



Applications, Principles and Theories

Lecturer

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Overview

1. Foundation of human interaction
2. Communication principles
3. Human Computer Interaction
4. Principles of Interaction Design
5. Principles, theories and standards of user interfaces, Menu Systems and Applications

Foundation of Human Interactions

- Whenever we use any of our senses, we interact with information
- The Ubiquity of information plays a role in studying cognitive, physical, neurological, social, emotional and economic aspects of interaction
- To design effective systems whether computer-based, sociotechnical or purely human to support interaction with information requires in-depth understanding of HII
- In ecology design of an IS, the designer creates a virtual ecology that maps the interactions between humans and their environment onto the system

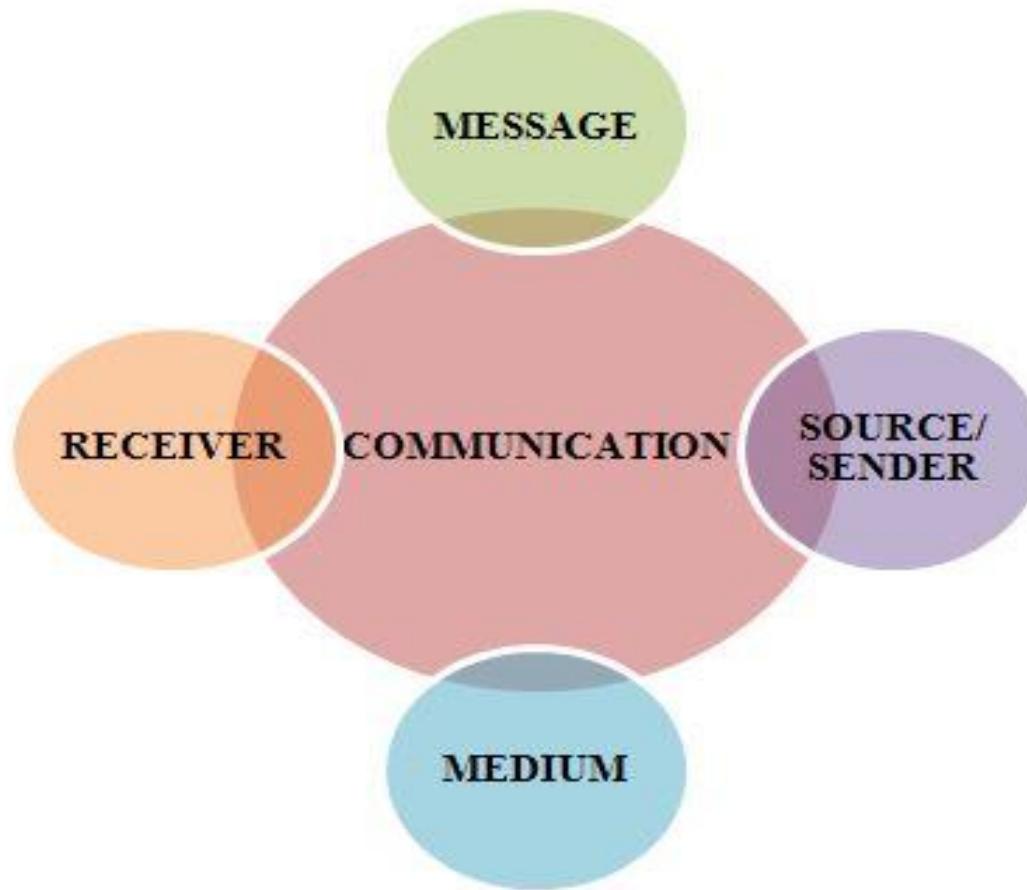


Communication Principles

- ❑ Have you ever imagined a world and life without any communication?
- ❑ Principles consist of the **validated guidelines** that are used in performing different tasks or functions to achieve **pre-defined goals**

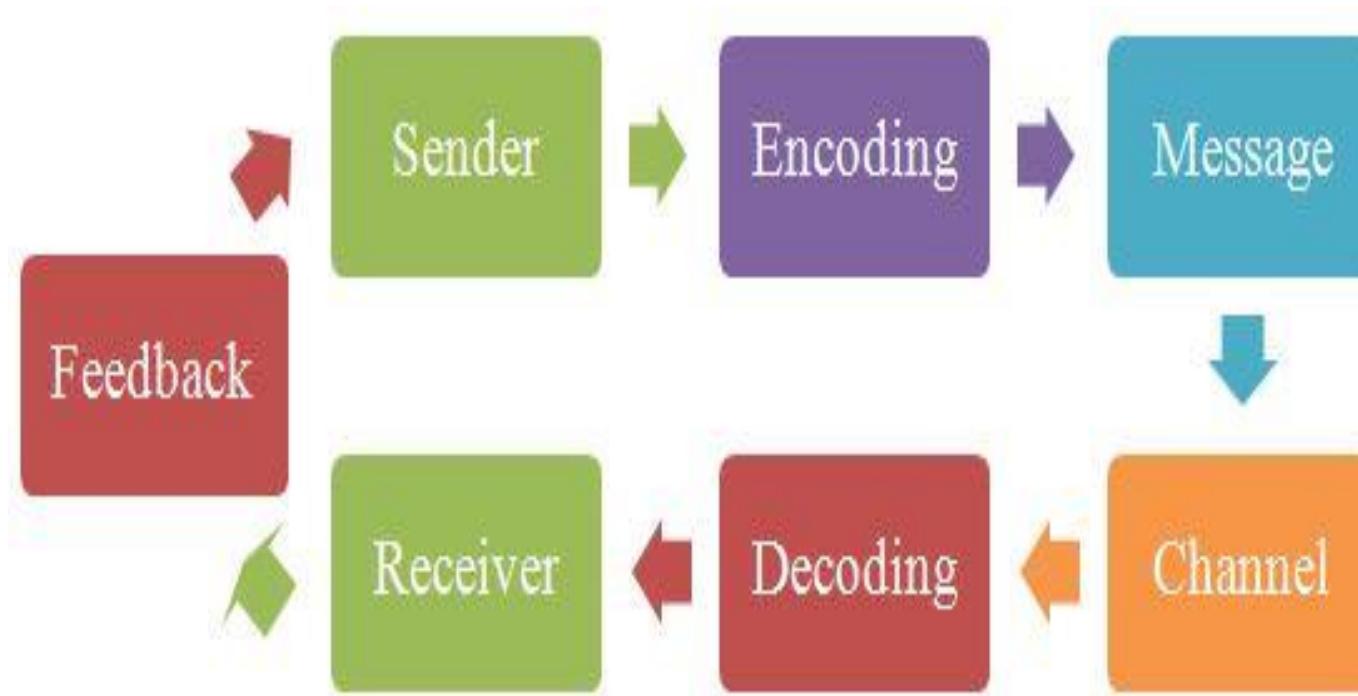


Elements of Communication





Communication Process





Human Computer Interaction

So many badly designed things in this world ...!!!





Human Computer Interaction

The 2000 USA Presidential Ballot in Florida

Confusion at Palm Beach County polls

Some Al Gore supporters may have mistakenly voted for Pat Buchanan because of the ballot's design.

Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.

Punching the second hole casts a vote for the Reform party.

ELECTORS FOR PRESIDENT AND VICE PRESIDENT	
(A vote for the candidates will actually be a vote for their electors.)	
(Vote for Group)	
(REPUBLICAN)	
GEORGE W. BUSH - PRESIDENT	3 ➤
DICK CHENEY - VICE PRESIDENT	
(DEMOCRATIC)	
AL GORE - PRESIDENT	5 ➤
JOE LIEBERMAN - VICE PRESIDENT	
(LIBERTARIAN)	
HARRY BROWNE - PRESIDENT	7 ➤
ART OLIVIER - VICE PRESIDENT	
(GREEN)	
RALPH NADER - PRESIDENT	9 ➤
WINONA LaDUKE - VICE PRESIDENT	
(SOCIALIST WORKERS)	
JAMES HARRIS - PRESIDENT	11 ➤
MARGARET TROWE - VICE PRESIDENT	
(NATURAL LAW)	
JOHN HAGELIN - PRESIDENT	13 ➤
NAT GOLDHABER - VICE PRESIDENT	
(REFORM)	
PAT BUCHANAN - PRESIDENT	4 ←
EZOLA FOSTER - VICE PRESIDENT	
(SOCIALIST)	
DAVID McREYNOLDS - PRESIDENT	6 ←
MARY CAL HOLLIS - VICE PRESIDENT	
(CONSTITUTION)	
HOWARD PHILLIPS - PRESIDENT	8 ←
J. CURTIS FRAZIER - VICE PRESIDENT	
(WORKERS WORLD)	
MONICA MOOREHEAD - PRESIDENT	10 ←
GLORIA La RIVA - VICE PRESIDENT	
WRITE-IN CANDIDATE	
To vote for a write-in candidate, follow the directions on the long stub of your ballot card.	

Sun-Sentinel graphic



Human Computer Interaction

And Well designed things



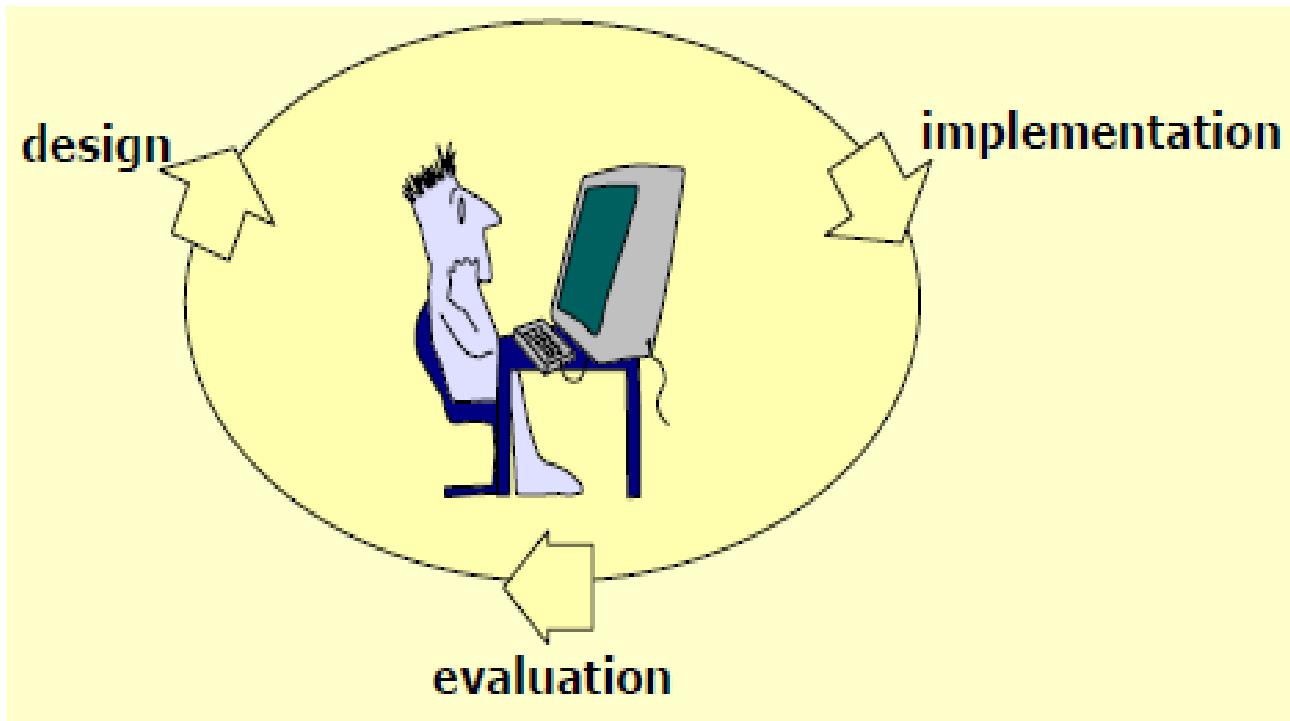
www.idsa.org

<http://www.vision.org>



Human Computer Interaction

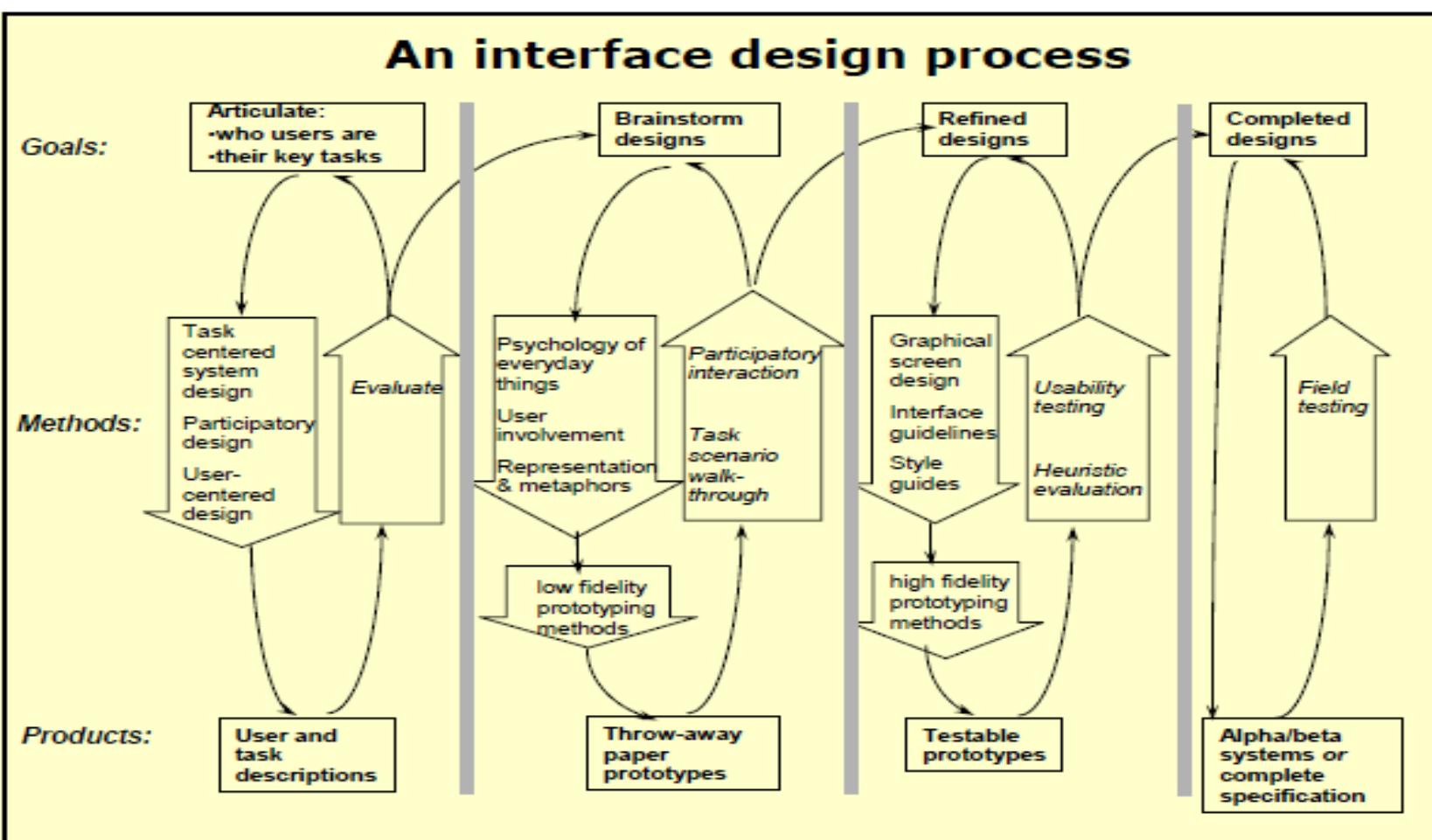
A discipline concerned with the



Of interactive computing systems for human use.



Human Computer Interaction





Human Computer Interaction

HCI is made up of;

- Theories:** Learn and apply
- Models:** create and use
- Methods:** Master and apply
- Guidelines:** Learn and use
- Principles:** understand and apply
- Techniques:** Master and use



Human Computer Interaction

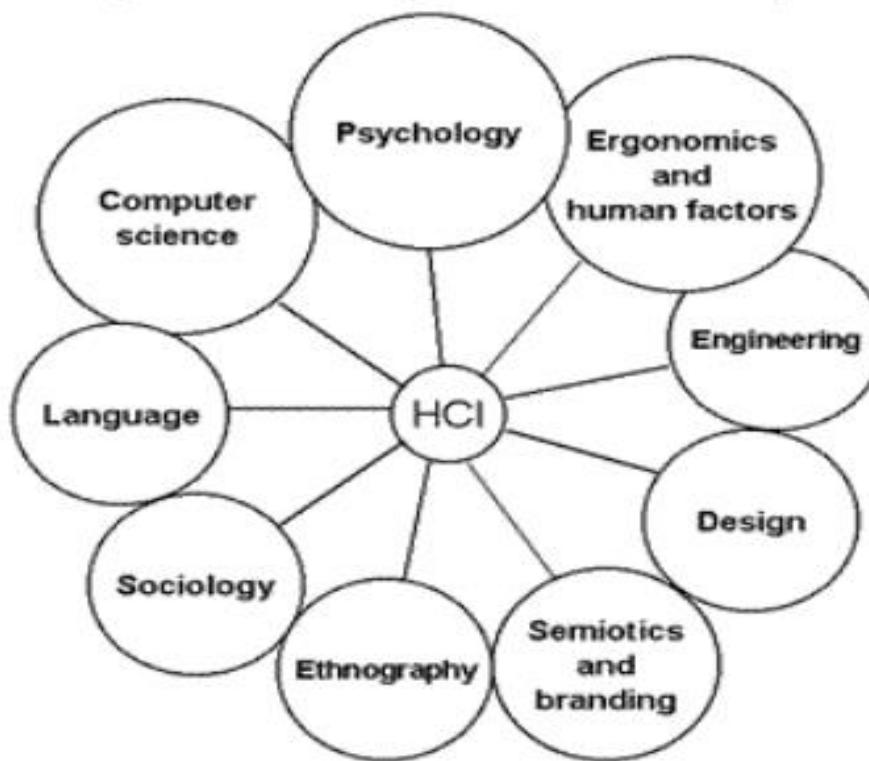
- ❑ HCI appeared in 1980s with advent of personal computing
- ❑ After machines like Apple Macintosh, IBM PC 5150 and Commodore 64 became available in homes and offices, sophisticated electronic systems were available to general consumers of uses such as word processors, games units and accounting aids.
- ❑ Consequently, as computers were no longer room-sized, expensive tools for experts in specialized environments, the need to create human-computer interaction that was easy and efficient for less experienced users became vital
- ❑ HCI is multidisciplinary field of study focusing on the design of computer technology and in particular interaction between humans and computers
- ❑ HCI has expanded to cover almost all forms of information technology design



Multidisciplinary Field of HCI

- ❑ HCI has expanded to incorporate multiple disciplines such as computer science, cognitive science, human-factors engineering

...





Human Computer Interaction..

- ❑ HCI is now not just about improving usability of desktop computers
- ❑ With the rise of technologies like Internet and Smartphones, computer use has moved away from desktop to embrace mobile world
- ❑ HCI has grown to be broader, larger and much more diverse than computer science itself. It has expanded from initial focus on individual and generic user behaviour to include social and organizational computing, accessibility for the elderly, cognitively and physically impaired, and for all people and for the widest possible spectrum of human experiences and activities.



Human Computer Interaction..

- ❑ HCI expanded from desktop office apps to include games, learning and education, commerce, health and medical apps, emergency planning and response, and systems to support collaboration and community
- ❑ HCI expanded from early graphical user interface to include myriad interaction techniques and devices, multi-modal interactions, tool support for model-based user interface specification, host of emerging ubiquitous, handheld and context-aware interaction



UX value of HCI and related Realms

- ❑ HCI overlaps with User-centered design (UCD), user interface (UI) design and user experience (UX) design
- ❑ HCI was forerunner to UX

The Evolution of UX Design



INTERACTION DESIGN
FOUNDATION

INTERACTION-DESIGN.ORG



Human Computer Interaction

HCI is changing

- Physical things
- GUI Interfaces
- Collaborative interfaces
- Internet technologies
- Social technology
- Ubiquitous technology
- ???



Human Computer Interaction

HCI is

- Inventing the future
- Improving the present
- Creating experiences
- Changing the world for the better
- Understanding how people think, reason, understand, plan, react
- Understand that people are embedded in social structures
- Aware of the tasks people want to do (work, rest and play)
- Technologically aware



Human Computer Interaction

HCI is

- Creative
- Design-aware (user-centred design, task-artifact cycle)
- Evaluative (Cognitive walkthrough, questionnaires, statistics)



Human Computer Interaction

The User

- Perceptual-motor control
- Decision making
- Social cognition



Principles of Interaction Design

To make better interactive technology, we need to

- Know about how people **interact** with things
- Know about what people **can and can't do**
- Know about the **situations** in which people do things
- Know about the **basics** of good design
- Understand people's **goals**



Interaction Design

Laws of Interaction Design

3 Good Reasons for Laws in ID

- ❖ Describe: Understand what is going on
- ❖ Predict: What will happen if
- ❖ Generate: New alternatives

We shall learn about laws of

- Computers
- Human motor skills
- Human Cognition



Interaction Design

Laws of Interaction Design

About Computers:

- ❖ Moore's Law
- ❖ Buxton's Law
- ❖ God's Law

About human motor skills:

- ❖ Fitts' Law
- ❖ Steering Law
- ❖ Guiard's Kinematic chain model

About Human Cognition:

- ❖ Hick's Law
- ❖ Law of practice
- ❖ Murphy's Law

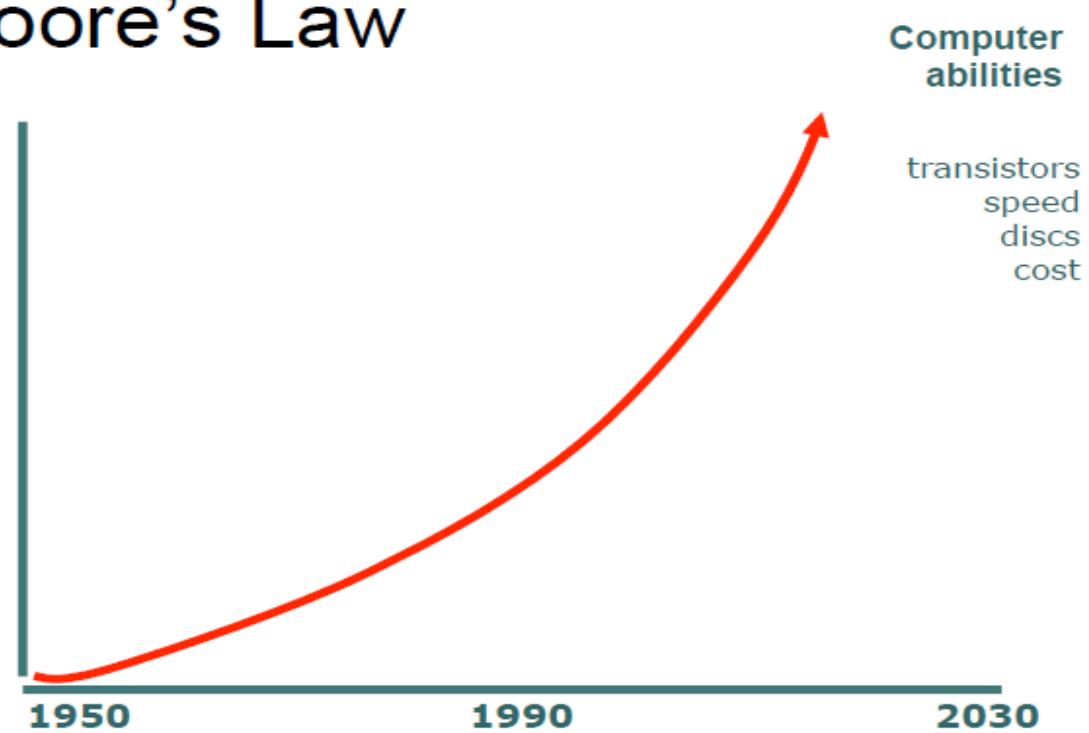


Interaction Design

Moore's Implications (Don't worry much about...)

- Computing power
- Storage capacity
- Screen resolution
- Device size
- Weight
- Battery life (?)

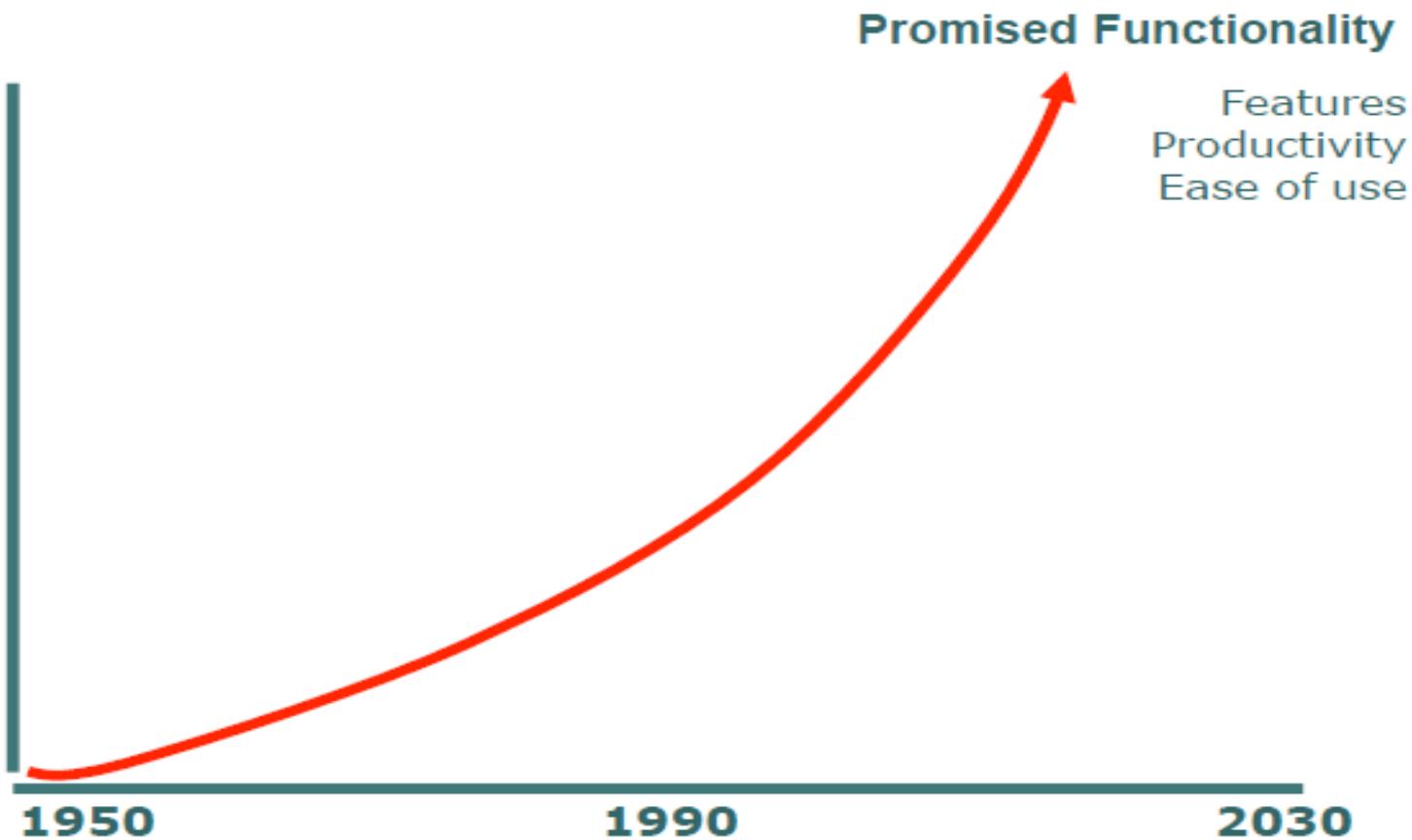
Moore's Law





Interaction Design

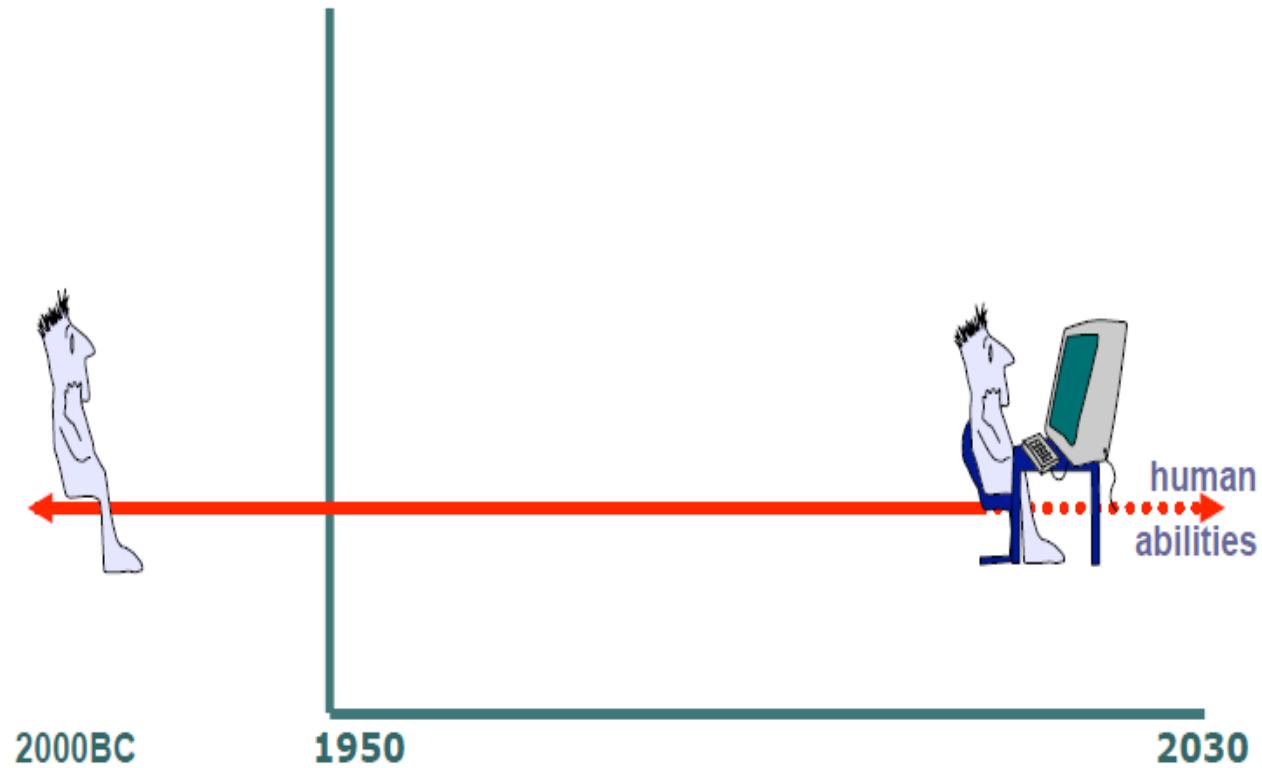
Buxton's Law





Interaction Design

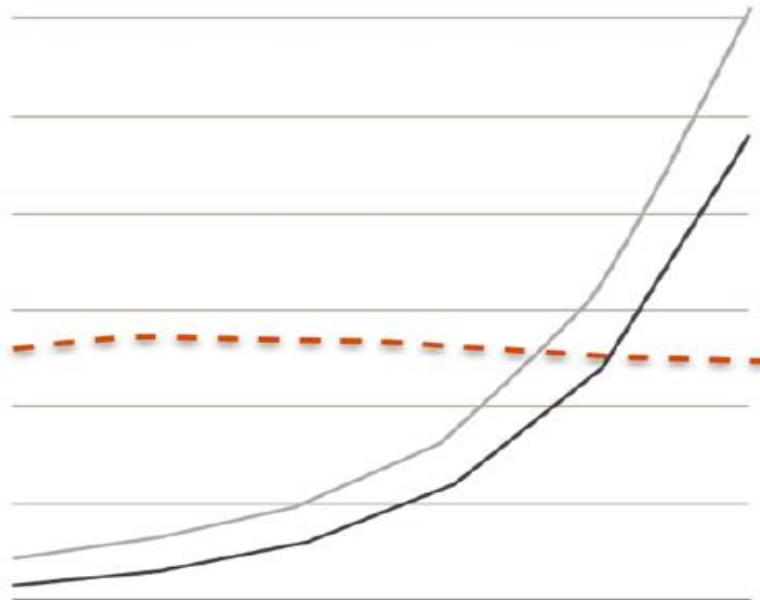
God's Law (Psychology)





Interaction Design

Buxton's law

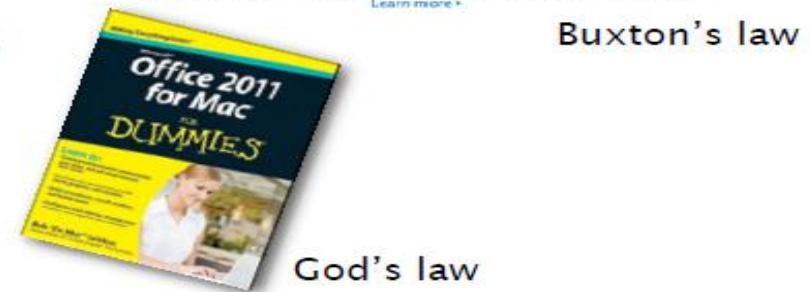


Moore's law



With iOS 5, we've added over 200 new features — taking a mobile operating system that was already years ahead of anything else and moving it even further ahead.

[Learn more +](#)



Buxton's law

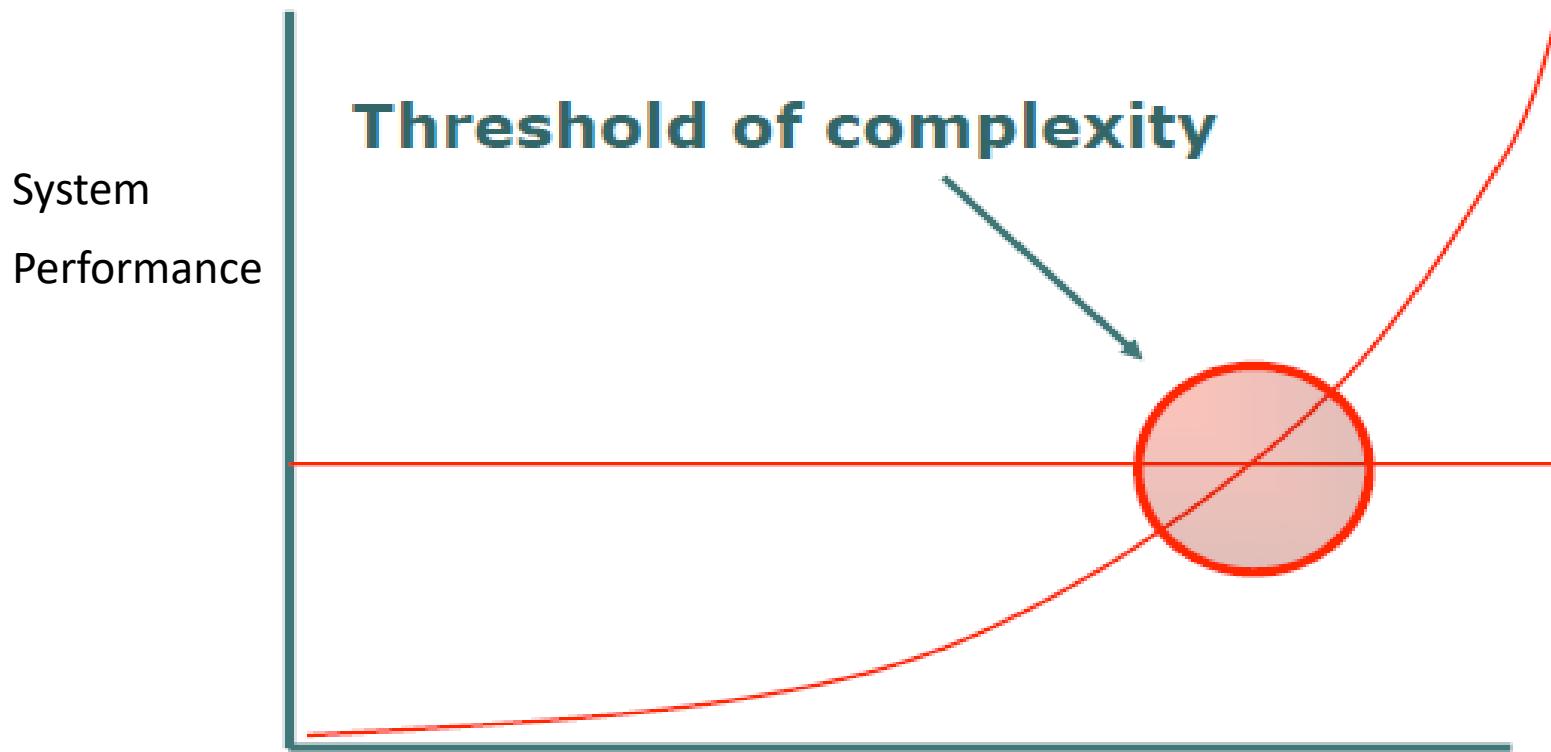
God's law

<http://www.billbuxton.com/LessIsMore.pdf>



Interaction Design

What is the bottleneck ????



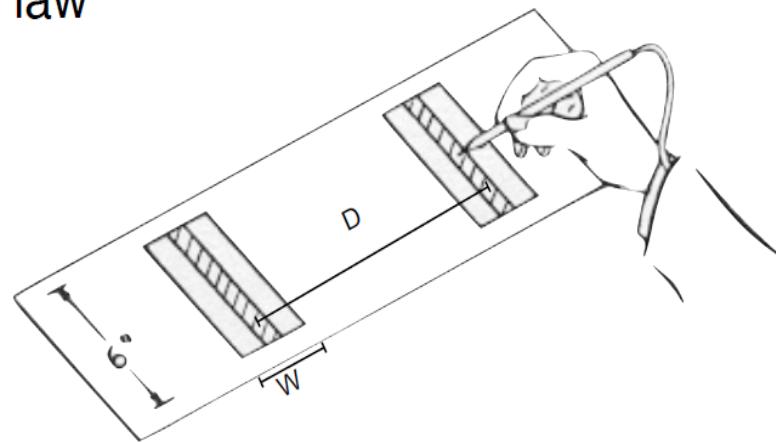
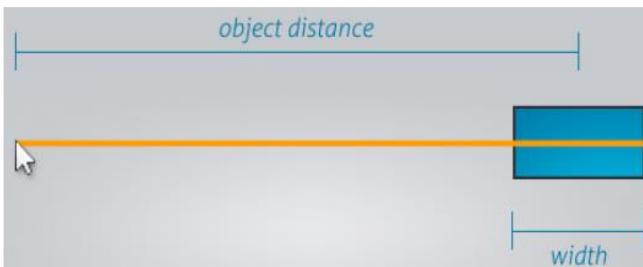


Interaction Design

Fitts' Law

The time to acquire a target is a function of the distance to and width of the target

Fitts' law



$$MT = a + b * ID = a + b * \log_2\left(\frac{D}{W} + 1\right)$$

Movement Time Distance
 ↓
 Coefficients
 a: Intercept
 b: Slope
 Width



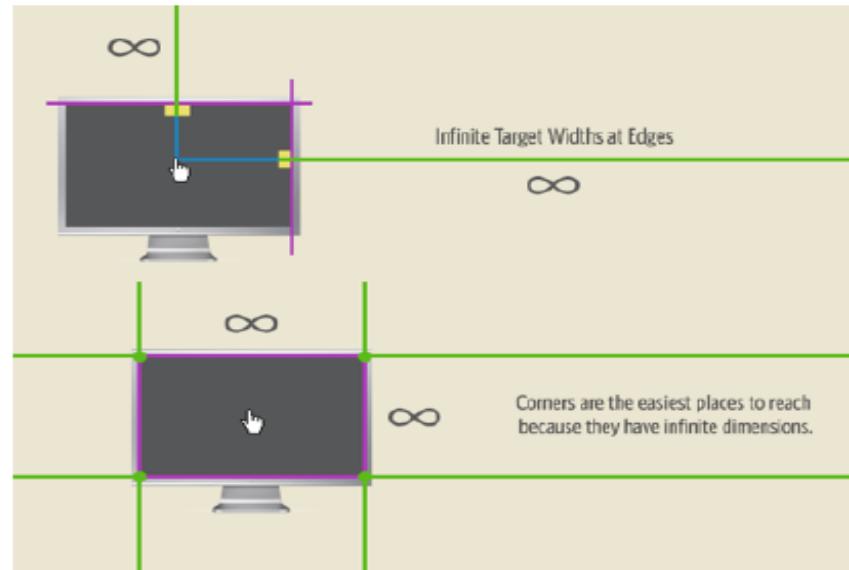
Interaction Design

Implications of Fitts' Law

Larger targets are easier to hit
-> maximize button size

Movement time increases
(logarithmically) with distance
-> minimize distances
-> no movement is even better!

Infinite targets:
-> leverage screen borders
-> leverage corners

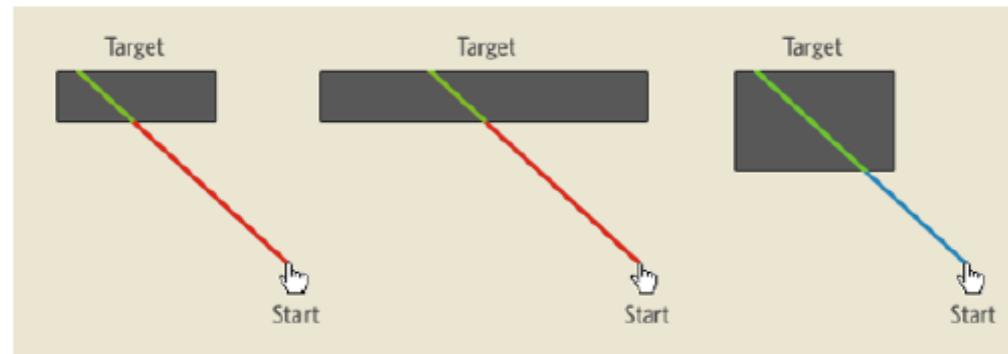




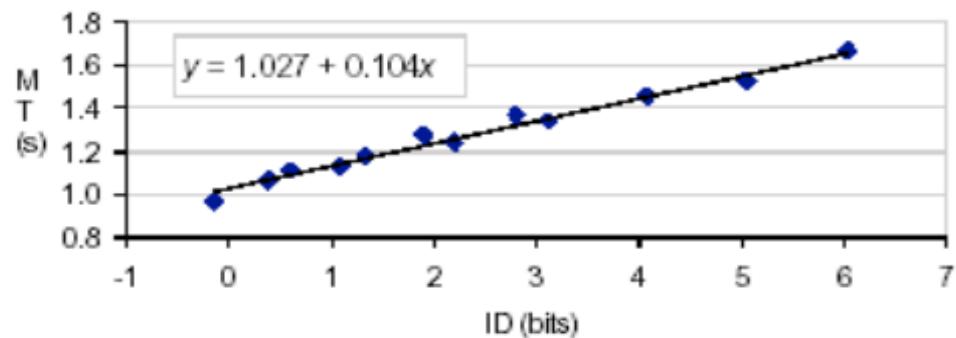
Interaction Design

Bigger Is Not Always Better

Movement direction to target



Logarithmic improvements
with size



MacKenzie's reevaluation of Card's Fitts' Experiment for text selection

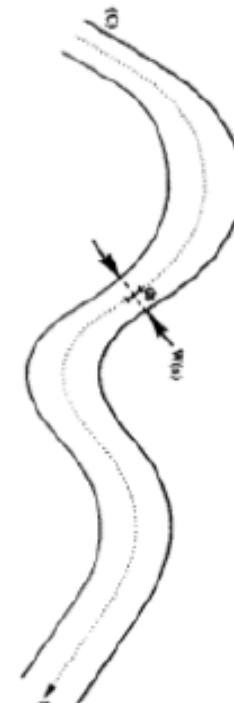
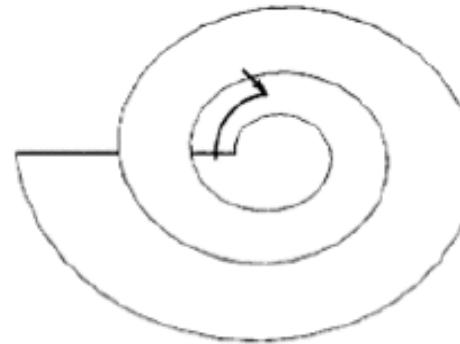
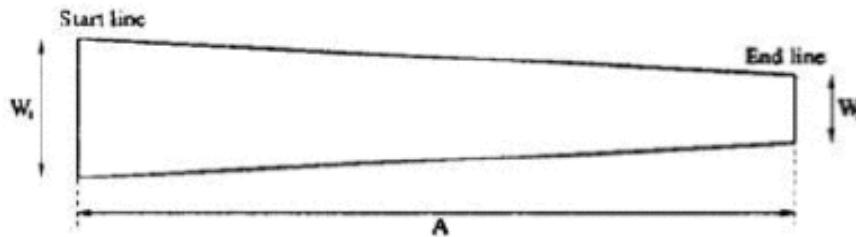


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Steering Law

Why is it called Steering Law ?

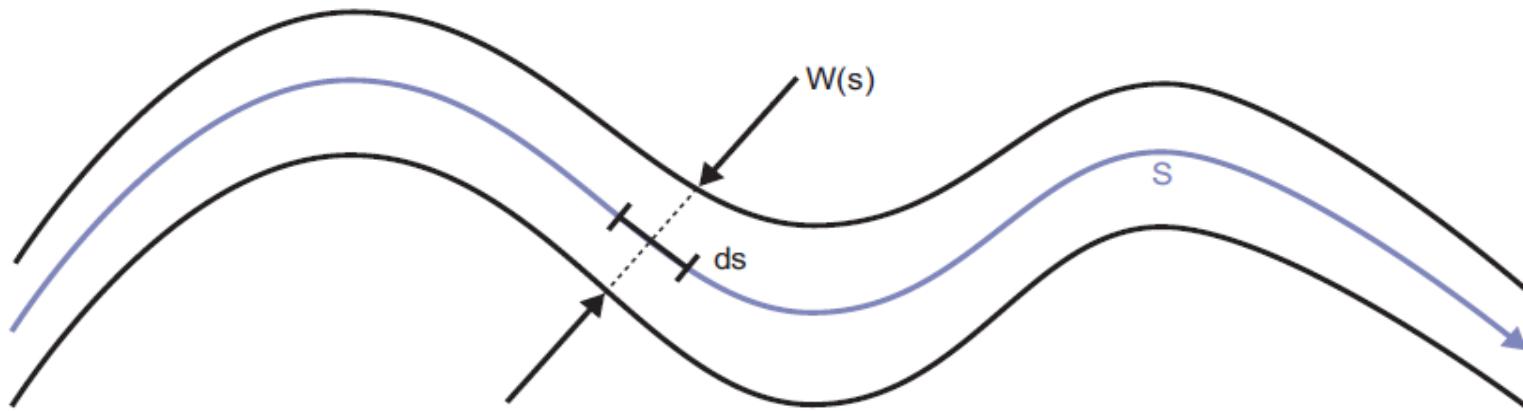
- Early work focused on car driving scenarios and models with straight tunnels
- Various example tunnel shapes have been explored





Interaction Design

Steering Law on Curved Paths



average time to navigate through the path

$$T = a + b * \int_S \frac{1}{W(s)} ds$$

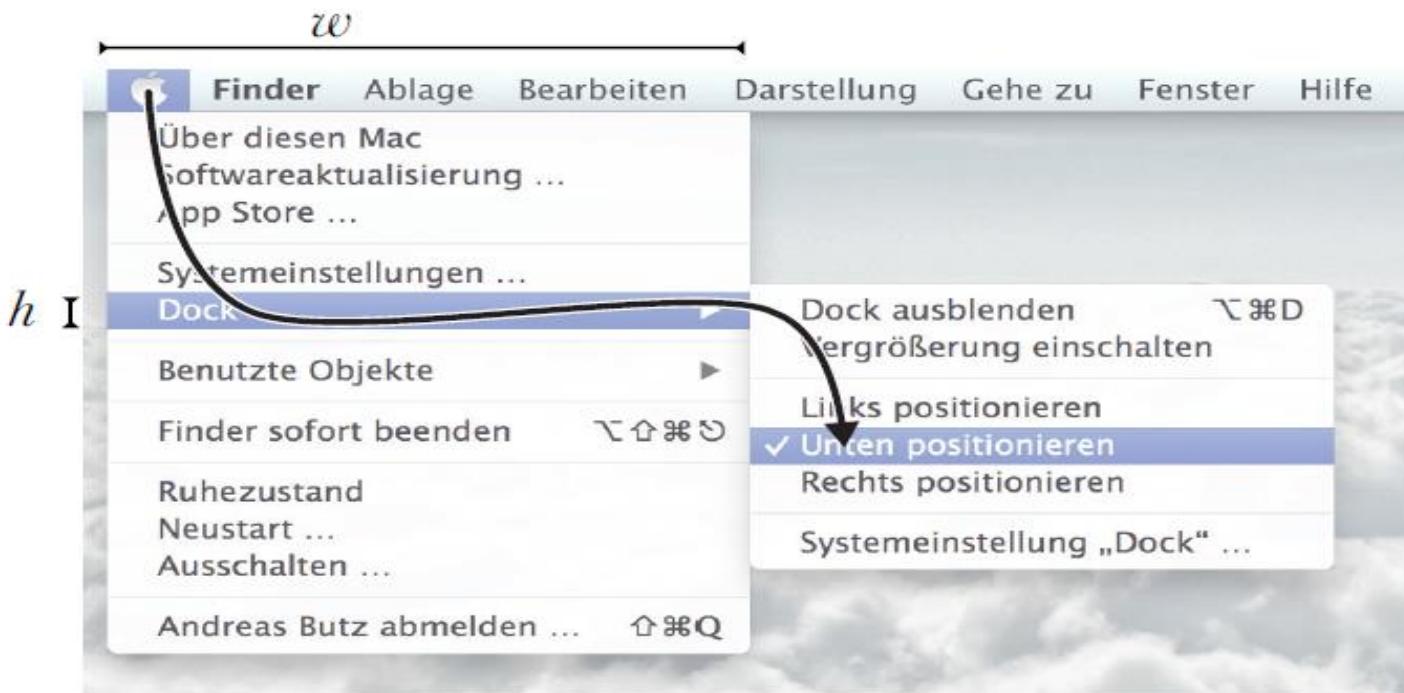
↑ ↑ S ↗

experimentally fitted constants width of the path at s



Interaction Design

Example of Application of Steering Law



$$T = \left[a_1 + b_1 * \log_2 \left(\frac{nh}{h} + 1 \right) \right] + \left[a_2 + b_2 * \frac{w}{h} \right] + \dots$$

vertical: Fitts' law

horizontal: steering law



Interaction Design

Quick Class Discussion

How can we use Fitts' law and steering law to make a computer game more challenging ?





Interaction Design

Guillard's Kinematic chain Law

Human capability

“Under standard conditions, the spontaneous writing speed of adults is **reduced** by some **20%** when instructions **prevent the non-preferred hand from manipulating the page**”

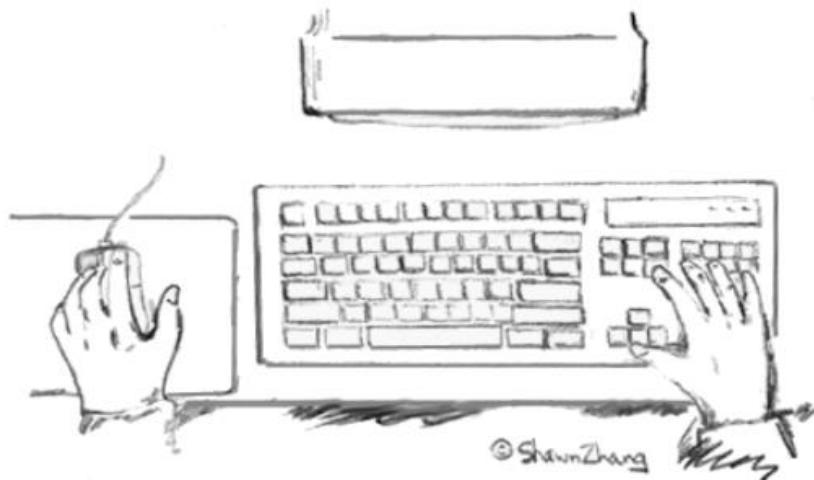
Non-dominant hand provides a frame of reference for the dominant hand

- Non-dominant hand operates at a coarse temporal and spatial scale
- Dominant hand operates at a fine temporal and spatial scale



Interaction Design

Two handed-interaction at the desktop



Which tasks in daily life follow a similar distribution of roles between the hands???

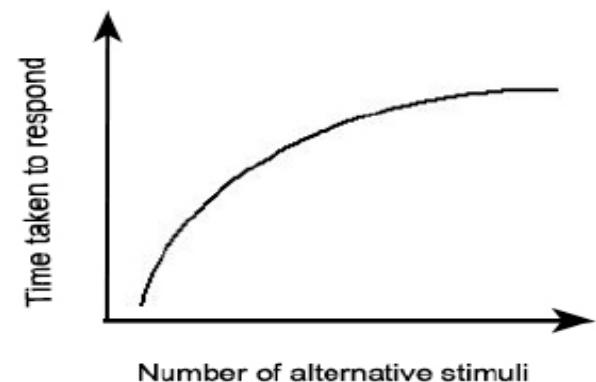
Which ones don't ???



Interaction Design

Hick's Law

*Given n known and **equally probable** choices, the average reaction **time** T required **to choose among them** is:*



$$\text{Time} \longrightarrow T = b \cdot \log_2 (n + 1)$$

↑ ↑
Coefficient Choices

↓
binary search strategy



Interaction Design

Example of Hick's Law



<http://www.hier-luebeck.de/wp-content/uploads/2010/09/StartMenueWindows7.jpg>



http://www.photosophic.com/iphone_screen



Interaction Design

The Power Law of practice

- When performing a task based on practice trials, people improve in speed at a decaying exponential rate.
- The time needed for a particular task decreases in proportion to the number of practice trials taken raised to a power of about $a = -0.4$
- The logarithm of the time needed for a particular task decreases linearly with the logarithm of the number of practice trials taken (this formulation is for the math geeks... ;-)

Completion time for trial n

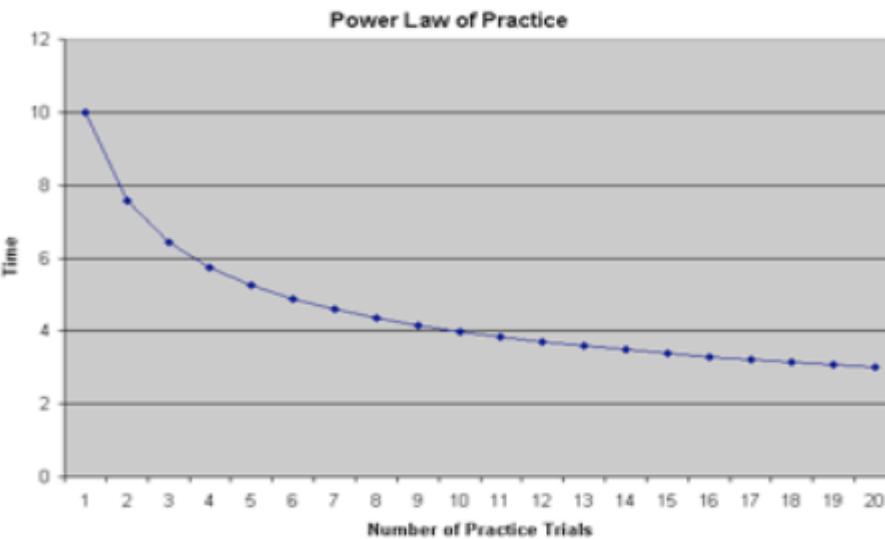
↓

$$T(n) = T(1) n^a + c$$

↑

Completion time for trial 1

Constants





Interaction Design

Murphy's Law

“Whatever can go wrong, will go wrong.”

[Edward Aloysius Murphy Jr. 1949]

“If there’s more than one possible outcome of a job or task, and one of those outcomes will result in disaster or an undesirable consequences, then somebody will do it that way.”



Interaction Design

Implications of Murphy's Law

Prepare for human errors, wrong input

- Do sanity checks in dialogs
- Provide useful defaults
- Make serious mistakes hard

When building stuff, provide extra time for:

- Mistakes in manufacturing
- Non-functional tools
- Faulty material
- Misunderstandings



Interaction Design

Examples of Murphy's Law



github

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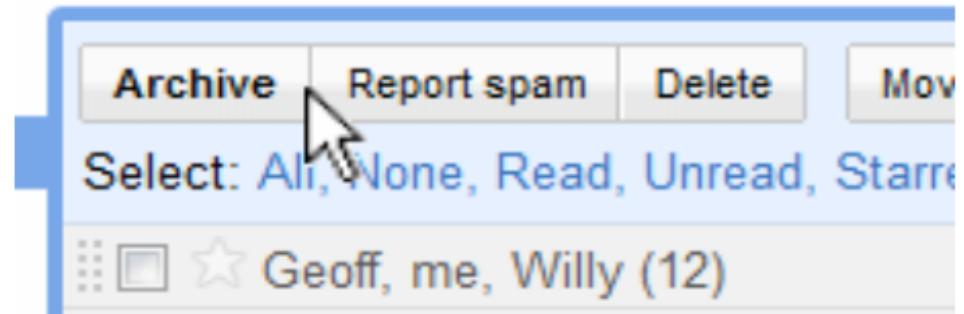
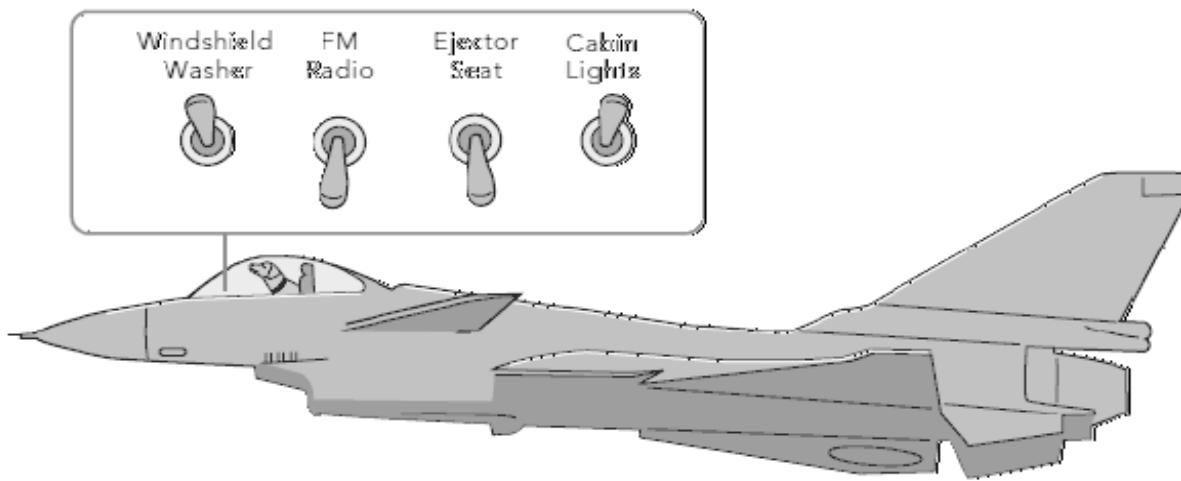


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Interaction Design

Murphy's Vs Fitts' Law





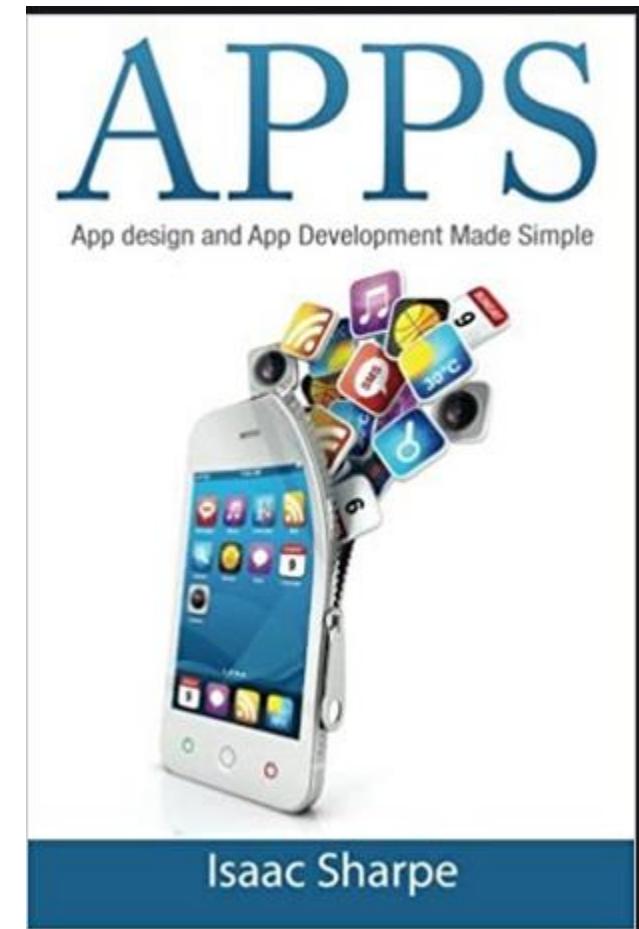
Principles, Theories and standards of user interfaces

- User Interfaces
- Menu Systems and Applications



User interfaces

- There are millions of apps on the store today but many have found it hard to thrive, others have been successful, one common thing in successful applications, they have a great feel and look.





Presentation Overview

1. An overview user interface
2. Input devices for user interfaces
3. Types of a user interface
4. Reasons for an efficient design
5. User interface and user experience
6. Aspects to consider in the development of a user interface
7. User interface best practices
8. User interface principles
9. Menu systems and applications
10. Navigation and different kinds of navigation
11. Types of menus



An overview of a user interface

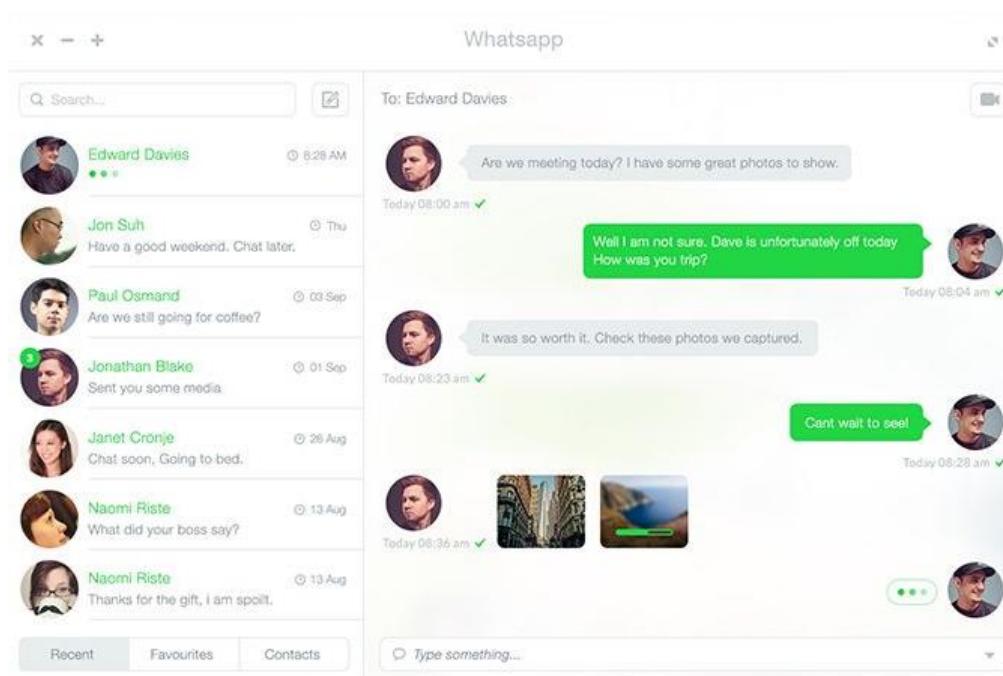
Definition of a user interface.

- It entails the appearance of an application when a user is interacting with it.
- It includes the apps design, graphics and presentation and usually touch sensitive on a mobile device to allow a user to interact with the devices applications, features, content and functions.
- Many users are looking for applications that look appealing and feel good when using them.



An overview of a user interface

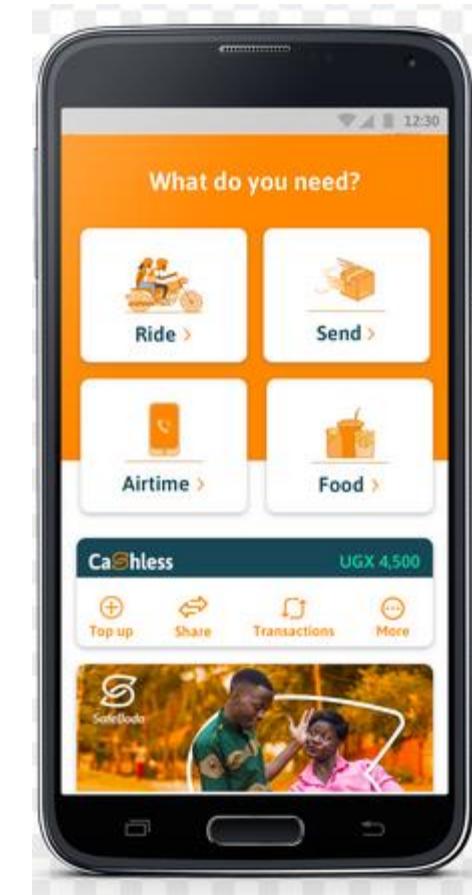
- Mobile user requirements are different from those of desktop applications





An overview of a user interface

- A visually appealing and engaging app is as a result of having an efficient User Experience (UX) and User Interface (UI).
- Symbols are used more excessively and controls are hidden until accessed.
- Symbols must be smaller and no room for text labels as this would bring confusion.
- Users have to be able to understand a command icon and its meaning through a legible text or comprehensive graphical representation.
- An excellent User Interface will create an instant attraction to your app while superb UX will put a lasting impact on the user's mind.





Input devices for user interfaces

- UI is created in layers of interaction that appeal to the human senses(senses, touch , auditory and more).
- Include input and output devices.
- An **input device** is any hardware device that sends data to a computer allowing you to interact with and control it.

Examples

- Touchscreens, keyboards, mice, remote controls, microphones, interactive voice response.
- Output devices like monitors, speakers, printers.



Types of user interfaces

- **Form-based user interface**

Used to enter data into a program or application by offering a limited selection of choices for example a settings menu on a device's application

The screenshot shows a sign-up page with the following fields:

- Email or Phone
- Password
- Keep me logged in
- [Forgot your password?](#)
- Sign Up**
- It's free and always will be.
- First Name
- Last Name
- Your Email
- Re-enter Email
- New Password
- Birthday:
Month: Day: Year: Why do I need to provide my birthday?
- Female Male
- By clicking Sign Up, you agree to our Terms and Conditions and read our Data Use Policy, including our Cookie Use.
- Continue**
- You can create a Business-only Page from here, but it's not recommended**
- [Create a Page for a celebrity, band or business.](#)



Types of user interfaces

- Graphical user interface

A tactile UI input with a visual UI output





Types of user interfaces

- **Menu-driven user interface**

A UI uses a list of choices to navigate through a program





Types of user interfaces

- Touch user interface

UI through haptics. Commonly in smart phones, tablets, laptops.

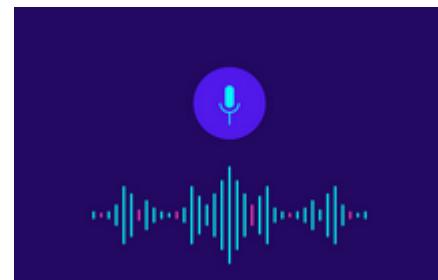




Types of user interfaces

- **Voice input interface**

Interactions between humans and machines using auditory commands
for example talk to text, GPS,





Reasons for an efficient UI design

- It enhances customer satisfaction
- Helps to understand your audience
- Builds your brand
- Saves time and money

How UI/UX design make your app successful

- Mobile app users like applications that are easy to use and more engaging for example WhatsApp which has offered their users seamless navigation and an attractive interface
- A great user interface gives users a realistic feel when using the app and a continuous flow of valuable information. More users will be interested hence creating a natural traffic.



User interface and user experience

- Both related and equally important but differ in specifics
- UI designed around the intended look and feel
- UX spans the entire process of conceptualization, development and delivery.

Differences

User experience	User interface
purpose and functionality of the product	quality of users interaction with the product
components such as market research, identifying user needs	more artistic design components
overall project management	while UI focuses on the design of the product.



Aspects to consider in the UID development

- Retain uniformity
- Use a simple design
- Provide fast loading speed
- Use standard elements
- Make it more attractive
- Focus on your intended audience
- Use adaptive UI Design
- Include feedback and response time
- Provide user assistance and help
- Forgiving interphase



Aspects to consider ...

- **Retain uniformity**

Ensure consistency across all platforms as this will increase familiarity with the app.

This makes it easy for users to interact with your application



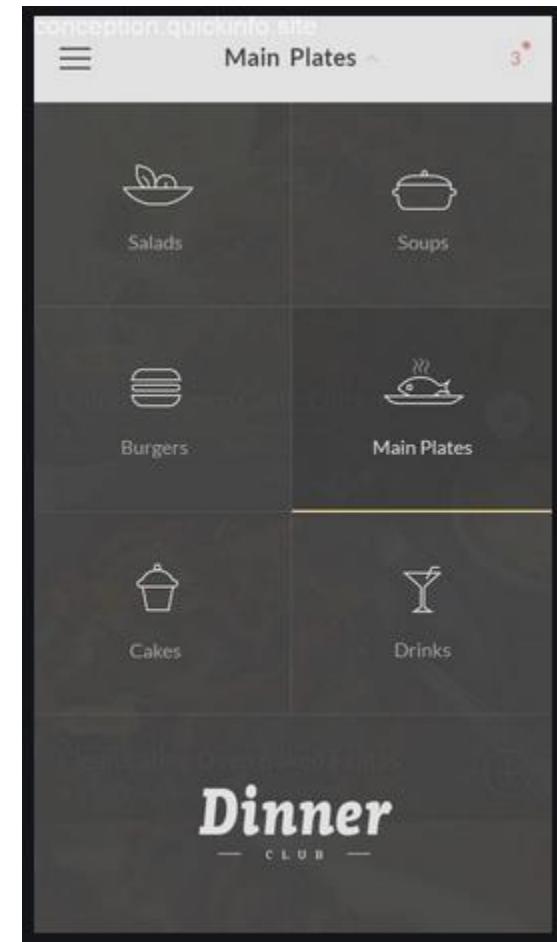


Aspects to consider ...

- **Use a simple design**

An app should be designed to provide exceptional services at a minimal input.

This encourages usability and loyalty to the app.





Aspects to consider ...

- **Provide fast loading speed**

Users want to save time hence prefer an application with short loading span

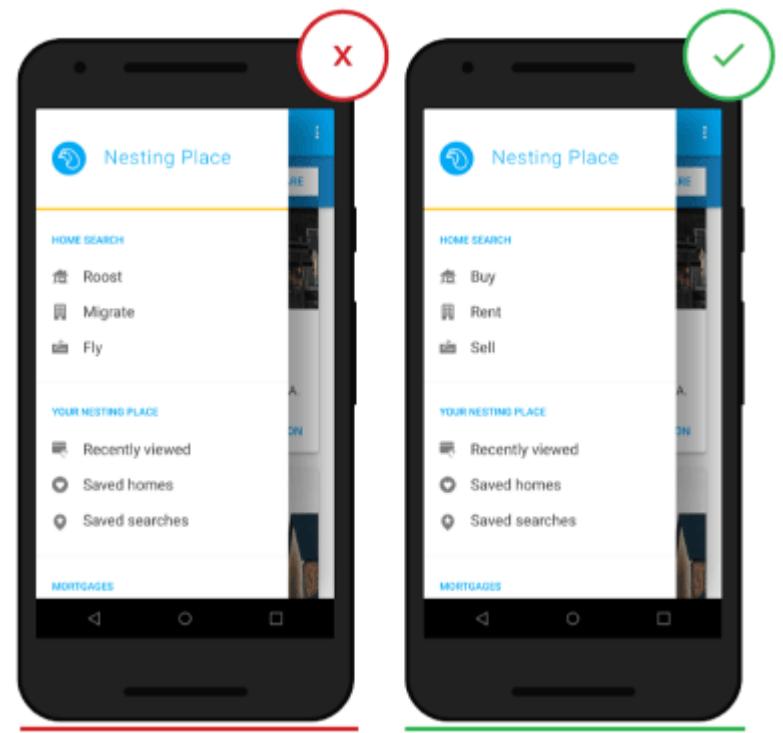




Aspects to consider ...

- **Use standard elements**

Use of standard symbols, colors, buttons and icons in order not to require any additional guidelines on how to use the app



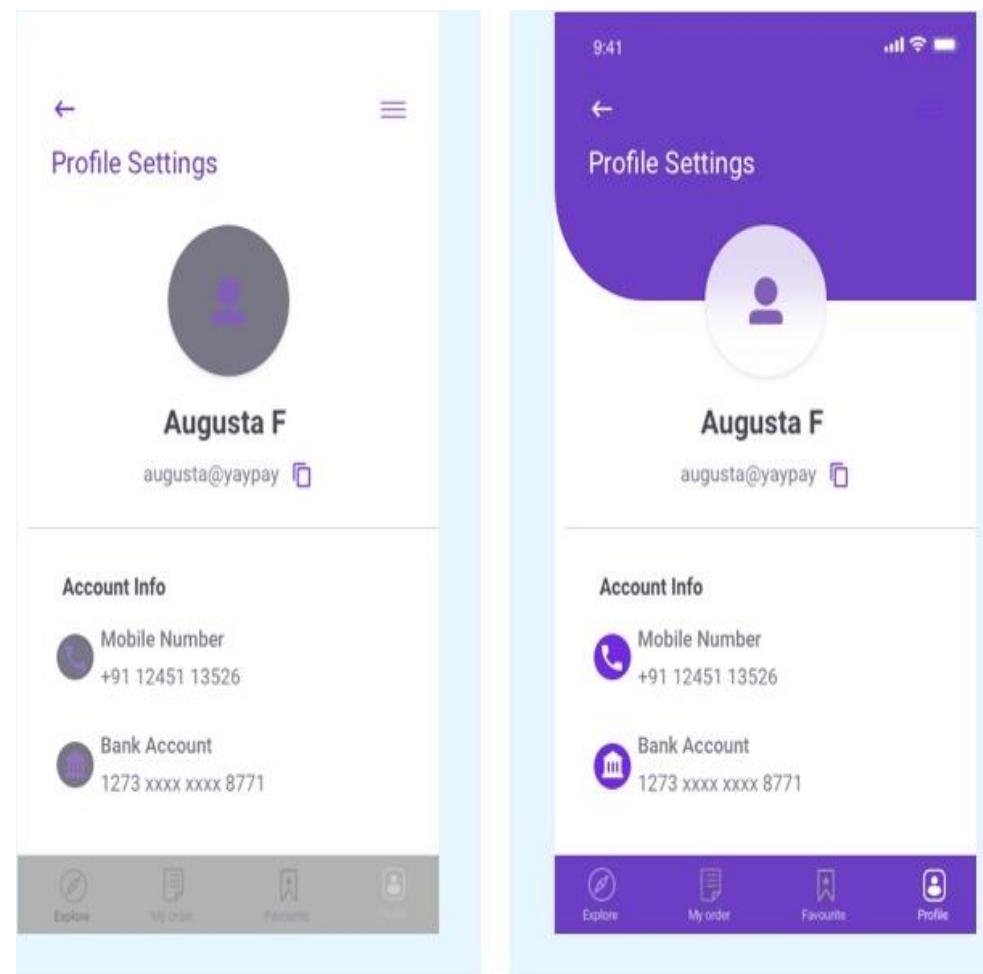


Aspects to consider ...

- **Make it more attractive**

An attractive app is easy to navigate.

Color, icons but too many colors can reduce the visual appeal of the application





Aspects to consider ...

- **Focus on your intended audience**

A good app should focus on the target market.

Empathize with the user to have a clear understanding of their Preferences.

This is the first impression

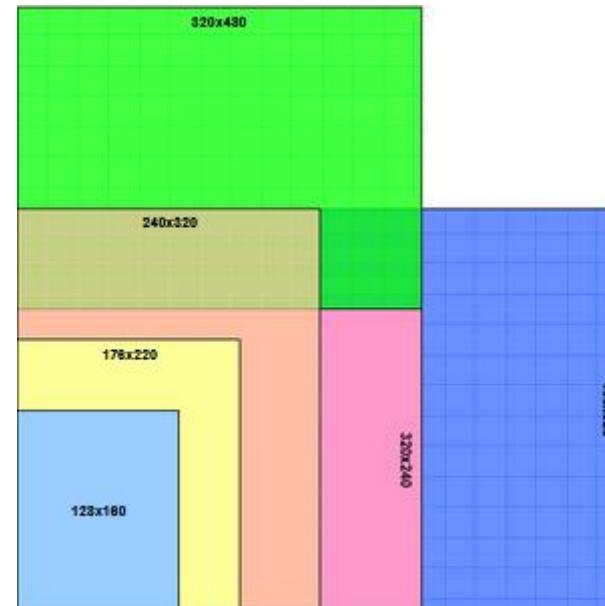
The screenshot shows the mobile application interface for 'WHAT TO EXPECT.com Baby Tracker'. At the top, there's a purple header bar with the 'WHAT TO EXPECT.com' logo on the left and a 'Baby Tracker' button on the right. Below the header, a navigation bar features three tabs: 'Tracker' (which is highlighted in dark blue), 'Groups', and 'Development'. To the right of the tabs is a circular arrow icon. The main content area has a light blue background. At the top of this area, the text 'Tracking: Baby 1' is displayed next to a right-pointing arrow. Below this, a message says 'Pick an activity to track, or view the Log.' Four large, rounded square buttons are arranged in a 2x2 grid. The top-left button is blue and labeled 'Sleeping' with an icon of a baby in a stroller. The top-right button is green and labeled 'Feeding' with an icon of a bib. The bottom-left button is purple and labeled 'Diapers' with an icon of a diaper. The bottom-right button is orange and labeled 'Vaccinations' with an icon of a checkmark inside a box. At the bottom of the screen is a large blue rectangular button labeled 'View Log' in white text. To the right of this button is a small circular icon containing a white letter 'i'.



Aspects to consider ...

- **Adaptive UI design**

Solve the problem of designing for varying screen sizes and resolutions, too many screens which is difficult.



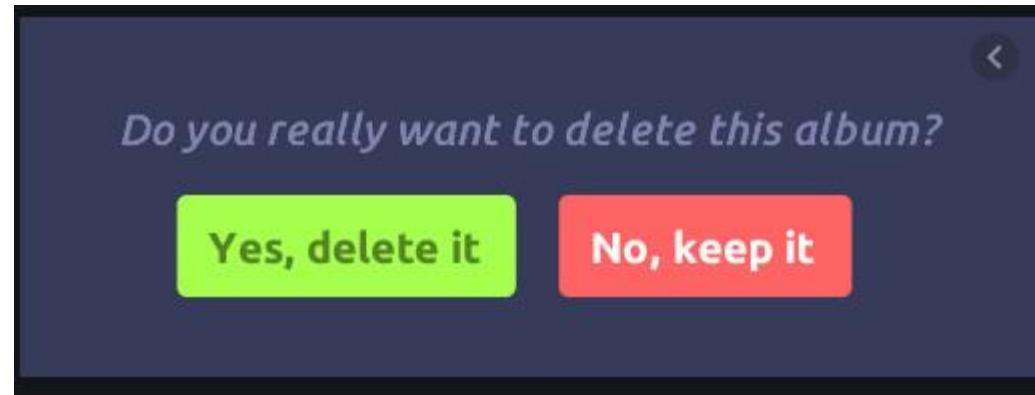


Aspects to consider ...

- **Forgiving phase**

Users can make mistakes while using an app.

A good app should have a forgiving phase that can save users from errors that can be costly





User interface best practices

- The layout of information, commands content in an app should echo those of the operating system in placement.
- While application may diverge to some degree of style, consistency allows users to intuit or at least learn how to use the interface.
- Click points must be usable for touch based selection with a finger. This means that a click point can't be too small or narrow in any direction to avoid unwanted section or near by selections also known as fat fingering
- Maximize content window size. On small screens, the UI should not necessarily dominate screen size. It is important to recognize that object of UI is to facilitate use of content and app not just the interface.
- The number of controls displayed at any time should be appropriate to avoid overwhelming and confusing the user



User interface principles

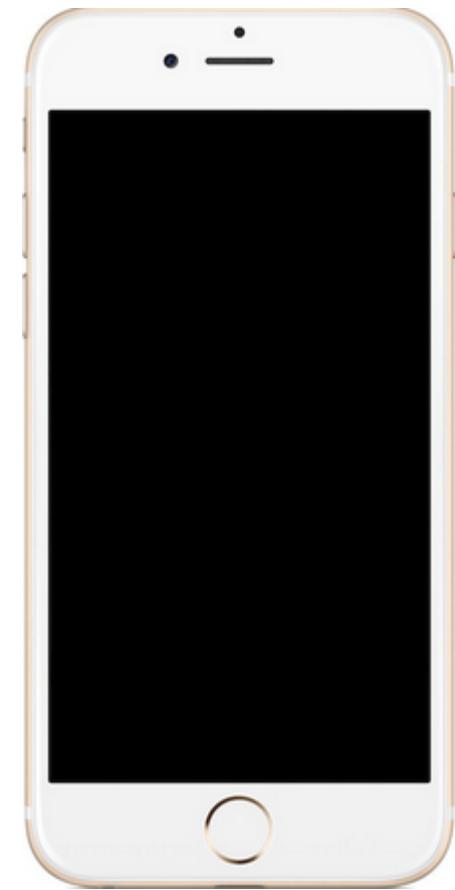
- Content first approach
- High resolution images
- Full screen size matters
- No clutter
- First impression
- User focused
- Color phycology
- Smart organization reduces screen overload
- Keep secondary actions secondary
- Keep users in control
- Humans are more
- Appearance follows behavior



User interface principles

- **Full screen size matters**

Loss of borders and introduction of full size screens in smart phones, no buttons on phones hence while designing the graphics, do not follow the old age rule.



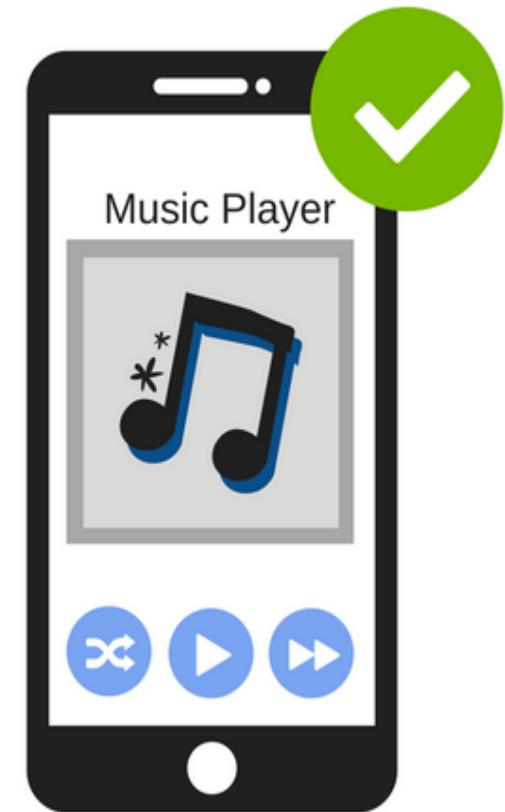
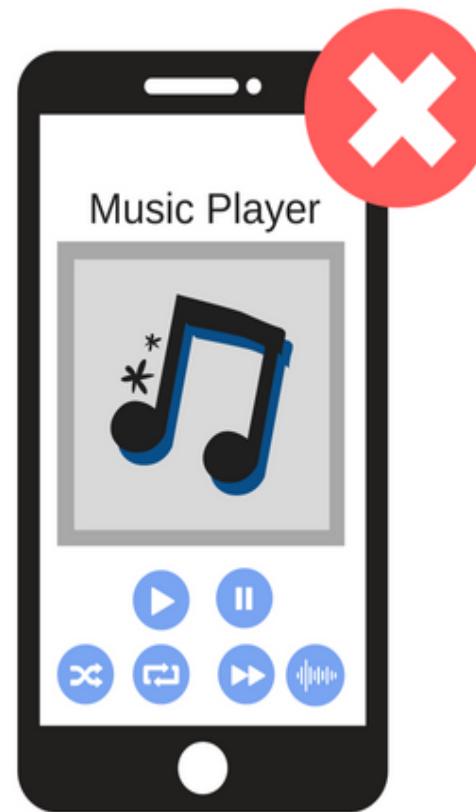


User interface principles

- No clutter

Clarity is important.

Too many buttons or images only complicate usability and irritate customers





User interface principles

- **First impression**

Like a home page for a website, apps icon is the first thing visitors notice. mobile User interface apps icons should entice users to download it



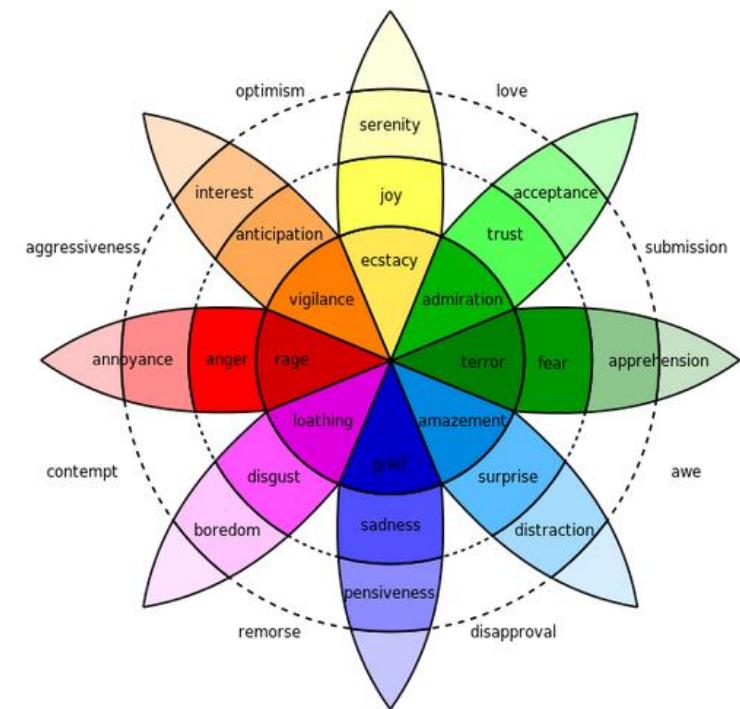


User interface principles

- **Color psychology**

Include subtle animation when transitioning between screens.

Every color tells a different story and invokes a specific emotion



Robert Plutchik's famous "wheel of emotions"

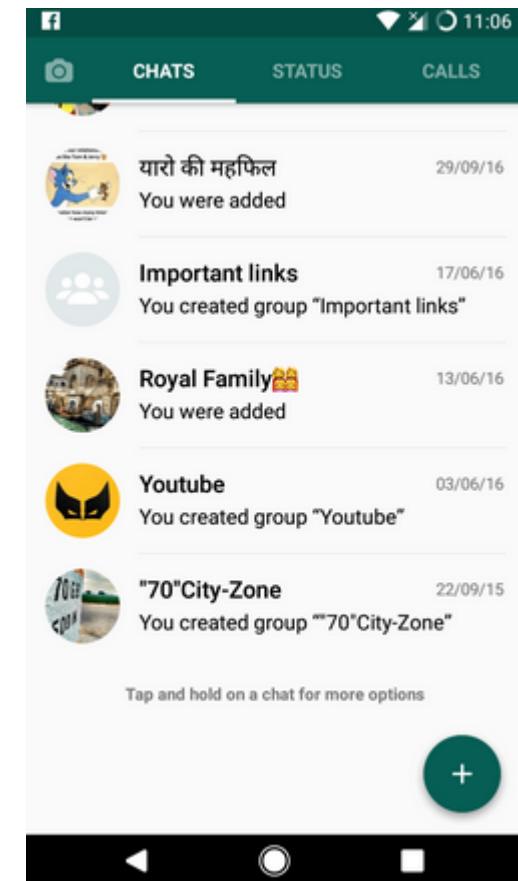


User interface principles

- Smart organization reduces screen overload

This makes the many elements appear as few.

This helps users to understand your interface easier and quickly





User interface principles

- Keep secondary actions secondary

Primary actions have secondary actions.

Keep them light weight visually or show them after achieving the primary action





User interface principles

- **Keep users in control**
Humans are more comfortable if they feel they are in control of themselves or the environment.
Surface the system with caution by giving an insight on what it is happening

The image shows two side-by-side user interface designs for a login form, illustrating different approaches to user feedback.

Left Design: This design provides immediate, specific feedback for each field. The "E-mail" field contains "me@domain.com". The "Password" field contains "*****". Below the password field, the word "Error!" is displayed in red, indicating an invalid password attempt. A large red circle at the bottom left contains a white "X", signifying failure.

Right Design: This design also provides immediate feedback. The "E-mail" field contains "me@domain.com". The "Password" field contains "*****". In this version, the error message "Password incorrect. If you don't remember your password, reset it" is displayed in red below the password field. A large green circle at the bottom right contains a white checkmark, signifying success.



User interface principles

- Appearance follows behavior

Humans are most comfortable with things that behave the way we expect. If it is a button, it should behave like a button

The diagram illustrates the principle of appearance following behavior by showing two side-by-side sections: 'Clickable buttons' and 'Non-clickable buttons'. A vertical dashed line separates the two.

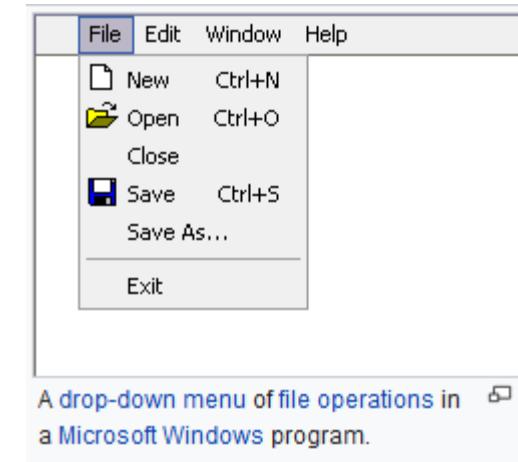
Clickable buttons: This section shows three interactive elements. At the top is a blue rectangular button labeled 'Booking'. Below it are two smaller, rounded rectangular buttons: one purple labeled 'One way' and one white with a purple border labeled 'Round trip'. At the bottom is a blue rounded rectangular button labeled 'View more recipes'.

Non-clickable buttons: This section shows three non-interactive elements. At the top is a grey rectangular box labeled 'Booking'. Below it is a large purple circle containing the text 'View more recipes'. To the right of the circle are two small, empty rectangular boxes: one white labeled 'One way' and one white with a purple border labeled 'Round trip'.



Menu systems and applications

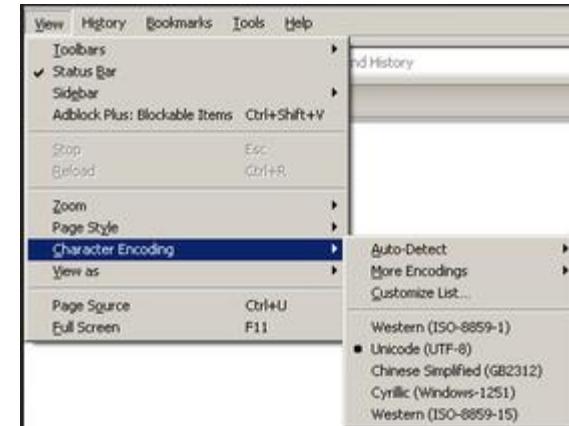
- A menu is a list of options or commands presented to the user of a computer or communication system.
- It can be a system's entire user interface or only part of a complex one.





Menu systems and applications

- Traditionally menu names are always supposed to be verbs such as file, edit but a single verb word is sometimes unclear hence allow multiple word menu names.
- Menus are sometimes hierachal organized allowing navigation through different levels of the menu structure. Criticized because any error in touching the boundary of the parent will hide the submenu.





Navigation

2 kinds

- Linear navigation
- Non-linear navigation
- **Linear navigation**

A user chooses an option from a menu by using an input device passing one item to another until reaching the desired selection.

For example a reverse video on a computer terminal

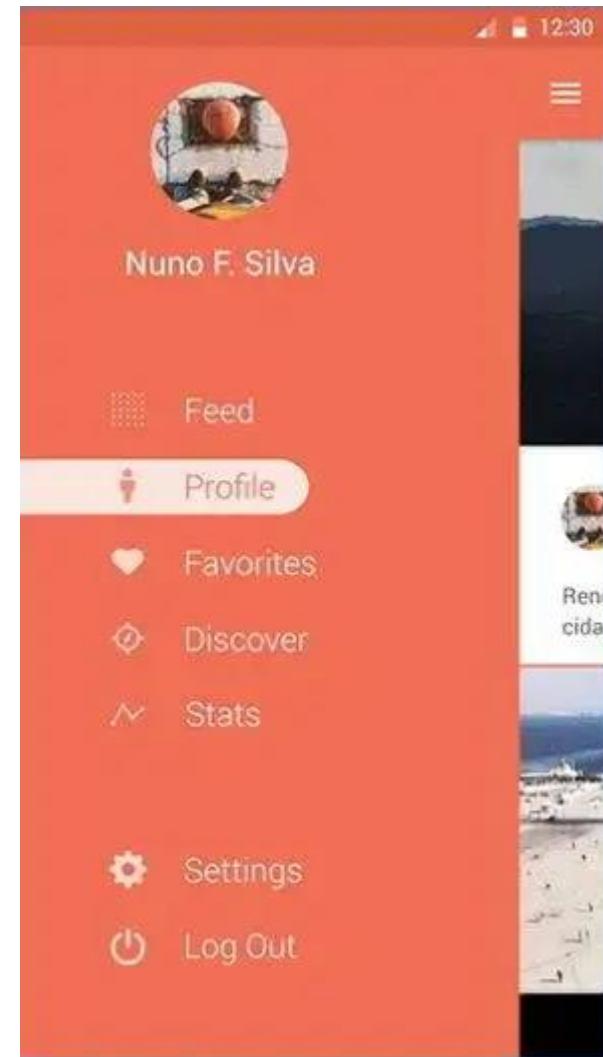
CII <L> TOTAL			
	A ITEM	B NO.	C UNIT
1	---	---	---
	MUCK RAKE	43	12.95
	TOOL CUT	100	1.95
	TONER TONER	250	4.00
	EYE SHUFF	2	0.95
			SUBTOTAL
			13155.50
			9.75% TAX
			1262.65
			TOTAL
			14438.16



Navigation

- **Non linear navigation**

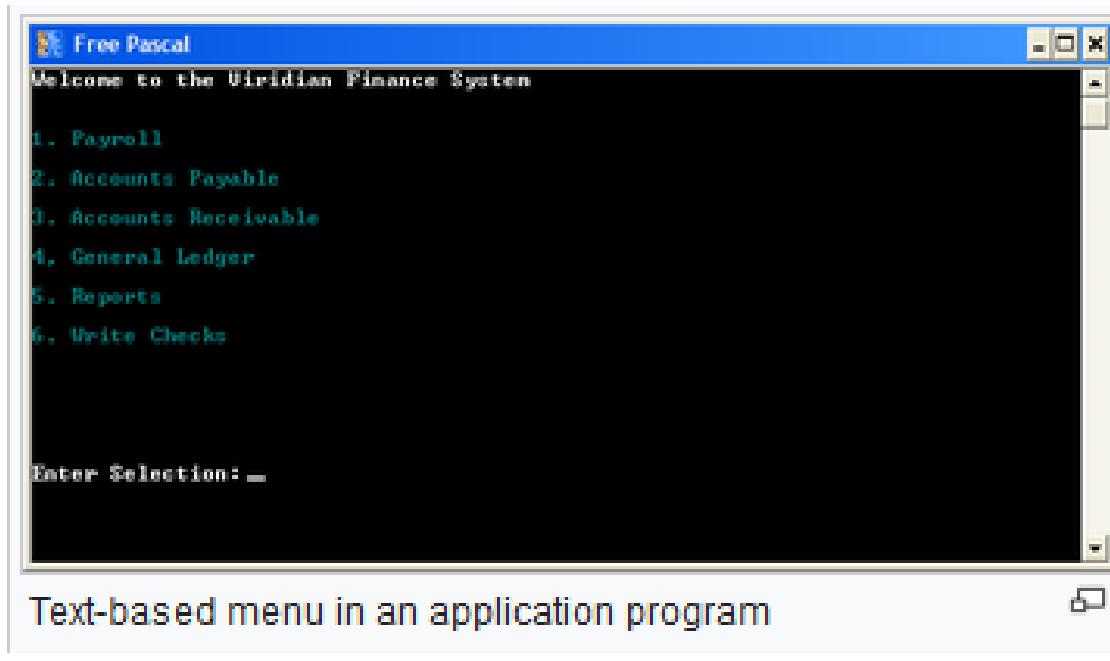
Touch user interfaces and menu options that accept codes to select menu options without navigation





Types of menu

- A computer using a command line interface presents a list of relevant commands with assigned shortcuts. These can be numbers, digits, characters on the screen

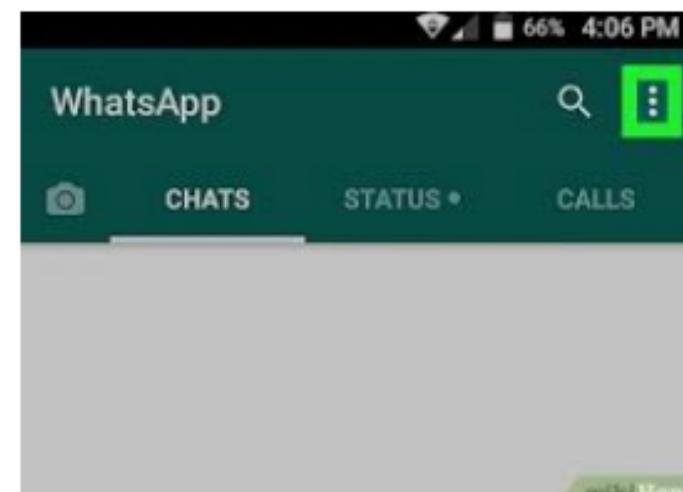
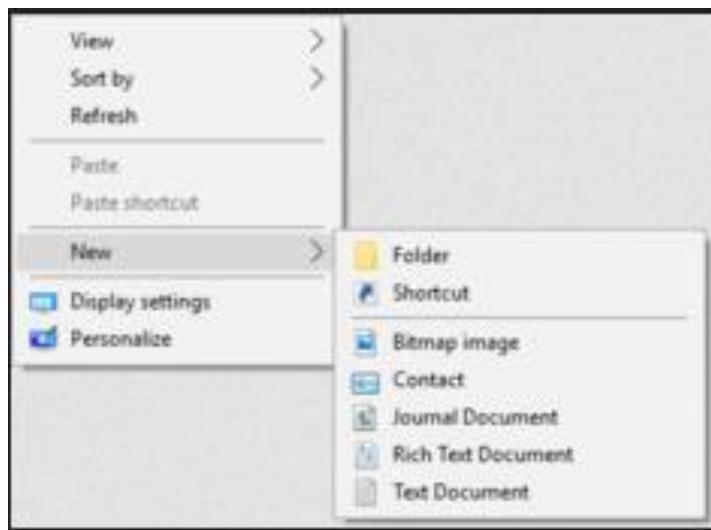




Types of menu

- A computer using GUI presents menus with a combination of text, and symbols to represent choices.

A context menu is a menu in GUI that appears upon user interaction for example right click of a mouse but offers limited choices.



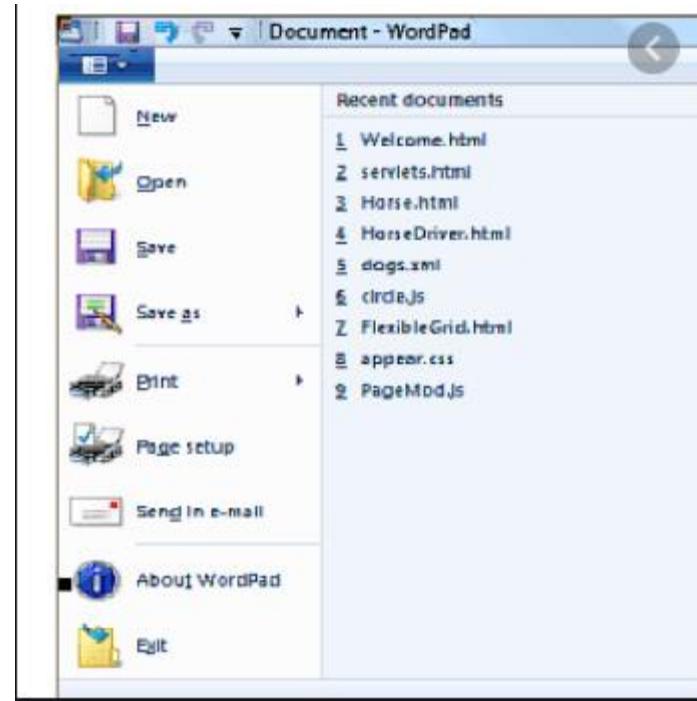


Types of menu

- Pull down menus

Commonly used in menu bars

A common use of pull down menus is to provide convenient access to various operations such as saving , opening a file, quitting a program.





Types of menu

- Attached ellipses

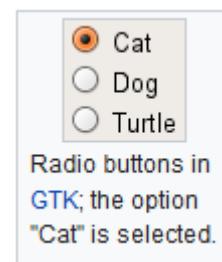
An appended ellipses ("...") means that upon selection, another dialog will follow, where the user can or must make a choice



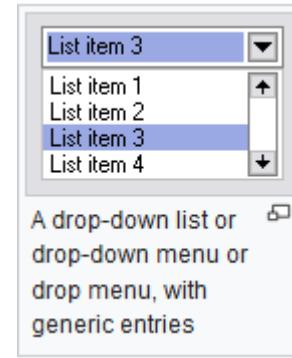


Types of menu

- Dropdown menu
- Hamburger menu
- Pie menu
- Radio button menu
- WIMP (computers)



Radio buttons in GTK; the option "Cat" is selected.



A drop-down list or drop-down menu or drop menu, with generic entries

DPM Course Presentation-Module 9.pptx [Autosaved] - PowerPoint (Product Activated)

File Home Insert Design Transitions Animations Slide Show Review View Tell me what you want to do...

Cut Copy Paste Format Painter Clipboard Slides

Font

Document Recovery

PowerPoint has recovered the following files. Save the ones you wish to keep.

Available Files

DPM Course Presentatio... Version created from the l... 27/03/2021 22:35

Attached ellipses

Collapsed menu icon as used on the Hamburger Button

A hamburger, the origin of the nickname



A pie menu.



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10. <https://www.cs.bham.ac.uk/internal/courses/hci/lectures/HCIlecture1.pdf>
11. <https://www.medien.ifi.lmu.de/lehre/ss16/id/IxD-SS16-06-LawsofID.pdf>
12. https://pages.cpsc.ucalgary.ca/~saul/hci_topics/pdf_files/introduction_181.pdf



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