Interacção Pessoa-Máquina

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Objectives

- **Understand the human factors which drive the usage of computer systems.**
- **Understand novel paradigms for human-computer interaction**
- **Know and apply usability principles.**
- **Know and apply prototyping techniques.**
- **Know and apply interfaces evaluation techniques.**
- **Develop creative capabilities to come up with innovative solutions for interaction problems.**
- **Fit HCI in the engineering project.**

Program

- Introduction - Human-Computer Interaction (HCI): What? Why? When?
- Usability principles
- Characteristics of interactive systems
- Human factors in the HCI
- User centered design and iterative design process
- User and task analysis
- Sketching and prototyping
- Interaction design principles
- Interaction styles
- Graphic design
- Interaction paradigms
- Evaluation techniques
- Future perspectives

Textbooks

- Dix, Alan, Finlay, Janet, Abowd, Gregory, Beale, Russel. Human-Computer Interaction. Prentice Hall Europe, London, 2003.
- Norman, Donald. *The Design of Everyday Things*. MIT Press, 1998.
- Nielsen, Jacob, *Usability Engineering*, Academic Press, 1993.

Lecture slides will be available on CLIP.

Complementary:

- Mullet, K. and Sano, D., Designing Visual Interfaces, Prentice Hall, 1995.
- Gonçalves, D., Fonseca, M.J., and Campos, P., Introdução ao Design de Interfaces. FCA, 2017.
- Moggridge, B. Designing Interactions. MIT Press, Massachusetts, 2007.
- Shneiderman, B. Designing the User Interface: Strategies for Effective Human-Computer Interaction (third edition). Addison-Wesley,1998.
- Tufte, E. *Envisioning Information*, Connecticut Graphic Press, 2003.

Additional readings will be provided during classes and on the course web site.

Evaluation

Final grade =

35%T1 + 35%T2 + 30%PW

Minimal grades:

(mean (T1; T2) >= 10) AND (PW >= 10)

Evaluation

Dates (to be confirmed):

- T1: October 28
- T2: December 7

Mandatory lab classes:

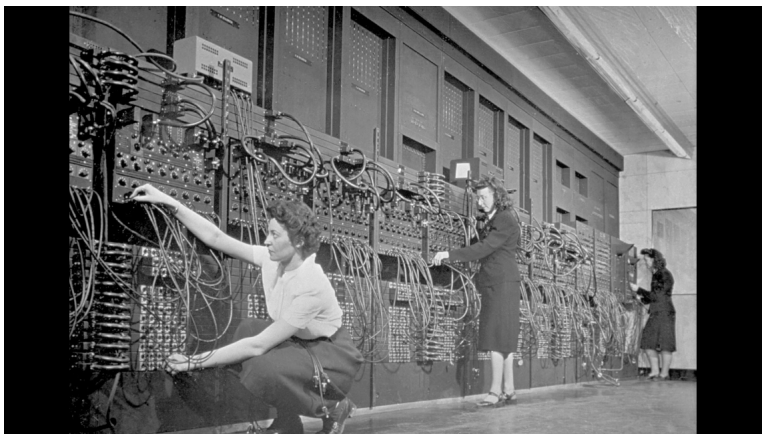
- Prototype testing day (October 14 and 16)
- Heuristic evaluation
- Project presentation

Course web site

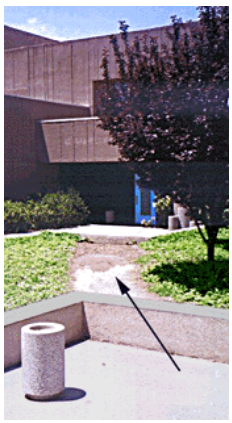
http://ctp.di.fct.unl.pt/~tir/IPM

Interface Design

Interface Design



Interface Design



Interface Design

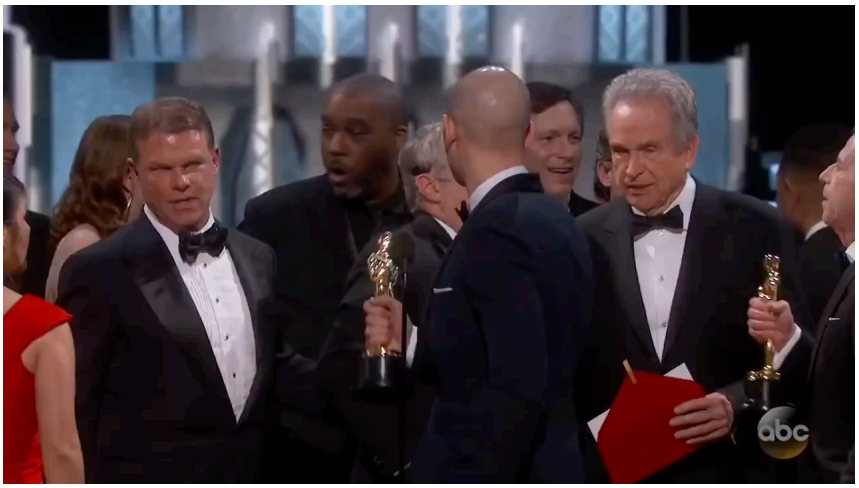
People shouldn't have to read
a manual to open a door,
even if it is only one word long
(push/pull)

Don Norman

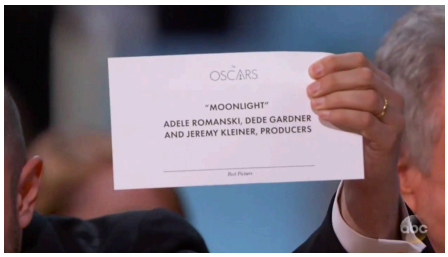
Interface Design

Interface Design

Interface Design



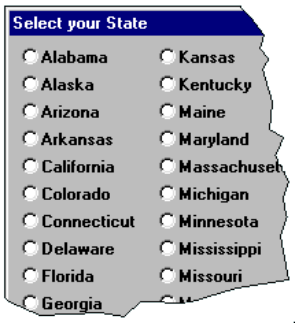
Interface Design



Interface Design

Alternative design by Benjamin Bannister

Interface Design



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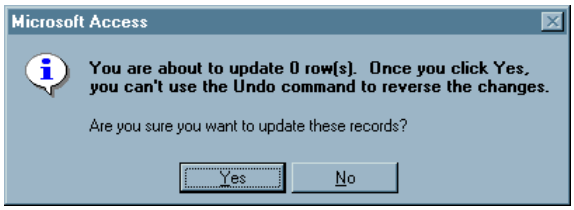
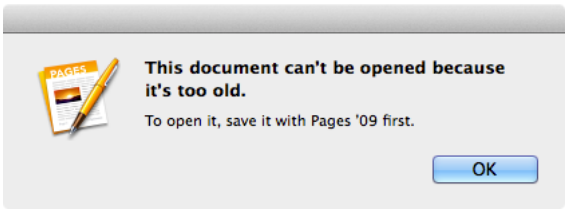
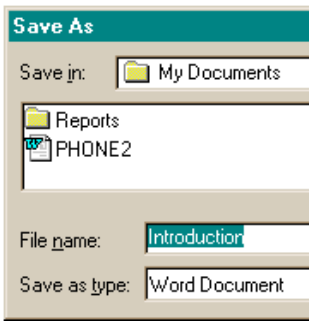


Interface Design



Interface Design

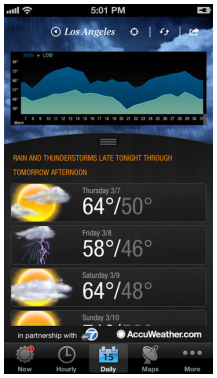


Interface Design

Whenever your local SMS Administrator sends you an actual software Package, the SMS Package Command Manager will appear (usually at network logon time) displaying the available Package(s). The following screenshots display scenes similar to what you will see when you receive an actual SMS Package.

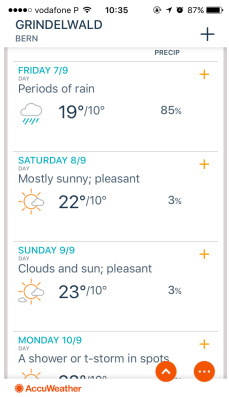
To start the demonstration, click the "CLICK HERE" button at the bottom of the screen.

Interface Design



Accuweather YahooWeather

Interface Design



Accuweather

What is Human-Computer Interaction (HCI)?

What is HCI?

- Factories in the beginning of XX century
  - human performance evaluation in manual tasks
- Second World War
  - production of more effective weapons
- Formation of the Ergonomics Research Society, 1949.
- Man-Machine Interaction => HCI
- The study of Human-Computer Interaction involves several aspects:
  - Physical
  - Psychological
  - Theoretical

What is HCI?

"HCI involves the design, implementation and evaluation of interactive systems in the context of the user's task."

Dix,1998

What is HCI?

"If I were to sum up interaction design in a sentence, I would say that it's about shaping our everyday life through digital artifacts – for work, for play, and for entertainement."

Gillian Crampton Smith, interview of January 30, 2002

What is HCI?

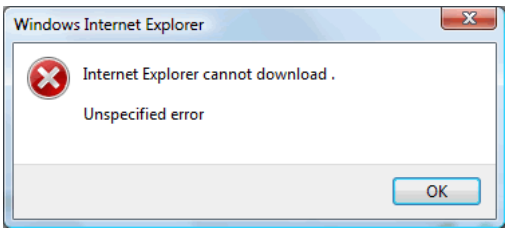
- Must know:
  - the users
  - the tasks
  - the usage context
- Should apply:
  - Iterative user-centred design
  - Usability principles
  - Evaluation techniques

HCI – Why?

- It's not just about "how big should be the buttons?" or "which colour should be used for the background?"

- It can affect:
  - Effectiveness
  - Safety
  - Mood
  - Productivity
  - …

HCI – Why?



Good design: Feedback - error warning
The user knows there is an error

Bad design: Not enough information. The user doesn't know:
- the cause
- the solution

HCI – Why?

The world's atomic energy authorities have been on alert since reports surfaced linking the **deaths of eight patients undergoing treatment** for pelvic cancer at the National Oncology Institute in Panama City, Panama, to overexposure during radiation therapy.

The International Atomic Energy Association (IAEA), Vienna, Austria, which has been investigating the deaths, said the overdoses probably were not due to a malfunction of the radiotherapy machine, but to a **problem with the system's data entry method**.

In August 2000, the Oncology Institute **changed the process for entering coordinates** for "shielding blocks" designed to protect healthy tissue during radiation therapy. The IAEA report said the change, coupled with a lack of updated written standard procedures, **resulted in miscalculations of radiation intensity and treatment times.**

HCI – Why?

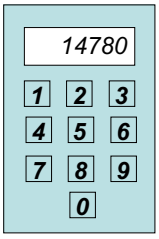
- Users' time isn't getting cheaper
  - Call center with 300 users
  - 700 screens/day
  - 230 days/year
  - User work cost: 5€/hour
  - Reduction of 3s/screen

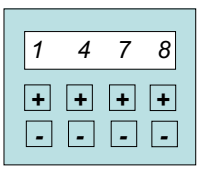
$\Rightarrow$ 201250 € / year

HCI – Why?

HCI – Why?

- Have the user in mind
- Try it out
- Involve the users in the design process
- Iterate





Mechanical syringe controller

HCI – Why?

- Systems must be robust and consistent.
- Must be prepared for the target users.
- Must support careless usage.
- Should be helpful => help to complete a task instead of creating extra obstacles.
- Interface design shouldn't be handled in the last minute.
  - Interface must be developed along with the rest of the system.

HCI – Related disciplines

- Computer Sciences
- Ergonomics and Human factors
- Artificial Intelligence
- Cognitive Psychology
- Sociology
- Design
- Management
- ...

User Interfaces

User interfaces are hard to design

- **User interface takes a lot of software development effort**
- **UI accounts for ~ 50% of:**
  - Design time
  - Implementation time
  - Maintenance time
  - Code size

(Myers & Rosson, "Survey on user interface programming", CHI '92)

User interfaces are hard to design

- **The user is always right**
  - if users have problems with an aspect of the interface, then there must be something wrong with it
- **The user is not always right**
  - user interface design can not be derived just by asking users what they would like. Users often don't know what is good for them. (ex: Klemmer, *Ergonomics, Ablex, 1989, pp 197-201).*
- **Users are not designers**
  - they don't come up with design ideas from scratch
  - they react to concrete designs they do not like
  - so, we should present suggested designs in a form users can understand (prototypes)

(ex: Grudin & Barnard, "When does an abbreviation become a word?", CHI '85)

User interfaces are hard to design

- **You (the developer) are not a typical user**
  - You know far more about your application than any user. It's very hard to forget things you know.
- **You need to communicate with the users**
  - Speak their language.
  - Collect their requirements, communicate your solutions and get their feedback.

Usability

Usability

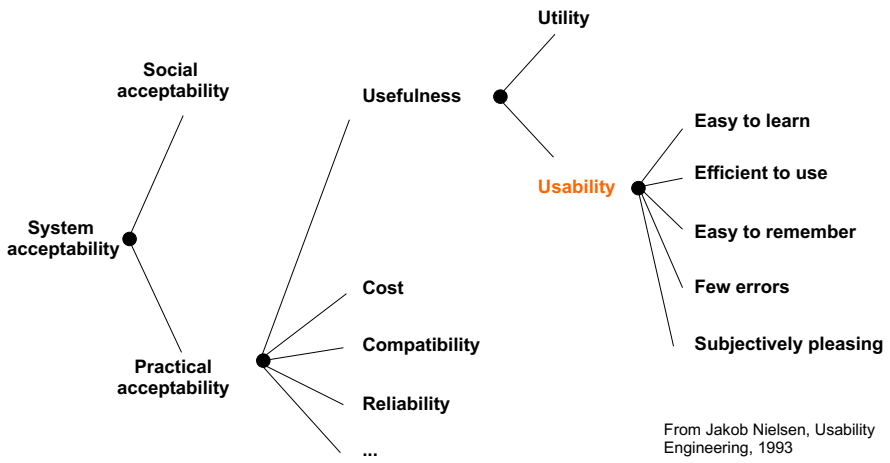
"Knowing some usability principles will help you see the problems yourself and help keep you from creating them in the first place"

Krug, 2014

Usability

The New Yorker, May, 2012

System acceptability



From Jakob Nielsen, Usability Engineering, 1993

Usability definition

- ISO 9241 usability standard

"Effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in a particular environment."

- Functional specifications: crucial to ensuring system functionality
- Usability specifications: crucial to ensuring system usability

ISO 9241 Usability standard

Assume traditional usability principles:

- effectiveness
  - can we achieve what we want to?
- efficiency
  - can we make it without wasting effort?
- satisfaction
  - do we enjoy the process?

Usability

How well users can use the system's functionality?

Usability Attributes

- **Learnability**
  - easy with which new users can begin effective interaction and achieve maximal performance.
- **Efficiency**
  - once the user has learned to use the system, a high level of productivity should be possible.
- **Memorability**
  - should be easy to remember.
- **Errors**
  - should have a low error rate.
- **Satisfaction**
  - should be pleasant to use

(Jakob Nielsen, Usability Engineering, 1993)

Usability measurements

- We can quantify these measures of usability
- Usability is measured relative to certain users (selected to be as representative as possible of the intended users) and certain tasks
- Measurements can be made:
  - in the lab
  - in the wild

Usability - Learnability

- Easy of learn – refers to the novice user's experience on the initial part of the learning curve.
- How do users learn to use a new interface?
  Most of the time:
  - They don't try to learn it first (there are some exceptions!)
    - They don't read the manual or the online help
    - They don't take a class
  - They try to learn by doing
    - They have a goal
    - Explore the interface to achieve that goal

Usability - Learnability

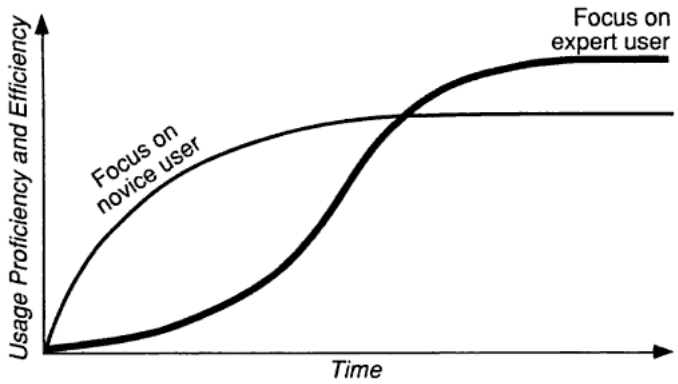
- User interface should clearly communicate how it works and how it is supposed to be used.
- Help (users look for help when they get stuck) should goal-oriented and searchable.
- Highly learnable systems allow users to reach a reasonable level of usage proficiency within a short time.

Usability - Learnability

- Pick some users who have not used the system before and measure the time it takes them to reach a specified level of proficiency in using it.
- Express the specified level of proficiency:
  - state that the users have to be able to complete a certain task successfully.
  - specify that users need to be able to complete a set of tasks in a certain minimum time before one will consider them as having "learned" the system.

Usability - Learnability

- Learning curve



From Jakob Nielsen, Usability Engineering, 1993

Usability – Efficiency of use

- Efficiency refers to the expert user's steady state level of performance at the time when the learning curve flattens out.

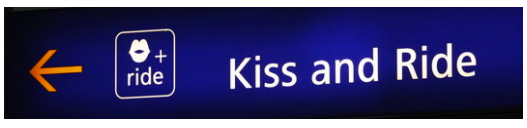
- Users are considered experienced (expert users):
  - if they say so
  - if they have been users for more than a certain amount of time.

Usability – Efficiency of use

- Experience can also be defined by the number of hours spent using the system.
  - test users are asked to use the system for a certain number of hours, after which their efficiency is measured.
- Continuously measure user's performance (ex: in terms of number of seconds to do a specific task) until it stops to increase, when the user is considered to reach the steady-state level of performance.

Usability – Memorability

- Casual users are people who use a system intermittently (expert users use the system frequently).
- In contrast to novice users, casual users have used the system before and do not need to learn it all from scratch.
- Casual users only need to remember how to use the system based on their previous learning.



Usability – Memorability

- Standard user test with casual users that have been away from the system for a certain time.
- Memory test: after users finish a test session, ask them to explain the effect of various commands or the name of a command that does a certain thing (assess the number of correct answers).
  - GUI – Recognition vs Recall
  - Mayes et al., 1988

Usability – Errors

- Users should make as few errors as possible when using a computer system.
- Error: action that does not accomplish the desired goal.
  - Norman's mistakes and slips
- Error rate is measured by counting the number of such actions made by the user while performing a certain task.
  - Can be measured simultaneously with other usability attributes

Usability – Errors

- Some errors are immediately corrected by the user and have no other effect than to slowdown the user's task completion rate.
  - Need not to be counted separately, as their effect is included in the efficiency of use.
- Catastrophic errors should be counted separately from minor errors and special effort should be made to minimize their occurrence and frequency.

Usability – Satisfaction

- How pleasant it is to use the system.
- Psychophysiological measures (pupil dilatation, blood pressure, heart rate):
  - often intrusive
- Simply ask the users for their subjective opinion (average of multiple answers).
- The most difficult episode a user experience is the most memorable one.

Usability – Satisfaction

- Questionnaires:

Users are asked to rate the system on 1-5 or 1-7 rating scales that are normally either:

- **Likert scale** – users indicate their level of agreement with certain statements.

  "It was very easy to learn how to use the system."

  Strongly Disagree 1 2 3 4 5 Strongly Agree

- **Semantic differential scale** - lists two opposite terms along some dimension and asks the user to place the system on the most appropriate rating along the dimension.

  Please mark the positions that best reflect your impressions of the system:

Pleasing	_ _ _ _ _	*Irritating*
Complete	_ _ _ _ _	*Incomplete*
Fast to use	_ _ _ _ _	*Slow to use*

Usability – Satisfaction

- Questionnaires:
  - No matter what rating scales are used, they should be subjected to **pilot testing** to make sure that the questions are interpreted properly by the users.
  - Users tend to be positive, unless they have had a really unpleasant experience. This phenomenon can be partly counteracted by using **reverse polarity** on some questions.
  - Final rating for subjective satisfaction is often calculated as a mean of the ratings for the individual answers (after compensating for any use of reverse polarity).
  - If multiple systems are tested, subjective satisfaction can be measured by asking users which system they prefer and how strongly they prefer various systems over the others.

Usability – Trade-offs

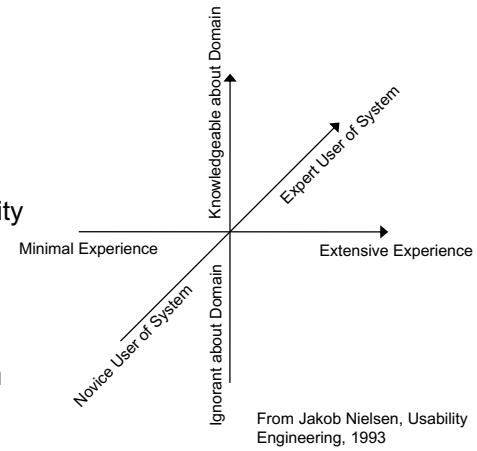
- Not all usability aspects can be given equal weight in a given design project.
- It is not always possible to achieve optimal scores for all usability attributes simultaneously.
  - avoiding catastrophic errors may lead to a user interface that is less efficient to use.
- When usability trade-offs seem necessary, try to find a win-win solution that can satisfy both requirements.
- If that is not possible, define which usability attributes are the most important given the specific circumstances of the project (user & task analysis).

Usability – Trade-offs

- Depends on the user

  Typically:
  - Novices – need learnability
  - Expert – need efficiency
  - Infrequent – need memorability

- Depends on the application



From Jakob Nielsen, Usability Engineering, 1993

Usability – Trade-offs

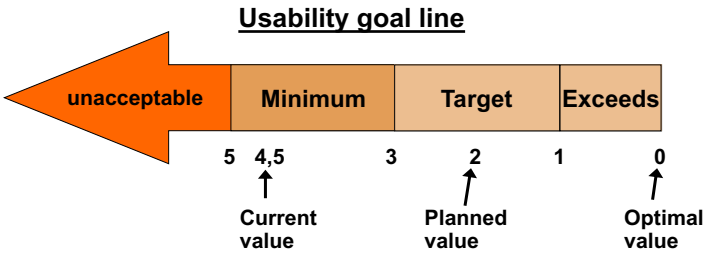
- Considerations other than usability may lead to designs violating some usability principle.
  - ex: security considerations often require access controls that are non-user friendly – error message in login.
- Make priorities clear on the basis of users and task analysis
  - ex:
    - learnability – when new employees are constantly being brought in on a temporary base
    - memorability – when application is used periodically, once every 3 months.

Usability – Trade-offs

- "best of both worlds"
  - accelerators – user interface elements that allow the users to perform frequent tasks quickly, even though the same task can also be performed in a more general, and possibly slower way. Ex: function keys, command name abbreviations, ...

Usability – Goal setting

- For each usability attribute of interest, several different levels of performance can be specified as part of the goal-setting process.



From Jakob Nielsen, Usability Engineering, 1993

Usability – goal setting

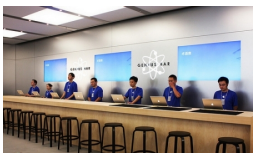
- Usability goals are reasonable easy to set for new versions of existing systems or for systems that have a clearly defined competitor on the market
  - Minimal acceptable usability = current usability level
  - Target usability = sufficiently large improvement to induce changes on the system
- For complete new systems without any competition, usability goals are much harder to set
  - Define a set of sample tasks and ask several usability specialists
  - Get an idea of the minimum acceptable level by asking users (could be dangerous!)

Usability – Good design

"Every designer wants to build a high-quality interactive system that is admired by colleagues, celebrated by users, circulated widely, and imitated frequently."

(Shneiderman, 1992)

User Experience (UX) Design



User Experience (UX) Design

Wake-up experience

User Experience (UX) Design

- *Similar look*
- *Same user interface*
- *Same outcome*

So quiet!

- … incomparable experience

Such a different experien

- *Different technology*
- *Different user interface*
- *Comparable usability*
- *Same outcome*

Buxton, 2005

Usability

"Let's design systems to fit people instead of the other way around."

Randolph Bias

References

- Buxton, B. Experience Design vs. Interface Design. Rotman Magazine, pp. 47-49, 2005. http://www.billbuxton.com/experienceDesign.pdf
- Dix, Alan, Finlay, Janet, Abowd, Gregory, Beale, Russel. Human-Computer Interaction. Prentice Hall Europe, London, 1998.
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- Mayes, J.T., Draper, S.W, Mcgregor, A.M. and Oatley, K. Information Flow in a User Interface: The Effect of Experience and Context on the Recall of MacWrite Screens. In Jones, D.M. and Winder, R. (Eds.), People and Computers IV. Cambridge University Press, Cambridge, UK, pp. 275-289,1988.
- Myers, B,and Rosson, M. B., Survey on user interface programming. Proc. of CHI '92, pp. 195-202.