

# Goals of HCI: Usability + ? = UX

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- Less clicks
- Less buttons
- Less thought
- Less time
- Less energy (calorie)
- Less stress
- Less knowledge?
- Well, generally speaking ... ^^



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# Guidelines, Principles, and Theories



# Principles, Guidelines, and Theories (Rules, ...)

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- All are “stuff” by which we must design and implement HCI
- What’s the difference? → don’t know ...
  - Principle
    - Highest level / More fundamental, widely applicable
    - Based more on experience
    - Enduring than guidelines
    - Often need more clarification
  - Guideline
    - Specific to an organization, task, situation, or something
    - Shared language in a given domain
    - Based on best practices (still specific → difficult to apply somewhere else)
    - ~ Standards (Standards may be more strict)
  - Theory
    - Based on science
      - Mostly empirical anyway (so arguably true)
      - Nevertheless, there are “accepted” empirical results
    - May not be so practical



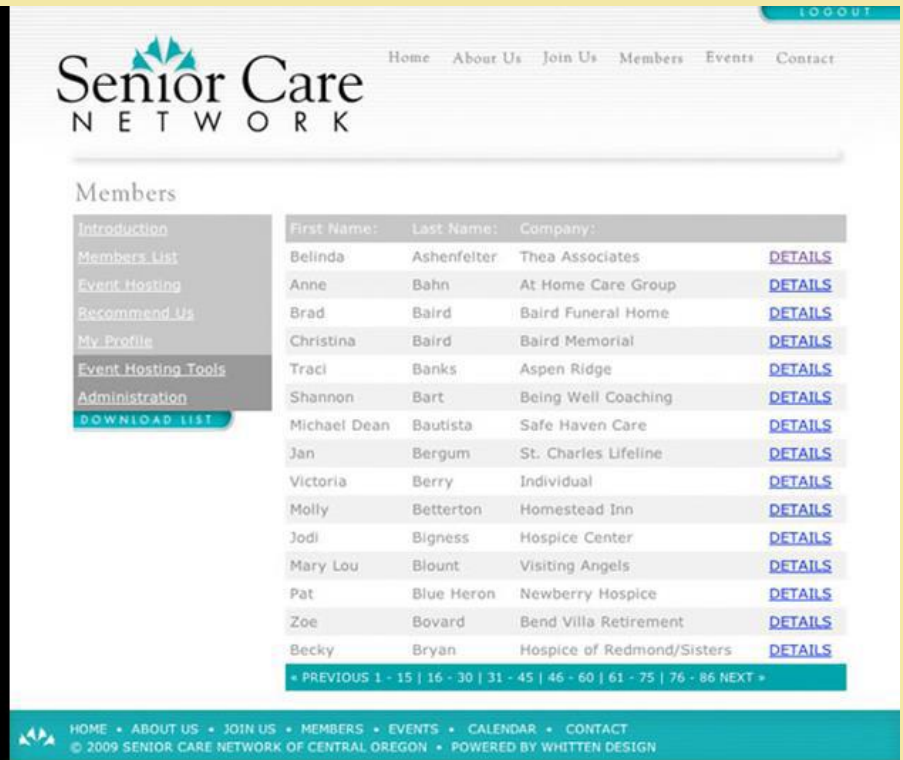
# Principle: “Know thy user” (Hansen, 1971)

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- Age, gender, physical and cognitive abilities, education, cultural or ethnic background, training, motivation, goals and personality
- Design goals based on skill level
  - Novice or first-time users
  - Knowledgeable intermittent users
  - Expert frequent users
- Vs. Universal UI
- Never guess
  - Setting oneself in someone else’s shoe does not really work that well (better than nothing ...)



# Know thy user



# Principle: Identify the tasks

- Do task analysis and modeling (usually involve long hours observing and interviewing users)
  - Decomposition of high level tasks / sequence
  - Relative task frequencies / importance
- Same task can have a different task (interaction) model !
  - Example: Connecting to Wifi

	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

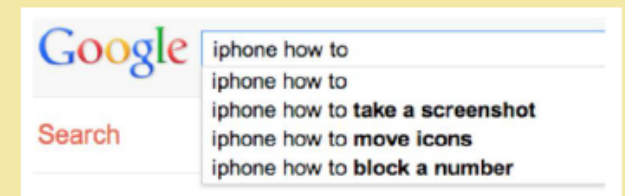


# Tasks are really goals!

(what does the task achieve for you?)

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- Task/Goal structure ~ UI structure
  - Affects learning – Learn the task/app by exploring the interface
    - Learn the task/app by exploring the interface (How do I make a oval ?)
    - Will not read the manual / take class
    - Remember learnability as part of usability?
    - Just do it!: User explores interface for features that satisfy the goal
      - Same as AI rule based system!
        - Look for rules that satisfy the conclusion in a chained fashion
    - Q: What is the right “sequence of action” structure?

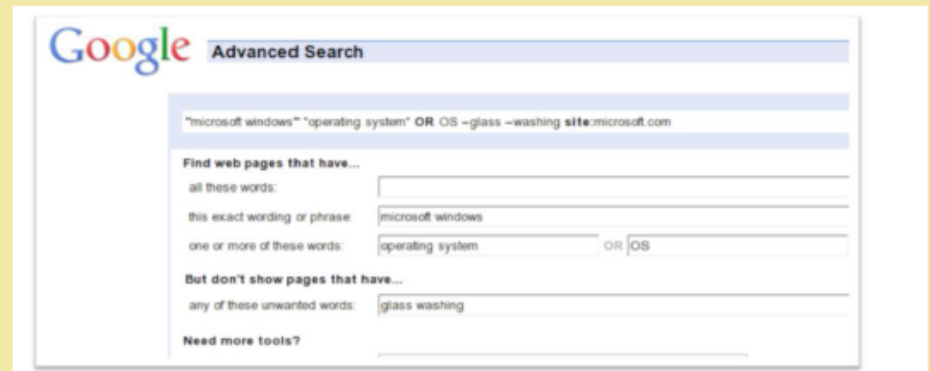


- Affects help system
  - At what points, what kinds of helps, how to organize the help system, ...
  - How help system communicates with you



# Extracting the task model (or the goal structure)

- Extract by watching (and focus on the goals ... what are the actions for?)
- Reversely how to teach the user – User learns by watching too
  - Youtube how to videos
- Implication to UI's
  - Self disclosure UI
  - Give guides/hints/reminders of the goals

A screenshot of Google's Advanced Search interface. At the top, the Google logo is followed by "Advanced Search". Below this is a search bar containing the text: "microsoft windows" "operating system" OR OS -glass -washing site:microsoft.com. Underneath the search bar, there are several sections for refining the search. The first section is "Find web pages that have..." with three sub-sections: "all these words:" (empty), "this exact wording or phrase:" (microsoft windows), and "one or more of these words:" (operating system OR OS). The second section is "But don't show pages that have..." with a sub-section "any of these unwanted words:" (glass washing). At the bottom, there is a link "Need more tools?" and a link to "Customize search".

Google's advanced search form





Help user  
do exercise

Set up the  
plan

Select  
exercise

Set the  
goal / count

Set the  
pace

Pace the  
exercise

Start

Stop

Pause

End

Skip

Look at  
history data

Today

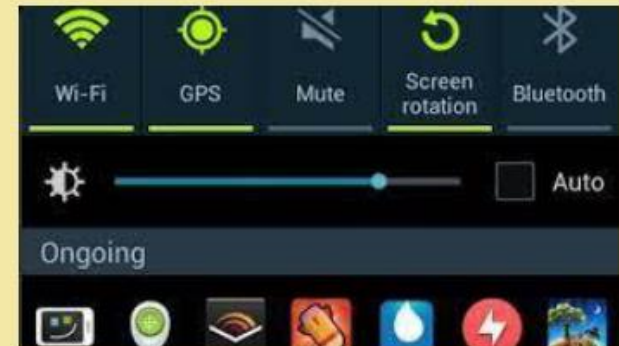
Last week

Last month



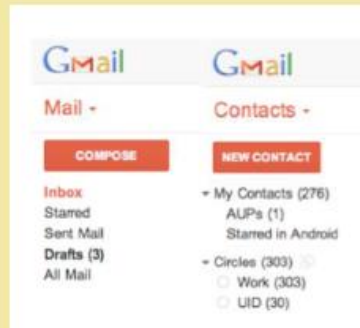
# Principle: Minimize memory load

- Recognition rather than recall (Long term memory)
- Short term memory
- Keeping the awareness/context (of what is going on)
  - Multitasking

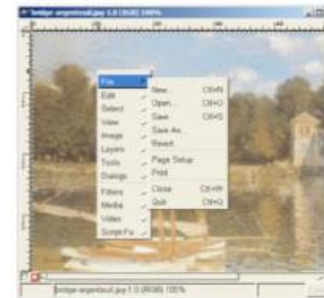


# 일관성 / Consistency

- Related to memory principle
- Labeling / color / font / GUI layout, ...
- Task structure and sequence
- Interface location
- Interface style
- Within / Across
- Similar things should look and act the same
- Different things should look different also called the principle of “least surprise”



**Internal:**  
with itself



**External:**  
with other UIs or the  
real world



**Metaphorical:**  
with the chosen  
interface metaphor

Courtesy of Juho Kim



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## Consistent

delete/insert character

delete/insert word

delete/insert line

delete/insert paragraph

## Inconsistent A

delete/insert character

remove/bring word

destroy/create line

kill/birth paragraph

## Inconsistent B

delete/insert character

remove/insert word

delete/insert line

delete/insert paragraph



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# Consistency through grammars

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## High-level rule schemas describing command syntax:

1. task [Direction, Unit] -> symbol [Direction] + letter [Unit]
2. symbol [Direction=forward] -> "CTRL"
3. symbol [Direction=backward] -> "ESC"
4. letter [Unit=word] -> "W"
5. letter [Unit=char] -> "C"

## Generates a consistent grammar:

move cursor one character forward	CTRL-C
move cursor one character backward	ESC-C
move cursor one word forward	CTRL-W
move cursor one word backward	ESC-W



# Provide Closure

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- Indicate a task/subtask is over
- Provide confirmation and related information
- Contextual reminder

## Thank you for your order

**Order number is: 308512033**

You will receive an email confirmation shortly at info@baymard.com

[Print Receipt](#)

### Save your information for next time

Create Password: Required  
  
(4-18 characters)

Verify Password: Required

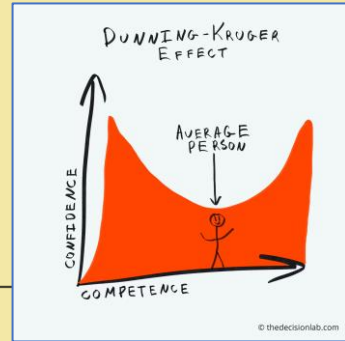
Create Account

[> Detailed Order Receipt](#)

[> Return Policy](#)



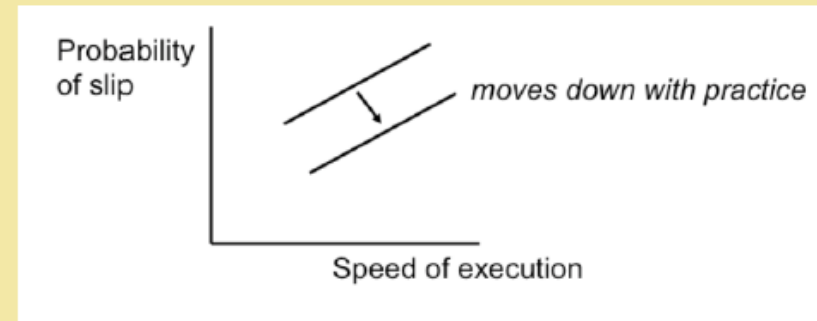
# Prevent errors



person's lack of knowledge and skills in a certain area cause them to overestimate their own competence. By contrast, also causes those who excel in a given area to think the task is simple for everyone, and underestimate their relative abilities as well.

- Slips and lapses: Failure to correctly execute a procedure

- Slip is a failure of execution
  - “Strong-but-wrong” effect
    - Similarity / High frequency
  - Inattention or inappropriate attention
    - Speed / accuracy tradeoff
- Lapse is a failure of memory
  - Typically found in skilled behavior



- Mistakes

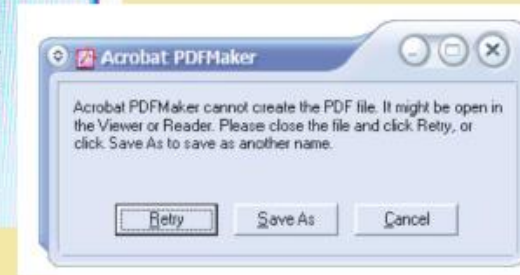
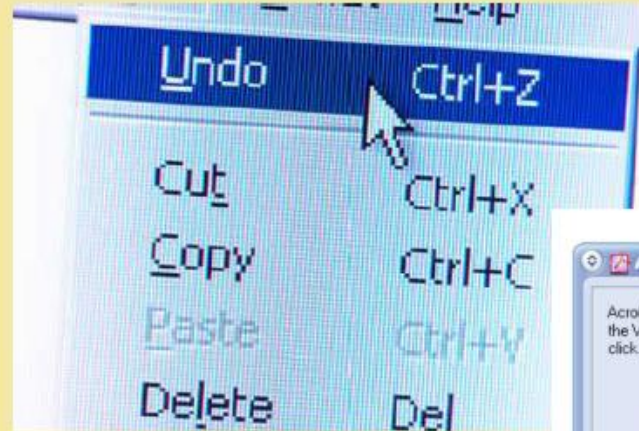
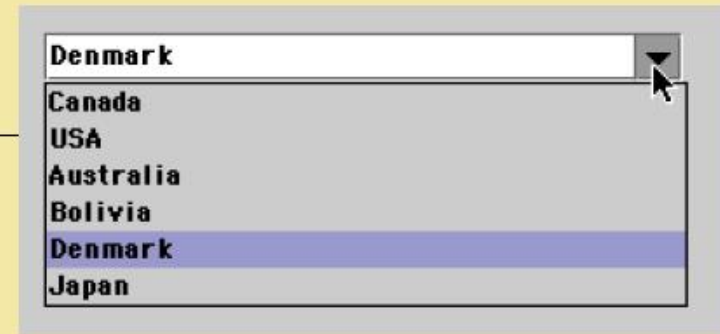
- Using wrong procedure for the goal
- Typically found in rule-based behavior or problem-solving behavior





# Examples ...

- Correct actions
  - Gray out inappropriate actions
  - Selection rather than freestyle typing
  - Automatic completion
  - Reversal of action
- Complete sequences
  - Single abstract commands
  - Macros and subroutines
- Eliminate or Increase visibility of mode
- Make error messages specific, positive in tone, and constructive
- Provide ways to recover / Undo



# Principle: Choose the “right” interaction style

- **Direct Manipulation**
- **Menu selection**
- **Form filling**
- **Command language**
- **Natural language**
- **Gestures**

## Advantages

### Direct manipulation

Visually presents task concepts  
Allows easy learning

Allows easy retention  
Allows errors to be avoided  
Encourages exploration  
Affords high subjective satisfaction

### Menu selection

Shortens learning  
Reduces keystrokes  
Structures decision making  
Permits use of dialog-management tools  
Allows easy support of error handling

### Form fillin

Simplifies data entry  
Requires modest training  
Gives convenient assistance  
Permits use of form-management tools

### Command language

Is flexible  
Appeals to “power” users

Supports user initiative

Allows convenient creation of user-defined macros

### Natural language

Relieves burden of learning syntax

## Disadvantages

May be hard to program  
May require graphics display and pointing devices

Presents danger of many menus  
May slow frequent users  
Consumes screen space  
Requires rapid display rate

Consumes screen space

Has poor error handling  
Requires substantial training and memorization

Requires clarification dialog  
May not show context  
May require more keystrokes  
Is unpredictable



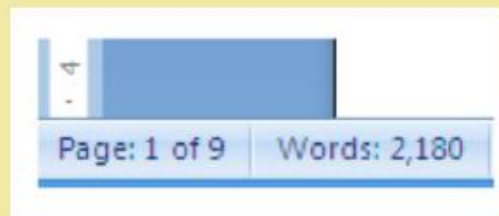
VS





# Provide Useful Feedback

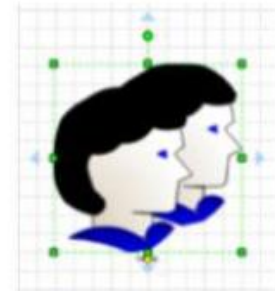
- Actions Should Have Immediately Visible Effects
- Visible Model State: Awareness/Context ...
  - Continuous visual representation of model
    - What to visualize should be guided by the user's tasks



- Selection highlight



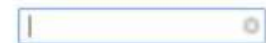
- Selection handles



- Drag & drop mouse cursor



- Keyboard focus

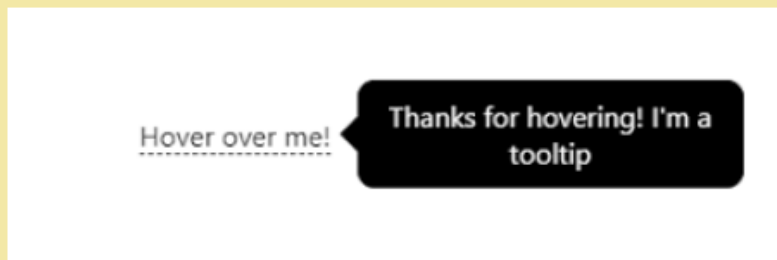


Manage your synced data on [Google Dashboard](#)



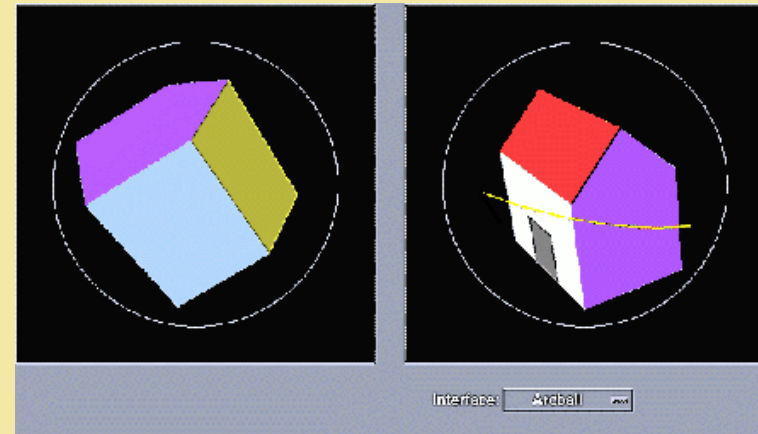
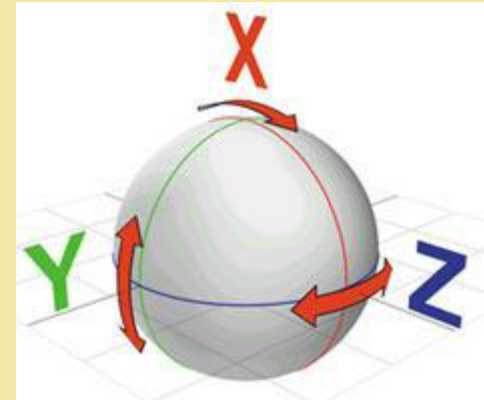
# Information Scent

- Information foraging theory
  - Humans gathering information can be modeled like animals gathering food
  - Constantly evaluating and making decisions to maximize information collected against cost of obtaining it
- Information scent
  - Cues on a link that indicate how profitable it will be to follow the link to its destination
  - Others: Glance, Tooltip, Previews, ...



# Natural and Intuitive

- Affordance
- Metaphors
- Ergonomic
  - I don't want to go out my way to ...
- As in the real world (vs. magic/simple?)
  - Voice / Gestures
  - 3D / Multimodal



# Principles:

## 8 golden rules of interface design + 1

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1. Strive for consistency
2. Cater to universal usability?
3. Offer informative feedback
4. Design dialogs to yield closure
5. Prevent errors
6. Permit easy reversal of actions
7. Support internal locus of control –  
Experienced operators strongly desire the sense that they are in charge of the system and that the system responds to their actions. Design the system to make users the initiators of actions rather than the responders.
8. Reduce short term memory

The right division of labor



# Division of Labor: Automation and human control

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- Successful integration:
  - Users can avoid:
    - Routine, tedious, and error prone tasks
  - Users can concentrate on:
    - Making critical decisions, coping with unexpected situations, and planning future actions
- Supervisory control needed to deal with real world open systems
  - E.g. air-traffic controllers with low frequency, but high consequences of failure
  - FAA: design should place the user in control and automate only to improve system performance, without reducing human involvement





# Division of Labor: Automation and human control

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- Autonomous UI agents?
  - knows user's likes and dislikes (how?) and keeps track of user performance
  - makes proper inferences (how?) and responds to novel situations
  - performs competently with little guidance
  - adapts behavior to suit user's needs
    - response time, length of messages, density of feedback, content of menus, order of menu items, type of feedback, content of help screens
  - can be problematic (alternative: make it user controllable)
    - system may make surprising changes
    - user must pause to see what has happened
    - user may not be able to
      - predict next change
      - interpret what has happened
      - restore system to previous state



# Other notable principles

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- Do participatory design
- Keep it simple and stupid (KISS)
- Do not anthropomorphize (why not?)



## GUIDELINE CATEGORIES

기준	주요 범주	예시
사용자 유형	나이/세대/성별 장애/접근성[W3C] 소비자 집단 직업 문화/국적[ref]	아이 [ref], 노인 [ref], 시각 장애인 [ref], 베이비 붐 세대, 학생, 부모, 동양인, 운동 선수
플랫폼/시스템 구성	이동형/휴대형기기/데스크탑 대형 화면/임베디드 가상현실 공용 장치 운영체제/네트워크	스마트폰 [ref], 스마트패드 장치, 데스크탑 [ref], 키오스크, 임베디드 운영체제, 클라우드 기반 [ref], 네비게이션 시스템, 게임 장치, MP3 플레이어, 전자 책
서비스 제공자 / 기관	개인 공공 설계 형식 / 정체성	NASA [ref], 고려대학교 [ref], 안드로이드 [ref], iOS [ref], 윈도우즈 XP [ref]
인터페이스 형식/양식 / 기술	WIMP / 비 WIMP 3D 다중 양식	목소리/청각 [ref][std], 제스처 [ref], 싱글/멀티터치 [ref], 탭 타일/햅틱, 다중 양식 [ref][std], 메뉴 기반 [ref], GUI/위젯 [ref], 시각적 인식 [ref][std]
작업/조작 맥락	위치/장소/시간 [std] 소음/조명 몸 제약 [tsd]	사무실, 실외, 도로/거리, 집, 자동차, 지하철, 강의실, 아이즈프리(Eyes free), 핸드즈프리, 잘 쓰는 손(handedness)
응용 프로그램	게임 / 미디어/정보 / 전자 상업 / 설계/편집 / 소셜 네트워크 서비스	
HCI 하위 구분 (일반)	화면 배치 [ref] / 정보 구조/네비게이션 [ref] / 입력 방법 [ref] / 정보/결과 가시화 [ref] / 설계 절차와 실행 [ref] / 사용자 경험 [ref] / 일반적인 미학	

# Accessibility guidelines

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- Provide a text equivalent for every non-text element
- For any time-based multimedia presentation synchronize equivalent alternatives
- Information conveyed with color should also be conveyed without it
- Title each frame to facilitate from identification and navigation



# Web3C Accessibility Guidelines

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- 지각할 수 있는
  - 문자로 나타나지 않은 내용에 대해 문자 대안을 제공한다.
  - 멀티미디어에는 주석이나 다른 대안을 제공한다.
  - 기술의 도움을 받아, 본 의미를 잃지 않으면서 여러 방법으로 표현할 수 있는 내용을 만들어야 한다.
- 운용할 수 있는
  - 모든 기능을 키보드로 사용할 수 있게 한다.
  - 사용자에게 내용을 읽고 사용할 시간을 충분히 주어야 한다.
- 이해할 수 있는
  - 문자를 읽을 수 있고 이해할 수 있게 만들어야 한다.
  - 예측할 수 있게 내용이 나타나고 작동해야 한다.

...

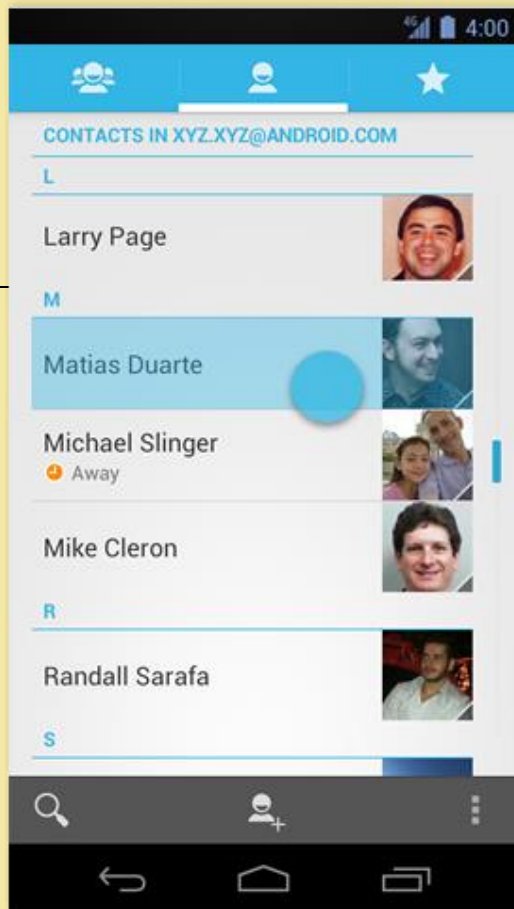


# Guideline for Mobile (J. Tidwell)

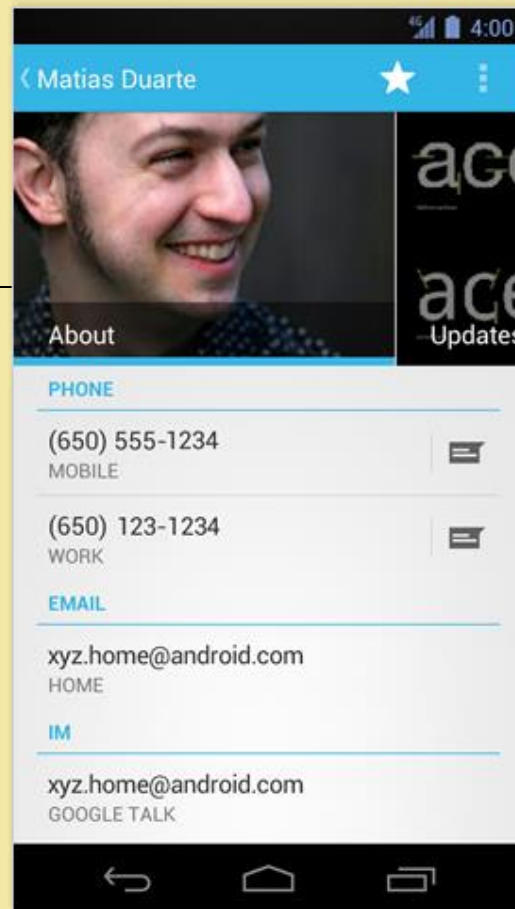
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- 빠른 상태 정보(특히 네트워크 연결과 서비스를 고려했을 때)
- 타이핑을 최소화하고 여러 입력 도구를 사용 (e.g. 버튼, 터치, 음성, 손 필기 인식, 가상 키보드 등)
- 작업 집중의 어려움 (고도로 밀집된 정보의 공간에서 혼란을 덜 유발)
- 더욱 큰 선택 대상 (쉽고 정확하게 선택하고 조작하기 위해).
- 화면 공간을 효율적으로 사용 (정보를 요약)





List view



Detail view

Google

“당신의 앱은 콘텐츠를 조절해 화면 크기와 방향을 바꿔더라도 꾸준히 균형 잡히고 심미학적으로 만족스러운 배치를 제공해야 한다.”

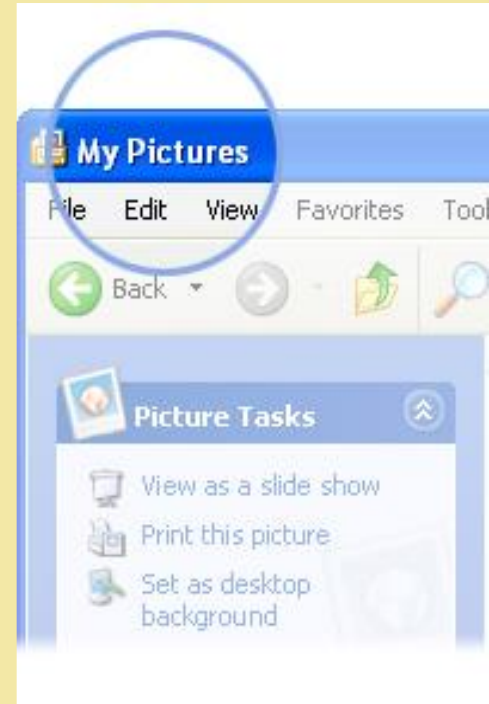
“...가로 방향 화면으로 충분한 공간이 있을 때는 여러 가지를 하나로 혼합하여 보여줄 것이고 공간이 부족하다면 그것들을 분할해서 ...”



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# Apple iOS

- Franking Gothic은 14포인트 이상의 문자에서만 사용. 제목에 사용되며 절대 본문에 사용되어서는 안 된다.
- Tahoma는 시스템의 기본 서체이다. Tahoma는 크기 8, 9, 혹은 11로 사용.
- Verdana (bold, 크기 8)는 오직 tear-off/floating 팔레트의 제목 바에만 사용.
- Trebuchet MS (bold, 크기 10) 는 창의 제목 바에만 사용.





# Guideline on Flash

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MIL-STD-1472C on flash content:

“Flash: Flash coding shall be employed to call the users attention to mission critical events only. No more than 2 flash rates shall be used. Where one rate is used, the rate shall be between 3 and 5 flashes per second. Where two rates are used the second rate shall be less than 2 per second.”



# Phone in the car (Green et al.)

하위 범주	번호	지침
일반	11.1	자동차에서의 휴대폰은 사람들이 집에서 사용하는 전화기와 비슷하게 동작해야 한다. “통화” 버튼은 연결을 하며 “전원” 버튼은 전화를 켜거나 끈다는 점이 일관되지 못하다.
음성 대화	11.16	음성 명령어와 버튼 레이블들은 같은 맥락으로 사용되어야 한다. 주요 명령어에는 “전화걸기(Dial)”, “저장하기(Store)”, “불러오기(Recall)”, “지우기(Clear)” 등이 있다. 이것은 일관성 원칙의 한 예이다.
수동 발신	11.24	“저장하기(Store)”와 “불러오기(Recall)” 버튼은 비슷한 기능을 수행하기 때문에 서로 인접해 있어야 한다. 이것은 집단화 원칙의 한 예이다.



# Organizing the display (Guideline or Principle?)

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- Smith and Mosier (1986)
  - Consistency of data display
  - Efficient information assimilation by the user
  - Minimal memory load on the user
  - Compatibility of data display with data entry
  - Flexibility for user control of data display
- Liavitt et al. (US HHS)



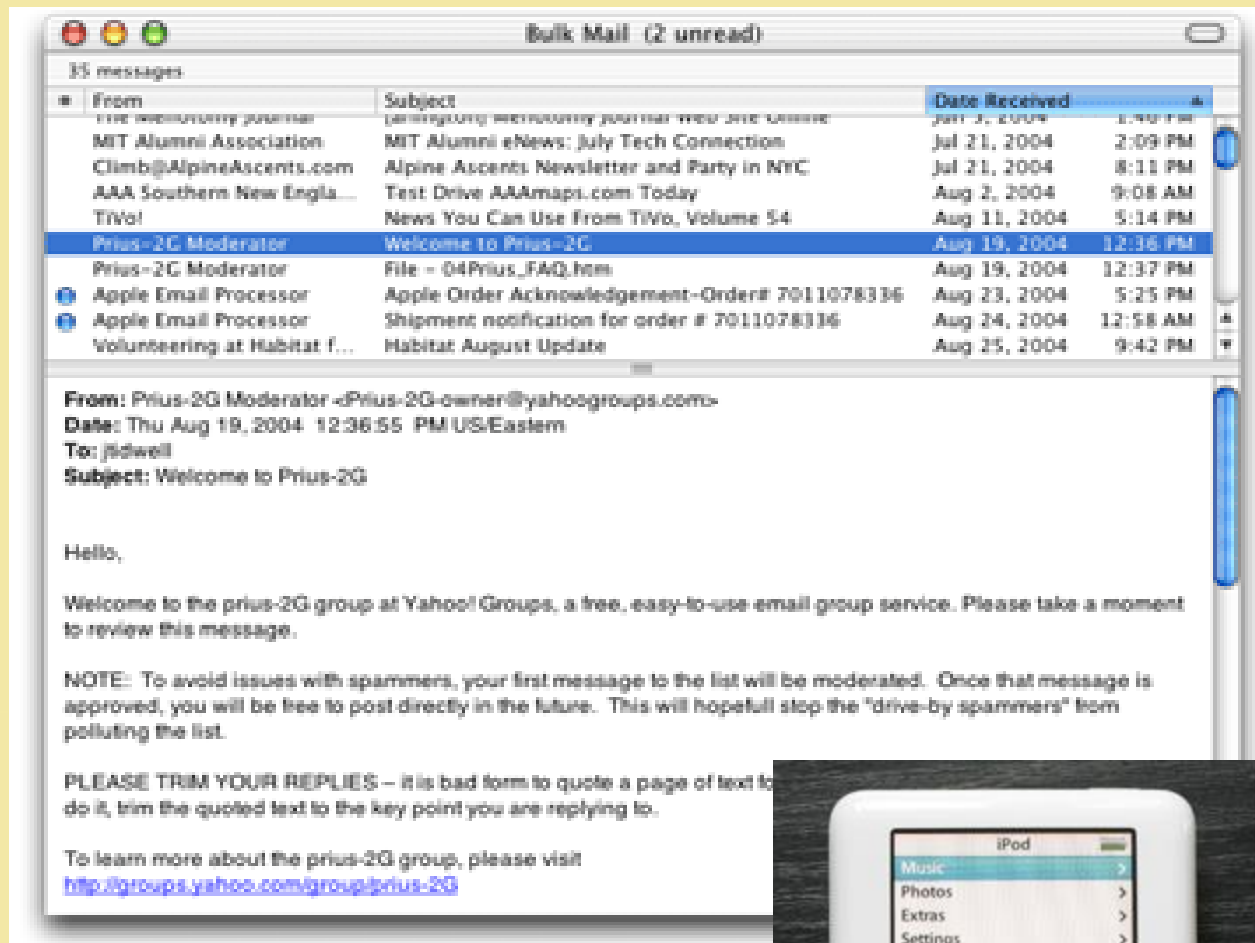
지침	설명
어수선한 화면을 피해야 한다	사용자로 하여금 어수선하다고 느끼지 않는 페이지들을 만들어야 한다.
중요한 항목들을 일관되게 배치해야 한다	중요하고 클릭할 수 있는 항목들을 같은 위치에, 페이지의 상단에 가깝게 배치해 그것들의 위치를 쉽게 예측할 수 있게 해야 한다.
중요한 항목들을 상단 가운데에 배치해야 한다	가장 중요한 항목들을 웹 페이지의 상단 가운데에 배치해 사용자가 정보를 찾는 것을 쉽게 해야 한다.
비교하기 쉬운 구조여야 한다	페이지를 구조화하여 항목들이 쉽게 비교될 수 있어야 한다. 사용자가 해당 항목들을 분석해 유사성, 차이, 추세와 관계를 알 수 있어야 한다.
중요도의 등급을 정해야 한다	정보의 중요도 등급을 설립하여 이 방식을 웹 사이트의 모든 페이지에 적용할 수 있어야 한다.
화면 밀도를 최적화해야 한다	페이지에서 원하는 정보를 쉽게 찾기 위해, 페이지들을 너무 정보들로 복잡하지 않게 만들어야 한다.

# Example Guideline (or Principle?): Navigating the interface

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- Sample of the **National Cancer Institutes** guidelines:
  - Standardize task sequences
  - Ensure that embedded links are descriptive
  - Use unique and descriptive headings
  - Use check boxes for binary choices
  - Develop pages that will print properly
  - Use thumbnail images to preview larger images





Design patterns according to guideline category



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# Facilitating data entry (Guideline or Principle?)

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- Smith and Mosier (1986)
  - Consistency of data-entry transactions
  - Minimal input actions by user
  - Minimal memory load on users
  - Compatibility of data entry with data display
  - Flexibility for user control of data entry



# Data Entry

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- 데이터입력 처리 과정의 일관성: 비슷한 순서의 상황에서는 항상 비슷한 구획 문자나 약어를 사용하여야 한다.
- 사용자로부터의 최소한의 입력: 입력 행동이 적다는 것은 더 높은 생산성을 의미한다. 예를 들어 하나의 키 입력, 마우스 선택, 자동 완성 기능, 자동 커서 배치 등을 이용해 전체 입력을 피할 수 있다.
- 버튼과 데이터 입력 필드의 명백하게 명칭 표시를 입력 필드에 가까이 배치한다.
- 데이터 입력과 선택 필드를 손의 움직임 방향과 탐색 방향이 자연스럽게끔 배치한다 (e.g. 위에서 아래로, 왼쪽에서 오른쪽으로).
- ...





# Getting the user's attention

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- Intensity
- Marking
- Size
- Choice of fonts
- Inverse video
- Blinking
- Color
- Audio



# Commercial guidelines

- Often associated with commercial toolkit
- Guideline usually concern “style” but also sometimes address usability (c.f. VISTA UX Guide, XP Guide, developer.apple.com, etc.)

## Outlines

**When illustrating Windows XP-style icons, add an outline to the image to provide definition and ensure that the image works well on different background colors.**

### Controls

#### Common controls

Enter PIN

PIN must be 4 digits

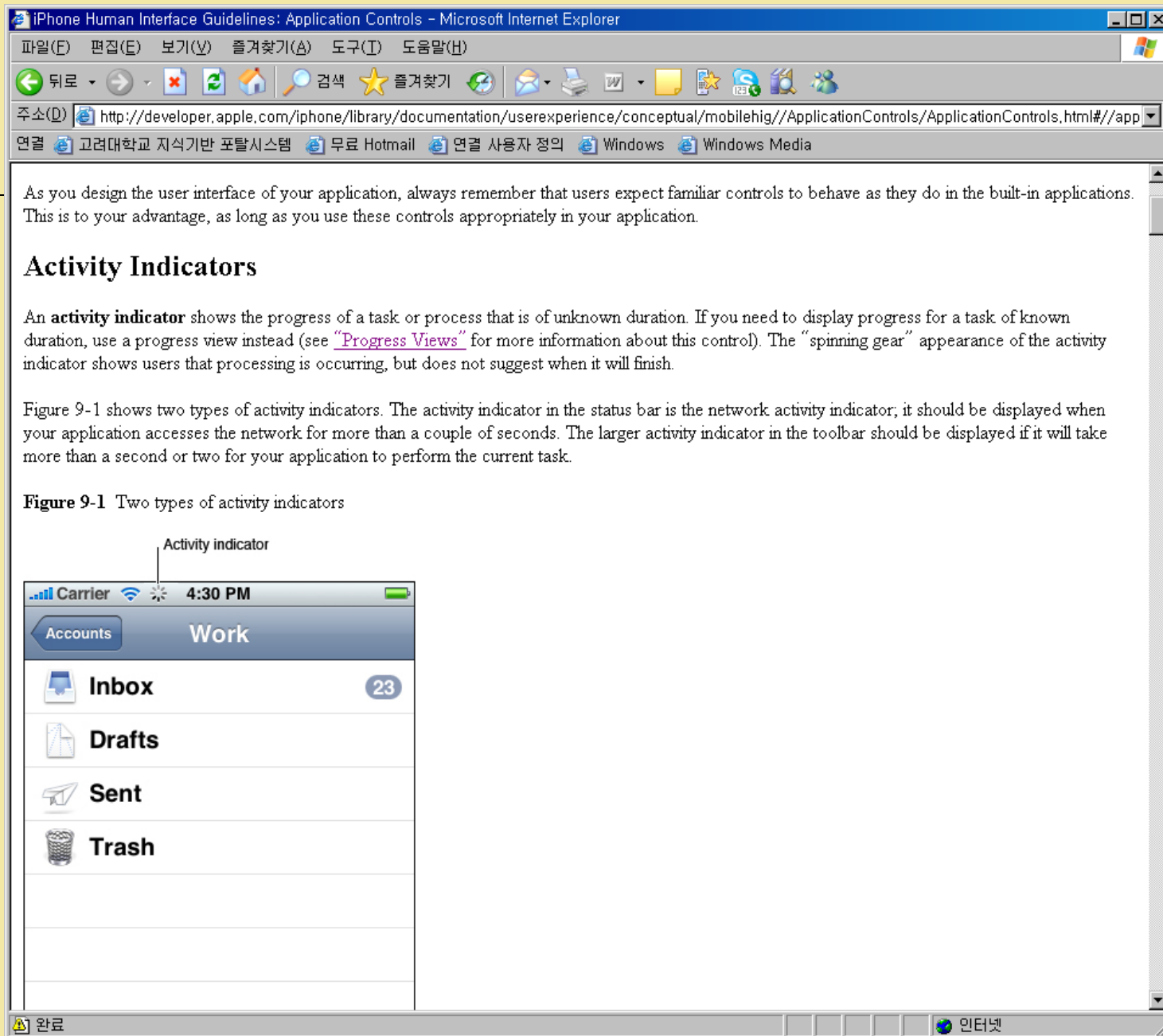


**Caps Lock is on**

Having Caps Lock on may cause you to enter your password incorrectly.

Press Caps Lock to turn it off before entering your password.







## Visual Guidelines

### Welcome

#### + What's New

#### About the Design

#### Fonts

#### Colors

#### + Icons

#### + Controls

#### + Folders & Layouts

#### FAQ

## Welcome to the Windows XP Visual Guidelines

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We are excited to share with you the new look and feel of Windows XP.

We changed the look of Windows to make your computer more exciting to use. Say goodbye to Windows grey and say hello to fresh colors, soft curves, rich gradients and friendly typography and imagery.

The Windows XP look is based on simplicity, color, freshness and excitement. We believe that visual design is integral to the user experience. We hope these guidelines help you generate excitement about Windows XP in your efforts.



The default Blue color scheme is fresh, vivid and engaging. This color scheme is the signature of the product and has the essence of the new Windows XP.



# Fonts

To improve visual interest and hierarchy, Windows XP uses some new typefaces and a variety of type sizes. To better support our Microsoft brand, we've introduced Franklin Gothic into the Windows XP user interface.

Franklin Gothic Medium  
*Franklin Gothic Medium Italic*

Franklin Gothic is used only for text over 14 point. Franklin Gothic is often used for headers, and should never be used for body text.

Tahoma

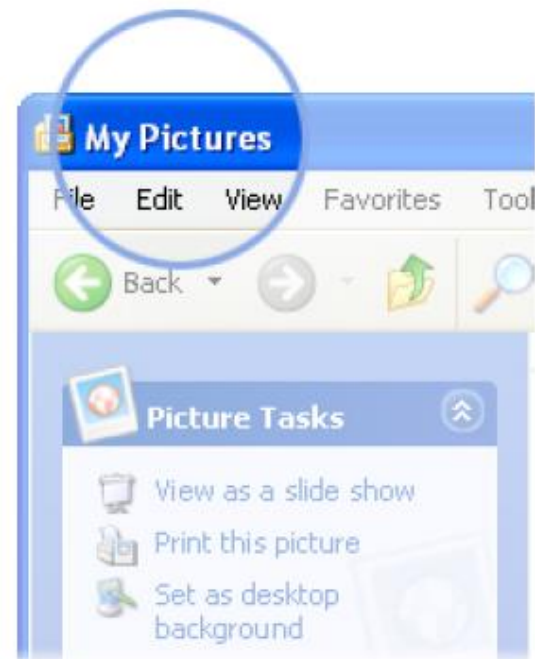
Tahoma is used as the system's default font. Tahoma should be used at 8, 9 or 11 point sizes

Verdana

Verdana is used only for title bars of tear-off/floating palettes- Verdana Bold, 8 point.

Trebuchet MS

Trebuchet MS is used only for the title bars of



Example of Trebuchet MS Bold 10 point in the My Pictures title bar.



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## Characteristics of Windows XP-style Icons

1. Color is rich and complementary to the Windows XP look.
2. Angle and perspective provides a dynamic energy to the images.
3. Edges and corners of elements are soft and slightly rounded.
4. Light source is coming from the upper left-hand corner with the addition of an ambient light to illuminate other parts of the icon.
5. The use of gradients provide dimension and give the icon a richer appearance.
6. A drop shadow provides contrast and dimension.
7. Outlines provide definition.
8. Everyday objects have a more modern consumer look such as computers and devices.





## Radio Buttons

Radio buttons have 3 sizes: 13x13, 16x16 and 25x25 pixels. Only the 16x16 size is available in Windows XP. Windows XP automatically uses the best size based on the video card DPI settings.

The text for a radio button should change depending on its state. The following RGB values should be used for the text of these states:

**Checked Disabled Text: R: 161 G: 161 B: 146**

**Unchecked Disabled Text: R: 161 G: 161 B: 146**

- ☐ unchecked normal
- ☐ unchecked hot
- ☐ unchecked pressed
- ☐ unchecked disabled
- ☒ checked normal
- ☒ checked hot
- ☒ checked pressed
- ☒ checked disabled

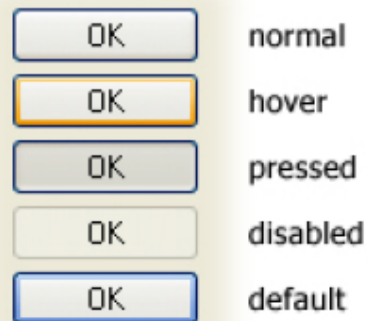
Radio button states

## Command Buttons

A command button should typically be 75 pixels wide (50 dialog units) by 23 pixels tall (14 dialog units). The curve of a command button is a 1 pixel indent.

The button text for a command button should change depending on its state.

**Disabled Text: R: 161 G: 161 B: 146**



Command button states



## Text Boxes

The colors for an edit box should change depending on its state.

**Normal Border Color: R: 127 G: 157 B: 185**

**Fill Color:**

**Disabled: R: 235 G: 235 B: 228**

**Read Only: R: 235 G: 235 B: 228**

**Text Color:**

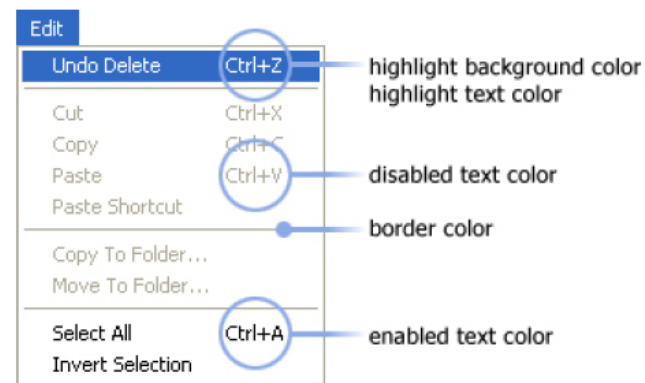
**Disabled: R: 161 G: 161 B: 146**

**Read Only: R: 0 G: 0 B: 0**



**Text box states**





**Highlight Background Color: R: 49, G: 106, B: 197**

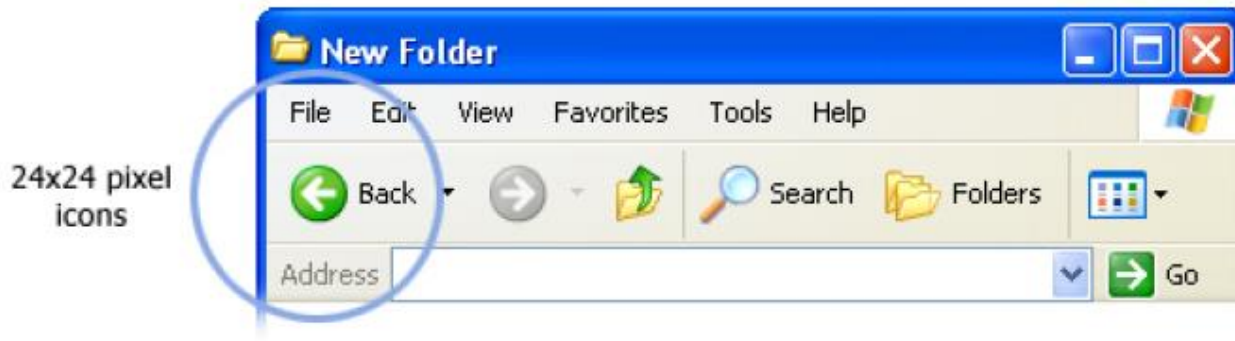
**Highlight Text Color: R: 255, G: 255, B: 255**

**Border + Separator Color: R: 128, G: 128, B: 128**

**Disabled Text Color: R: 128, G: 128, B: 128**

## Toolbars

The Windows XP toolbar displays 2 icon sizes: 24x24 and 16x16 pixels. There are 2 icon states: default and hot. By default, the icons are in color and on mouse-over they appear slightly more saturated.



log off



cancel

turn off



forward

restart



back

standby



undock

switch user



close



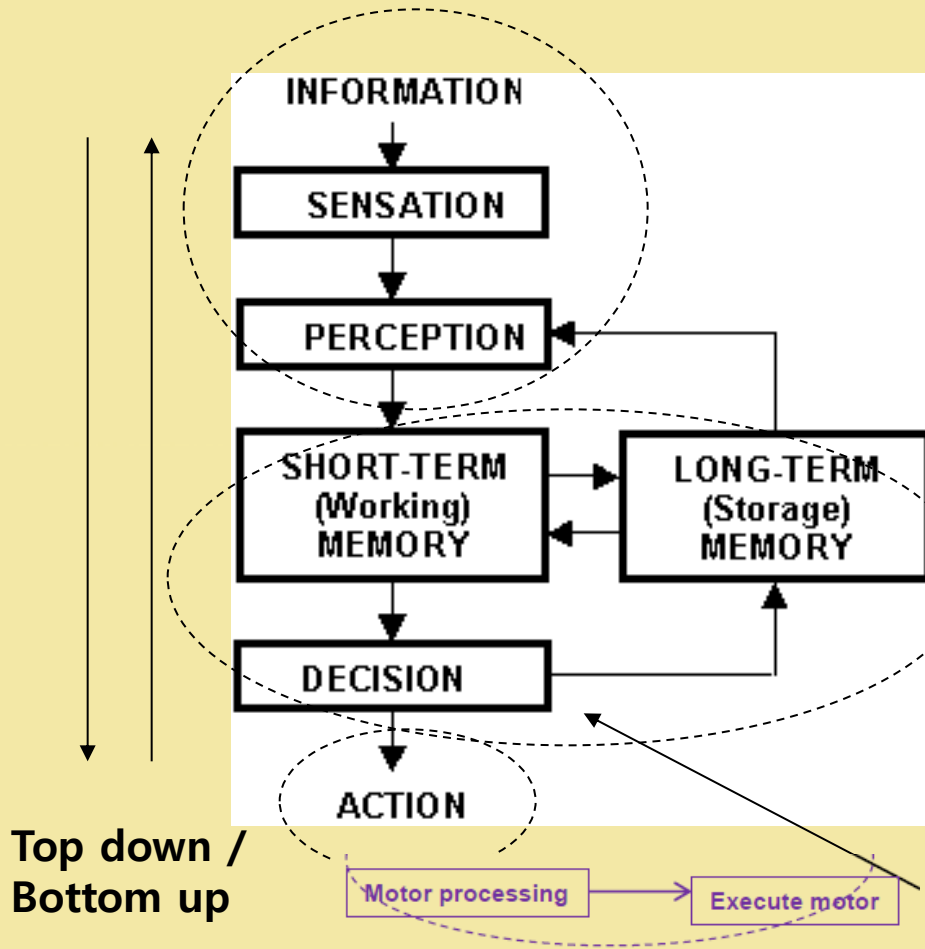
# Theory: Cognitive Science and Human Factors

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- Cognitive Factors
    - Task modeling and problem solving model
  - Human Factors: Perceptual side
    - Assessment of interface based on sensorial information processing capabilities (e.g. human reaction)
  - Human Factors: Action side
    - Motor-task performance prediction: **Fitt's Law**
- e.g. GOMS**



# Human Information Processing Model



Different Kinds of knowledge

- Rules / Declarative
- Procedural / Episodic
- Meta/control knowledge
- Schema and mental model
- Hierarchy / Semantic net

Planning (subgoalting) and Learning

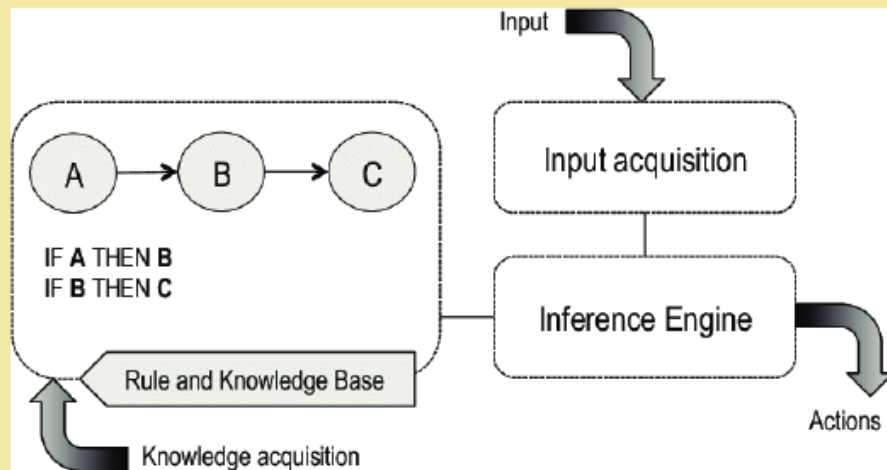
Selective attention



# Subgoaling

- Rule based / Knowledge based reasoning  
(vs. pattern recognition)

Achieve goal C



Backward chaining

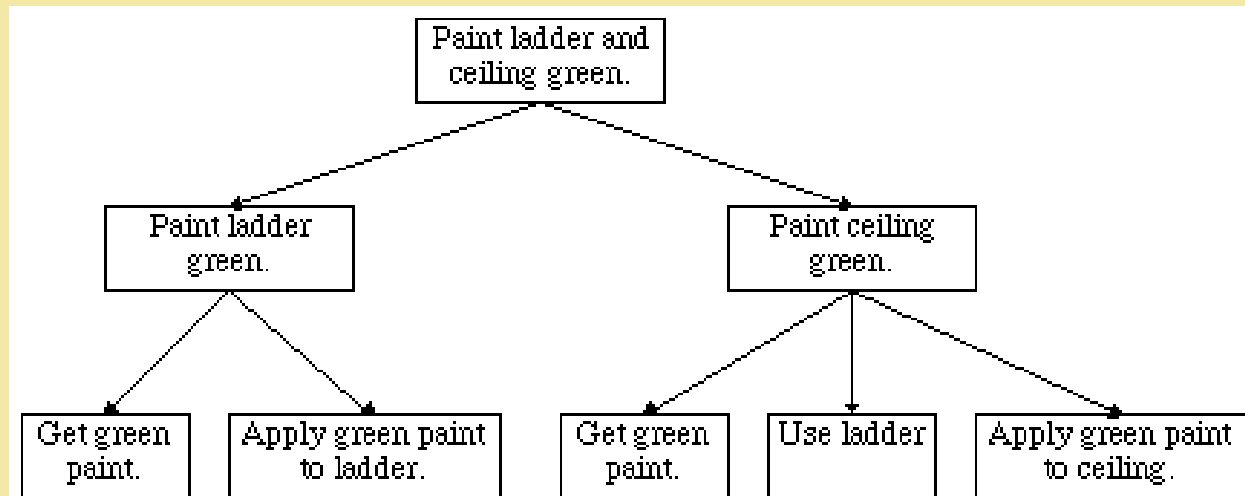
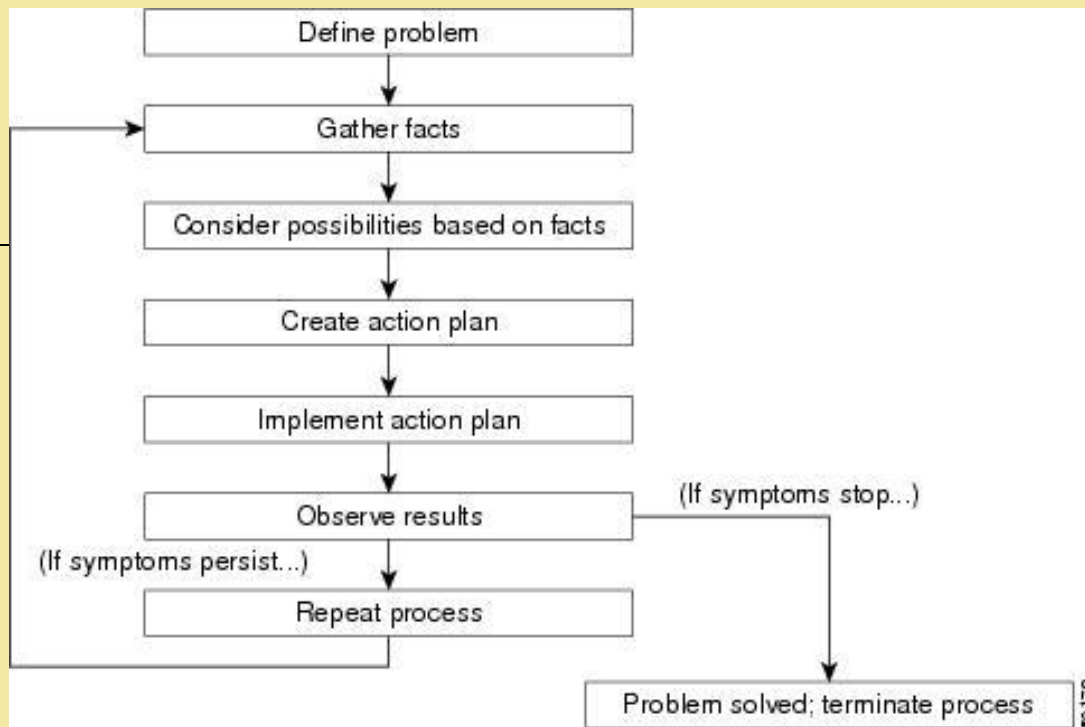
- Find rule that achieves C
- Need B (B is now another subgoal)
- Find rule that achieves B
- Or maybe B is already given (fact, observed in the world)
- Check if A is a fact or try to achieve A (another subgoal)
- And so on ...

What if there are multiple rules to satisfy B?

- Use another rule to find the best rule!
- Like **meta knowledge**
- Where does meta end?
- More expertise, more meta reasoning (2-4 levels)
- Novices are like 1-2 level







# Norman's Theory about Stages of action

---

1. Forming the goal
2. Forming the intention
3. Specifying the action
4. Executing the action
5. Perceiving the system state
6. Interpreting the system state
7. Evaluating the outcome

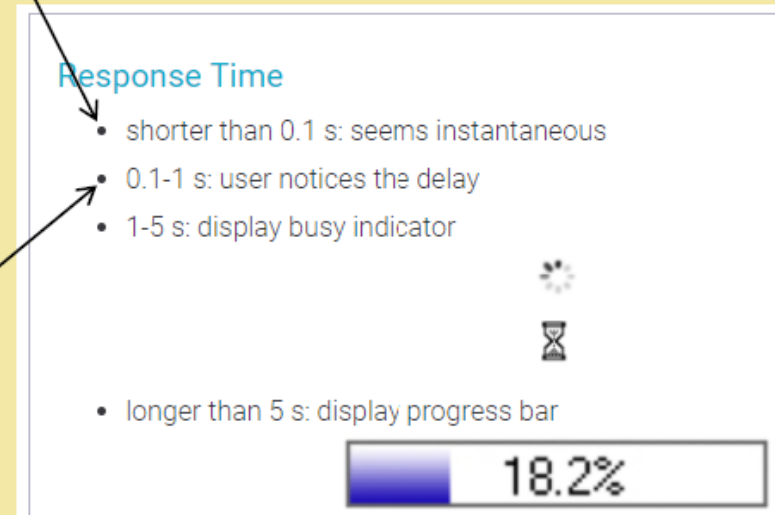
**Mental model (of the task)**  
**Vs.**  
**Actual model**

- Norman's contributions
  - Context of cycles of action and evaluation.
  - *Gulf of execution*: Mismatch between the user's intentions and the allowable actions
  - *Gulf of evaluation*: Mismatch between the system's representation and the users' expectations



# Information processing speed

- Low level perception: ~ 100ms [50-200 ms]
  - Multimodal/Perceptual Fusion
    - Multiple events/stimuli (e.g. Phone ring and vibration) fused as one
      - Otherwise felt as two separate events
    - Action/response may seem like instantaneous and with causality
    - Computer animation looks smooth at 20 fps
    - Upper bound on computer response
- Cognitive processing: ~ 70ms [30-100 ms]
- Action: ~ 70ms [25-170 ms]



# STM / WM and Implications

---

- $7 \pm 2$  “chunks” in WM (Miller 56)
  - A.k.a. Magic number
  - Chunk ? - Mysterious unit of information
    - Others have used bits for measure of information
- All memory needs refreshing (like dynamic RAM !?)
  - Half life of working memory chunks
    - E.g. 70 seconds for one item, 7 seconds for three, ...
- Chunking: Cramming stuff into one “UNIT” by abstracting away details
  - Learning and remembering is involved



# STM / WM and Implications

---

- Minimize load
- Provide feedback with visual/multimodal echoes
  - To refresh the working memory
- Exploit chunking
  - Information content to be organized in “chunks”
    - CIA instead of “Central Intelligence Agency”
  - Make connection among chunks
  - Keep numbers separate from letters
    - 456 IST vs. 4L3RR
  - Multimodality
    - Each modal has WM by itself (don’t overload one particular channel)



# LTM and Implications

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- Requires constant refreshing
- Works a lot by association
  - Context in multitasking
- Various types
  - Rules/Declarative
  - Episodic/Procedural
  - Association and semantic net
  - Models, schemas and hierarchy
    - Task subtask hierarchy



# Object/Action Interface model

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Object-action design:

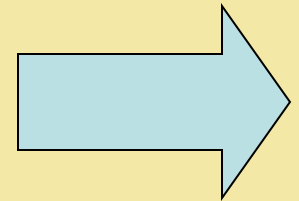
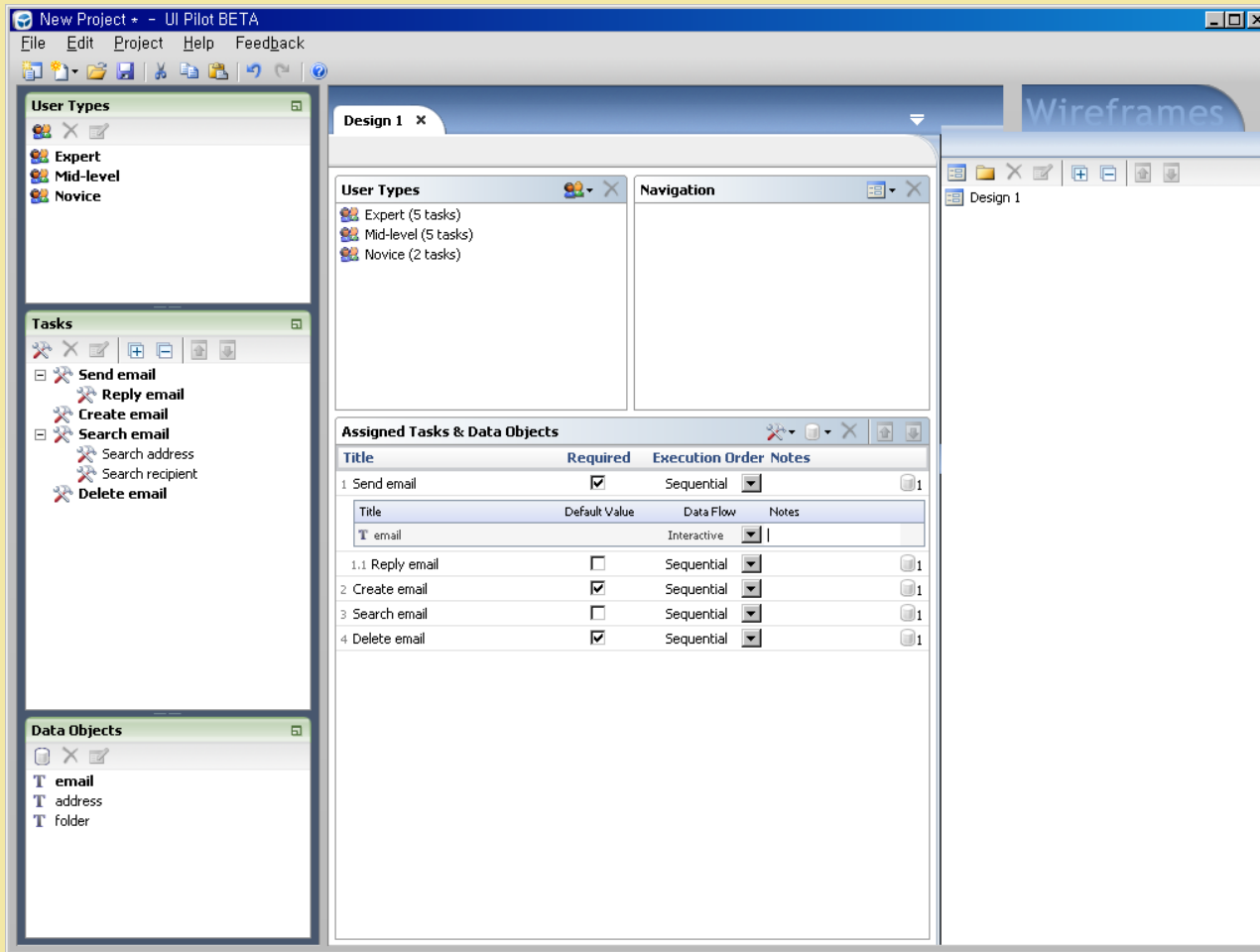
1. understand the task.
  - real-world objects
  - actions applied to those object
2. create metaphoric representations of interface objects and actions
3. designer makes interface actions visible to users

Obtain “interface **hierarchy** of action and objects

**Suits Object oriented approach to UI development!**



# e.g. UIPilot ([www.redwhale.com](http://www.redwhale.com))



Tool to help organize tasks, users, and objects and their inter-relationships





# Design 1

PAGE INFORMATION			USERS			
Name	Design 1		Expert, Mid-level, Novice			
Description						
ASSIGNED TASKS						
Name	Execution Order	Required	Data Objects			
			Name	Type	Default Value	I/O
Send email	Sequential	True	email	Text		Interactive
•Reply email	Sequential	False	email	Text		Interactive
Create email	Sequential	True	email	Text		Interactive
Search email	Sequential	False	email	Text		Interactive
Delete email	Sequential	True	email	Text		Interactive

