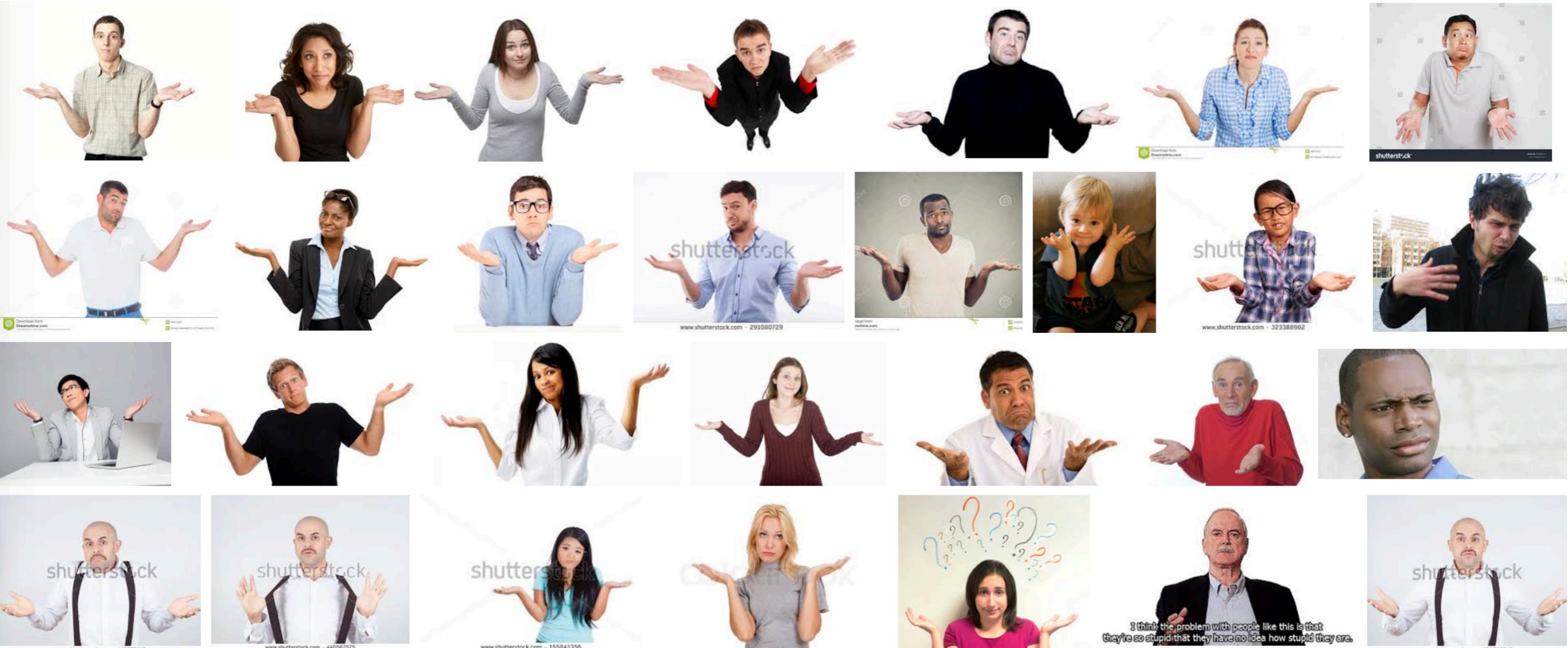
1. Brief history and examples
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Defining gesture



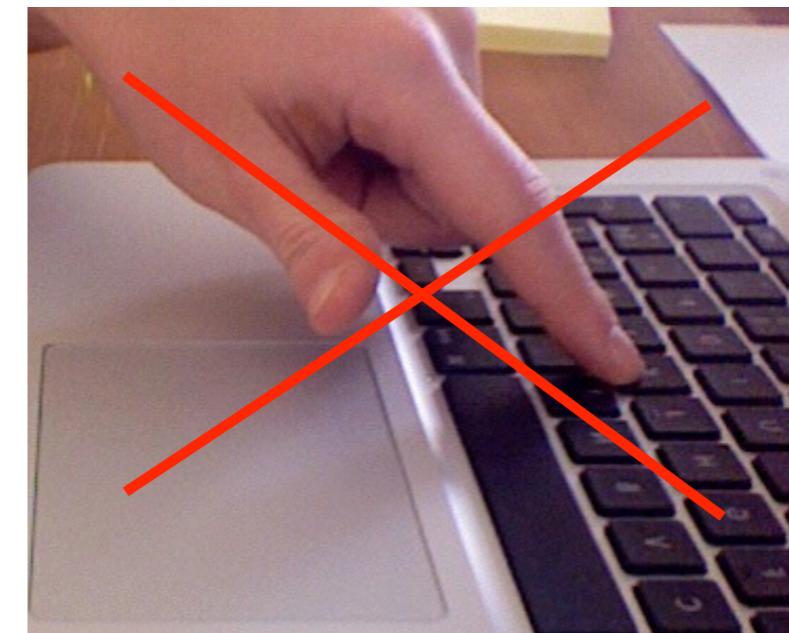
> Gesture: definitions, functions

Defining gesture



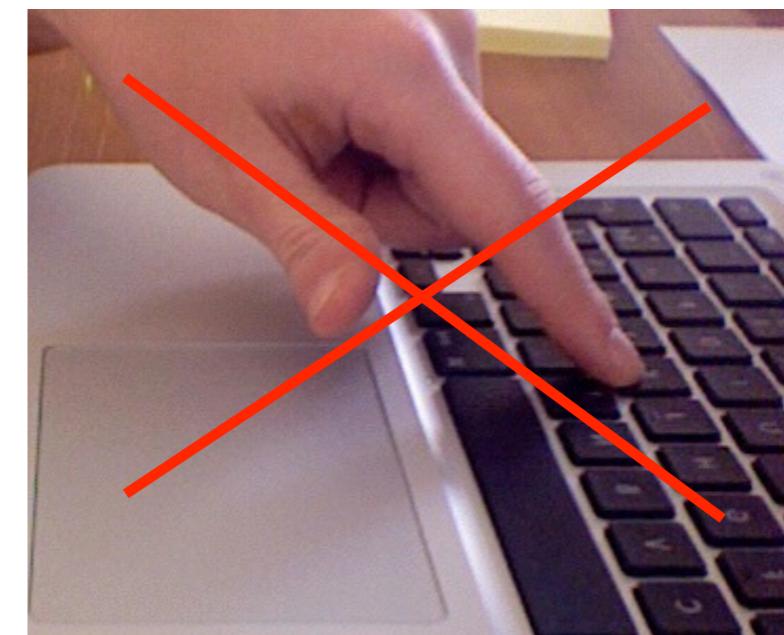
Defining gesture

HCI: A **gesture** is a **movement** of the body that contains information (Kurtenbach & Hulteen, 1990)



Defining gesture

HCI: A **gesture** is a **movement** of the body that contains information (Kurtenbach & Hulteen, 1990)



=> **What** it is performed

Defining gesture

Non-Verbal Communication: “Gesture [...] is a label for actions that have the features of manifest **deliberate expressiveness**” (Kendon, 2004)



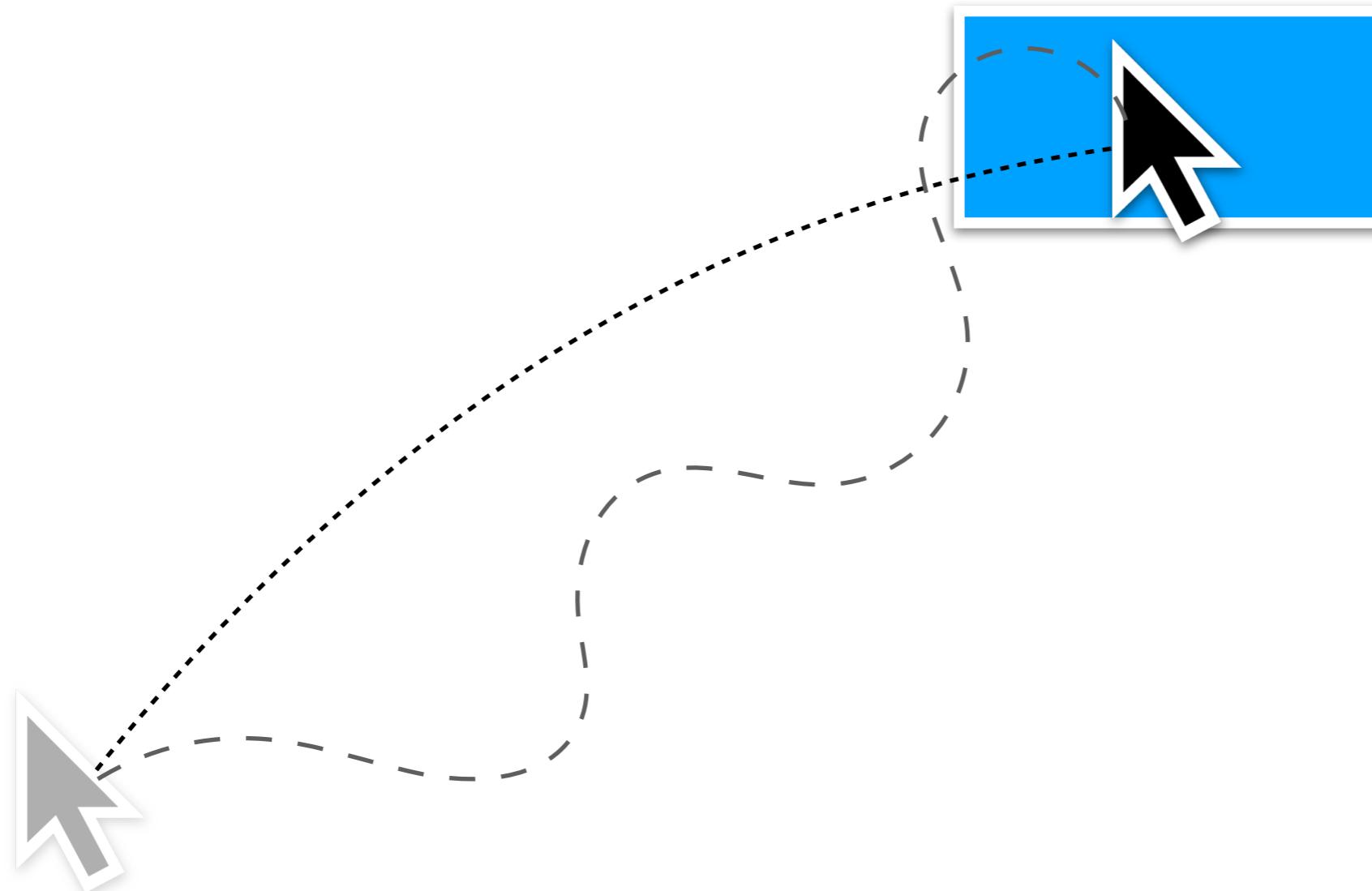
Defining gesture

Non-Verbal Communication: “Gesture [...] is a label for actions that have the features of manifest **deliberate expressiveness**” (Kendon, 2004)



=> **What** and **How** it is performed

Is pointing a gesture?



Functions

Semiotic gestures

- To communicate meaningful information

Ergotic gestures

- To manipulate the physical world and create artefacts

Epistemic gestures

- To learn from the environment through tactile experience and haptic exploration

(Cadoz, C. Le geste, canal de communication homme/machine: la communication “instrumentale”. techniques et sciences informatiques. Vol 13 - n01/1994, pages 31 à 61.

> Gesture: definitions, functions

Semiotic gestures

To **communicate** meaningful information



Semiotic gestures

To communicate meaningful information



> Gesture: definitions, functions

Semiotic gestures

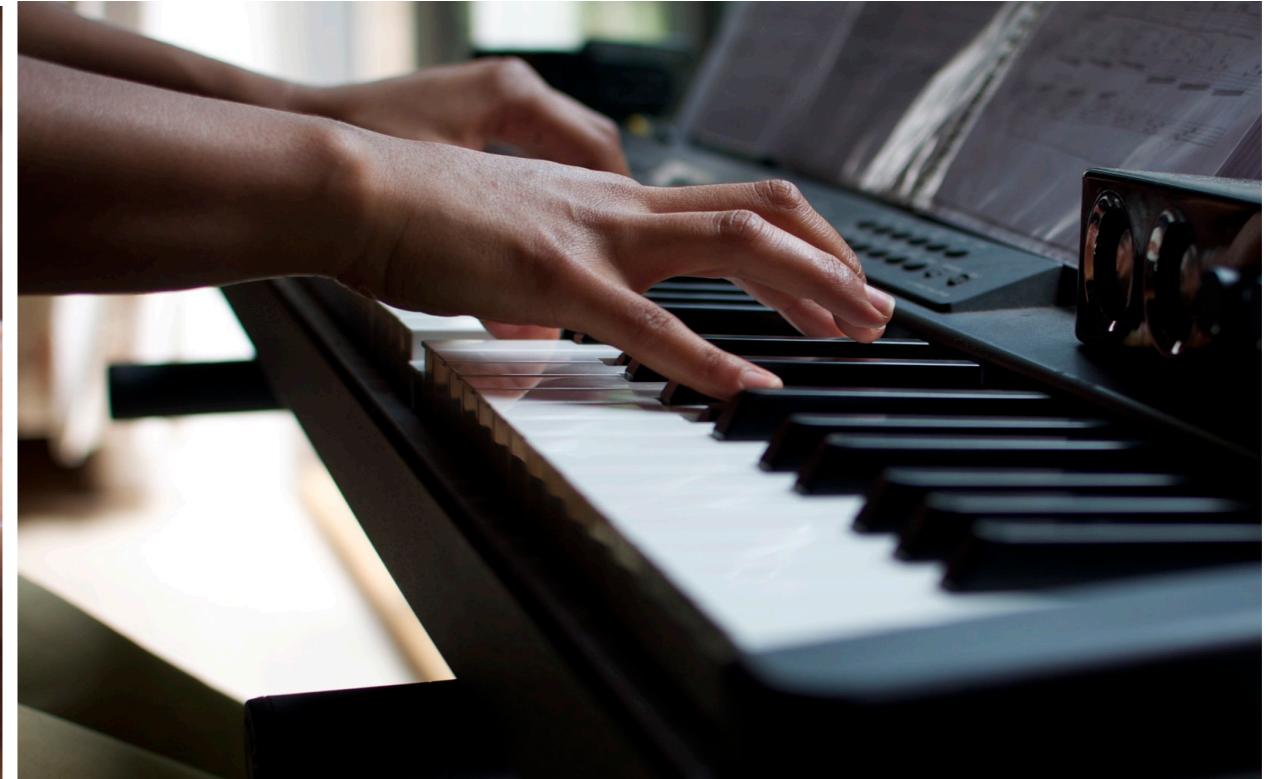
To communicate meaningful information



> Gesture: definitions, functions

Ergodic gestures

To **manipulate** the physical world and create artefacts



Epistemic gestures

To **learn** from the environment through tactile experience and haptic exploration



Synthesis

Aspects of a gesture

- can be static (= **posture**) or dynamic
- is defined in time
- is linked to a transfer of information
(e.g. ergotic, epistemic)
- is deliberate
- conveys expression



Exercice

From Gestural Interaction you know, find examples of

- Semiotic
- Ergotic
- Epistemic

Which one is the most used?

Outline

1. Brief history and examples
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Why using gestures in UI?

...

Why using gestures in UI?

Based on user's existing drawing and handwriting **skills**

Physically **chunk a command** and its operands into a single action

Implicit and fast **mode switching**

Eyes-free interaction

Alternative to buttons for small displays

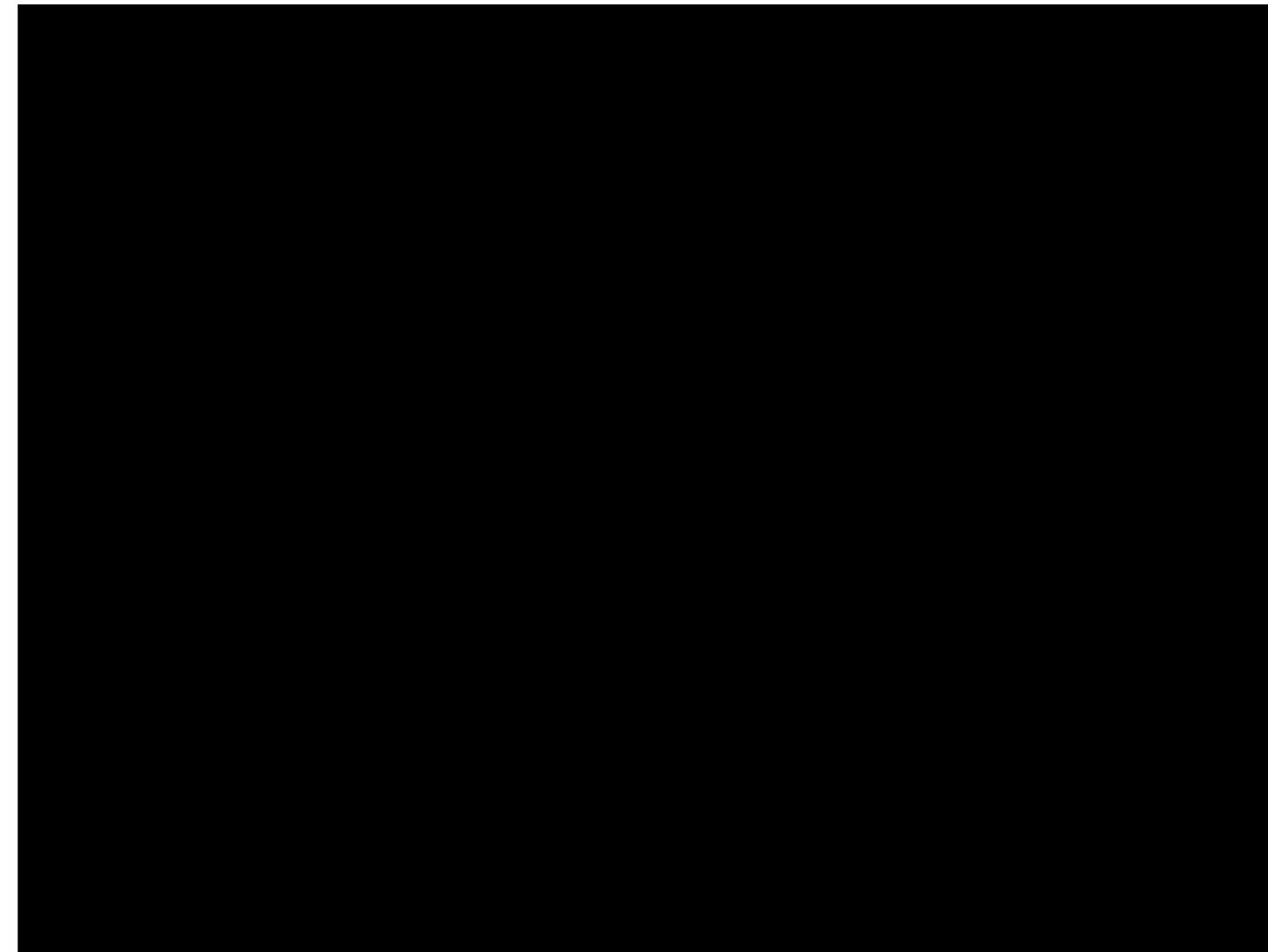
Fun

Distant interaction

...

Why using gestures in UI?

Drawing skills



Thorne, M., Burke, D. van de Panne, M. Motion doodles: an interface for sketching character motion. *SIGGRAPH'07*

Why using gestures in UI?

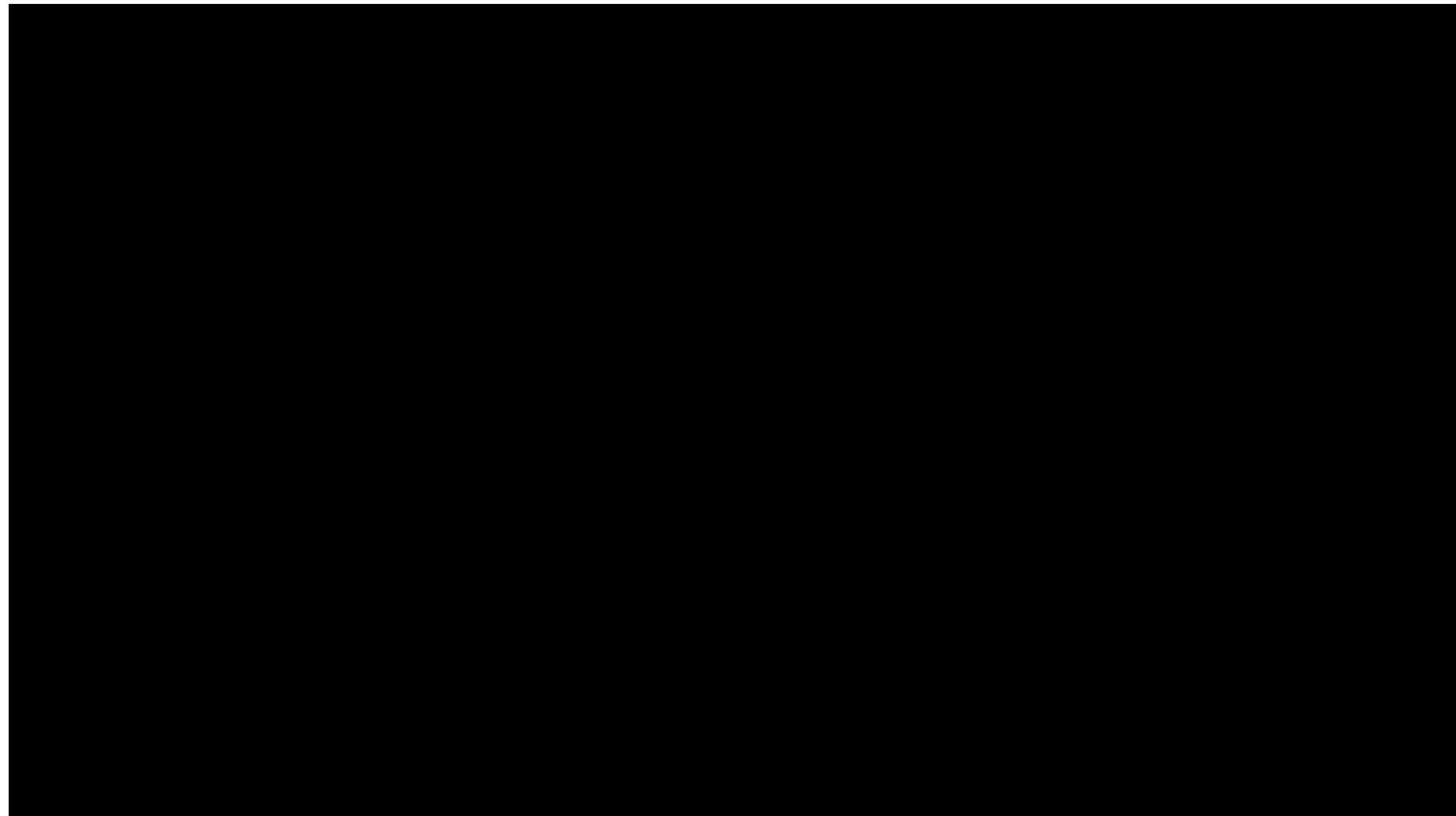
Fun!



Muller et al. Looking Glass: A Field Study on Noticing Interactivity of a Shop Window. CHI'12

Why using gestures in UI?

Fun!



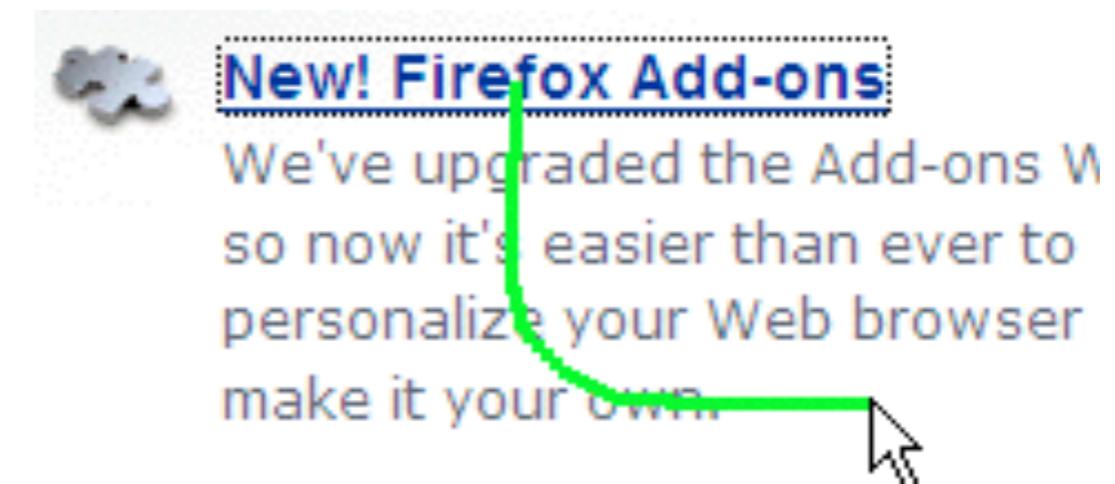
Muller et al. Looking Glass: A Field Study on Noticing Interactivity of a Shop Window. CHI'12

Discrete outputs

Discrete means separated and divided elements in a set.

Example: letters are discrete elements of an alphabet.

Gesture to command :



Gesture to symbol:

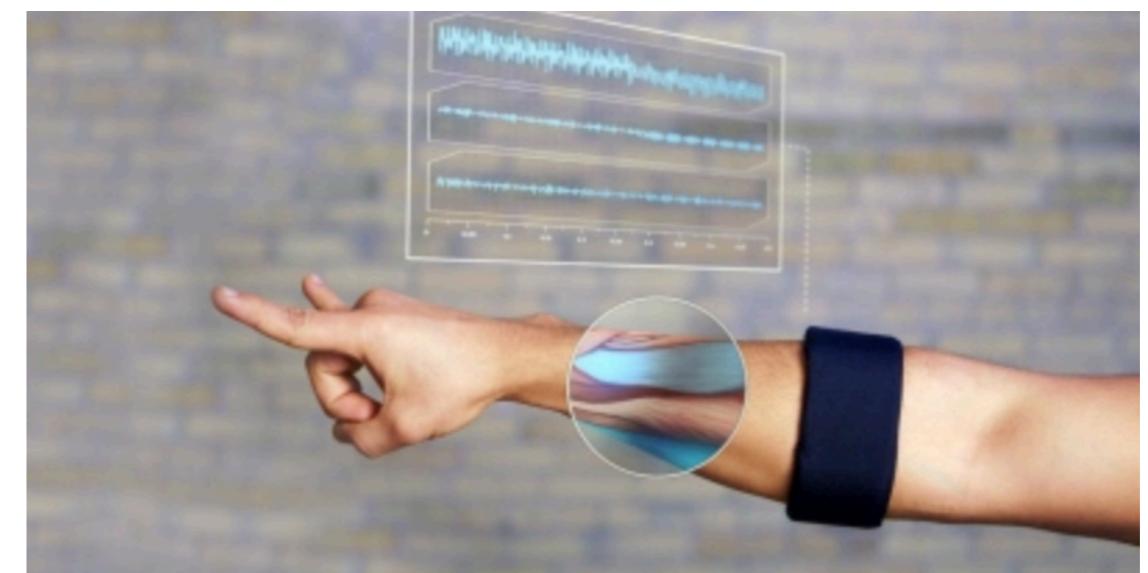
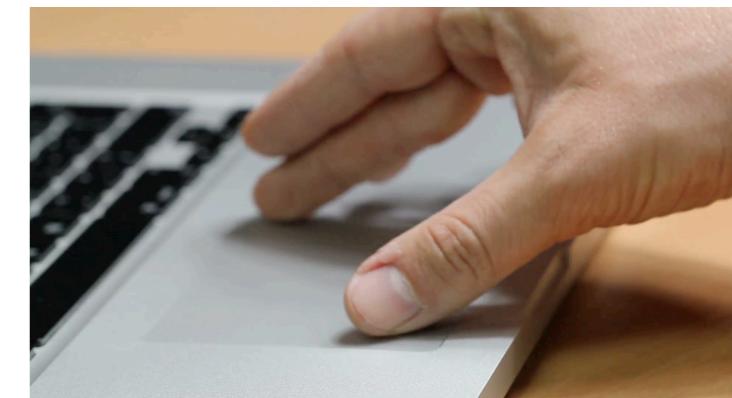
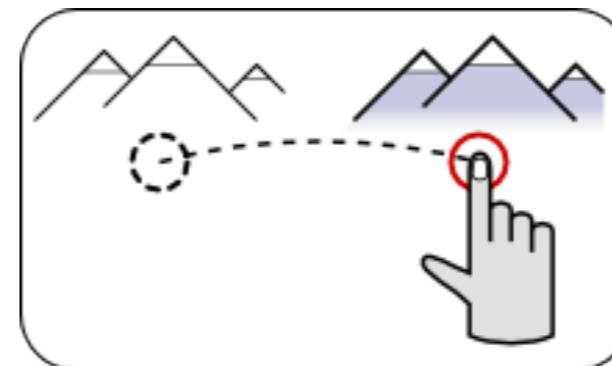
- Gesture to textual symbols



Continuous outputs

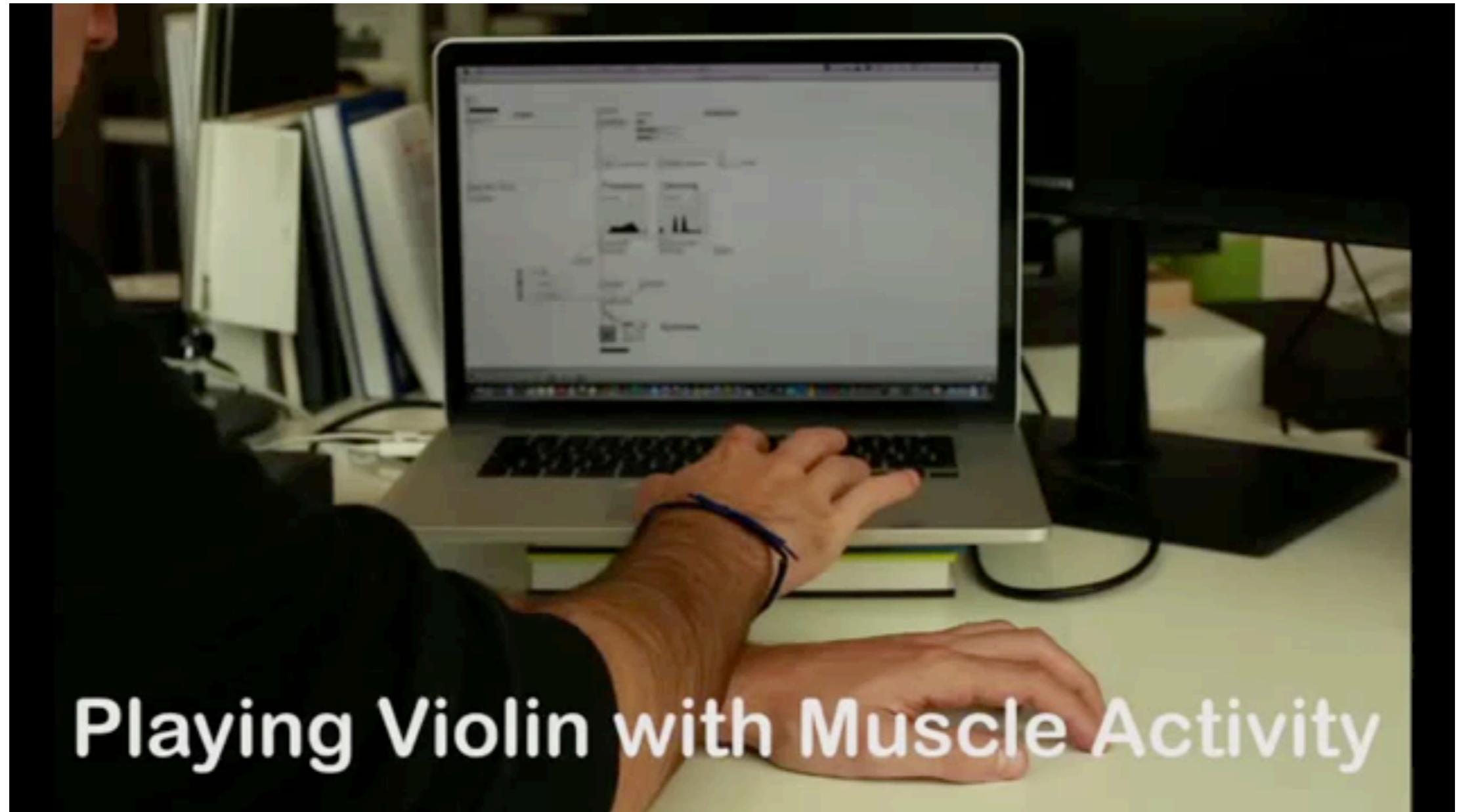
Gesture to range of values:

- Uni-dimensional “Sliders”
- Bi-dimensional pads
- High-dimensional



Myo by Thalmic

“Musical” example

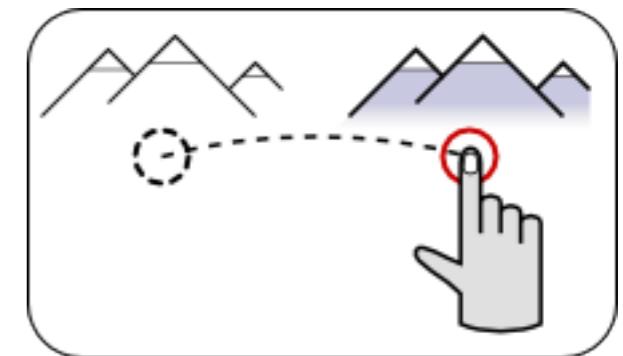


(Caramiaux, Donnarumma, Tanaka. Understanding Gesture Expressivity through Muscle Sensing, ACM ToCHI 2015)

Analog vs. abstract gestures

Analog gestures

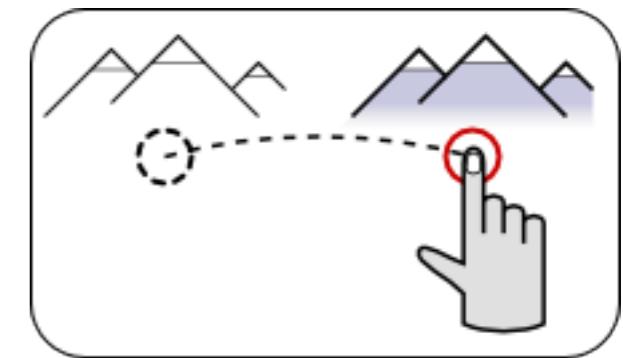
- Mimic the physical or conventional effects of the world
- Direct manipulation
- Easier to learn
- Example : slide gesture can cause a document to pan



Analog vs. abstract gestures

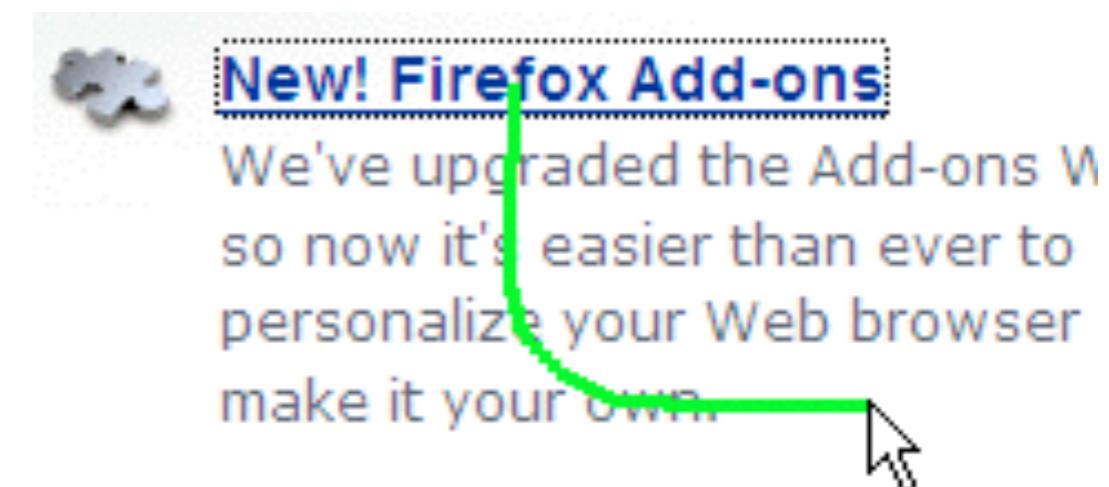
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Abstract gestures

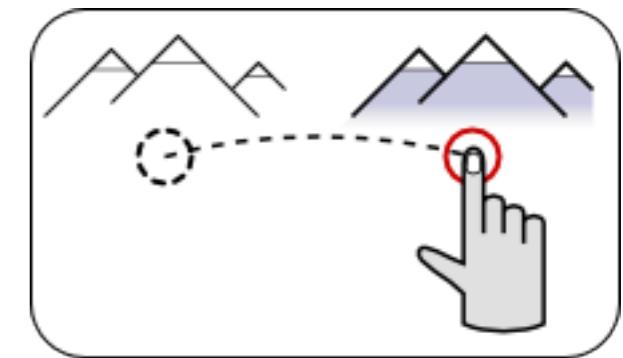
- Arbitrary
- Example: draw X to close a document



Analog vs. abstract gestures

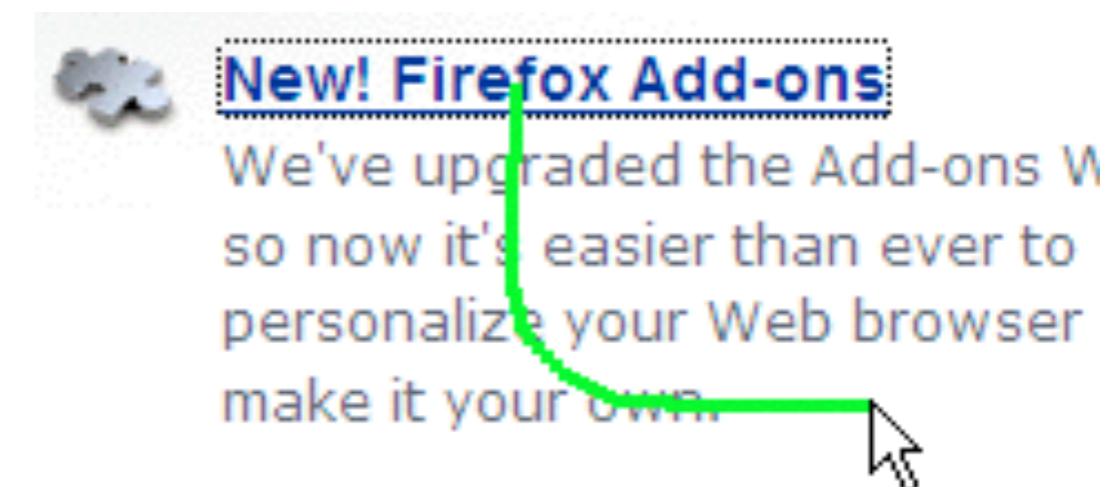
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Abstract gestures

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Analog-Abstract classification

- Is a spectrum (not a dichotomy)
- Resemble physical effects to a degree

Processing: post hoc vs. realtime

Post hoc

- Recognizing a gesture after it has been completely drawn

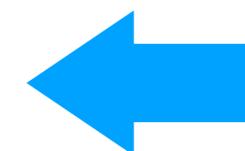
Realtime

- Recognising a gesture as it is drawn
- Requires feedback

Temporality: post hoc, realtime

Post hoc

- Recognizing a gesture after it has been completely drawn



Commonly used strategy

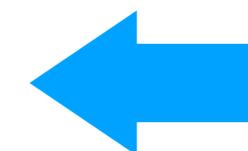
Realtime

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Temporality: post hoc, realtime

Post hoc

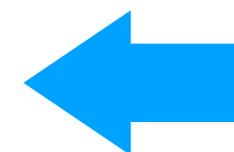
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Commonly used strategy

Realtime

- Recognising a gesture as it is drawn
- Requires feedback



**More powerful,
more challenging!**

'post-hoc' example: \$1 recogniser

<http://depts.washington.edu/madlab/proj/dollar/index.html>

Wobbrock, J. O., Wilson, A. D., & Li, Y. Gestures without libraries, toolkits or training: a \$1 recognizer for user interface prototypes. *UIST'07*

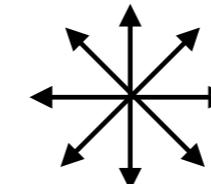
'realtime' example: GVF

Caramiaux, B., Montecchio, N., Tanaka, A., & Bevilacqua, F. Adaptive gesture recognition with variation estimation for interactive systems. ACM *TiS* 2015

Complexity

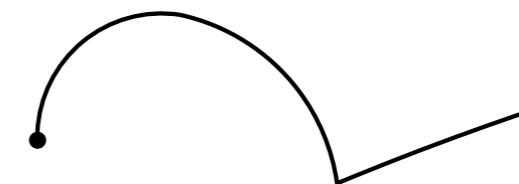
Zero order

- Touch points (soft button tap)
- orientation, finger id, pression



First order

- Stroke gestures



Higher order

- Multi-stroke gesture
- multi-touch gesture (multiple fingers or multiple hands)

Complexity is related to the difficulty to memorise and perform (**cognitive** and **motor** constraints, see Lecture 3)

Relationship with the device



On the device



with the device



around the device



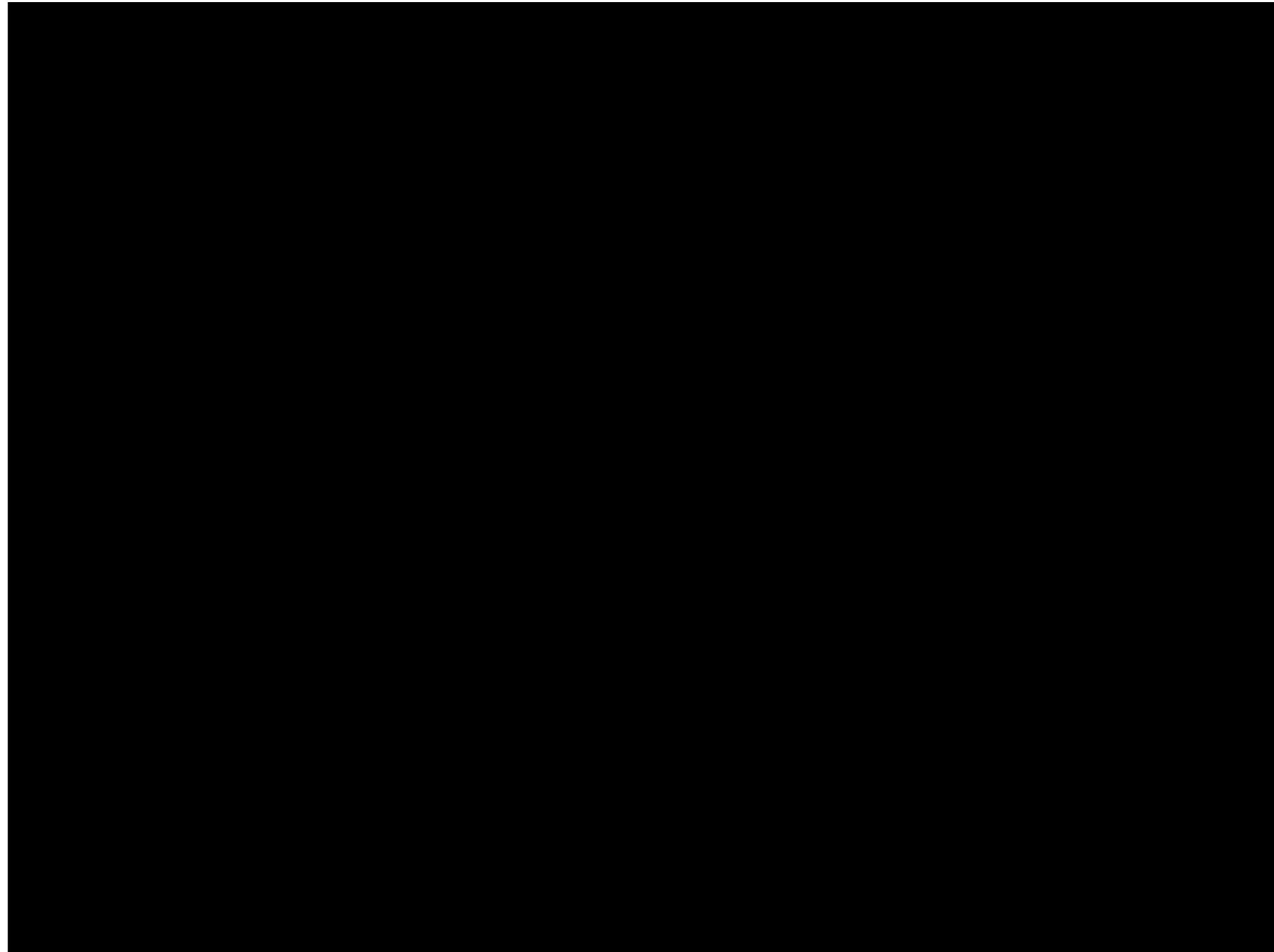
far from the device

> Gestures in interaction

On the device



On the device - music



On the “device” (object augmentation)

mogees

On the device - Modalities

Finger

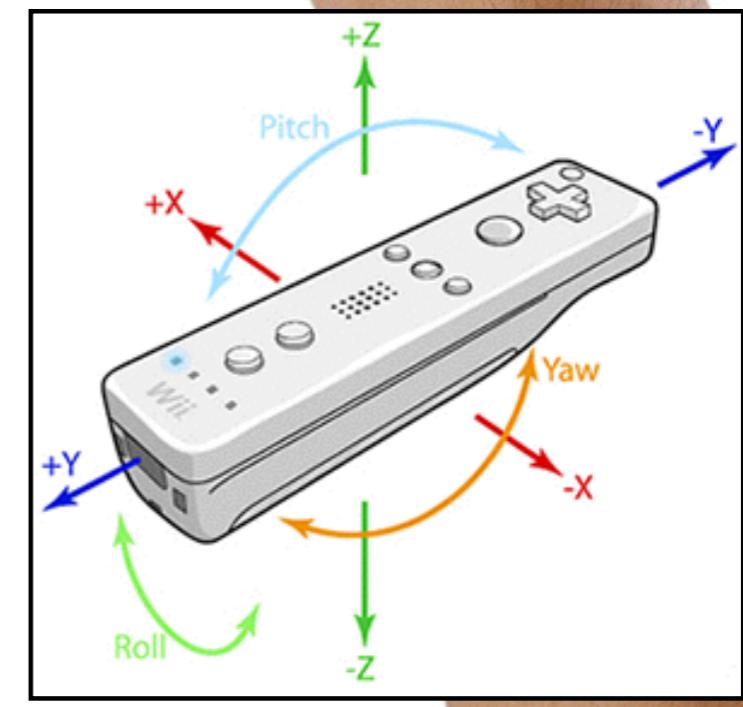
- pressure
- finger id
- orientation of finger

Multi-touch

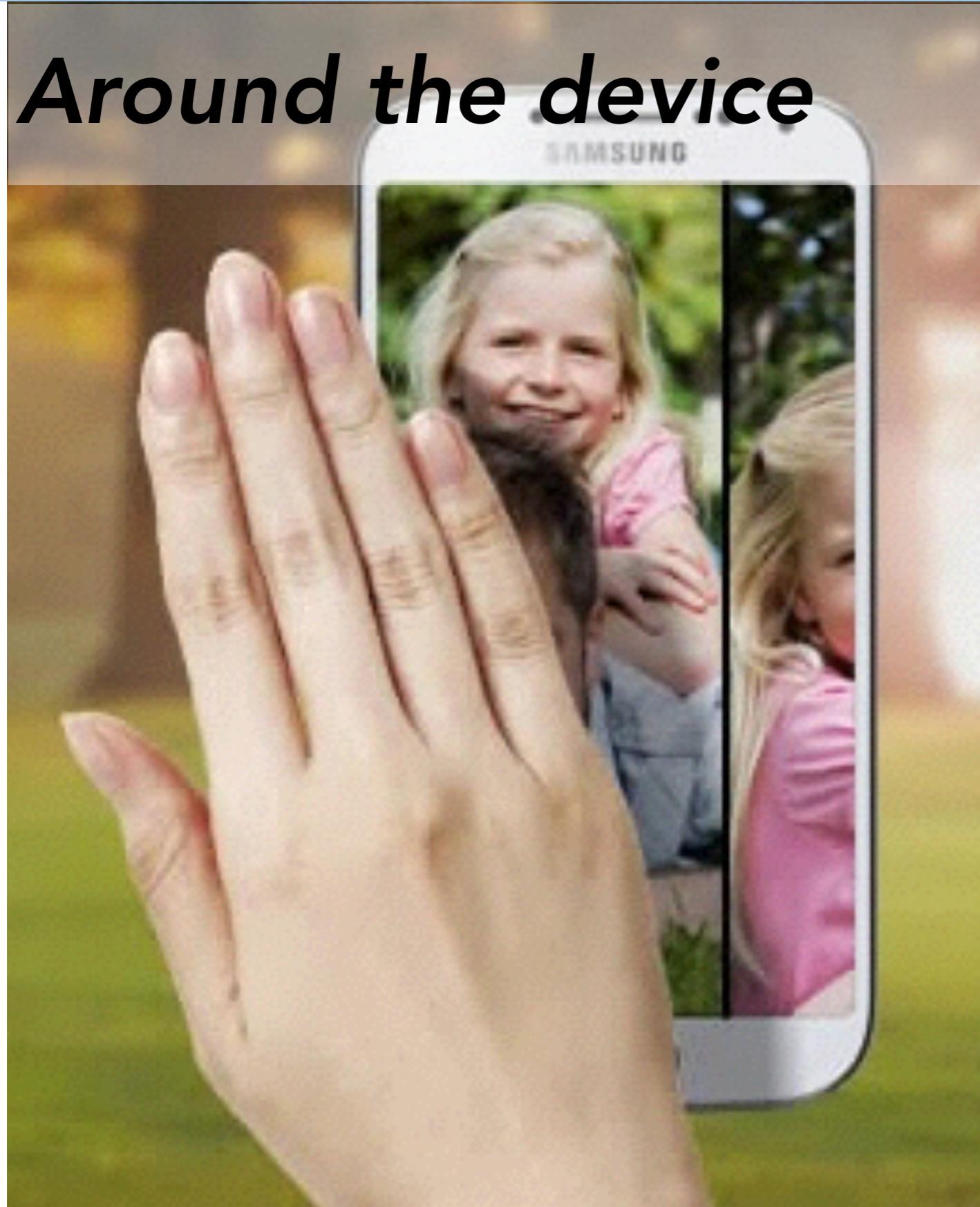
- Object
- Number of fingers body part

Pen vs. touch objects

With the device

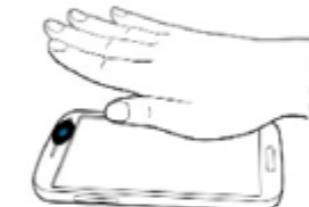


> Gestures in interaction

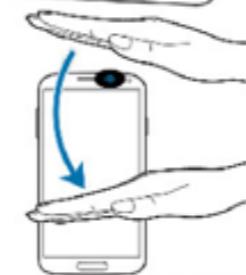


Around the device

Quick Glance
When the screen is turned off, move your hand above the sensor to view notifications, missed calls, new messages, time and date, and more.



Air Jump
While viewing emails or webpages, move your hand up or down across the sensor to scroll the page up or down.



Air Browse
Move your hand to the left or right across the sensor to browse images, webpages, songs, or memos. time and date, and more.



Air Move
Tap and hold an icon with one hand, and then move your other hand to the left or right across the sensor to move the icon to another location. You can also use this to move items in your calendar.



Air Call-Accept
When a call comes in, move your hand to the left, and then to the right across the sensor to answer the call.



S4
AllAboutGalaxyS4

Source: Galaxy S4 User Manual

Around the device

**Abracadabra: Wireless, High-Precision,
and Unpowered Finger Input for Very
Small Mobile Devices**

Chris Harrison

chris.harrison@cs.cmu.edu

Scott Hudson

scott.hudson@cs.cmu.edu



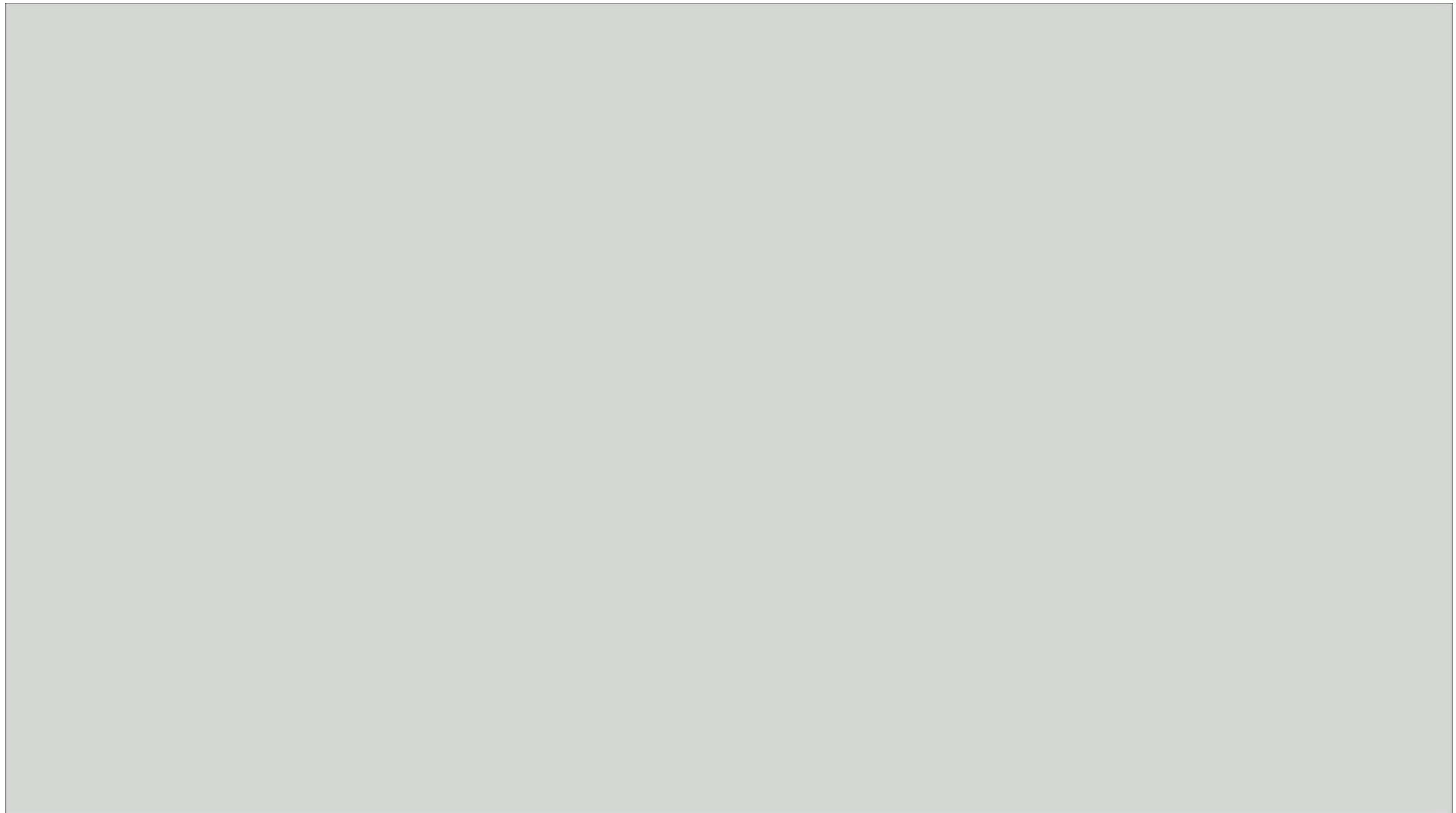
Human-
Computer
Interaction
Institute

Carnegie Mellon

Far from the device



Far from the device



LeapMotion

Synthesis

Gestures can be “mapped” to discrete and/or continuous outputs

Gestures can be analog or abstract

- Depending on the extent to which they mimic the physical or conventional aspect of the world

Gestures can be processed (typically recognized) after execution or during execution

Complexity of gestures has several orders and involves expertise

Gesture can relate with the device according to four different ways

- On, with, around, or far