
Human Computer Interaction

The Computer

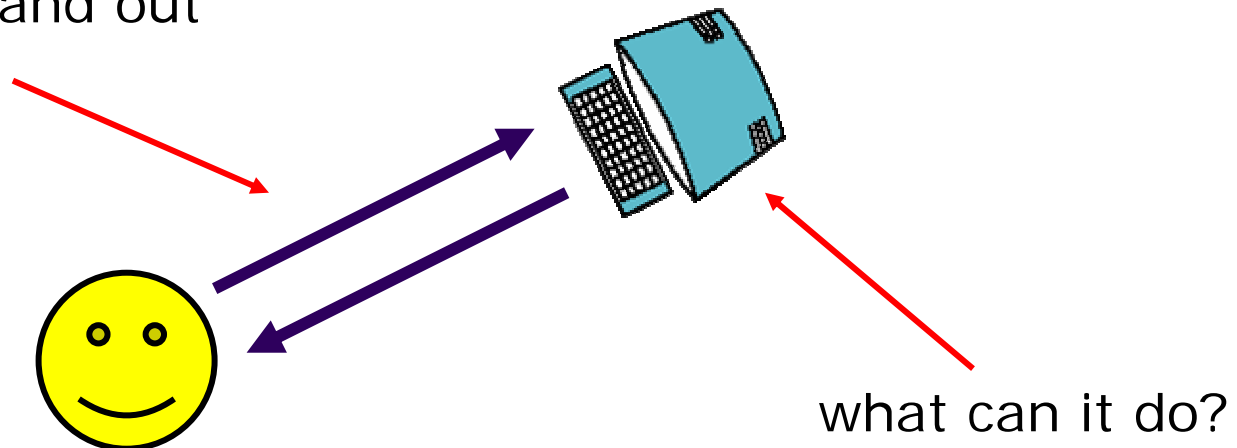
Lecture # 3

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Interacting with Computers

to understand human–*computer* interaction
... need to understand computers!

what goes in and out



Interaction = Transfer of information

The Computer

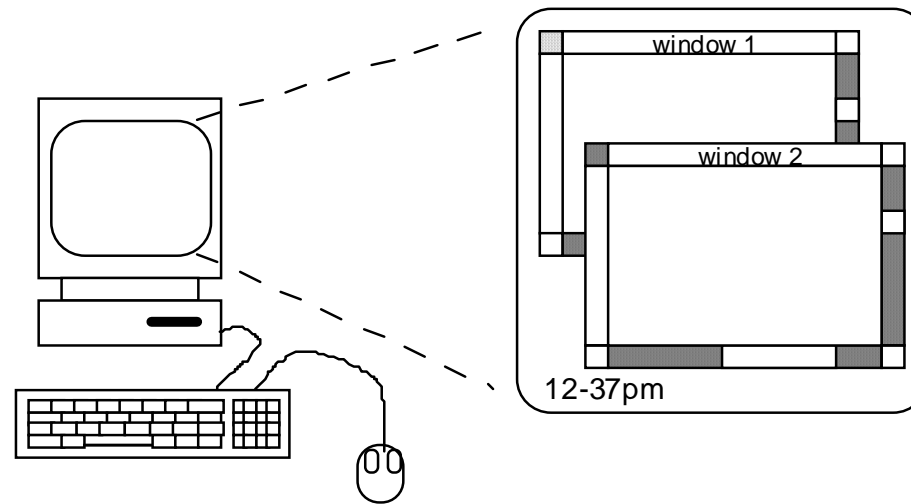
- A computer system is made up of various elements
 - Each of these elements affects the interaction
- **Input devices** – text entry and pointing
- **Output devices** – screens, digital paper
- **Interaction** – e.g. sound, haptic etc.
- **Paper** – as output (print) and input (scan)
- **Memory** – RAM & permanent media
- **Processing** – Speed of processing, networks

Contents

- Introduction
- Text Entry Devices
- Positioning, Pointing & Drawing
- Display Devices
- Physical Controls, Sensors & Special Devices
- Paper: Printing & Scanning

A Typical Computer System

- Computer



- Variations



In your house ...



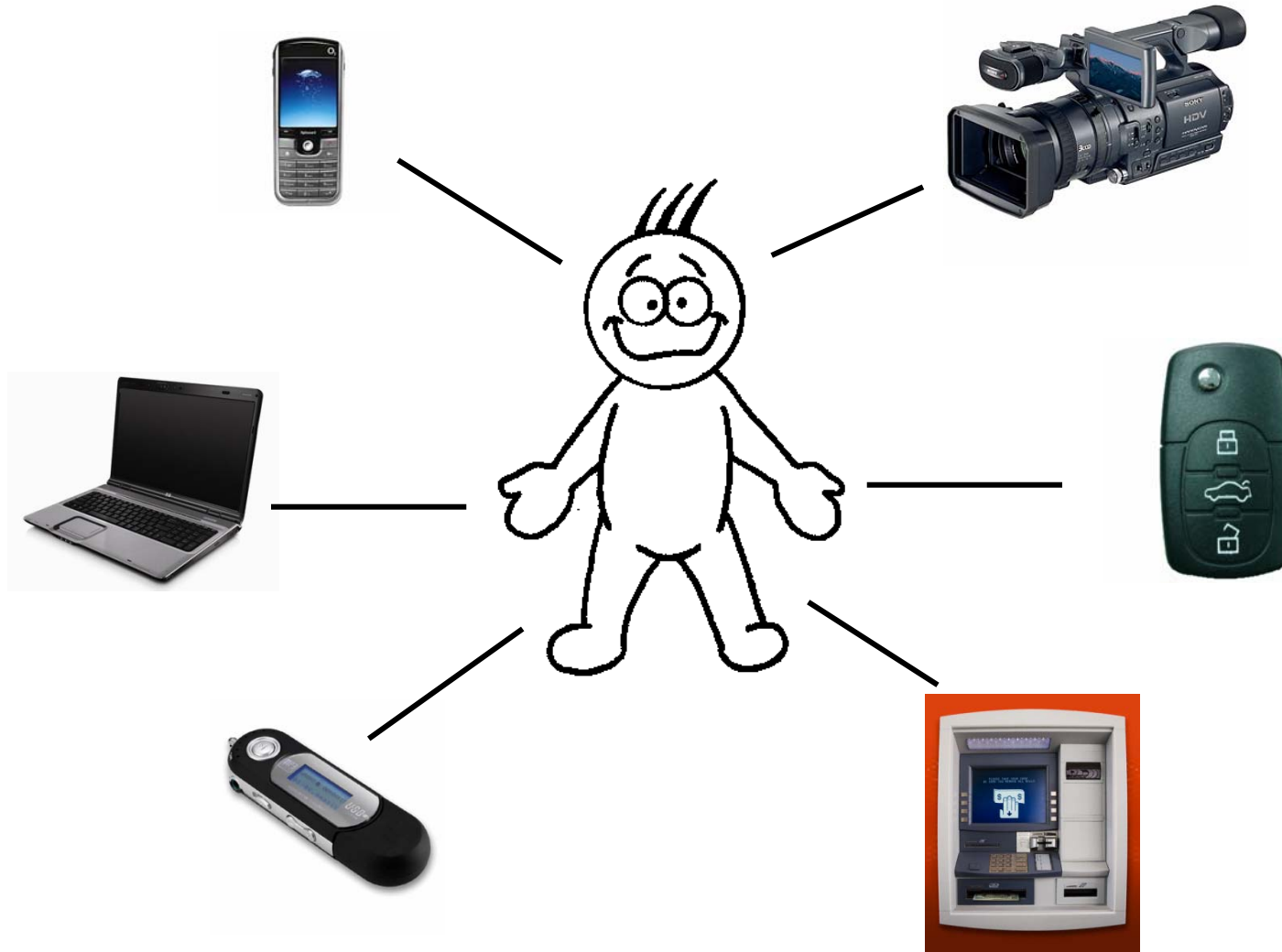
In your pockets ...



And many more ...



More Devices – More Interaction



Contents

- Introduction
- **Text Entry Devices**
- Positioning, Pointing & Drawing
- Display Devices
- Physical Controls, Sensors & Special Devices
- Paper: Printing & Scanning

Text Entry Devices

- Keyboards
- Chord keyboards
- Phone Pads
- Handwriting
- Speech

Keyboards

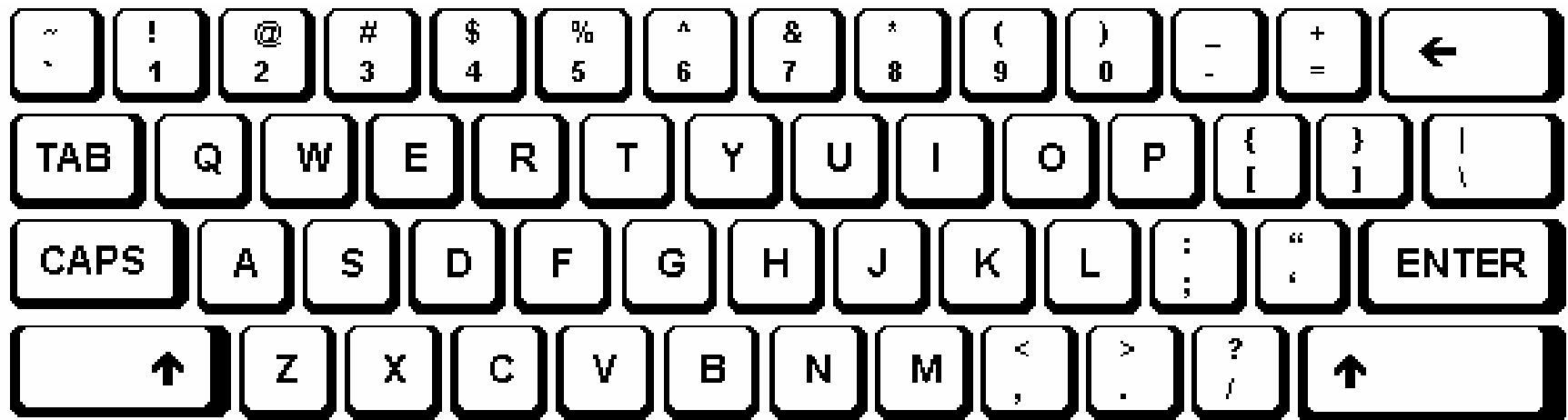
- Most common text input device
- Allows rapid entry of text by experienced users
- Usually connected by cable, but can be wireless
- Standardized layouts: first six letters of first row
 - QWERTY, AZERTY

Layout - QWERTY

- Standardized layout – But:
 - Non-alphanumeric keys are placed differently
 - Accented symbols for different scripts
 - é, è, à, ù etc.
 - Minor differences: \$, £, €
- QWERTY arrangement not optimal for typing
 - Layout to prevent typewriters jamming



Layout QWERTY



Alternative Keyboard Layouts

- Alphabetic
 - Keys arranged in alphabetic order
 - Not faster for trained typists
 - Not faster for beginners either!

A	B	C	D	E	F	G	H	Back	Up	Link
I	J	K	L	M	N	O	P	Enter	Down	Link
Q	R	S	T	U	V	W	X	Left	Right	Escape
Y	Z	!	?	,	.	Spacebar		Tab	Shift	Caps Lock

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DVORAK* Keyboard

- 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

***August Dvorak** (1894 –1975) was an educational psychologist and professor at the University of Washington

DVORAK Keyboard

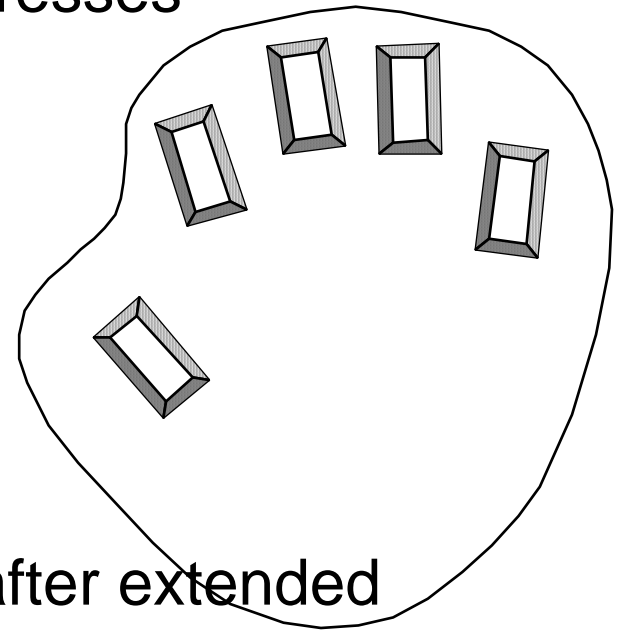
~ `	1	2	3	4	5	6	7	8	9	0	{ [}]	Backspace ←
Tab ↔	" ,	< ,	> .	P	Y	F	G	C	R	L	? /	+ =	 \ Enter ↵
Caps Lock ⇧	A	O	E	U	I	D	H	T	N	S	- _	Enter ↵	
Shift ⇧	:	Q	J	K	X	B	M	W	V	Z	Shift ⇧		
Ctrl	Win Key	Alt							Alt Gr	Win Key	Menu	Ctrl	

Ergonomic Designs

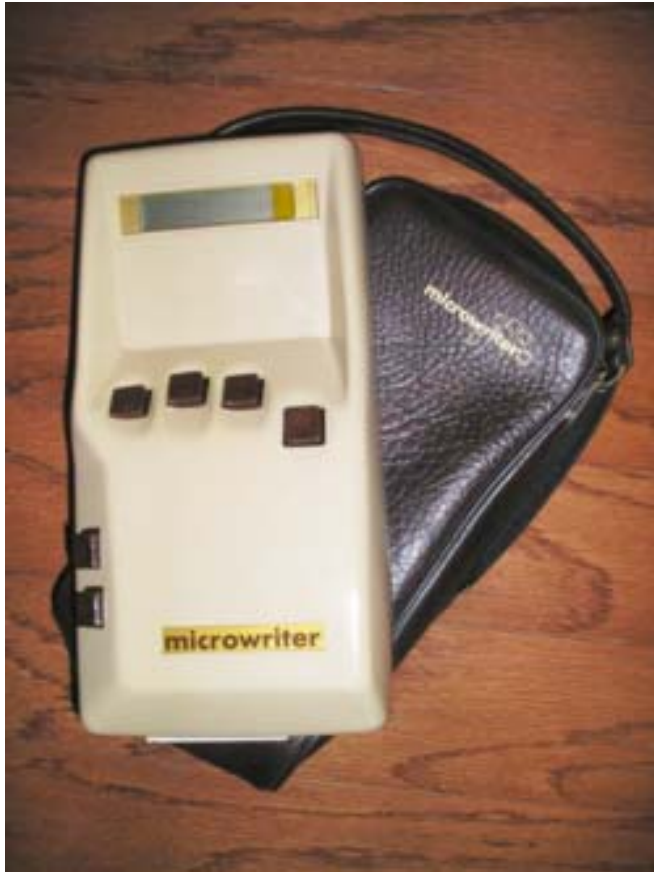


Chord Keyboards

- Only a few keys – Four or Five
- Letters typed as combination of key presses
- Similar to playing a chord on a Piano
- Compact size
 - Ideal for portable applications
- Fast – once you have trained
- BUT - social resistance, plus fatigue after extended use

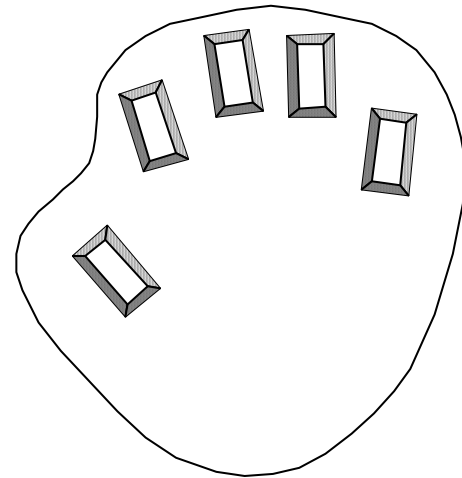


Chord Keyboard



Chord Keyboards

- Each key is mapped to a number and then can be mapped to a corresponding letter or command
- By pressing two or more keys together the user can generate many combinations
- Original mapping, five keys: 1,2,4,8,16
- Key Mappings
 - a = 1
 - b = 2
 - c = 3
 - d = 4 etc.
- User presses keys $1 + 2 = 3$ simultaneously the letter "c" appears
- Each finger controls one key which corresponds to one BIT



Phone Pad & 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

- Surprisingly fast!



The Computer

- T9 predictive entry
- Type as if single key for each letter
- Use dictionary to 'guess' the right word
 - Word completion
- Example
 - If you type 4-3 the phone might guess "he"
 - Changes its guess to "gel" when you continue with the next letter (4-3-5).
 - When you add the fourth letter (4-3-5-5) it will guess "hello" and you can press the space key (#) to enter the whole word plus a space
- But 26 -> menu 'am' or 'an'



Handwriting Recognition



Handwriting Recognition

- Text can be input into the computer, using a pen and a tablet
- Technical problems:
 - Segmenting joined up writing into individual letters
 - Interpreting individual letters
 - Coping with different styles of handwriting
- Used in PDAs, and tablet computers ...
... leave the keyboard on the desk!

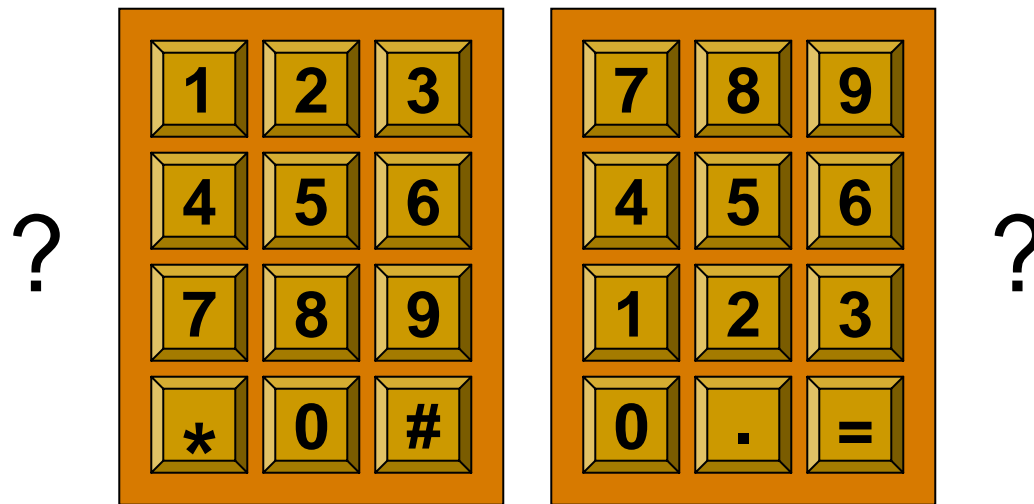
Speech Recognition

- Improving rapidly
- Most successful when:
 - Single user – initial training and learns peculiarities
 - Limited vocabulary systems
- Problems with
 - External noise interfering
 - Imprecision of pronunciation
 - Large vocabularies
 - Different speakers



Numeric Keypads

- For entering numbers quickly
 - Calculator, Phone, PC Keyboard, Telephones
- Two different layouts



Numeric Keypads

- Calculator-style vs. Telephone-style



Computer



ATM

Contents

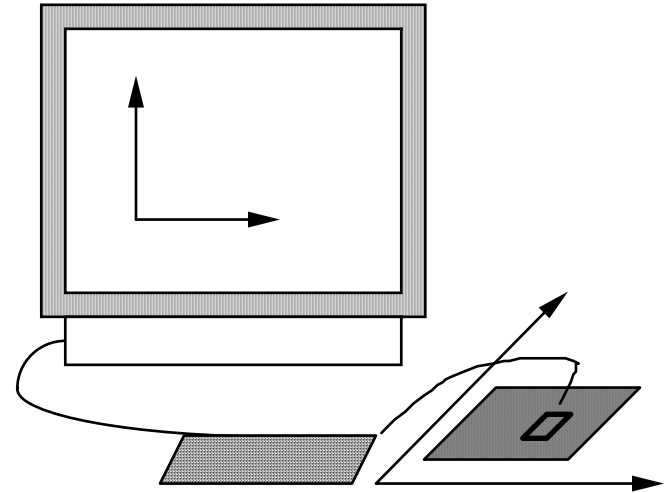
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Positioning, Pointing & Drawing

- Mouse
- Touchpad
- Trackballs & Thumbwheels
- Joysticks & Keyboard nipples
- Touch screens
- Tablets

The Mouse

- Handheld pointing device
 - Very common
 - Easy to use
- Buttons
 - Usually from 1 to 3 buttons on top, used for making a selection, indicating an option, or to initiate drawing etc.
- Relative movement is detected
- Mapping transformation
 - Left/right movement – Direct mapping
 - Up/down movement – Away/towards the user



The Mouse

- Two methods for detecting movement
- Mechanical
 - Ball on underside of mouse turns as mouse is moved
- Optical
 - Light emitting diode on underside of mouse
 - Less susceptible to dust and dirt
 - Detects fluctuating alterations in reflected light intensity to calculate relative motion



The Mouse

- Footmouse
- 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

- Small touch sensitive tablets
- Finger strokes to move mouse pointer
- Used mainly in laptop computers
- Acceleration settings
 - Fast stroke
 - Lots of pixels per inch moved
 - Initial movement to the target
 - Slow stroke
 - Less pixels per inch
 - For accurate positioning



Trackball

- Ball is rotated inside static housing
- Like an upside down mouse!
- Relative motion moves cursor
- Separate buttons for picking
- Fairly Accurate
- Hard to draw
 - Long movements are difficult



Thumbwheels

- Two orthogonal Dials
 - X-Y cursor position
 - Cheap
 - Slow and difficult to manipulate
- For fast scrolling – single thumbwheel dial on mouse



Joystick

- Movement of stick – Movement of cursor
- Buttons for control
- Absolute Joystick
 - Position of joystick controls cursor
- Isometric Joystick
 - Pressure on the joystick controls velocity
- Used widely in computer games



Keyboard Nipple

- For laptop computers
- Miniature joystick in the middle of the keyboard



Touch Screens

- Detect the presence of finger or stylus on the screen
- *Direct* pointing device
- Advantages:
 - Fast, and requires no specialised pointer
 - Good for menu selection
 - Input as well as output device
 - Examples?



ATM, Ticketing machines, Iphone

Touch Screens

- Disadvantages:
 - Finger can mark screen
 - Imprecise (finger is a fairly blunt instrument!)
 - Difficult to select small regions or perform accurate drawing
 - Lifting arm can be tiring



Stylus & Light Pen

■ Stylus

- Small pen-like pointer to draw directly on screen
- On touch sensitive surfaces
- Used in PDA, tablets PCs and drawing tables



■ Light Pen

- Uses light from screen to detect location
- Now rarely used



■ Both

- Very Direct and obvious to use
- Can obscure the screen

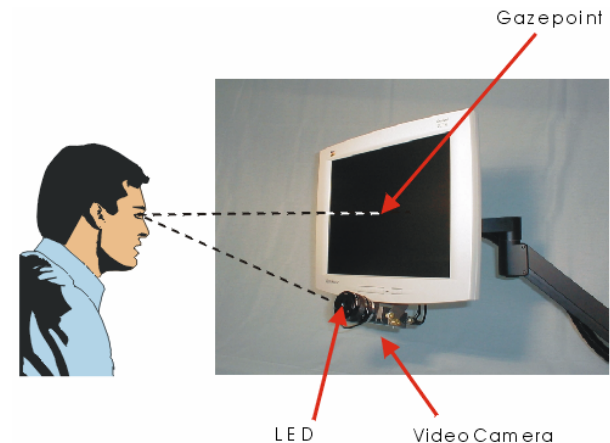
Digitizing Tablet

- Freehand Drawing
- Substitute to Mouse
- Surface Contact
 - Pen or Puck
- Can be used for text input
 - Provided: handwriting recognition support



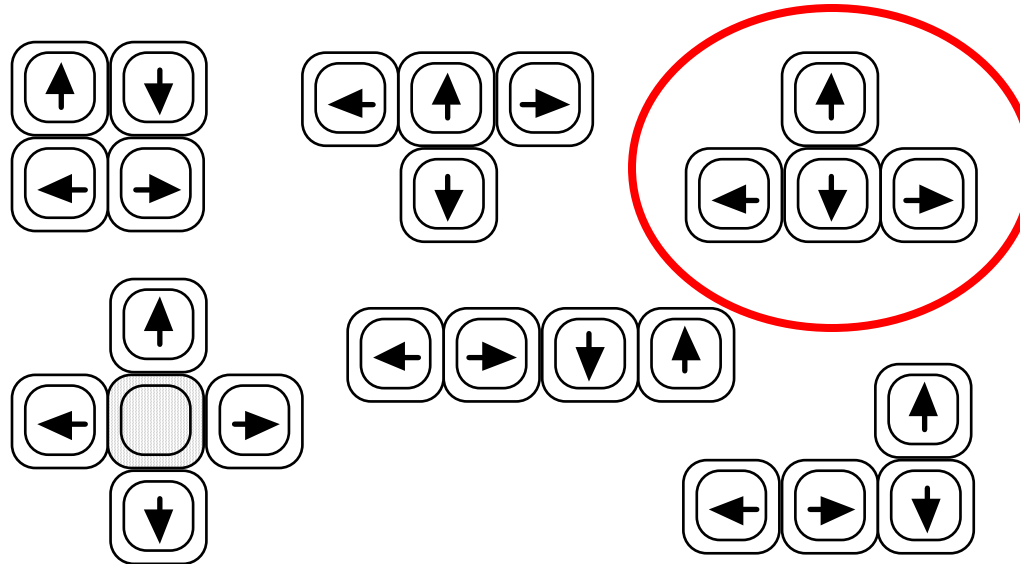
Eyegaze

- Control interface by eye gaze direction
 - e.g. look at a menu item to select it
- Special Glasses, Headset or built into the Screen
- Uses laser beam reflected off retina
- Potential for hands-free control
- Uses
 - Hands occupied
 - Good for **Selection** but not for **Drawing**
 - Distinguish: Deliberate gaze or accidental glance



Cursor Keys

- Four keys (up, down, left, right) on keyboard
- Positioning within lists (menus), spread sheets etc.
- Basic motion for text-editing tasks
- No standardised layout, but inverted “T”, most common



Discrete Positioning Controls

- In phones, TV controls etc.
 - Cursor pads or mini-joysticks
 - Dedicated Function/Menu Selection
 - Mainly for menu selection



Contents

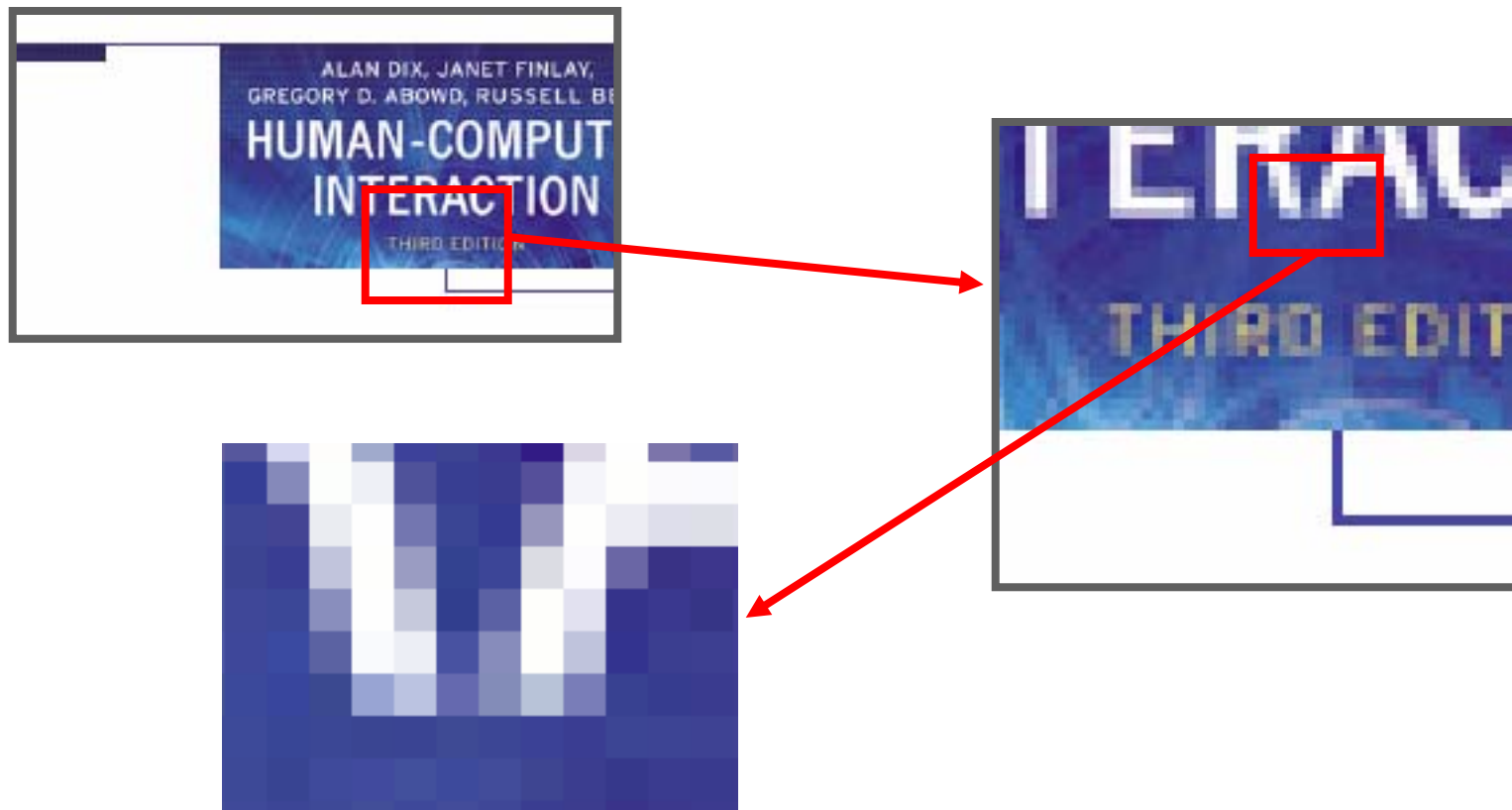
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Display Devices

- Bitmap Screens
 - CRT & LCD
- Large and Situated Displays
- Digital Paper

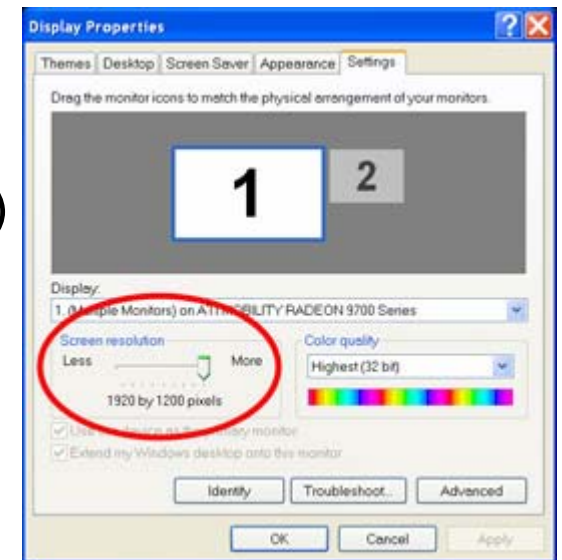
Bitmap Displays

- Screen: Vast number of color dots



Resolution

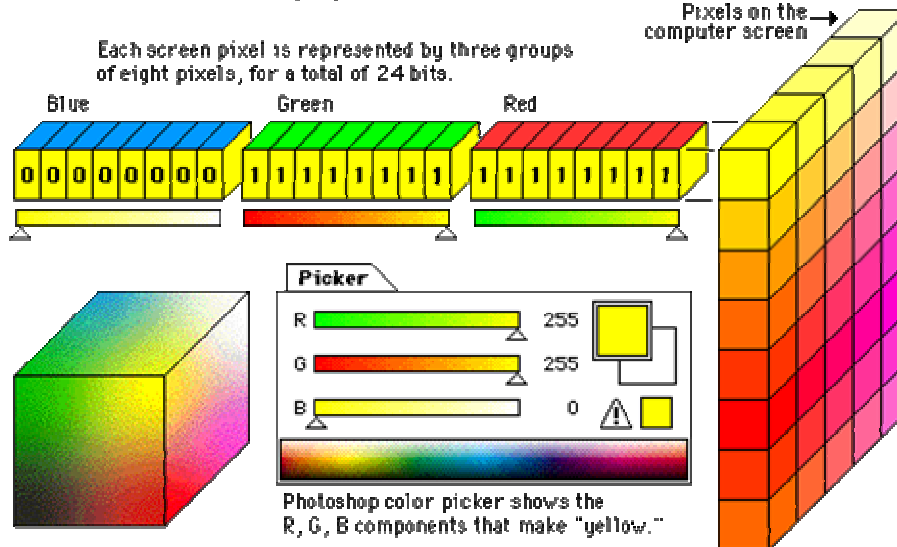
- Resolution ... used (inconsistently) for
 - Number of pixels on screen (width x height)
 - e.g. 1024x768 pixels
 - Density of pixels (in pixels or dots per inch - dpi)
 - Typically between 72 and 96 dpi
- Aspect ratio
 - Ration between width and height
 - 4:3 for most screens, 16:9 for wide-screen TV



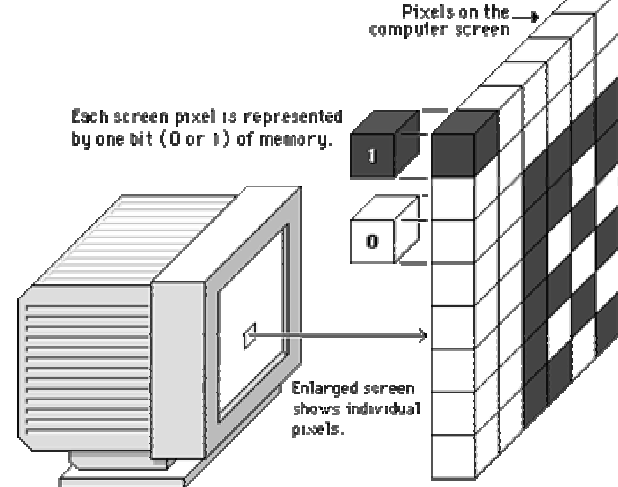
Color Depth

- How many different colours for each pixel?
- One bit per pixel – On/Off
- 8 bits per pixel – $256(2^8)$ Colours
- 8 bits for each red, blue, green
 - Millions of colours

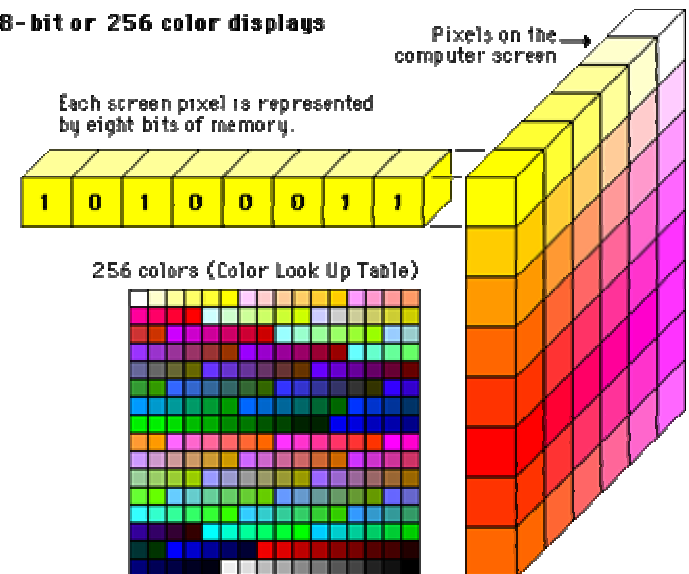
24-bit “true color” displays



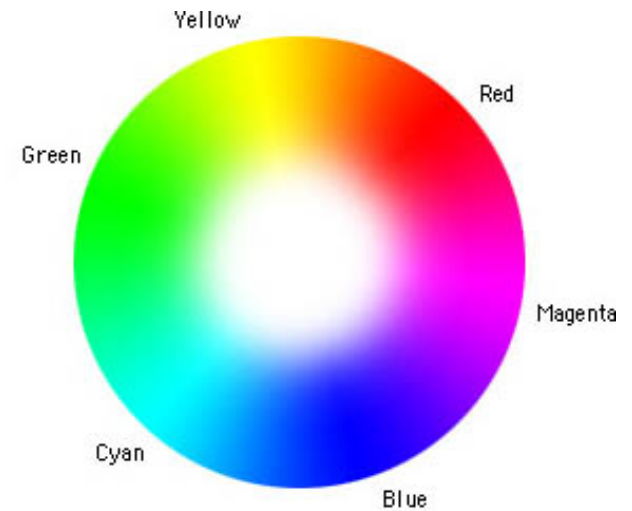
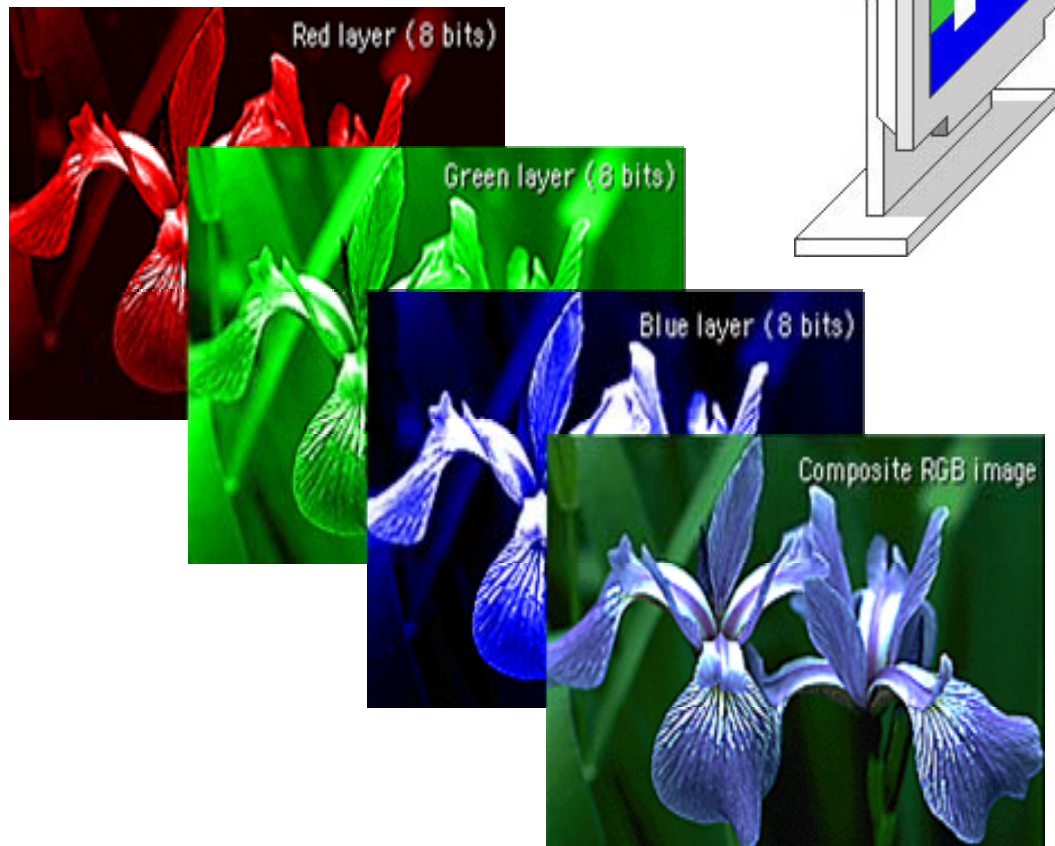
One-bit black and white display



8-bit or 256 color displays



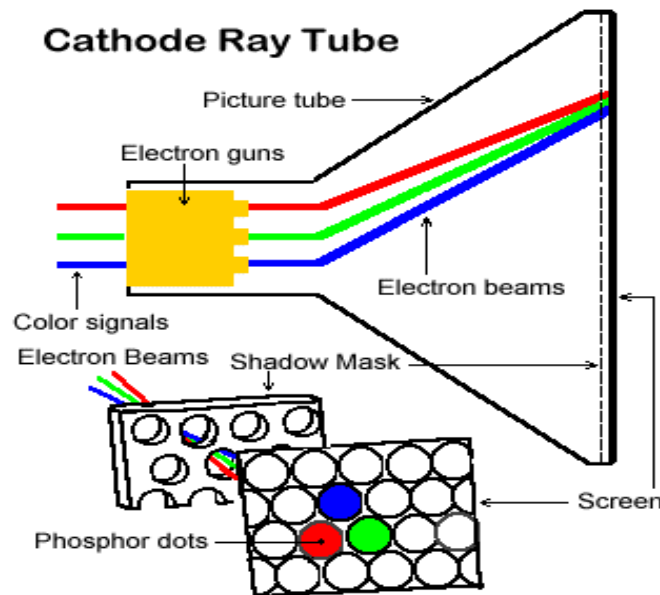
Color Depth



Technologies

■ Cathode Ray Tube

- Television Screens & Computer Monitors
- Stream of electrons emitted from electron gun, focused and directed by magnetic fields, hit phosphor-coated screen which glows



Technologies

- Liquid Crystal Display (LCD)
 - PDAs, Notebooks etc.
 - Increasingly for desktop and home tv
 - Smaller and lighter
 - Layer of liquid crystal b/w two glass plates



Large Displays

- Used for meetings, lectures etc.
- Technology
 - Plasma – Usually wide screen
 - Video Wall – Several small screens
 - Video Projectors

Situated Displays

- Displays in public places
- Display only
 - Information relevant to the location
- Interactive
 - May use stylus, touch sensitive screen
- In All Cases
 - 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

Digital Paper

- Thin and flexible – Electronically written
- Keep contents when removed from electric supply
- Uses?
 - o Banners – Updates are not frequent
 - o 'Soft' Book



References

- Chapter 2: Human Computer Interaction by Dix et al.
- User Interface Hall of Fame/Shame

