SINGAPORE UNIVERSITY OF
TECHNOLOGY AND DESIGN

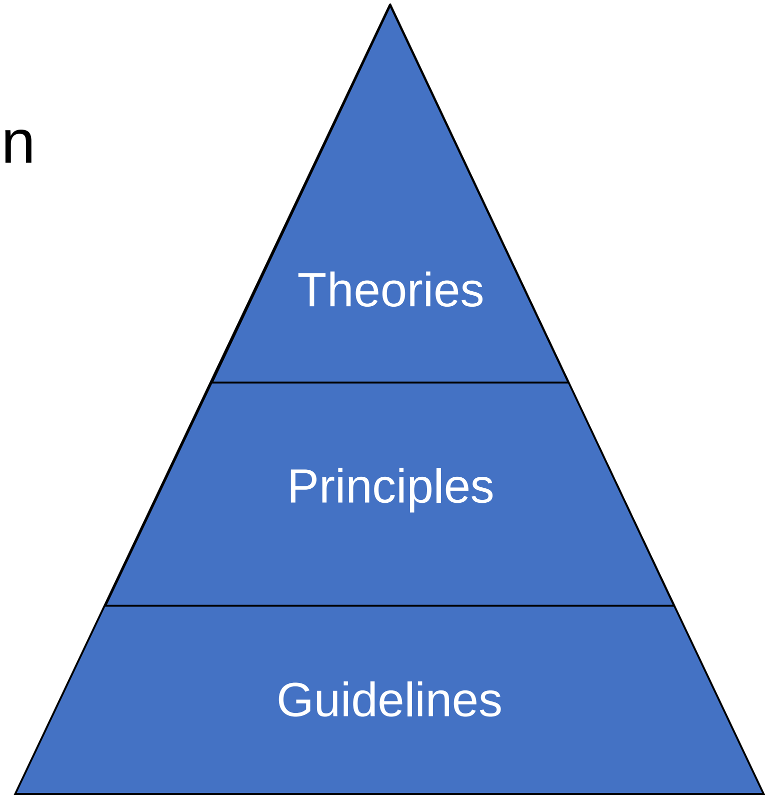
User Interface Design & Implementation

UI Design Principles

Week 2 – Lecture 3

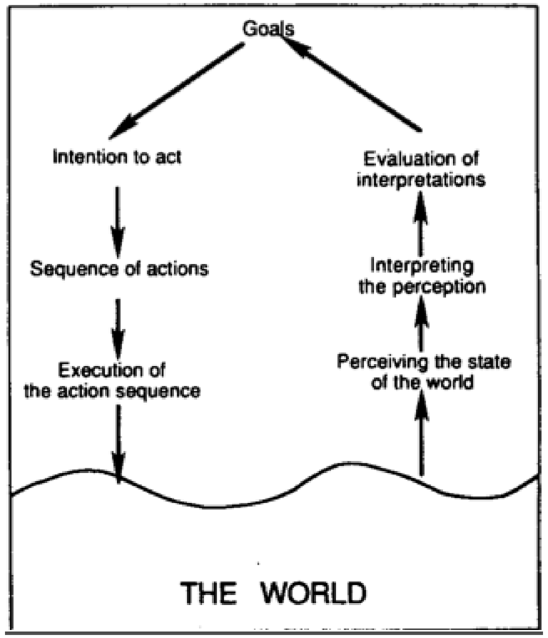
Theories, Principles, and Guidelines

- Theories and models
  - Frameworks to structure and explain UI design
  - Supports thinking and communication about UI design
  - Provide predictions to compare and guide UI design
- Principles
  - Strategies or rules
  - Influence the design of the UI
  - Analyse and compare design alternatives
- Guidelines
  - Specific and practical
  - Focused advice about good practices
  - Prescribe cures for design problems
  - Provide helpful reminders based on accumulated experience

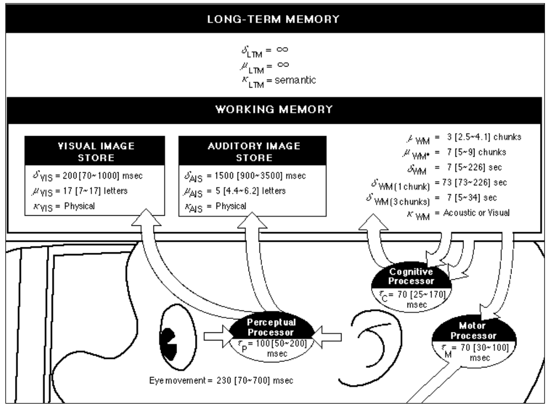


Theories and Models

- Explanatory – what, why, how
  - Norman’s seven stages of action
  - Provide a framework for thinking about user interaction
  - Help researchers/designers understand how people interact with dynamic systems
  - Help researchers/designers observe and describe user activities and behaviors


Goals
Intention to act
Sequence of actions
Execution of the action sequence
Evaluation of interpretations
Interpreting the perception
Perceiving the state of the world
THE WORLD

- Predictive – controlled variables, statistics
  - MHP – Model Human Processor
  - KLM – Keystroke-Level Model
  - Give approximations of user behaviors before real users are brought into the testing environment


LONG-TERM MEMORY
$\delta_{LTM} = \infty$
$\mu_{LTM} = \infty$
κ_{LTM} = semantic
WORKING MEMORY
VISUAL IMAGE STORE
δ_{VIS} = 200 [70~1000] msec
μ_{VIS} = 17 [7~17] letters
κ_{VIS} = Physical
AUDITORY IMAGE STORE
δ_{AIS} = 1500 [900~3500] msec
μ_{AIS} = 5 [4.4~6.2] letters
κ_{AIS} = Physical
μ_{WM} = 3 [2.5~4.1] chunks
μ_{WM^*} = 7 [5~9] chunks
δ_{WM} = 7 [5~226] sec
$\delta_{WM (1 chunk)}$ = 73 [73~226] sec
$\delta_{WM (3 chunks)}$ = 7 [5~34] sec
κ_{WM} = Acoustic or Visual
Cognitive Processor
τ_C = 70 [25~170] msec
Perceptual Processor
τ_P = 100 [50~200] msec
Motor Processor
τ_M = 70 [30~100] msec
Eye movement = 230 [70~700] msec

Principles

- More actionable strategies and rules for UI design compared to Theories and Models

- More fundamental, widely applicable, and enduring compared to Guidelines

- Examples of principles of UI design
  - Four principles of good design
  - Determine and design for user's skill levels
  - Identify user tasks
  - Five primary interaction styles
  - Prevent errors
  - Eight golden rules of interface design
  - Ten usability heuristics

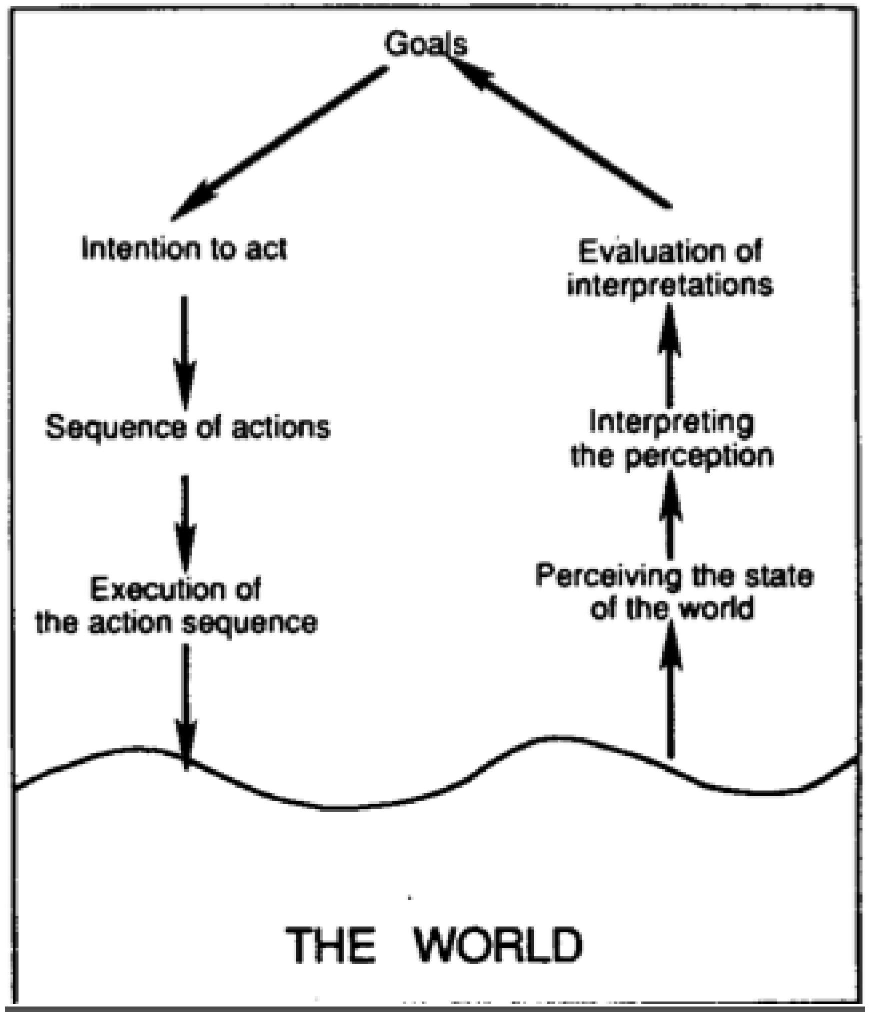
Four principles of good design *by Don Norman*

1. System state and action alternatives should be visible

2. A good conceptual model with a consistent system image

3. Interface should include good mappings that reveal the relationships between stages

4. User should receive continuous feedback



Goals
Intention to act
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THE WORLD

User skill levels

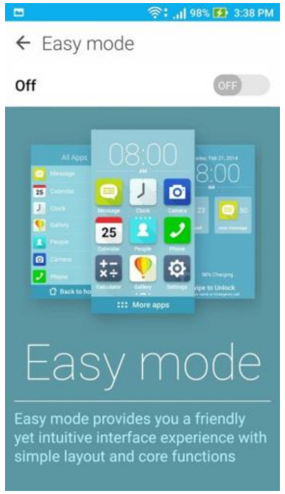
- Designers’ and developers’ prior knowledge and implicit assumptions about the user get in the way of good UI design

- UI mantras
  - “the user is not like me”
  - “know thy user”

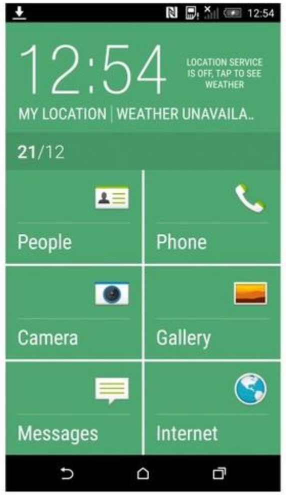
- Profiles of user groups
  - Age and gender
  - Physical and cognitive abilities
  - Education, training and cultural background
  - Motivation, goals and personality

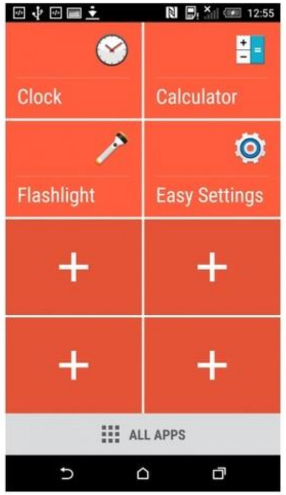
Determine and design for user’s skill levels

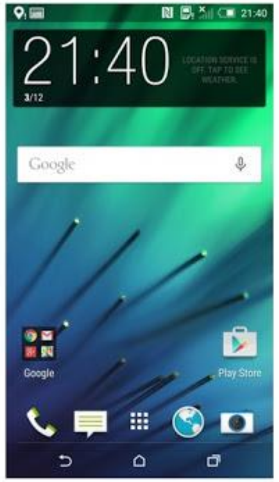
- Novice or first-time users
  - Small number of objects and actions
  - Instructions and quick-start demonstrations
  - Good error messages
- Knowledgeable intermittent users
  - Consistency and grouping of objects and actions
  - Reversal of actions (undo); recovery from errors to encourage exploration and learning
- Expert frequent users
  - Fast and accurate (low error) interaction
  - Brief feedback
  - Repeat actions (redo), shortcuts and macros
- Multi-layer designs
  - Support users at their initial skill level
  - Transit users as they increase their skill level

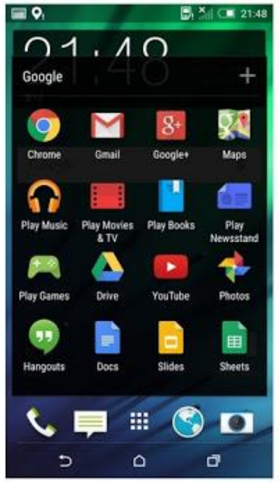


Easy mode provides you a friendly yet intuitive interface experience with simple layout and core functions


12:54
LOCATION SERVICE IS OFF, TAP TO SEE WEATHER
MY LOCATION | WEATHER UNAVAILA..
21/12
People
Phone
Camera
Gallery
Messages
Internet





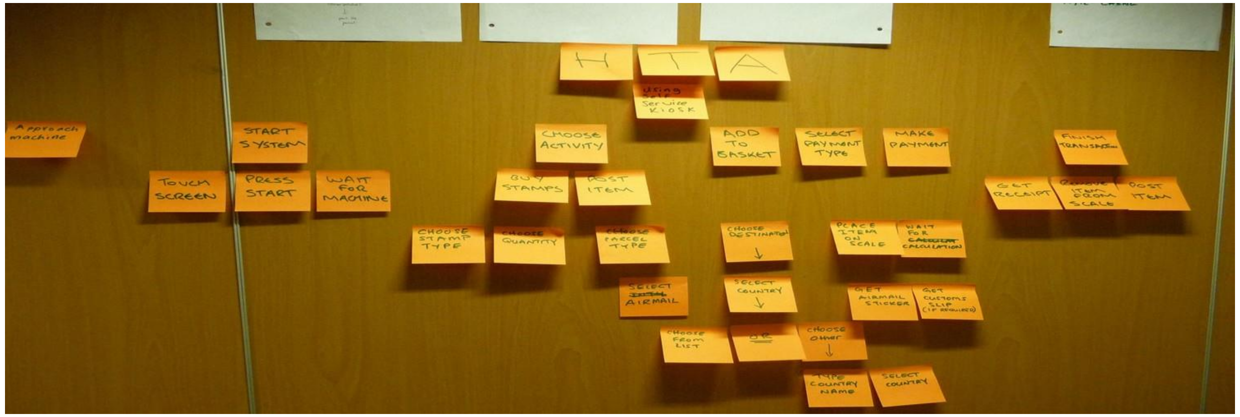


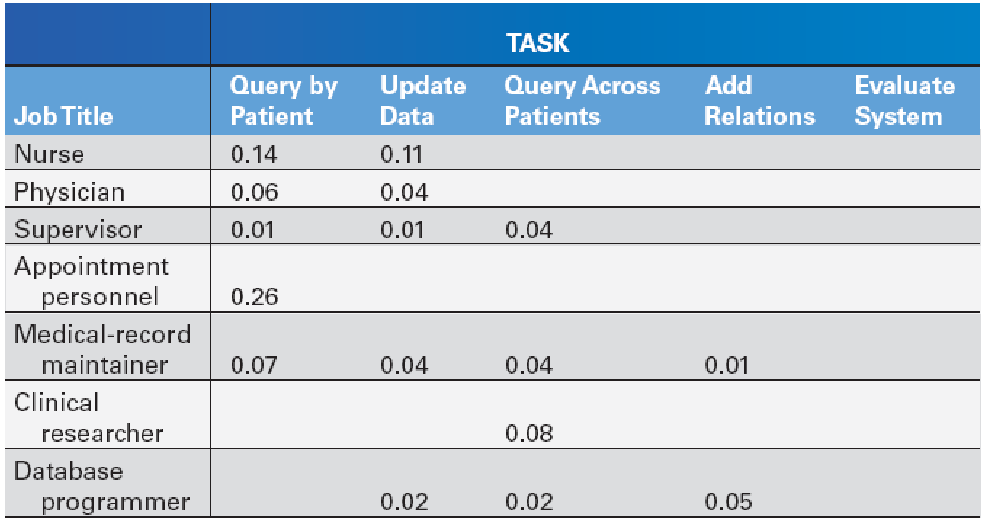
Identify user tasks

- Task analysis is difficult
  - Review of documents
    - Training manuals
    - Operation manuals
  - Long hours observing users
    - What users actually do
  - Skillful interviewing of users
    - Why users do what they did?

- Decomposition of high level tasks
  - Prioritize on critical tasks
  - Prioritize on bottleneck tasks

- Relative task frequencies
  - Prioritize on high frequency tasks

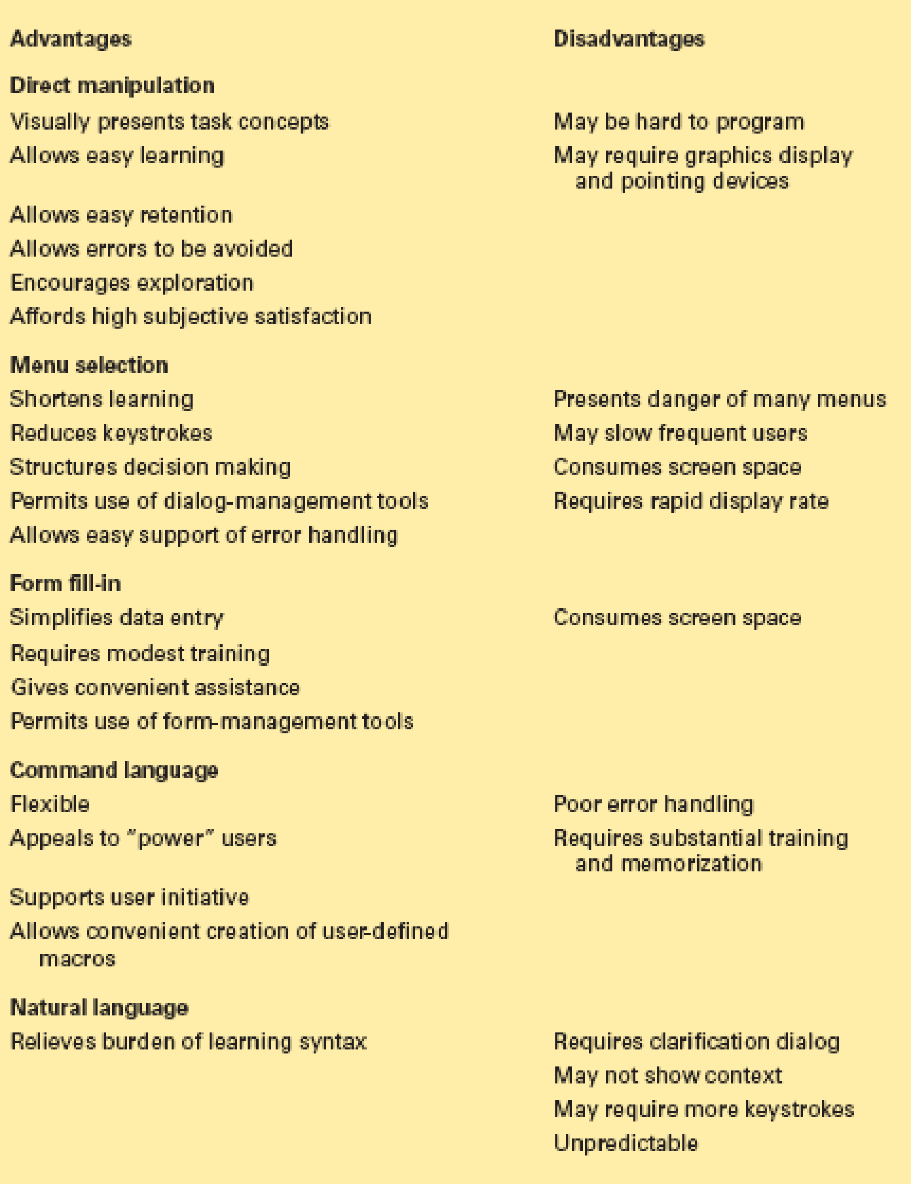




	TASK				
Job Title	Query by Patient	Update Data	Query Across Patients	Add Relations	Evaluate System
Nurse	0.14	0.11			
Physician	0.06	0.04			
Supervisor	0.01	0.01	0.04		
Appointment personnel	0.26				
Medical-record maintainer	0.07	0.04	0.04	0.01	
Clinical researcher			0.08		
Database programmer		0.02	0.02	0.05	

Five interaction styles

- Direct Manipulation
- Menu selection
- Form fill-in
- Command language
- Natural language



Advantages	Disadvantages
Direct manipulation	
Visually presents task concepts	May be hard to program
Allows easy learning	May require graphics display and pointing devices
Allows easy retention	
Allows errors to be avoided	
Encourages exploration	
Affords high subjective satisfaction	
Menu selection	
Shortens learning	Presents danger of many menus
Reduces keystrokes	May slow frequent users
Structures decision making	Consumes screen space
Permits use of dialog-management tools	Requires rapid display rate
Allows easy support of error handling	
Form fill-in	
Simplifies data entry	Consumes screen space
Requires modest training	
Gives convenient assistance	
Permits use of form-management tools	
Command language	
Flexible	Poor error handling
Appeals to "power" users	Requires substantial training and memorization
Supports user initiative	
Allows convenient creation of user-defined macros	
Natural language	
Relieves burden of learning syntax	Requires clarification dialog
	May not show context
	May require more keystrokes
	Unpredictable

Prevent errors

- Mistakes and slips (Norman, 1983)
    - User establishes an intention to act.
    - If the intention is not appropriate, this is a **mistake**.
    - If the action is not what was intended, this is a **slip**.

- Correct actions
    - Gray out inappropriate actions
    - Selection rather than freestyle typing (recognition versus recall)
    - Automatic completion

- Complete sequences
    - Single abstract commands
    - Macros and subroutines

Prevent errors

- Better error messages
  - Specific, positive, and constructive
    - “Printer is off, please turn on” instead of “Illegal Operation”
  - Help reduce similar errors
  - Reduce frustration and increase satisfaction

- Reduce chance for error
  - Organize information, screens and menus
  - Commands and menu choices should be distinctive
  - State of the interface should be known (change cursor when busy)
  - Consistency of actions (Yes/No order of buttons)

Eight golden rules of interface design *by Ben Shneiderman*

1. Strive for consistency
2. Seek universal usability
3. Offer informative feedback
4. Design dialogs to yield closure
5. Prevent errors
6. Permit easy reversal of actions
7. Keep users in control
8. Reduce short-term memory load

Ten usability heuristics *by Jakob Nielsen*

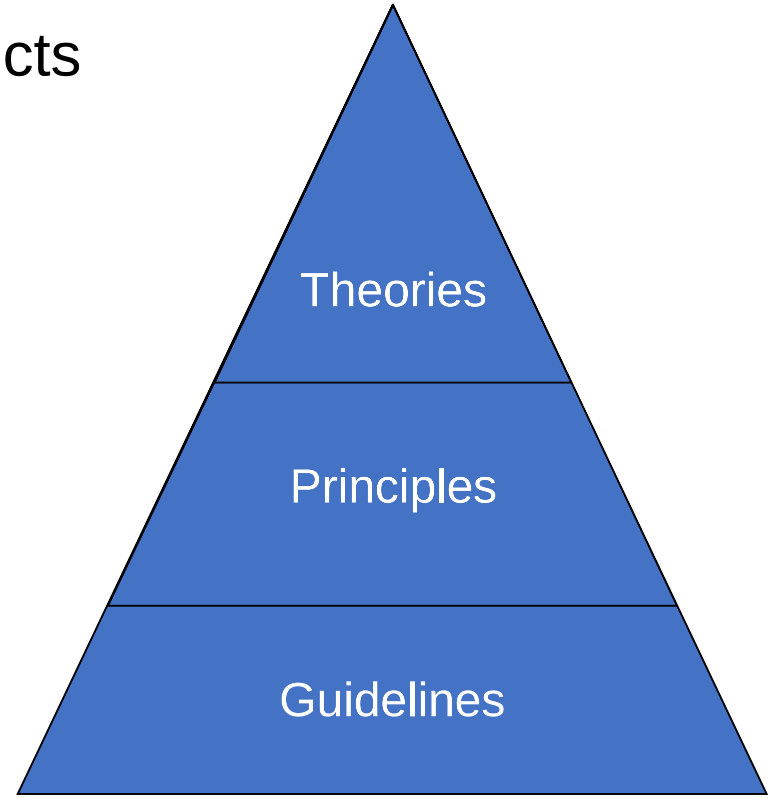
1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation

Class Activity

- Ten usability heuristics
  - Group discussion on examples you found
  - Presentations of best examples
  - Class discussion after each example

Guidelines

- Shared language
  - For teams of designers and developers in large projects
  - For third-party products on a system or platform
    - Software for macOS or Windows
    - Apps for iOS or Android
- Promote best practices and consistency
  - When to use check-boxes versus radio-buttons
  - Layouts (position, size, borders, etc)
  - Color palettes
- Critics of guidelines
  - Too specific, incomplete, hard to apply, contradictory,
  - and sometimes wrong
- Supporters of guidelines
  - Encapsulate experience



Examples of design guidelines

https://developer.apple.com/design/human-interface-guidelines/

https://www.microsoft.com/design/fluent/#/

https://material.io/

https://www.carbondesignsystem.com/

https://www.w3.org/TR/WCAG21/