Human Computer Interaction: Computers

CSCI 4620U| SOFE 4850U | CSCI 5540G

Dr. Christopher Collins

Lecture 5 - Computers

Acknowledgement: Parts of these lectures are based on material prepared by Ron Baecker, Ravin Balakrishnan, John Chattoe, Ilona Posner, Scott Klemmer, and Jeremy Bradbury.

Today

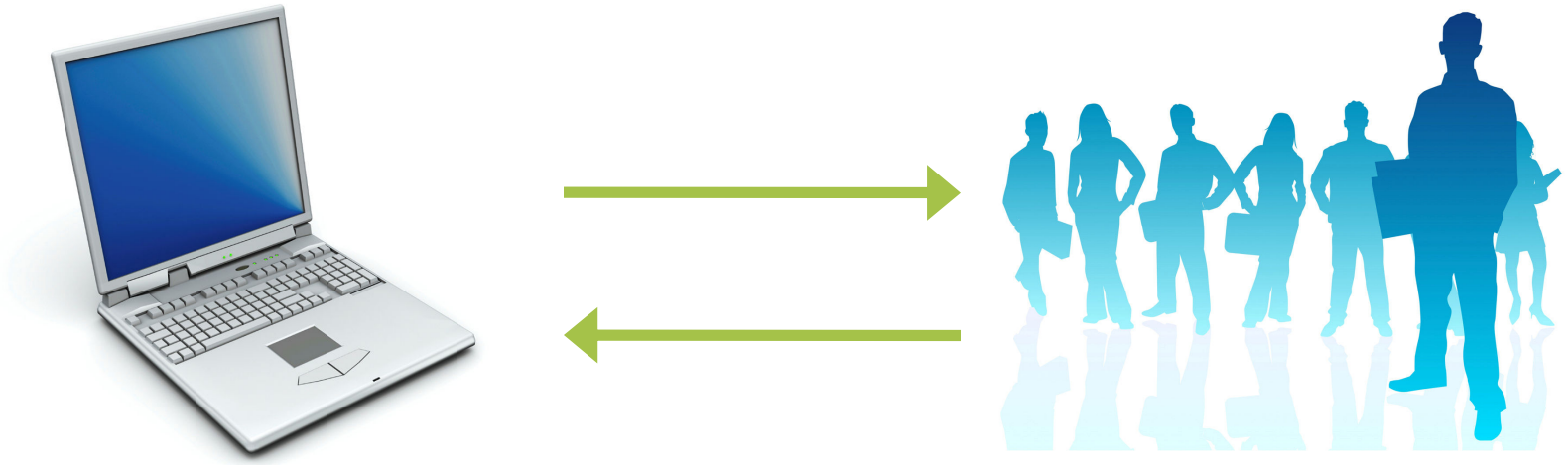
- Characteristics of Computers
  - Input
  - Output
  - Memory, Processing, Networking


election candidates, Manoussi was an ad-
visory member of the RCMP's "cultural di-
versity committee" in the National Capital
Region. He is listed among foreign partici-
pants on the May conference website, and
an Iranian journalist now living in Canada
told Maclean's that a colleague had identi-
fied Manoussi
week after
Turn Off Airplane Mode or
Use Wi-Fi to Access Data
Settings
OK
received a temporary resi-
dent from Canada's
Department of In-
dustry in 2007, but which shows up on In-
ternet searches only among lists of Man-
oussi's credentials and affiliations.
Davood Rafiei, an associate professor in
the department of computer science at the


Scan
Scan another page?
Yes
No

Computer Input/Output

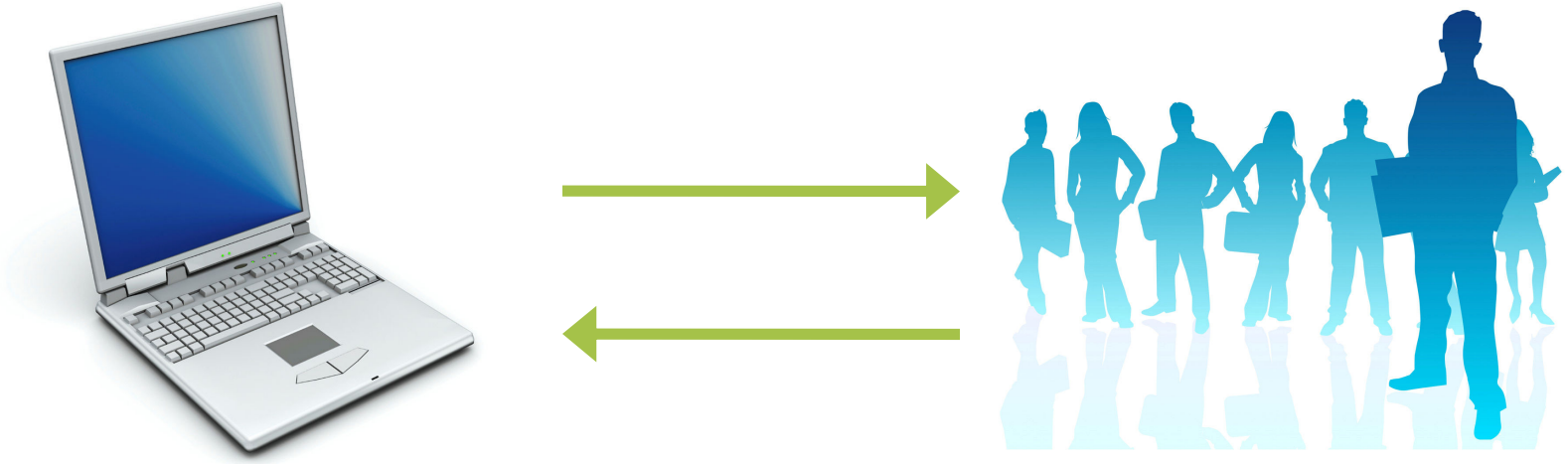
- There are many different kinds of input and output devices for computers



What is a computer?

Computer Input/Output

- Can you think of more input and output devices now?



Computer Input

- Computers have a variety of different devices available for the following kinds of input:
  - Text entry
  - Drawing objects
  - Selection of items on a screen

Input

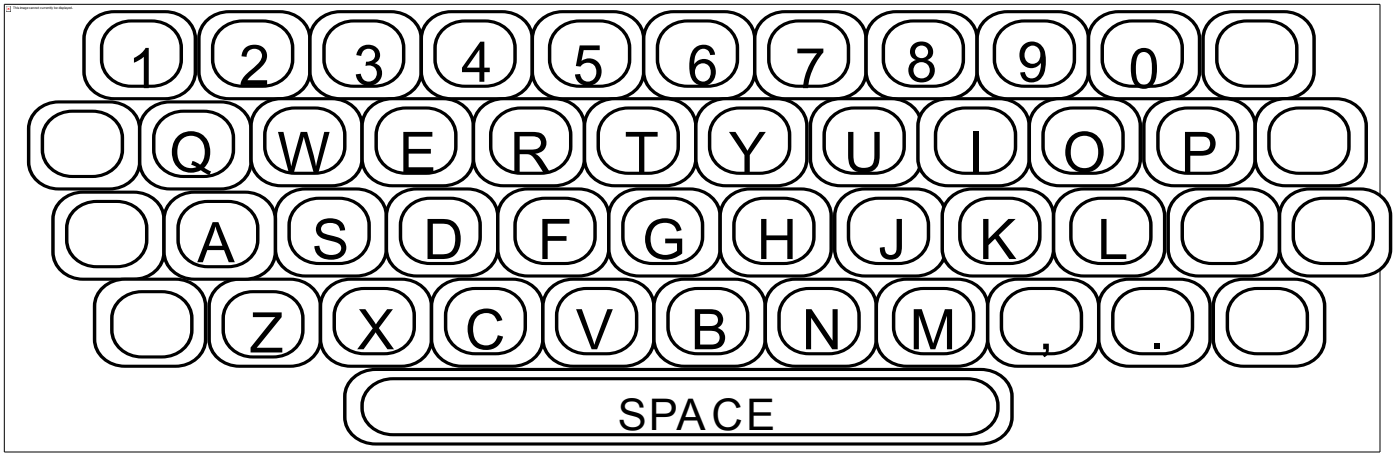
KEYBOARDS

Computer Input: Keyboard

- Alphabetic keyboards…
  - Letters are arranged according to the alphabet
- Chord keyboards…
  - 4-5 keys – different key combinations are used for different letters
- Alternative designs…
  - Pressure sensitivity, gesture, predictive text

QWERTY Keyboard

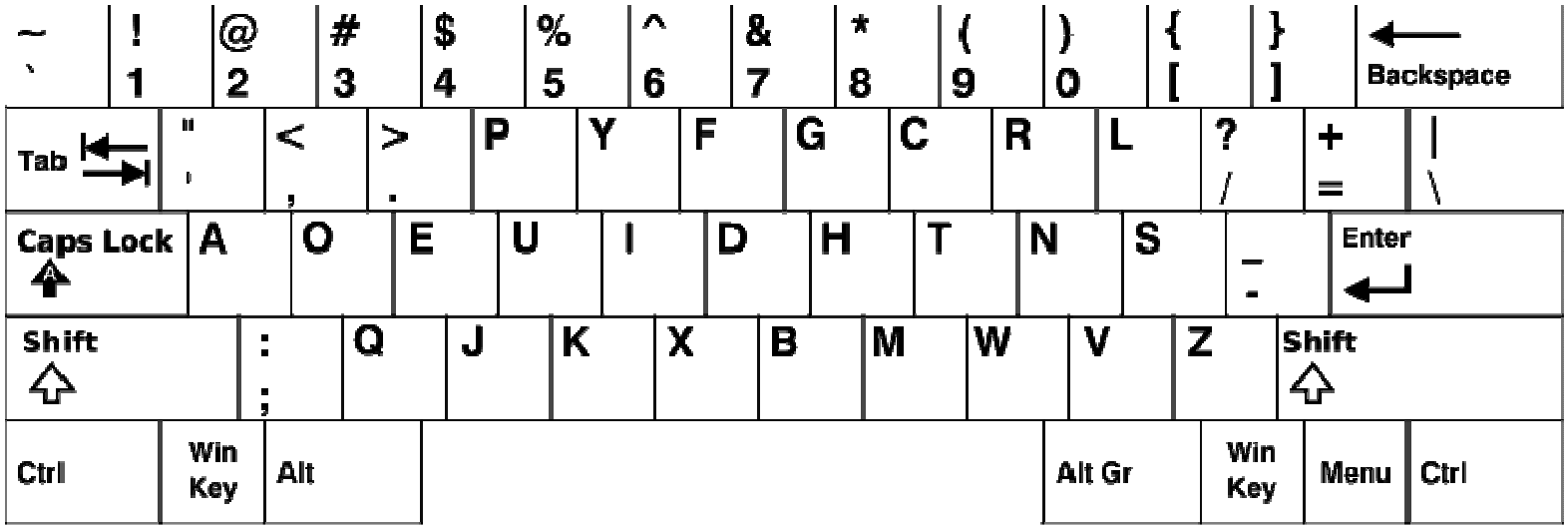
- Keyboards are the most common input device used for text entry:
- Different layouts exist including the QWERTY Keyboard…



(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction")*

DVORAK Keyboard

- The DVORAK keyboard…



(Source: Wikipedia - http://en.wikipedia.org/wiki/Image:KB_United_States_Dvorak.svg)

Computer Input: Keyboard

- In addition to efficiency, another important criteria for keyboard layout and design is ergonomics
  - Why? Reduce repetitive strain injuries

Source: Microsoft website - http://www.microsoft.com/hardware/mouseandkeyboard/docs/nek4k/nek4k.html

Ergonomic Keyboard

- There are many different ergonomic keyboards including the left-hand keyboard below
  - You can check out more keyboard layouts at: http://www.maltron.com/maltron-keyboards.html

(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction")*

Multi-push Keyboards: T9

- 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 word
  - hello = 43556 …
  - but 26 -> menu ‘am’ or ‘an’

Chord keyboards

only a few keys - four or 5

letters typed as combination of keypresses

compact size

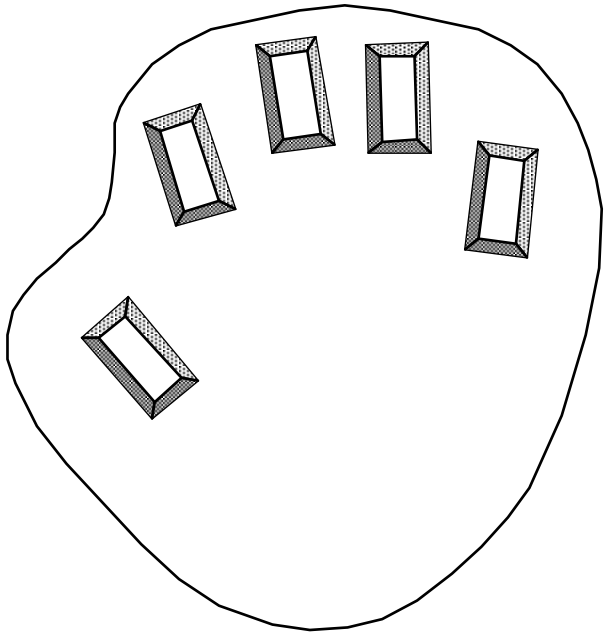
- ideal for portable applications

short learning time

- keypresses reflect letter shape

fast

- once you have trained

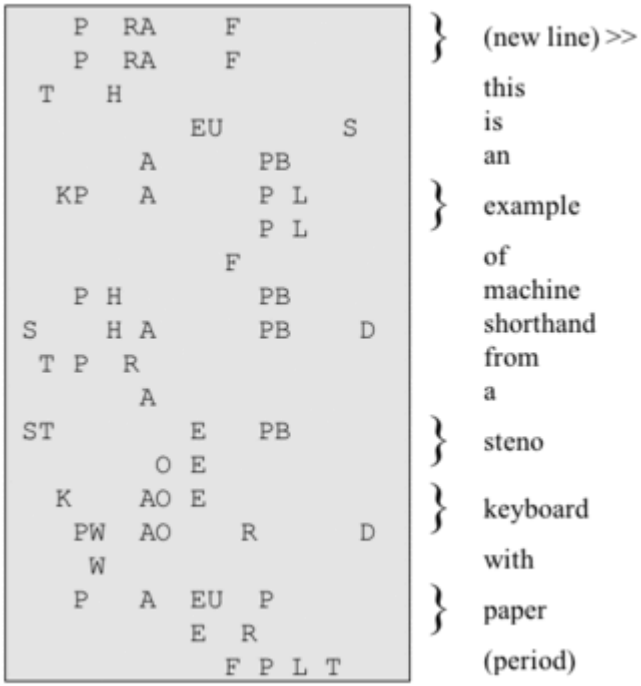


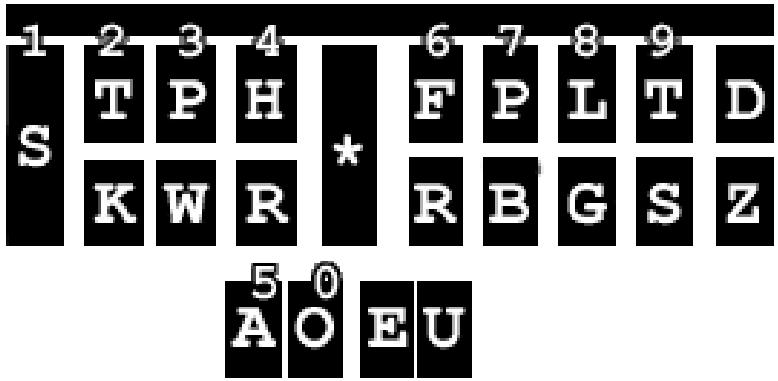
BUT - social resistance, plus fatigue after extended use

NEW – niche market for some wearables

Stenotype

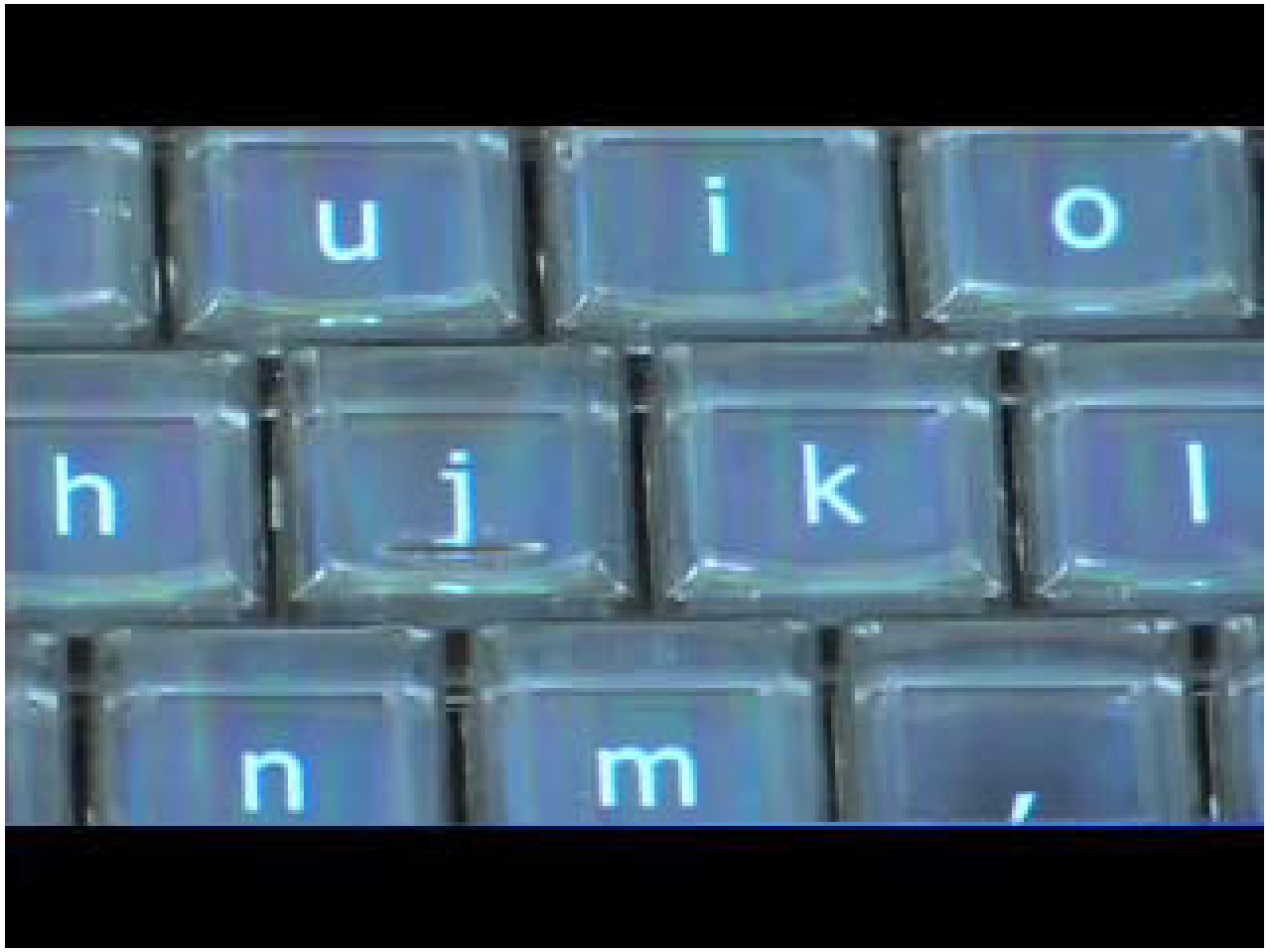
- A chord keyboard for transcription
- Typist enters a form of shorthand, computer translates it to full word





http://en.wikipedia.org/wiki/Stenotype

Keyboard Displays



Source: YouTube video - http://www.youtube.com/watch?v=IJ5rX6WpxTk

Pressure Sensitive Keyboard

(Source: UIST 2009 Student Design Competition: http://www.youtube.com/watch?v=PDl8eYIASf0

Swype Keyboard

(Source: MobileBurn via Youtube: http://www.youtube.com/watch?v=mRUoWUhcRlE

Tactus Keyboard

http://www.tactustechnology.com/

Input

MOUSE

Computer Input: Mouse

- The primary purpose of a mouse is for selection of items on a computer screen (navigation of a 2D space)
  - The mouse is moved to position the cursor on the screen and a button is clicked (or double-clicked) to select an icon, etc.
- A mouse also has limited applications as a drawing device
- Alternatives to a mouse include: a touchpad, a trackball and a joystick (absolute and isometric)

Computer Input: Mouse

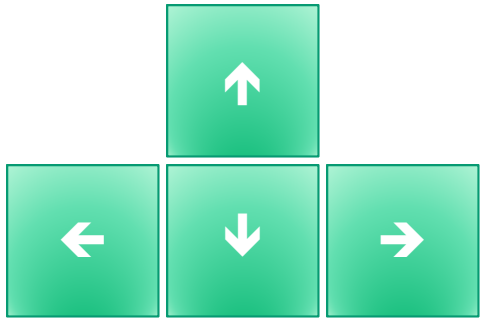
First Mouse, Douglas Engelbart, 1964 Source: YouTube video - http://www.youtube.com/watch?v=1MPJZ6M52dI

Input

ALTERNATIVE INPUT DEVICES

Cursor Keys

- Cursor keys can also be used for selection
- What is the difference between this kind of selection and selection using a mouse?

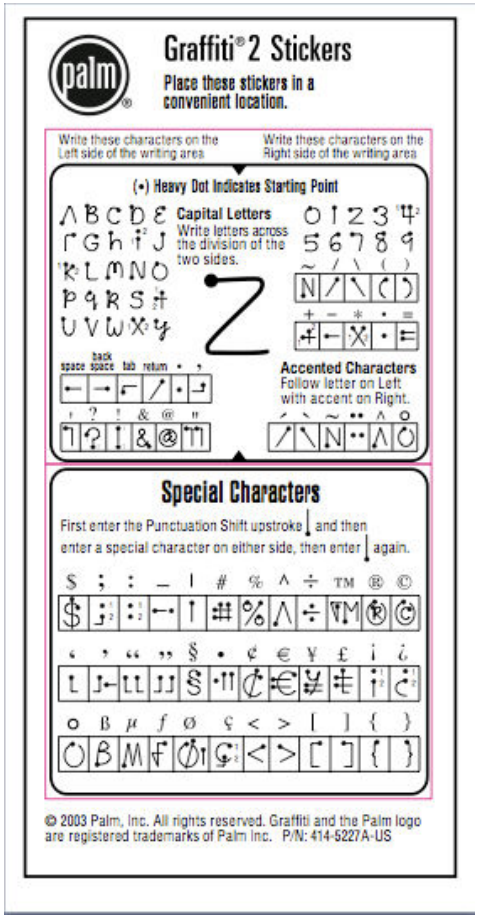


Alternative Input: Speech

- Using a microphone to input speech is another alternative method of input
- Speech recognition converts what we say into something that can be understood as *meaningful* computer input

Handwriting

- Using a stylus or tablet to input handwriting
- **Example:** recognition of handwriting (numbers, letters, words) occurs on Palm devices where users input text using Graffiti® 2
- Easier alternative maybe gesture recognition



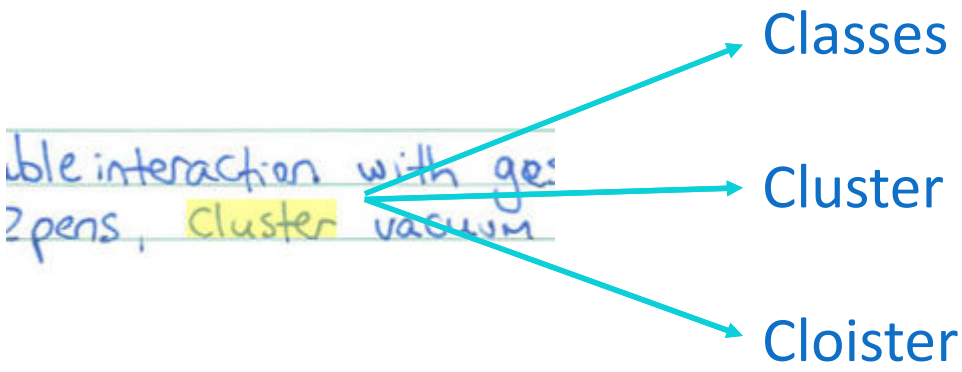
Source: Palm - http://www.palm.com/us/support/handbooks/graffiti2_sticker.pdf

Technical Challenges in Handwriting

- capturing all useful information - stroke path, pressure, etc. in a natural manner
- segmenting joined up writing into individual letters
- interpreting individual letters
- coping with different styles of handwriting

Accommodating Handwriting Errors

- Handwriting recognition is imprecise, conversion to text can be frustrating
- Systems like Evernote recognize text in the background and provide several alternatives
  - Useful for searching handwritten notes (false positive not as bad as false negative)



Touch

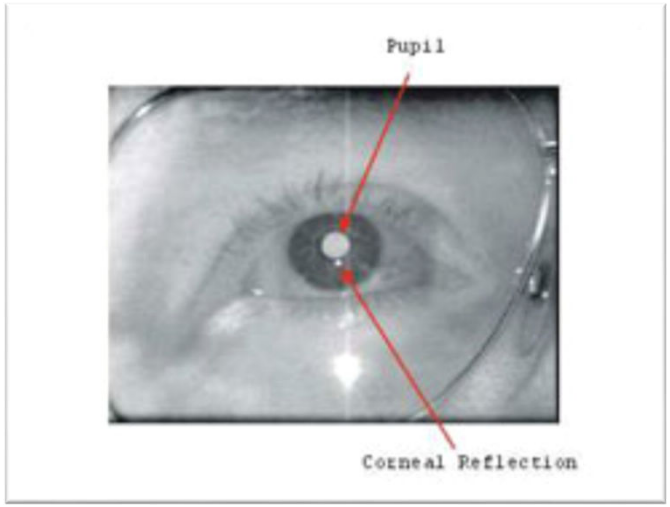
- Using a touch-sensitive screen is another input method…
- How well does touch support the work of a mouse? a physical keyboard?

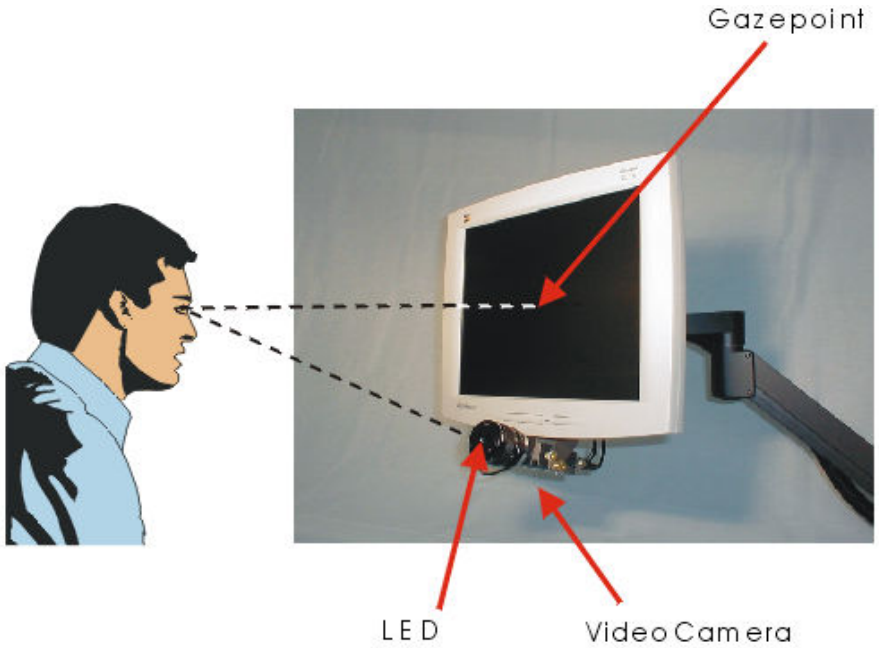
Touch

- Using a touch-sensitive screen is another input method…
- How well does touch support the work of a mouse? a physical keyboard?
- Software level prediction and error correction are more important

Gaze

- Gaze input uses camera to track the pupil using reflection of invisible light





Source: LC Technologies website - http://www.eyegaze.com/content/research-tools

Tangible Devices

- Physical device which can be manipulated to send signals to computer
- Often designed for a specific purpose

(PocoPoco Musical Controller)

(Reactable)

3D Input

- cockpit and virtual controls
  - steering wheels, knobs and dials … just like real!
- the 3D mouse
  - six-degrees of movement: x, y, z + roll, pitch, yaw
- data glove
  - fibre optics used to detect finger position
- gesture devices
  - Infrared light and sensors (Leap motion)
- VR helmets
  - detect head motion and possibly eye gaze (Oculus)
- whole body tracking
  - accelerometers strapped to limbs, reflective dots and video processing, depth camera (Kinect)

Input: Scanners

- Take paper and convert it into an image
- Types of scanner
  - flat-bed: paper placed on a glass plate, whole page converted into image
  - hand-held: scanner passed over paper, digitising strip typically 3-4” wide
  - camera: specialized camera modes for documents
- Shines light at paper and note intensity of reflection
- Typical resolutions from 600–2400 dpi
- Optical Character Recognition (OCR): turn image into text

Alternative Input: Physical Controls

- specialist controls needed …
  - industrial controls, consumer products, etc.

large buttons

clear dials

tiny buttons

multi-function control

easy-clean smooth buttons

Environment and bio-sensing

- sensors all around us
  - car courtesy light – small switch on door
  - ultrasound detectors – security, washbasins
  - RFID security tags in shops
  - temperature, weight, location
- … and even our own bodies …
  - iris scanners, body temperature, heart rate, galvanic skin response, blink rate, steps and stairs

Computer Input: Alternatives

In-class Activity:

Break-up in groups of 3-4 and answer the following questions with respect to a tablet with handwriting recognition, a microphone with speech recognition, a touch sensitive screen and eye gaze.

- What kind of input can each be used for?
- What kind of input can each *not* be used for?
- Why isn't each more widely used?

Computer Input: Alternatives

Homework Activity:

Answer the following questions with respect to a tablet with handwriting recognition, a microphone with speech recognition, a touch sensitive screen and eye gaze.

- What kind of input can each be used for?
- What kind of input can each *not* be used for?
- Why isn't each more widely used?

In-class Activity:

	Tablet with hand writing recognition	Microphone with speech recognition	Touch-sensitive screen	Eye gaze tracking
What kind of input can it be used for?				
What kind of input can it not be used for?				
Why isn't it more widely used?				

Computer Output

- Computers also need devices to output information to the user
  - Displays (most important!)
  - Sound
  - Printing

Output

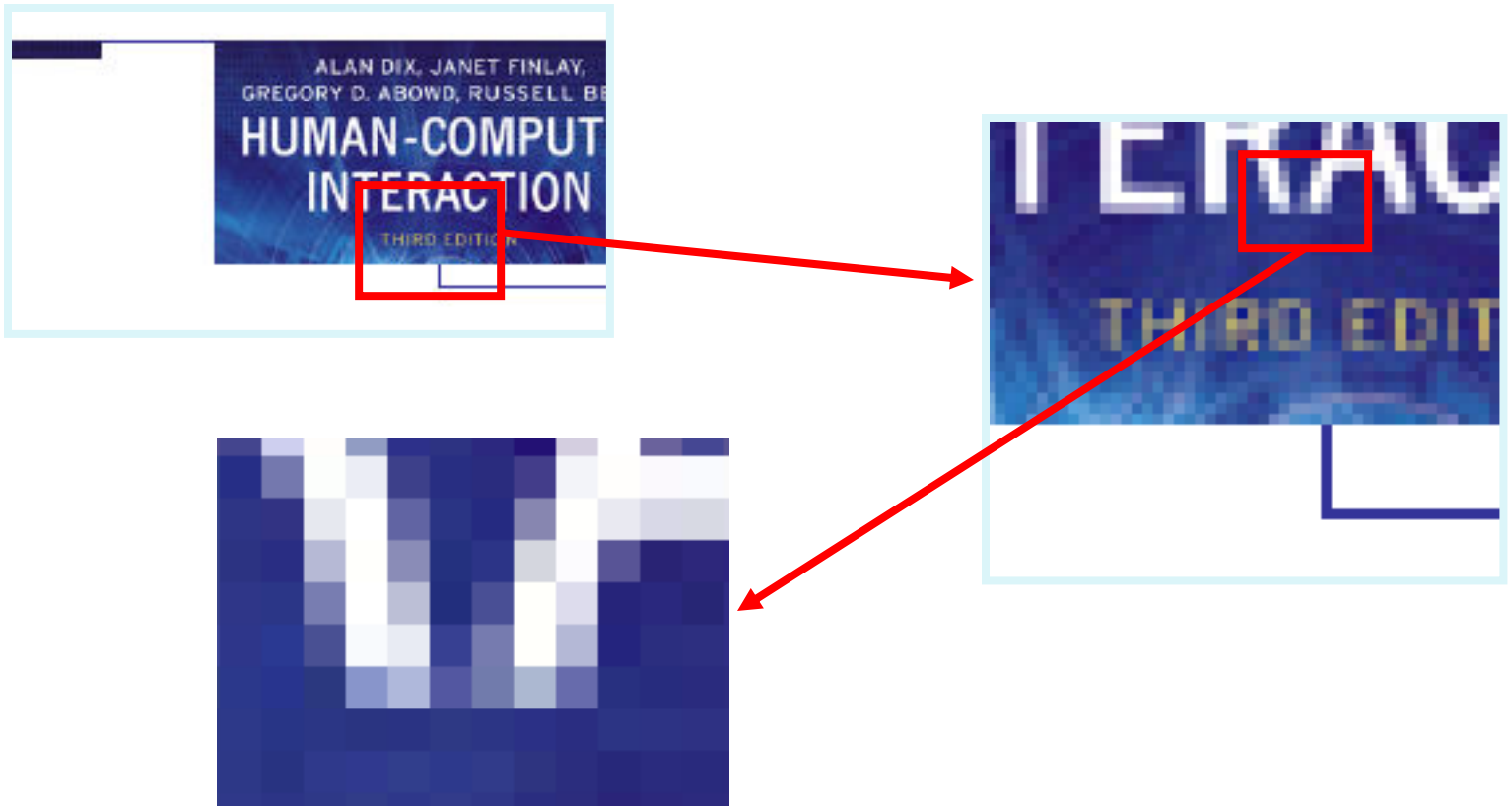
DISPLAYS

Computer Output: Displays

- The standard for computer displays is liquid crystal or LCD
  - The old standard was CRT (or Cathode ray tube)
- How does LCD vs. CRT affect Human-computer interaction?

LCD: bitmap displays

- screen is vast number of coloured dots



Display Resolution

- Resolution … used (inconsistently) for
  - number of pixels on screen (width x height)
  - density of pixels (in pixels or dots per inch - dpi)
    - 350-450 dpi for mobile devices (2014)
    - Best human vision about 600 dpi
- Aspect ratio
  - ratio between width and height
  - 16:9 for most screens (previously 4:3)

Display Colour Depth

- How many different colours for each pixel?
  - black/white or greys only
  - 256 from a palette
  - More bits per channel (bpc):
    - 24 bit “true color” = 8 bits each for red/green/blue = millions of colours
    - 32 bit = 24 bit + alpha transparency
    - 30/36/48 bit “deep color” now supported

Displays: OLED

- The future of displays often refers to “digital paper”
  - The characteristics of digital paper is that it is thin and cheap
  - Consider a new technology called OLED (Organic Light Emitting Diodes) which has a 3mm thick display panel

Sony's XEL1 11" OLED
Source:website - http://www.sonystyle.ca

Displays: E-Ink

- Low energy
- High resolution
- No backlight
- Slower to redraw
- Specific applications?

Kobo eReader

Large displays

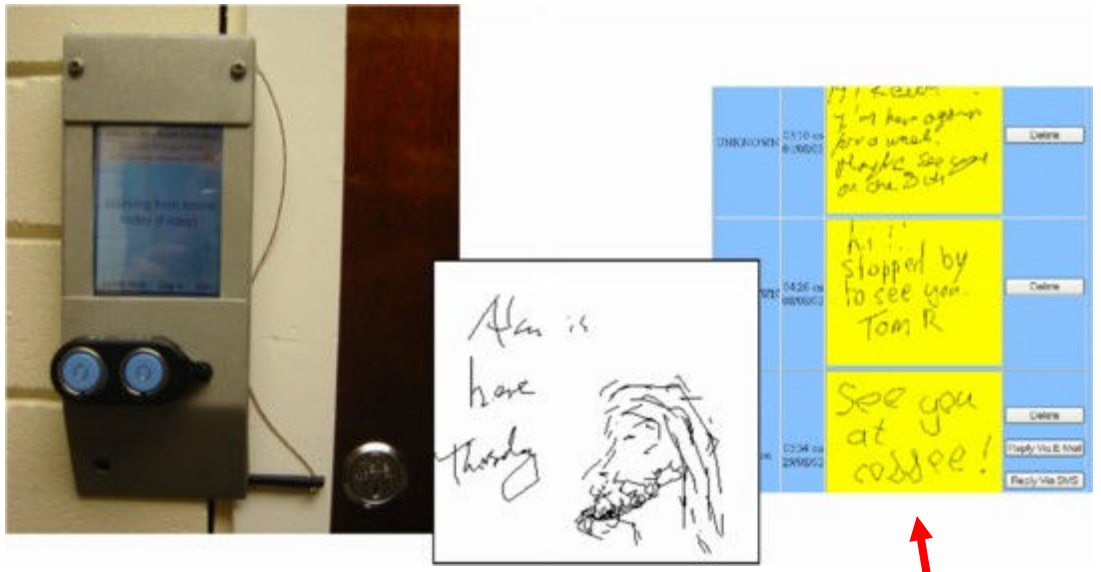
- used for meetings, lectures, etc.
- technology
  - plasma – usually wide screen
  - video walls – lots of small screens together with small bezel
  - projected – RGB lights or LCD projector
    - – hand/body obscures screen
    - – may be solved by 2 projectors + clever software
  - back-projected
    - – frosted glass + projector behind

Situated displays

- displays in ‘public’ places
  - large or small
  - very public or for small group
- display only
  - for information relevant to location
- or interactive
  - use stylus, touch sensitive screem
- in all cases … the location matters
  - meaning of information or interaction is related to the location

“Hermes”: a situated display

small displays
beside
office doors



handwritten
notes left
using stylus

office owner
reads notes
using web interface

Lighting systems

- Household lights can act as outputs and respond to events (e.g. Philips Hue)

Dedicated displays

- analog representations:
  - dials, gauges, lights, etc.
- digital displays:
  - small LCD screens, LED lights, etc.
- head-up displays
  - found in aircraft cockpits
  - show most important controls
    … depending on context

OTHER OUTPUTS

Sound

- Usually stereo, but can offer many more channels
- Used for error indications
- Confirmation of actions e.g. keyclick
- Popular for gaming and virtual reality
- Research is happening into spatialized sound for data, notifications

Printing

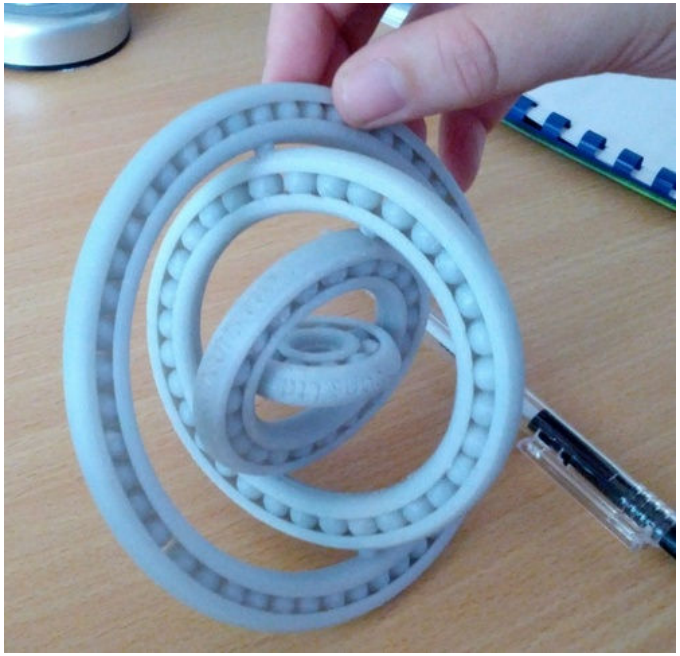
- Resolution
  - size and spacing of the dots
  - measured in dots per inch (dpi)
- Colour Quality
- Speed
  - usually measured in pages per minute
- Cost

Printing: Readability

- lowercase
  - easy to read shape of words
- UPPERCASE
  - better for individual letters and non-words
    e.g. flight numbers: BA793 vs. ba793
- serif fonts
  - helps your eye on long lines of printed text
  - but sans serif often better on screen

3D Printing

- Objects created from plastic beads and bonding solution
- Moveable parts possible

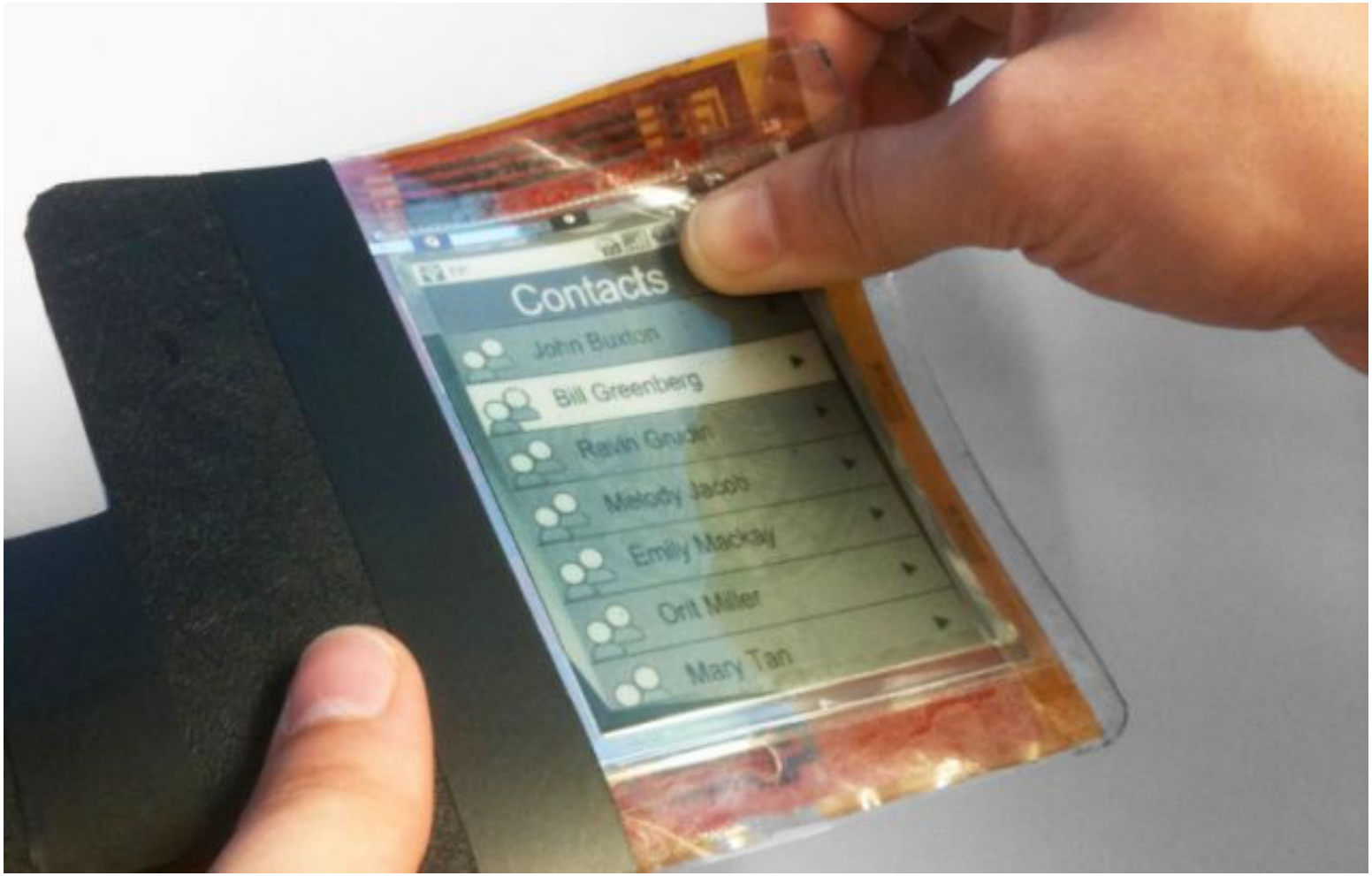


COUPLED I/O

VR, Simulators, Caves

- VR headset for single person
- “Cave” for multiple people
  - scenes projected on walls
  - realistic environment
- Simulator
  - Cave or VR display
  - hydraulic rams
  - real controls

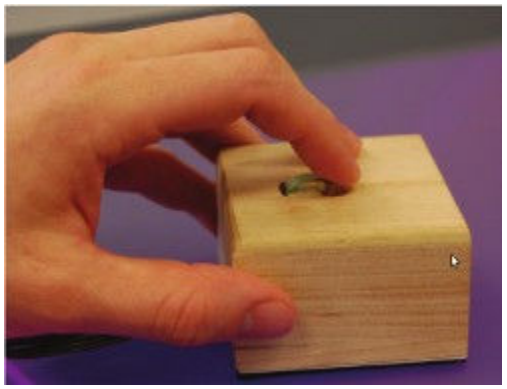
Flexible Displays



Queen's University Paper Phone
http://www.humanmedialab.org/paperphone/

Haptics

- Phantom:
  - 6 DOF input
  - Force feedback output
- Wiimote:
  - motion in / vibrate out
- Tabletop puck
  - 1D pressure input
  - Force feedback out



Haptic Tabletop Puck

Wiimote

Phantom Omni Haptic Device

OTHER COMPUTER CHARACTERISTICS

Memory

- Computers are good at storing information in various ways:
  - Fast, but volatile memory (RAM)
  - Cheaper, longer term storage (Disks)
  - Hybrid: fast and persistent (flash memory)

Network

- Sustainable transfer rates
- Latency
- Conflicts (concurrency)

Processing Speed

- Designers tend to assume fast processors, and make interfaces more and more complicated
- But problems occur, because processing cannot keep up with all the tasks it needs to do
  - cursor overshooting because system has buffered keypresses
  - icon wars - user clicks on icon, nothing happens, clicks on another, then system responds and windows fly everywhere
- Also problems if system is too fast - e.g. help screens may scroll through text much too rapidly to be read

Limitations on interactive performance

- Computation bound
  - Computation takes ages, causing frustration for the user
- Storage channel bound
  - Bottleneck in transference of data from disk to memory
- Graphics bound
  - Common bottleneck: updating displays requires a lot of effort - sometimes helped by adding a graphics co-processor optimised to take on the burden
- Network capacity
  - Many computers networked - shared resources and files, access to printers etc. - but interactive performance can be reduced by slow network speed

Summary

- Today we:
  - Reviewed the characteristics of computers

Your Action Items

- Continue posting your examples of “Usability Wins and Epic Fails” under Blackboard discussion
- Read Neilsen’s Heuristics and how to conduct a heuristic evaluation
- Prepare term project part 2a for lab Sept 30/Oct 3

Ongoing Course Evaluation

- Please complete the Lecture 5 daily feedback form if you have comments about this lesson