ISYS2110
Analysis and Design of Web Information Systems

Lecture 8
User Interface Design

Semester 1, 2018
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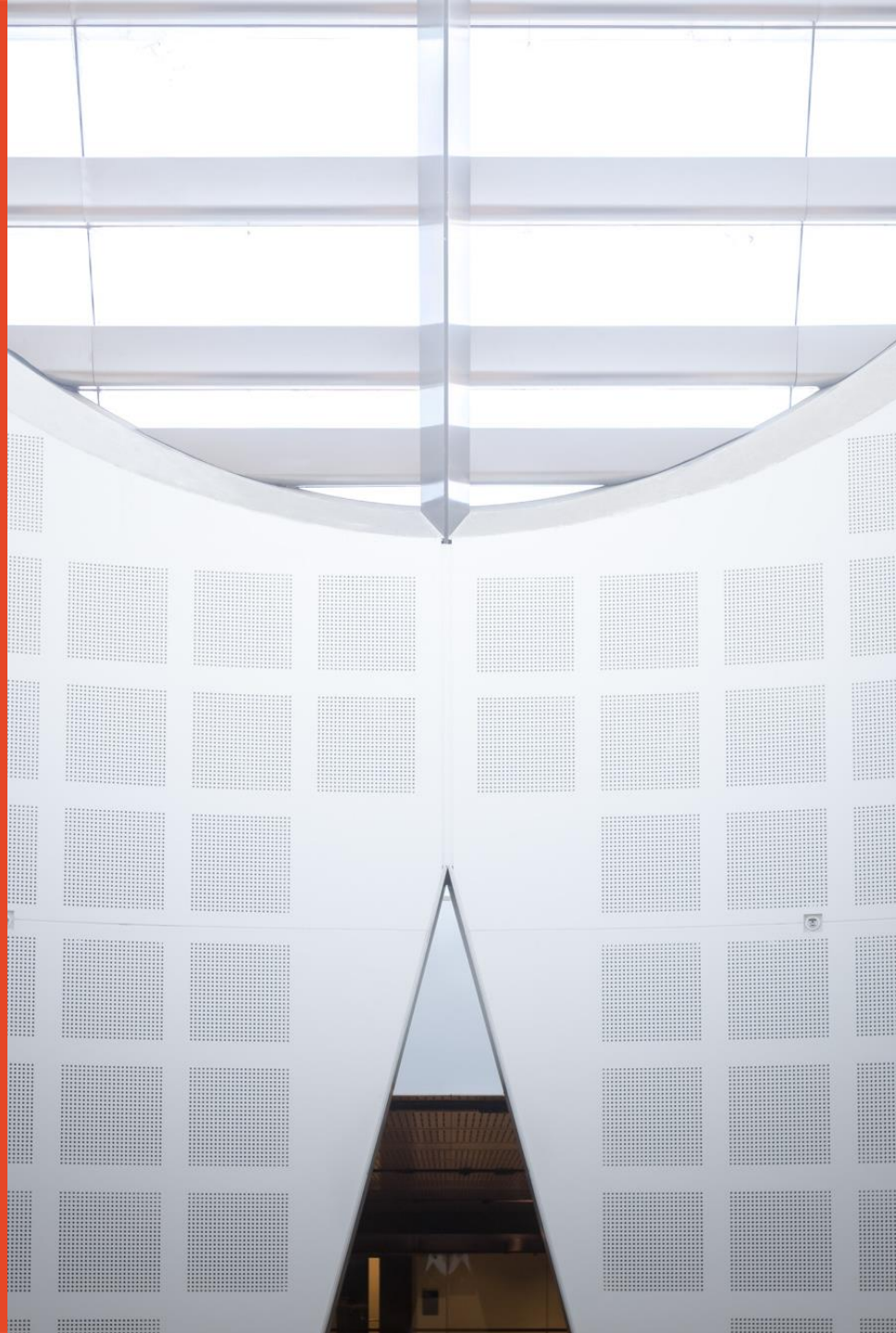


Learning Objectives

- Explain the concept of user interface design and human-computer interaction
- Discuss Habits of Successful Interface Designers

- Explain Guidelines for User Interface Design
- Discuss technology trends
- Discuss challenges of designing for different devices

What is User Interface (UI)?

- The user interface is the part of the system that you can see, hear and feel.
- Describes how users interact with a computer system
- Comprises features that affect two-way communications between the user and the computer
- A physical space that allows human-computer interaction (HCI)

References: Lauesen, Soren. *User interface design: a software engineering perspective*. Pearson Education, 2005.
Image source: Pixabay

User Interface -- Usability

- How well the UI is designed affects the usability of the system.

- **Usability**: the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. (ISO 9241-11)

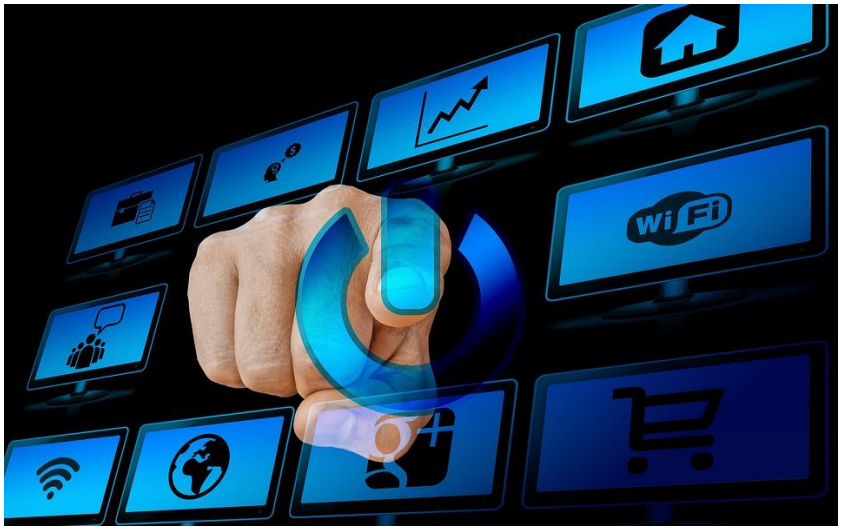


Image source: Wikimedia Commons

User Interface – Interface Types

- **Visual interface: Graphical User Interface (GUI)**
  - graphics, colour, typography, etc.
  - GUI elements: buttons, icons, prompts, display cards, menus, scroll bars, form elements, etc.

- **Auditory interface:** Voice user interface design e.g.

- **Non-traditional interfaces:** e.g. Motion detection. Gestures. Voice recognition etc.

References: Cohen, Michael Harris, James P. Giangola, and Jennifer Balogh. *Voice user interface design*. Addison-Wesley Professional, 2004.
Kortum, Philip. *HCI beyond the GUI: Design for haptic, speech, olfactory, and other nontraditional interfaces*. Elsevier, 2008.

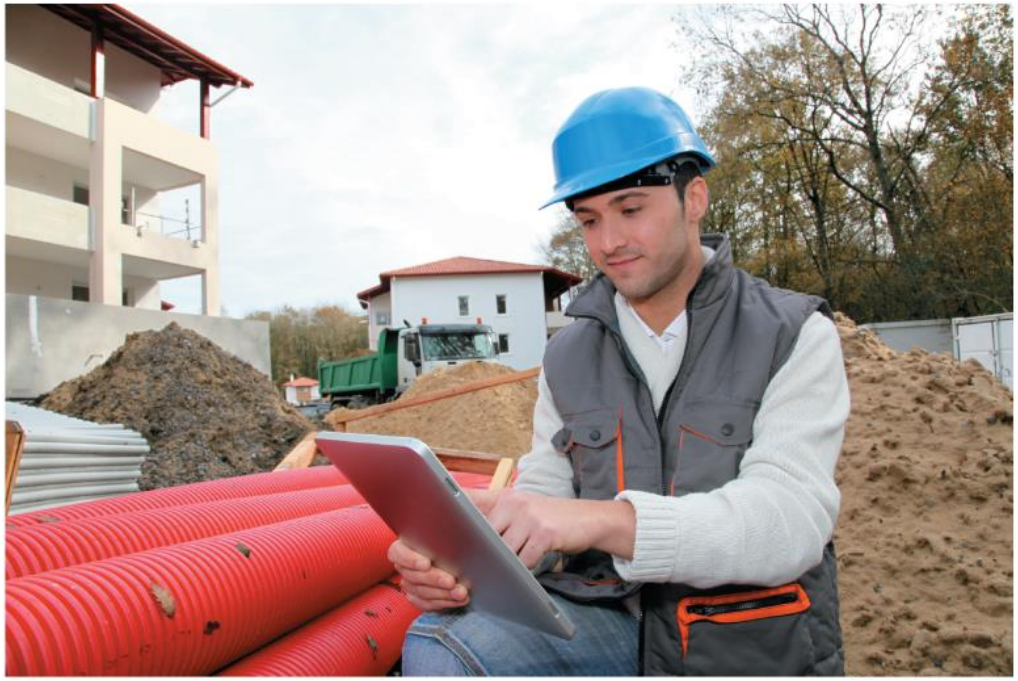
Interaction Design

- Designing interactive products to support the way people communicate in their everyday and working lives.
  - UI design goes hand in hand with interaction design in order to support usability.

References: Rogers, Yvonne, Helen Sharp, and Jenny Preece. *Interaction design: beyond human-computer interaction*. John Wiley & Sons, 2011

Interaction Design

- Depending on the interaction entities, it can be:
  - **Human-Computer Interaction (HCI):** Describes the relationship between computers/technology and people who use it to perform their jobs/tasks, e.g. designing web and mobile apps to support human needs.



References: Rogers, Yvonne, Helen Sharp, and Jenny Preece. *Interaction design: beyond human-computer interaction*. John Wiley & Sons, 2011

Interaction Design

- **Machine to Machine interaction** - e.g. Internet of Things(IOT), embedded computing, peer-to-peer networks and other distributed computing, etc.)

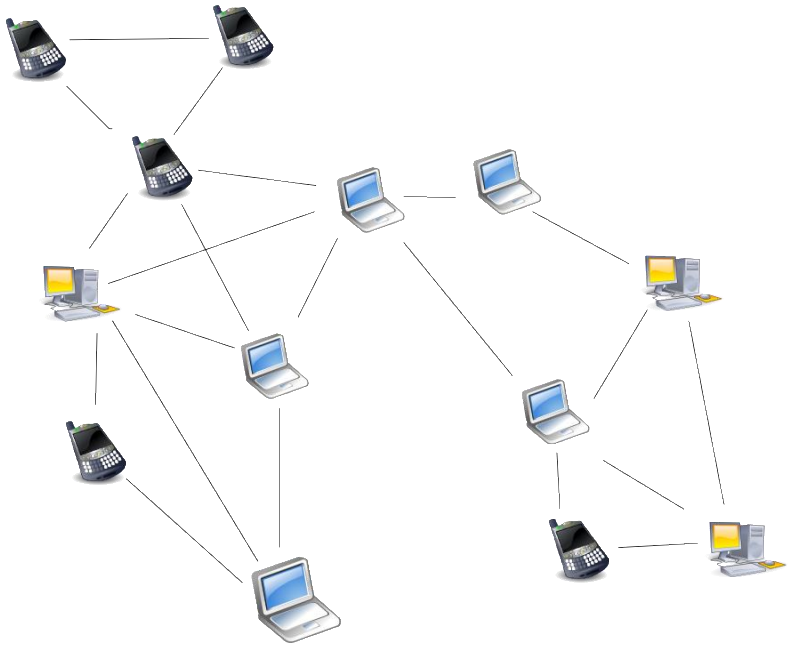


Image source: Wikipedia – Unstructured P2P networks

Interaction Design

- **Human-Robot Interaction** - e.g. Humanoid robots like ASIMO (ASIMO-Wikipedia), robots for aged-care (Sparrow and Sparrow,2006), search and rescue operation robots (Casper and Murphy, 2003), etc.

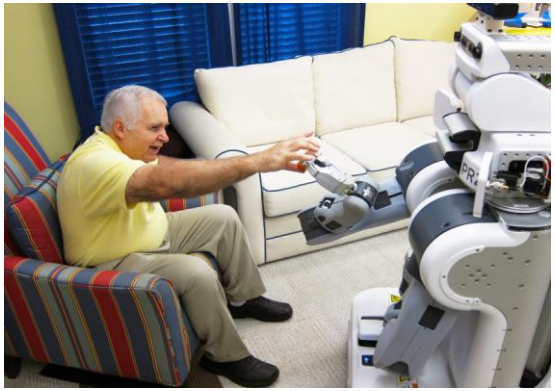


Image source: United States Department of Defens, http://robohub.org/tag/robots-for-eldercare/, https://agmetalminer.com/2011/08/03/automated-mining-moving-away-from-human-workers-to-grab-more-gold/

Interaction Design

- **Animal-Computer Interaction –** Support usability for animals/ other species involved mostly in research, health, rescue and other domains. Emerging field (Mancini, 2017)

Image source: http://www.core77.com/posts/27128/In-Acknowledgement-of-the-Presumed-to-Boom-Animal-Wearables-Market-Here-are-a-Few-Pet-Human-Wearable-Comparisons

Designing for users

- **Human-centred design:** Design should support the user's needs.
  - Empathise with the user
  - This includes designing for different groups of people.

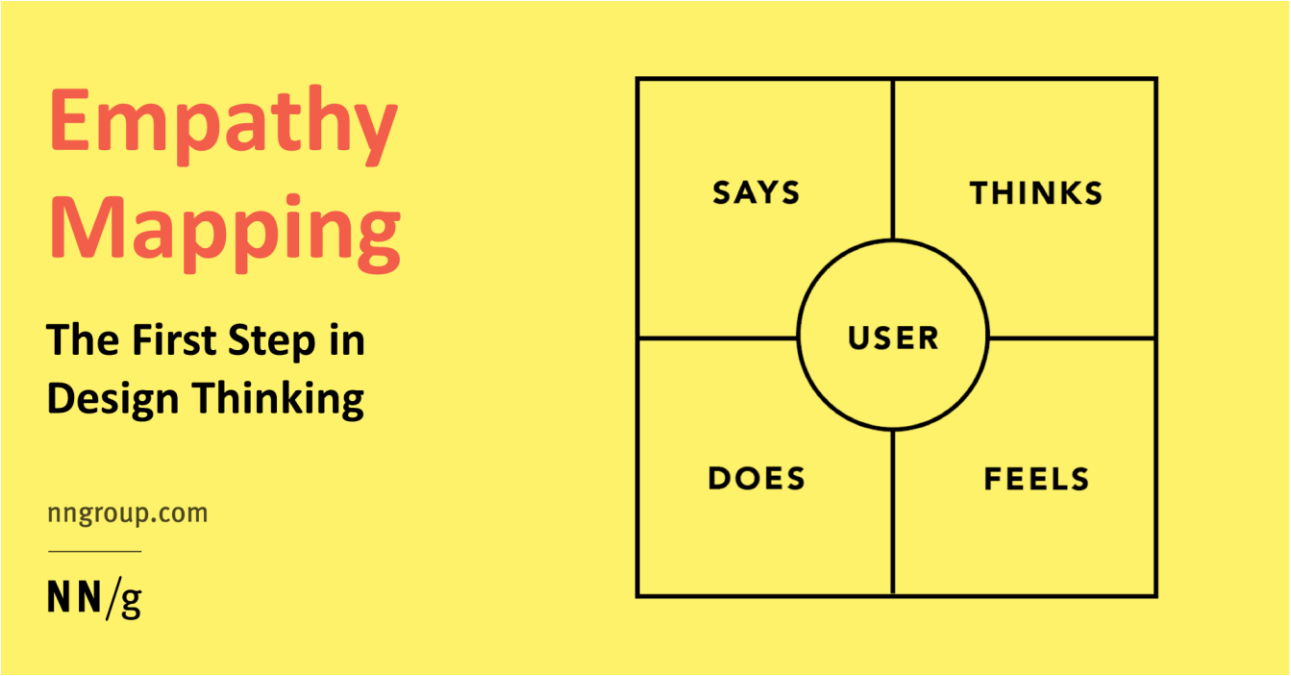


Image source: nngroup.com

Designing for users continued…

- **Design for accessibility:** Support usability for users with reduced abilities e.g. short sighted, colour blind, mental and learning disabilities.
  - *Did you know: Blue is the dominant colour in Facebook UI because Mark Zuckerberg is red-green colour blind.*
- Most platforms have guidelines for supporting usability for reduced abilities.
  - Android accessibility guidelines
  - iOS accessibility guidelines

Reference: https://www.interaction-design.org/literature/article/accessibility-usability-for-all

Designing for users continued…

- **Design for different languages and cultures:** Design for different
  - Languages: Scripts, accents, writing direction, etc.
  - Culture: design for different social protocols, verbal and non-verbal behaviour, etc.
- Most platforms have guidelines for supporting other languages and cultures
  - Apple internationalisation
  - Android languages and cultures

Reference: https://web.njit.edu/~turoff/coursenotes/CIS732/samplepro/user_interface_internationalizat.htm

Habits of Successful Interface Designers

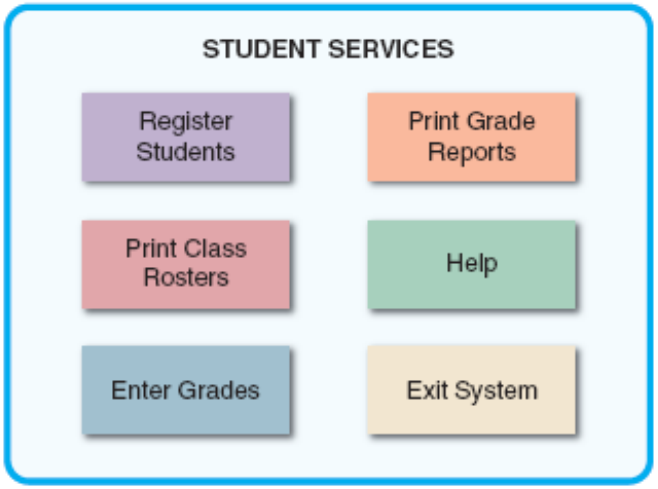
- **Understand the Business**
  - The interface designer must understand:
    - The underlying business functions
    - How the system supports individual, departmental, and enterprise goals
- **Maximize Graphical Effectiveness**
  - A well-designed interface enables rapid learning

- **Think Like a User**
  - The designer must see the system from a user's perspective

Habits of Successful Interface Designers (Cont. 1)

- **Use Models and Prototypes**
  - Designers can present initial screen designs to users in the form of a **storyboard**
    - Users should test the design and provide feedback
- **Focus on Usability**
  - Include main options in the opening screen
  - Offer a reasonable number of choices

  that a user easily can comprehend



The opening screen displays the main options for a student registration system. A user can click an option to see lower-level actions and menu choices.

Habits of Successful Interface Designers (Cont. 2)

- **Invite Feedback**
  - Monitor system usage and solicit user suggestions
  - Determine if system features are being used as intended by observing and surveying users
- **Document Everything**
  - Document all screen designs for later use by programmers
  - User-approved sketches and storyboards can be used to document the user interface

Guidelines for User Interface Design

- **Create an Interface That Is Easy to Learn and Use**
  - Focus on system design objectives
  - Create a design that is easy to understand and remember
  - Provide commands, actions, and system responses that are consistent and predictable
  - Allow users to correct errors easily
  - Clearly label all controls, buttons, and icons

Guidelines for User Interface Design (Cont. 1)

- **Create an Interface That Is Easy to Learn and Use (Cont.)**
  - Select familiar images that users can understand
    - Provide on-screen instructions that are logical, concise, and clear
  - Show all commands in a list of menu items
    - Dim any commands that are not available to the user
  - Make it easy to navigate or return to any level in the menu structure

Guidelines for User Interface Design (Cont. 2)

- **Enhance User Productivity**
  - Organize tasks, commands, and functions in groups that resemble actual business operations
  - Create alphabetical menu lists or place the selections used frequently at the top of the menu list
  - Provide shortcuts for experienced users
  - Use default values if the majority of values in a field are the same
  - Use a duplicate value function, but allow users to turn this feature on or off as they prefer

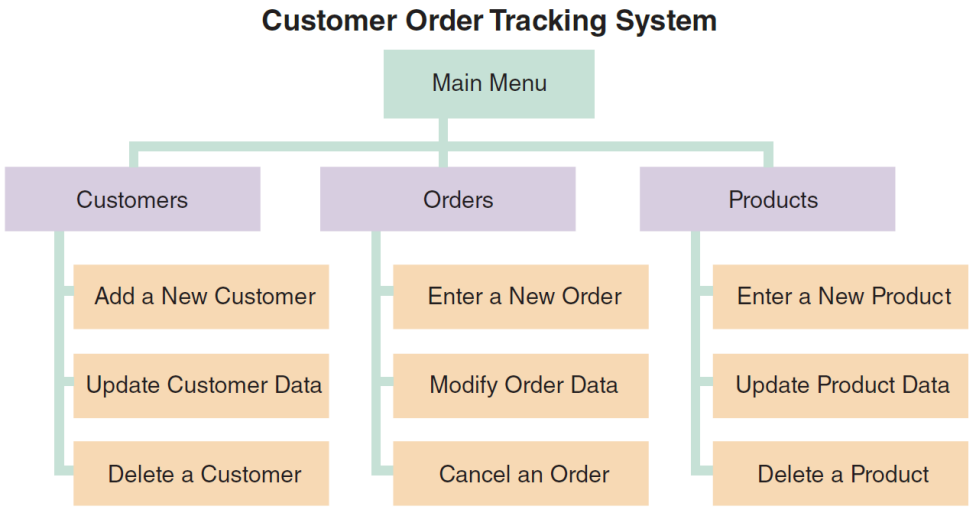
Guidelines for User Interface Design (Cont. 3)

- **Enhance User Productivity (Cont.)**
  - Provide a fast-find feature
  - If available, consider a **natural language** feature that allows users to type commands or requests in normal text phrases
- **Provide Users with Help and Feedback**
  - Ensure that help is always available on demand
  - Provide user-selected help and context-sensitive help
  - Provide a direct route for users to return to the point from where help was requested
  - Include contact information

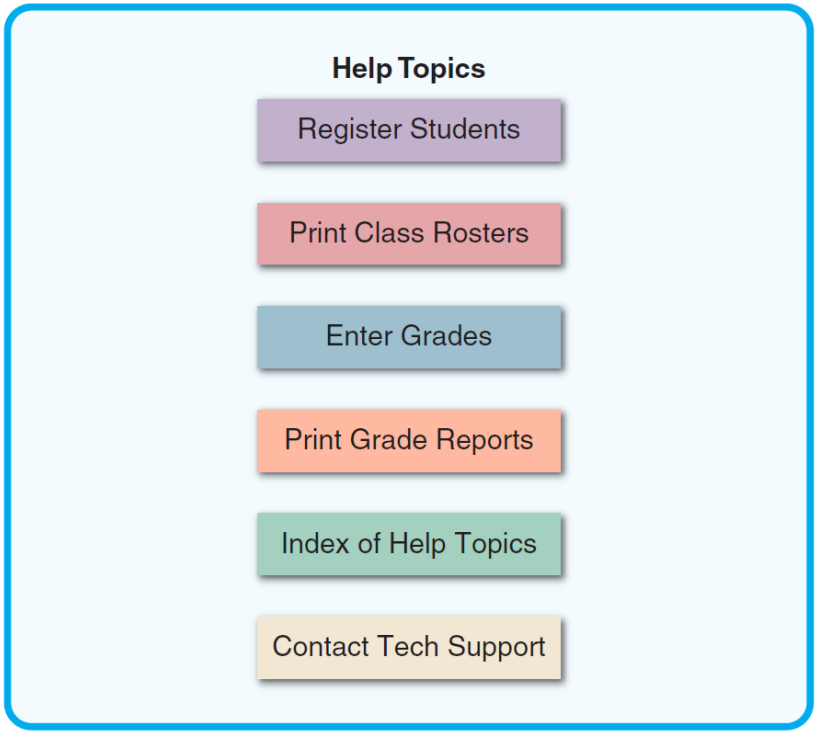
Guidelines for User Interface Design (Cont. 4)

- **Provide Users with Help and Feedback (Cont.)**
  - Require user confirmation before data deletion
  - Provide an "Undo" key
  - When a user-entered command contains an error, highlight the erroneous part
  - Use hypertext links to assist users
  - Display messages at a logical place on the screen
  - Alert users to lengthy processing times or delays
  - Allow messages to remain on the screen long enough for users to read them
  - Let the user know whether the task or operation was successful or not

Guidelines for User Interface Design (Cont. 5)



This menu hierarchy shows tasks, commands, and functions organized into logical groups and sequences. The structure resembles a functional decomposition diagram (FDD), which is a model of business functions and processes.



The main Help screen for a student registration system.

Guidelines for User Interface Design (Cont. 6)

- **Provide Users with Help and Feedback (Cont.)**
  - Provide a text explanation for an icon or image on a control button
  - Use messages that are specific, understandable, and professional
- **Create an Attractive Layout and Design**
  - Use appropriate colors to highlight different areas of the screen
  - Use special effects sparingly
  - Use hyperlinks that allow users to navigate to related topics
  - Group related objects and information

Guidelines for User Interface Design (Cont. 7)

- **Create an Attractive Layout and Design (Cont.)**
  - Display titles, messages, and instructions in a consistent manner
  - Ensure that commands and similar mouse actions will have the same effect
  - Require the user to confirm the entry by pressing Enter or Tab
  - Remember that users are accustomed to a pattern of red = stop, yellow = caution, and green = go
  - Provide a keystroke alternative for each menu command
  - Avoid complex terms and technical jargon

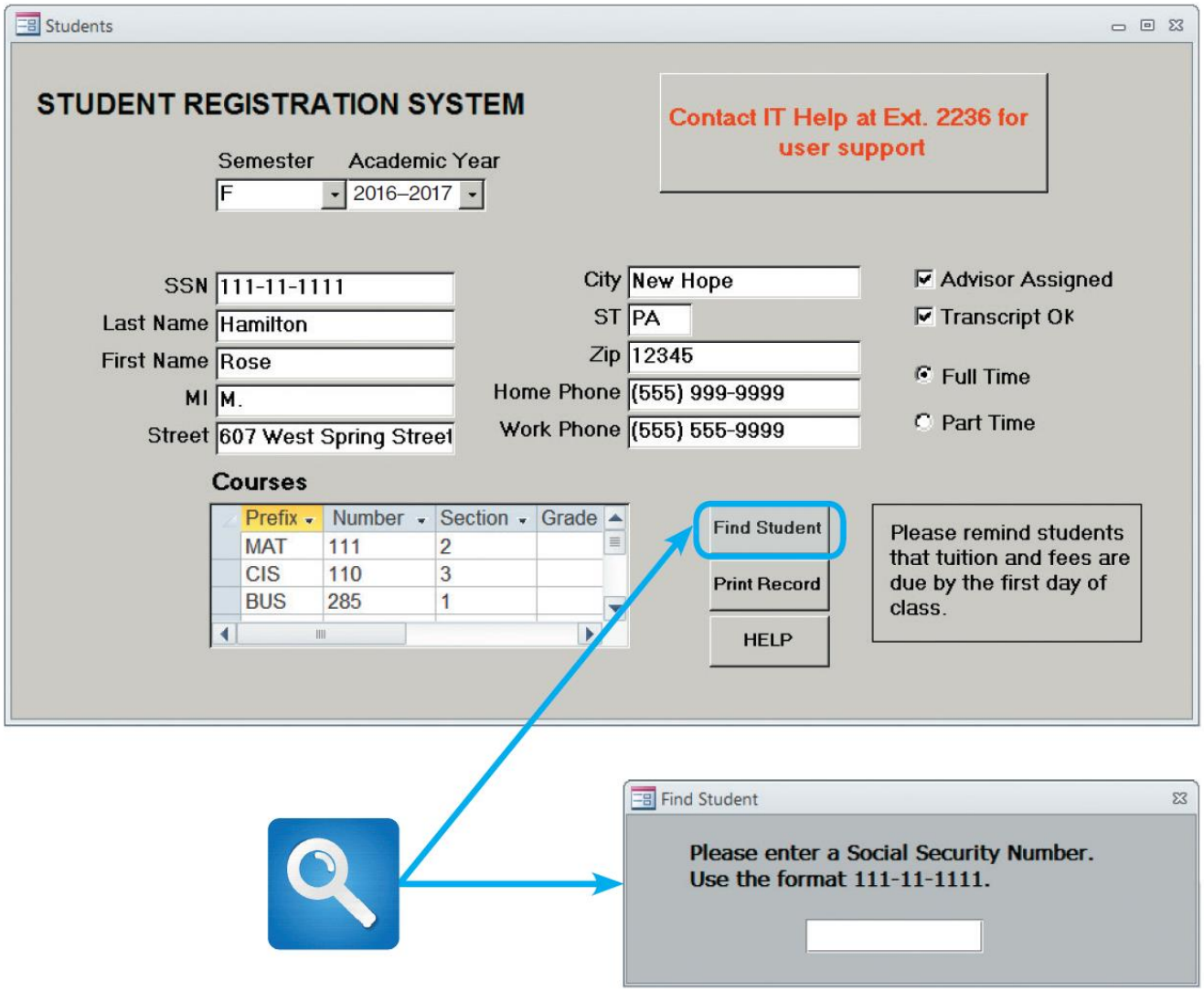
Guidelines for User Interface Design (Cont. 8)

- **Enhance the Interface**
  - Opening screen is important as it introduces the application
    - The starting point can be a **switchboard** with well-placed command buttons for navigation
  - Use a **command button** to initiate an action
  - Try to create customized **menu bars** and toolbars
  - Add a shortcut feature that lets a user select a **menu command**
  - If variable input data is needed, provide a **dialog box** that explains what is required

Guidelines for User Interface Design (Cont. 9)

- **Enhance the Interface (Cont.)**
  - A **toggle button** makes it easy to show on or off status
  - Use **list boxes** that display the available choices
  - Use an **option button**, or a **radio button**, to control user choices
  - If **check boxes** are used to select one or more choices from a group, show the choices with a checkmark or an X
  - When dates must be entered, use a **calendar control**

Guidelines for User Interface Design (Cont. 10)



A data entry screen for the student registration system. This screen uses several design features that are described in the text. When a user clicks the Find Student command button, a dialog box is displayed with instructions.

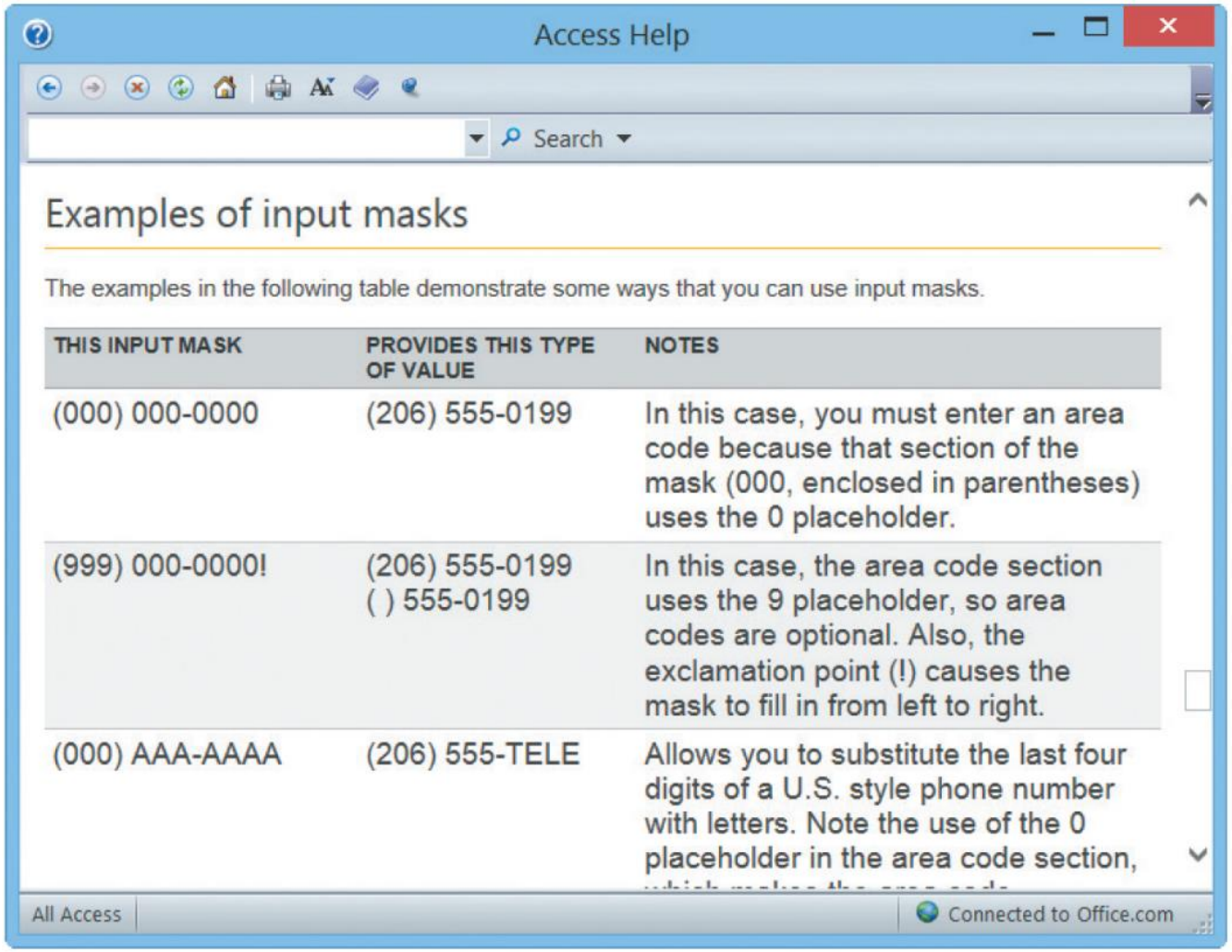
Guidelines for User Interface Design (Cont. 11)

- **Focus on Data Entry Screens**
  - Use the **form filling** method whenever possible
  - Restrict user access to screen locations where data is entered
  - Provide a way to leave the data entry screen at any time without entering the current record
  - Provide a descriptive caption for every field
  - Provide a means for users to move among fields on the form in a standard order or in any order they choose
  - Allow users to add, change, delete, and view records

Guidelines for User Interface Design (Cont. 12)

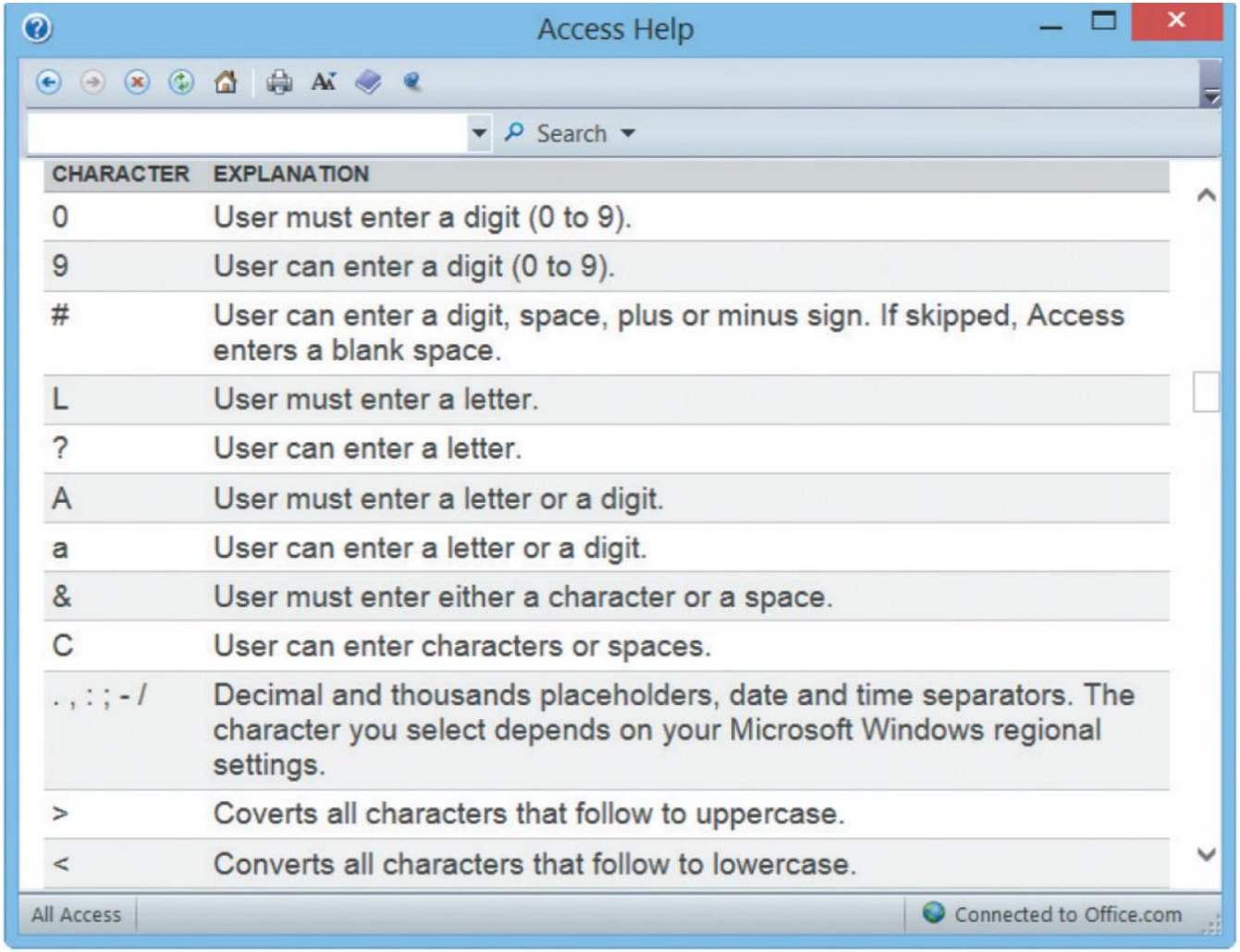
- **Focus on Data Entry Screens (Cont.)**
  - Design the screen form layout to match the layout of the source document
  - Display a sample format like MMDDYY and use an **input mask**
  - Require an ending stroke for every field
  - Do not require users to type leading zeros for numeric fields or trailing zeros for decimals
  - Display default values
  - Provide users with an opportunity to confirm the accuracy of input data before displaying it

Guidelines for User Interface Design (Cont. 13)



Microsoft Access provides various input masks for dates, phone numbers, and postal codes, among others. In addition, it is easy to create a custom mask using the characters shown here.

Guidelines for User Interface Design (Cont. 13)



CHARACTER	EXPLANATION
0	User must enter a digit (0 to 9).
9	User can enter a digit (0 to 9).
#	User can enter a digit, space, plus or minus sign. If skipped, Access enters a blank space.
L	User must enter a letter.
?	User can enter a letter.
A	User must enter a letter or a digit.
a	User can enter a letter or a digit.
&	User must enter either a character or a space.
C	User can enter characters or spaces.
. , : ; - /	Decimal and thousands placeholders, date and time separators. The character you select depends on your Microsoft Windows regional settings.
>	Coverts all characters that follow to uppercase.
<	Converts all characters that follow to lowercase.

Microsoft Access provides various input masks for dates, phone numbers, and postal codes, among others. In addition, it is easy to create a custom mask using the characters shown here.

Guidelines for User Interface Design (Cont. 14)

- **Focus on Data Entry Screens (Cont.)**
  - Use a default value when a field value will be constant for successive records or throughout the data entry session

- **Use Validation Rules**
  - **Sequence check:** Used when the data must be in some predetermined sequence
  - **Existence check:** Applies to mandatory data items
  - **Data type check:** Tests to ensure that a data item fits the required data type
  - **Range check:** Used to verify that data items fall between a specified minimum and maximum value

Guidelines for User Interface Design (Cont. 15)

- **Use Validation Rules (Cont.)**
  - **Reasonableness check:** Identifies values that are questionable, but not necessarily wrong
  - **Validity check:** Used for data items that must have certain values
  - **Combination check:** Performed on two or more fields to ensure that they are consistent or reasonable when considered together
  - **Batch controls:** Totals used to verify batch input

Guidelines for User Interface Design (Cont. 17)

- **Reduce Input Volume**
  - Input necessary data only
  - Do not input data that the user can retrieve from system files or calculate from other data
  - Do not input constant data
  - Use codes as they are shorter than the data they represent

Class Exercise 1 – User Interface Design

- A retail company in Sydney is working on an online system to manage its growing business. The company asked you to help design the user interface.

- Design a data entry screen for entering new members.

- 2-5 Students should work together to complete the task.
- You have 10-15 minutes !

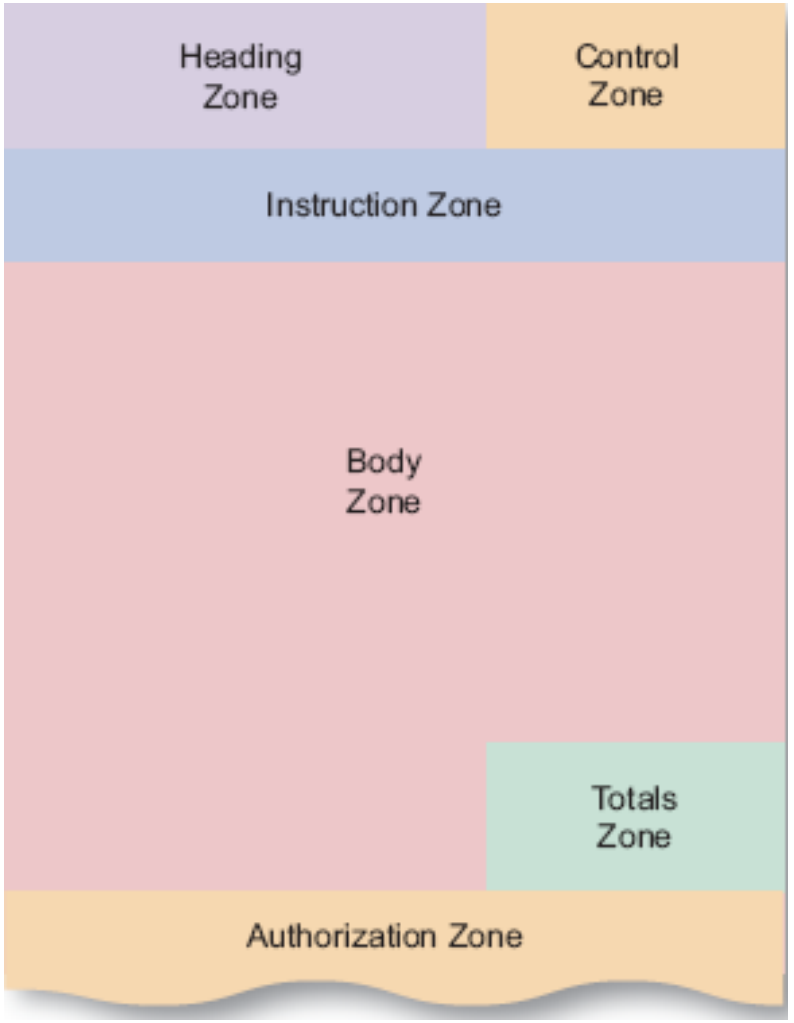
Source Document and Form Design

- **Garbage in, garbage out (GIGO)**: Quality of the output depends on the quality of the input
- **Source document**: Collects input data, triggers an input action, and provides a record of the original transaction

- A good **form layout** makes the form easy to complete and provides enough space
  - Information should flow on a form from left to right and top to bottom

Source Document and Form Design (Cont.)

- Order and placement of printed fields should be logical
- Totals should be identified clearly



Source document zones.

Technology Issues

INPUT TECHNOLOGY		
Traditional	**Evolving**	**Emerging**
Keyboard	Body motion detection	Brain-Computer Interface (BCI)
Mouse	Advanced voice recognition	Neural networks
Pointing devices	Biological feedback	Artificial intelligence (AI)
Microphone	Embedded magnetic data	Advanced motion sensors
OCR (optical character recognition)	RFID	Two-way satellite interface
MICR (magnetic ink character recognition)	Advanced optical recognition	Virtual environments
Graphic input devices	Physical adaptation devices	3-D technology

Input devices can be very traditional, or based on the latest technology.

Technology Trends

- technology is rapidly evolving and with the most disruptive potential, following are few examples:
  - *Artificial Intelligence (AI)*
  - *Virtual and Augmented Reality (VR & AR)*
  - *Voice Interaction technology*
  - *Self Driving Cars*

Reference:

Technology Trends: AI

- Dictionary definitions focus on AI being a sub-field of computer science.

  "How machines can imitate human intelligence (being human-like rather than becoming human). "
- Build systems that think exactly like humans do ("strong AI")
- Just get systems to work without figuring out how human reasoning works ("weak AI")
- Use human reasoning as a model but not necessarily the end goal

https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/#4040d8dc4f5d
Image source: Adobe Stock

Technology Trends: VR

- Immersive experience that provides the opportunity to be digitally transported to a different, place, time or environment.
- Comprised of 360 video or rendered content (like video game).
- physical objects/controllers that influence the digital experience

https://www.slideshare.net/digiday/the-different-between-virtual-reality-and-augmented-reality-digiday-wtf-vr-may-11th-2016?qid=d18c27b9-7597-4838-9225-481a10a0d310&v=&b=&from_search=1
Image source: roadtovr

Technology Trends: AR

- Immersive experience that provide the opportunity for digital content, images, 3D models, etc. to render themselves on top / in and around your real, physical space.
- Is generally comprised of rendered content, but video concepts look promising.
- Content in context to one's environment, task, activity.

https://www.slideshare.net/digiday/the-different-between-virtual-reality-and-augmented-reality-digiday-wtf-vr-may-11th-2016?qid=d18c27b9-7597-4838-9225-481a10a0d310&v=&b=&from_search=1
Image source: Realitytechnologies

Technology Trends: Voice Interaction Technology

- Voice as an interface is fast becoming a major piece of the digital ecosystem.
- Takes advantage of advances in AI, speech recognition and Natural language processing
- Amazon's Alexa, Google Home, Apple's Siri, Microsoft's Cortana etc.
- Warnings:
  - Alignment of values
  - Transparency.
  - Authenticity.

https://www.iotforall.com/future-ai-voice-technology/
Image source: xtendiot

Technology trends: Self-Driving Cars

- **Autonomous vehicle:** A driverless vehicle capable of capable of sensing its environment and navigating without human input.
- **Objectives:** Navigate to a given destination based on passenger-provided instructions
- Avoid environmental obstacle
- Safely avoid other vehicles
- Obey the laws of the road
- Ethical challenges

https://en.wikipedia.org/wiki/Autonomous_car
Image source: independent.co.uk

Technology trends: Self-Driving Cars

- What happened to Uber Self-Driving Car?

Challenges of designing for different devices

- Computers and software have come a long way since the first digital computers

- **Desktop Applications** (operating system specific and strict hardware requirements)
- **Web Applications** (client-server model, wide storage and processing resources, interactive, media-rich interfaces)
- **Mobile Applications** (limited storage, processing and battery)

- User interactions differ across these technologies.

Reference: https://www.seguetech.com/desktop-vs-web-applications/

Challenges of designing …

- Interface design guidelines for developers and designers, there are device and platform specific interface design guidelines are available.
  - Microsoft guidelines for desktop applications
  - Human interface guidelines for IPhone
  - Web applications design guidelines

Challenges of designing …

- Mobile: design challenges
  - Slow and Error-Prone Typing
  - Less Context
  - Inaccurate Clicks
  - Poor Connectivity
  - Slow Hardware
  - Less Storage Capacity

Reference: https://baymard.com/blog/mobile-design-limitations
Image Source: Adobe

Tools and Techniques

- Some commonly used methods used in the design process are:
- **User research**- To find out the needs of the users to create new systems or improve existing systems. Some common techniques include
  - ethnography
  - user analytics
  - usability testing and evaluation (A/B testing)
  - interviews, etc.

- **Usability heuristics:** Heuristics used to evaluate the UI and interaction design.

Reference:

Tools and techniques

- **Prototyping**: A model or representation of the system. Can range from low to high level functionality.
  - **Low-fidelity prototype** - Mostly includes 2D mock-ups of the system to portray the size, position and orientation of features as well as the overall layout . Low technical skills required. No functionality. Usually uses **wireframes** – Skeletal layout of the screen.
  - **Medium-fidelity prototype** - Has the visual look and feel, portrays most of the interactions between the user and the system. No to very little functionality.
  - **High-fidelity prototype** - Full or some functionality. Needs a full understanding of technical skills like coding.

Class Quiz

- (Q1) What restricts data entry and prevents errors?

Class Exercise 2 – User Interface Design

- It will take approximately 30 minutes
- 2-5 Students should work together to complete the task.

Lecture Summary

- User Interface comprises features that affect two-way communications between the user and the computer

- User interface design must be based on the perspective of the user