CPE/CSC 486: Human-Computer Interaction

Franz J. Kurfess

Computer Science Department
California Polytechnic State University
San Luis Obispo, CA, U.S.A.

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Course Overview

- Introduction
- Cognitive Foundations
- Input-Output Devices
- Interaction Spaces
- Interaction Styles
- Interaction with Mobile Devices
- Speech-Based Interaction
- User Assistance
- Natural User Interfaces
- Case Studies
- Project Presentations

Chapter Overview
Interacting with Devices

- **Agenda**
- **Motivation**
- **Objectives**
- **Basic Concepts**
  - Problem Space
  - Interaction
  - Information Transmission Channel
  - Encoding
- **Interaction Space Characteristics**
  - spatial aspects
    - dimensions
    - proximity
  - temporal aspects
    - dimension
    - persistence
  - transmission
    - encoding
    - medium
  - resilience
  - navigation
- **Important Concepts and Terms**
- **Chapter Summary**

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Logistics

- **Use of HCI Lab Facilities**
  - Morae
  - reservations for exclusive use of the lab
- **Open House: Fri, April 13 + Sat, April 14**
  - opportunity for usability evaluations and data collection
    - Fri ~2:30 - 4:00 pm: new students, parents
- **Loaner Devices Checkout**
  - iPads, XBox + Kinect, PS3 + Move, Qualcomm Android kits
- **Assignments**
  - A1 due today
    - project-related => TRAC Wiki
    - others => PolyLearn Assignment Submission
  - A2 published (same as 484 - A4)
- **Research Activity**
  - topic selected?
  - dissemination method discussed (paper, blog, video)
- **Term Project**
  - addition of students who enrolled late
  - contact and regular meetings with external customers

Motivation

- the devices used for input and output determine the nature and capacity of information transferred between human and computer
- characteristics of the I/O devices influence user interface design to a large degree
- the choice of an inappropriate or inadequate design will diminish the performance of the task
- combinations of I/O devices can increase the usability of a system

Objectives

- identify the main I/O devices used in computer systems
- know the important characteristics of these devices
- evaluate the suitability of I/O devices for particular purposes or tasks
- be able to select an appropriate combination of I/O devices for a specific task

Basic Concepts
-
Interaction Spaces

- Problem Space
- Interaction
- Information Transmission Channel
- Encoding

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Problem Space

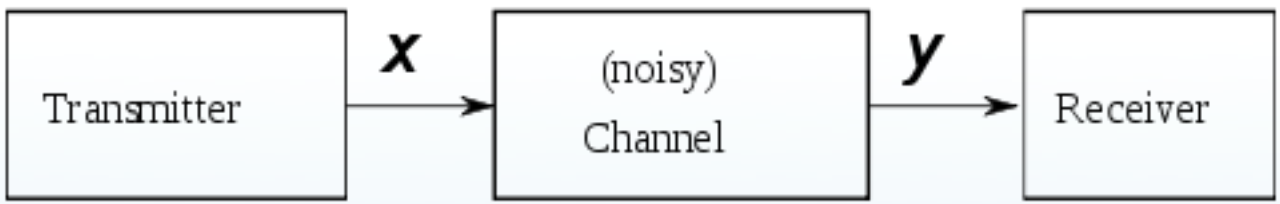
- **"Interaction Space" in analogy to "Problem Space"**
  - abstract space that captures possible interactions
    - analogous to possible solutions in the problem space
  - possibly represented as a graph
    - I'm not sure if this actually works ...
    - may require a suitable abstraction
      - continuous => discrete?
  - interaction
    - path through the interaction space
  - interaction points
    - nodes in the graph spanning the interaction space
  -

Interaction

- **sequence of communication activities between two entities**
  - in this context:
    - human
    - computer
- **requires communication channels**
  - pairs of compatible actuators and sensors

Information Transmission Channel

- **connects a transmitter and a receiver**
- **transmits information**
  - possibly affected by noise
  - limited by the channel capacity

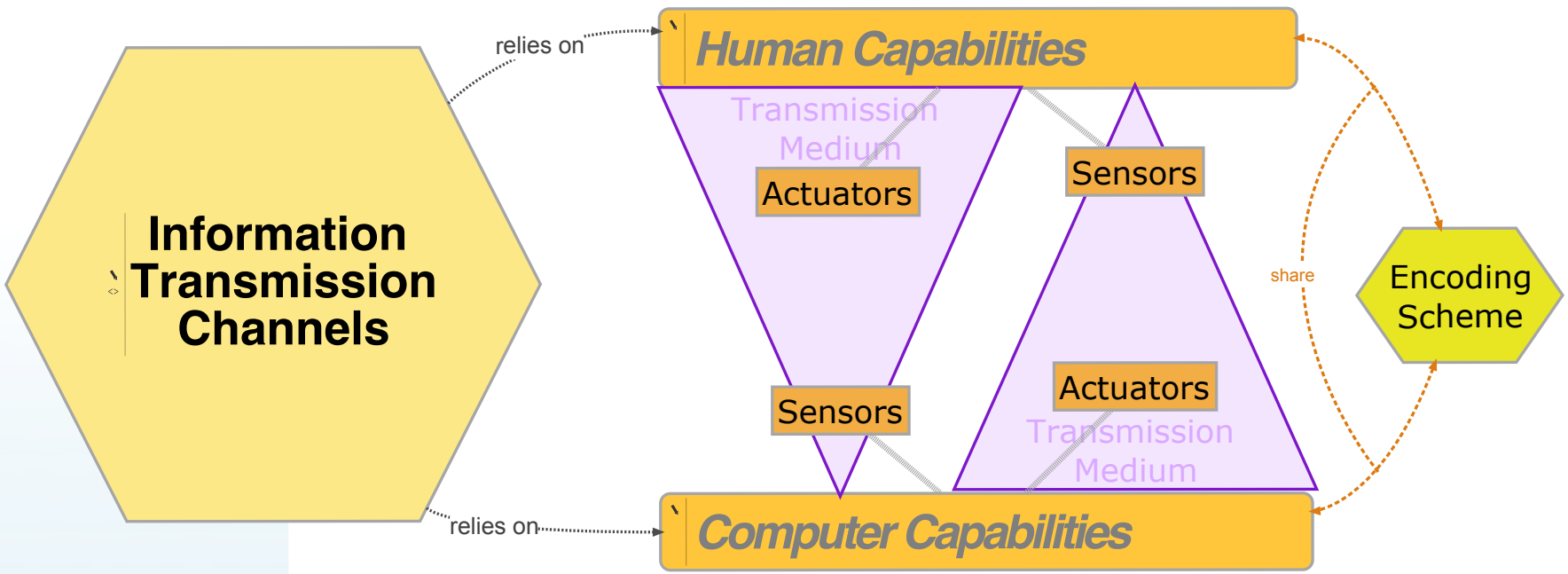


http://en.wikipedia.org/wiki/Channel_(communications)
http://en.wikipedia.org/wiki/Channel_capacity

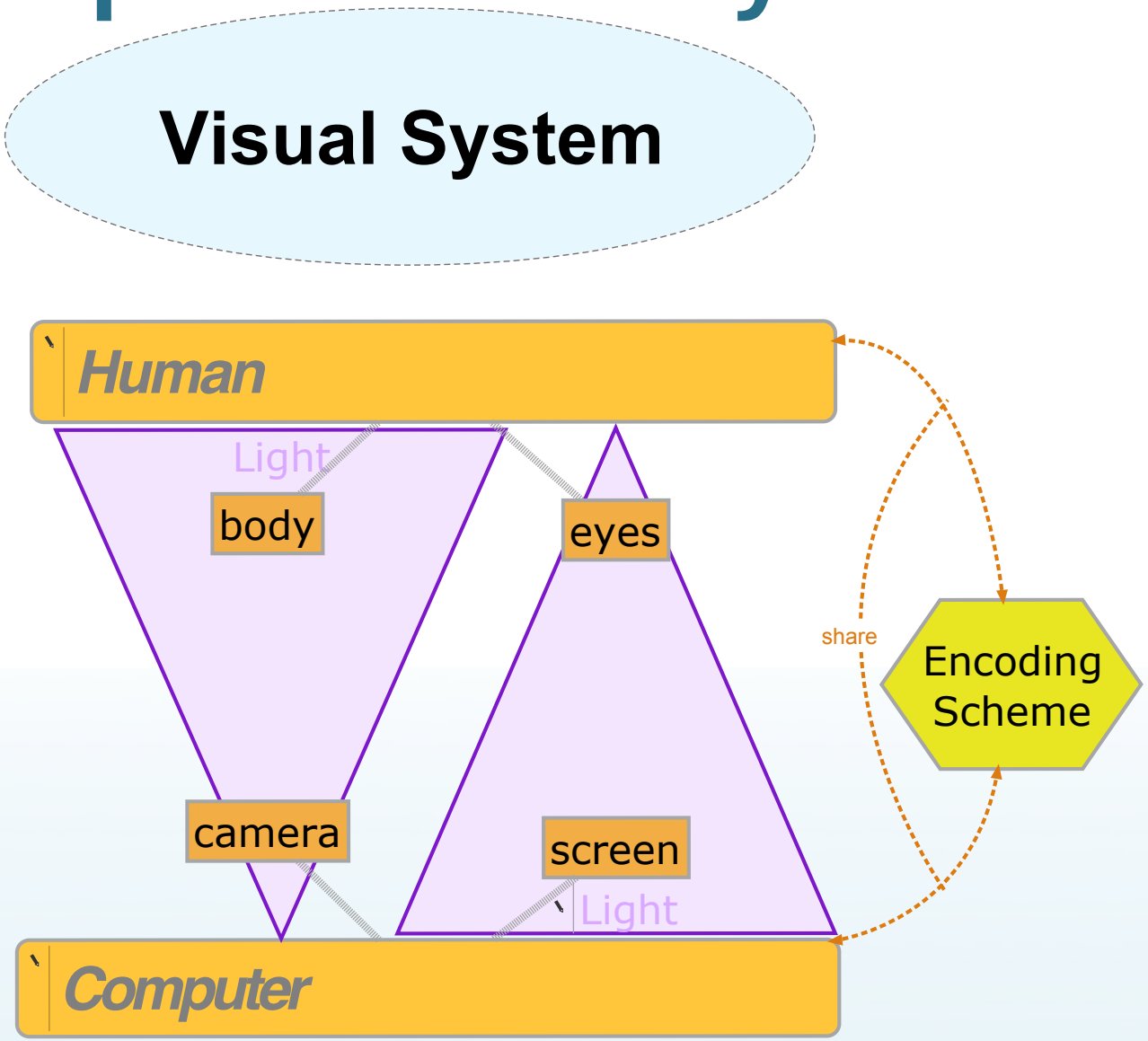
Encoding

- **mapping from a source alphabet to a target alphabet**
  - decoding is the reverse operation
-

Information Transmission Channels Diagram



Example: Visual System



Characteristics
-
Interaction Spaces

Spatial Aspects

- **dimensions**
  - 1D
  - 2D
  - 2.5D
  - 3D
- **proximity**
  - direct contact
    - touch
  - close proximity
    - within reach
  - medium
    - within transmission range
  - far
    - beyond transmission range

Temporal Aspects

- **dimensions**
  - 1D
    - linear nature of time
  - 1.5 D
    - signals as waves?
- **persistence**
  - duration of signal availability
    - sender
    - receiver
  - signal preservation
    - natural via remembering
    - technological via recording

Signal Transmission

- **encoding**
  - text, icon, image, sound
- **transmission method**
  - electromagnetic waves
    - light
    - sound
  - direct contact
- **transmission medium**
  - natural
    - air, water, solid material
  - technology
    - wire, wireless

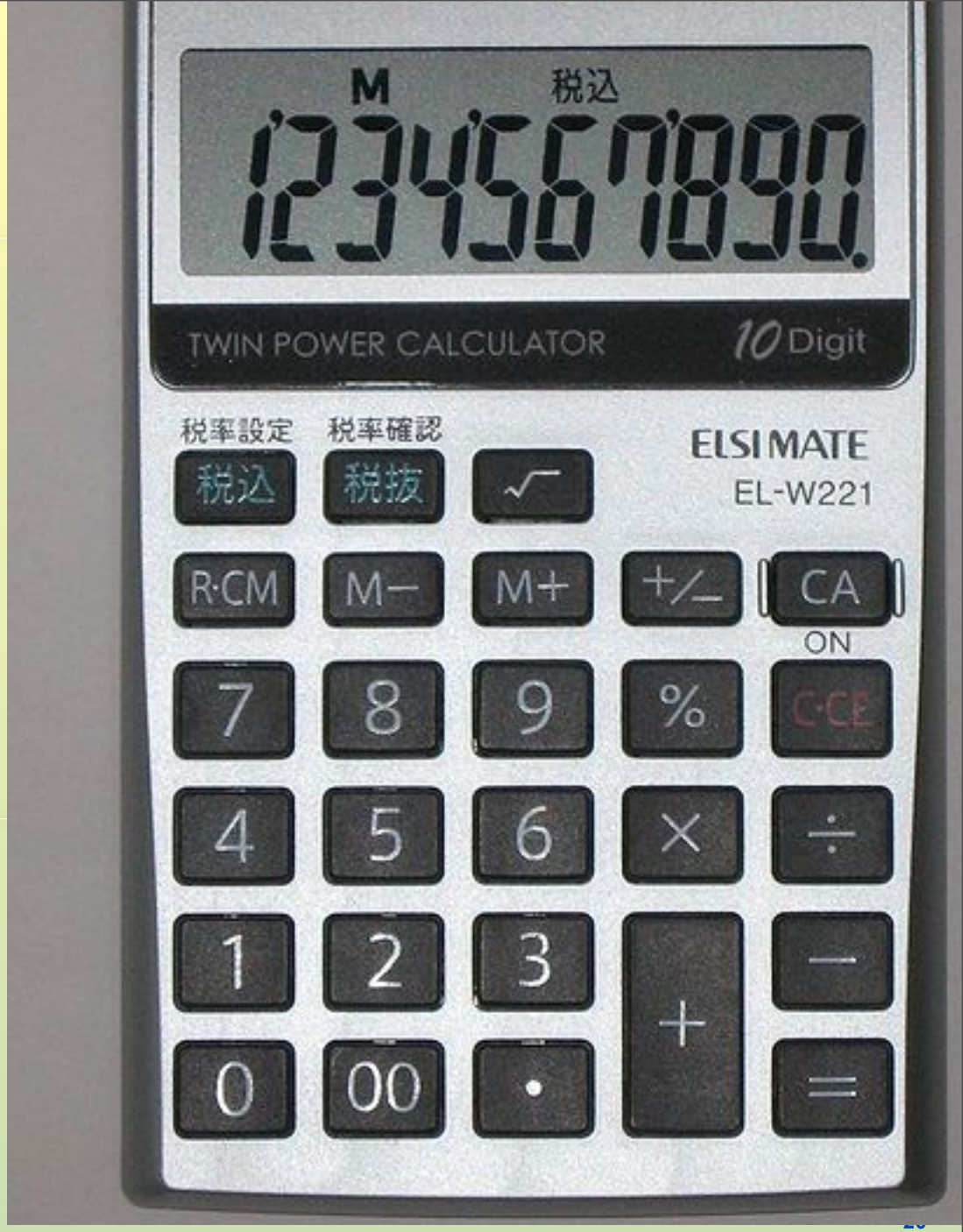
Resilience

- **capability to resist interference**
  - noise
  - multiple signals
  - attention

Navigation

- selection of relevant elements of the interaction space

Example: Calculator



http://en.wikipedia.org/wiki/File:SHARP_ELSIMATE_EL-W221.jpg

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Interaction Space

- **domain: simple arithmetic calculations**
- **interaction**
  - pressing a number key results in the display of its value
  - sequence of input actions terminated by an operator key yields an output by the device
    - somewhat simplified
- **information transmission channels**
  - calculator => human: visual
  - human => calculator: touch

Sensor & Actuator Configuration

- **Input**
  - set of keys
    - labeled with symbols indicating values [0 ... 9] and operations
- **Output**
  - 10-digit LCD panel
    - 10 times seven-segment digit
    - additional symbols for operations

Interaction Space Characteristics

- **spatial**
  - 2-D arrangement of LCD panel and input symbols
    - mostly for convenience
    - spatial arrangement of 7-segment digits is important
      - decimal system with powers of 10
      - very limited 2-D display
        - with powers of 10 as horizontal dimension
        - digits indicate value for the vertical dimension
- **temporal**
  - 1-D
    - sequential
  - persistence
    - high: signal remains until it is overwritten

Channel Capacity: Human => Device

- ~ 30 keys
- no chording
- no modifier keys
- limited input sequence
  - precision: limit on numerical digits
  - limit on operations unclear
    - internal memory limit?
- input speed ~ 1 key / second
  - more limited by human capabilities than by device constraints

Channel Capacity: Device => Human

- **10 times 7-segment display**
  - all can be simultaneously active
    - equivalent of chording in input devices
- **~10 additional symbols**
  - limited simultaneous activity
  - some act as modifier symbols
    - minus symbol for negative values
    - decimal points
- **limited output**
  - no sequences: all values displayed simultaneously
    - with the exception of input confirmation for pressed keys
  - limited to 10 numerical digits
    - precision
    - magnitude
- **output response time**
  - ~ tenths of seconds (estimate)
    - "fast enough" for human capabilities
    - possibly slower for complex calculations

Activity: Interaction with a Simple Device

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http://en.wikipedia.org/wiki/File:SHARP_ELSIMATE_EL-W221.jpg

Interaction Space

- **domain**
- **interaction method**
  - brief, informal description
- **information transmission channels**
  - device => human
  - human => device
- **Sensor & Actuator Configuration**
  - Input
  - Output
- **Interaction Space Characteristics**
  - spatial
  - temporal
- **Channel Capacity:**
  - Human => Device
    - keys
      - modifier keys
      - chording
    - input sequences
    - input speed
  - Device => Human
    - output components (actuators)
      - simultaneously active ?
        - equivalent of chording in input devices
    - output sequences
    - output speed
      - response time

Important Concepts and Terms

- auditory input/output
- brain-computer interaction (BCI)
- button
- camera
- controls
- cursor keys
- display
- handwriting recognition
- human-machine interface
- icon
- input devices
- joystick
- key
- keyboard
- microphone
- monitor
- mouse
- output devices
- pointing devices
- printing devices
- scanner
- screen
- speech recognition
- speech synthesis
- sound
- switch
- tactile input/output
- trackball
- touch screen
- usability
- use case scenarios
- visual input/output

Additional Reading

[Mustillo]

Chapter Summary