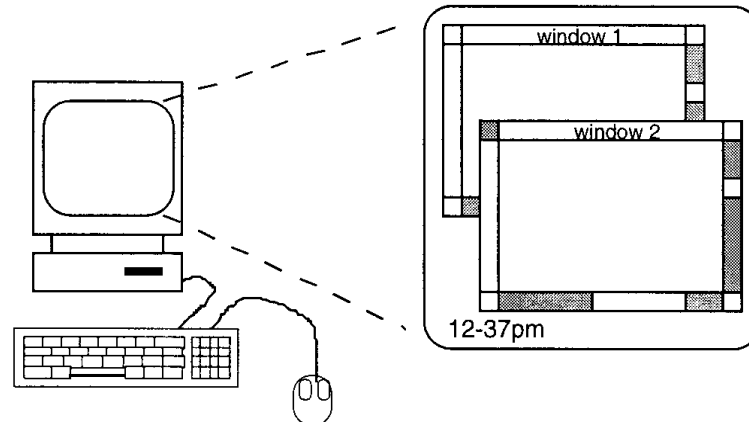


Computer & Interaction

- Computer Input Devices
- Computer Output Devices
- Interaction Models
- Interface Types

Interaction Devices



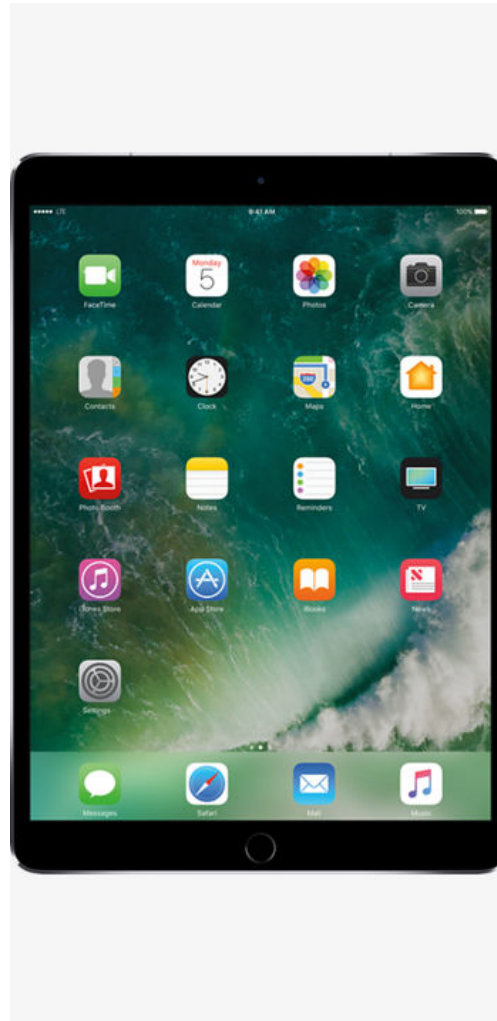
A typical computer system:

- screen, or monitor, on which there are
 - Windows – separate areas that behave independently
- Keyboard
- Mouse

These devices dictate **styles of interactions** that the system supports

Interaction Devices

Mobile computer system: Tablet PC, iPad, Smart phone



Interaction Devices

Input

Keyboard

Pointing devices

 Mouse

 Trackball

 Joystick

 Pen

 Touch screen

Speech

Video/Image/Gesture

 Camera

 Sensors

Output

Screen

Printer

Plotter

Loudspeaker (sound, speech)

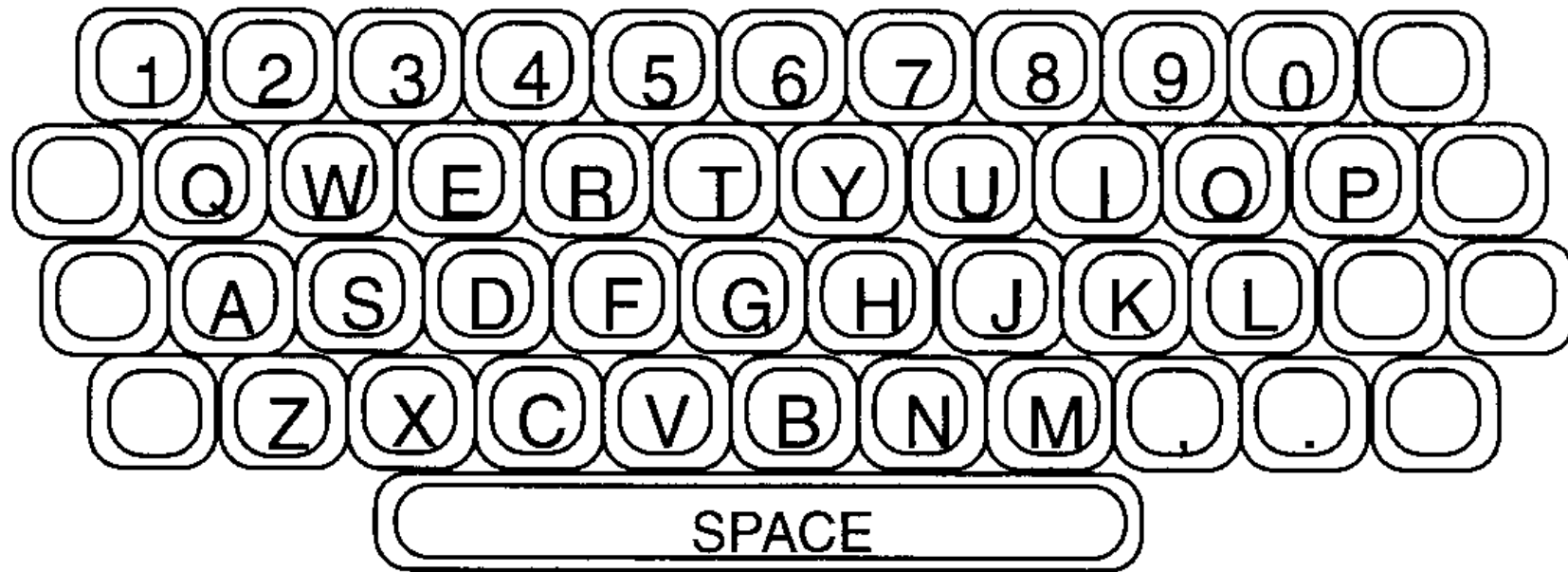
Braille reader

Input Devices

- **Keyboard**

- Common text input device

- **QWERTY** is the standard layout (developed in 1870s)



- Keypress closes connection, causing a character code to be sent

Input Devices

- Allow rapid entry of text by experienced users, 150 words per minutes is possible
- QWERTY arrangement is not optimal for typing - layout due to typewriters. For typewriters, if we type too fast, the keys (the arms of the typewriters) will jam together.



Input Devices

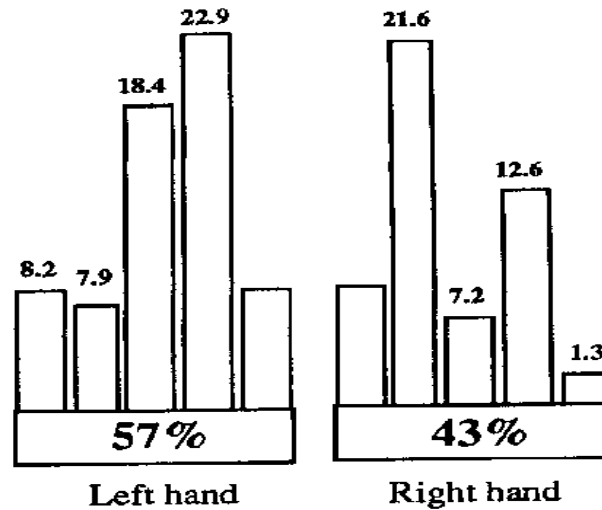
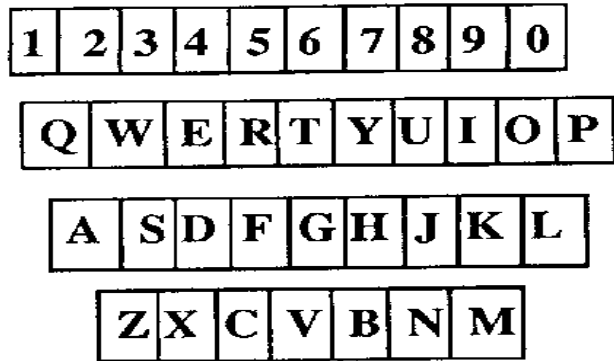
- Other keyboard designs can allow faster typing but large social base of QWERTY typists produce reluctance to change
- Biased towards left hand
- Other suggested keyboard layouts:
 - **Alphabetic**
 - Keys arranged in alphabetic order, ABCDE...
 - Not faster for trained typists
 - Not faster for beginners

Input Devices

- **Dvorak** (developed in 1920s)
 - Common letters under dominant fingers
 - Biased towards right hand (or left hand)
 - Common combinations of letters alternate between hands (e.g., ARE, WERE, GREAT)
 - 10-15% improvement in speed and reduction in fatigue
 - Large social base of QWERTY typists produce market pressures not to change
 - <http://www.mwbrooks.com/dvorak/support.html>
- **User Defined**
 - e.g., Janko's keyboard
<http://solair.eunet.rs/~janko/engdload.htm>

Input Devices

Qwerty keyboard:



Dvorak keyboard:

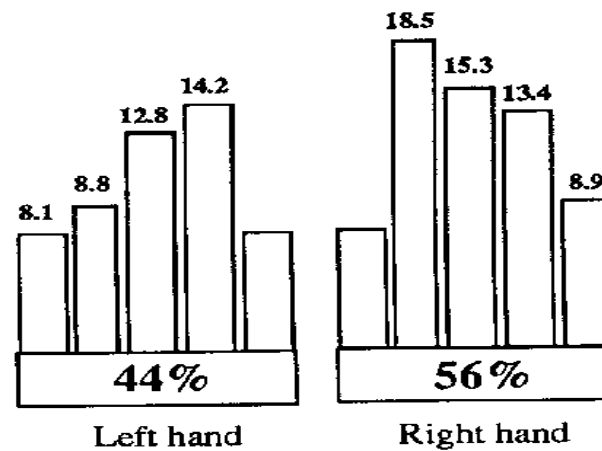
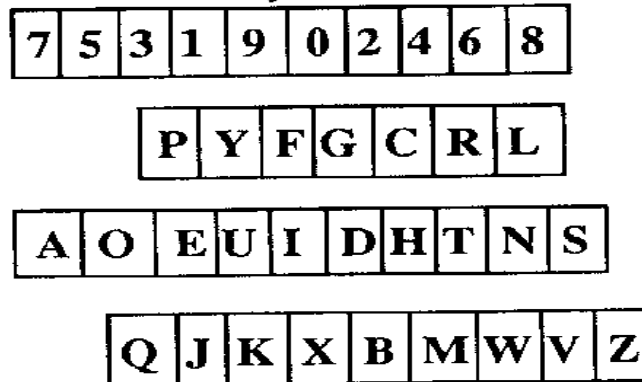


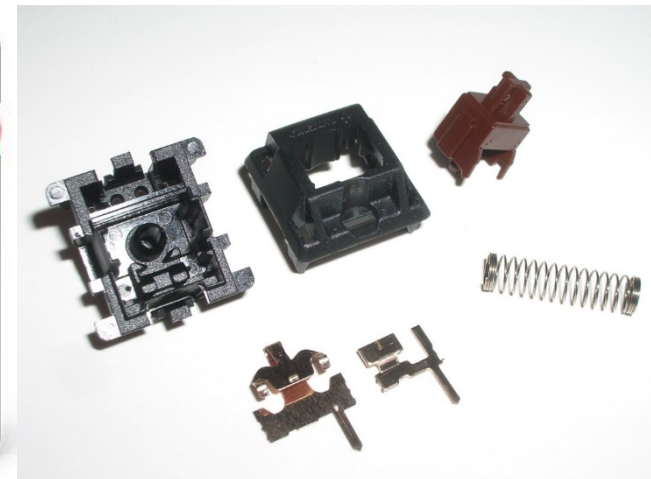
Figure 12-2 Alpha key layouts: QWERTY and Dvorak. From Cakir, Hart, and Stewart, *The VDT Manual* (New York: John Wiley and Sons, 1980). With permission.

Input Devices

- Ergonomically designed

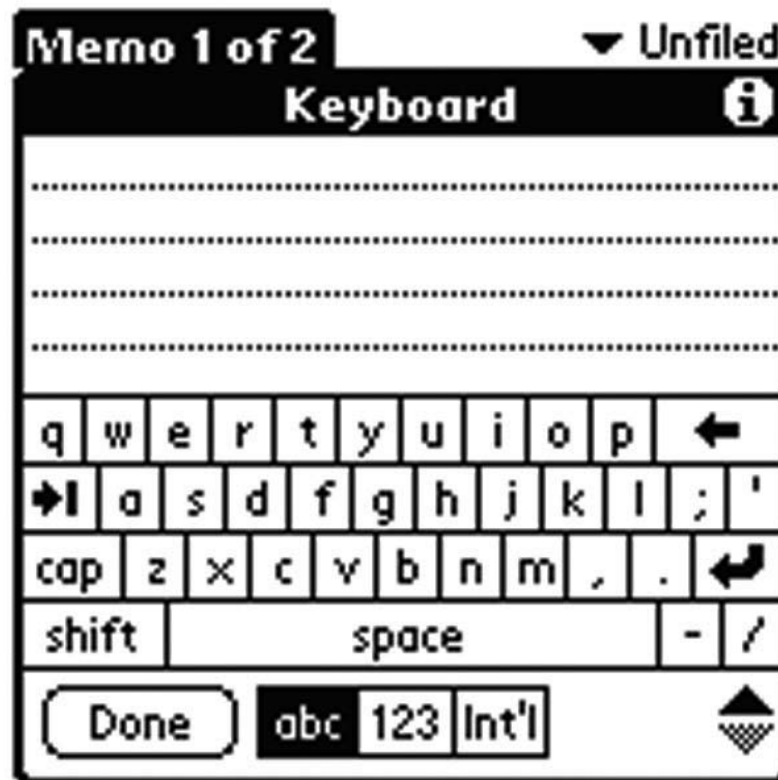


- Mechanical



Input Devices

- For mobile devices
 - Virtual keyboard: can achieve 20-30 words/min.



Input Devices

- Foldable keyboard and roll-up keyboard



Input Devices

- Virtual projection keyboard

Laser Projection Keyboard



Which one do you prefer more? Virtual, Foldable, Roll-up or Projection? Why?

Input Devices

- **Numeric keypad**
 - Input number
 - Two layouts: telephone & calculator
 - Locate the numeric keypad to the right of the alpha key area

1	2	3
4	5	6
7	8	9
	0	

Telephone

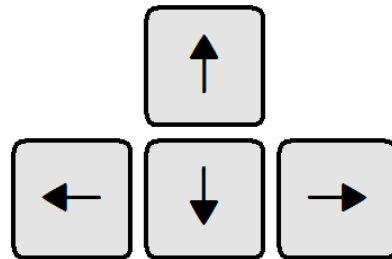
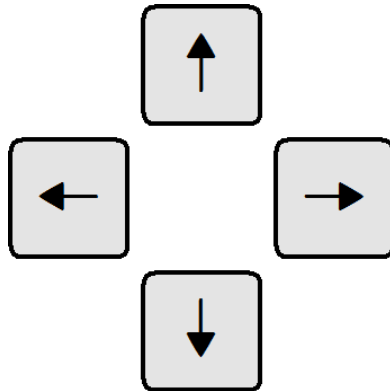
7	8	9
4	5	6
1	2	3
	0	

Calculator

Input Devices

■ Arrow keys

- Buttons on a computer keyboard to move the cursor in one of the four directions
- Advantage: Easy to use
- Disadvantage: No diagonal or continuous movement



- Inverted-T layout is most common because the frequent cursor key transition is “down-to-left”, facilitating us to position our index and middle fingers

They are usually located at the right bottom. Why?

Input Devices

■ Stylus

- Recognize handwritten text input into computer

- Advantages:

- No training is needed
- Compact size (handheld organisers use handwriting recognition technology & do away with a bulky keyboard)

- Disadvantages :

- Relatively low recognition accuracy
 - Variation between the handwriting of individuals
 - Handwriting of same person is varying

Russell's handwriting

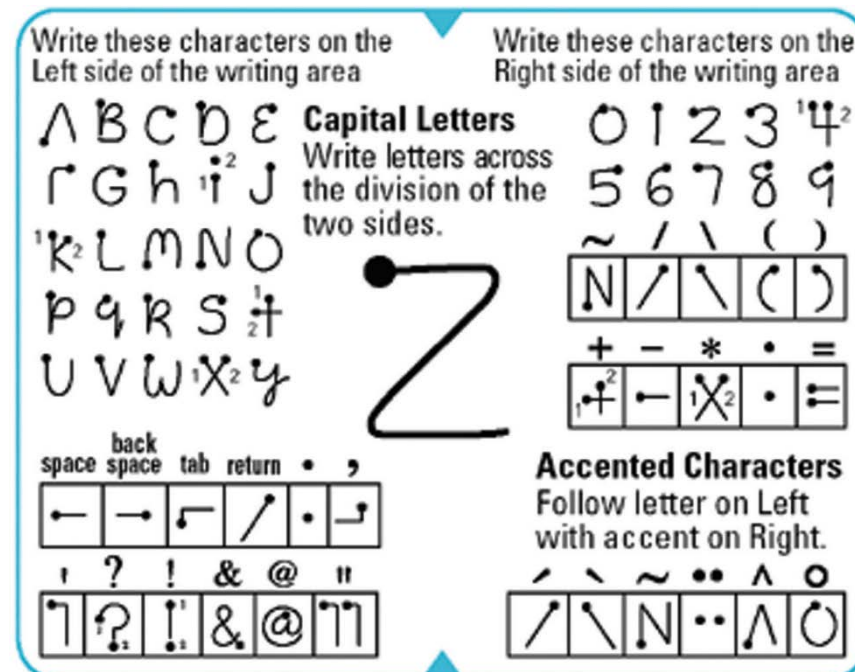
Janet's handwriting

Gregory's handwriting

Alan's handwriting

Input Devices

- Recognition rate can be improved via special data-entry methods, e.g., unistrokes or Graffiti



<http://sandbox.xerox.com/parctab/csl9501/node4.html>

- Speed is slow: maximum is 25 words/minute but the speed of a typist is 60 words/minute

Input Devices

- **Speech input**
 - Available in commercial applications such as PCCW telephone enquiry systems as well as Windows and smartphones
<https://www.youtube.com/watch?v=f4dIAV4E2UA>
 - Accuracy in discrete word recognition is higher than that in continuous speech recognition
 - With AI, speech recognition system is now almost as accurate as humans, i.e., around 95% word accuracy rate
<https://9to5google.com/2017/06/01/google-speech-recognition-humans/>
 - Voice-activated personal assistant platforms such as Alexa and Siri continue to grow in popularity

Input Devices

- Types of errors
 - Substitution - a word from the vocabulary is mistaken for another
 - Rejection - a word from the vocabulary is detected but rejected
 - Insertion - a word that was not spoken is detected
 - Deletion - a word that was spoken but is missed
 - Background noise
 - Imprecision of pronunciation

Input Devices

- Advantages:
 - Much training is not needed
 - Good for the case when hands/eyes are occupied or disabled
- Disadvantages:
 - Feedback may be limited (Verification procedures slow down speed)
 - Speech is a single channel mode: cannot speak while listening, cannot listen to >1 messages simultaneously
 - Not appropriate for use in open or noisy environments

Input Devices

Some guidelines for speech recognition interface design

- Consider voice recognition as an input device when user's hands are occupied or user's eyes are busy
- Avoid voice recognition as an input device in open environments (noise & security)
- Provide a familiar vocabulary
e.g., user is more consistent when pronouncing familiar words
- Words used should be distinctive
e.g., "pick" & "quit" are very similar; use "select" & "quit" is better

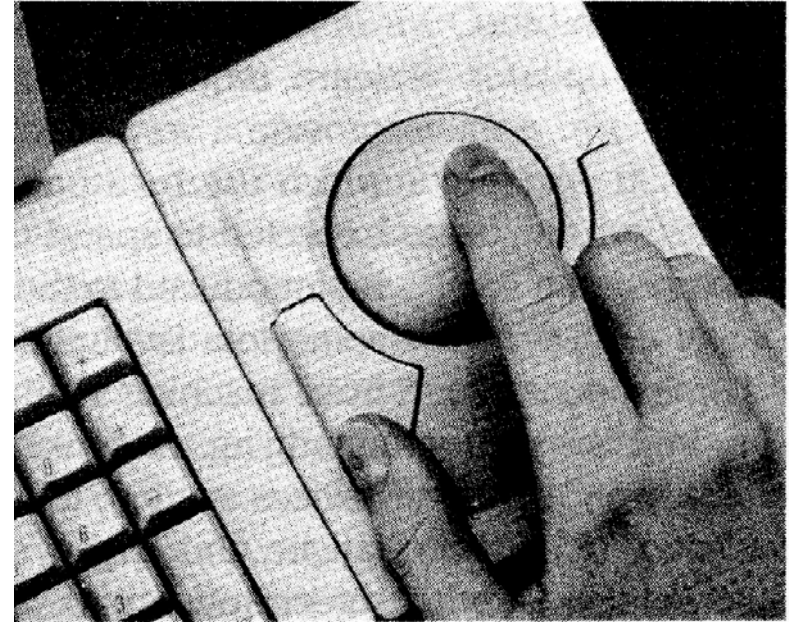
Input Devices

- **Mouse**
 - A very common handheld pointing device
 - Characteristics - planar movement, buttons
 - Mechanical and optical
 - Advantages:
 - Direct relationship between hand & cursor movement on all 3 issues of direction, speed, & distance
 - Allow diagonal & continuous movement
 - Easy to use
 - Disadvantage:
 - Require that the hand be removed from the keyboard

Input Devices

■ Trackball

- Like an upside-down mouse
- Advantages:
 - Direct relationship between hand & cursor movement on all 2 issues of direction & speed
 - Allow diagonal & continuous movement
 - Comparing with mouse, less physical space is required
- Disadvantages:
 - Require that the hand be removed from keyboard
 - No direct relationship on distance



Input Devices

- Touchscreen

- Detect the presence of finger (or stylus) on the screen

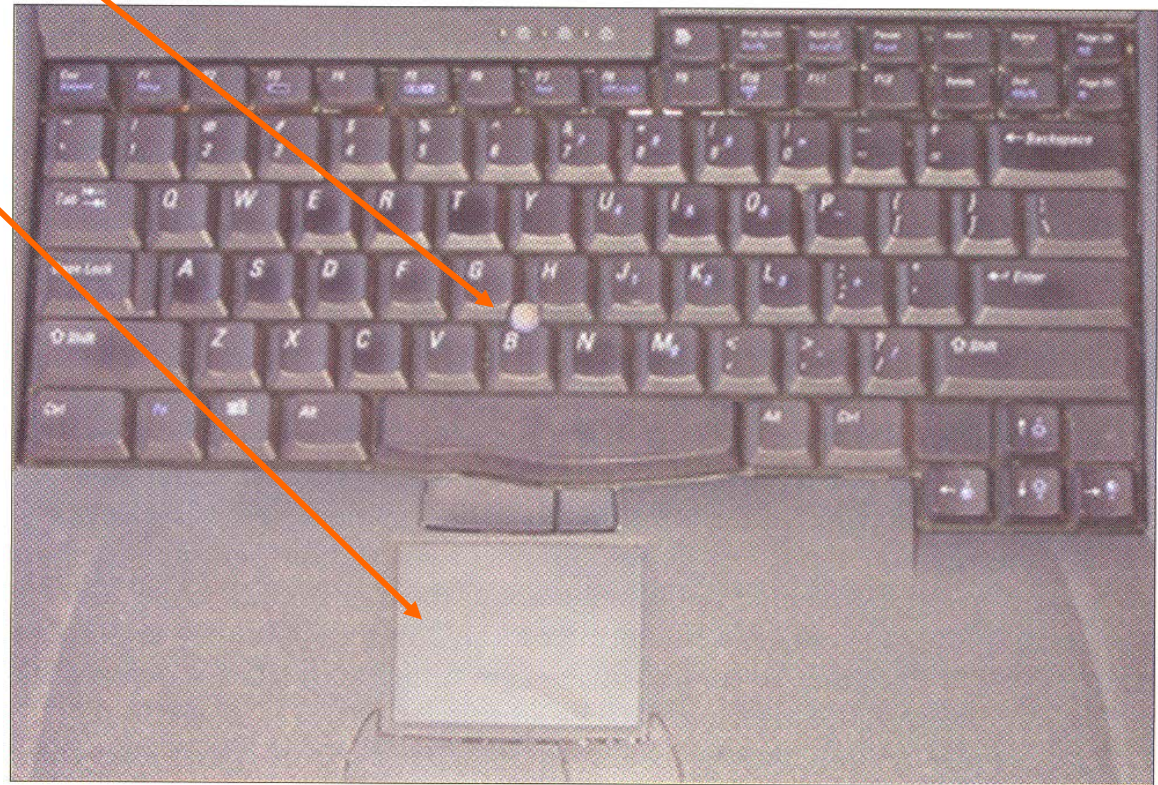


Input Devices

- Advantages:
 - **Direct** (vs. select an item on screen with a mouse)
 - Fast
 - Good for menu selection
- Disadvantages:
 - Finger print can mark screen
 - Hand obscures screen
 - Fatigue
 - Imprecise - difficult to select small regions or a larger screen is needed, although pointing at a single pixel is possible using the **lift-off** strategy:
 - Touch the screen surface
 - A cursor then appears for dragging around
 - Lift off finger when the desired position is reached

Input Devices

- **Trackpoint**
 - Joystick in notebook PC
- **Touchpad**
 - Similar to touchscreen



Input Devices

Some **guidelines** for pointing device selection:

- Use touchscreen when training is low, targets are large, discrete & spread out, frequency of use is low, desk space is small, & the task requires little or no text input e.g., information desk for tourist, cashier system in shops
- Mouse is faster than trackball
- Minimize hand & eye movement between input devices e.g., if a fill-in form includes some text entry & some multiple-choice selections, each input type should be grouped together

Input Devices

- Video/Image/Gesture



Intel RealSense 3D cameras feature three lenses, a standard 2D camera for regular photo and video, along with an infrared camera and an infrared laser projector. The infrared parts allow RealSense to see the distance between objects, separating objects from the background layers behind them and allowing for much better object, facial and gesture recognition than a traditional camera

Input Devices

Leap Motion controller is a small USB peripheral device which is designed to be placed on a physical desktop, and it can also be mounted onto a virtual reality headset or embedded in PCs. Two monochromatic IR cameras and three infrared LEDs are used to detect hand and finger motions



Input Devices

Microsoft's Xbox Kinect comprising an RGB camera for facial recognition plus video capturing, a depth sensor (an infrared projector paired with a monochrome camera) for movement tracking, and downward-facing mics for voice recognition



Output Devices

- Computer screen
 - LCD/LED/Plasma/OLED
 - 3D perception is possible with or without specific eyewear



Output Devices

▪ Electronic ink (e-ink)

- Display technology designed to mimic the appearance of ordinary ink on paper used in e-readers
- Paper-like readability (300 pixels per inch)
- Support writing



Kindle Paperwhite



<http://www.eink.com/>

Output Devices

▪ Speech output

- Digitized speech - recorded **human** speech directly in digital format
- Synthesized speech - generated using **computers** via speech processing techniques

Which one is more preferable?

- Current technology supports numerous spoken language output, e.g., English, Japanese, Mandarin
- Text-to-speech function is available in Microsoft Office, i.e., "Speak"
- For more natural sounding speech:

<https://www.nuance.com/>

<http://dsp.ee.cuhk.edu.hk/license.php>

Output Devices

- Advantage:
 - Useful when user's eyes are busy or user cannot access the screen
- Disadvantages:
 - Limited information because speech is transient
 - Lack of privacy & security under open environment
 - Speech is a single channel mode, i.e., we cannot listen multiple messages simultaneously
 - Spoken rate (~120-180 words/min.) is slower than reading (~200-300 words/min.)

Output Devices

- Some **guidelines** for use of speech output
 - Consider as output device when user's eyes are busy or user cannot access the screen
 - Avoid as output device in open environment, when privacy & security are important, when frequency of use is high, when multiple messages must be sent simultaneously, when human memory is overloaded
 - Use output rate of approximately 180 words per min.
 - Structure voice instructional prompts to present the goal first & the action last
e.g., telephone banking system
"For playing message, press two" is better than
"Please press two to play message"

Why?

Output Devices

- **Sound**
 - Used as feedback and entertainment, e.g.,
 - Confirm actions
 - Offer warning
 - Provide mood context in games
 - Simulate various musical instruments
 - Simulate various animal sounds

Output Devices

- Braille display
 - Pins provide output for the blind

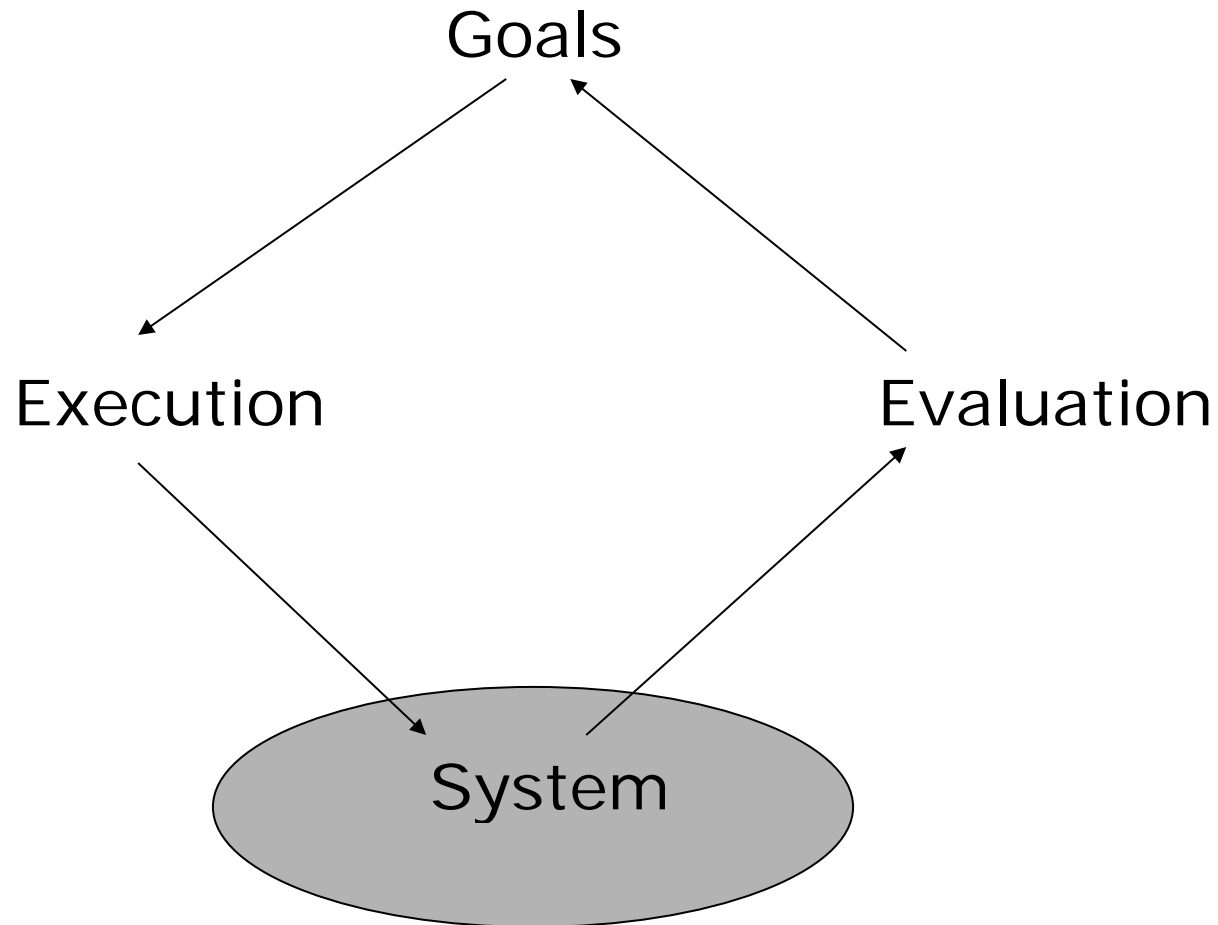


Interaction Model

- **Interaction**: communication between user & system
- Why study interaction models?
 - Help us to understand what is going on in the interaction between user & system
 - Help us to identify problematic areas within the design
 - Address differences, if any, between what user wants & system does

Interaction Model

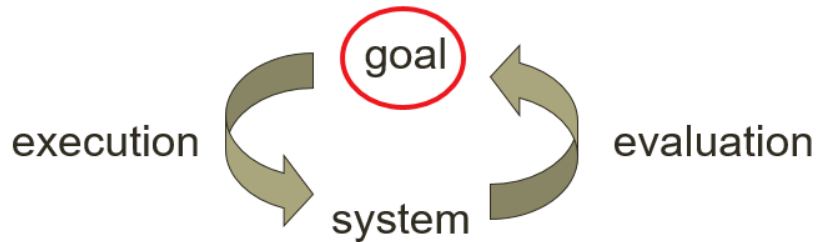
- Norman's interaction framework
 - 2 major phases: **execution** & **evaluation**



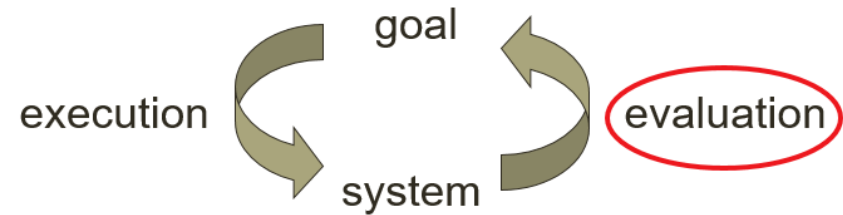
Interaction Model

- Can be subdivided into further stages:
 1. Establish the goal (Desired output from a performed task, some idea of what we want to happen)
 2. Form intention (Specific action required to meet the goal)
 3. Specify action sequence at interface
 4. Execute action
 5. Perceive system state
 6. Interpret system state
 7. Evaluate the outcome
- Concentrate on the user view of the interface
- Can be considered as execution/evaluation loop

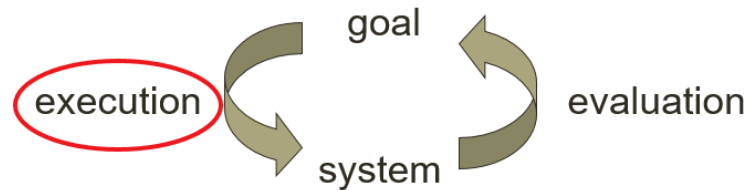
Interaction Model



- user establishes the goal
- formulates intention
- specifies actions at interface
- executes action
- perceives system state
- interprets system state
- evaluates system state with respect to goal



- user establishes the goal
- formulates intention
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- user establishes the goal
- formulates intention
- specifies actions at interface
- executes action
- perceives system state
- interprets system state
- evaluates system state with respect to goal

Interaction Model

You are reading a book, and evening is coming:

- Establish goal: Need more light
- Form intention: Switch on desk lamp
- Specify action sequence: Press lamp switch
- Execute action
- Perceive system state: More light now
- Interpret system state: Lamp is switched on
- Evaluate outcome: Enough light and goal completed

Interaction Model

Establish goal	Move a sentence from one paragraph to another paragraph in a WORD document
Form intention	Use Edit menu to move a piece of text from one paragraph to another (Shortcut keys can be used)
Specify action sequence	(1) Highlight the text by moving & clicking a mouse (2) Click the cut button, (3) Move the cursor to new position and (4) Click the paste button
Execute action	Execute the actions: An error scenario - the user highlights the text correct but clicks on the copy button instead of the cut button then completes the action
Perceive result	User sees the text in correct position but notices that it is still in the original position as well
Interpret result	User realizes, he or she uses the copy rather than cut
Evaluate outcome	User knows that the goal has not been completed & it is necessary to delete the text in the original position, this lead to a new goal & set of actions

Interaction Model

Explain why some interfaces cause problems to users:

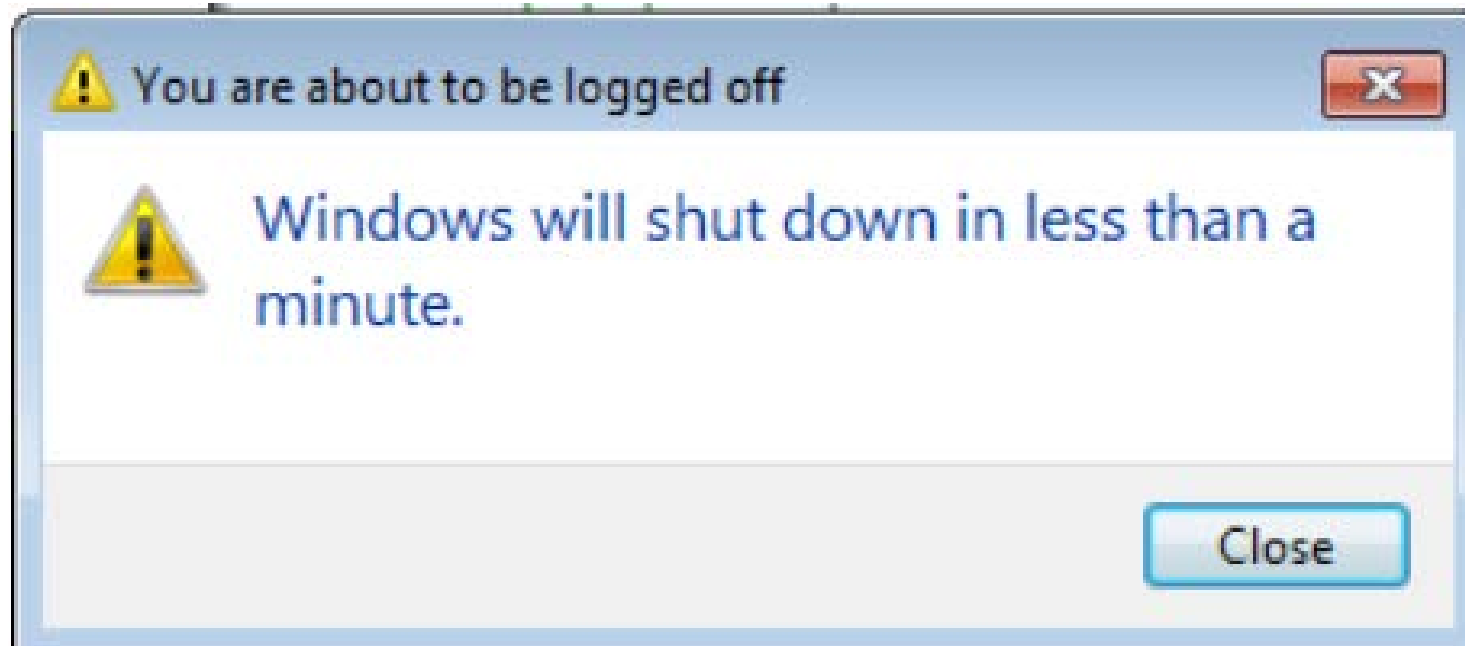
- Gulfs of **execution**
 - Mismatch between user's intention & allowable actions, e.g.,
 - The system does not support the user's goal
 - Sequence of actions is invalid
 - Does the interface allow us to carry out the actions required by the intention? E.g.,
 - **Goal** is to save a file
 - **Intention** is to use the file menu
 - **Action** is to click the save option
 - Is there a save option in the file menu?

Interaction Model

- Gulfs of **evaluation**
 - Mismatch between system's presentation & user's expectation, e.g.,
 - Failure to notice current system status
 - Poor feedback from system
 - Given a particular interface design, how easily can you:
 - Determine the function of the device?
 - Determine whether the system is in the desired state?
 - Determine what actions are possible?
 - Perform the valid action?

Interaction Model

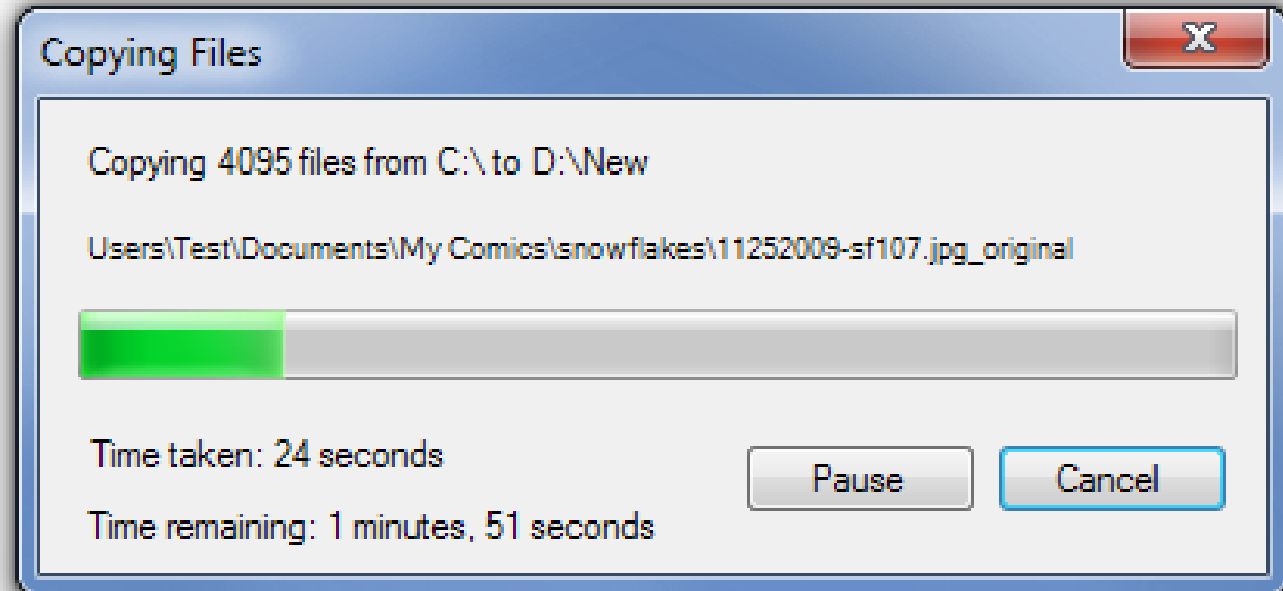
Suppose you want to keep using the PC:



Does it correspond to gulfs of execution or evaluation?

Interaction Model

Suppose you are copying a number of files:



Does it correspond to gulfs of execution or evaluation?

Among these two interfaces, which one do you prefer?

Interaction Model

These are related to two types of human error:

- Slip (careless, due to the change of context)
 - Understand system and goal
 - Correct formulation of action
 - Incorrect action
- Mistake (incorrect conceptual model)
 - May not even have right goal

How to fix?

Slip – better interface design (better tolerance for slip)

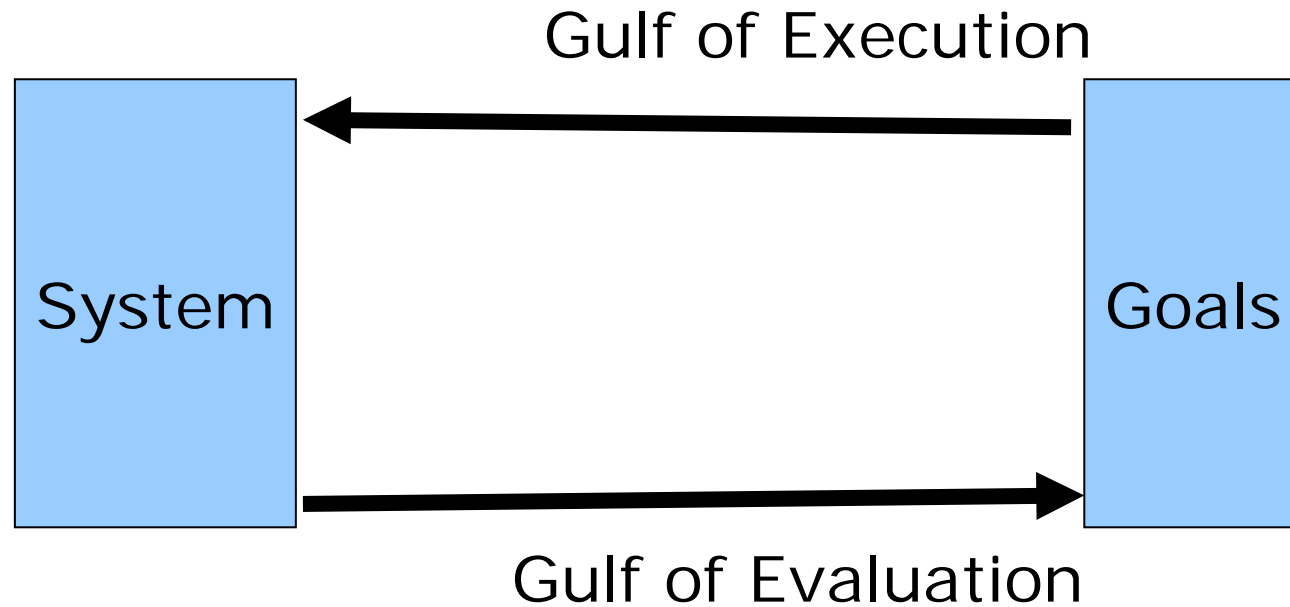
Mistake – better understanding of system

Interaction Model



Is it related to slip or mistake? How to fix?

Interaction Model



We aim to minimize these two gulfs

According to Norman: "The gulf is small when the system provides information about its state in a form that is easy to get, is easy to interpret, and matches the way the person thinks of the system"

Interaction Model

This can be achieved:

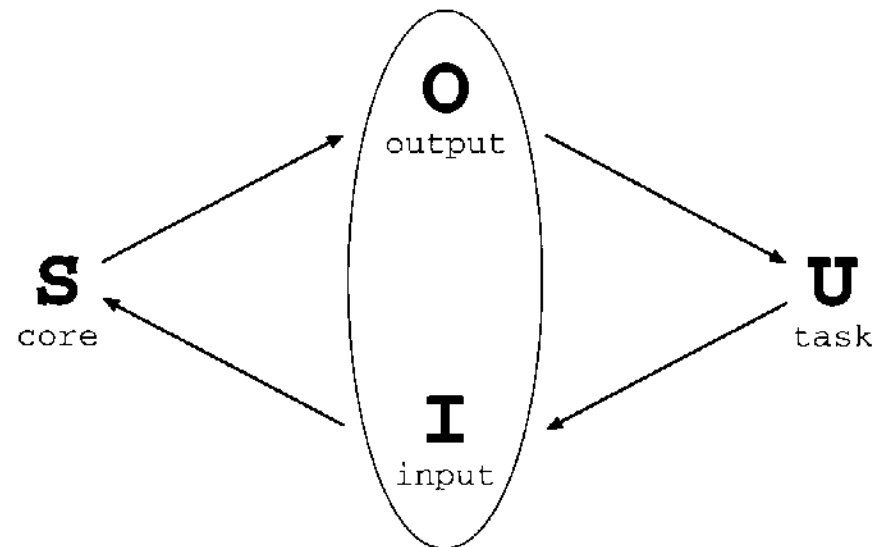
- Good **visibility** – State and action alternatives should be visible
- Good **conceptual model** – Agree with user's intention
- Good **mapping**
- **Feedback** – User should receive continuous feedback

User failures can occur:

- Users form an inadequate goal
- Might not find the correct interface object because of an incomprehensible label or icon
- May not know how to specify or execute a desired action
- May receive inappropriate or misleading feedback

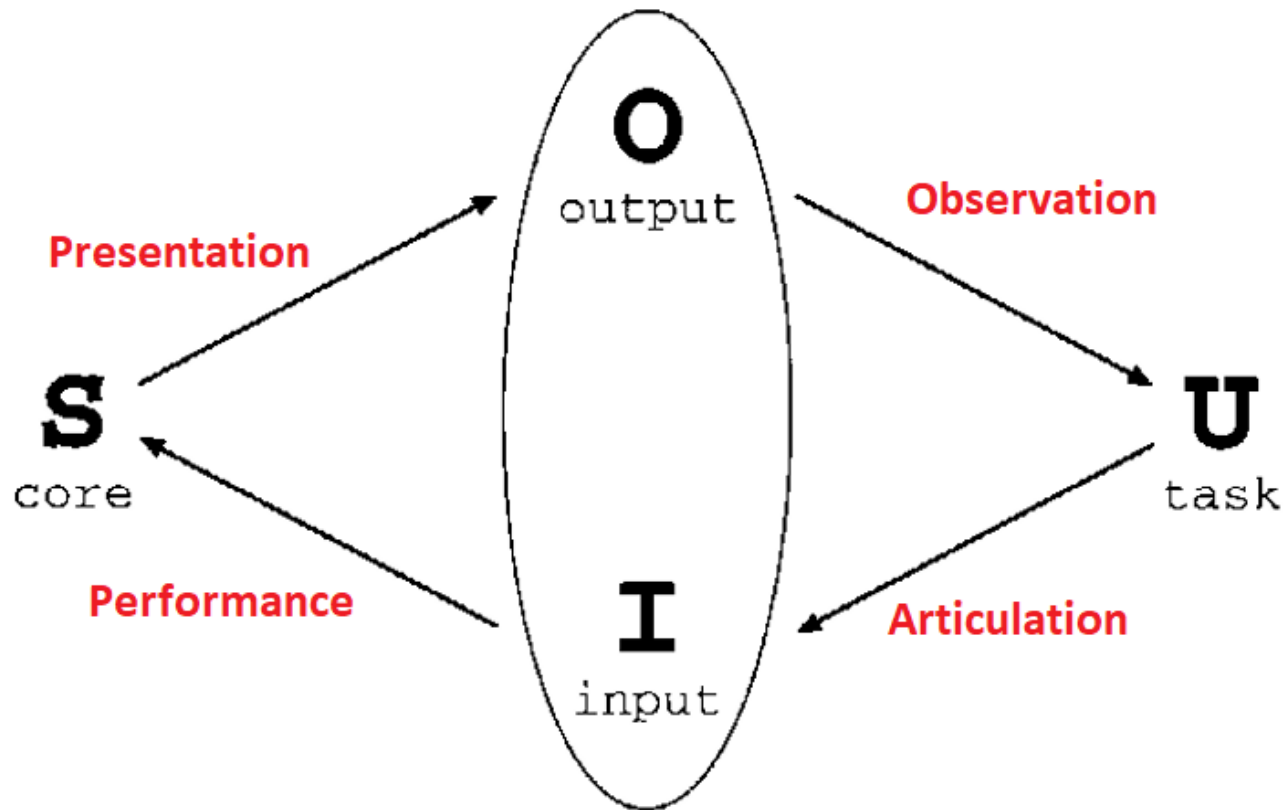
Interaction Model

- Model by **Abowd & Beale**
 - Extended Norman's model
 - 4 components
 - **User** (U)
 - **Input** (I)
 - **System** (S)
 - **Output** (O)
 - **Steps** involved
 - User intentions translated into actions at the interface
 - Translated into alternations of system state
 - Which in turn are reflected in the output display
 - Which is then interpreted by user



Interaction Model

- Input and output together form the interface
- Each component has its own unique language: problems occur when language translation between two adjacent components is in error



Interaction Model

- Four translations between components:
 - Articulation – User begins the interactive cycle with the formulation of a goal and a task to achieve that goal. He articulates the task in input language (translated from task language)
 - Performance – Interface translates input language into core language as operations to be performed by system. System is in a new state
 - Presentation – System presents the new state (results) in terms of output language
 - Observation – User observes output and assess the results of the interaction relative to the original goal. He translates the output language into personal understanding

Interaction Model

- Example of **translation problem**: user is not sure if the DVD recorder is set to record properly
- Maybe:
 - From user to interface, the user has pressed keys on remote control in the wrong order (articulation)
 - From interface to system, DVD recorder can record on any channel but remote control cannot select channels (performance)
 - From system to interface, DVD recorder display panel does not indicate that the program has been set (presentation)
 - From interface to user, user does not interpret the indication properly (observation)

Interaction Model

Assessment can be done at each translation

- Articulation
 - Judged in terms of coverage from tasks to input and relative ease with which translation is accomplished
 - Larger the gulf of execution, the more difficulty user will face in translating intentions to actions. Conversely, if translation is easy, gulf of execution will be small, e.g., icon versus command-line interfaces for file operations
- Performance
 - Assessing whether the translated input reach as many system states as possible, e.g., remote control does not allow user to power off the unit but it can be solved by increasing implementation cost

Interaction Model

- Presentation
 - Assessing whether all relevant system changes are sufficiently expressive in the output
 - Important in minimizing the gulf of evaluation
- Observation
 - Assessing how easy and complete can the system state be observed by the user
 - Problems include incompleteness of the presentation and misinterpretation by user, e.g., HTML editing without seeing browser output, determining the time accurately on an unmarked analog clock



Interface Types

- **Command line interface**
 - Can be:
 - Single characters
 - Short abbreviations
 - Whole words
 - Combination of them
 - Typical examples: Unix system & DOS

```
sable.soc.staffs.ac.uk> javac HelloWorldApp
javac: invalid argument: HelloWorldApp
use: javac [-g][-O][-classpath path][-d dir] file.java...
sable.soc.staffs.ac.uk> javac HelloWorldApp.java
sable.soc.staffs.ac.uk> java HelloWorldApp
Hello world!!
sable.soc.staffs.ac.uk>
```

- Suitable for repetitive tasks
- Better for expert users than novices

Interface Types

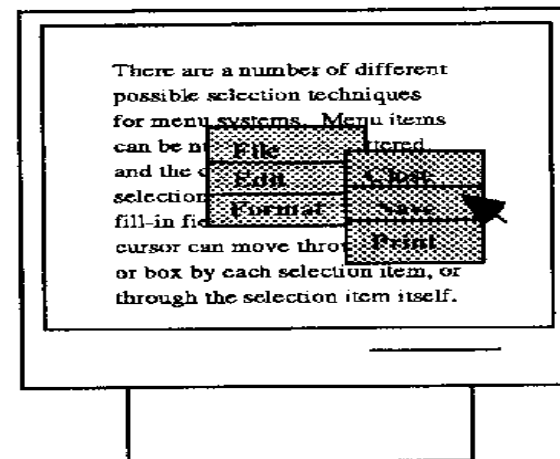
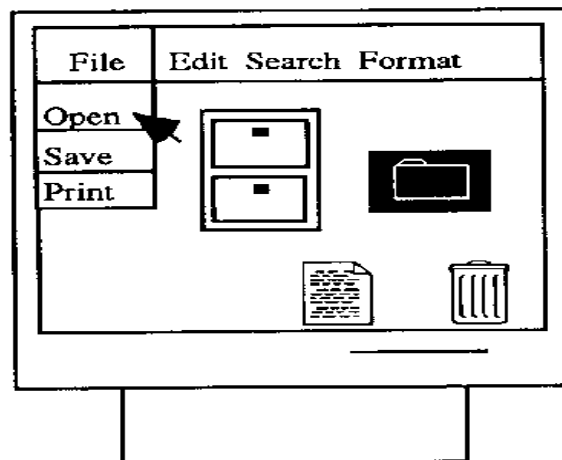
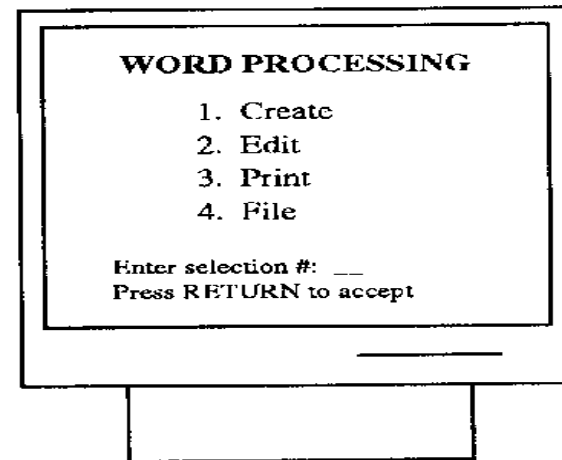
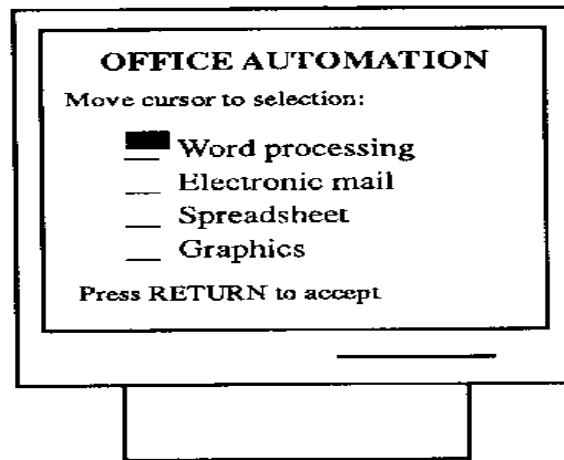
- Oldest and original user interaction style
- Powerful, offering immediate access to system functions. It is also flexible and able to incorporate options or parameters to vary its behaviour
- It requires the user to press a function key or type a command into a designated entry area on a screen
- One problem is that they must be remembered and they test one's power of recall. No clues about what commands are available exist on the screen
- Another problem is that command lines can be cryptic and obscure with complex syntax. They are also very prone to, and intolerant of, typing errors that can lead to user frustration

Interface Types

■ Menus

- **Set of options** displayed on the screen
- Options visible: rely on recognition rather than recall
- Selected by using mouse, numeric, cursor, function or alphabetic keys
- Menu systems can be purely text based, with options presented as numbered choices
- Menu can have graphical component, with menu appearing in box, & choices are made either by typing initial letter, or moving around with arrow keys or mouse

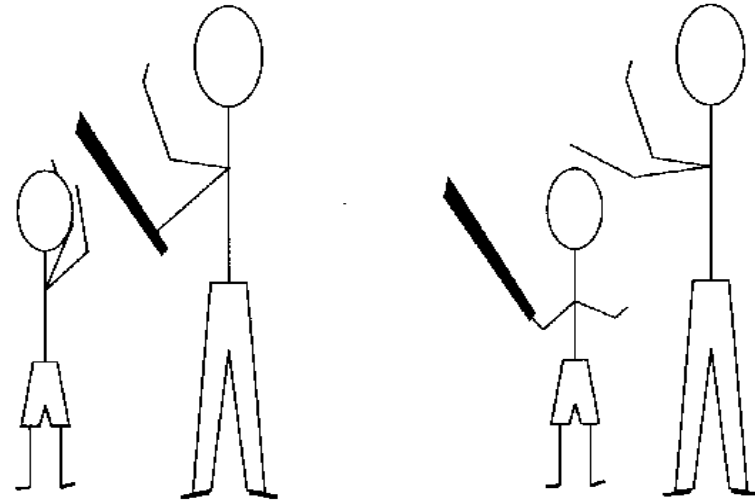
Interface Types



Interface Types

Natural language

- An attractive option:
familiar
- Speech recognition or typed natural language
- Problems
 - Vague & ambiguous
e.g., The man hits the boy with the stick.



Is “The man uses a stick to hit the boy” or

“The man hits the boy who holds a stick”?

Interface Types

■ Form fill-in

- Screen like paper form
- A number of fields in which user is expected to type in data
- Each field has a label (caption) that indicates the type of data to be entered in that field
- **Spreadsheet** is a variant of form filling

Improved:

STUDENT REGISTRATION					
STUDENT					
Name:	<input type="text"/>	*Major:	<input type="text"/>	Year:	<input type="text"/>
ID:	<input type="text"/>	Track:	<input type="text"/>	Status:	<input type="text"/>
COURSES					
Number	*Title	Section	Sequence		
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	

Figure 5-5 Fill-in form caption and field design.

Interface Types

- Very useful for collecting information
- Today's typical on-screen form contains a series of fields for the user to type information or select option(s) from a list of choices
- In old text-based systems, screen forms were composed entirely of fields into which the user had to type information
- Screen fill-in forms are derived from their antecedents, paper forms, indicating its advantage of familiarity. If it is designed well, a form will aid the user in understanding its purpose and allow fast and easy entry of information
- Conversely, a poorly designed screen form can be inefficient and aggravating to complete

Interface Types

- Question & answer
 - Combine some of the features of both menus & fill-in form
 - User is led through interaction via a series of questions, yes/no, multiple choice, etc.

MASSACHUSETTS 1990 TAX FORM 1

Enter your name:
(Last, First M.)
>Jones, Jean A.

Enter your marital status:
(M = married, S = single.)
>M

Are you filing jointly or separately?:
(J = jointly, S = separately.)
>J

Enter your spouse's name:
(Last, First M.)
>Jones, James R.

Interface Types

- WIMP

- Consist of

- Windows

- Icons

- Menus

- Pointers

- Another form: windows, icons, mice & pull-down menus

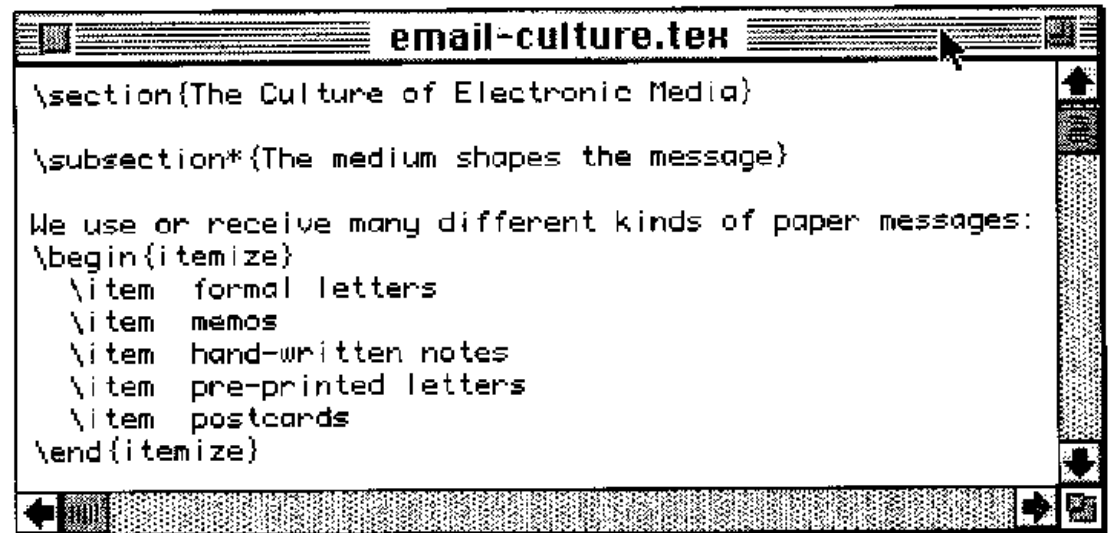
- Default style for majority of interactive computer systems today, especially PCs & desktop machines

- Support **direct manipulation** of selecting, moving and resizing objects

Interface Types

■ Windows

- Areas of the screen that behave as if they were independent terminals
- Can contain text or graphics
- Can be moved or resized
- Can overlap & obscure each other, or can be laid out next to one another (tiled)
- Scrollbars allow the user to move the contents of the window up & down or from side to side
- Title bars describe the name of the window

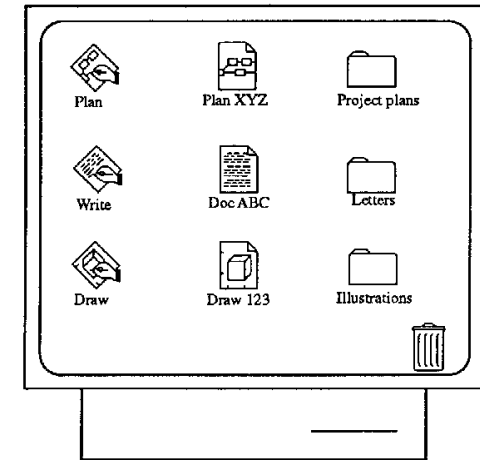


```
email-culture.tex
\section{The Culture of Electronic Media}
\subsection*{The medium shapes the message}
We use or receive many different kinds of paper messages:
\begin{itemize}
  \item formal letters
  \item memos
  \item hand-written notes
  \item pre-printed letters
  \item postcards
\end{itemize}
```

Interface Types

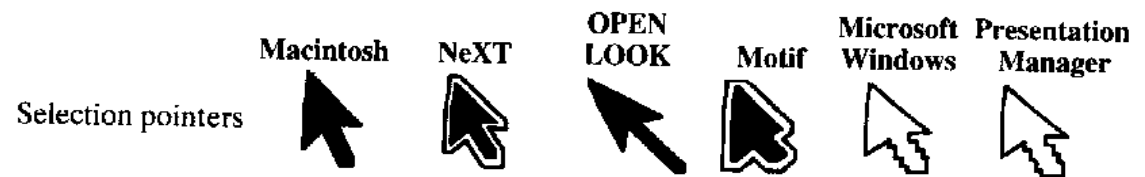
■ Icons

- Small picture or image, used to represent some objects (file, folder, etc.) in the interface
- Windows can be closed down to this small representation (iconised) allowing many windows to be accessible



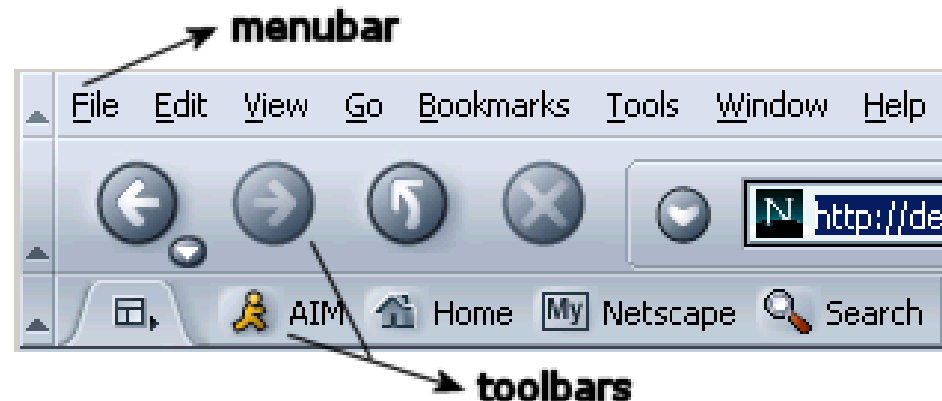
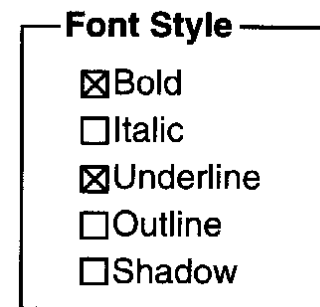
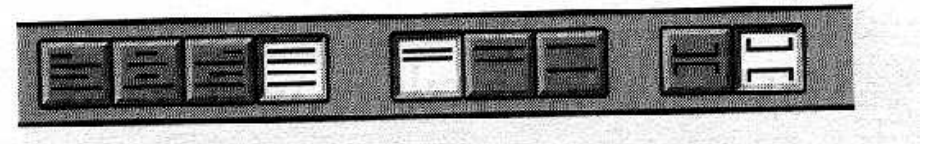
■ Pointers

- The pointer is controlled by mouse, joystick, trackball, cursor keys or keyboard



Interface Types

- Other WIMP related styles
 - Radio button** - set of mutually exclusive choices
 - Check box** - set of non-exclusive choices
 - Toolbar** – collection of small buttons, each with icons



How to distinguish a menu bar and a toolbar?

Interface Types

- **Dialogue box** - information windows that pop up to inform of some important event or request certain information

Title:

Subject:

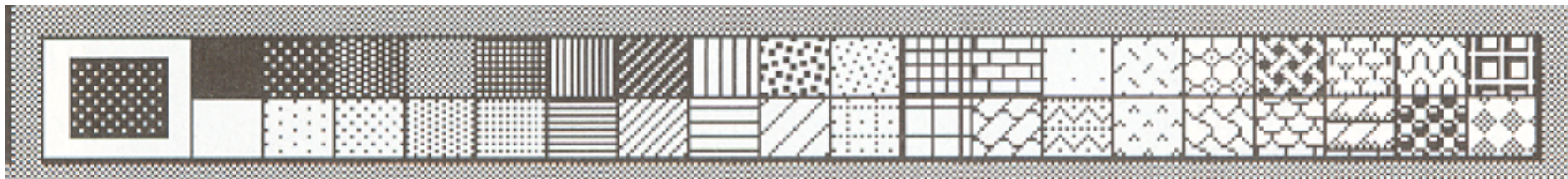
Author:

Version:

Keywords:

Figure 6-29 Dialog box

- **Palettes** – mechanism for making the set of possible modes and the active mode visible to user



Interface Types

- **Virtual Reality (VR)**
 - Refer to the experience of interacting with an artificial environment, which makes it feel virtually real
 - Images are displayed stereoscopically to the users through shutter glasses and objects within the vision field can be interacted with via an input device
 - Provide immersive experience because users can interact with objects and navigate in 3D space
 - Illusion afforded by current technology can make virtual objects appear to be very life-like and behave according to the laws of physics, e.g., landing and take-off terrains developed for flight simulations

Interface Types

- Offer different viewpoints, e.g., first-person perspective in flying/driving simulations and shooter game DOOM, third-person perspective in Tomb Raider game via controlling the interactions of Lara Croft
- Other applications include IMAX cinemas, virtual prototype home for real estate industry, education

<http://www.etnet.com.hk/www/tc/lifestyle/officetips/executive/61966>



H. C. So

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Semester A 2019-2020

Interface Types



<http://www.info.gov.hk/gia/general/201705/31/P2017053100453.htm>

中原地產 CentaVideo
CENTALINE PROPERTY 視頻搵樓

網上搵樓 | 分行網絡 簡

港島 九龍 新界東 新界西 搜索 VR睇樓

Property Name	Location	Rooms	Price	Area
明園 第一期中層 7室	北角/炮台山	3房	售 \$778萬	實 662 呎 售:\$11,752/呎
摩星嶺村 A3座 A3室	西半山	4房	售 \$6,600萬	實 2,508 呎 售:\$26,315/呎 建 3,000 呎 售:\$22,000/呎
縉城峰 1座 高層 A室	堅尼地城/西營盤	3房	售 \$2,350萬	實 879 呎 售:\$26,734/呎 建 1,186 呎 售:\$19,814/呎
越苑 中層 A室	西半山	4房	售 \$4,600萬 租 \$10萬	實 2,666 呎 售:\$17,254/呎 租:\$38/呎 建 3,729 呎 售:\$12,335/呎 租:\$27/呎

<http://hk.centanet.com/findproperty/zh-HK/Home/VideoHome>

Interface Types

- **Augmented Reality (AR)**

- Bridge physical and digital worlds: virtual representations are superimposed on physical devices and objects
- Many AR apps available for a range of contexts, from education to car navigation, e.g., Pokémon Go, Virtuali-Tee, fashion exhibition, and virtual fitting

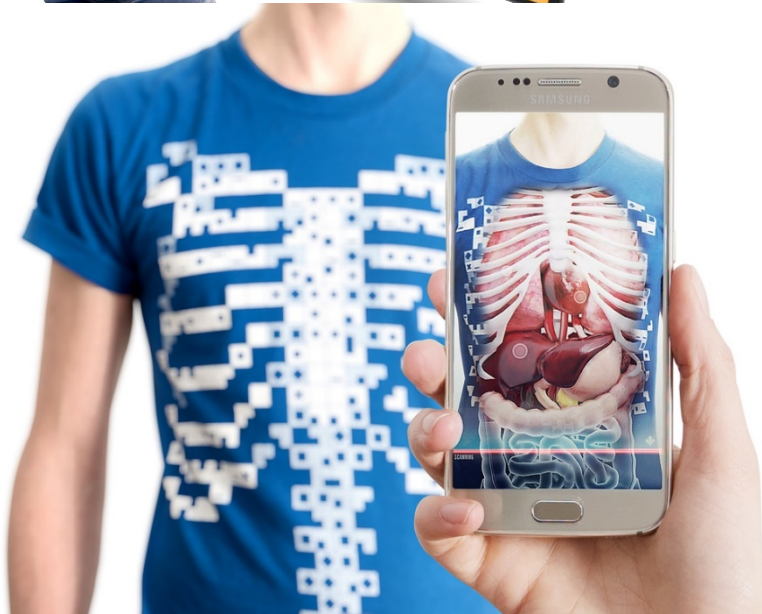
<http://www.japantrends.com/issey-miyake-fashion-exhibition-augmented-reality-app/>

<https://www.curiscope.com/products/virtuali-tee>

<http://www.create.com/web/our-portfolio/city-university-of-hong-kong-annual-report/>

- To reveal digital information, the user opens the AR app on a smartphone or tablet, and the content appears superimposed on what is viewed through the screen

Interface Types



Interface Types

■ Haptic

- Provide tactile feedback by applying vibration and forces to the user using actuators that are embedded in his clothing or a device he is carrying
- Example interfaces include gaming consoles employing vibration to enrich experience, MusicJacket for guiding people to learn musical instrument, and Haptic Braille

