

# Unit 7. Usability

Interfaces Persona Computador  
Dept. Sistemas Informáticos y  
Computación. UPV

## VIRTUAL TEACHING

### Purpose:

Provision of the higher education public service  
(art. 1 LOU)

### Responsible:

Universitat Politècnica de València.

**Rights of access, rectification, deletion, portability, limitation or opposition to the treatment in accordance with privacy policies:**

<http://www.upv.es/contenidos/DPD/>

### Intellectual property:

Exclusive use in the virtual classroom environment.

Dissemination, distribution or disclosure of recorded classes, particularly on social networks or services dedicated to sharing notes, is prohibited.

Violation of this prohibition may generate disciplinary, administrative or civil liability.



UNIVERSITAT  
POLITÈCNICA  
DE VALÈNCIA



# Unit Goals

- ▶ To appreciate the advantages of usable user interfaces
- ▶ Being able to objectively measure different usability features of a system.
- ▶ To be aware of the tradeoffs designers must take to create usable interfaces, depending on the application
- ▶ To know the areas where usable interfaces are critical, and the most important UI features for each area
- ▶ To know what universal usability is, and its necessity in the current society, and realize the diversity of users of computer applications. To be aware of the special needs of disabled users, children and older adults.

# Overview

- ▶ Introduction
- ▶ Usability Goals and Measures
- ▶ Areas that require usable UI
- ▶ Universal Usability

# Introduction

## ► The good interfaces

- strengthen the user confidence,
- allow the user to have an accurate mental model of the system to predict what will happen after some action, and
- ideally, they ‘disappear’, allowing the user to focus on the task.

# Introduction

- ▶ The user interface is the part of the system that the user sees, hear and feel
- ▶ There are other parts of the system that are hidden, like the database.
  - The user doesn't see them, but tries to imagine how they work
- ▶ What are the properties of a good IT system?
  - Correctness, availability, performance, security, easy of use, maintainability...
  - But the developers focus most of the time on functionality

# Usability Factors

- ▶ Properties of a usable interface:
  1. Fit for use (or functionality). The system supports the user's tasks
  2. Ease of learning (for different groups of users)
  3. Task efficiency. How efficient is it for the frequent user?
  4. Ease of remembering.
  5. Subjective satisfaction.
  6. Reduce errors.
- ▶ It is difficult to design systems that scores high in every aspect, so it is important to decide which aspects are the most important for our system

# Usability Goals and Measures

- ▶ ISO 9241 standard: *Ergonomics of Human-System Interaction*. Part 11: Guidance on usability
  - usability: 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
    - effectiveness: accuracy and completeness
    - efficiency: consumed resources
    - satisfaction: freedom from discomfort, user attitude

# Usability Goals and Measures

- ▶ ISO 9241 measure examples for overall usability:

Effectiveness measures	Efficiency measures	Satisfaction measures
Percentage of goals achieved	Time to complete a task	Rating scale of satisfaction
Percentage of users successfully completing task	Tasks completed per unit time	Frequency of discretionary use
Average accuracy of completed tasks	Monetary costs of performing the task	Frequency of complaints

# Usability Goals and Measures

- ▶ ISO 9241 measures for other usability goals:

Goal	Effectiveness measures	Efficiency measures	Satisfaction measures
Meet needs of trained users	Number of power tasks performed; Percentage of relevant functions used	Relative efficiency compared with an expert user	Rating scale for satisfaction with power features
Meet needs to walk up and use	Percentage of tasks completed successfully on first attempt	Time taken on first attempt*; Relative efficiency on first attempt	Rate of voluntary use
Meets needs for infrequent or intermittent use	Percentage of tasks completed successfully after a specified period of non-use	Time spent re-learning functions*; Number of persistent errors	Frequency of use

\* With respect a specified level of effectiveness

# Usability Goals and Measures

- ▶ ISO 9241 measures for other usability goals:

Goal	Effectiveness measures	Efficiency measures	Satisfaction measures
Minimization of support requirements	Number of references to documentation; Number of calls to support; Number of accesses to help	Productive time*; Time to learn to criterion*	Rating scale for satisfaction with support facilities
Learnability	Number of functions learned; Percentage of users who manage to learn to criterion	Time to learn to criterion* Time to re-learn to criterion*; Relative efficiency while learning	Rating scale for ease of learning

\* With respect a specified level of effectiveness

# Usability Goals and Measures

- ▶ ISO 9241 measures for other usability goals:

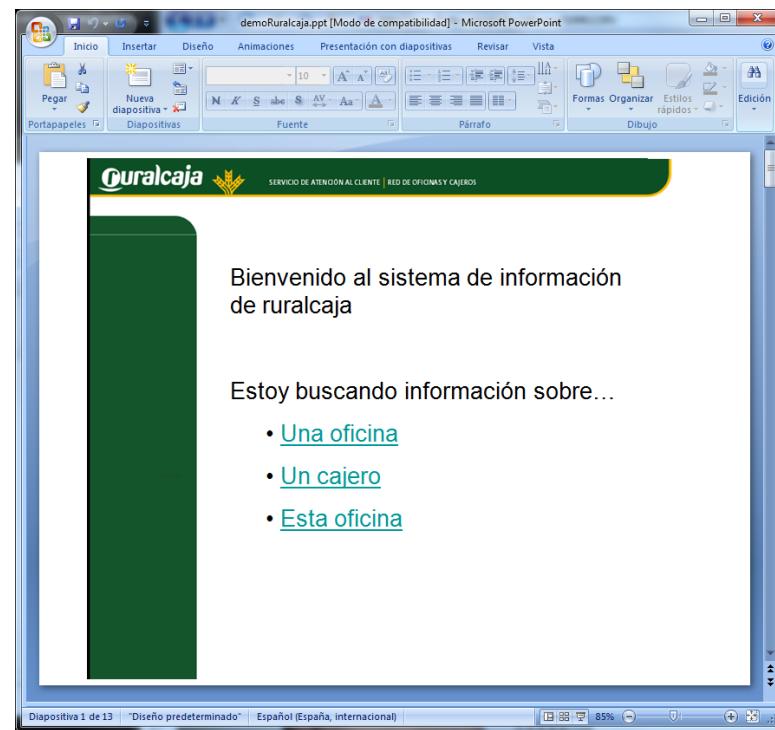
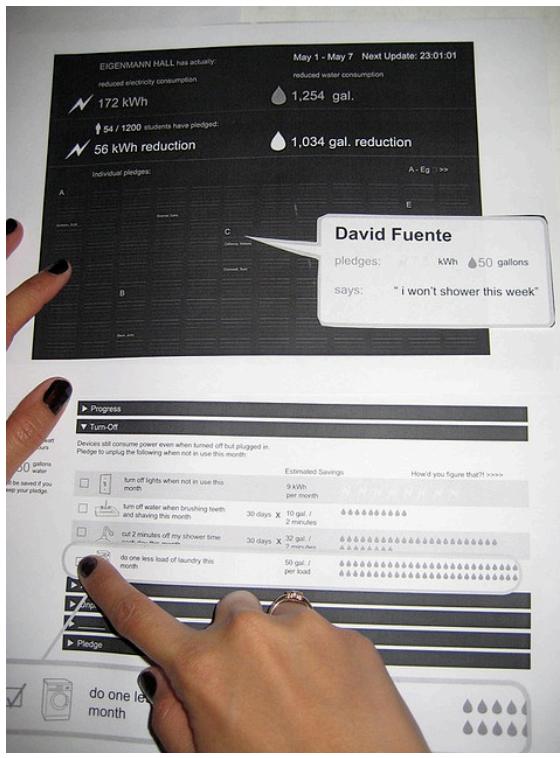
Goal	Effectiveness measures	Efficiency measures	Satisfaction measures
Error tolerance	Percentage of errors corrected or reported by the system; Numbers of user errors tolerated	Time spent on correcting errors	Rating scale for error handling
Legibility	Percentage of words read correctly at normal viewing distance	Time to correctly read a specified number of characters	Rating scale for visual discomfort

# Usability Goals and Measures

- ▶ Often, designers have to favor one aspect against others, depending on the application:
  - Higher time to learn could be acceptable, if that means an increased task-performance speed
  - If the rate of errors has to be minimized, then the speed of performance can be penalized.
- ▶ The managers of the project should clearly define the goals of the application, to support the decisions made
- ▶ It is easier to measure usability in the final system, but then it might be too late

# Usability Goals and Measures

- ▶ Several prototypes should be built to be reviewed by designers and users



# Usability Goals and Measures

- ▶ The prototypes can be:
  - low-fidelity paper mock-ups, or
  - high-fidelity interactive prototypes.
- ▶ Sometimes, user documentation and online help are written before building the interface, to refine the design.
- ▶ Then, the application is implemented with the proper tools.
- ▶ Finally, the acceptance test certifies that the product meets the goals set in the requirements.

# Areas that require usable UI

- ▶ In general, any computer system benefits from a usable interface, but in the following domains, a usable UI is even more important
  - Life-critical systems
  - Industrial and commercial systems
  - Home and entertainment applications
  - Exploratory, creative and collaborative interfaces
  - Socio-technical systems

# Example of usability study

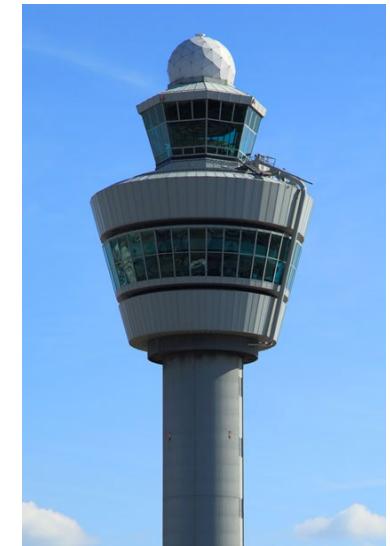
## ► Usability measures:

- Time to learn. How long does it take for a typical user to learn how to perform some task?
- Speed of performance. How long does it take to complete a predefined benchmark?
- Rate of errors by users. How many and what type of errors the user made during the test?
- Retention over time. How well do the users use the application after one hour, a day or a week?
- Subjective satisfaction. How much did users like using various aspects of the application?

# Areas that require usable UI

## Life-critical systems

Usability Measures	Importance
Time to learn	LOW
Speed of performance	HIGH
Rate of errors	HIGH
Retention over time	BY REPETITION
Subjective satisfaction	LOW



# Areas that require usable UI

## Life-critical systems



# Areas that require usable UI

## Life-critical systems



Fuente: <http://huelvaya.es/2017/06/25/denuncian-colas-de-espera-en-la-atencion-de-emergencias-del-112/>

# Areas that require usable UI

## Life-critical systems



# Areas that require usable UI

## Life-critical systems



Fuente: <http://www.valencia.es>

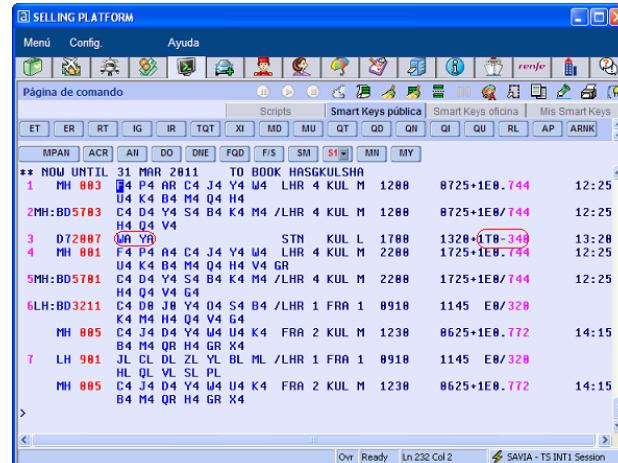
# Areas that require usable UI

## Industrial and commercial uses

Usability Measures	Importance
Time to learn	HIGH
Speed of performance	HIGH
Rate of errors	MODERATE
Retention over time	BY REPETITION
Subjective satisfaction	MODEST



Nathaniel C. Sheetz



Amadeus reservation system



[flickr.com/photos/islandgal](https://flickr.com/photos/islandgal)

# Areas that require usable UI

## Home and entertainment applications

Usability Measures	Importance
Time to learn	HIGH
Speed of performance	MODERATE
Rate of errors	HIGH
Retention over time	MODERATE
Subjective satisfaction	HIGH



Two screenshots of user interfaces for home and entertainment applications. The left screenshot shows the YouTube homepage, featuring video thumbnails for "50 Cent Old Navy When You Say...," "Música Jammie Helmoyz Videoclip (2011)," and "Cine y animación MILEY CYRUS WILL KILL YOU!." The right screenshot shows the Facebook registration page, which includes a diagram of a social network with several user icons connected by lines, and fields for entering name, surname, email, and password.



# Areas that require usable UI

Exploratory, creative, and collaborative interfaces

Usability Measures	Importance
Time to learn	MODERATE
Speed of performance	MODERATE
Rate of errors	MODERATE
Retention over time	MODERATE
Subjective satisfaction	HIGH

 Another Sample Page

Edit Add Tools

Added by Sarah Maddox last edited by Sarah Maddox on Jun 09, 2008

Start of sample page content.

Lore ipsum dolor sit amet, consectetur adipiscing elit. Aliquam fermentum vestibulum est. Cras rhoncus. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Sed quis tortor Donec ipsum. Mauris condimentum odio nec porta fringilla, ante neque malesuada massa, in dignissim eros velit at tellus. Donec et iusto in ligula eleifend consetetur. Donec volutpat eleifend augue. Integer gravida sodales leo. Nunc vehicula neque ac erat. Vivamus non nisl. Fusce ac magna. Suspisse euismod libero eget mauris.

End of sample page content.

**Labels** Edit Labels  
(None)

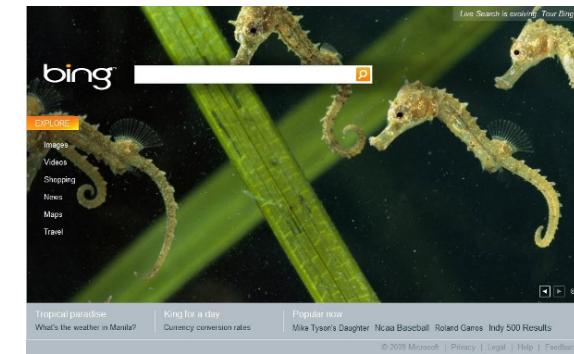
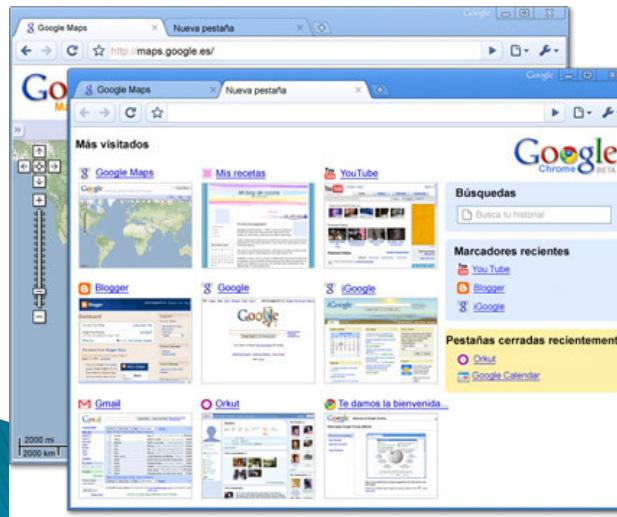
**Comments (2)** Hide Comments | Collapse All | Add Comment

 Sarah Maddox says:  
I don't understand Latin!  
[Edit](#) | [Remove](#) | [Reply](#)

 Anonymous says:  
Mor non plus.  
[Edit](#) | [Remove](#) | [Reply](#)

[Add Comment](#)

confluence.atlassian.com



# Areas that require usable UI

## Sociotechnical systems

Usability Measures	Importance
Time to learn	HIGH
Speed of performance	HIGH
Rate of errors	HIGH
Retention over time	LOW
Subjective satisfaction	LOW



wi-ltd.com



emergencycommandsystem.com

# Universal Usability

- ▶ It is the process of creating products which are usable by people with the widest possible range of abilities, operating within the widest possible range of situations, as is commercially practical
- ▶ User interface designers must take into account the wide variety of users, paying attention to:
  - Physical abilities and physical workspaces
  - Cognitive and perceptual abilities
  - Personality differences
  - Cultural and international diversity
  - Users with disabilities
  - Older adult users
  - Children
  - Hardware and software diversity

# Universal Usability

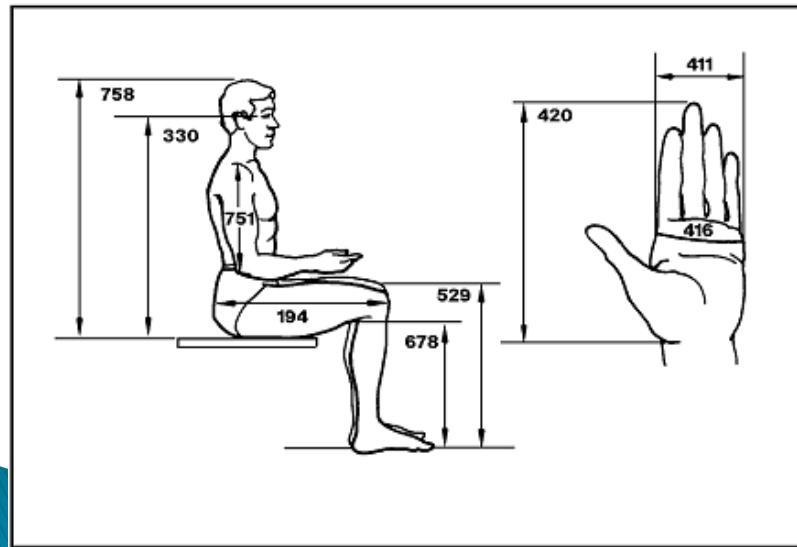
## Physical abilities and physical workspaces

- ▶ Ergonomics study how to adapt the work environment to the workers
- ▶ Principles of Ergonomic Design (UNE-EN-614-1)
  - a) The usage height or other functional dimensions of the machine should be adapted to the worker and to the type of work to do, for example, being adjustable
  - b) The type, situation and configuration possibilities of seats should be adequate for the body dimensions of the operator and for the tasks performed
  - c) Enough clearance should be allocated for all the body parts, so the tasks can be performed with proper postures and movements, facilitating the access and posture changes
  - d) The handles and pedals of the machines should be adapted to the functional anatomy of the hand or foot, and to the dimension of the operators
  - e) The controls, handles and pedals used most frequently should be located within reach of the hands or feet of the operator, when located in the proper working posture

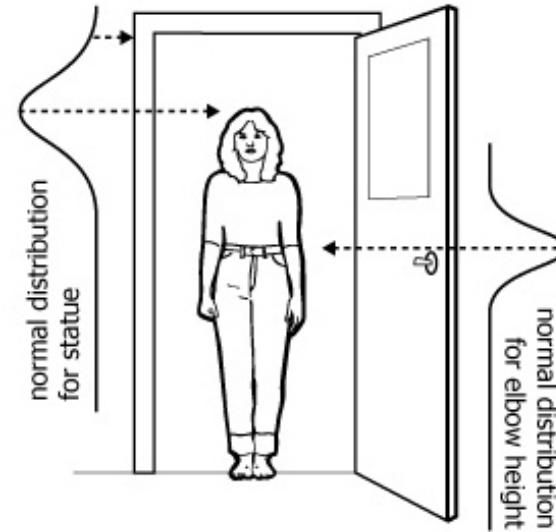
# Universal Usability

## Physical abilities and physical workspaces

- ▶ The anthropometry is the science that measures the dimensions of the human body
  - Static anthropometry: provide standard dimensions of persons (head, mouth, finger lengths, heights, etc) in a population, typically standing or seated
  - Anthropometric data of Spanish working population
    - [http://www.insht.es/InshtWeb/Contenidos/Documentacion/TextosOnline/Rev\\_INSHT/2001/14/artFondoTextCompl.pdf](http://www.insht.es/InshtWeb/Contenidos/Documentacion/TextosOnline/Rev_INSHT/2001/14/artFondoTextCompl.pdf)



<http://msis.jsc.nasa.gov/sections/section03.htm>



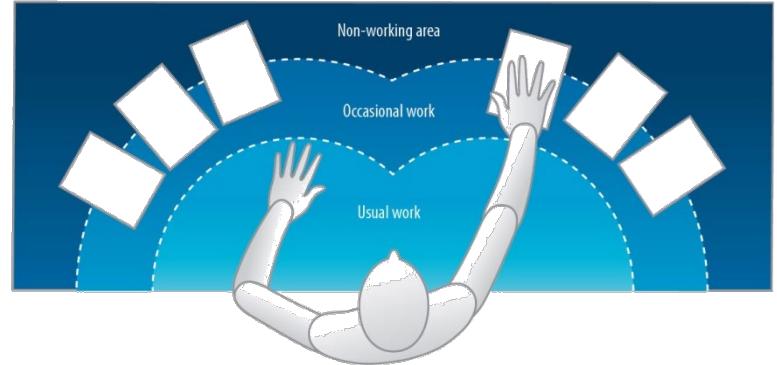
<http://dined.io.tudelft.nl>  
Interfaces Persona Computador

# Universal Usability

## Physical abilities and physical workspaces

### ▶ Dynamic anthropometry

- Describes moving ranges, reaches, trajectories: maximum distance to reach an object while seated, speed of keystrokes, force to lift an object, etc.



<http://mcr.coreconcepts.com.sg/workplacehealth/>

### ▶ Designers have to take into account those measures to create interfaces that are useful for the majority of the population

- e.g. a cellphone keypad: key size, separation between the keys, amount of force to operate them...
- Whenever possible, allow the user to customize the interface (e.g. screen brightness and contrast, height and inclination of chairs...) If it is not possible, build several versions

# Universal Usability

## Physical abilities and physical workspaces

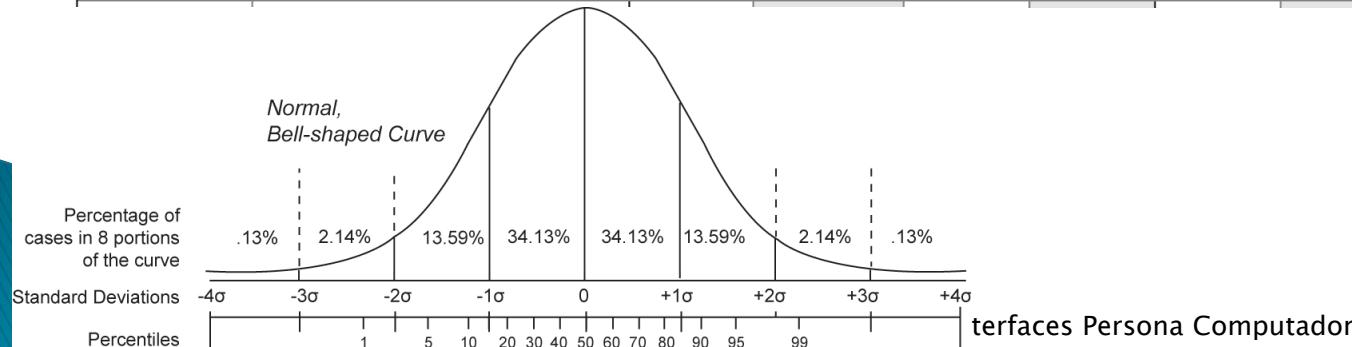
- ▶ The norm UNE EN 614-1 establishes some recommendations, such as:
  - When defining clearance in the work space (for example, leg room), a value in the percentile 95 or higher should be used
  - For reaches (for example, distance between a control and the user), a value in the percentile 5 or lower should be used

### Measurement with the subject seated (mm)

Nº (Refer. ISO 7250:1996)	Designación	Tamaño muestra	Media	Desviac típica	Error típico	Percentiles				
						P 1	P 5	P 50	P 95	P 99
23 (No incl.)	Thigh height, seated	1712	558,21	35,14	0,849	473	498	558	615	632

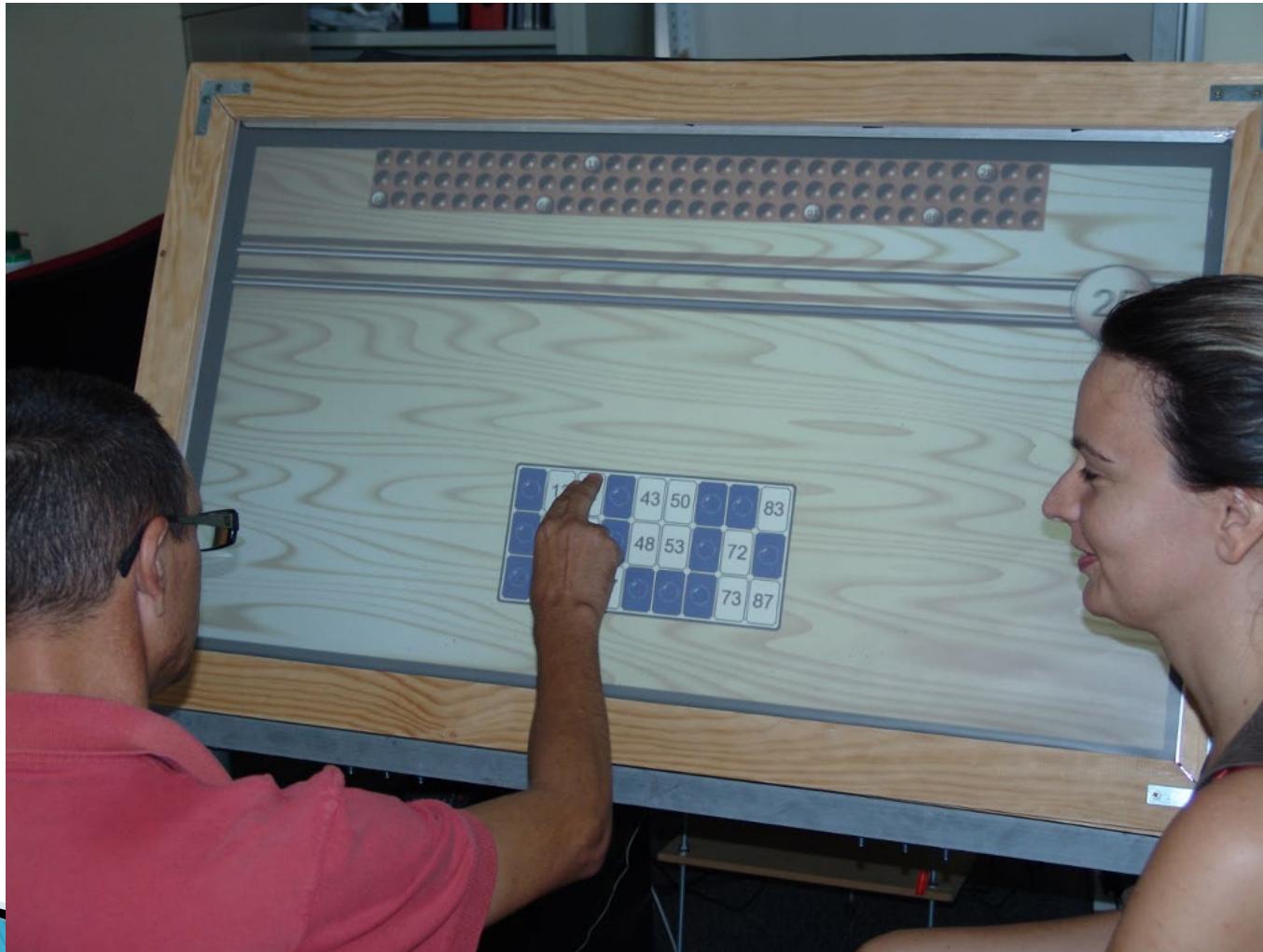
### Functional measurements (mm)

39 (4.4.2)	Maximum horizontal reach	1719	698,83	54,25	1,308	570	606	700	785	818
------------	--------------------------	------	--------	-------	-------	-----	-----	-----	-----	-----



# Universal Usability

## Physical abilities and physical workspaces



# Universal Usability

## Physical abilities and physical workspaces

- ▶ *ISO 9241: Ergonomics of human-system interaction.* It is a multi-part standard divided into several series:
  - 100 series: Software ergonomics
  - 200 series: Human system interaction processes
  - 300 series: Displays and display related hardware
  - 400 series: Physical input devices - ergonomics principles
  - 500 series: Workplace ergonomics
  - 600 series: Environment ergonomics
  - 700 series: Application domains - Control rooms
  - 900 series: Tactile and haptic interactions

# Universal Usability

## Personality differences

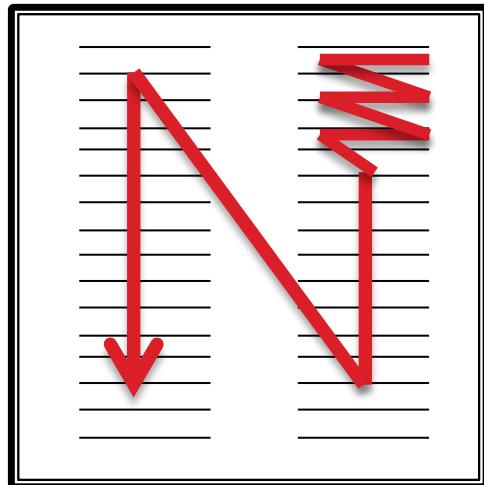
- ▶ There is a wide variety of personal preferences: technophilia/technophobia, graphics vs. tabular data, minimalist interfaces vs dense interfaces, etc.
- ▶ Other differences
  - Videogames preferences
  - Unfortunate wording of actions (kill a process, abort a program...)



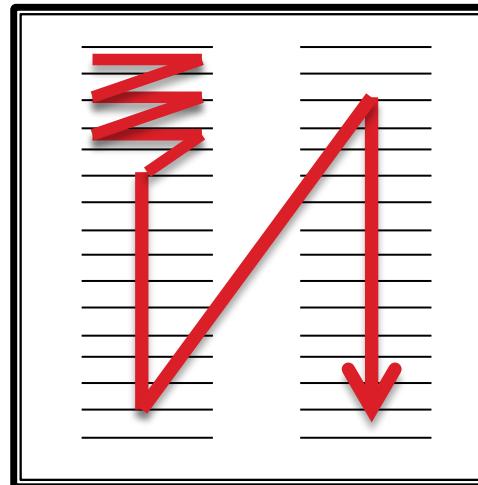
# Universal Usability

## Cultural and international diversity

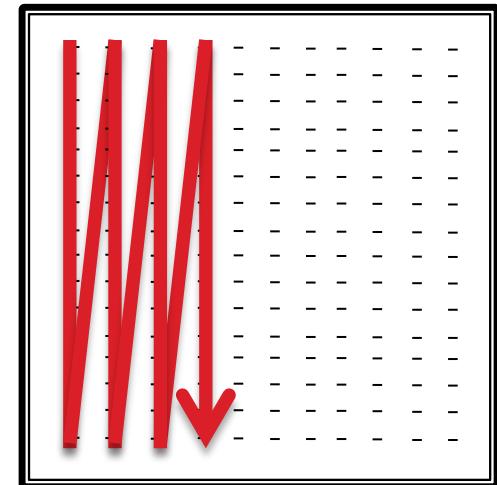
- ▶ Designers should be able to adapt their interfaces to cultural, ethnic, racial or linguistic differences



Arabic, Hebrew



European  
languages



Chinese,  
Japanese

# Universal Usability

## Cultural and international diversity

- ▶ Depending on their cultural background, users may prefer simple, static interfaces, while other users may prefer dynamic, rich interfaces
- ▶ Furthermore, preferences change quickly



# Universal Usability

## Cultural and international diversity

- ▶ Software architectures should provide flexible methods to adapt applications to different languages:
  - characters, numerals, special characters, and diacriticals
  - left-to-right vs. right-to-left vs. vertical input and reading
  - date and time formats
  - numeric and currency formats
  - weights and measures
  - telephone numbers and addresses
  - names and titles (Mr., Ms. Mme...)
  - id numbers
  - capitalization and punctuation
  - pluralization, grammar and spelling
  - ...

Mars Climate --> example of measures problems

# Universal Usability

## Users with disabilities

The screenshot shows the homepage of the Agencia Tributaria website. At the top, there is a banner featuring the Spanish Government logo and the text "GOBIERNO DE ESPAÑA". Below it is the Agencia Tributaria logo, which consists of a stylized blue and yellow graphic followed by the text "Agencia Tributaria". A navigation bar with four tabs is visible: "La Agencia Tributaria" (selected), "Ciudadanos", "Empresas y profesionales", and "Colaboradores".

The main content area features a photograph of a person in a wheelchair looking up at a set of stairs, with the word "Accesibilidad" overlaid. To the right of the photo is a search bar with a placeholder "Buscar:" and a "Buscar" button. Below the search bar are links for "Búsqueda avanzada" and "Portales:", with a dropdown menu labeled "-seleccione portal--" and a "Ir al portal" button.

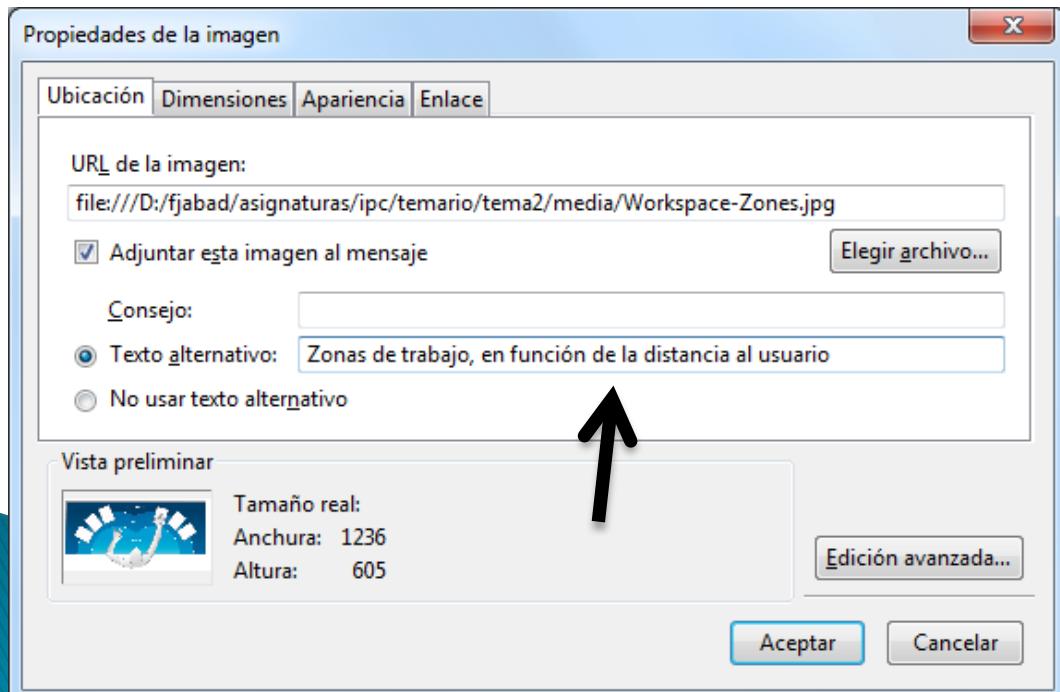
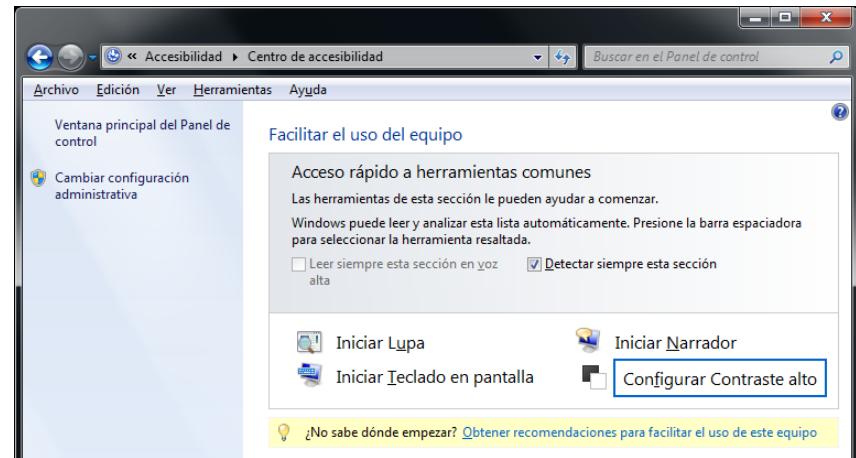
A large blue button labeled "Sede electrónica Oficina Virtual" is prominently displayed. On the left side of the page, there is a sidebar with the text "Inicio" and "Accesibilidad". Below this, a section titled "Accesibilidad" contains a link to "Certificación de Accesibilidad".

At the bottom left, there are two accessibility certification logos: "euracert eAccessibility AA" and "WCAG-WAI AA". On the right side, there is a sidebar titled "Acceda directamente" containing links to various services: "A un clic", "Calendario del contribuyente", "Carta de Servicios", "Certificados Electrónicos", "Descarga de programas de ayuda", "Folletos informativos", and "Modelos y formularios".

# Universal Usability

## Users with disabilities

- ▶ Different abilities:
  - Vision-impaired
  - Hearing-impaired
  - Motor disabilities
  - Cognitive disabilities



# Universal Usability

## Users with disabilities

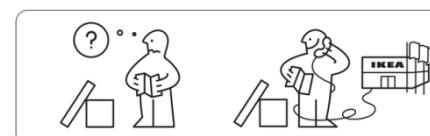
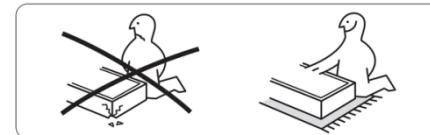
[https://www.ncsu.edu/ncsu/design/cud/pubs\\_p/docs/poster.pdf](https://www.ncsu.edu/ncsu/design/cud/pubs_p/docs/poster.pdf)

- ▶ Principles of Universal Design (Center for Universal Design, NCSU):

- Equitable use
- Flexibility in use
- Simple and intuitive use
- Perceptible information
- Tolerance for error
- Low physical effort
- Size and space for approach and use



loganstitches.wordpress.com



[designboom.com/project/elbow-door-handle/](http://designboom.com/project/elbow-door-handle/)

INTERFAZES PERSONA COMPUTADOR

# Universal Usability

## Users with disabilities

- ▶ Accessibility tools:
  - Screen magnifiers
  - Text-to-speech
  - Speech recognition
  - Visual warnings
  - Eye-controlled pointers



humanware.com



**JAWSforWindows**  
Screen Reading Software



quadstick.com



tobii.com

*JAWS, the world's most advanced screen reader, is distributed in more than 50 countries and translated into 17 languages.*

JAWS supports versions

freedomscientific.com

# Universal Usability

## Users with disabilities

- ▶ Many countries have passed legislation to ensure access to information technology public services to users with disabilities. In Spain:
  - Real Decreto 1.494/2007, November 12th. Regulation on the basic conditions for access of people with disabilities to technology, products and services related to the information society and media
  - Norma UNE 139801:2003 Computer applications for persons with disabilities. Accessibility requirements for computers. Hardware
  - Norma UNE 139802:2009 Software accessibility requirements (Spanish version of EN ISO 9241-171:2008)

# Universal Usability

## Users with disabilities

- ▶ There are different standards to build accessible web contents:
  - In Spain: [Norma UNE 139803:2004](#). Applications for people with disabilities. Accessibility requirements for Web content
  - Web Content Accessibility Guidelines (WCAG) 2.0 - W3C Recommendation <https://www.w3.org/TR/WCAG20-TECHS/>
- ▶ Use online tools for checking the accessibility of your web design:
  - [www.tawdis.net](http://www.tawdis.net)
  - <http://www.w3.org/WAI/eval/Overview.html>
  - <https://www.w3.org/WAI/ER/tools/>
- ▶ More information (in Spanish) in the book cited at the end of this unit (Ficha 6.11)

# Universal Usability

## Users with disabilities

- ▶ Taking into account the necessities of users with some disability from the beginning of projects:
  - Does not increase the cost a lot
  - Increase the level of usability of the system for **all** the users

# Universal Usability

## Users with disabilities

- ▶ Taking into account the special requirements of users with disabilities from the first moment
  - does not increase the cost of the project too much,
  - and makes the application more usable for all the users
    - TV subtitles: useful for hearing-impaired users, but also for learning a new language
    - Alternative text in images provides a description for vision-impaired users, but also improve the search results



YOU HAVE TO SEE IT TO BELIEVE IT!

## FLASH-MATIC TUNING BY ZENITH

ONLY ZENITH HAS IT!

A flash of magic light from across the room (no wires, no cords) turns set on, off, or changes channels...and you remain in your easy chair!

With a beam of magic light

YOU CAN ALSO SHUT OFF LONG, ANNOYING COMMERCIALS WHILE PICTURE REMAINS ON SCREEN!

Here is a truly amazing new television development—and only Zenith has it! Just think! Without bending from your easy chair, you can turn your television set on, off, or change channels with a beam of light! Stop all those annoying commercials while the picture remains on the screen. Just a flash of light does it. There are no wires or cords. This is not an accessory. It is a built-in part of every Zenith television. And it's only \$14.95. Stop at your Zenith dealer's soon. Super-quality television begins as low as \$399.95.\*

The Biarritz Model V2254HQZ, 27" Flash-Matic Tuning, Cathode-ray, Grid-grained finish cabinet on casters, and a Economy Color (CX24HQZ), as low as \$399.95.\*

**ZENITH** ® The royalty of TELEVISION AND RADIO

Baked by 35 years of leadership in television and radio technology.

ALSO MAKERS OF PIANO HARMONIQUES AND ZENITH RADIO CORPORATION, Chicago, Ill.

[tvhistory.tv](http://tvhistory.tv)

# Universal Usability

## Older adult users

- ▶ Aging has negative effects on both physical and cognitive abilities
- ▶ Computers can provide new opportunities for social interaction, if we can adapt the user interfaces
- ▶ In turn, society can benefit from a quick access to the experience and emotional support from older adults.

# Universal Usability

## Older adult users

- ▶ The UI should allow the user to adapt the font size, the contrast of the screens and the volume of sounds
- ▶ Interfaces can also be designed with easy to use pointing devices, clearer navigation paths, consistent layouts and simpler commands



independentliving.com

# Universal Usability

## Children

- ▶ The main motivations of this type of users is entertainment and education. Depending on their age, they use:
  - computer-controlled toys, music generators, art tools.
  - when they learn to read, they can use the keyboard and access to desktop, web or mobile applications
  - teenagers may become advanced users.



leapfrog.com

A screenshot of a web browser displaying the 'clan' section of the RTVE.es website. The page features a purple header with the 'clan' logo and navigation links for 'Portada', 'Videos y juegos', 'Programación', 'Concursos', 'Series', 'Padres', and 'Mi página'. Below the header, there is a large image of a cartoon character and text about 'Pocoyó, embajador infantil de la Hora del Planeta'. To the right, there are several smaller video thumbnail links and a 'Ver todas las noticias' button.

# Universal Usability

## Children

- ▶ The goals of children-oriented tools are:
  - accelerate the educative process,
  - facilitate the socialization with peers, and
  - improve self-confidence.
- ▶ Videogames are always a controversial topic, having both supporters and opponents.
- ▶ Children search for interactive engagement that gives them control and feedback, and help them to interact with peers

# Universal Usability

## Children

- ▶ In general, children
  - can deal with some frustrations and with threatening stories, as long as they know that they can start over without severe penalties
  - do not tolerate patronizing comments or inappropriate humor,
  - like familiar characters, exploratory environments and repetition.
- ▶ Designers can:
  - study the children behavior and give them the prototypes for testing, or
  - allow them to become part of the design team, interacting with them during the process.

# Universal Usability

## Children

- ▶ UI designers must take into account children's limitations, and avoid
  - double click, mouse dragging and small targets,
  - complex texts, and
  - complex command sequences.
- ▶ Other concerns are short attention spans and limited capacity to work with multiple concepts simultaneously.
- ▶ Security should be a top level requirement in web-based software for children



[tinyhandsapps.com/](http://tinyhandsapps.com/)

# Universal Usability

## Accomodating hardware and software diversity

- ▶ Designers should also take into account the wide range of systems where applications may run, both hardware...
  - old hardware with, for example, low display resolution and reduced memory
  - modern hardware, with greater storage capacity and faster processors, or
  - mobile devices, with small screens and limited memory.
- ▶ and software
  - different OS versions, different web browsers...



# References

- ▶ Shneiderman, B. y Plaisant, C. Designing the User Interface. Pearson 5th ed., 2010
  - Sections 1.2, 1.3 y 1.4
- ▶ Lauesen, S. User Interface Design. A Software Engineering Perspective. 2005
  - Chapter 1
- ▶ Scott Klemmer. Human-Computer Interaction Design @ UCSD
  - <https://www.coursera.org/course/hcidesign>
- ▶ Accessibility:
  - IMSERSO ¡Pregúntame sobre accesibilidad y ayudas técnicas!.  
[http://www.ibv.org/index.php/es/revista-ibv/show\\_product/79/58](http://www.ibv.org/index.php/es/revista-ibv/show_product/79/58)
  - <http://www.nia.nih.gov/health/publication/making-your-website-senior-friendly>
- ▶ Usability:
  - <http://www.userfocus.co.uk/articles/index.html>
  - <http://olgacarreras.blogspot.com.es> (In Spanish)
  - <http://www.nngroup.com/articles/>
  - <http://www.usabilityfirst.com/>