

Lecture 2

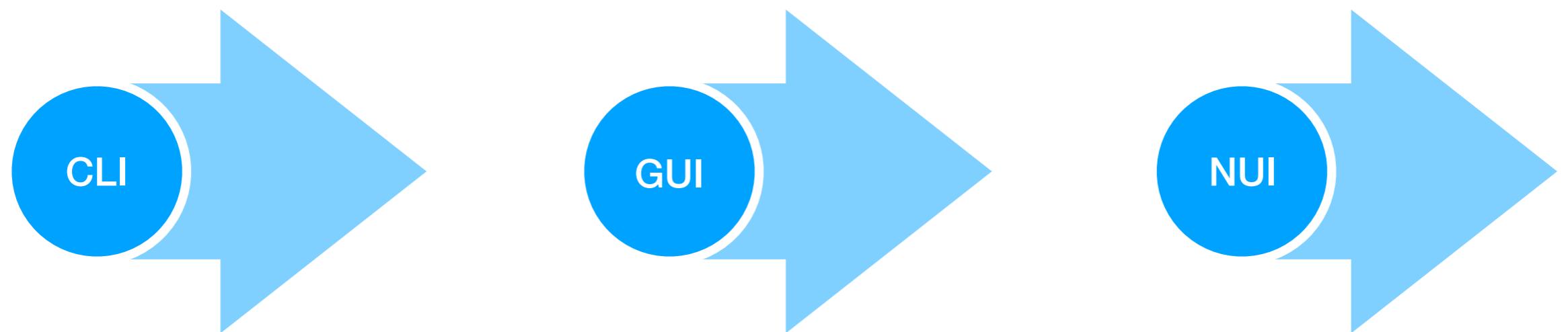
Gestural Interaction

Baptiste Caramiaux

Outline

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

1. Brief history and examples



Applications

Gestural interaction
with mobile systems

Somehow more
“natural” than writing
text



Applications

Shape Writer



“Quick”

Kristensson, P.O. and Zhai, S. (2004). SHARK²: A Large Vocabulary Shorthand Writing System for Pen-Based Computers. *UIST*

Applications

Video games



Applications



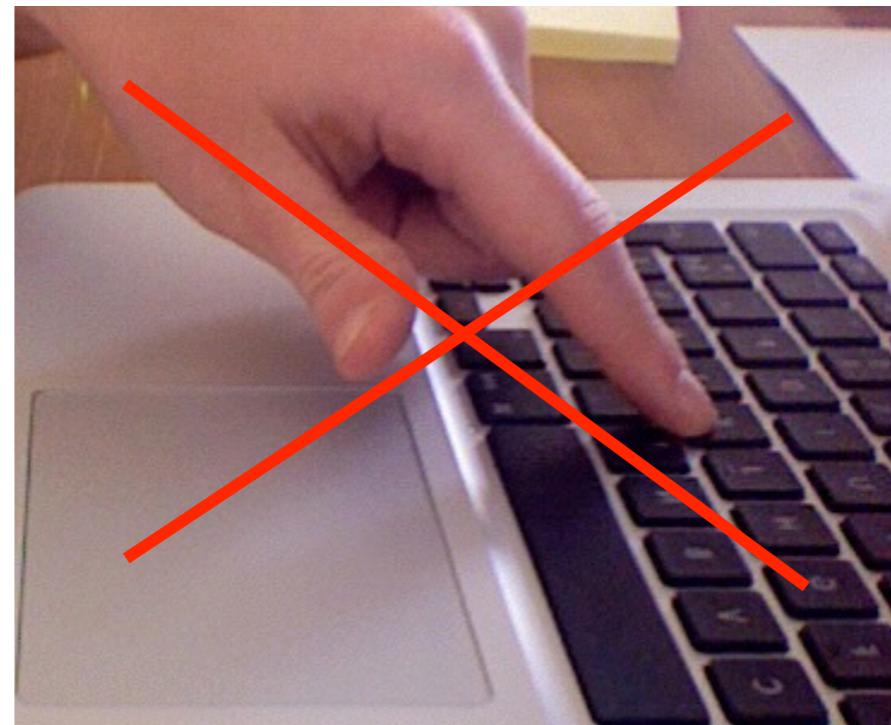
Science Fiction



2. Gesture: definitions, functions

Defining gesture

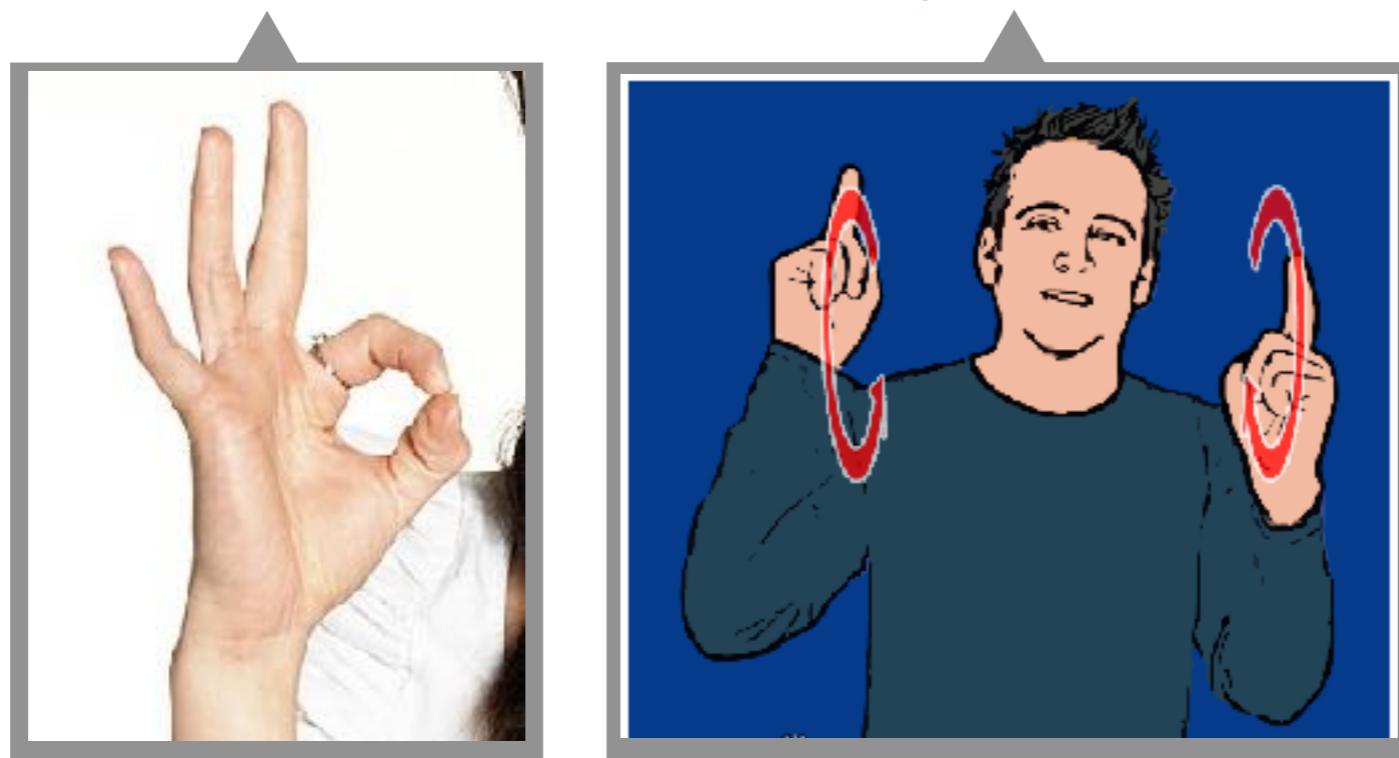
A **gesture** is a **motion** of the body that contains information
[Kurtenbach & Buxton]



=> **What** it is performed

Static and dynamic gestures

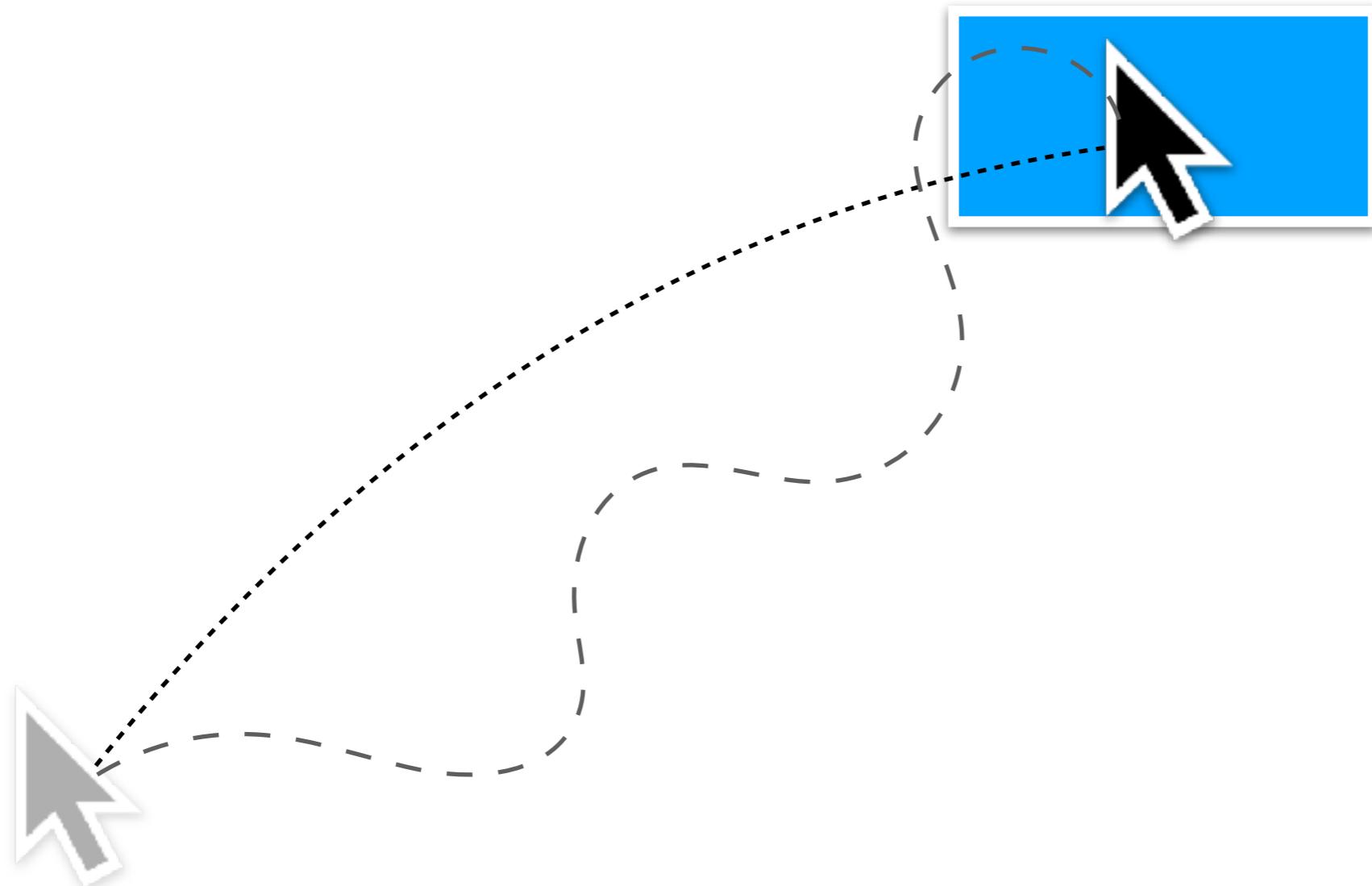
Gesture can be **static** (aka *posture*) or **dynamic**



Alternative definition: a gesture is a motion of the body, with a clear **beginning** and an **end**, that **conveys** information

=> **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

Semiotic gestures

To communicate meaningful information



Ergodic gestures

To manipulate the physical world and create artefacts



Epistemic gestures

To learn from the environment through tactile experience and haptic exploration



3. Gestures in interaction

Why using gestures in UI?

Why using gestures in UI?

Based on user's existing drawing and handwriting **skills**
[Kurtenbach et al. 94]

Physically chunk a command and its operands into a single action
[Buxton et al. 86]

Implicit and fast mode switching

Eyes-free interaction

Alternative to buttons for small displays

Fun

Distant interaction

...

Why using gestures in UI?

Pick up examples

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:

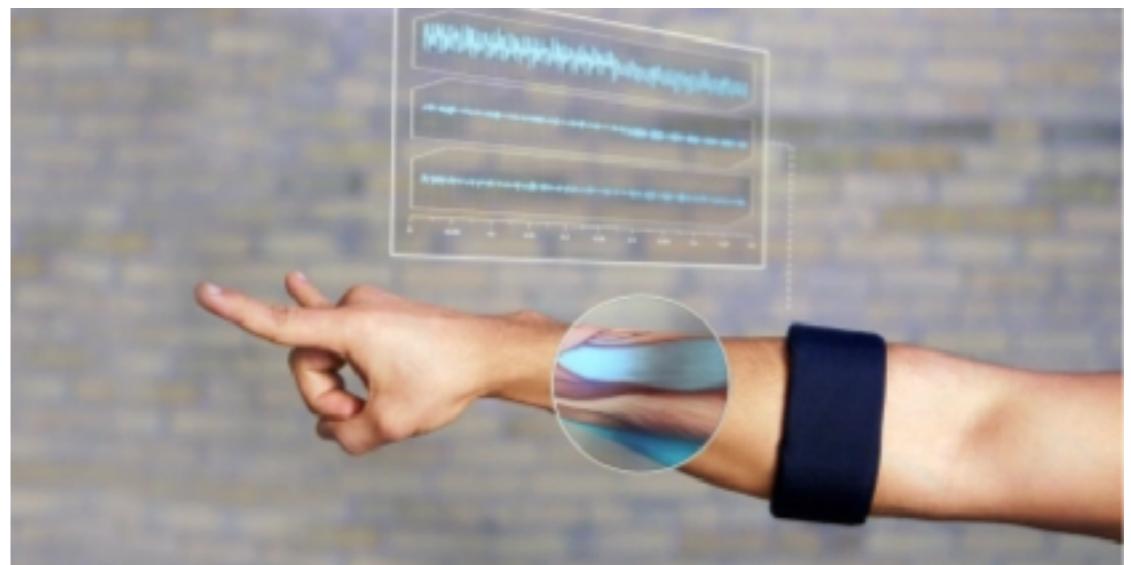
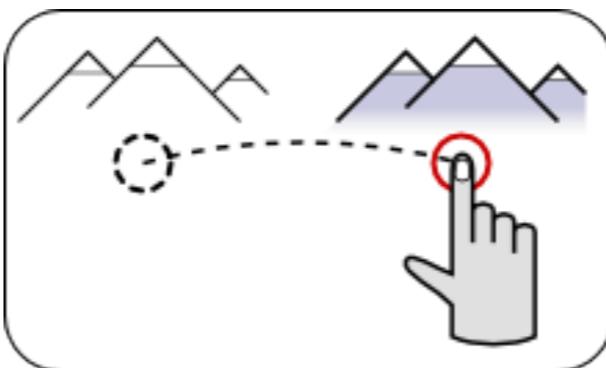
- Gesture to textual symbols



Continuous outputs

Gesture to range of values:

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



Myo by Thalmic

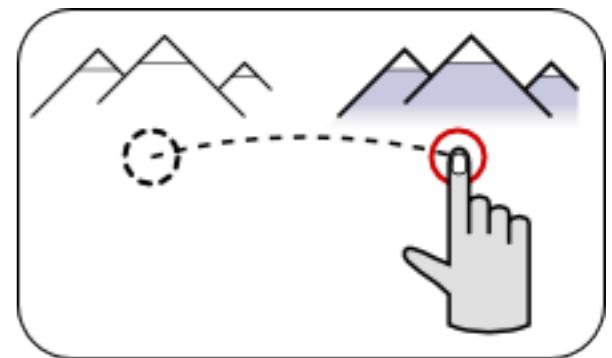
Musical example

Violin

Analog vs. abstract gestures

Analog gestures

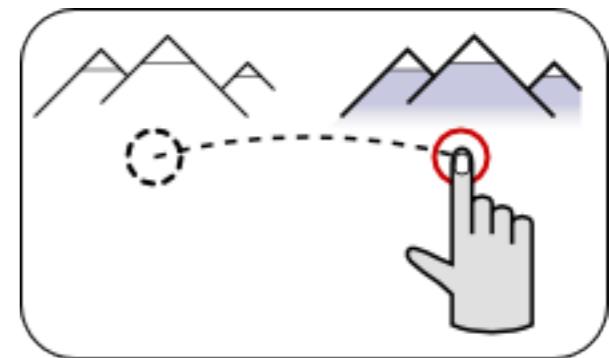
- Mimic the physical or conventional effects of the world
- Direct manipulation
- easier to learn
- example : slide gesture can cause a document to pan



Analog vs. abstract gestures

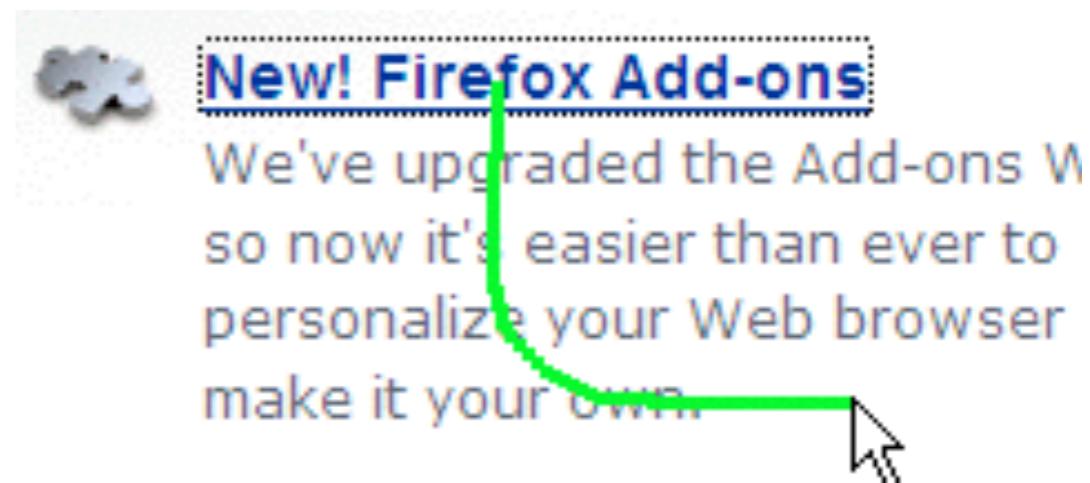
Analog gestures

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



Abstract gestures

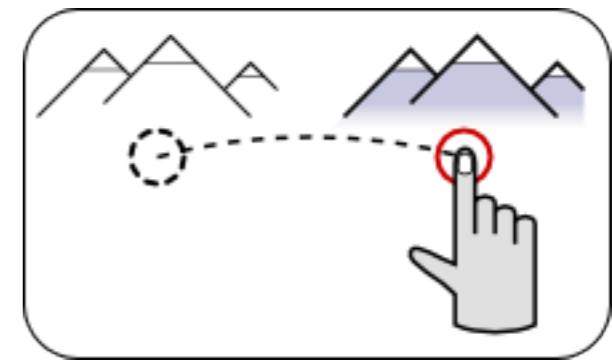
- arbitrary
- example: draw X to close a document



Analog vs. abstract gestures

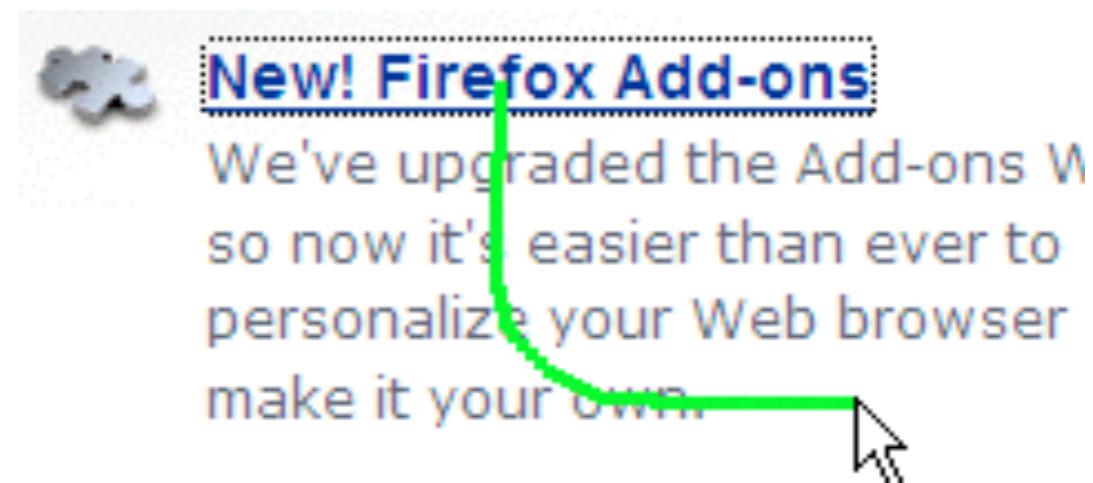
Analog gestures

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



Abstract gestures

- arbitrary
- example: draw X to close a document



Analog-Abstract classification

- is a spectrum (not a dichotomy)
- resemble physical effects to a degree

Temporality: post hoc, realtime

Post hoc

- Recognizing a gesture after it has been completely drawn

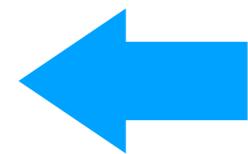
Realtime

- 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

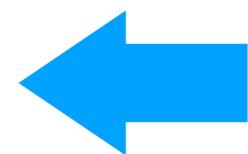
Realtime

- Recognising a gesture as it is drawn
- Requires feedback

Temporality: post hoc, realtime

Post hoc

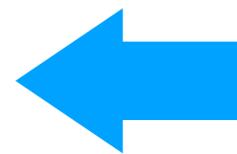
- Recognizing a gesture after it has been completely drawn



Commonly used strategy

Realtime

- Recognising a gesture as it is drawn
- Requires feedback



**More powerful,
more challenging!**

'post-hoc' example: \$1 recogniser

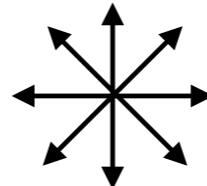
<http://depts.washington.edu/madlab/proj/dollar/index.html>

'realtime' example: GVF

Complexity

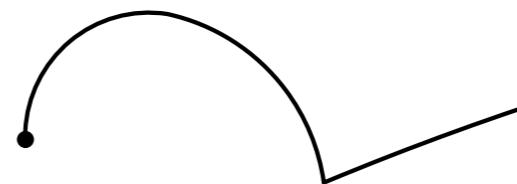
Zero order

- 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



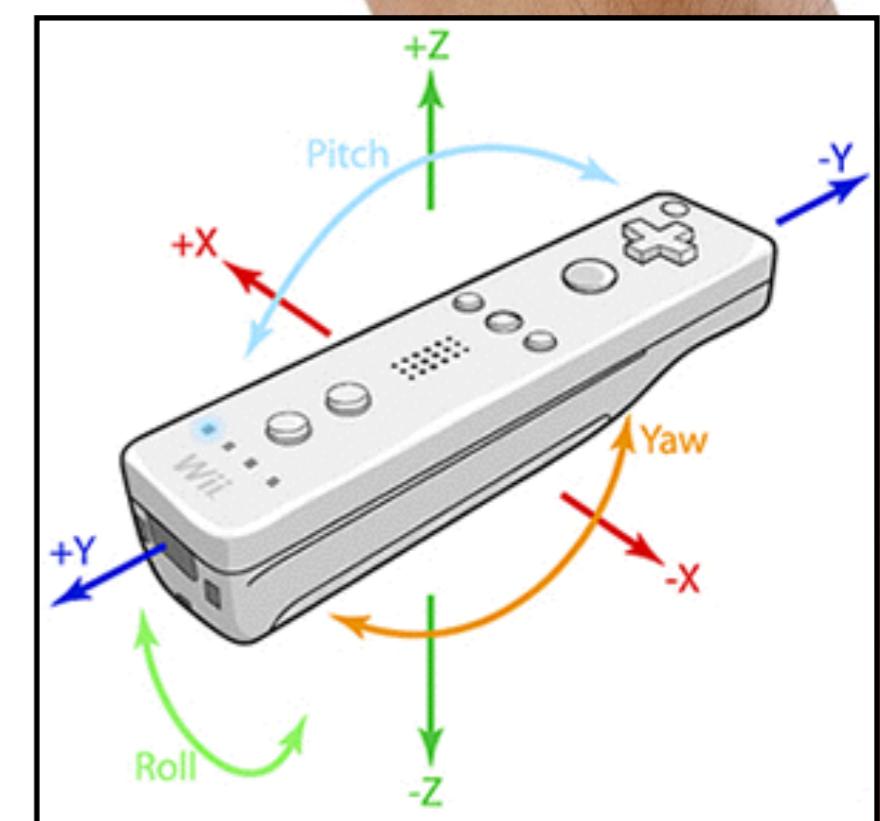
around the device



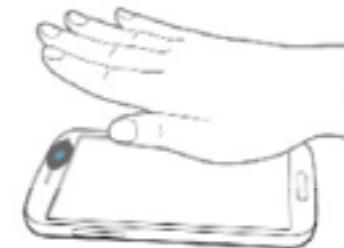
far from the device

On the device

With the device



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

Far from the device

Kinect, myo, leap

4. Designing gestural interaction

Designing gestural interactions

Imagine you are a **designer**

You have a list of **24 commands** ...

...and you want (have) to build a **gestural interface**

What do you have to do?

Steps

Create a **gesture set**

Define a gesture-command **mapping**

Build a gesture **recognizer**

Provide a **teaching** method

Evaluate your design

Steps

→ Create a **gesture set**

Define a gesture-command **mapping**

Build a gesture **recognizer**

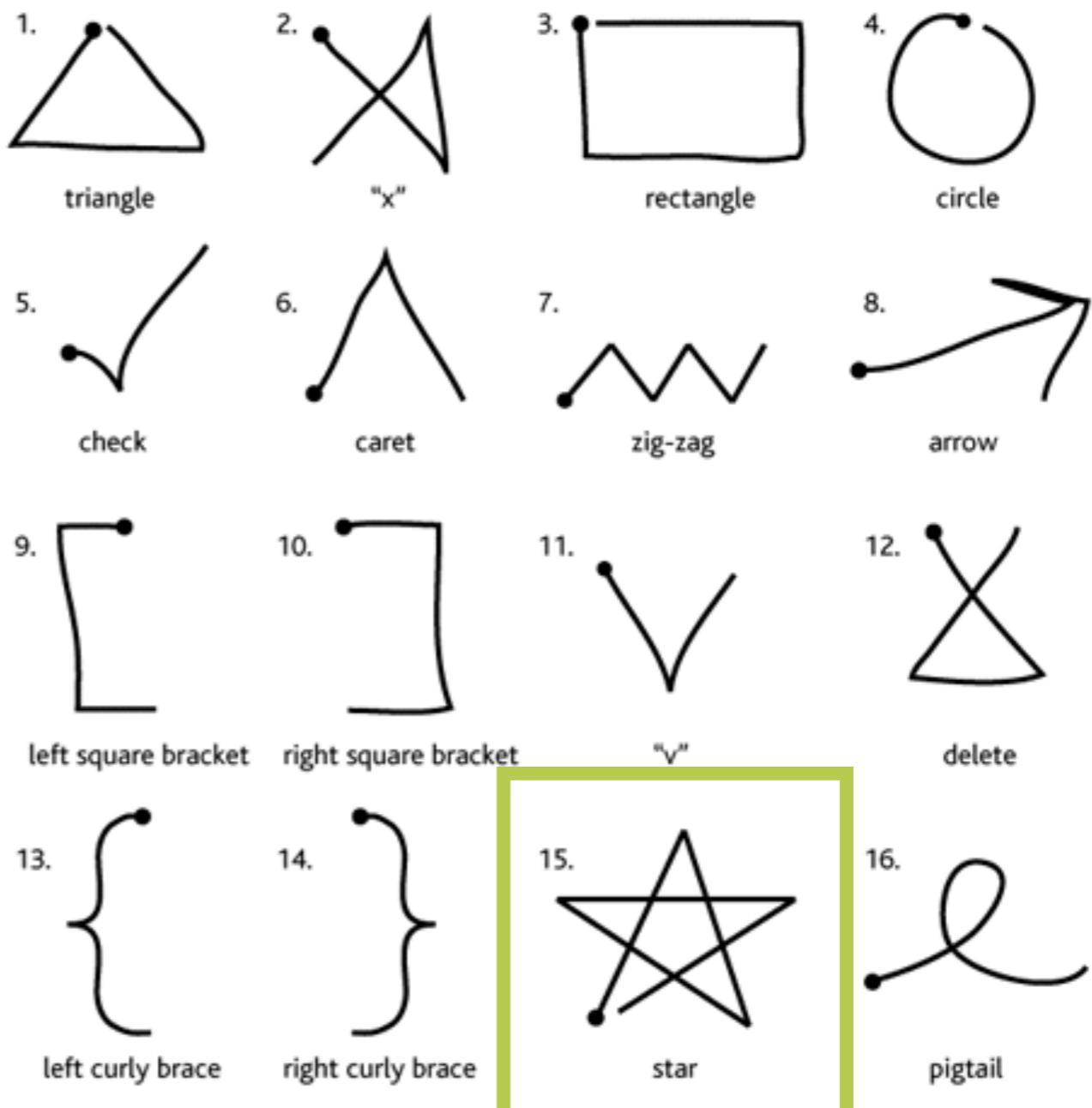
Provide a **teaching** method

Evaluate your design

Create a gesture set

No Grammar

Gestures as symbols



Create a gesture set

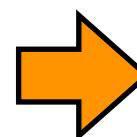
Grammar

Hierarchy, articulatory meaning



Orientation + Curvature

Steps

 Create a **gesture set**

Define a **gesture-command mapping**

Build a **gesture recognizer**

Provide a **teaching** method

Evaluate your design

User-centred approach

Goal

- Capture “natural” mappings

User-centred approach

Goal

- Capture “natural” mappings

Procedure:

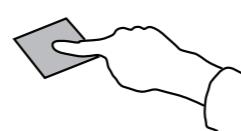
- Several users
- The experimenter shows the effect
- Users have to guess the gesture
- For each command, keep the most frequent gesture

User-centred approach

Examples on a touch surface

- Select

Select Single₁:tap

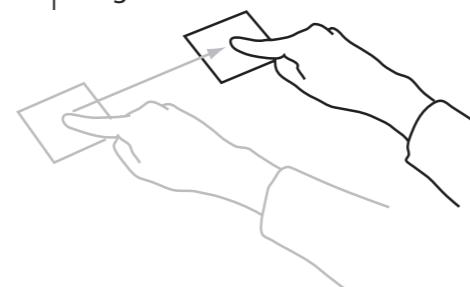


Select Single₂:lasso

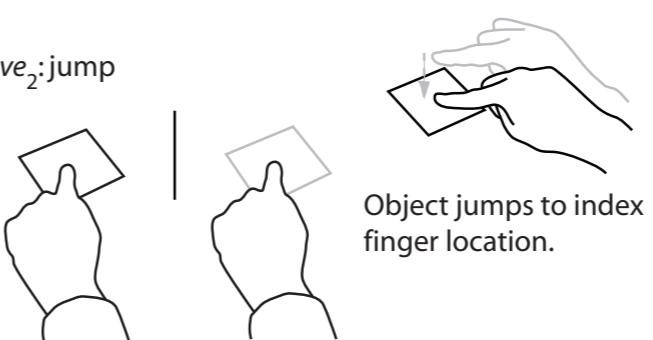


- Move

Move₁:drag

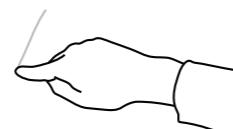


Move₂:jump



- Cut

Cut:slash



Cuts current selection (made via Select Single or Select Group).

(Wilson et al. User-Defined Gestures for Surface Computing. CHI'2009)

Is it a good technique?

Advantage: used expectation from users (“natural” mappings)

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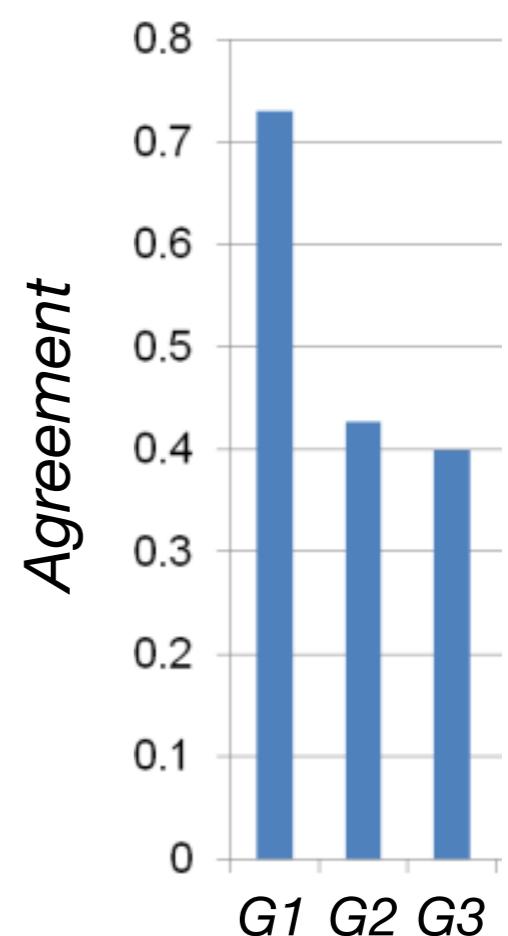
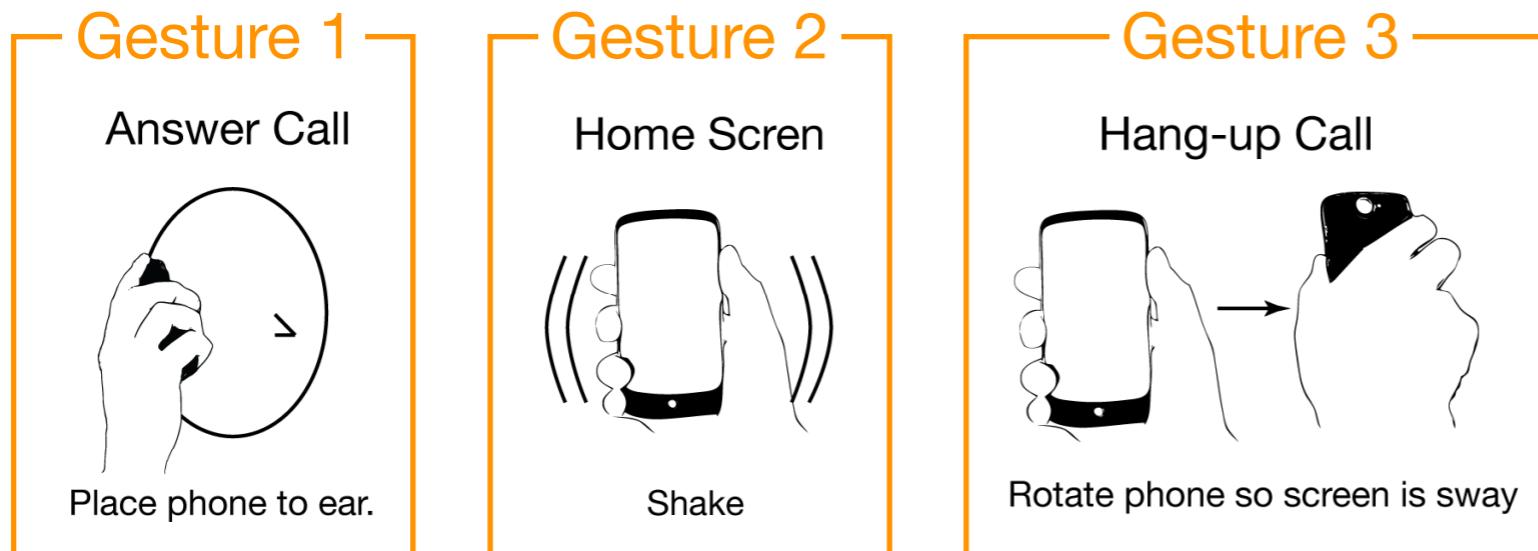
Problem: does work for a tiny set of gestures

Is it a good technique?

Advantage: used expectation from users (“natural” mappings)

Problem: does work for a tiny set of gestures

Example with mobile interaction



(Ruiz et al. User-Defined Motion Gestures for Mobile Interaction. CHI'2011)

Other approaches

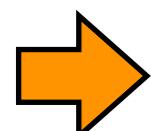
Semantic relationships

Questioning the mapping

If no agreement, is gestural interaction needed at all?

Steps

Create a **gesture set**

 Define a **gesture-command mapping**

Build a gesture recognizer

Provide a teaching method

Evaluate your design

Gesture recognition

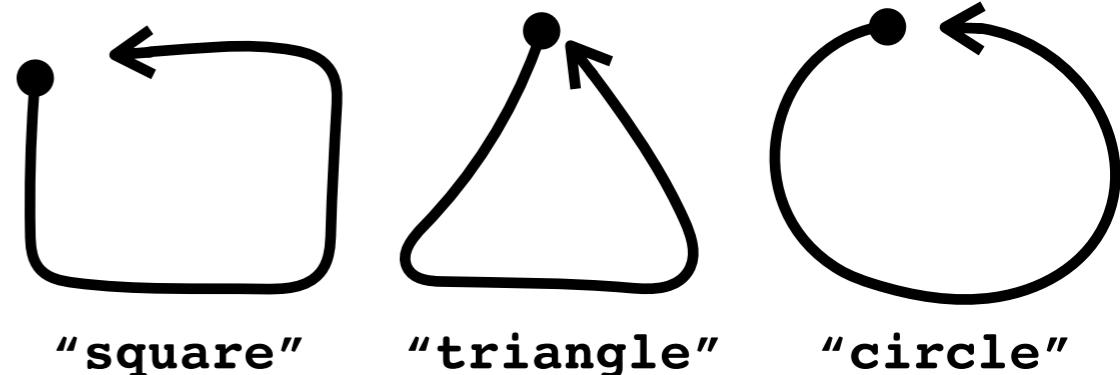
A gesture **recognizer** is a system able to take an **input gesture** and **classify** it as being one of the defined gestures of a given **vocabulary**.

Two main strategies

- Template-based approach
- Training-based approach

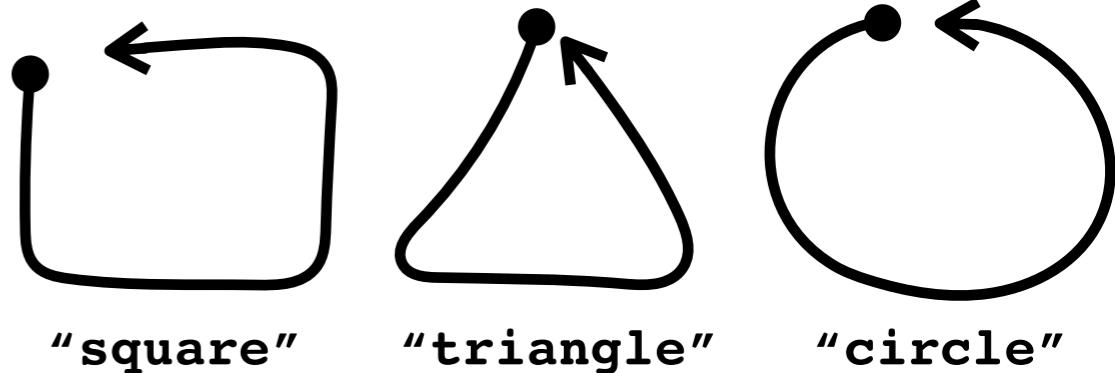
Template-based

Record a set of gestures (**vocabulary**)
and assign a label to each gesture

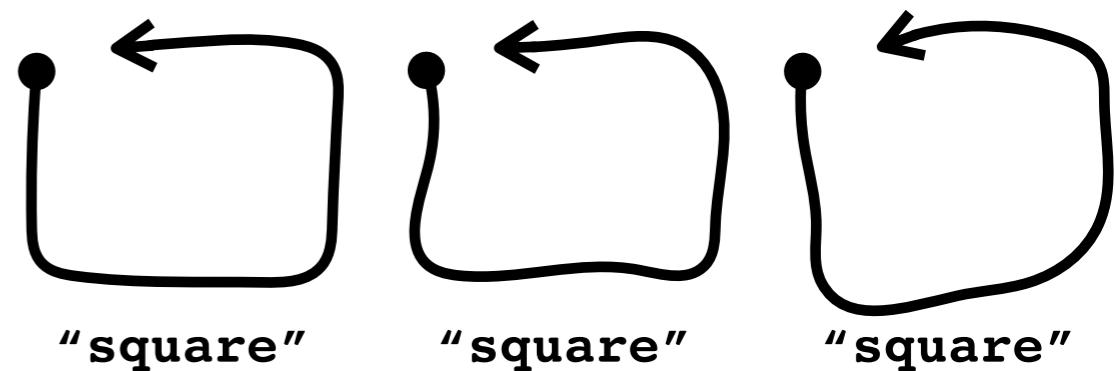


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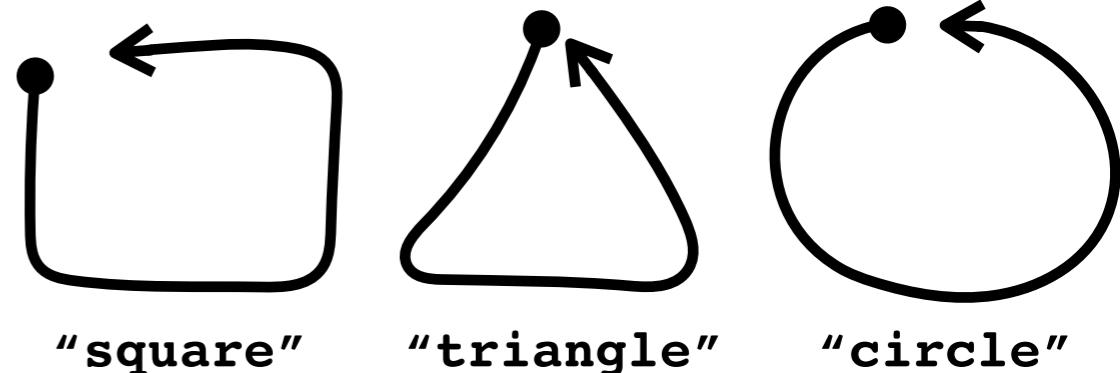


Each recorded gesture can be recorded
once or a multiple times (with the **same label**)

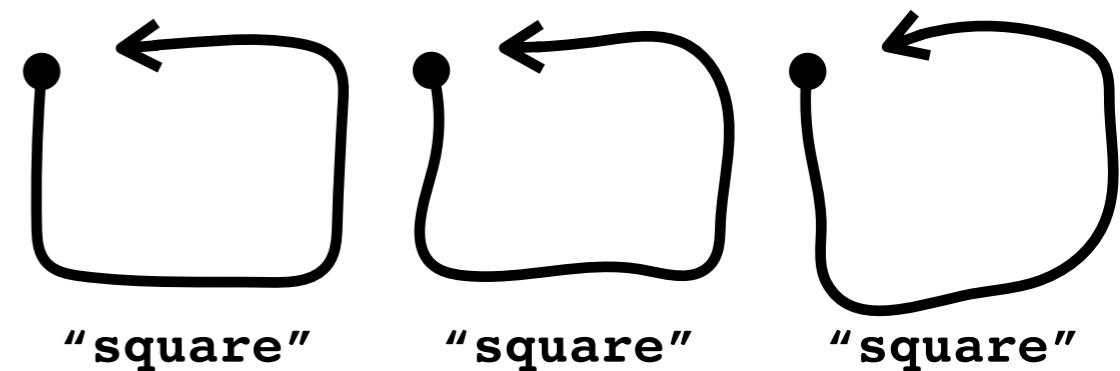


Template-based

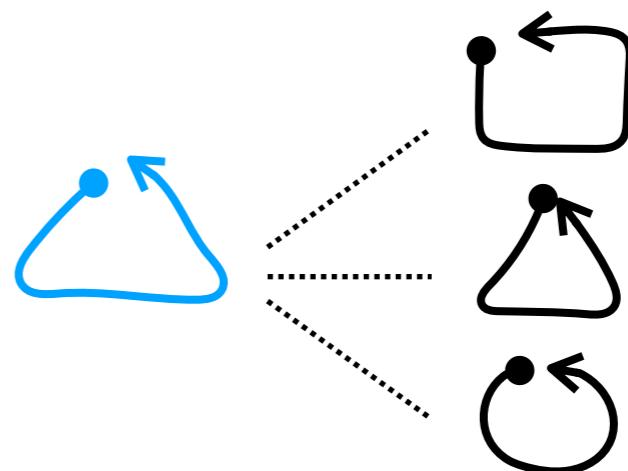
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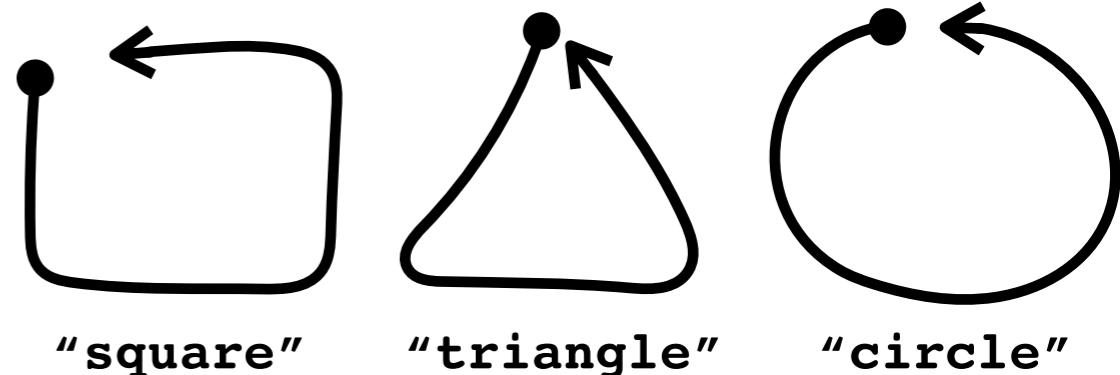


For an input unknown gesture, compute
distance between the input gesture and the
pre-recorded gestures

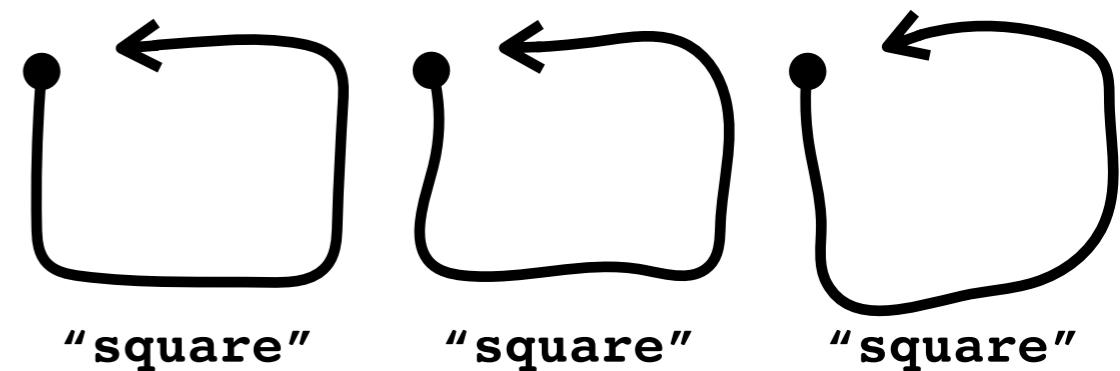


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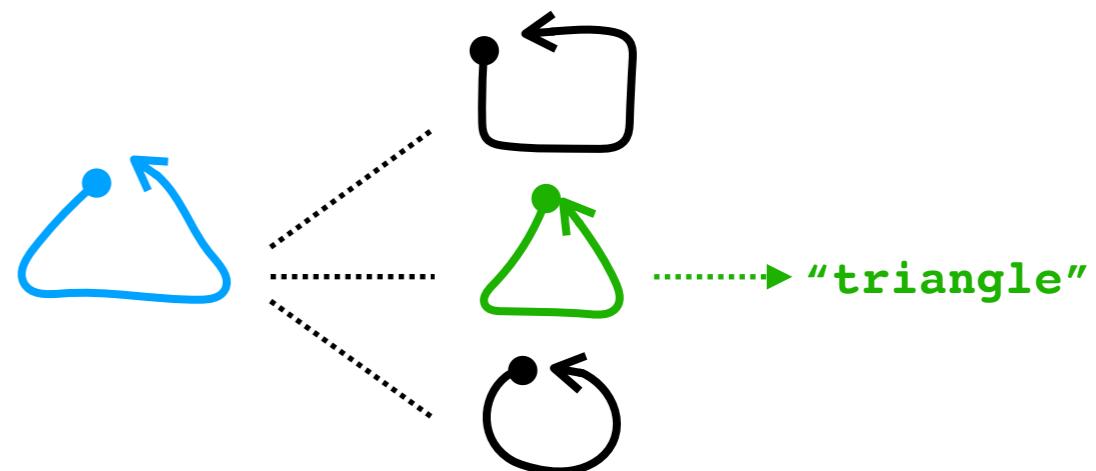
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and assign a label to each gesture



Each recorded gesture can be recorded
once or a multiple times (with the **same label**)



For an input unknown gesture, compute
distance between the input gesture and the
pre-recorded gestures



Return gesture label w.r.t smallest distance value

Examples

HCI literature

- Rubine (Rubine, 1991)
- \$1 recognizer (Wobbrock et al. 2007)

Machine-learning literature

- k-Nearest Neighbor
- Dynamic Time Warping for classification

Steps

Create a **gesture set**

Define a **gesture-command mapping**

 **Build a gesture recognizer**

Provide a teaching method

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Steps

Create a gesture set

Define a gesture-command mapping

Build a gesture recognizer

→ Provide a teaching method

Evaluate your design

Guidelines

If no agreement, is gestural interaction needed at all?