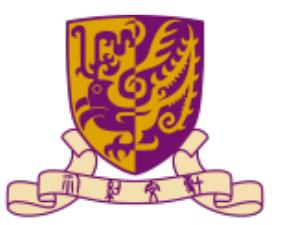

CSC4130

Introduction to Human-Computer Interaction

Lecture 4

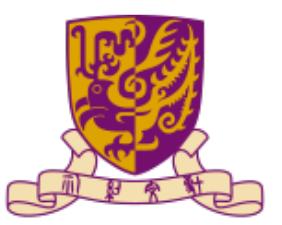
Computer





Outline

- Computer
- Text entry devices
- Positioning, pointing, and drawing
- Display devices
- Physical controls, sensors, and special devices



Outline

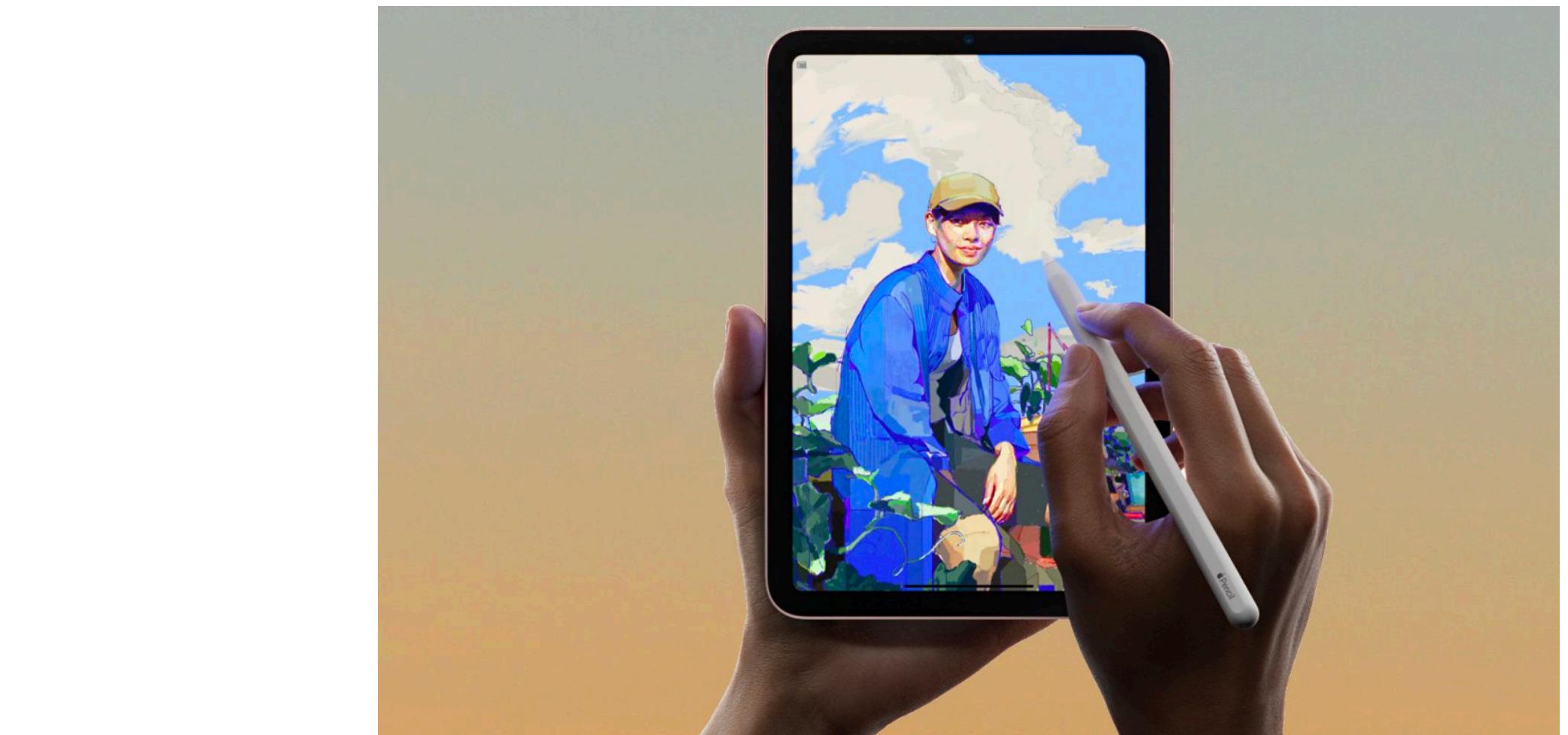
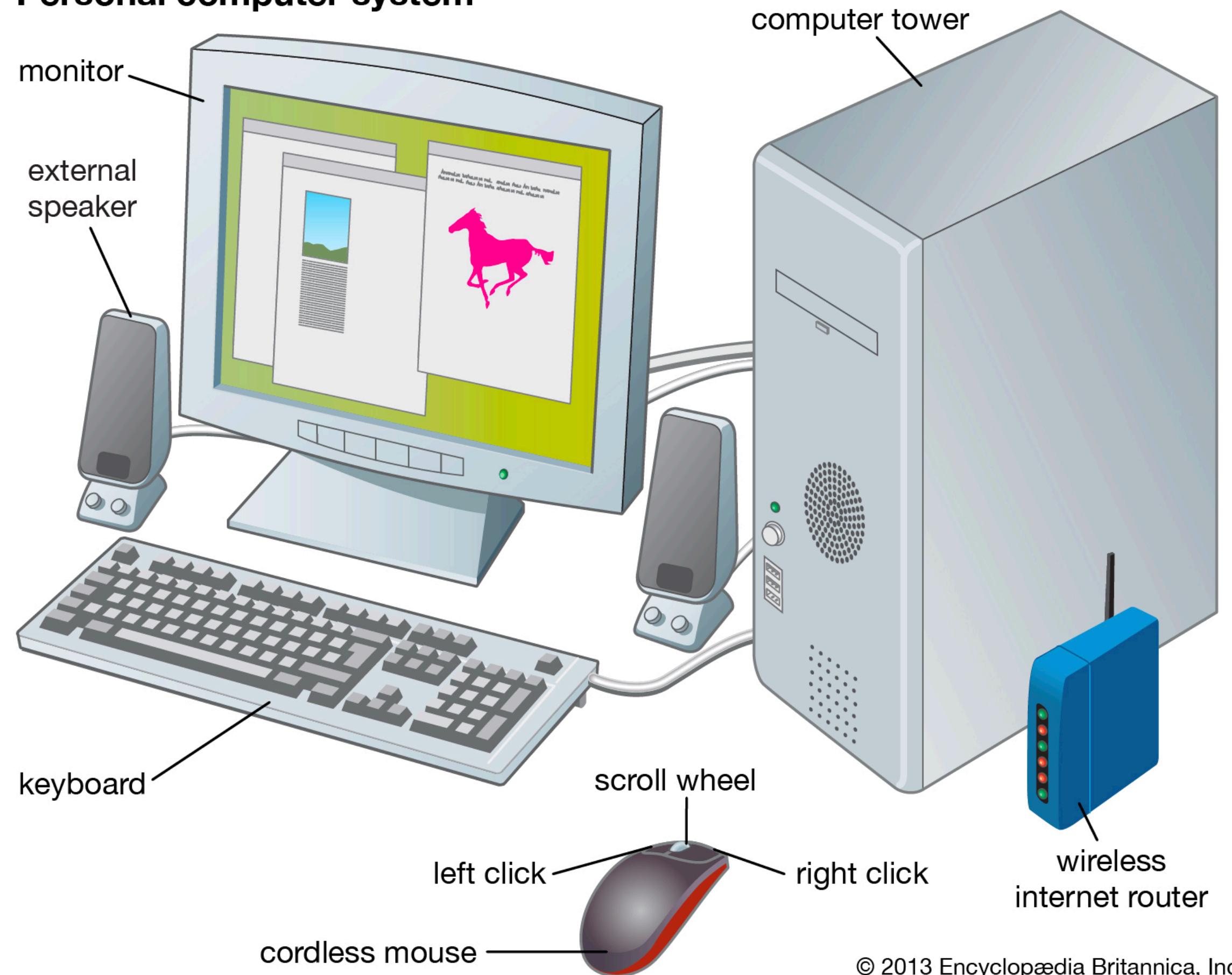
- Computer
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Computer

- Made up of various elements and each of these elements will affect the interaction
 - Input devices - text entry and pointing
 - Output devices - screen, digital paper
 - Physical interaction - sound, haptic, bio-sensing
 - Paper - as output (print) and input (scan)
 - Memory - RAM & permanent media, capacity and access
 - Processing - speed of processing, networks

Computer

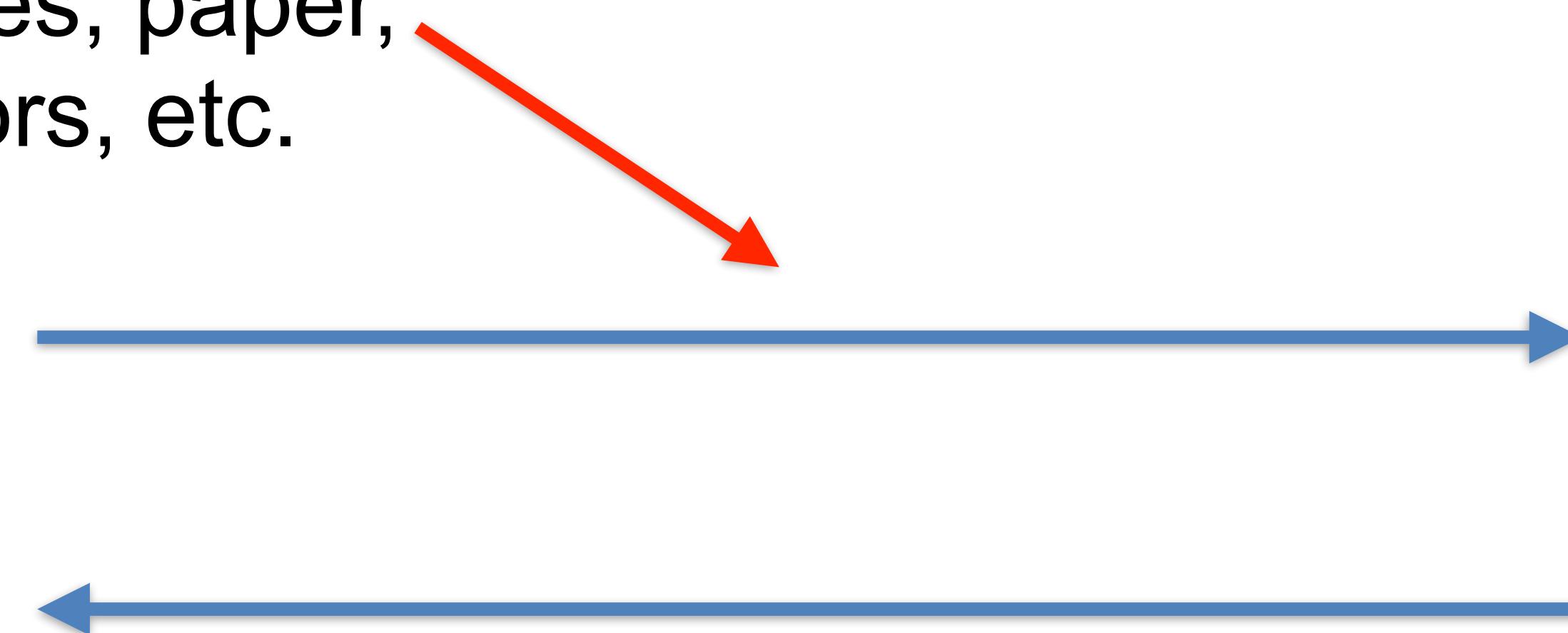
Personal computer system



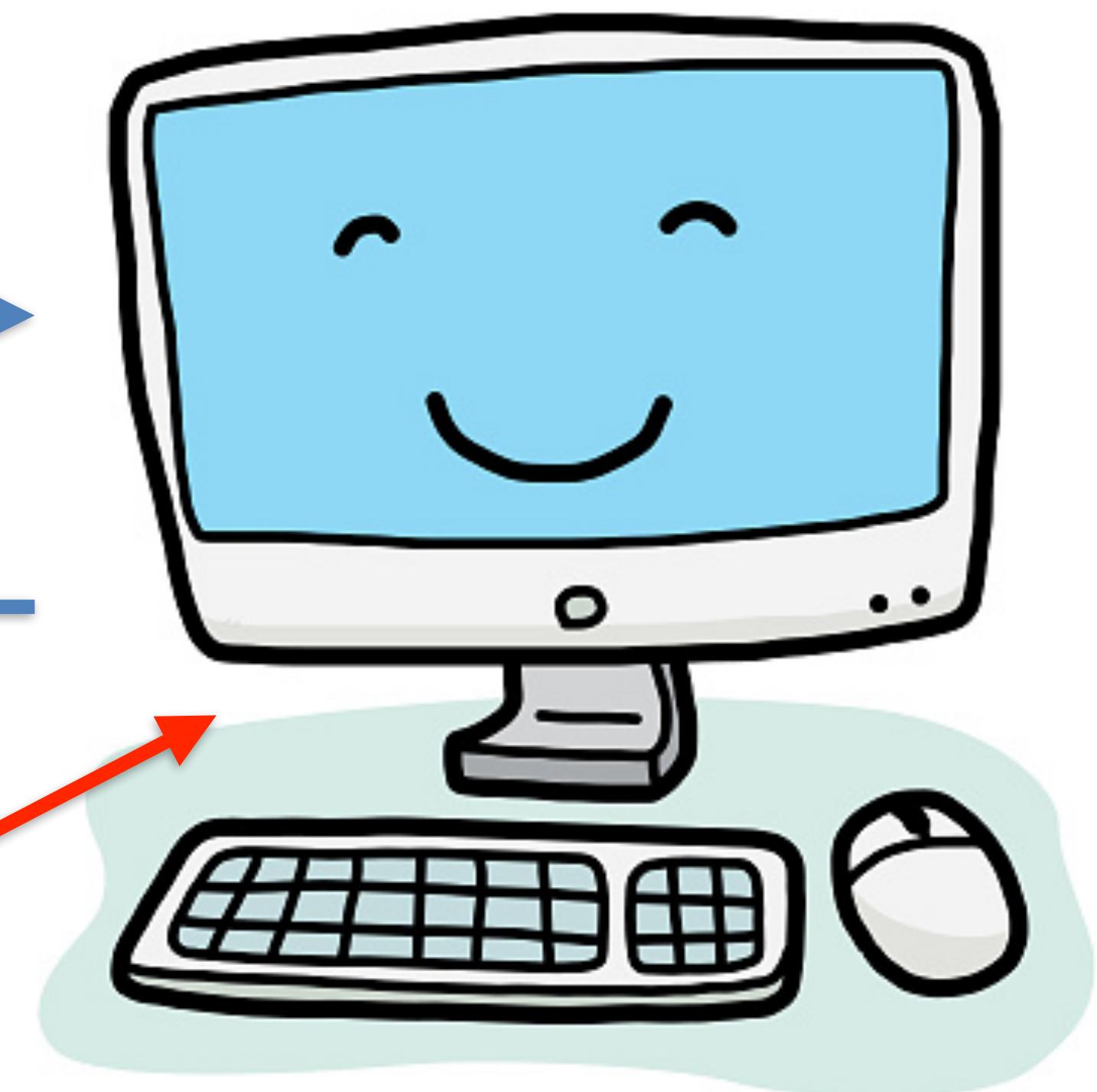
Interacting with computers

- To understand human-computer interaction ... need to understand computers

What goes in and out
devices, paper,
sensors, etc.

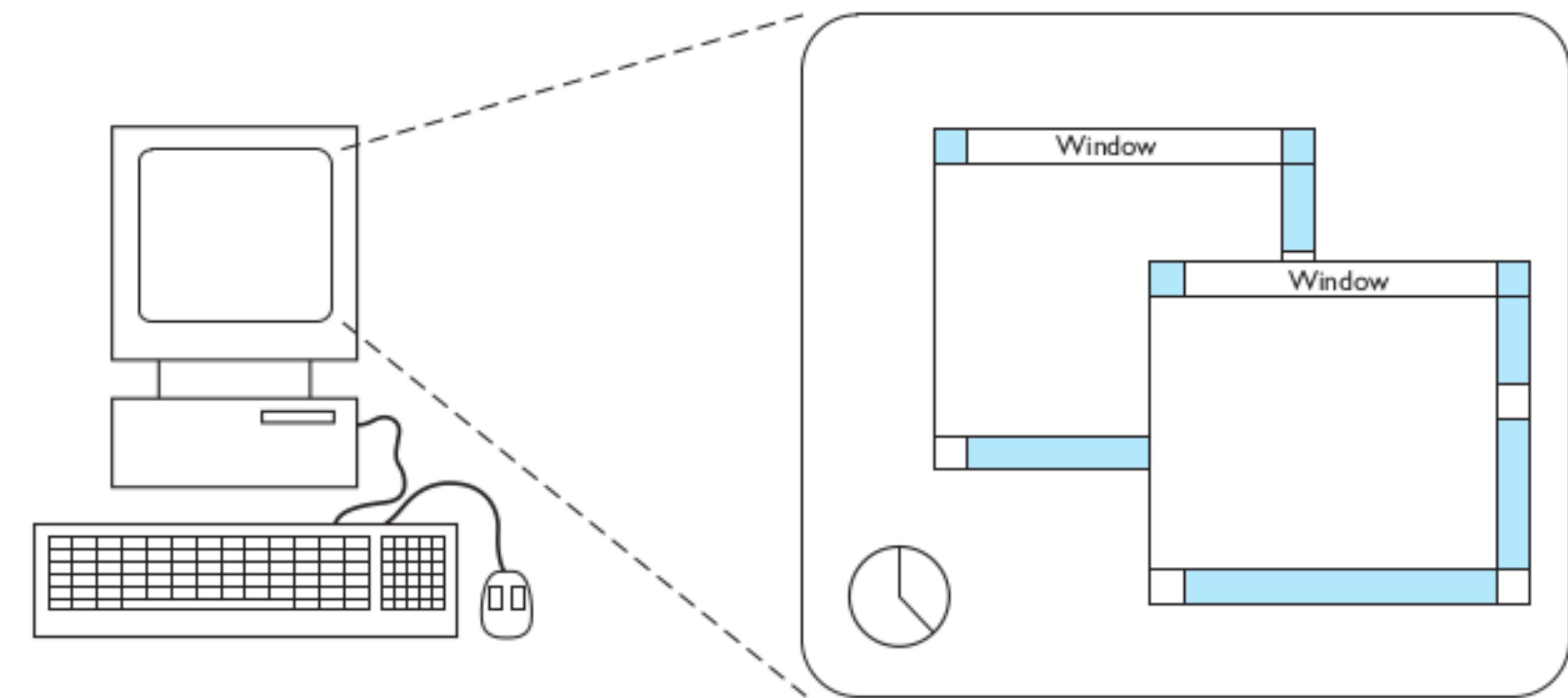


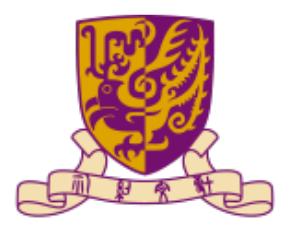
What it can do
memory, processing, networks, etc.



A typical computer system

- Screen, monitor on which there are windows
- Keyboard
- Mouse or trackpad
- Variations
 - Personal digital assistant (PDA)
 - Desktop
 - Laptop

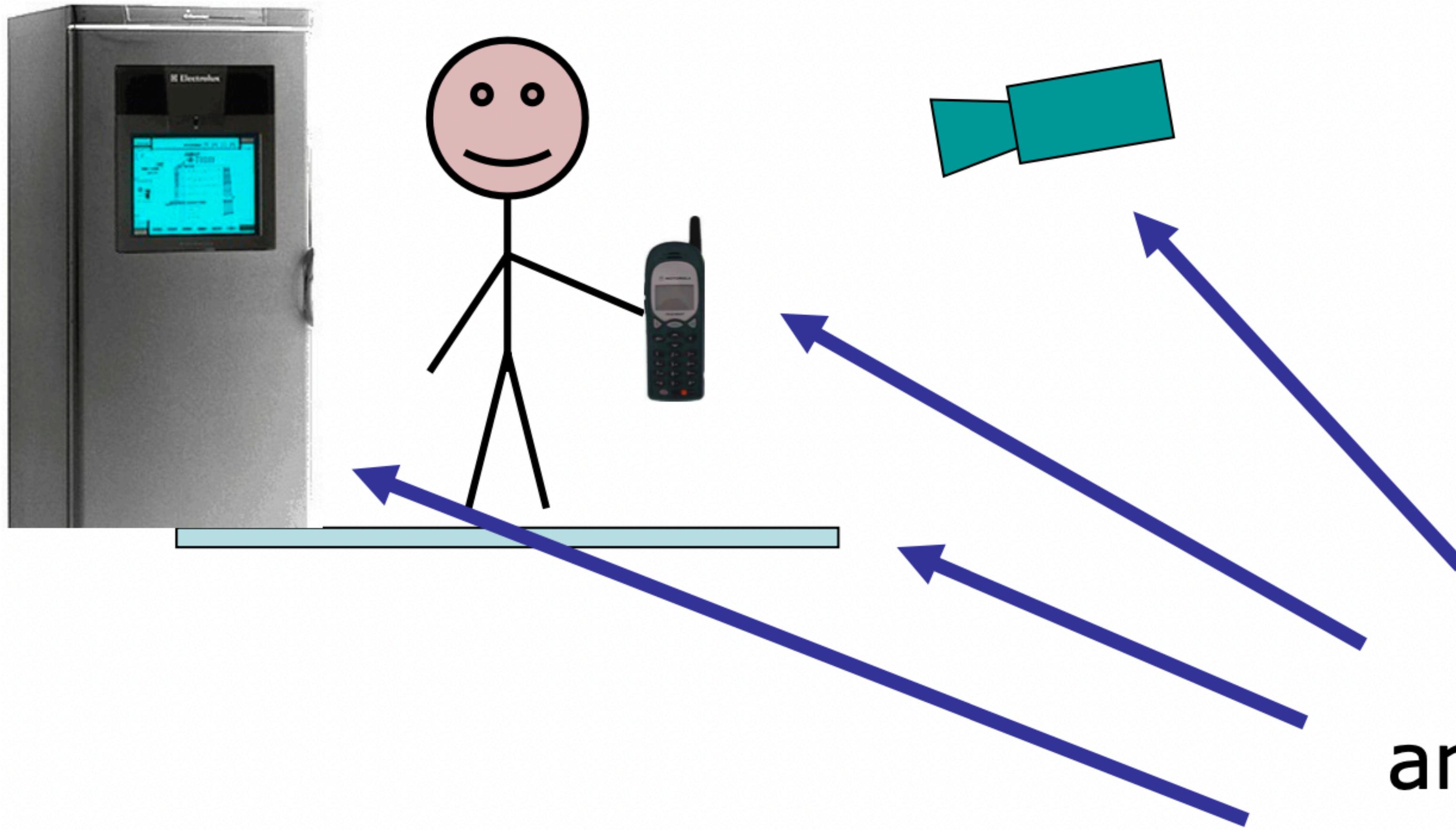




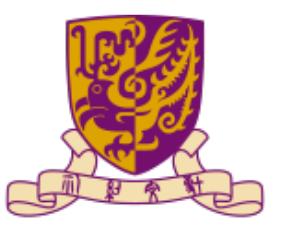
Interactivity

- Long ago in a galaxy far away ... batch processing
 - Punched card stacks or large data files prepared
 - Long wait ...
 - Line printer output
- Now most computing is interactive
 - Rapid feedback
 - The user in control (most of the time)
 - Doing rather than thinking

Richer interaction

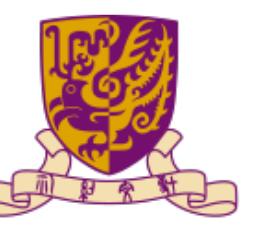


sensors
and devices
everywhere



Outline

- Computer
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Keyboards

- Most common text input device
- Allow rapid entry of text by experienced users
- Keypress closes connection, causing a character code to be sent
- Usually connected by cable, but can be wireless

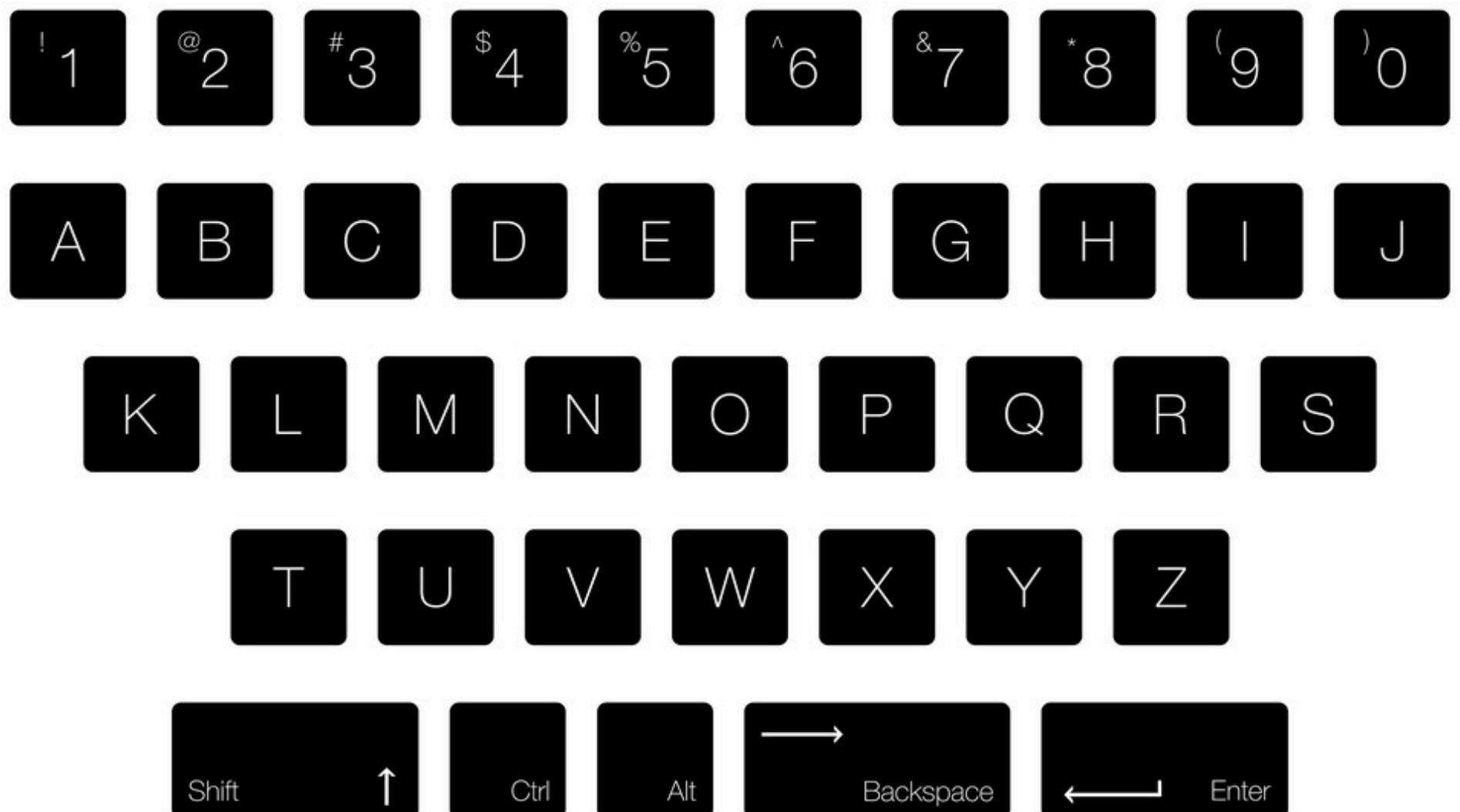
Layout - QWERTY

- Standardized layout, but
 - Non-alphanumeric keys are placed differently
 - Accented symbols needed for different scripts
- QWERTY arrangement not optimal for typing
 - Layout to prevent typewriter jamming



Alternative keyboard layouts

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



Alternative keyboard layouts

- Dvorak
 - Common letters under dominant fingers
 - Biased toward right hand
 - Common combinations of letter alternate between hands
 - 10-15% improvement in speed and reduction in fatigue



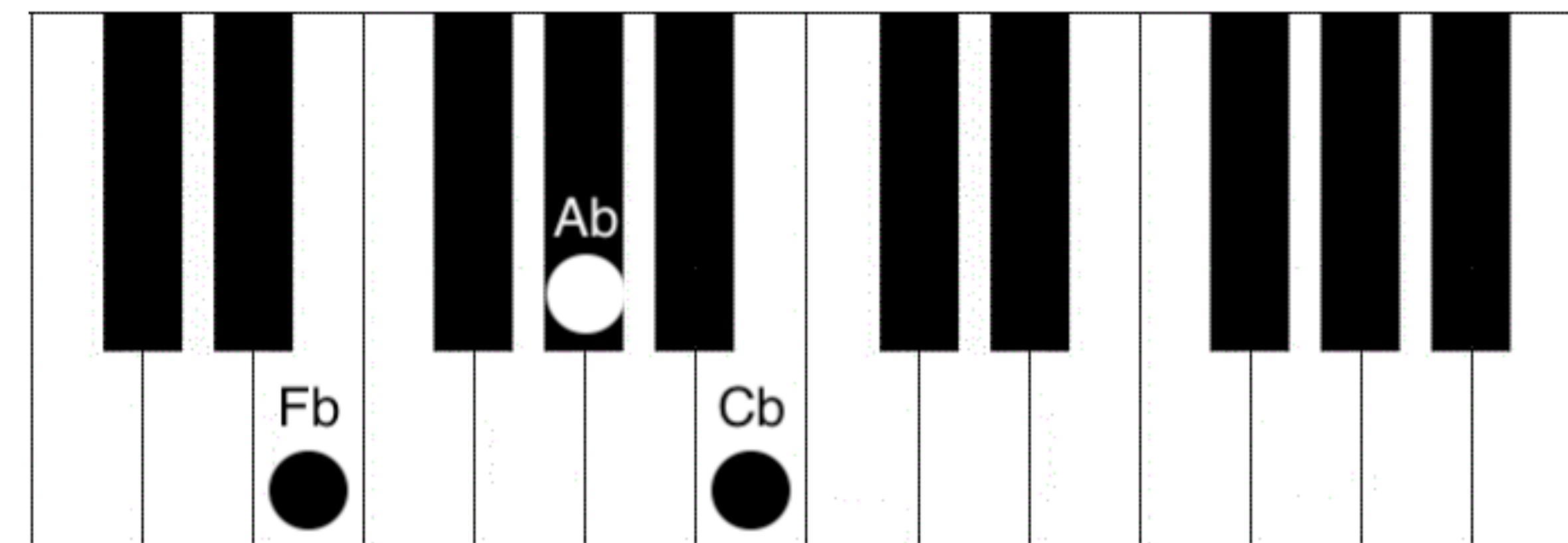
Special keyboards

- Design to reduce fatigue for repetitive strain injury (RSI)
- For one handed use e.g., the Maltron left-handed keyboard



Chord keyboards

- Only a few keys - 4 to 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



Phone pad and T9 entry

- Use numeric key with multiple presses
 - Hello = 4433555[pause]555666
 - Surprisingly fast
- T9 predictive entry
 - Type as if single key for each letter
 - Use dictionary to guess the right word



T9

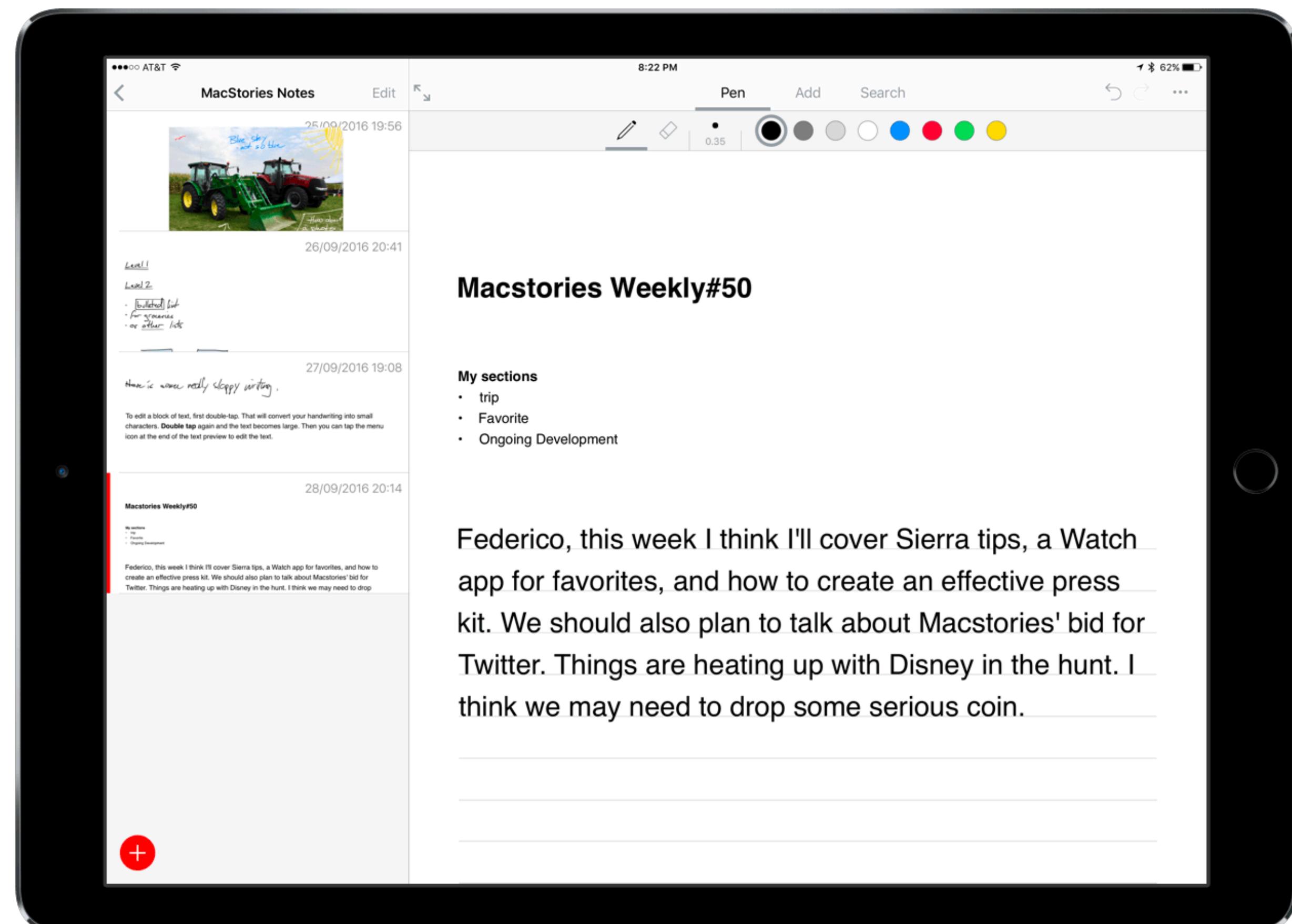
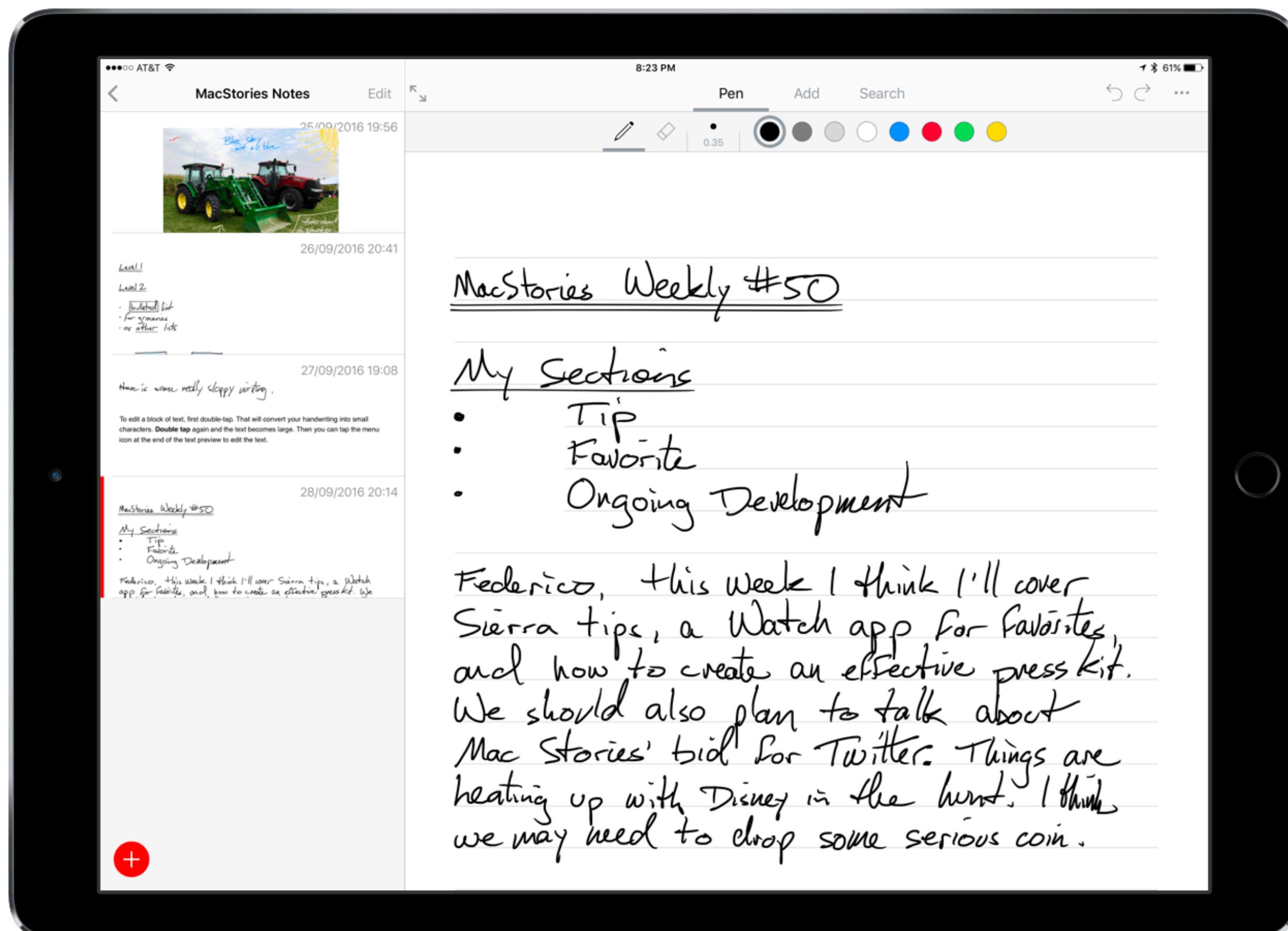
Phone



Handwriting recognition

- Text can be input into the computer, using a pen and a digesting tablet
- Technical problems:
 - Capturing all useful information - stroke path, pressure, etc.
 - Segmenting joined up writing into individual letters
 - Interpreting individual letters
 - Coping with different styles of handwriting
- Use in PDAs and tablet computers

Handwriting recognition



Speech recognition

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



Numeric keypads

- For entering numbers quickly
 - Calculator, PC keyboard
- For telephones

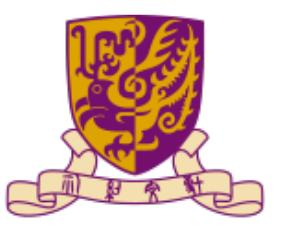
Why are the layouts for phone and calculator different?



Telephone



Calculator

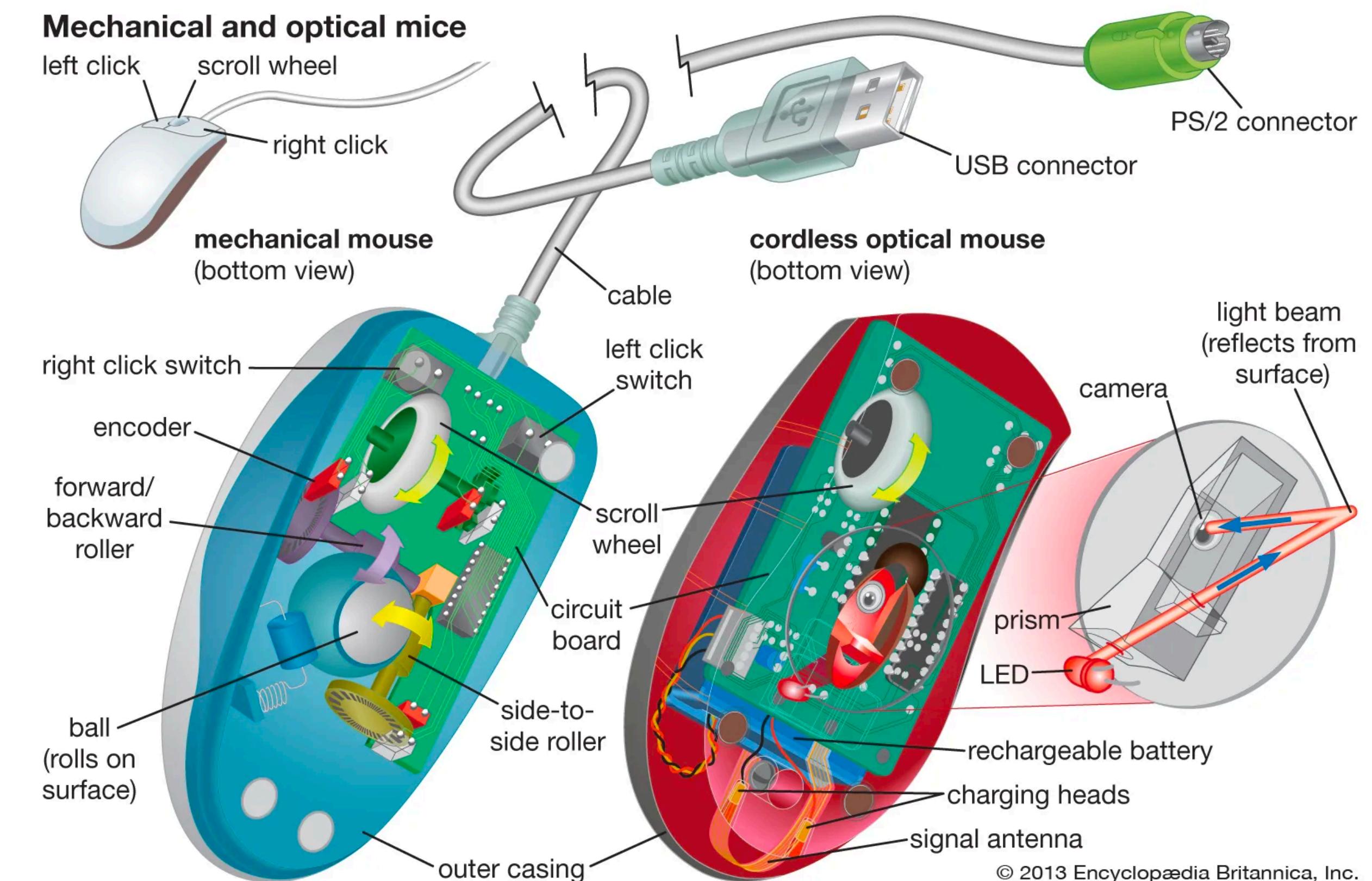


Outline

- Computer
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Mouse

- Handheld pointing device
 - Very common
 - Easy to use
- Two characteristics
 - Planar movement
 - Buttons



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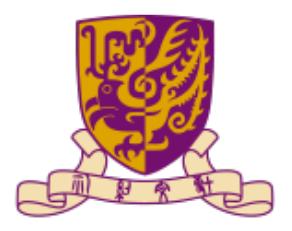


Mouse

- Located on desktop
 - Require physical space
 - No arm fatigue
- An indirect manipulation device
 - Device itself doesn't obscure screen, is accurate and fast
 - Hand-eye coordination problems for novice users

How mouse works

- Mechanical
 - Ball on underside of mouse
 - Rotate orthogonal potentiometers
 - Can be used on almost flat surface
- Optical
 - Light emitting diode on underside of mouse
 - May use special grid-like pad or just on desk
 - Less susceptible to dust and dirt
 - Detects fluctuating alterations in reflected light intensity to calculate relative motions in plane



Even by foot

- Some experiments with the footloose
 - Control 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
- Stroke to move mouse pointer
- Used mainly in laptop computers
- Good acceleration setting important
 - Fast stroke
 - Slow stroke



MULTI-TOUCH TOUCHPAD



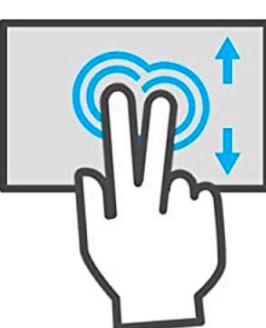
One finger tap



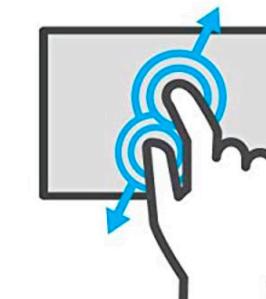
Tap two times
and slide



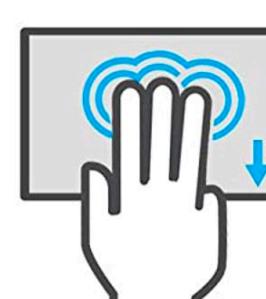
Two fingers tap



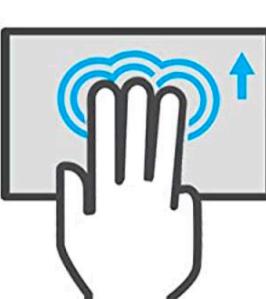
Two fingers
scroll



Two fingers zoom



Three fingers
swipe down



Three fingers
swipe up

Trackball and thumbwheels

- Trackball
 - Ball is rotated inside static housing
 - Relative motion moves cursor
 - Indirect device, fairly accurate
 - Separate buttons for picking
 - Vary fast for gaming
- Used in some portable and notebook computers
- Thumbwheels
 - For accurate CAD
 - For fast scrolling



Touch-sensitive screen

- Detect the presence of finger or stylus on the screen
 - Work by interrupting matrix of light beams, capacitance changes or ultrasonic reflections
 - Direct pointing device

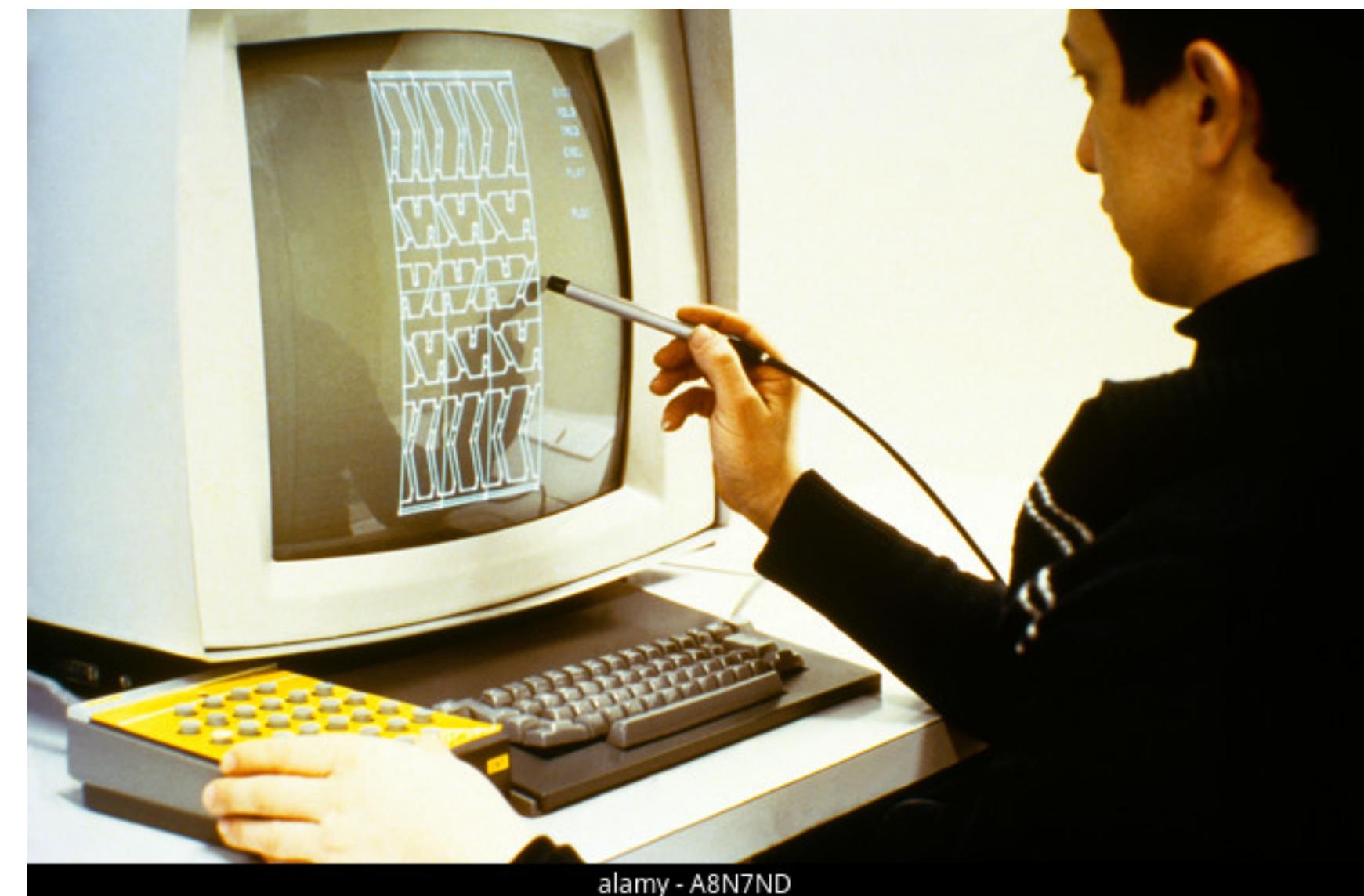


Touch-sensitive screens

- Advantages
 - Fast and require no specialized pointer
 - Good for menu selection
 - Suitable for use in hostile environment: clean and safe from damage
- Disadvantages
 - Finger can mark screen
 - Lifting arm can be tiring
 - Imprecise e.g., difficult to select small regions or perform accurate drawing

Stylus and light pen

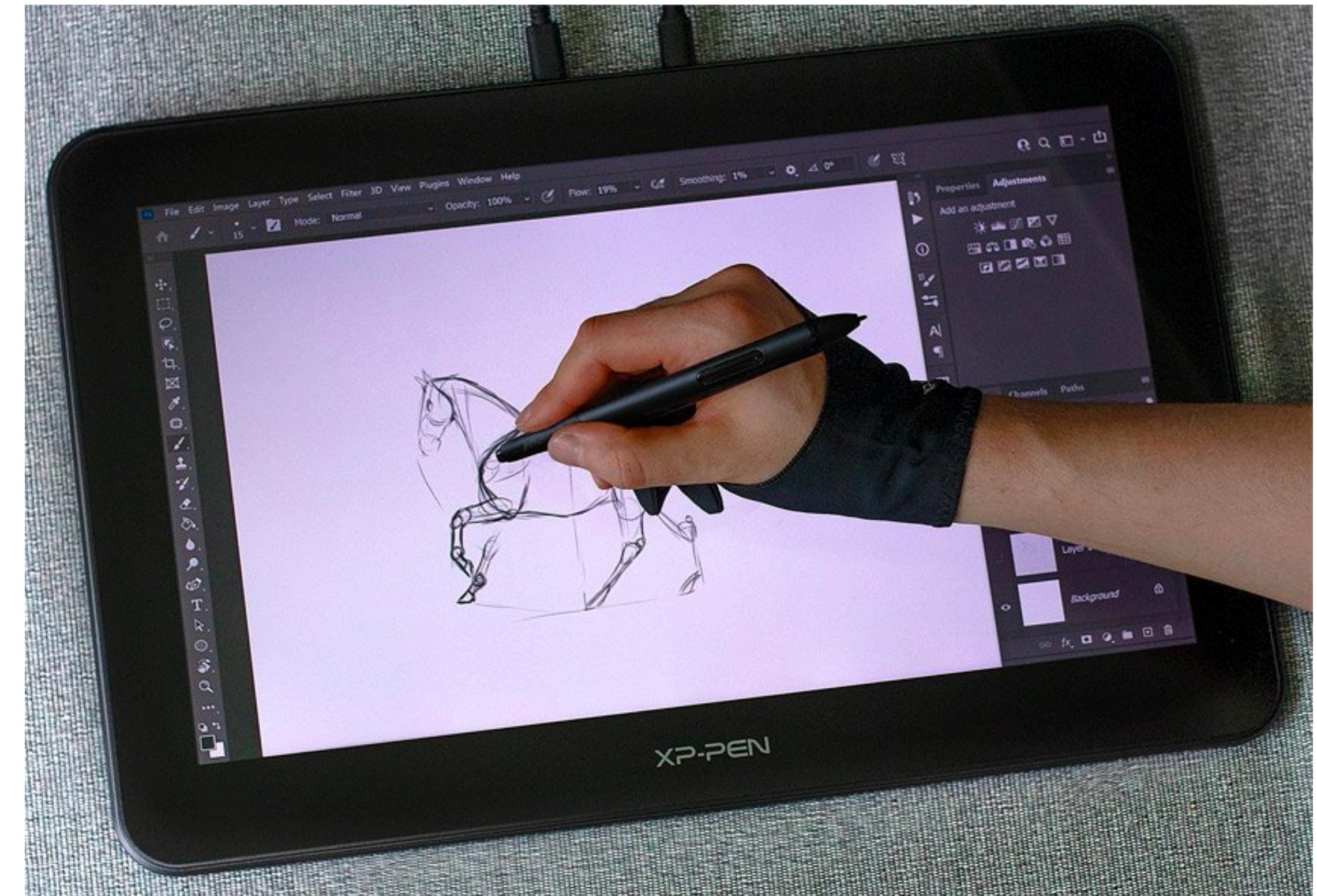
- Stylus
 - Small pen-like pointer to draw directly on screen
 - May use touch sensitive surface or magnetic detection
 - Use in PDA, tablet PCs and drawing tables
- Light pen
 - Now rarely used
 - Use light from screen to detect location
- Both
 - Very direct and obvious to use
 - But can obscure screen



light pen

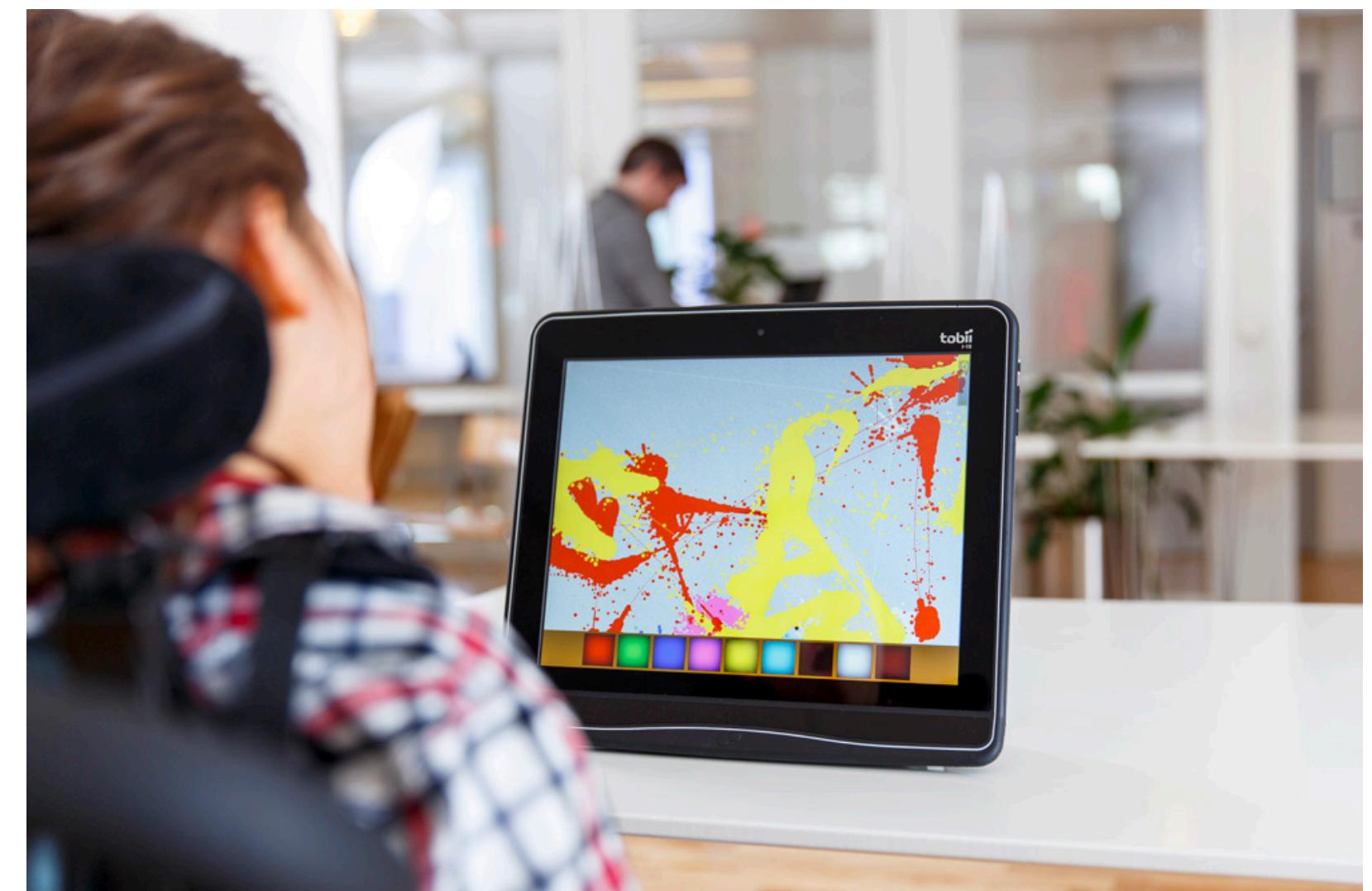
Digitizing tablet

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



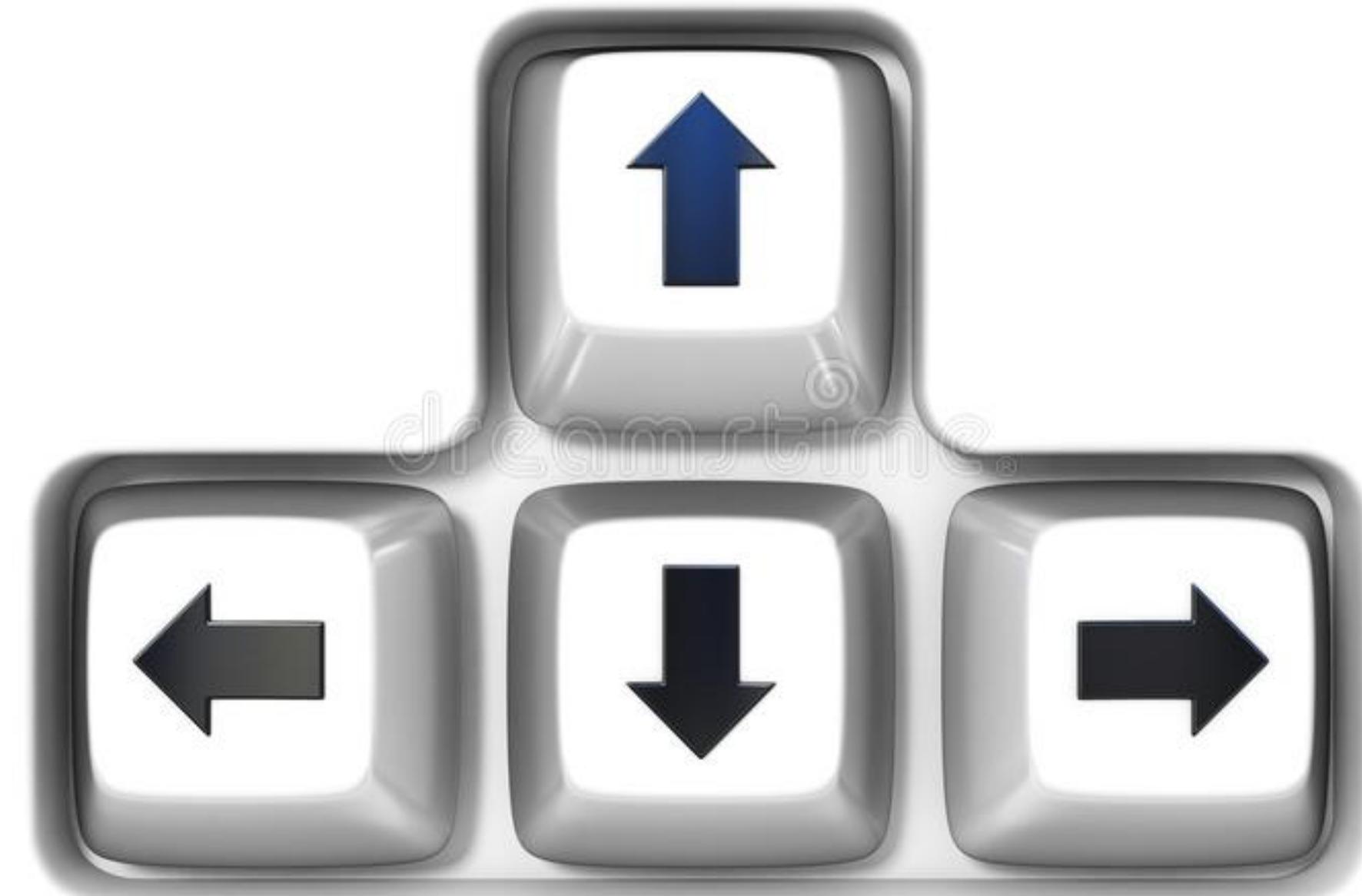
Eyegaze

- Control interface by eye gaze direction
- Mainly used for evaluation
- Potential for hand-free control
- High accuracy requires headset
- Cheaper and lower accuracy devices available



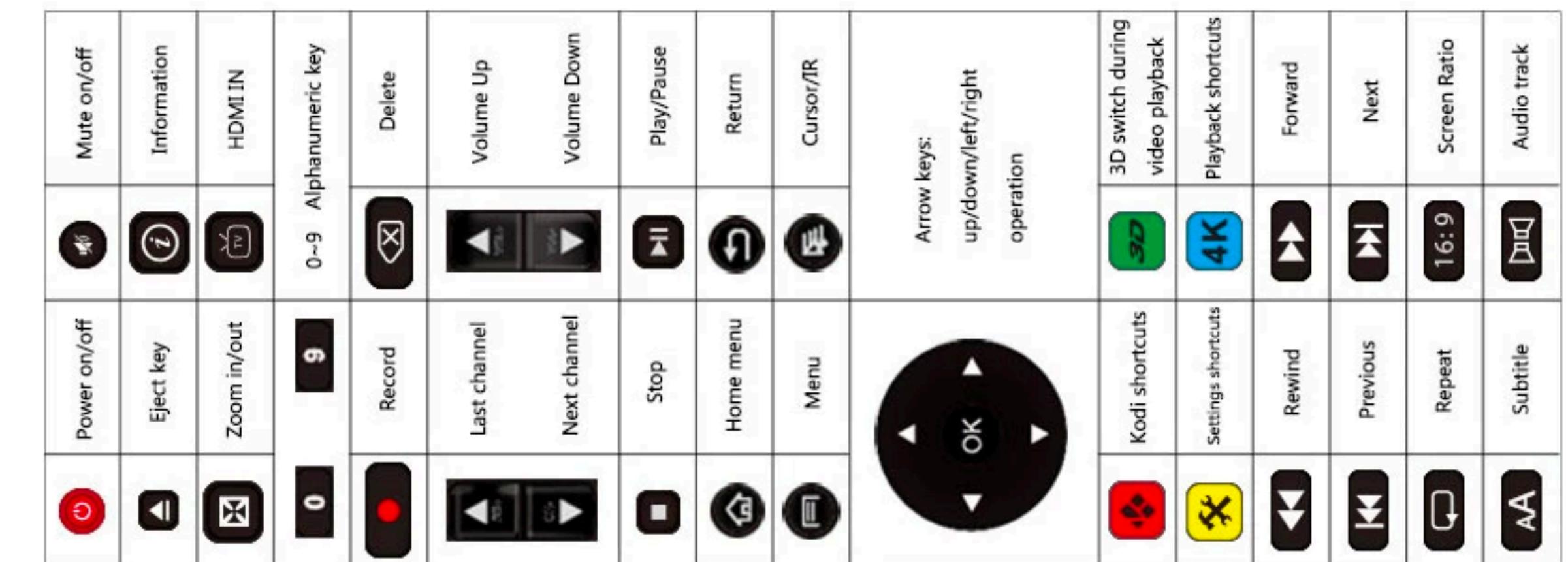
Cursor keys

- Four keys (up, down, left, right) on keyboard
- Very, very cheap, but slow
- Useful for not much more than basic motion for text-editing tasks



Discrete positioning controls

- In phones, TV controls, etc.
 - Cursor pads or mini-joysticks
 - Discrete left-right, up-down
 - Mainly for menu-selection



Remote control



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- **Display devices**
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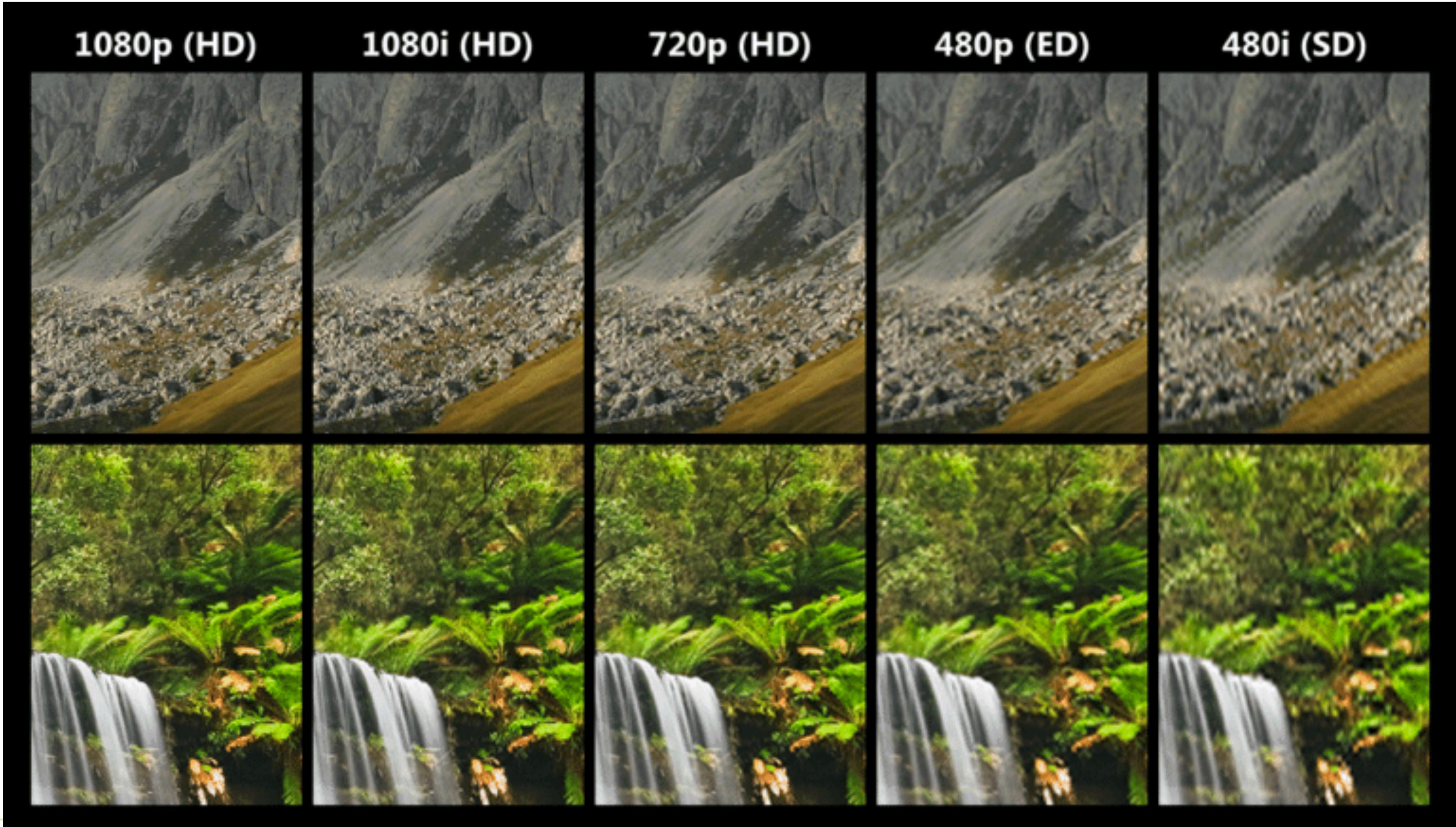
Bitmap displays

- Store information at each pixel in a rectangular grid
- Each pixel can be limited to black and white, grayscale, or full color



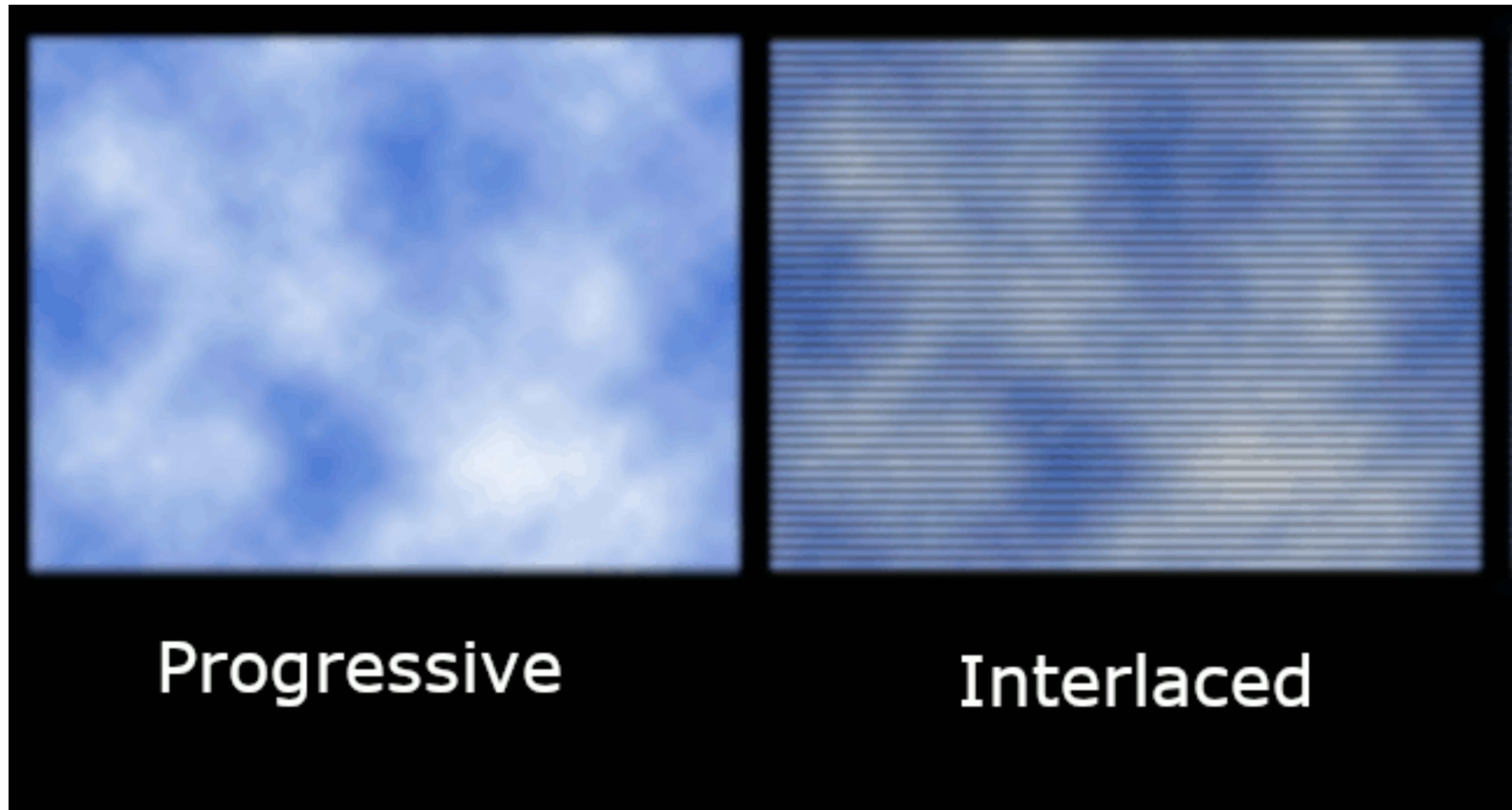
Resolution

- Total number of pixels (width x height)
- Density of pixels (in pixels or dots per inch - dpi)



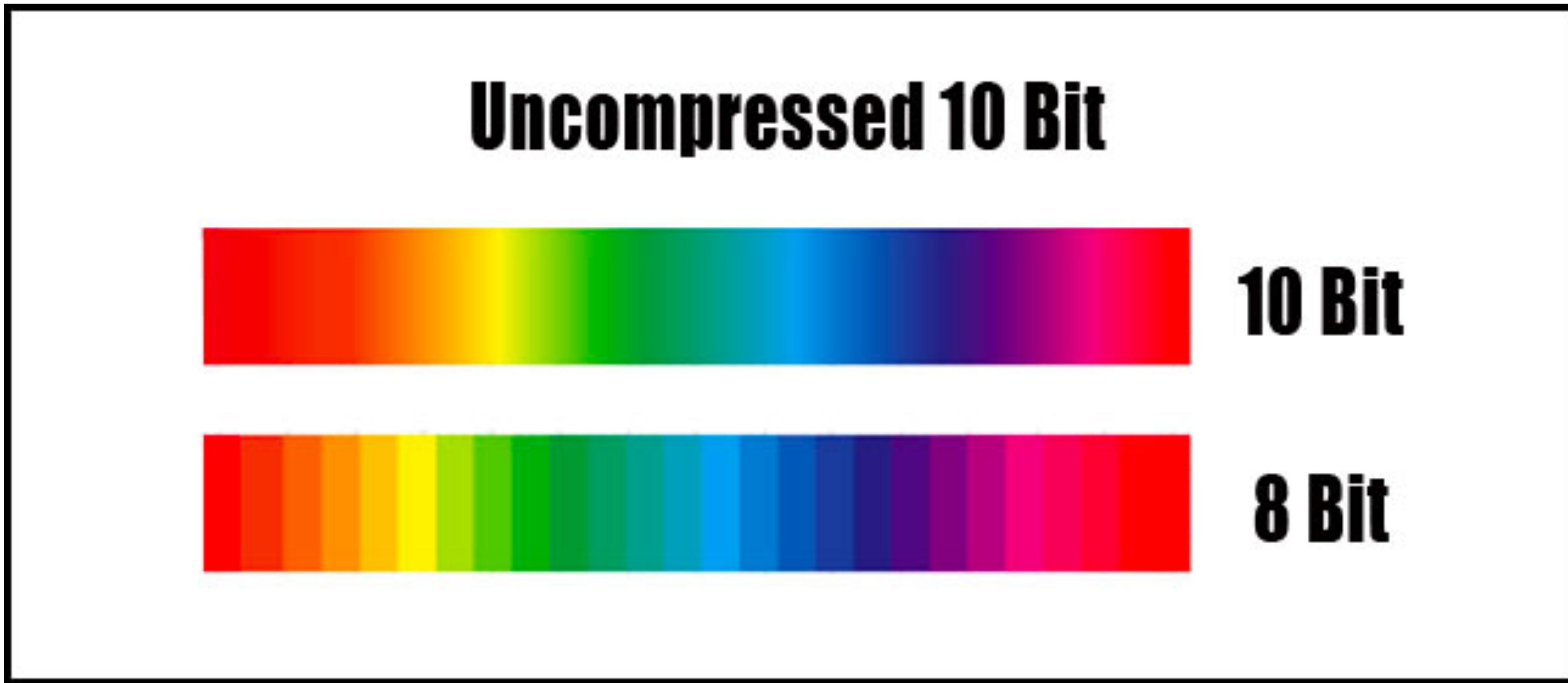
Resolution

- p: progressive
- l: interlaced



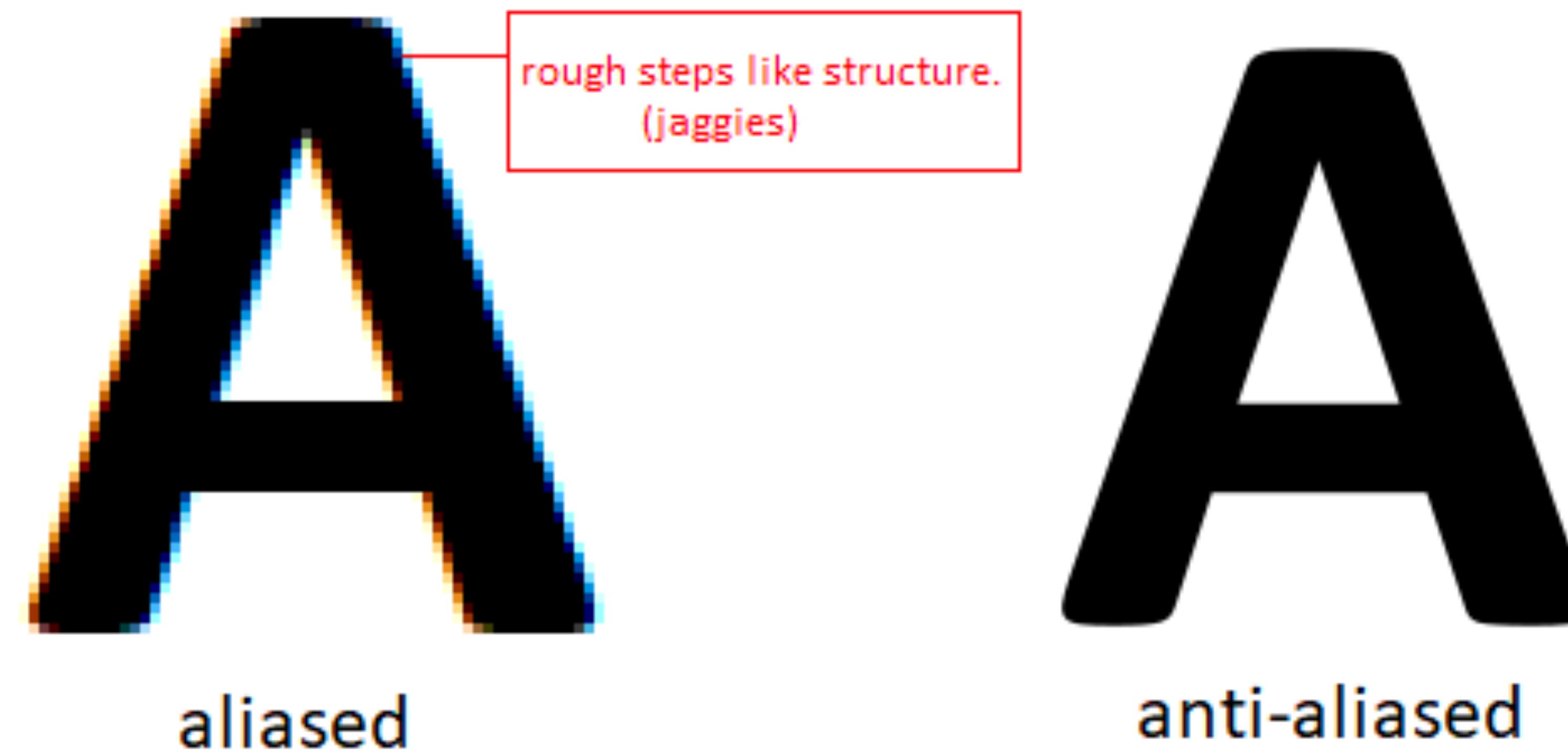
Color

- The set of color is determined by the number of bits
- Usually represented by three values (red, green, and blue), sometimes by four values (R,G,B, and opacity)

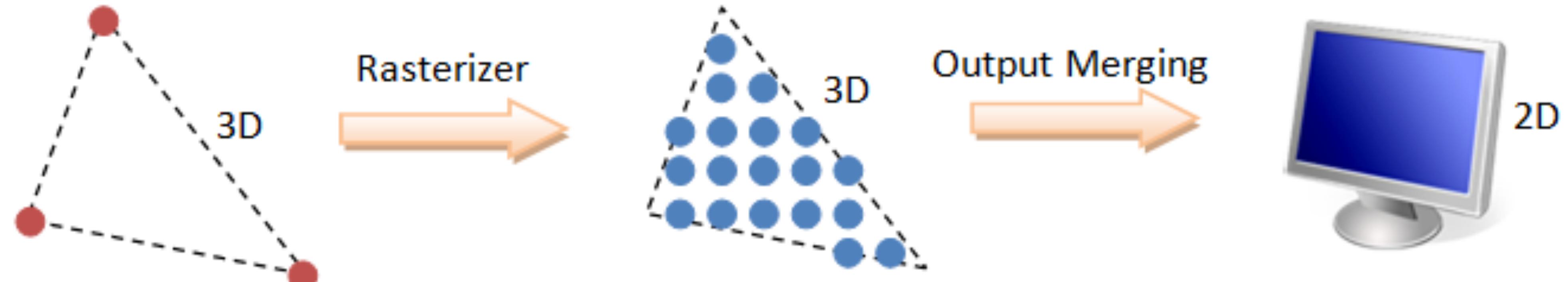


Jaggies and anti-aliasing

- Jaggy: rough edges cased by approximating the objects with pixels
- Anti-aliasing: soften the edges of objects and blur the discontinuity



How jaggies occur



A *primitive* is formed by one or more *vertices*. Vertices are not grid-aligned

Grid-aligned *fragments* are interpolated from vertices.

All primitives are merged to produce 2D *pixels* on the display

Vertex, Primitives, Fragment and Pixel

Large displays

- Used for meetings, lectures, etc.



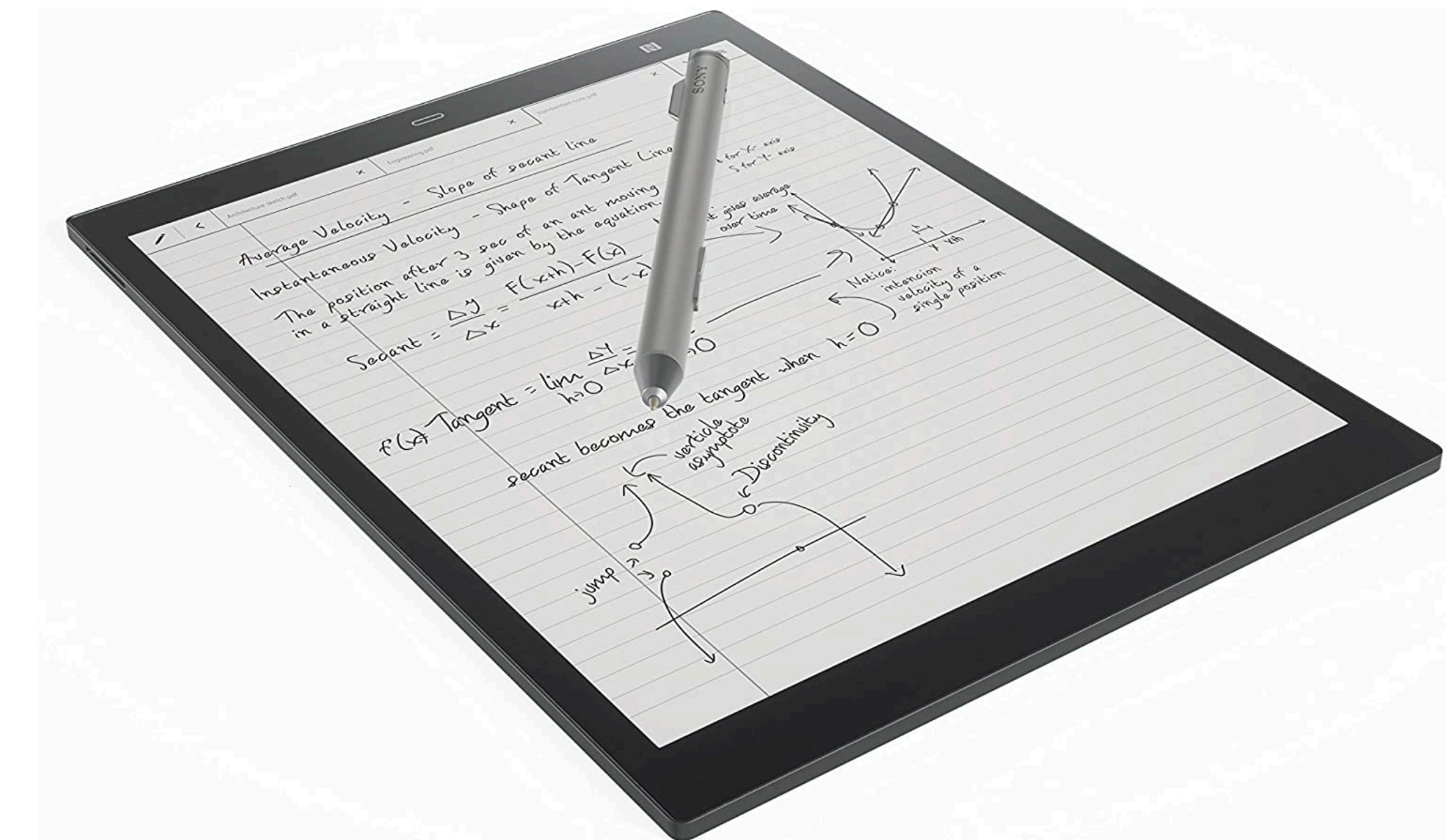
Situated displays

- Display in public places
- Display only for information relevant to location
- Interact using stylus, touch sensitive screen
- In all cases, the location matters - meaning of information or interaction is related to the location



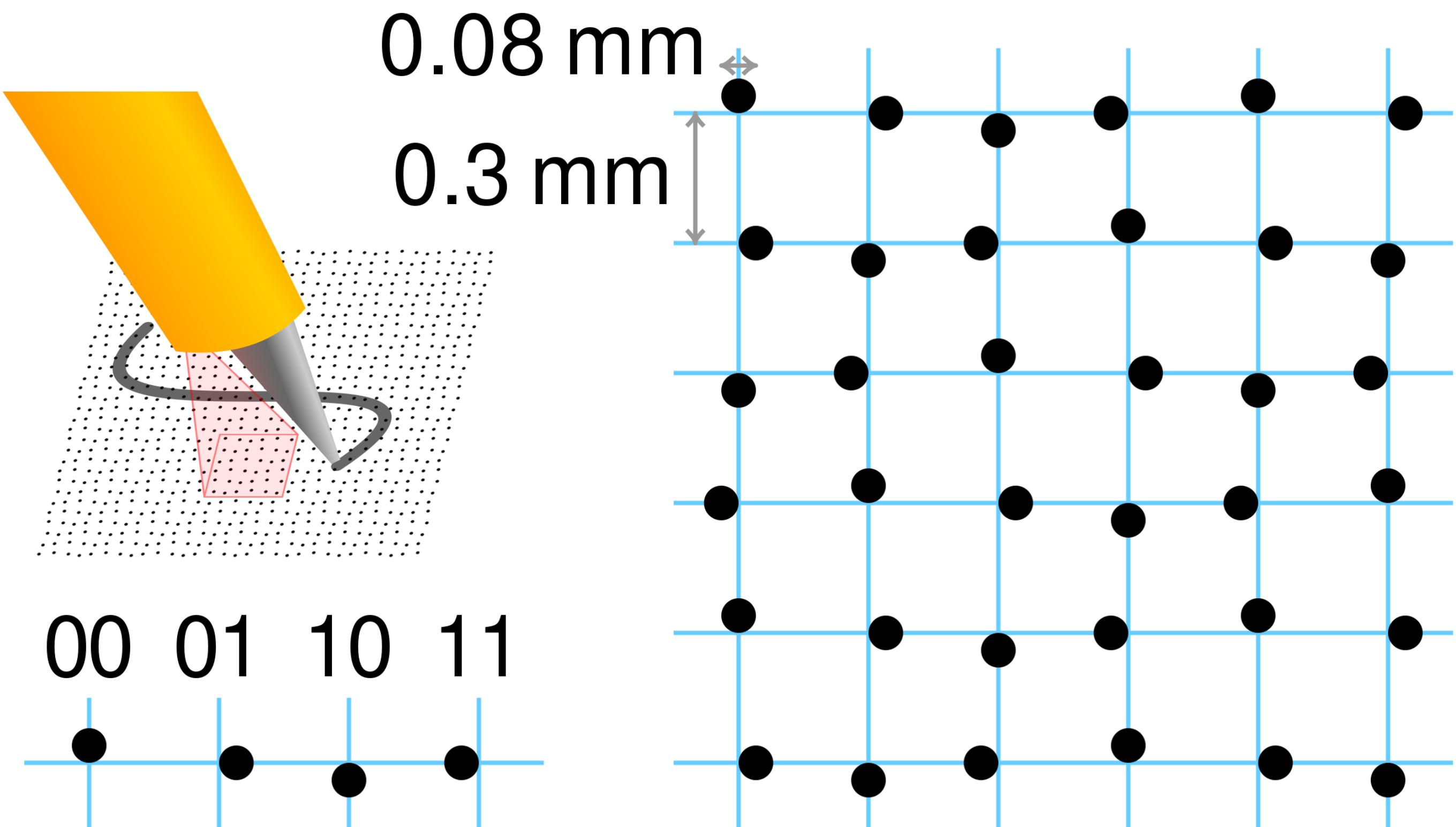
Digital paper

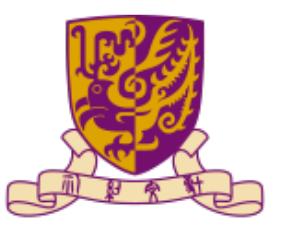
- This flexible sheets
- Updated electronically
- But retain display



Digital paper

- Small sphere turned
- Channels with colored liquid and contrasting spheres
- Rapidly developing area





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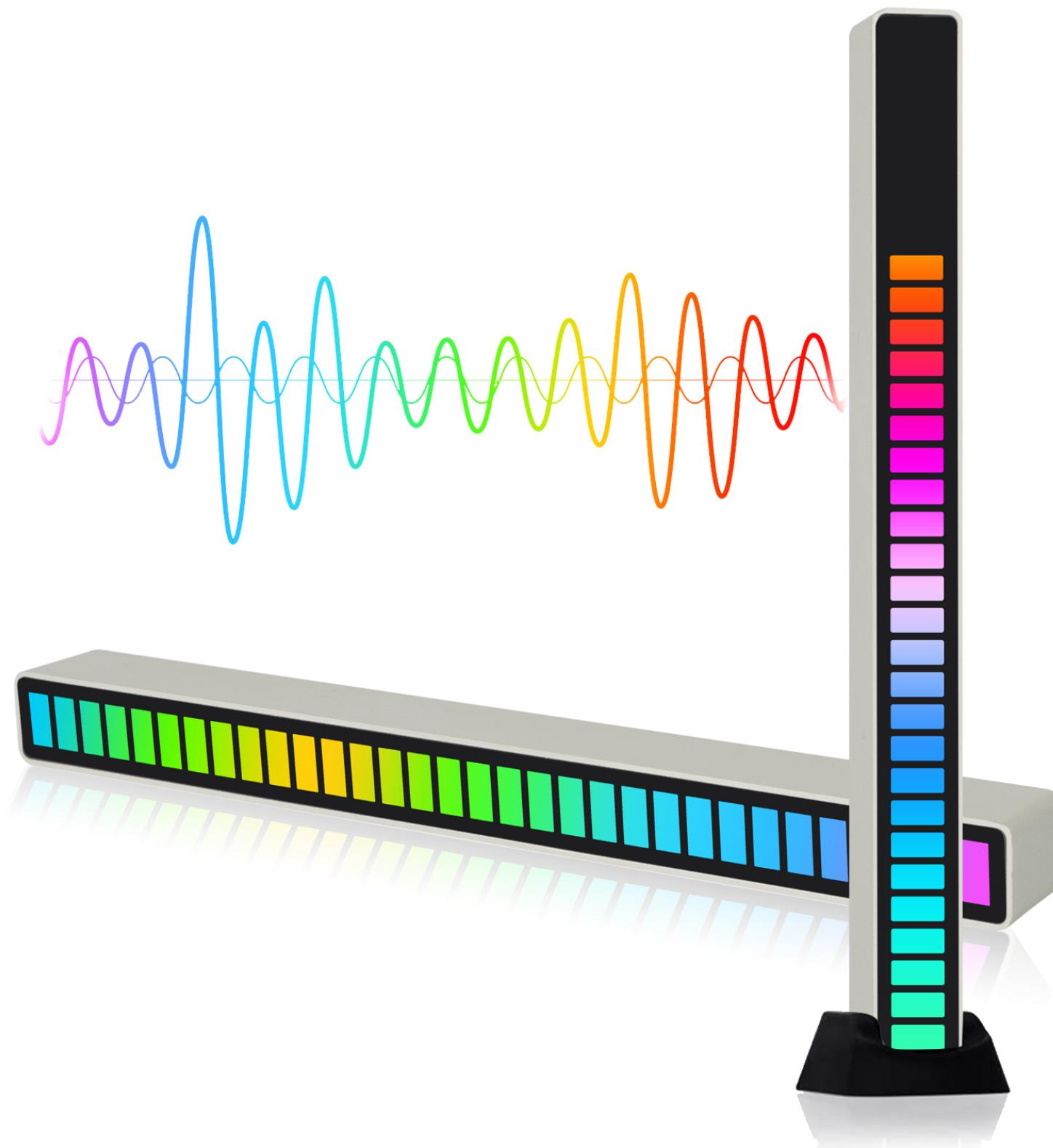
dedicated displays

- Analogue representations e.g., 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



Sounds

- Beeps, bongs, clunks, whistles, and whirrs
- Used for error indications
- Confirmation for actions e.g., key click



Touch, feel, and smell

- Touch and feeling important
 - In games, vibration and force feedback
 - In simulation, feel of surgical instruments
 - Called haptic devices
- Texture, smell, and taste
 - Current technology very limited



BMW iDrive

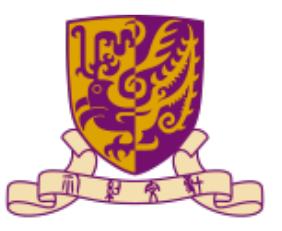
- For controlling menus
- Feel small bumps for each item
- Make it easier to select options



Physical controls

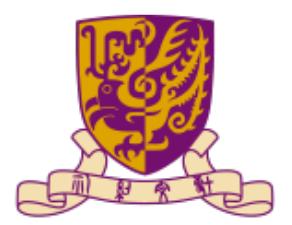
- Specialist controls needed
 - Industrial controls, consumer products, etc.





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, heart rate, skin response, etc.



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Thank Prof. Alan Dix for many of the slides!