Human Computer Interaction

Chapter 03 – Interfaces of interactive systems

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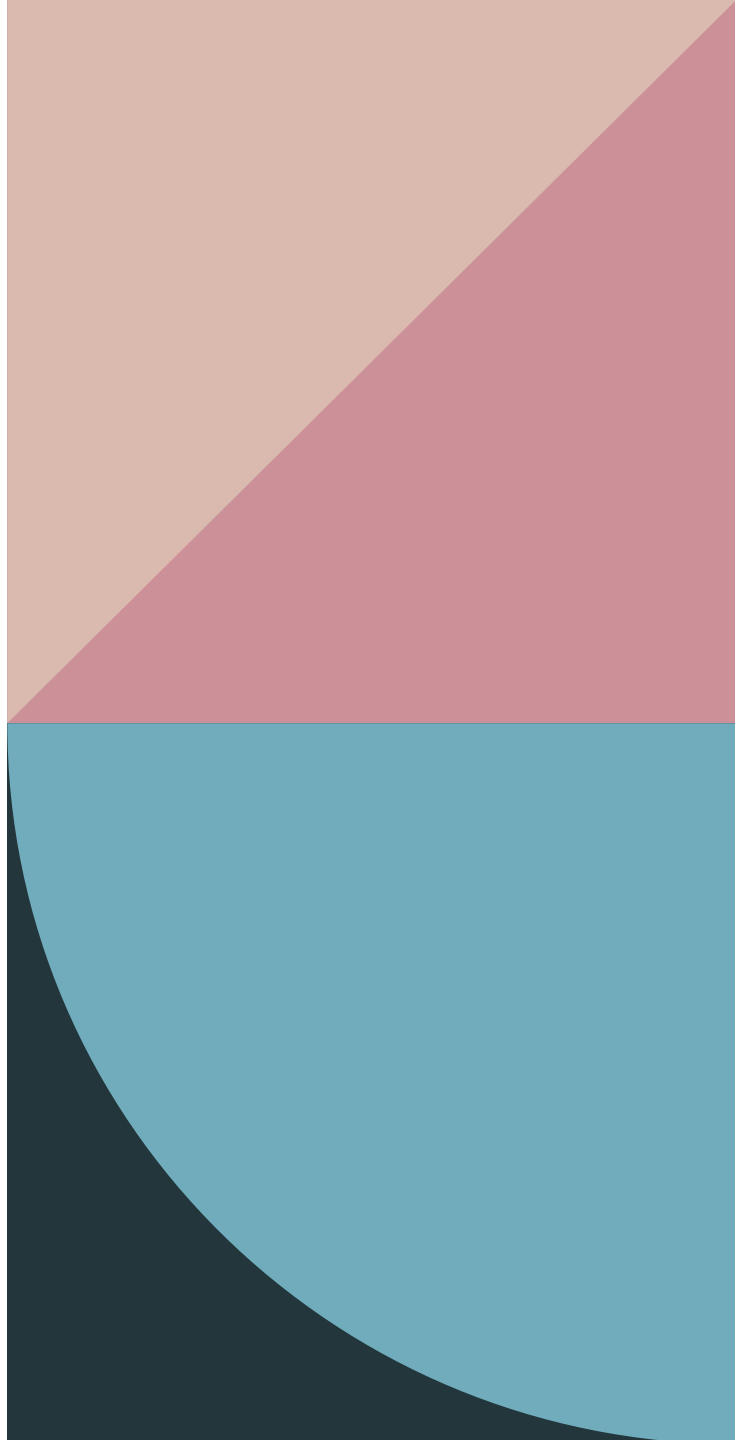
Upon completion of this lesson, students will be able to:

1. Recall the popular interaction models
2. Recall the contexts of interaction
3. Explain how interactive technologies provide usability paradigms
4. Use interaction models for describing the intended interaction between human and computer in the scope of an interactive system.

Objectives

1. Concepts
2. Interface through periods
3. Types of interactions

Content



Concepts

- Interaction models
- Interfaces

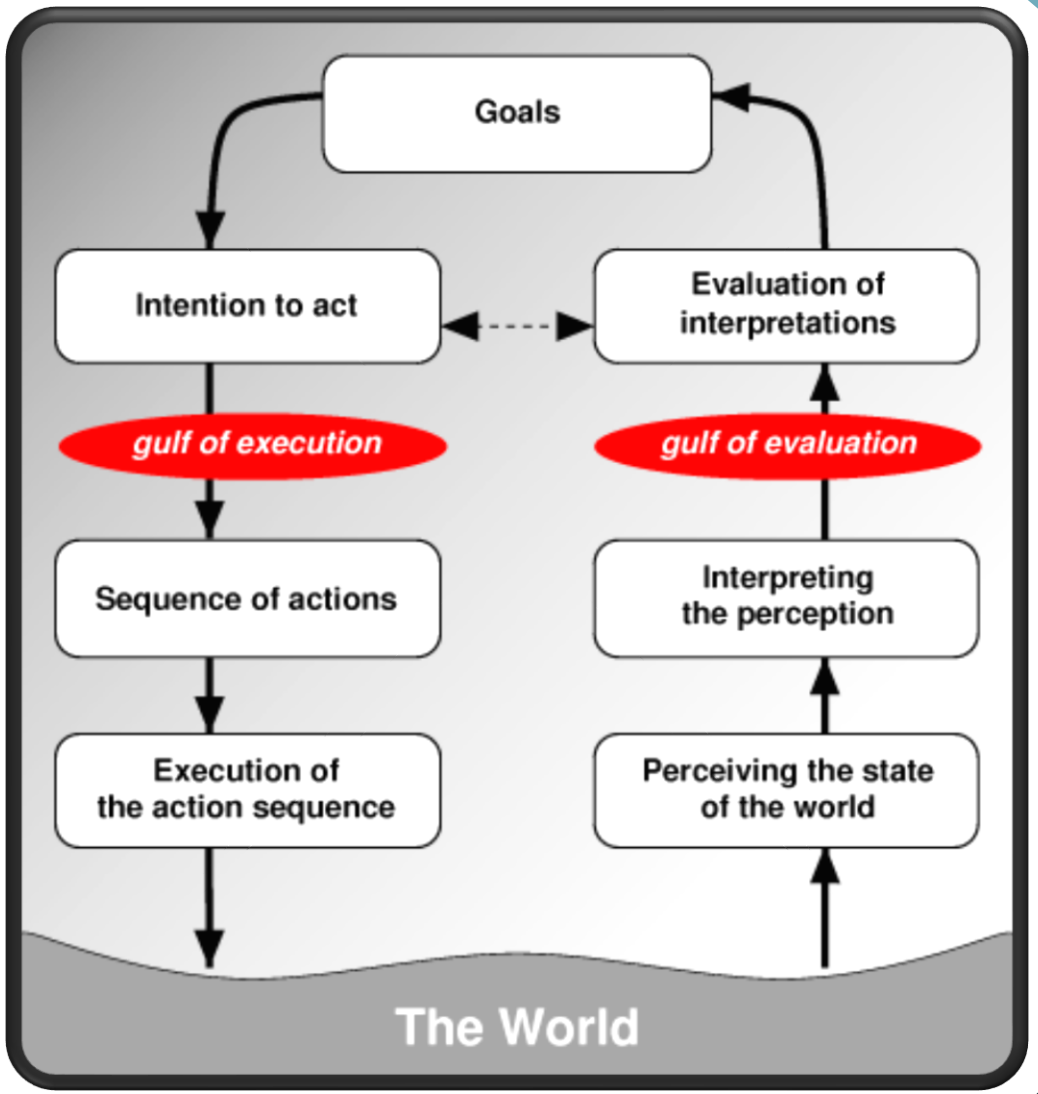
Interaction models

- What is the interaction model?
  - Describe the representation of the process of interaction between human AND and computer
- Research interaction models for what?
  - Understanding what is going on in the interaction between the user and the system
  - Identifying the sources and causes of difficulties in the interaction process

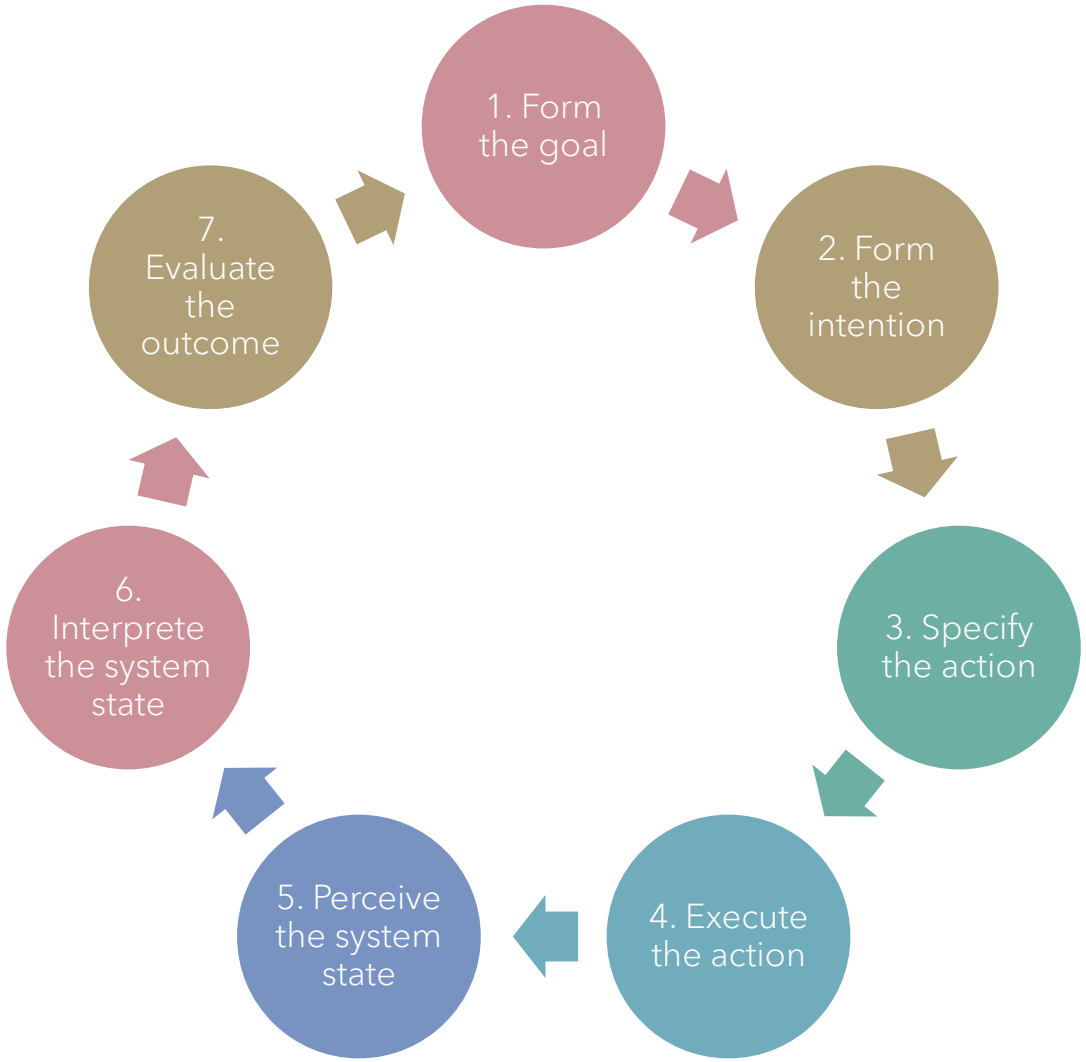
Classification

- From the user's side: Norman's execution-evaluation cycle
- From the interaction's side: Abowd and Beale's interaction framework

Gulf of Evaluation and Execution model

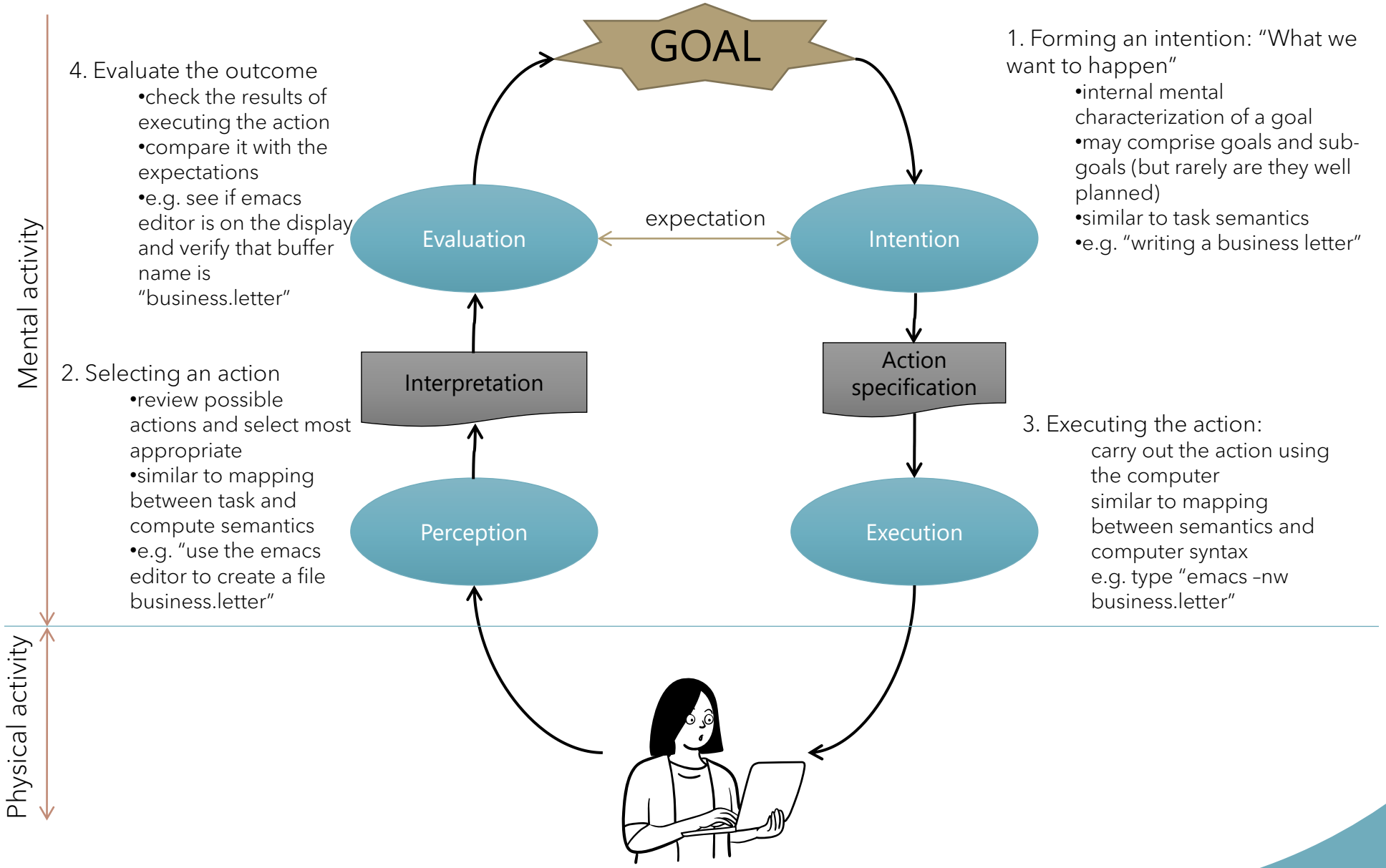


Execution-evaluation cycle



- Problems are identified as gulfs of execution and evaluation
  - Interaction cycle has two major phases : execution and evaluation
- 7 steps, each step defines an action of the user.
  - 4 major stages: intention, selection, execution, evaluation

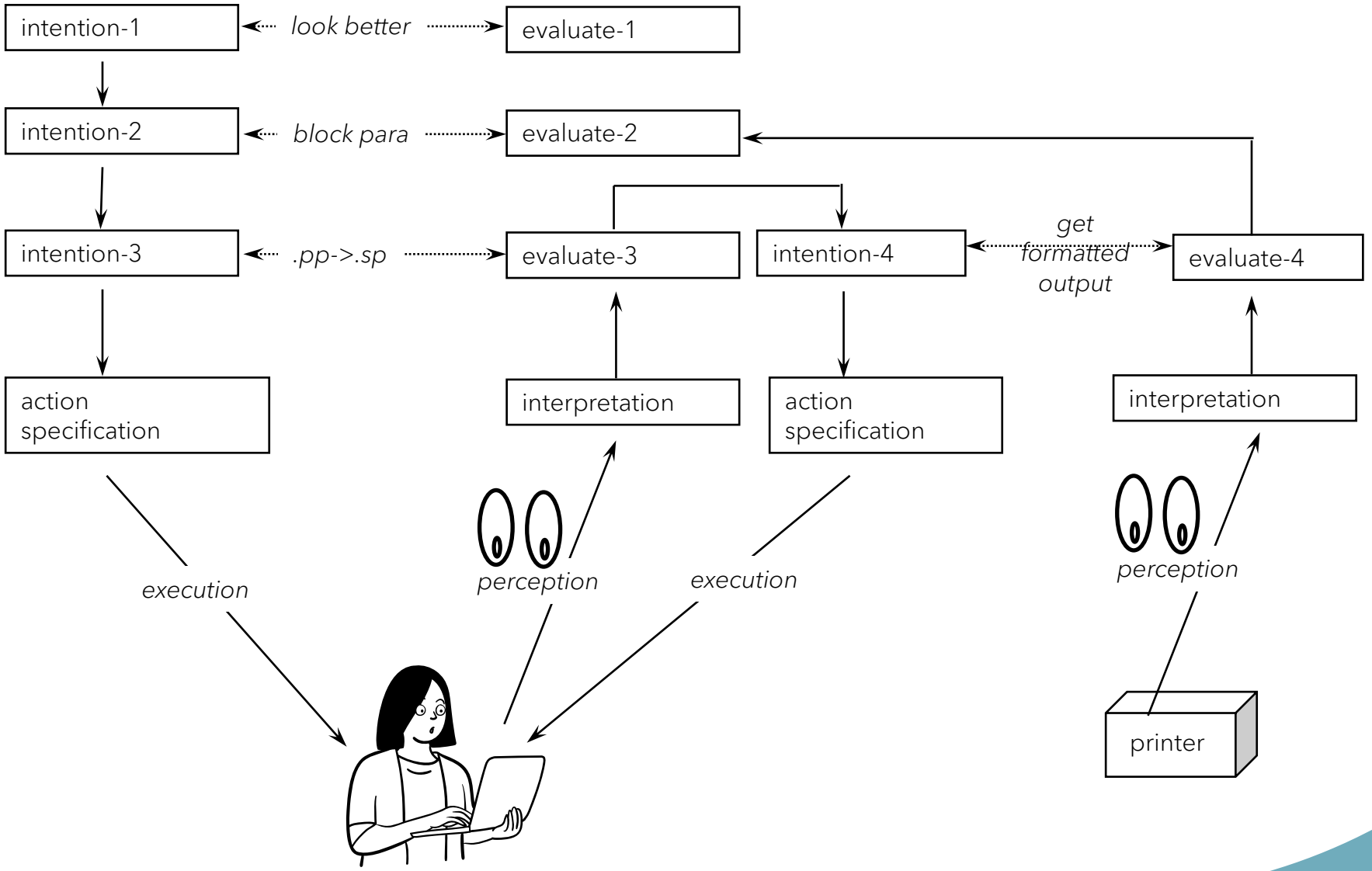
4 stages of an interaction: user activities when performing a task



How to use ?

- Some systems are harder to use this model than others
- Gulf of execution:
  - user's formulation of actions ≠ actions allowed by the system ?
- Gulf of evaluation:
  - user's expectation of changed system state ≠ actual presentation of this state ?

Case study: making a business letter look better



Gulf of Evaluation and Execution model

Pros

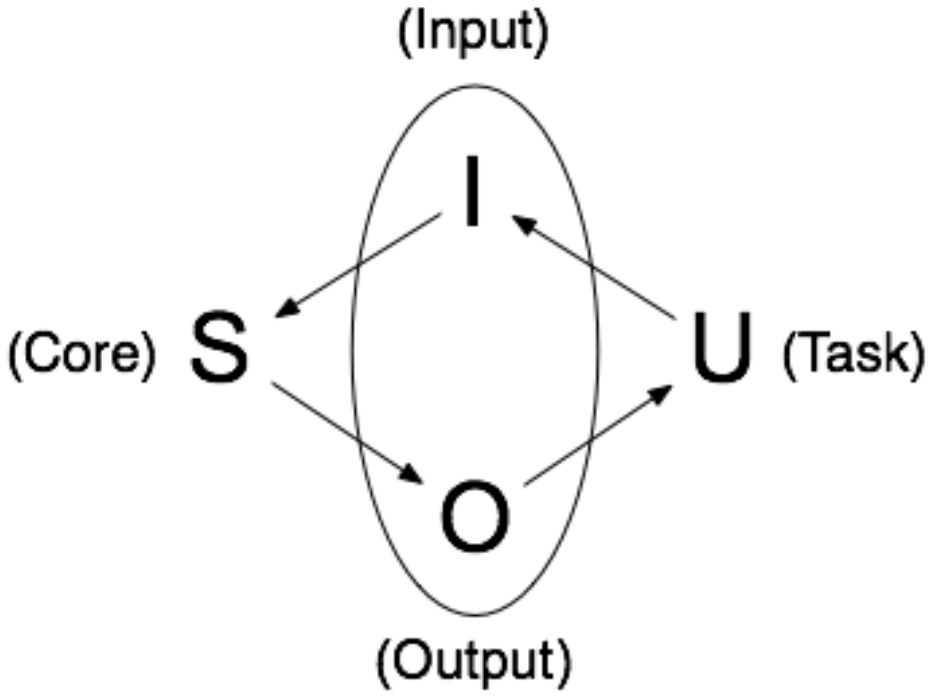
- Close to our understanding of user interaction
- Users form action plans
- Action plan is executed by computer
- During the execution, the user observes the results returned through the interface and decides on the next actions
- The Norman model is a useful means of understanding interactions: simple, specific

Cons

- Only consider the system from the user's point of view, not paying attention to communicating with the system through interaction

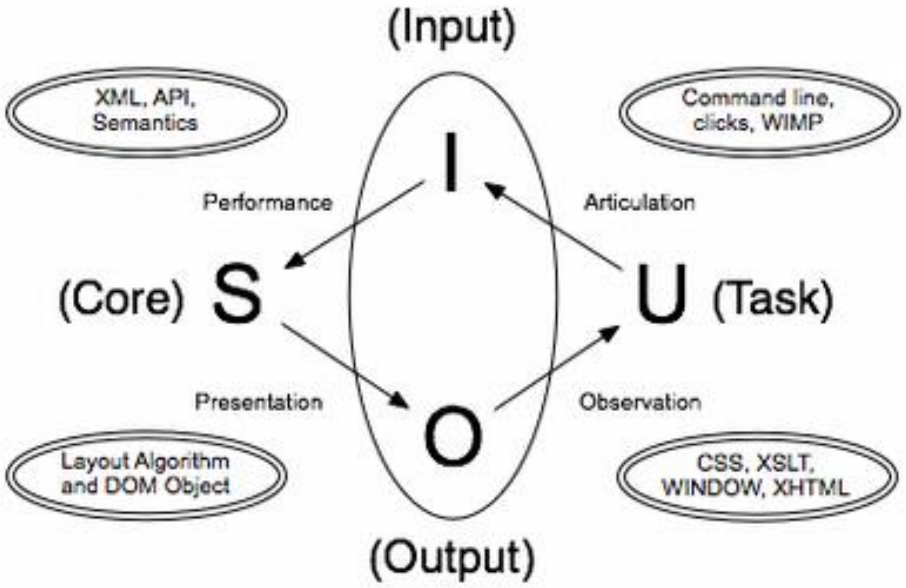
Interaction framework model

- Provides a more realistic description of HCI
- 4 components, each component has its own language:
  - Core
  - Task
  - Input
  - Output

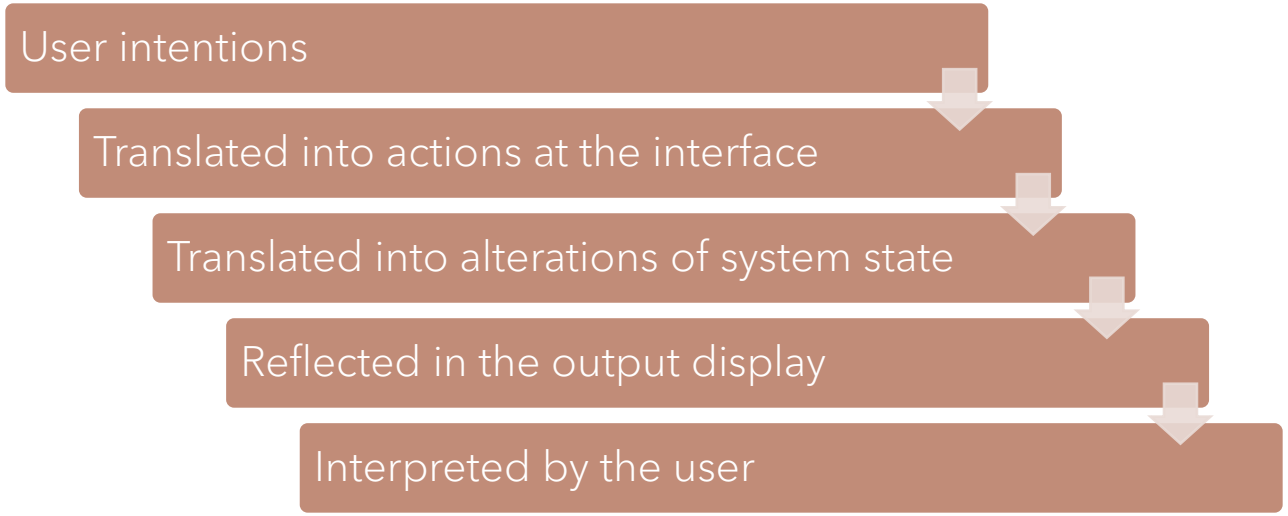


Example of interaction framework

- User → Input: (articulating a goal)
  - How easy is it to translate a goal requirement into the input language?
- Input → System:
  - Can all system stimuli be articulated by user language?
- System → Output (execution & evaluation)
  - Can system output device provide a complete view of system state?
- Output → User (interpretation by user)
  - Is information presented to user in a way that is easy to interpret ?

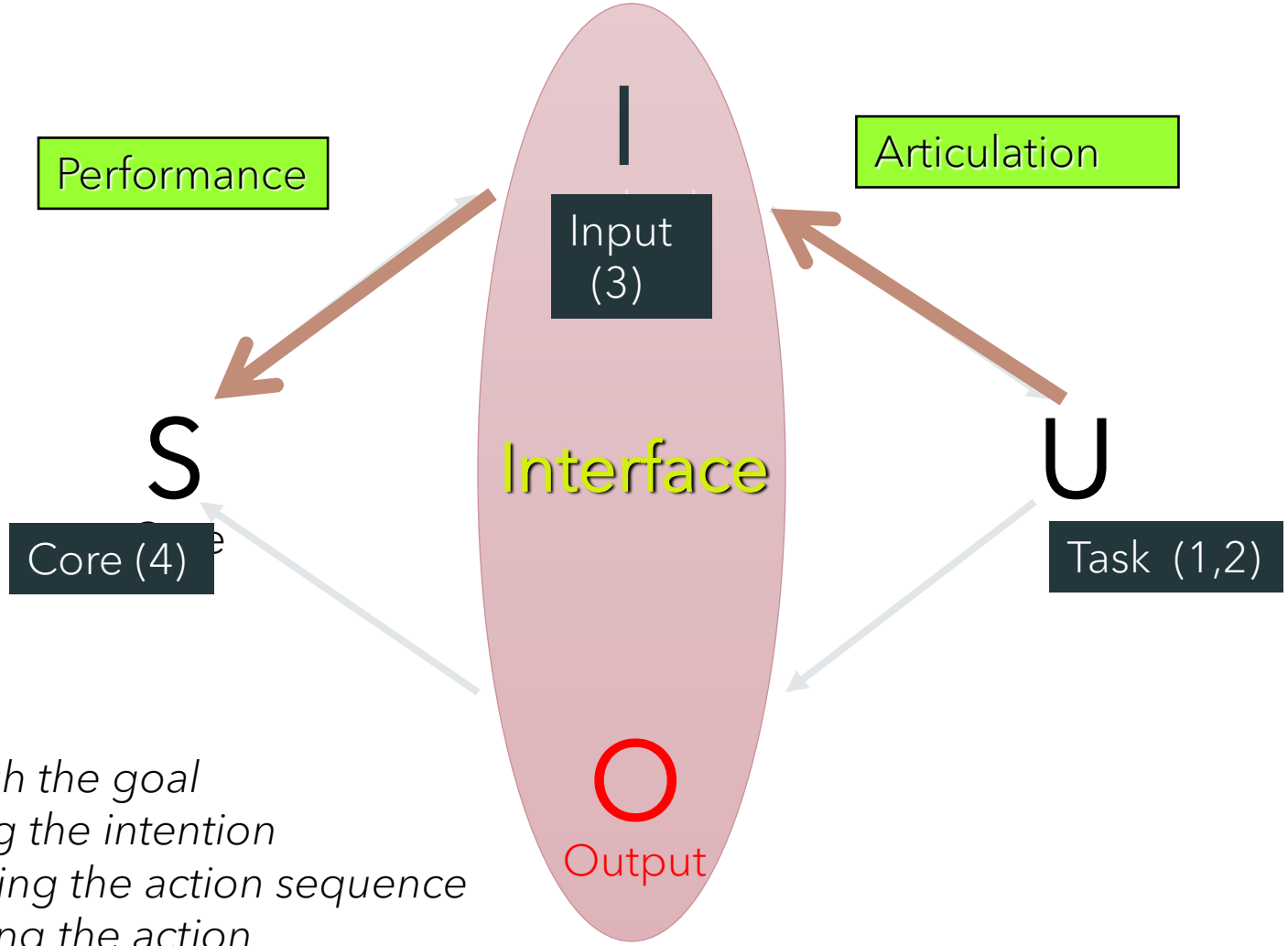


How to use this framework ?



- **Interaction** is achieved through both the
  - Dialogue design
  - Interface styles
- **Execution and evaluation** depends on
  - The input language (dialogue)
  - The user's ease in manipulating the interface through the input device.
  - Clear mapping from dialogue to task

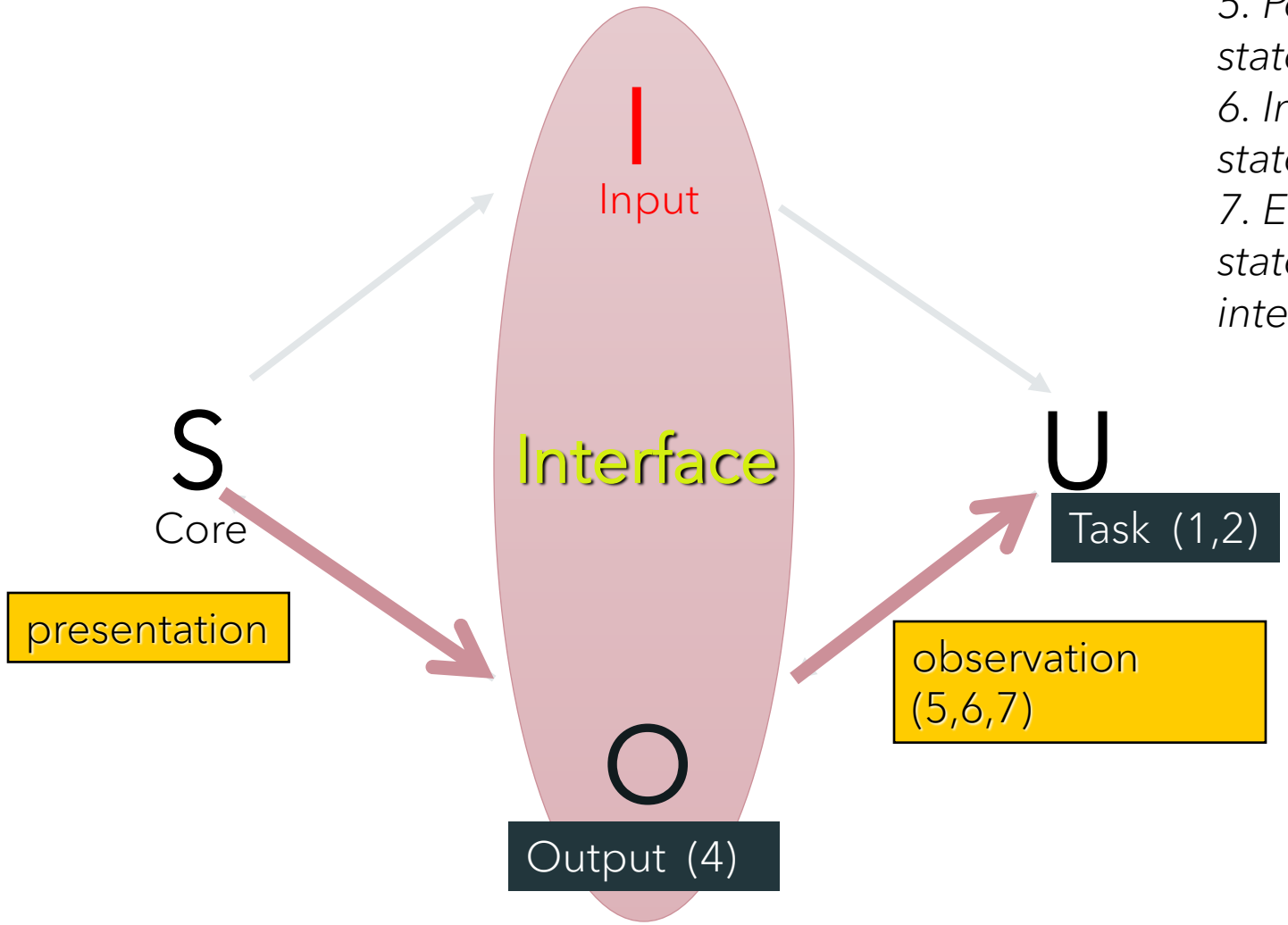
Norman's cycle vs. Abowd & Beale's framework
Execution phase of cycle



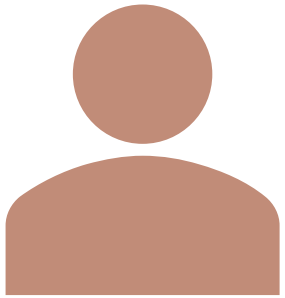
1. *Establish the goal*
2. *Forming the intention*
3. *Specifying the action sequence*
4. *Executing the action*

Norman's cycle vs. Abowd & Beale's framework
Evaluation phase of cycle

4. Executing the action
5. Perceiving the system state
6. Interpreting the system state
7. Evaluating the system state w.r.t. goals and intentions



Interfaces

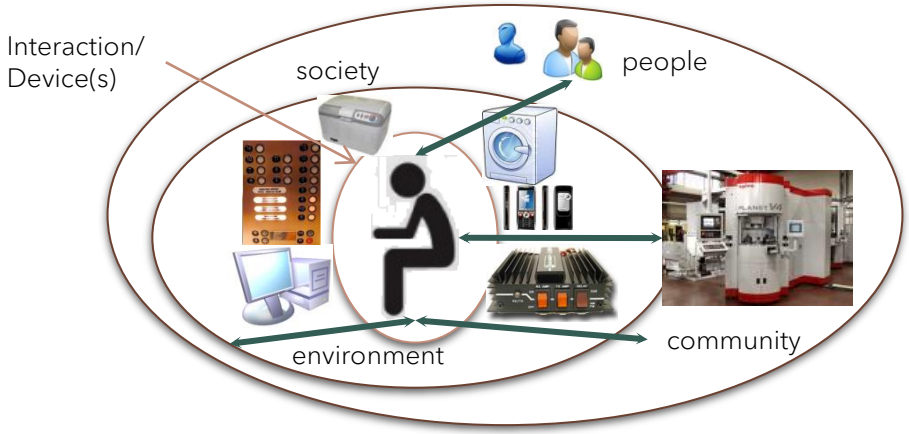


Human interface

User interface

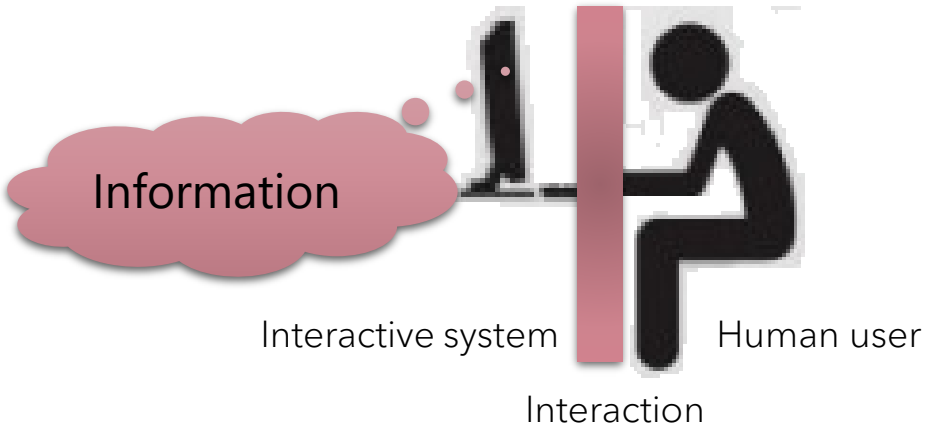
Human Interface

- Exchange information and interaction between people and systems
  - Operational methodology
  - Sequence of operations
  - Information display method
- taking into account factors such as people, devices, environment, society, community



User interface

- ISO 9241-110:2006: A user interface is all components of an interactive system (software or hardware) that provide information and control to the user to complete specific tasks with the interactive system.



Main components of user interface system

- Input: keyboard, mouse, trackball, one's finger (for touch-sensitive screens), and one's voice (for spoken instructions).
- Output: how computers transmit information to users by
  - Display screen
  - Voice
  - Sound
- The use of senses: touch, smell has not really been implemented.

Role of user interface

- User interface (UI) is one of the most important components of any computer system
  - UI allows the user to hear, see, and interact with the system.
  - The functional design (application core) is often transparent to the user, the user is in direct contact with the communication devices such as the monitor, keyboard and mouse.

Type of interactions

- Command line, Menus, Question and response, Forms
- Natural language
- Direct manipulation / WIMP / point and click
- Virtual reality

Command line

- Expresses instructions directly to computer by using function keys, single characters, abbreviations or whole word commands

→ Advantages

- powerful, flexible, quick

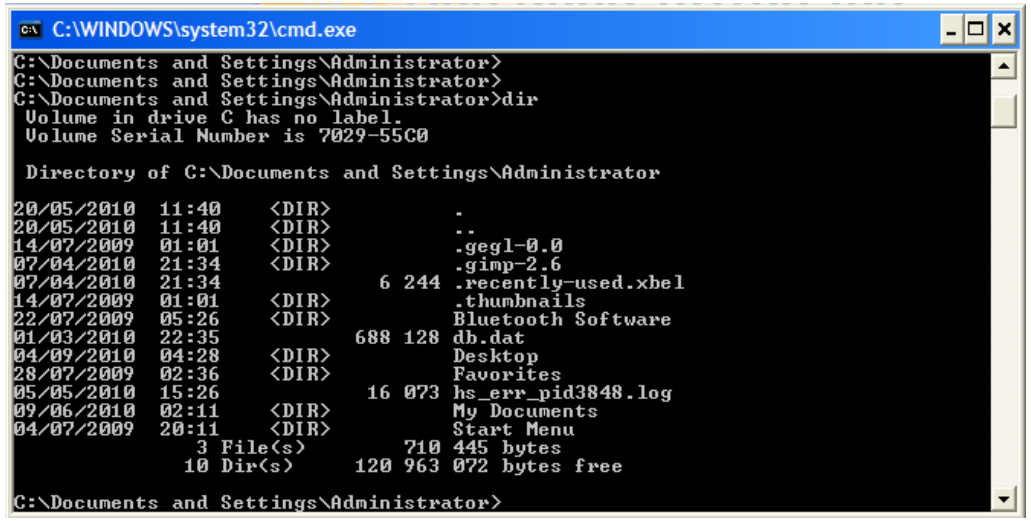
→ Disadvantages

- poor learn-ability, no cues, experts usually, inconsistent features, typing errors

- Exercise: cite out some examples of command line style
  - DOS or UNIX operating systems
  - programming languages
  - natural language interaction
  - accelerated access in menu screens in window systems

Guidelines for command lines

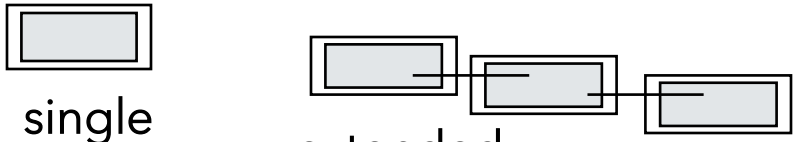
- no excess functionality
- cautious use of powerful destructive operations
  - eg. DEL *.*
- tailoring the language to suit different users
- a unifying concept, model, or metaphor can be useful
- consistency in the ordering of keywords and parameters
- a hierarchical structure for a large number of commands
- consistent abbreviation strategies should be used
- mnemonics should be meaningful



Menu interaction style

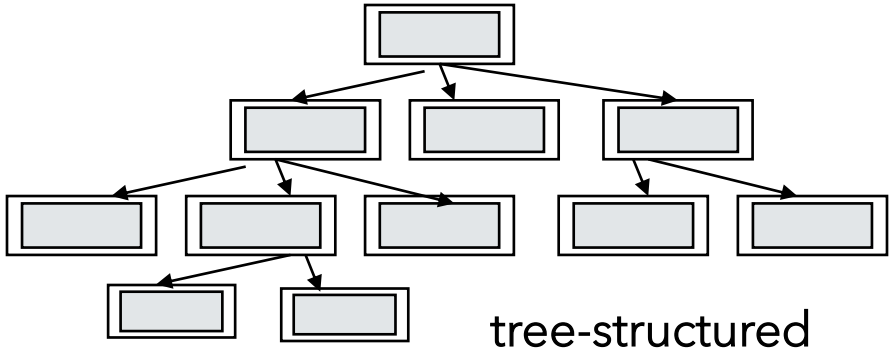
- Menu selection is especially useful when users:
  - have little training
  - do not use the system frequently
  - are unfamiliar with the terminology of the system
  - need help in structuring their decision making process.

Menu systems' structure

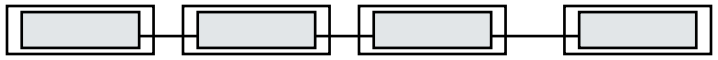


single

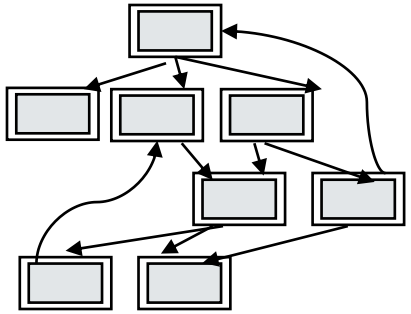
extended



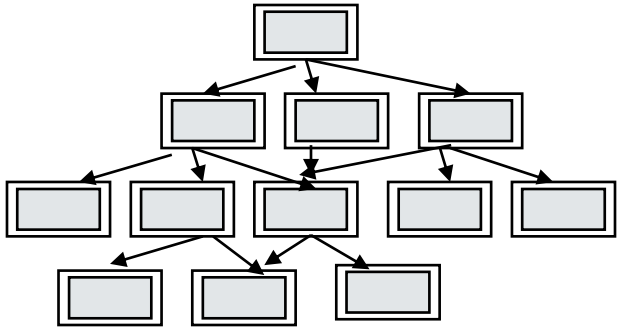
tree-structured
- hierarchical
- pull down
- pop-up
- circular



linear sequence



cyclic network



acyclic network

Menus Design Issues

- which kind to use
- what to include in menus at all
- words to use (action or description)
- how to group items
- choice of keyboard accelerators

Semantic organization of menu

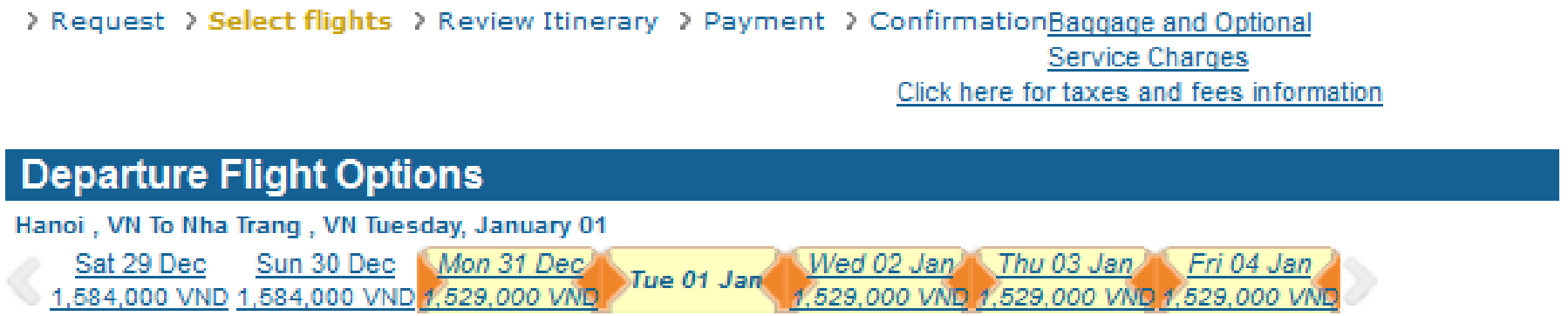
- Primary goal for menu designers: create a sensible, comprehensible, memorable, and convenient semantic organization relevant to the user's task:
  - break into logical categories
  - Hierarchical decomposition: every item belongs to a single category
  - Organization is done before considering the screen display.
- Choices for sequencing
  - Chronological ordering
  - Numeric ordering
  - Alphabetically sequence of terms
  - Groupings of related items (functional)
  - Most frequent items first
  - More important items first

Guidelines for item presentation sequence

- by natural order, if any
- if small number of options (7 or less) order by:
  - sequence of occurrence
  - frequency of occurrence
  - importance
- alphabetical order for long lists
- consistency in ordering

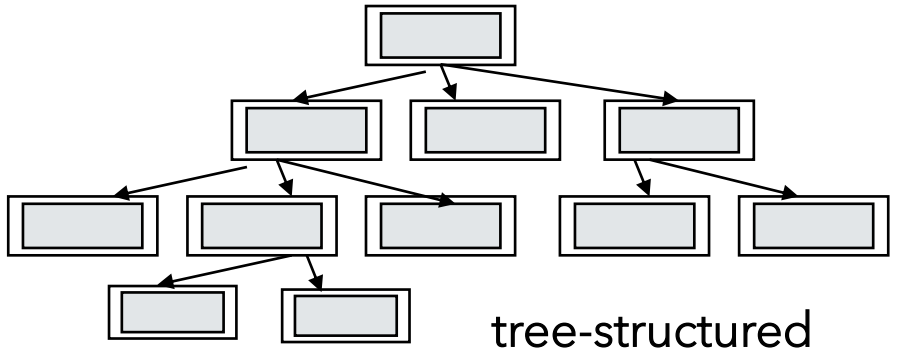
Guidelines for linear menus

- The user should:
  - be able to go back to previous screens
  - be able to terminate or restart the sequence
  - be presented with the choices in an order that matches their expectations
  - have a feeling for where they are in the sequence.



Guidelines for tree structure menu type

- A general or main menu
- Use terminology from the user's task domain
- Breadth is preferred over depth
- No more than three or four levels deep without logical categorization, limit choices to 4-8 items
- Distinct items
- A printed index, or "map", for large systems to orient users
- Improve design after feedback from users.



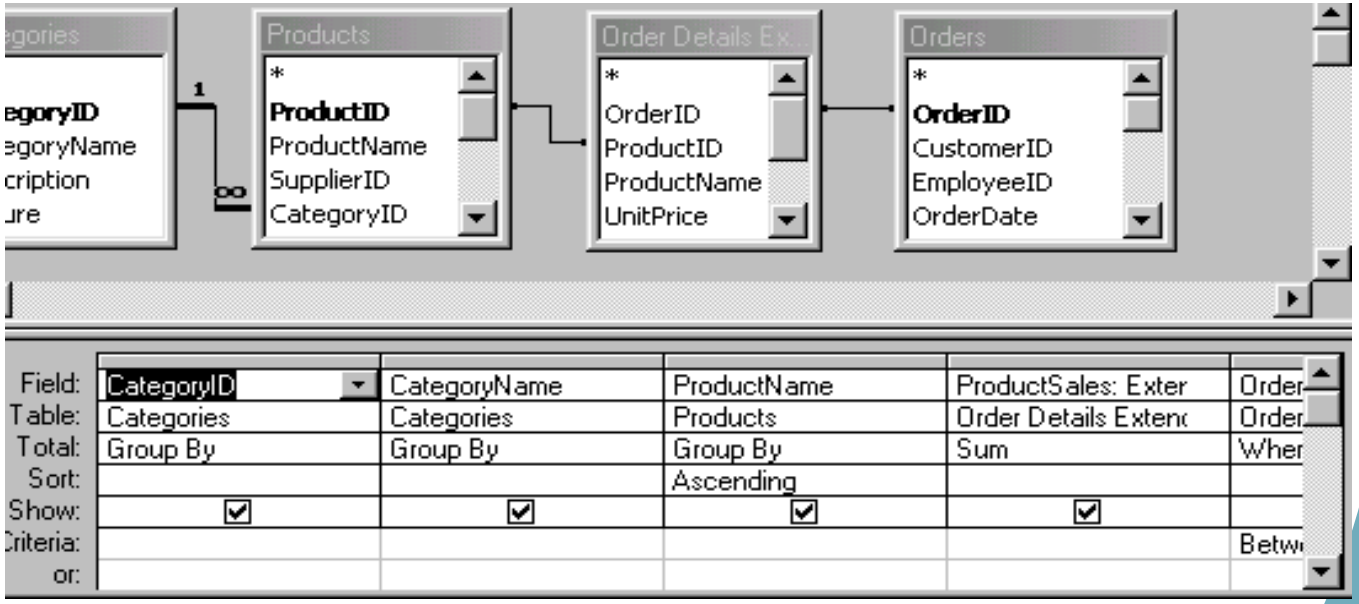
tree-structured
- hierarchical
- pull down
- pop-up
- circular

Approaches for quick access in menus

- Menus with type ahead
  - users types a string / character to represent particular menu choices
  - ensure distinct first letters of each item in menu layer
- Menu names and item numbers
  - option to initially type these in and go to the particular item
- Menu macros
  - individual tailoring of the system to represent frequently used choices
  - users define own pathways with macro, and assign own name to macro

Questions and answers style

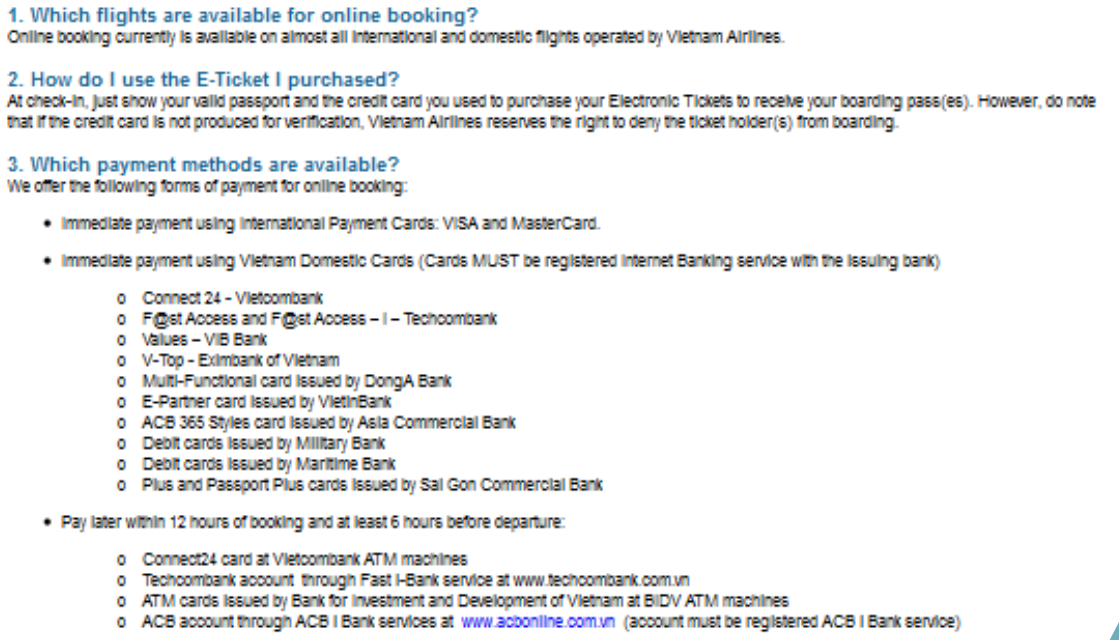
- Use with:
  - novice or casual users
  - some specific application areas
    - CAL ~ computer aided learning
    - DSS ~ decision support systems
    - ES ~ expert systems



- Note:
  - Limited in functionality and power compared to other interface styles.

Guidelines for question-and-answer dialogues

- one idea or question at a time
- make questions precise
- short user responses
- keep previous questions displayed
- field widths 25-40 characters
- fields are left-centered
- distinguish computer messages from keyed entries



1. Which flights are available for online booking?
Online booking currently is available on almost all international and domestic flights operated by Vietnam Airlines.

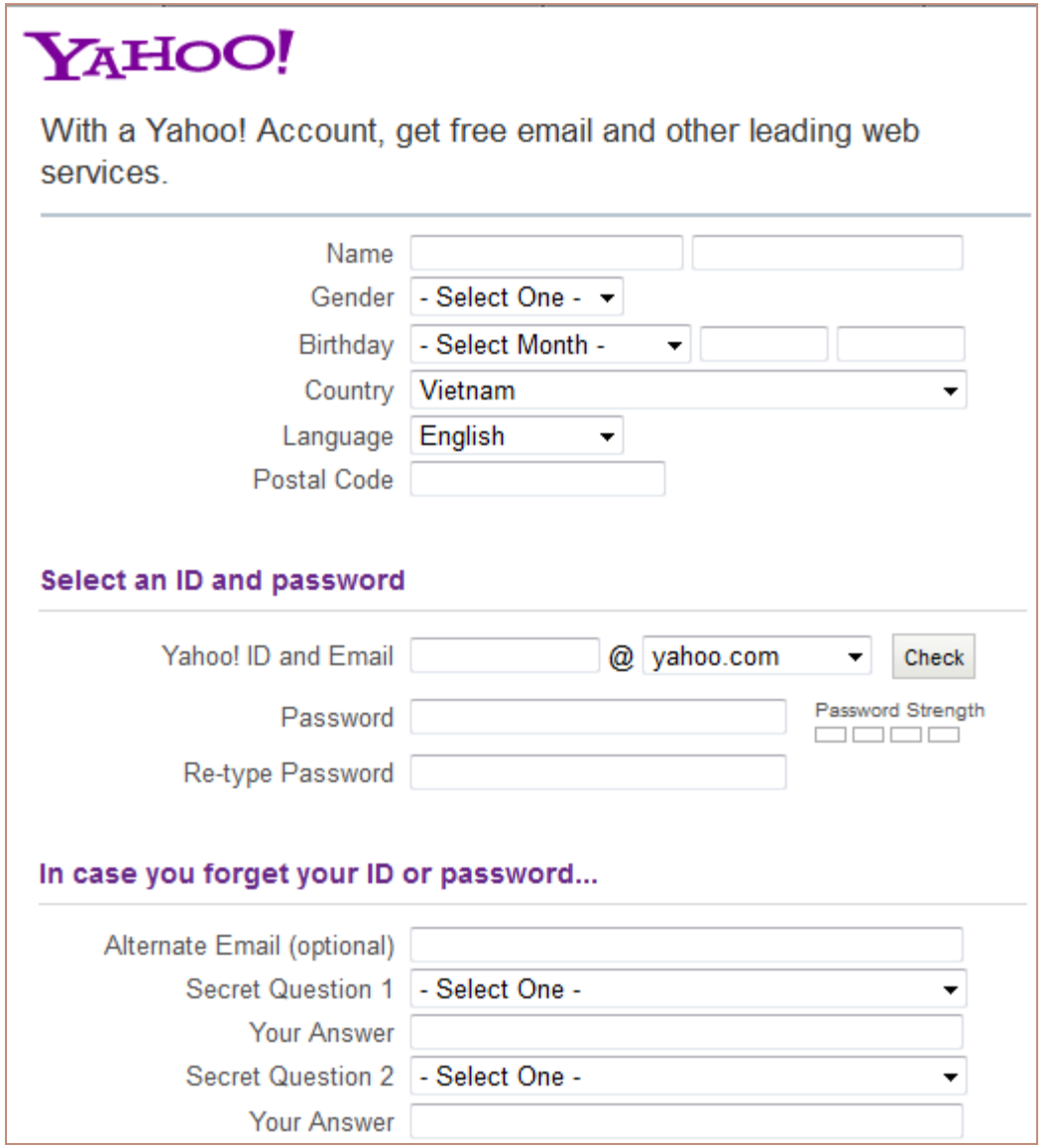
2. How do I use the E-Ticket I purchased?
At check-in, just show your valid passport and the credit card you used to purchase your Electronic Tickets to receive your boarding pass(es). However, do note that if the credit card is not produced for verification, Vietnam Airlines reserves the right to deny the ticket holder(s) from boarding.

3. Which payment methods are available?
We offer the following forms of payment for online booking:

- Immediate payment using International Payment Cards: VISA and MasterCard.
- Immediate payment using Vietnam Domestic Cards (Cards MUST be registered Internet Banking service with the issuing bank)
  - Connect 24 - Vietcombank
  - F@st Access and F@st Access – I – Techcombank
  - Values – VIB Bank
  - V-Top - Eximbank of Vietnam
  - Multi-Functional card issued by DongA Bank
  - E-Partner card issued by VietinBank
  - ACB 365 Styles card issued by Asia Commercial Bank
  - Debit cards issued by Military Bank
  - Debit cards issued by Maritime Bank
  - Plus and Passport Plus cards issued by Sai Gon Commercial Bank
- Pay later within 12 hours of booking and at least 6 hours before departure:
  - Connect24 card at Vietcombank ATM machines
  - Techcombank account through Fast I-Bank service at www.techcombank.com.vn
  - ATM cards issued by Bank for Investment and Development of Vietnam at BIDV ATM machines
  - ACB account through ACB I Bank services at www.acbonline.com.vn (account must be registered ACB I Bank service)

Form

- Advantages :
  - easy to learn
  - easy to use
  - is reassuring, because the user can see the whole screen of data at once
  - is quick
  - needs few instructions



Guidelines for form fill-in design

- meaningful title
- comprehensible instructions
- logical grouping and sequencing of fields
- nice layout
- familiar field labels
- consistent terminology and abbreviations
- visible space and boundaries for fields
- convenient cursor movement: tab, arrows
- error correction for characters and fields
- error messages for unacceptable values
- optional fields clearly marked
- explanatory messages for fields
- completion signal

Natural language style

- Speech recognition or typed natural language
- Advantages:
  - Familiar to user
  - the user does not have to learn a command syntax or mode of operation.
- Problems:
  - ambiguity of input
  - possibility of misunderstanding
  - requires lengthy, slow, data entry
  - the user may not be given help in structuring input
  - pointing and selecting from visual displays may be more attractive to users
- Solution ?
  - try to understand a subset
  - pick on key words

Direct manipulation

- Allows users to select and manipulate objects from screen in order to perform tasks.
- Continuous representation of object of interest
- Physical actions not syntax or commands
- Response is immediate
- Easily reversible, visible action
- Example: icon based imagery in drawing package, desktop metaphor

Description

Advantages:

- engenders enthusiasm
- novices learn basic functionality quickly
- experienced users work rapidly
- error messages are rarely needed
- users can see immediately if their actions are furthering their goals, and how to change it
- user experiences less anxiety, actions are reversible
- user gain confidences since they initiate the action, feel in control and predict system responses

Disadvantages

- not all tasks can be described as concrete objects
- not all actions can be performed directly
- Example:
  - How to make concrete the concept of a buffer
  - Apple Macintosh overcame this through cutting, pasting and hidden clipboard.

WIMP interface

- WIMP: Today's interface, in PC and desktop workstation areas (MS Windows, Mac OS, Unix window-based systems)
  - Windows: elements of the screen that act as independent terminals
  - Icon

    small picture to represent a closed window

    represent other aspects of system - waste-basket
  - Menus (or Mice): menu bar, pop-up menus, pull down menus, circular menus
  - Pointers (or Pull-down menus)

    point and select

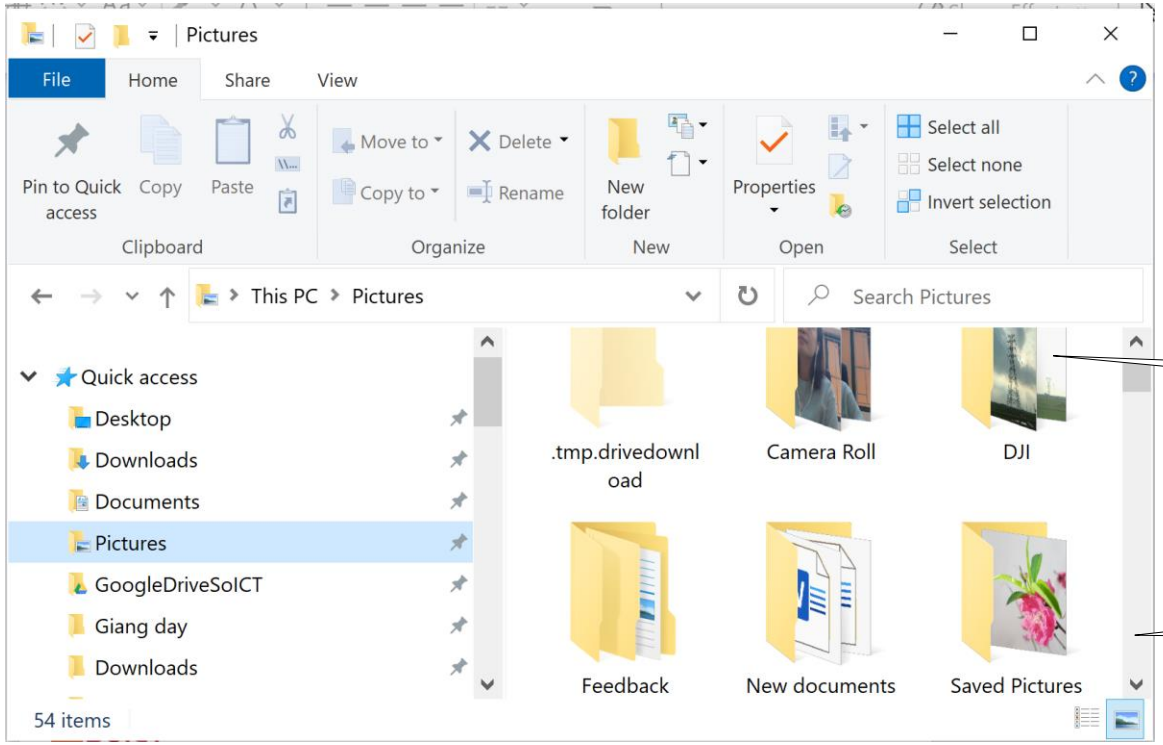
    modes

    hot spot - location where the image points
- Elements of WIMP interface are called widgets

WIMP interface

- Buttons
  - user can push to initiate a display
  - multi-choice - radio buttons
    - select one feature from a set of mutually exclusive options, such as sizes in font
  - binary selection: - on / off
    - eg page orientation
    - also called check boxes
- Palettes
  - a collection of icons to represent various modes of interaction
  - eg drawing package - pixel colour or pattern
  - toolbar palletes may be torn off from toolbar
- Dialog Boxes
  - information window used by system to bring user's attention to important information

WIMP - WINDOW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Pin to Quick access
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Delete
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Properties
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Pictures
Search Pictures
Quick access
Desktop
Downloads
Documents
Pictures
GoogleDriveSoICT
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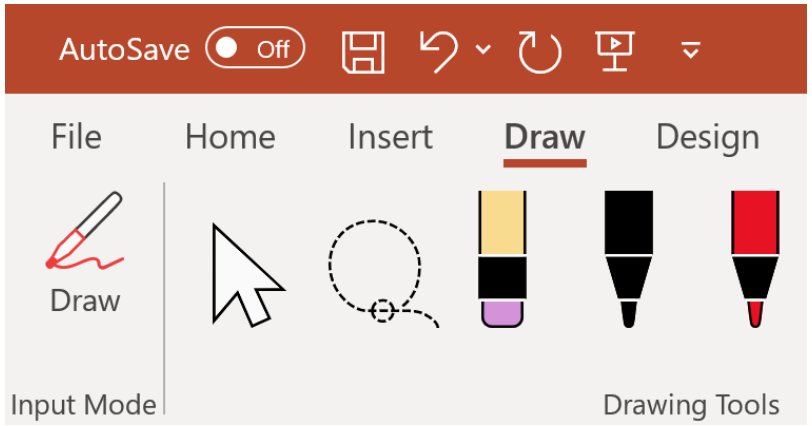
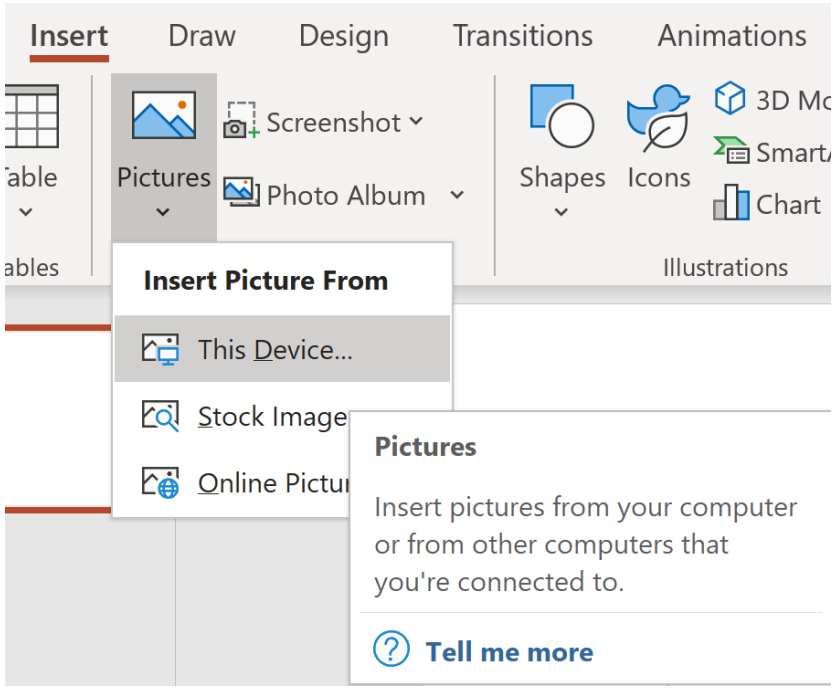
DJI
Feedback
New documents
Saved Pictures
54 items
Icons
Scroll Bar

WIMP – Icons

WIMP - Menu



a) 2 levels



b) Multiple levels

WIMP - Pointer

- Context-sensitive

Point and Click Interfaces

- used in ..
  - multimedia
  - web browsers
  - hypertext
- just click something!
  - icons, text links or location on map
- minimal typing

Virtual Reality

- Interaction styles
  - sense of direct physical presence: cues include visual, aural or haptic (touch)
  - sensory cues in three dimensions
  - Sound is used to aid navigation and location, being aware of other activities in the virtual world
  - Example: aircraft training
  - natural interaction: gestures typical of manipulating everyday objects
  - picking up, turning around, throwing and so on.

Immersion vs. desktop

- Immersion
  - "looking in" perspective
  - Providing a subjective feeling of environment, e.g:
  - helmet, data gloves and 3D world
  - metaphor of racing car travel compare to theme park activity - 3d world
- Desktop
  - "looking at" perspective
  - Changing environments to indicate motion, e.g.:
  - single screen for input and output, 3d mouse and keyboard, use of shadow
  - metaphor of moving through rooms as in games and 3d web environments

VR technologies

- visual display
  - 60 degrees vertically, 10 degrees horizontally
- head position sensing
  - head movement shows different imagery
- hand position sensing
  - data glove provides very accurate input
- force feedback
  - hand-operated devices
- sound input and output
  - bouncing balls, beating hearts, dropping objects
- other sensations - tilting, vibrating, smell?

Guidelines for virtual reality

- Users should be able to select actions rapidly by pointing or gesturing
- Need incremental and reversible control
- Need immediate display feedback
- No complex syntax
- Minimize computer concepts
- The VR should contain representations for objects and actions, e.g. a tool to change the shape of windows, as well as the windows.
- Designers should gain knowledge of cognitive psychology and human perception, so as to give feelings such as depth and movement realistically.

Exercices: Interaction styles

Interaction style	Main advantages	Main disadvantages	Application examples
Direct manipulation	Fast and intuitive interaction Easy to learn	May be hard to implement. Only suitable where there is a visual metaphor for tasks and objects.	Video games CAD systems
Menu selection	Avoids user error Little typing required	Slow for experienced users. Can become complex if many menu options.	Most general-purpose systems
Form fill-in	Simple data entry Easy to learn Checkable	Takes up a lot of screen space. Causes problems where user options do not match the form fields.	Stock control, Personal loan processing
command line	Powerful and flexible	Hard to learn. Poor error management.	Operating systems, Command and control systems
Natural language	Accessible to casual users Easily extended	Requires more typing. Natural language understanding systems are unreliable.	Information retrieval systems

Evolution of UI

1. Text user interface
2. Graphic user interface
3. Natural user interface
4. Organic user interface

User Interface Evolution

Text User Interface

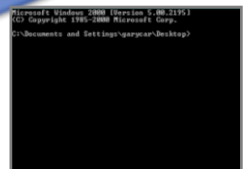
Command line

Terminal level

Programming level

Swith panels

Hardware level



Text user interface

- Interface that only uses text, symbols and colors available on a given text environment

Text user interface

TUI Technology

- Keyboard input

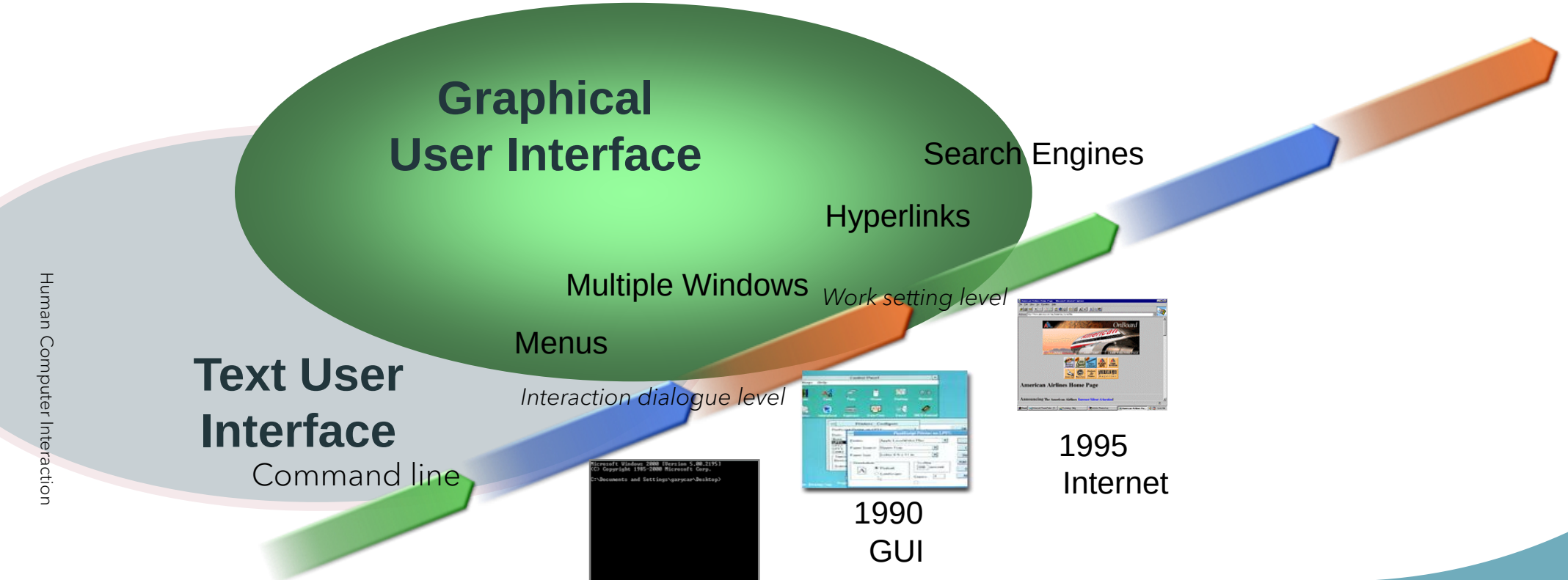
Enables

TUI Interaction

User is the expert and recalls

- What functions exist
- Where to go
- What to type (in which order)

User Interface Evolution



Graphical User Interface

GUI Technology
Direct manipulation

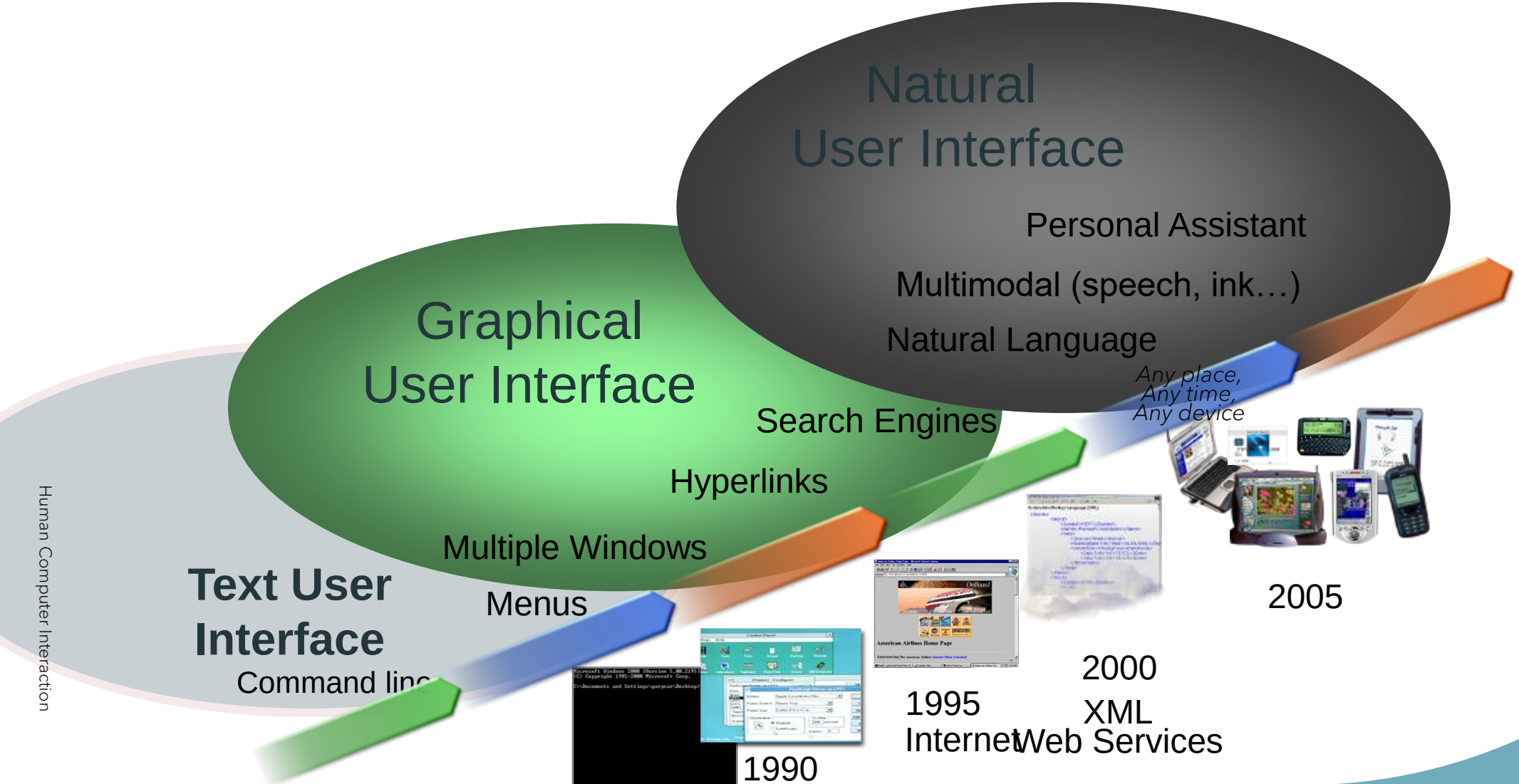
- Mouse / keyboard input
- Mouse input mapped to windows, menus, etc.
- Keyboard input (search) mapped to text index

Enables

GUI Interaction
User is the expert and recognizes

- What functions exist
- Where to go
- What to click (and in what order)
- What to type

User Interface Evolution




Typical example: NATURAL INTERFACE

Motivated by human-human interaction

Interacting with a Librarian

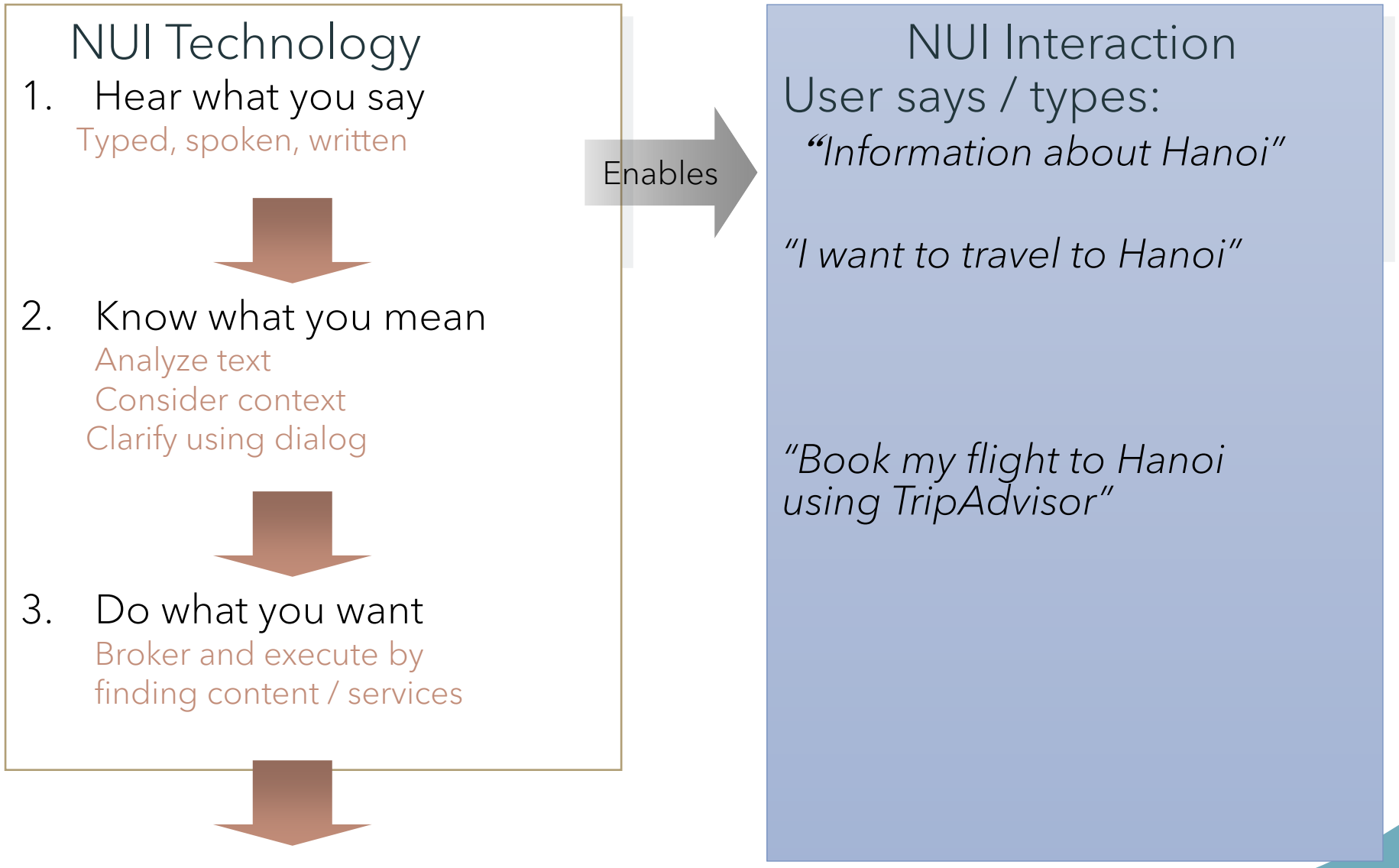
"Information about Hanoi"
"Chicago the city, university or food?"
"City"
"History or travel information?"
"Travel"

"Who knows about traveling to Hanoi?"

Books, magazines, other libraries…

Present choices

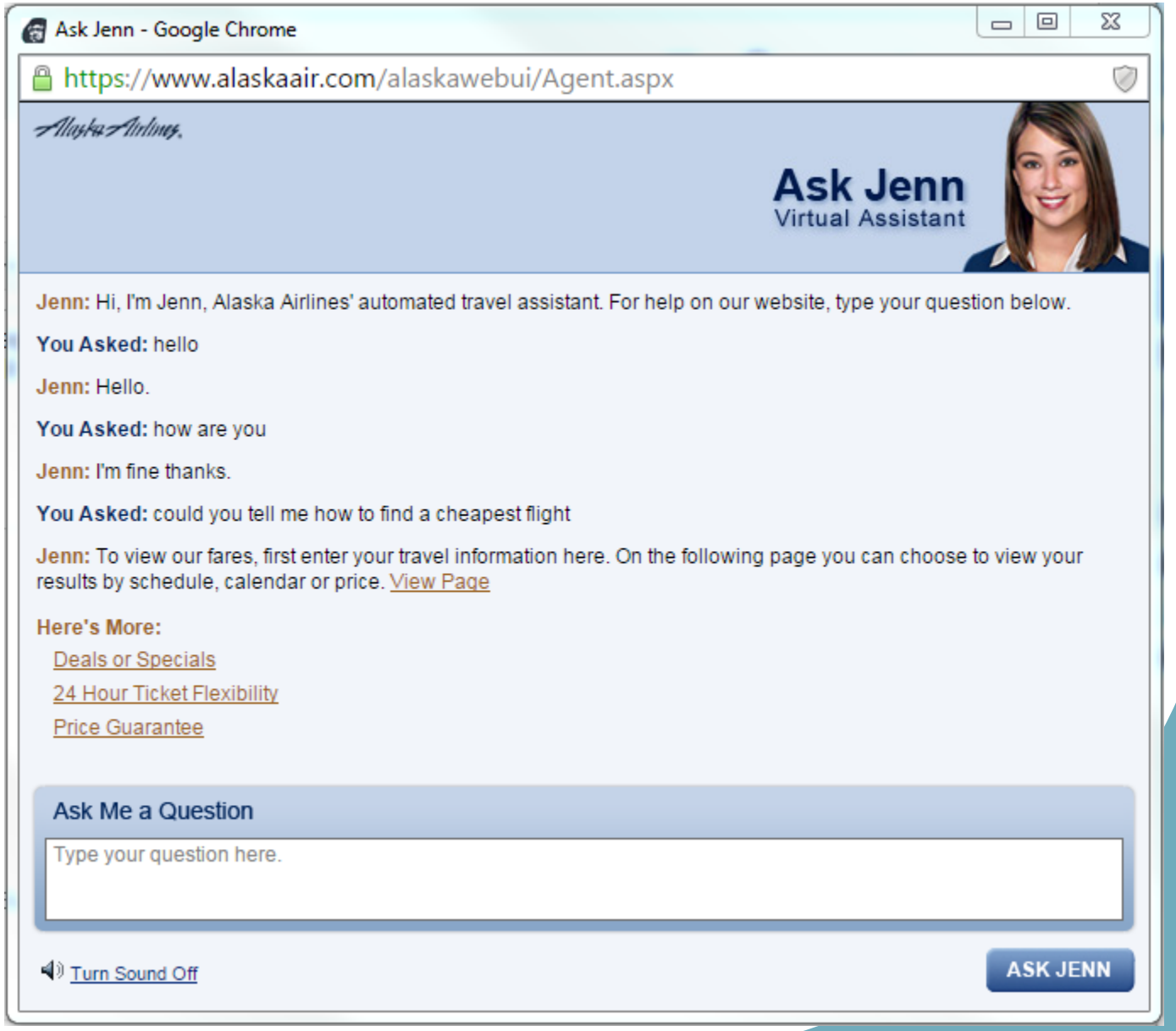
Natural User Interface (NUI)



Alaskaair online assistant

- The use of natural human language in UI to computers.

http://www.alaskaair.com/content/about-us/contact-us/online-help.aspx?lid=footer:contactUs



Motion-based video game

- Nintendo Wii U
- Microsoft's Xbox Kinect
- VR controllers

Reactable

- A multi-touch interface for playing music.
- Performers can simultaneously interact with it by moving and rotating physical objects on its surface.

http://www.reactable.com/products/live/
http://www.reactable.com/products/mobile/

Vodafone's vision of the future

- Young musicians will be able to create music with friends in remote places, all following or creating a musical score together.
- A wraparound screen shows video images of friends and displays the digital score.

http://www.thefwa.com/site/vodafone-future-vision

Rovio robotic webcam

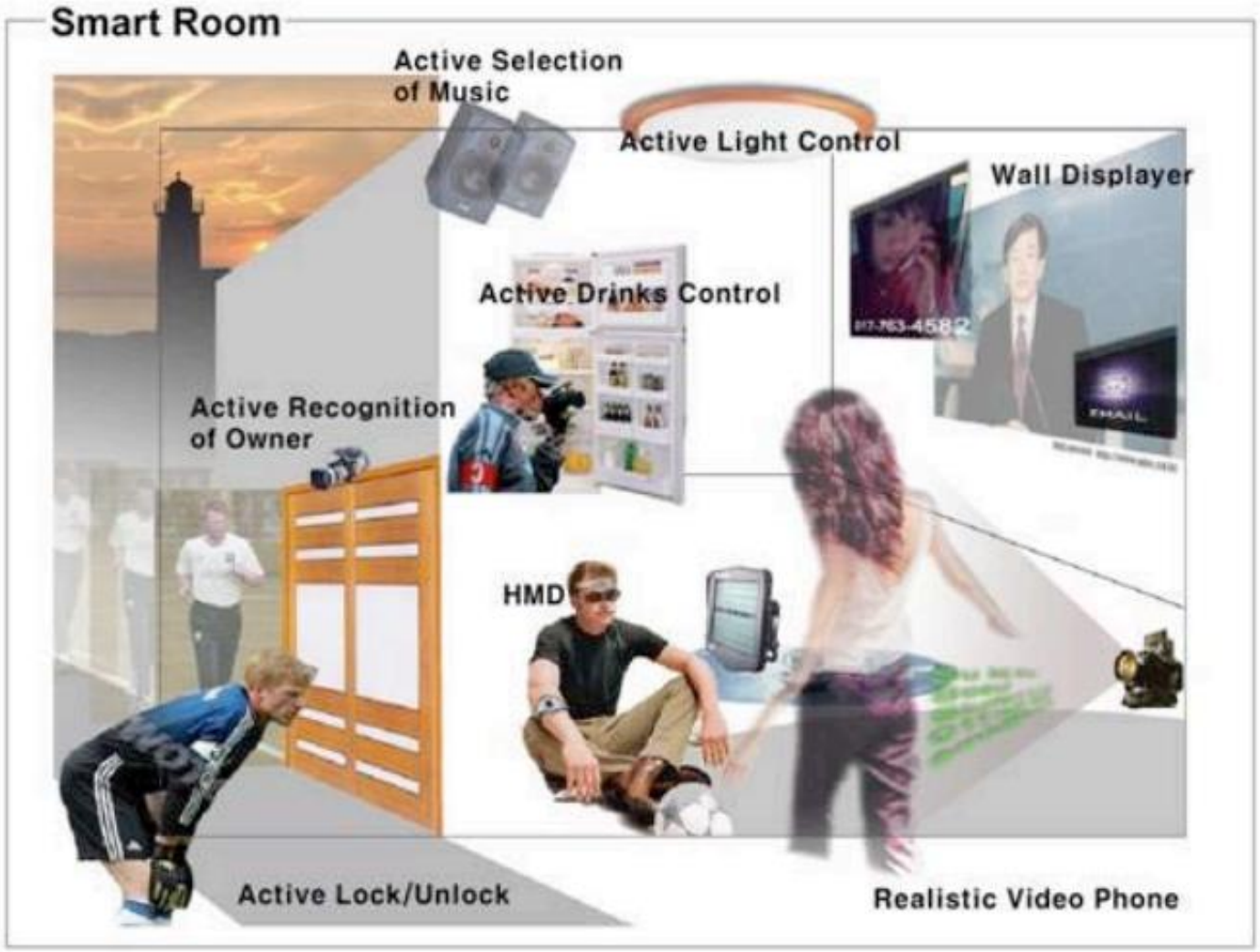
- Wirelessly connected to the Internet. It roams around the home, providing an audio and video link to keep an eye on family or pets when you are out.

http://www.wowwee.com/en/products/tech/telepresence/rovio/rovio

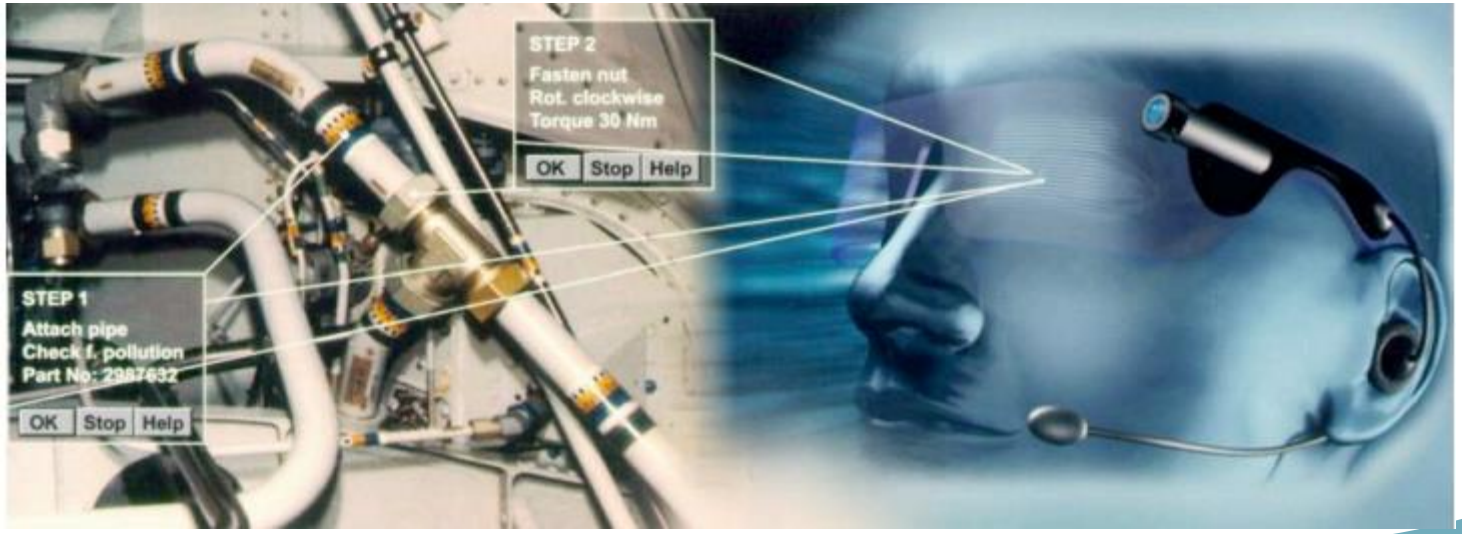
Internet of things: intelligent environment

- "A Thing" connects to Internet and participates with tasks
- Consequence of Ubiquitous / Cloud Computing

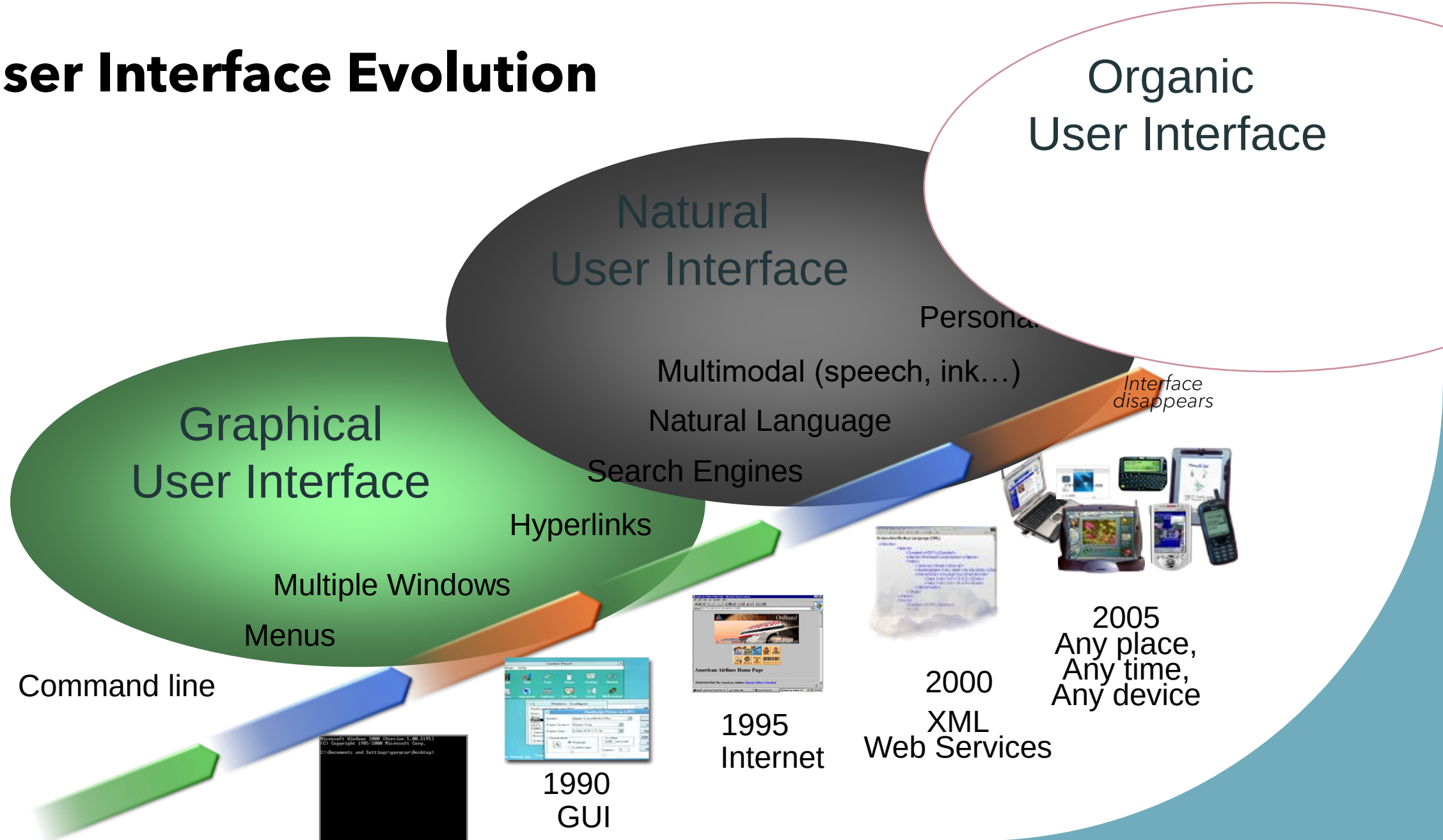
Smart room


Smart Room
Active Selection of Music
Active Light Control
Wall Displayer
Active Drinks Control
Active Recognition of Owner
HMD
Active Lock/Unlock
Realistic Video Phone

Virtual reality: game, repairing, manufacturing



User Interface Evolution



Organic User Interface (OUI)

OUI Technology

- Information is communicated through the everyday objects instead through texts or graphics
- The display shape can be changed upon inputs
- The input and output devices are not separated

Enables

OUI Interaction

User does as usual

- The interaction is likely the natural human physical interaction (e.g. grabbing, folding or other gestures)

Example: Paper Tab

- https://www.youtube.com/watch?v=81iiGWdsJgg

Thank you for your attentions!

Any questions?

References

- References:
  - HCI: Chapter 3, 4
  - ID: Chapter 3
- Textbook
  - HCI: Alan J. Dix, Janet E. Finlay, Gregory D. Abowd, Russell Beale, Janet E. Finley. Human-Computer Interaction, 3rd edition. Prentice Hall, 834 pages, 2004. ISBN: 978-0130461094.
  - ID: Helen Sharp, Yvonne Rogers, Jenn Preece. Interaction Design: Beyon Human-Computer Interaction, 2nd edition. Addison Wesley Publishing Company, 800 pages, 2007. ISBN: 978-0-470-01866-8
  - More book
- and related papers