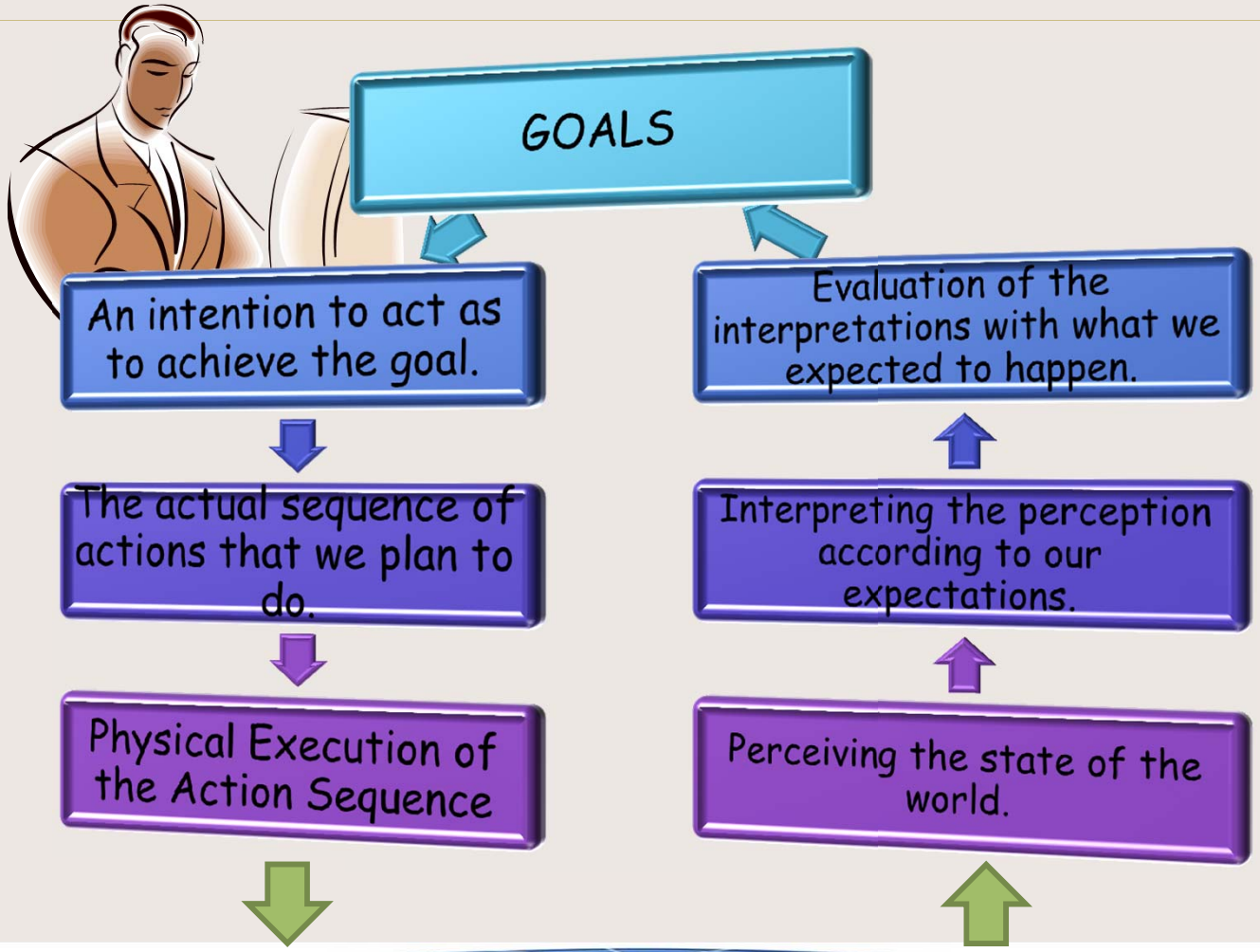
User Interface Design

Lecture 7

Choosing Interaction Elements

Hardware & Software Components

Review: Activity Cycle



Choosing Interaction Devices

- **Interaction Devices as Tools**
  - Tools to fit the task
- **Why Study Interaction Devices?**

Input Devices

- Keyboards, Keypads, Buttons and other devices:

Keyboards

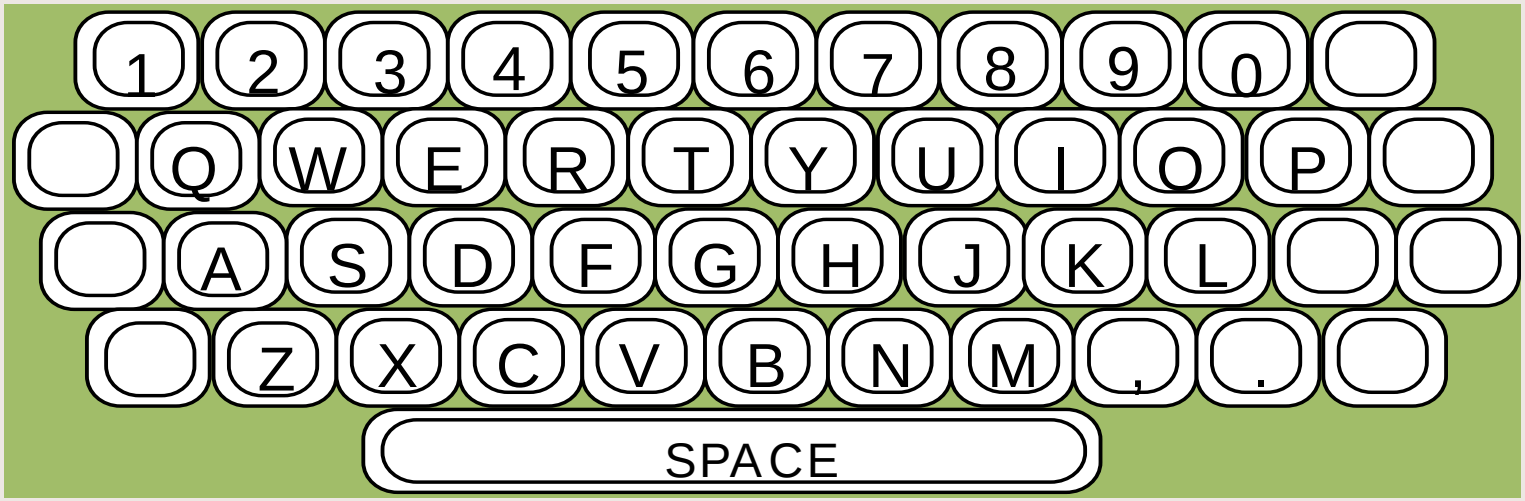
Layout – QWERTY

- invented by Sholes
- Standardised layout (American Standard Institute in 1971)

  but …
  - non-alphanumeric keys are placed differently
  - accented symbols needed for different scripts
  - minor differences between UK and USA keyboards

- QWERTY arrangement not optimal for typing
  - layout to prevent typewriters jamming!
- Alternative designs allow faster typing but large social base of QWERTY typists produces reluctance to change.

QWERTY (ctd)



Alternative keyboard layouts

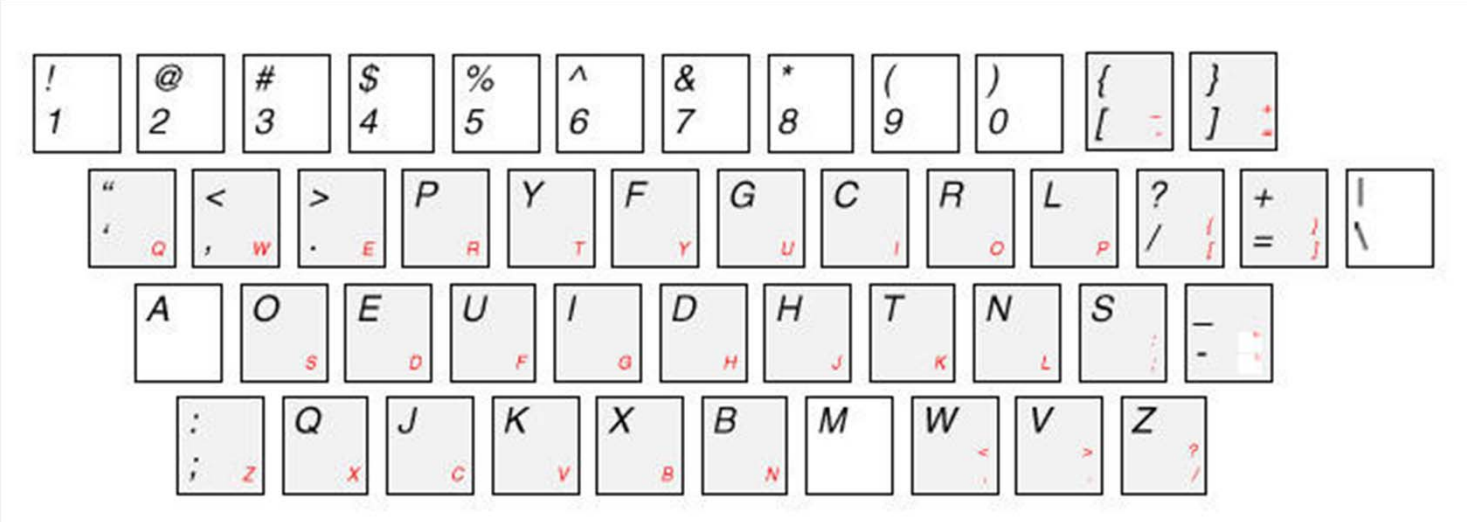
Alphabetic

- keys arranged in alphabetic order
- not faster for trained typists
- not faster for beginners either!

Dvorak

- common letters under dominant fingers
- biased towards right hand
- common combinations of letters alternate between hands
- 10-15% improvement in speed and reduction in fatigue
- But - large social base of QWERTY typists produce market pressures not to change

Alternative keyboard layouts



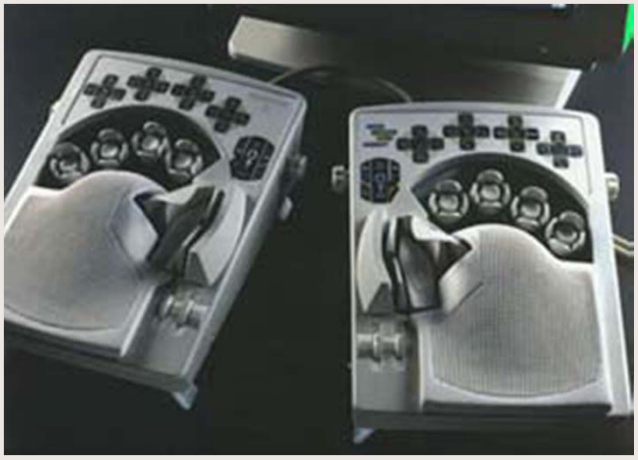
Dvorak Keyboard Layout

Special keyboards

- designs to reduce fatigue
- for one handed use

  e.g. the Maltron left-handed keyboard

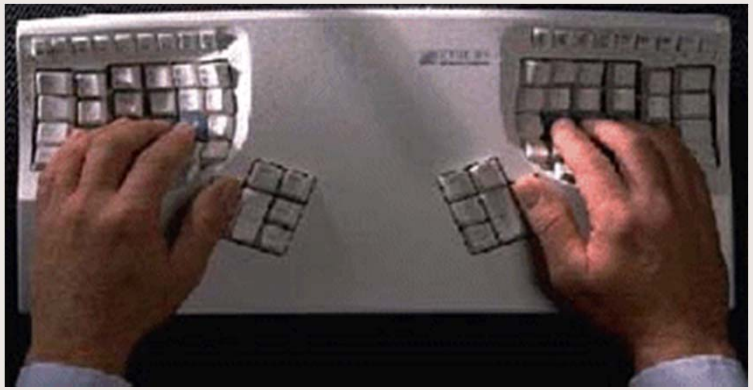
Special keyboards

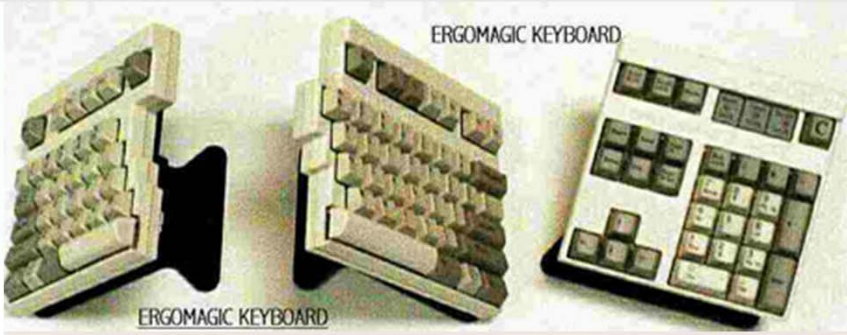


Special keyboards

Keyboard layouts

- Ergonomic





Chord keyboards

only a few keys - four or 5

letters typed as combination of keypresses

compact size

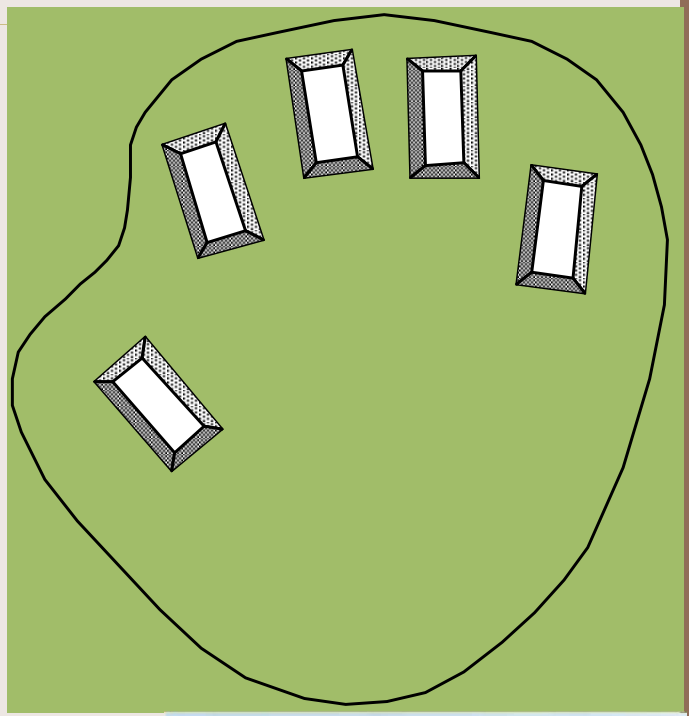
- ideal for portable applications

short learning time

- keypresses reflect letter shape

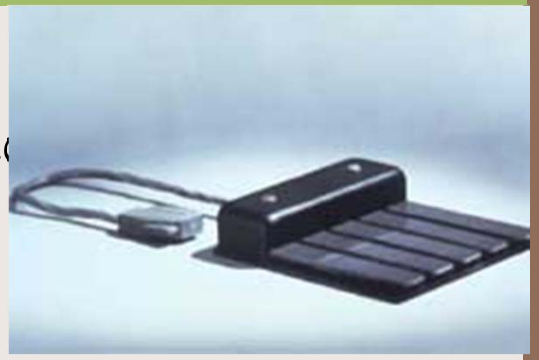
fast

- once you have trained



BUT - social resistance, plus fatigue after extende

NEW – niche market for some wearables



Phone pad and T9 entry

- use numeric keys with multiple presses

  2 - a b c 6 - m n o
  3 - d e f 7 - p q r s
  4 - g h i 8 - t u v
  5 - j k l 9 - w x y z

  hello = 4433555[pause]555666

  surprisingly fast!

- T9 predictive entry
  - type as if single key for each letter
  - use dictionary to 'guess' the right wo
  - hello = 43556 …
  - but 26 -> menu 'am' or 'an'

DialKeys

Choosing the keyboard

- What size do the keys need to be?
- What shape should the keyboard be?
- How robust does the keyboard need to be?

Input Devices

Pointing devices

Pointing

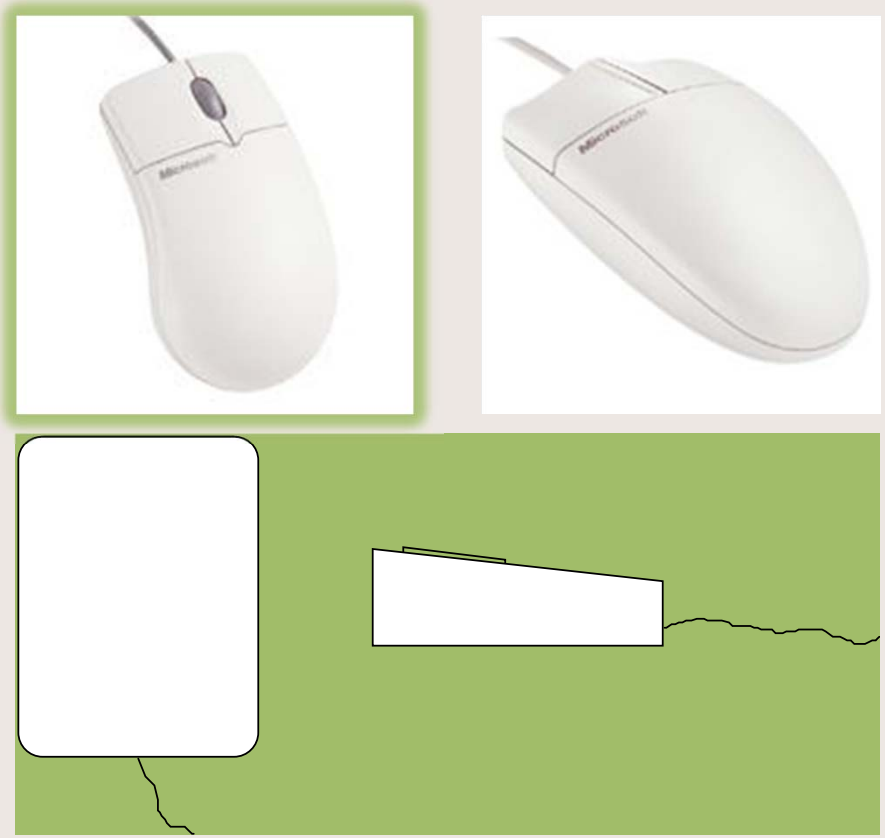
- Fitt's law
- Tm = a + b log(D/S + 1)
- a, b : device dependent
- D – distance
- S – size
- D/S – index of difficulty

Pointing tasks

- **select** – chooses from a set of items
- **position** – chooses a point in a one-, two-, three-, or higher dimension
- **orient** – chooses a direction
- **path** – series of position and orient operations

The mouse

- Handheld pointing device
  - very common
  - easy to use
- Two characteristics
  - planar movement
  - buttons

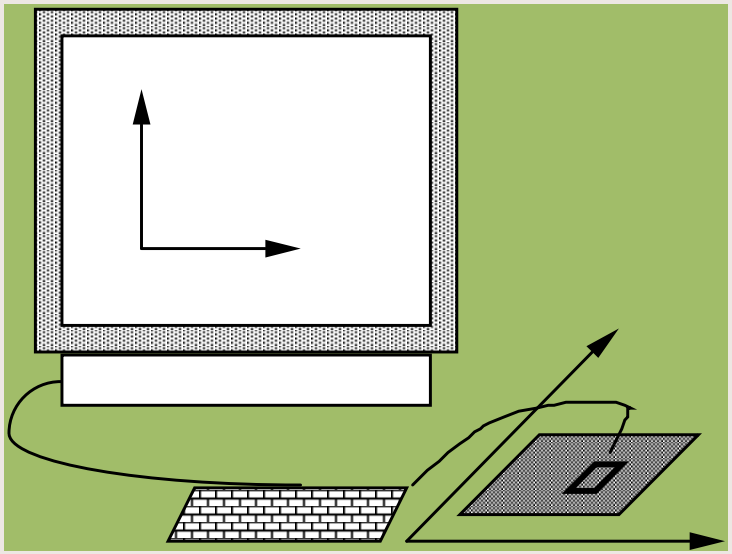


The mouse

Mouse located on desktop
- requires physical space
- no arm fatigue

Relative movement
- Screen cursor oriented in (x, y) plane,
- mouse movement in (x, z) plane …

… an *indirect* manipulation device.
- device itself doesn't obscure screen, is accurate and fast.
- hand-eye coordination problems for novice users



The first mouse

Nov. 17, 1970 D. C. ENGELBART 3,541,541

X-Y POSITION INDICATOR FOR A DISPLAY SYSTEM

Filed June 21, 1967 3 Sheets-Sheet 1

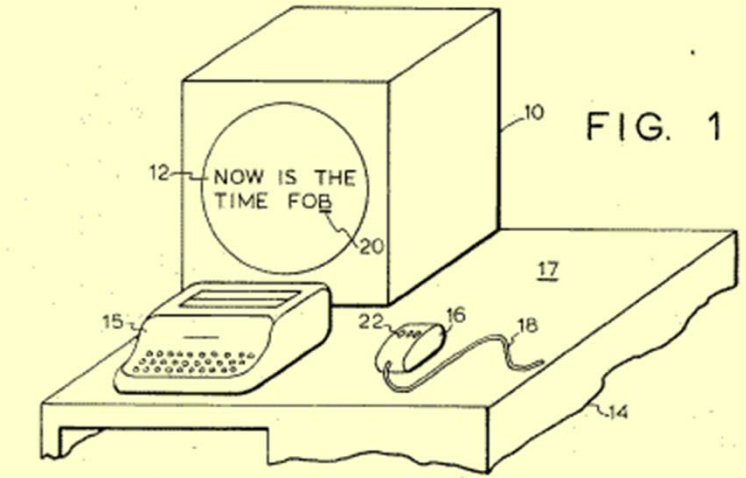


FIG. 1

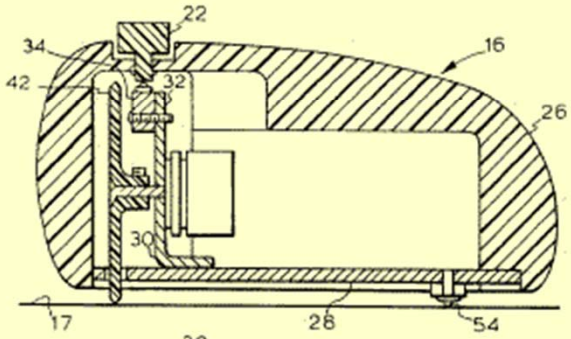


FIG. 2

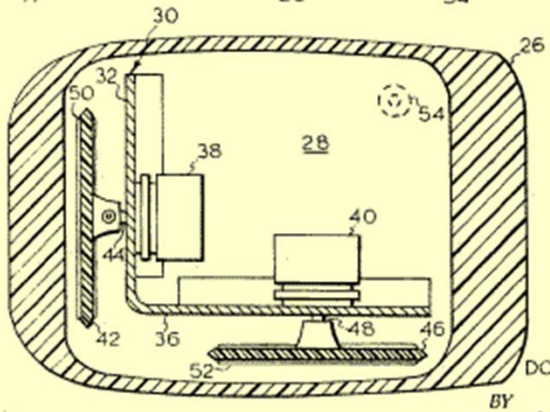
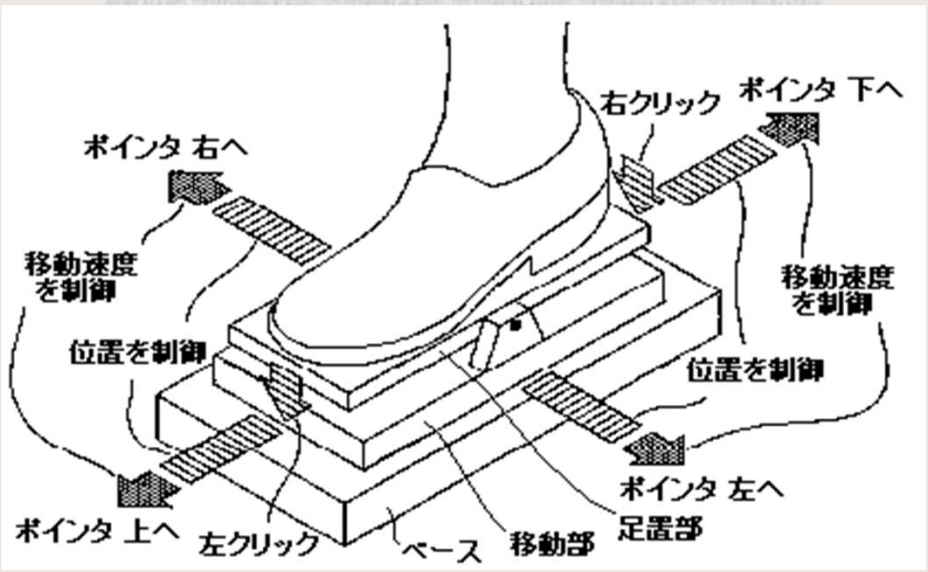


FIG. 3

INVENTOR.
DOUGLAS C. ENGELBART
BY
Lindenberg + Freilich
ATTORNEYS

Even by foot …

- some experiments with the *footmouse*
  - controlling mouse movement with feet …
  - not very common :-)
- but foot controls are common elsewhere:
  - car pedals
  - sewing machine speed control
  - organ and piano pedals



Touchpad

- good 'acceleration' settings important
  - fast stroke
    - lots of pixels per inch moved
    - initial movement to the target
  - slow stroke
    - less pixels per inch
    - for accurate positioning

Trackball

Trackball

- ball is rotated inside static housing
  - like an upside down mouse!
- relative motion moves cursor
- indirect device, fairly accurate

Joystick and keyboard nipple

Joystick

- indirect
- buttons for selection
- often used for computer games

Keyboard nipple (trackpoint)

- for laptop computers
- miniature joystick in the middle of the keyboard

Touch-sensitive screen

- How it works?
- Advantages & Disadvantages:

Stylus and light pen

Stylus
- small pen-like pointer to draw directly on screen
- may use touch sensitive surface or magnetic detection
- used in PDA, tablets PCs and drawing tables

Light Pen
- now rarely used
- uses light from screen to detect location

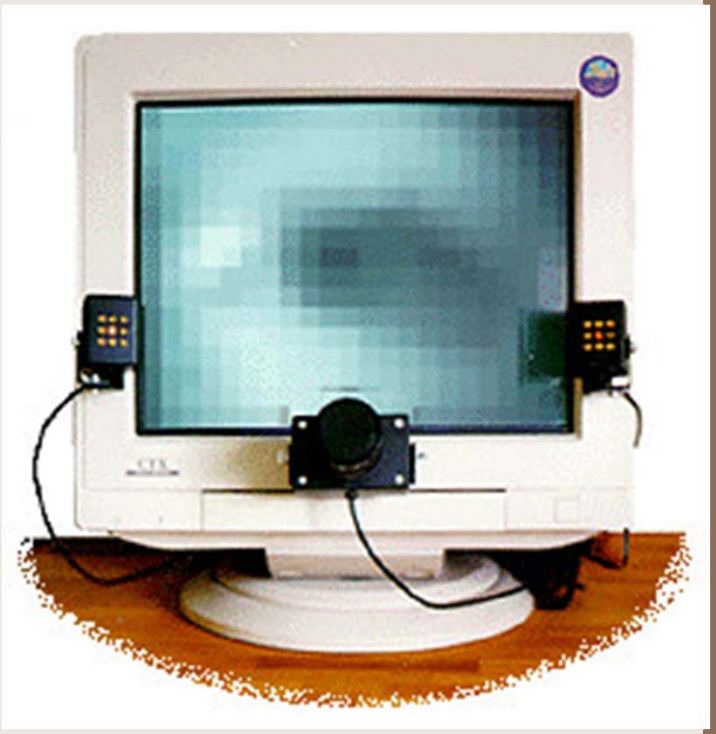
BOTH …
- very direct and obvious to use
- but can obscure screen

Digitizing tablet

- Mouse like-device with cross hairs
- used on special surface
  - rather like stylus
- very accurate
  - used for digitizing maps

Eye gaze

- control interface by eye gaze direction
  - e.g. look at a menu item to select it
- uses laser beam reflected off retina
  - … a very low power laser!
- mainly used for evaluation
- potential for hands-free control
- high accuracy requires headset
- cheaper and lower accuracy devices available
  - sit under the screen like a small webcam



Input Devices

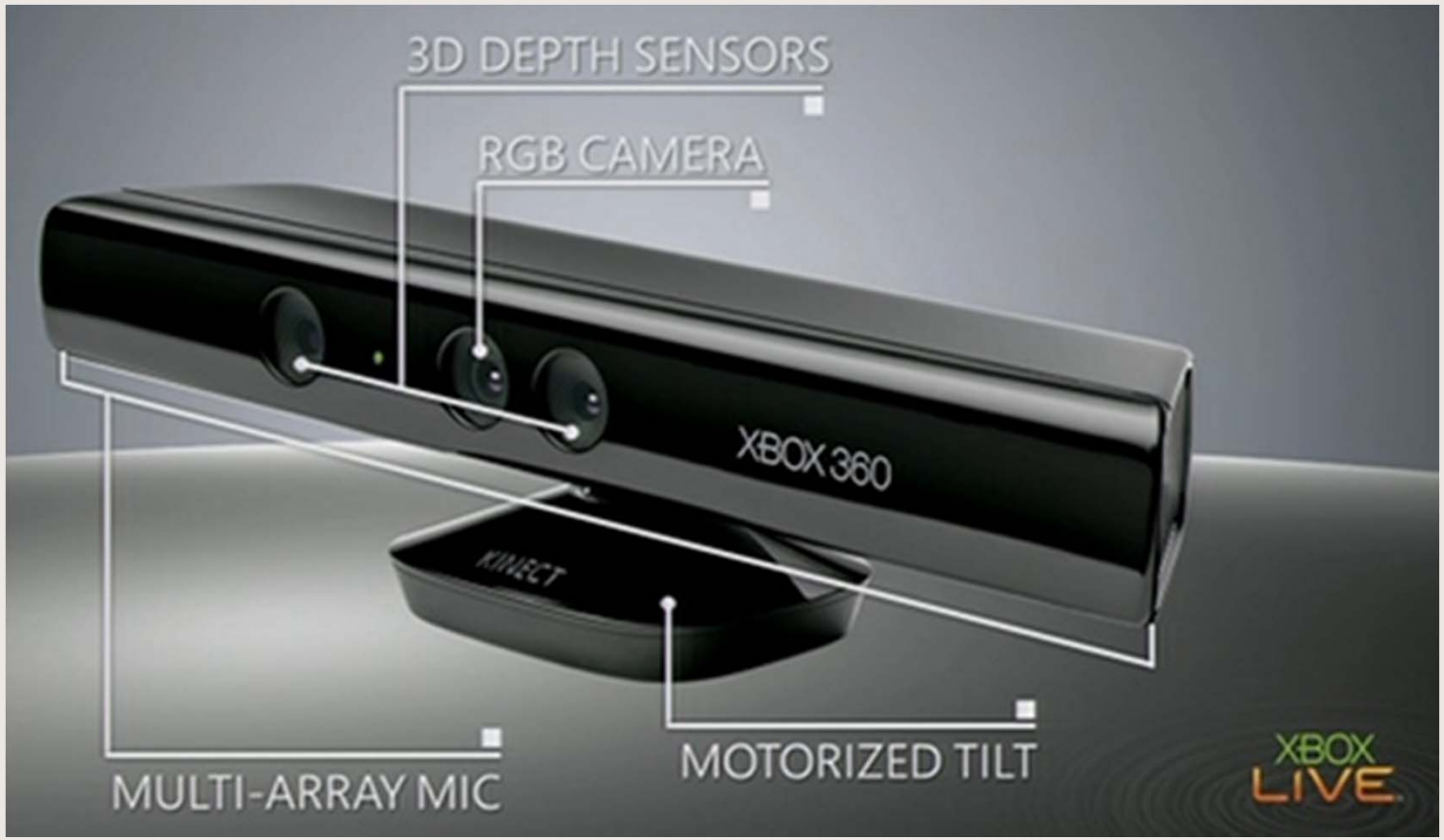
- Keyboards, Keypads, and Buttons
  - Choosing the Correct Keyboard, Keypad, and Buttons
- Pointing Devices
  - Different Types of Indirect Pointing Devices
    - Mouse, joystick, trackball, graphics tablet
  - Different Types of Direct Pointing Device
    - Touch screen, pen system, light pen
  - Choosing the Right Pointing Device
    - Learning curve, accuracy, fatigue factor, space, dexterity

Alternative Approaches to Entering Information

- Gesture
- Iris and Fingerprint Recognition
- Handwriting Recognition
- Speech Recognition

Wii remote

XBOX 360 KINECT



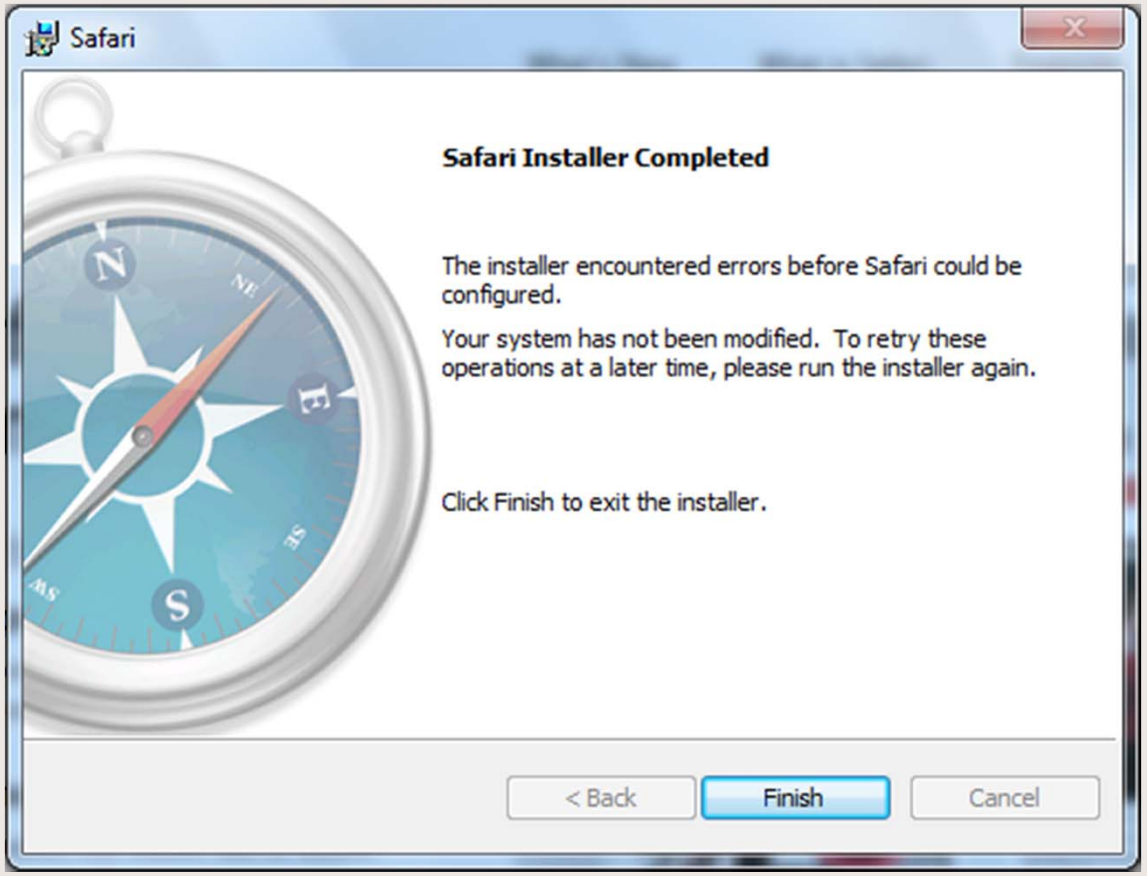
Output Devices

- Screens
  - Choosing the Right Screen
    - CRT, LCD, Plasma
    - Resolution, color bit depth, dimensions
- Loudspeakers
  - Woofers and tweeters, quality, size
- Simple Output Devices
  - LEDs, dials, gauges, buzzers

Alternative Approaches to Outputting Information

- Head-up displays
- Head-mounted displays (HMD)
- Stereoscopic displays (3D)

Hall of shame or fame?



Software

- Software components
  - Text
  - Color
  - Images
  - Moving images
  - Sound
- How to use/choose?

Text

- Major component

- Small
- Manipulated very easily
- Less ambiguous

Text

- How to Ensure That Your Text is Legible
  - typeface
  - type size
  - letter spacing
  - line spacing (leading)
  - line length
  - justification
  - line ending

Text (typeface)

Leaibility

Factor	Example	Detail
Typeface	Serif or sans serif	serif for printing, sans serif for screen
Type size	Too small is harder to read Too big is also hard	Depends on screen and printer resolution. Lower resolution requires larger size.
Letter spacing	Letters too close together are hard to read	L e t t e r s t o o f a r a p a r t a r e h a r d t o r e a d

Leaibility

Factor	Example	Detail
Line spacing (leading)	If you have small type sizes, then you can increase legibility by increasing the leading. This text is at the default leading If you have small type sizes, then you can increase legibility by increasing the leading. This text has extra leading	smaller type size, increasing line spacing longer line, wider spacing (but not to wide)
Justification	fully justified text can create uneven gaps between words on a page	fully justified text can create uneven gaps between words on a page
Line length/line ending	max line length ~60 chars (8 – 12 words)	short lines are easier to read if endings with grammatical boundaries

Text

- How to Ensure That Your Text Makes Sense
  - choose words and expressions that familiars to the users (speak the user's language)
  - abbreviations

Color

- Draw attention
- Show status
- Make the information clearer
- Make the display more attractive

Color

- The Characteristics of Color
  - visible colors
  - variable between computers vs. printers
  - color perception (screen vs. paper)
  - combination of colors

Color

- Choosing Colors with the Right Connotations
  - culture e.g., red for warning, or for lucky
  - some confusion, red for danger
    - red light indicate that the handbrake is on, but safe to take your foot off the brake pedal.
  - color saturation
    - different age
  - apply the color consistently

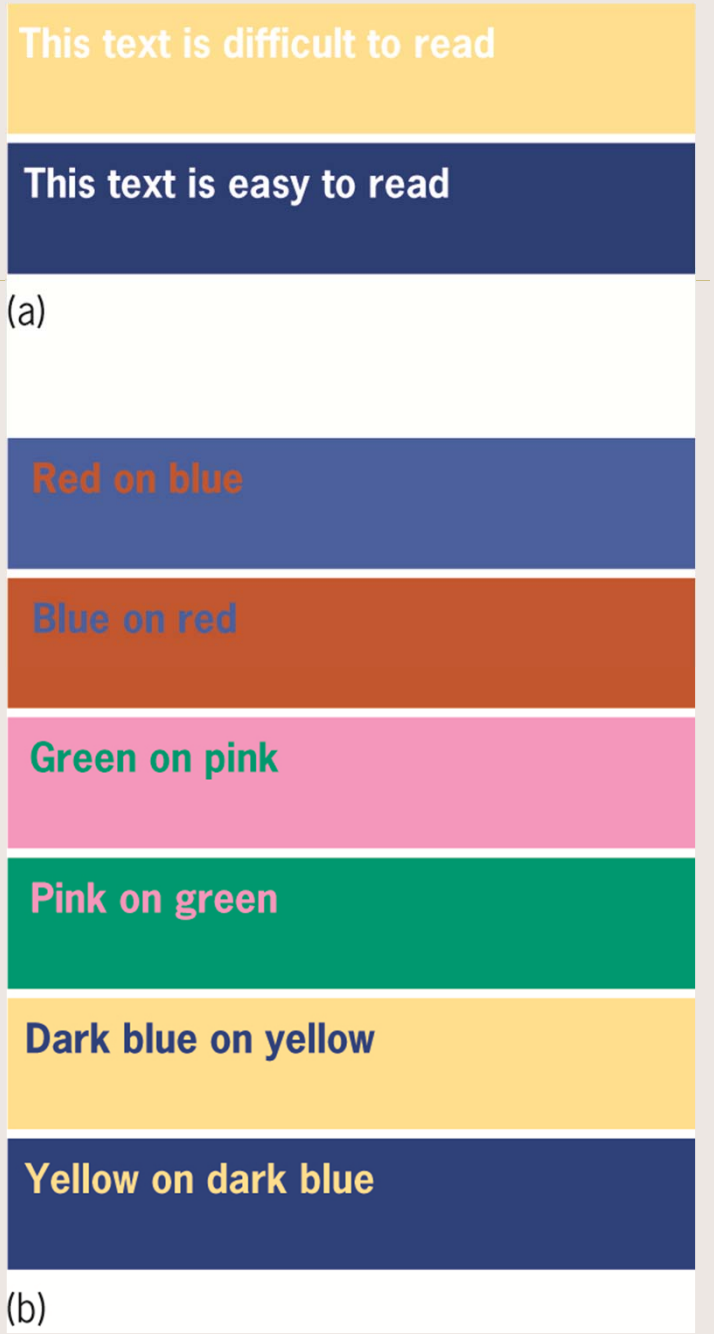
Exercise (5 minutes)

Look at the colors and write down a positive/negative for each color.

Color		Positive	Negative
Red			
Blue			
Blue-green			
Green			
Yellow			
Orange			
Purple			

Color

- How to Use Color Effectively
  - brightness
  - number of colors
  - color perception
  - color for reinforcement



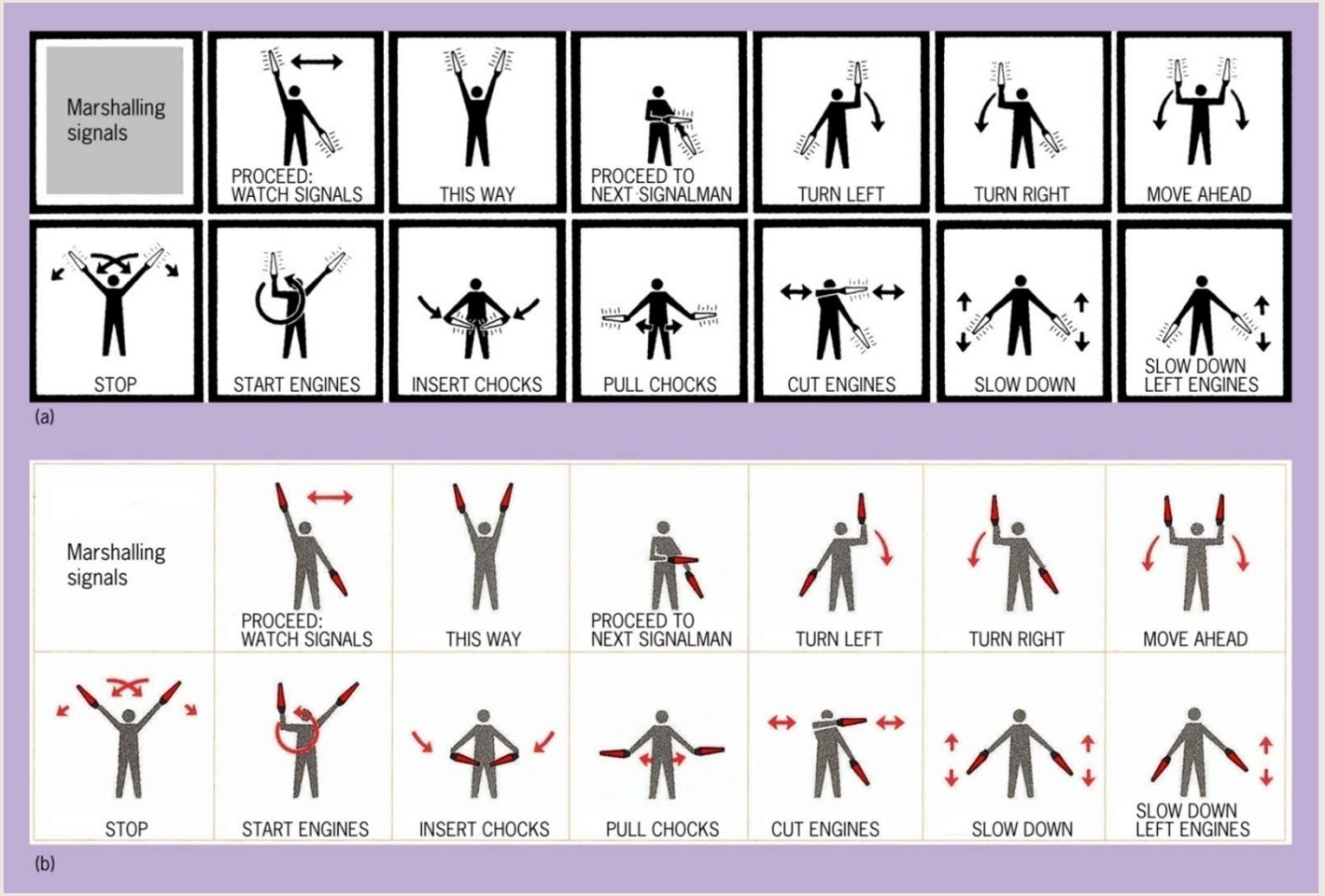
Color

Making Effective Use of Color	
Number of colors	limit, too many color can be confusing < 6 colors (in addition to black and white)
Design for monochrome	Designing in black and white first, then add color
Color perception	Varies, color blindness
Color for reinforcement	Should not used in isolation. (boundary)

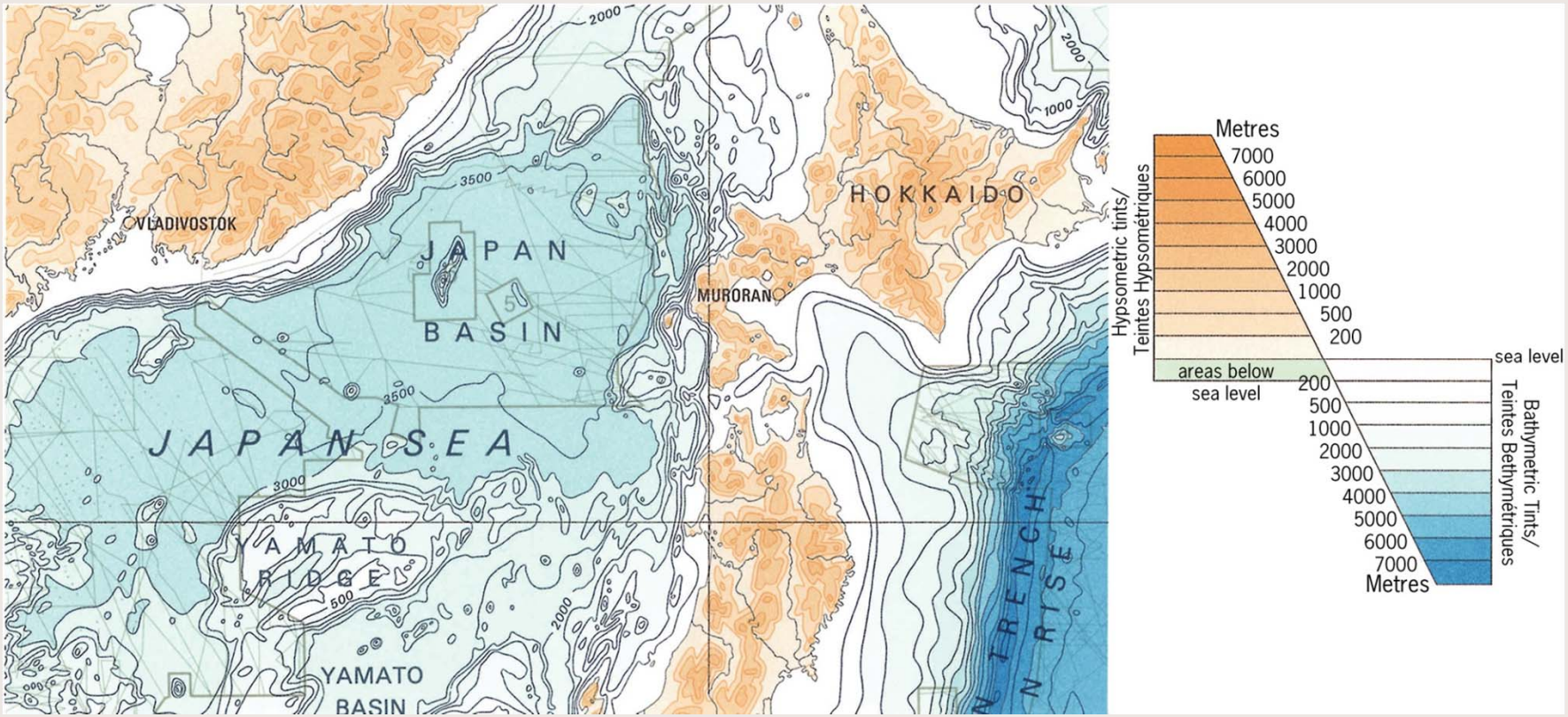
Color

- Using Color to Represent Information
  - emphasis
  - grouping
  - coding
  - perspective
  - layering

Color (emphasis)



Color (coding, perspective)



Images

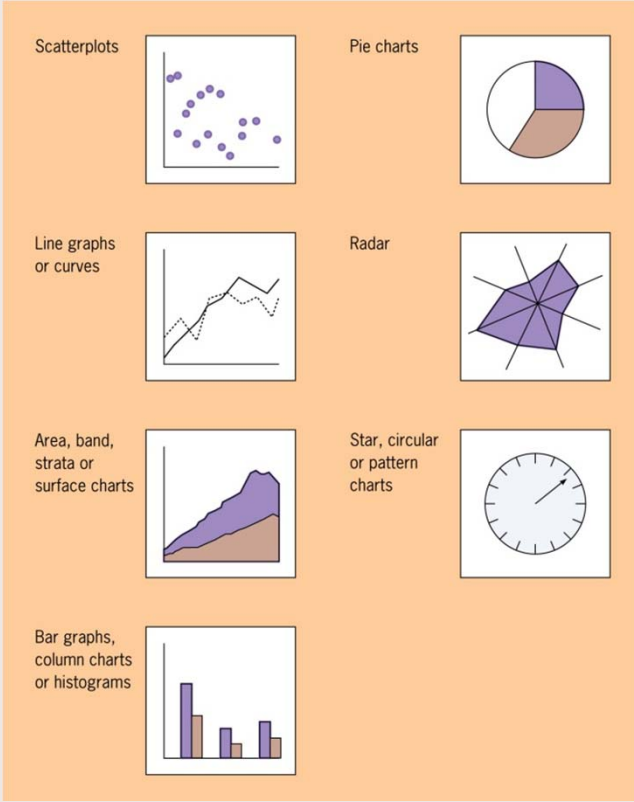
- Motivate, attract the attention
  - in advertising and marketing
- Communicate information
  - computer-based learning materials
- Help overcome language barriers
  - instruction manuals
- Support interaction
  - screen metaphors and icons

Images

- Using Images Effectively
  - pictures
    - a picture is worth a thousand words
  - diagrams
    - two-dimensional layout
    - illustrate relationships and processes
  - graphs and charts

Images

- Guidelines
  - choose the most appropriate type of image
  - design the image so that it meets the requirements of the tasks
  - follow any relevant conventions
  - combining text and images can be effective
  - take the user's screen resolution into account
  - images, photographs, are very large → long download time for web sites
    - for display only need 72 dpi resolution



Sound

- when eyes and attention are required to be away from screen
- involving process control
- visual impaired user
- Different types of sound
  - ambient sounds and sound effects
  - music
  - speech

Sound

- Making Good Use of Sound Effects
  - reinforce the visual component of the UI
    - turning a page on the screen could be accompanied by an appropriate sound
  - confirm the successful completion of an operation
  - attract attention
    - warning sound when error occurs

Sound

- Using Music Effectively
  - option to turn on/off
- Using Speech Effectively
  - simple
  - short
  - visual channel overloaded
  - message require an immediate response