

The Design of Interactive Computational Media

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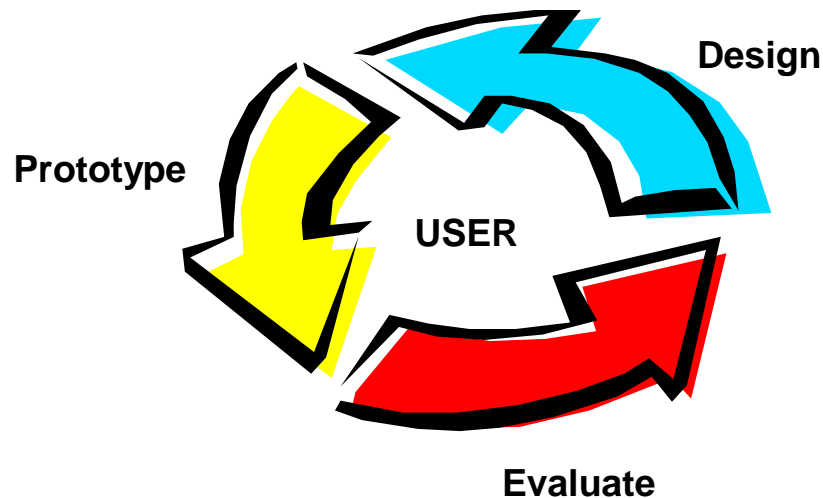
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Project

- ~~Phase 0: generating ideas~~
- Phase 1: establishing requirements
- Phase 2: designing prototype
- Phase 3: implementing prototype
- Phase 4: evaluating prototype



Phase 1: establishing requirements

- Myth: user is going to tell me the requirements!

Phase 1: establishing requirements

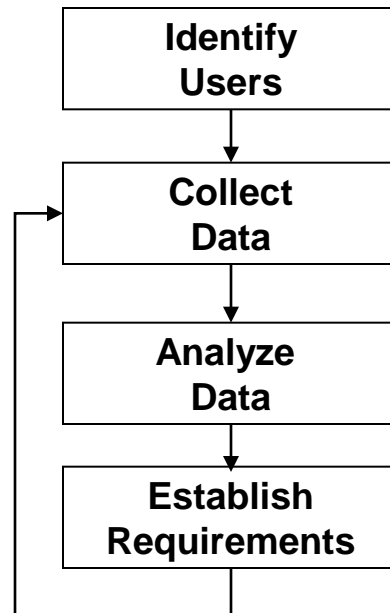
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- Myth: goals specified by the user form a coherent set

Phase 1: establishing requirements

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- Myth: goals specified by the user form a coherent set
- Myth: user will tell me all that is needed from the system

Phase 1: establishing requirements

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- Myth: goals specified by the user form a coherent set
- Myth: user will tell me all that is needed from the system
- Process:



Step 1: identifying Users

- Who are the users?

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- Primary users –
- Stakeholders:

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- Who are the users?
- Primary users – those who interact with an interface to do a task
- Stakeholders: anyone affected by primary users' ability to perform their tasks or who influences requirements
 - Managers, Product testers, Purchasing, Designers, Customer Reps, Union Reps, ...

Step 1: identifying Users

- Who are the users?
- Primary users – those who interact with an interface to do a task
- Stakeholders: anyone affected by primary users' ability to perform their tasks or who influences requirements
 - Managers, Product testers, Purchasing, Designers, Customer Reps, Union Reps, ...
- Give examples of stakeholders in the case of interactive media for
 - Digital libraries
 - Electronic classroom
 - Electronic medical record system

Why “you” don’t count as a user?

- You almost certainly aren’t typical
 - You’re too technically savvy
 - You don’t care (just) about the task
- It’s “cheating”!



The User...
a pretend person
who will mould to fit
your system

vs.



Mary
a real person with real
constraints trying to get
her job done

Identifying Users

- For your project, you'll deal with primary users
- In the real world, you'll work with the entire range of stakeholders
- But don't let organizational politics keep you away from the primary users
 - Managers or marketers can't define requirements or tasks... at least not successfully
 - Involve primary users in the entire process
 - Early input needed: usability delayed is usability denied

What if there are no real users?

- If there are no real users...
 - think again, there probably are!

Jeff Hawkins, the inventor of the Palm Pilot, was said to have carried a small block of wood around in his shirt pocket ... As various everyday situations arose, he would take out the block of wood and imagine how he would use the device.

The same technique can be used to evoke a response from expected end-users



Selecting Users to Work With

- Brainstorm a preliminary list
- Create a user – task matrix
 - These tasks are your initial, high-level ideas of what users are trying to accomplish
 - Think of what types of users would do each task

User-Task Matrix: example

Users	Query by Patient	Update Data	Query Across Patients	Add Relations	Evaluate System
Nurse	X	X			
Physician	X	X			
Appointment Personnel	X				
Medical-record maintainer	X	X	X	X	
DB Programmer			X	X	X

Narrowing the List

- Discuss your assumptions
- What do you want to know?
 - How users define themselves (jobs, tasks, mental models)
 - How they differ
 - How they will use the products over time

Selecting Users

- People who represent various activities, points of view, experience and skill levels
- Look for people who are thoughtful and articulate
- Ask around – see who gets recommended
- Beware of the person who wants to be your ‘best friend’
- But key informants are invaluable: people who know a lot and will share it with you

Users aren't Perfect

- Users aren't all-knowing
 - May have a very narrow view
 - May not be able to **articulate** what they do and what they know
 - May not envision possible new ways of doing things
- Users aren't designers
 - You must learn about the tasks from the users
 - Then use your design skills to create a design

Working with Users: tips

- Expectation management
 - No surprises, no disappointments
 - Timely training
 - Communication, but no hype
- Ownership
 - If users are actively involved, they're more likely to forgive or accept problems
 - Can make a big difference to acceptance and success of product

Step 2: collecting data

- What do they know?
 - systems, skills, etc.
- What do they do?
 - Tasks
- How do they do it now?
 - Scenarios
- What do they want to do?
 - new tasks

Data Collection: tools

- Questionnaires
- Interviews
- Focus Groups
- Naturalistic Observation
- Studying Documentation

Data Collection: questionnaires

- Can be administered in person, via phone, or via mail
- Must be designed and pre-tested with small samples
- Advantage:
 - “Precise,” allowing good control and comparability over a set of users
 - good for querying about stuff people *do* or *feel* (e.g., did you like the interface, what previous experience do you have)
- Disadvantage:
 - not as adaptable to individual characteristics or specific situations
 - Bad for determining underlying human abilities (e.g., what colors are better, how users learn a system, whether errors will be made)

Data Collection: questionnaires design

- Question formats

- Check boxes and ranges

- Gender: Male female

- Age: 0-20 21-30 31-40 41-50 51-60 71+

- Likert scales

- Strongly

- agree

- Agree

- Undecided

- Disagree

- Strongly

- disagree

- Semantic differential scales

- Picking numerical value along axis

Data Collection: questionnaires design

- Avoiding response bias through poorly worded questions
 - The interface is easy to use
False 5 4 3 2 1 True
 - vs.
 - The interface is
Hard to use -2 -1 0 1 2 Easy to use
- Open-ended versus closed-ended questions

Data Collection: valid questionnaires

- Data about users
 - Demographic information
 - Personality traits
 - Cognitive abilities
- Prior knowledge
 - Task domain
 - Computers
- Attitudes and experiences, including with computers
 - User satisfaction
 - Other perceptions of user experience

*Questionnaires are useful in
screening users and validating your findings*

Data Collection: invalid questionnaires

- How fast the user can accomplish tasks
- Where the user will make errors
- What command names to use
- How to organize items in the menu
- Which colors enhance visibility
- How a user learns commands

In short, questionnaires cannot assess information that the user is unaware of

Data Collection: questionnaires guidelines

- Design and pretest questionnaire
 - Ask clear questions
 - Ask questions that can be answered validly and reliably, *not*
 - Have you stopped doing <some taboo activity> yet?
 - In the last twenty years, how many times have the Leafs won?
- Be sure that every question has a purpose
- Keep the number of questions low
- Layout:
 - Introduction → General → Specific → Open Questions → End

Data Collection: questionnaire example

(1) The Computer Science Department at the University of Toronto is exploring ways in which people use the World Wide Web (WWW). Please assist us by filling out the following survey. (2) Your answers will be kept strictly confidential. (3) You may contact David Abrams (abrams@cs.toronto.edu) if you have any questions. Thank you for your participation.

(4) Win A New Computer Book

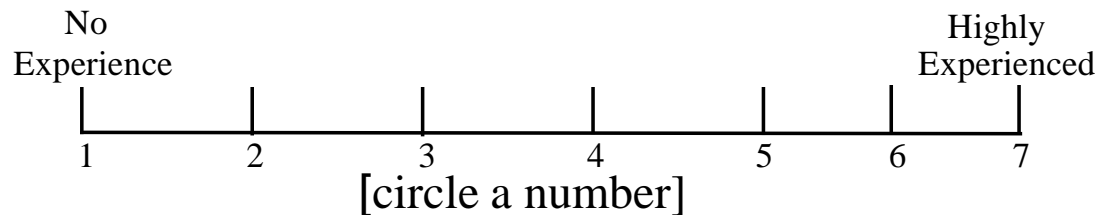
Your completed survey will be part of a drawing for five new computer books complements of Prentice Hall Canada, PTR Division Marketing Department. Enter your ticket number in the space provided below to win.

Ticket Number:

Data Collection: questionnaire example

(5) General Usage Characteristics

1.1) How do you describe your WWW experience?



1.2) On average, how many times do you make use of the WWW per week? _____

1.3) On average, how much time do you spend during each WWW session?

<input type="checkbox"/>	<input type="checkbox"/> under 10 min	<input type="checkbox"/> 10-30 min	<input type="checkbox"/> 30 min-1hr	<input type="checkbox"/> 1-2 hrs	<input type="checkbox"/> 2-3 hrs	<input type="checkbox"/> 3+ hrs
--------------------------	---------------------------------------	------------------------------------	-------------------------------------	----------------------------------	----------------------------------	---------------------------------

1.4) How many WWW bookmarks (hotlist items) do you have?

<input type="checkbox"/>	<input type="checkbox"/> none	<input type="checkbox"/> 1-10	<input type="checkbox"/> 11-25	<input type="checkbox"/> 26-100	<input type="checkbox"/> 101-300	<input type="checkbox"/> 300+
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Data Collection: questionnaire example

1.5) *How do you organize your bookmarks?*

- I don't organize - they stay in the order which I created them.
- I manually re-arrange bookmarks in a list.
- I create folders to group together related bookmarks.
- I create folders within folders to create a hierarchy of bookmarks.
- Other (describe) _____

1.6) *When do you usually organize your bookmarks?*

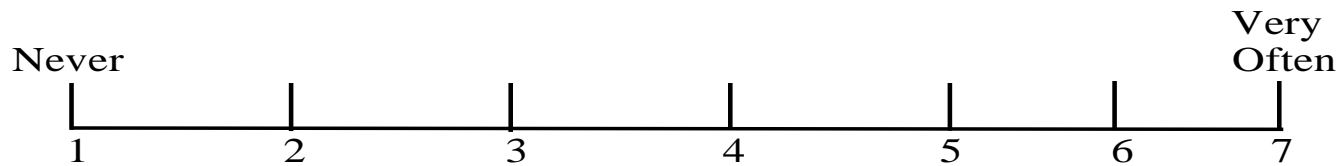
- I store each new bookmark in its place when I create it.
- I re-organize my bookmarks at the end of each browsing session.
- I organize bookmarks occasionally/sporadically.
- I never organize bookmarks.
- Other (describe) _____

Data Collection: questionnaire example

2) Your Typical WWW Browsing Patterns

Think back to a typical WWW browsing session, for example, the last time when you browsed the WWW for 20 minutes or more.

2.1) *Indicate how often you use the following techniques to organize bookmarks on a scale from 1 to 7.*



___ create a new bookmark

___ manually re-arrange bookmarks in a list

___ create folders to group together related bookmarks

___ create sub-folders within folders to manage a hierarchy

___ change the title of a bookmark

___ annotate a bookmark

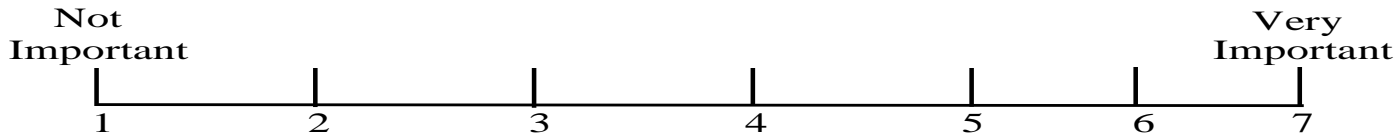
___ delete a bookmark

Data Collection: questionnaire example

2.2) *Approximately how many new bookmarks do you create during a typical session?*

<input type="checkbox"/> none	<input type="checkbox"/> 1-5	<input type="checkbox"/> 6-10	<input type="checkbox"/> 11-20	<input type="checkbox"/> 21 or more
-------------------------------	------------------------------	-------------------------------	--------------------------------	-------------------------------------

2.3) *Rank the importance of each reason for creating bookmarks on a scale of 1 to 7.*



_____ *Temporary Bookmark*: a temporary navigational landmark to come back to later during this session

_____ *Archival Bookmark*: a reference to store for use in future WWW sessions

_____ *Publishing Bookmark*: a hypertext link to add to my own WWW site

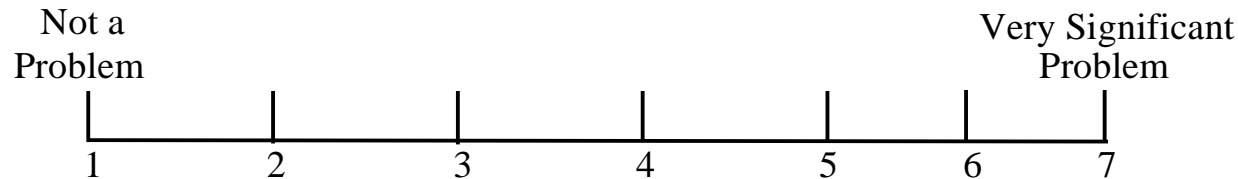
_____ *Collaborative Bookmark*: an item to give to a friend or third person

Other (describe) _____

Data Collection: questionnaire example

3) Rate Problems You Find with Existing Bookmarks

How significant/bothersome are each of the following possible bookmark problems?



____ I have trouble finding a bookmark stored somewhere in my hotlist/archive.

____ I open a bookmarked page to remember what's in it because the title doesn't describe the content.

____ There's no good way to organize my bookmarks.

____ I cannot see all my bookmarks on the screen at one time.

____ I cannot easily tell when the content of a bookmarked page changes on the WWW.

____ There's no quick and easy way to store a new bookmark in the correct place and continue browsing the WWW.

Other (describe)

Data Collection: questionnaire example

(6) 4) What do you like most and/or least about WWW bookmarks?

(7) 5) Personal Attributes

Gender:	<input type="checkbox"/> Male	<input type="checkbox"/> Female
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Age:	<input type="checkbox"/> under 20	<input type="checkbox"/> 20-29	<input type="checkbox"/> 30-39	<input type="checkbox"/> 40-49	<input type="checkbox"/> 50-59	<input type="checkbox"/> 60+
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(8) THANK YOU FOR YOUR SUPPORT

Data Collection: interviews

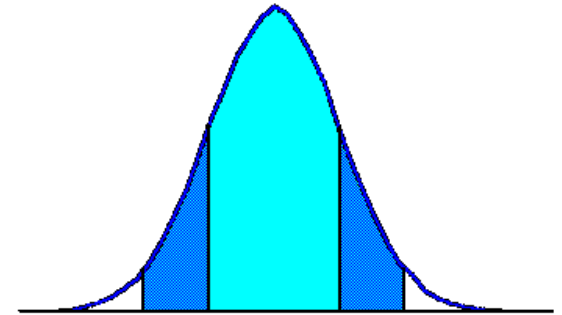
- Best done face-to-face
 - Adaptable to individual characteristics or specific situations
 - But still require careful planning and pre-testing
- Who to interview?
 - Think about social categories — Age, education, socio-economic class, job skills, etc.
 - Sampling broadly or focusing narrowly on a subset of individuals defined in terms of these categories
- How many people to interview?
 - Minimum of 3-4 interviews, ideally more
 - More (at least 2 per category) if sampling broadly
- What questions to ask interviewees? (depends on situation)
 - Questions about user characteristics, attitudes, skills, tasks, work practices, likes, dislikes, problems

Data Collection: interviews recording

- Notetaking is good, but...difficult to talk and write, consider a two person team
- Audio recording better, but problems to overcome...
 - Poor audio quality
 - Interviewee reluctance — allow turning off tape recorder
- Video recording even better, but problems to overcome...
 - Technical complexity
 - Intrusiveness, possible impact on interviewee

Data Collection: interviews techniques

- What techniques to use in conducting the interview?
 - Introduction → Warm-up → Main-body → cool-off → Closure



- Introduction:
 - Make the interviewee feel comfortable, relaxed
 - Make the interviewee feel important
 - Make the interviewee feel safe (e.g., confidentiality)
 - Help the interviewee understand what the interview is about (e.g., context, motivation, importance)
- Warm-up:
 - If discussing a system under design, show a prototype
- Cool-Off:
 - Ask if there is anything else interviewee would like to add
- Be gracious, respectful, and thankful

Data Collection: interviews design

- Structured
- Unstructured
 - Conversations, but guided by a plan
- Semi-structured (elements of both styles)

Data Collection: preparing for an interview

- Send them email ahead of time about purpose of study, who you are, why you are coming, what you will ask them about
- Tell them how much time you expect to need, and don't run overtime without their agreement
- Dress in a similar way to participants!
- Devise a system for coding names of participants to preserve confidentiality.
- Ask participants to complete an informed consent form

Data Collection: interviewing hints

- Do it in their environment if you can – but be aware of problems of noise, interruption, confidentiality
 - NOTICE things
- Ask about goals, don't just focus on tasks, listen for goals for the benefit of others
- Probe goals, tasks presented as goals
- Don't be shy, ask for more information, provide active feedback that you are listening
- Ask user if your interpretation is correct, listen for “no” in pauses, maybes
- Ask for leads if necessary

Data Collection: interviewing hints

- Things to avoid when preparing interview questions:
 - Long questions
 - Compound sentences - split into two
 - Jargon & language that the interviewee may not understand
 - Leading questions that make assumptions or blaming user
e.g., why do you like ...?
 - Unconscious biases e.g., gender stereotypes

Data Collection: interviewing example

- Interviewing a Professor about how people collaborate in writing activities...
- Opening statement?
- What do I want to ask about?

Data Collection: interviewing example

- Interviewing a Professor about how people collaborate in writing activities...
- Opening statement?

“I am studying how people write together. I would like to talk to you about the most recent (one especially memorable) joint authoring project you participated in. Be assured that all the information you will give in this interview will remain strictly confidential.”
- What do I want to ask about?
 - Background, Process, Control, Problems, Technology

Data Collection: interviewing example

- “I am studying how people write together. I would like to talk to you about the most recent (one especially memorable) joint authoring project you participated in. Be assured that all the information you will give in this interview will remain strictly confidential.
- **Background**
 - *Time*: When did this take place? How long did the entire project take?
 - *Document*: What type of document were you working on? How long was the final document?
 - *People*: Who were the participants? Were these people peers or subordinates or superiors? How were they chosen? Describe the other people's personalities. Did these people possess special skills? (known previously, not, ?) How important was it for everyone to work together?
 - What were you doing at that point in your life? (type of job, educational training?)
 - Describe in detail one day that you were working together on the project (the time of year, weather, location, purpose of meeting, productiveness of meeting, outcome of the meeting...)

Data Collection: interviewing example

- Process

- Did the writing proceed in stages or steps? What were these stages (planning/writing/revising)? What happened at each stage of the writing process?
- How did you share the work? Who did what? Was the work evenly divided? How was this decided on? Which stages of the writing (planning, drafting, revising) involved groups of people and which were done by individuals (Q2)?
- Was the process planned at the start or decided on over time? Was the plan followed?
- Was the process explicit? (Decide to do A,B,C then do A, B,C, or did individuals just do things?)
- Was the process used in this joint writing project, similar to your usual writing style when writing alone/ when writing with others?
- Would you say the process used was a success? Why/why not?

Data Collection: interviewing example

- Control

- Sometimes one or more persons take charge of the document, often this isn't a bad thing and it may improve the efficiency of the writing. Did this type of thing happen during your writing? Who was this person? How were they chosen?
- How did you find the errors? How did you fix the errors? Did everyone take part in reviewing the document and suggesting changes? How were the changes done? (permissions?)
- How was the final document compiled? Was anyone in charge of this stage?
- Afterwards, how was the credit divided? Was this discussed early on during the writing (How many authors? Who's first?)

- Problems

- How did the relationships work out?
- How did you handle/settle your disagreements?
- What other types of problems did you encounter during the writing?

Data Collection: interviewing example

- Technology
 - What is your educational/technical background (Q1)
 - What type of technology was used in the project? (Computers/typewriters/ telephone/fax/bus?) At what stages of the project was technology used? (Q2)
 - What did you like about the technology you had available to work on this project? What did you dislike about the technology? Did it ever get in the way? What would have make the technology easier to use (Q1)
 - What type of technology would have facilitated the writing process?
 - What else would you like to be able to do with the available technology (Q1)
- Is there anything else? Have I covered everything?
 - Would you say this project was a success?
 - Would you choose these people to work with again?
 - What is you attitude to joint writing? (positive/negative)

Data Collection: focus group

- Group interviews
 - Typically 3-10 participants
- Pros
 - Getting a consensus view
 - Highlighting areas of conflict
- Cons
 - Organizational politics
 - Difficult to schedule

Data Collection: naturalistic observation

- How one works is as important as what one accomplishes
- Spend time with stakeholders in their day-to-day tasks, observing work as it happens
- Gain insights into stakeholders' tasks
- Good for understanding the nature and context of the tasks
 - But, it requires time and commitment from a member of the design team, and it can result in a huge amount of data

Data Collection: naturalistic observation

- What to do?
 - Note everything the user does, what triggers it
 - Take pictures, sketch the environment
 - Who does the user interact with?
 - What paper or information is passed around?
 - Get copies of artifacts, preferably used
 - Where does a task end? does the user know what happens next
 - Focus on non-verbal behavior

- Ethnography, contextual inquiry

Data Collection: studying documentation

- Procedures and rules are often written down in manuals
- Good source of data about the steps involved in an activity, and any regulations governing a task
- Not to be used in isolation
- Good for understanding legislation, and getting background information
- No stakeholder time, which is a limiting factor on the other techniques

Data Collection: sources of bias or error

- The investigator
 - As questioner, as observer, as interpreter
- The choice & phrasing of questions
 - Tension between flexibility and consistency/accuracy
- The participant
 - Wanting to 'look good', fear of possible outcomes, not understanding questions or focus of investigation
 - How articulate, observant, reflective
 - Understanding of the situation (always THEIR understanding; idiosyncratic?)
- Interview/observation conditions
 - Unusual circumstances
 - Constraints

Data Collection: ethical issues

- Basic Principles:
 - Do not harm!
 - Informed Consent
 - Voluntary participation
 - Right to PRIVACY
- Research Protocols (Assignment 2a)
- Consent Forms (Assignment 2a)
 - Explanation of study and purpose
 - Ability to withdraw at any time
 - Anonymity, confidentiality

Data Collection: gaining trust with users

- Be honest
- Be interested
- Be sympathetic – but not artificially so
- LISTEN
- How you talk about others is how they assume you will talk about them
- Be gracious, respectful, and thankful

7 minute break

Step 3: data analysis

- Figure out what is important
- Affinity diagramming
 - group info & find relations between groups
 - Post-Its on large surfaces
 - haptic UI
 - immersive
 - persistent
 - brainstorming



Data Analysis

- Stakeholder analysis
 - Describing the users and other key groups
- Artifact analysis
 - Describing the environment, facilities, objects, documents, ...
- Task analysis
 - Describing the work people do and how they do it

Data Analysis: stakeholder analysis

- Physical characteristics
 - Age, gender
 - “Handicaps”, e.g., left-handed, glasses, colour-blind
- Knowledge and experience
 - Computer literacy
 - Novices
 - First-time users
 - Knowledgeable but infrequent
 - Experts
 - Domain or task literacy
 - Education
 - Native language, reading level, typing skill
 - System/application background: expert, experienced, novice

Data Analysis: stakeholder analysis

- Psychological characteristics
 - Attitude and motivation, e.g., committed, alienated
 - Cognitive style: verbal-analytic, spatial-intuitive
- Job characteristics
 - Mandatory vs. discretionary use; regular vs. casual use
 - Level of training, turnover rate
 - Importance, structure
- “Beyond characteristics” → Surveys, interviews, observation, reflection

Data Analysis: stakeholder analysis

- What is the Relationship Between Users & Data?
 - Personal data
 - always accessed at same machine?
 - do users move between machines?
 - Common data
 - used concurrently?
 - passed sequentially between users?
 - Remote access required?
 - Access to data restricted?

Data Analysis: sample user profiles

<i>Sample systems</i>	
Park information system	Airline reservations system
<i>User profiles</i>	
All job types	Clerical
All education levels	High school, community college
Male and female	Mostly female
Many languages	English
Age 6 and up	Age 20 and up
Many levels computer literacy	Moderate computer literacy
Low frequency of use	High frequency of use
No training, no manual	Mandatory training
Discretionary use	Mandatory use
<i>Possible resulting design choices</i>	
Touch screen	Keyboard
Menus, icons	Typed command language
Easy to learn (prompts. Structure, ...)	Easy to use (optimizations, flexibility)

Data Analysis: artifact analysis

- We seek to understand:
 - Artifacts or objects used in tasks, e.g., files, forms
 - Organization of artifacts, e.g., page → section → chapter → book
- Describing
 - The environment, e.g., rooms, buildings
 - Facilities, e.g., dining rooms, kitchens
 - Objects, e.g., tables, telephones, computers
 - Documents, e.g., schedules, records
- Techniques of artifact analysis
 - Observation
 - Written descriptions
 - Photographic and Video records
 - Copies of artifacts

Data analysis: tasks

- What is a task?
 - What someone does to achieve a goal
 - Multi tasks, same goal
 - Doesn't specify how they would do the job – separate the **What** from the **How**; concentrate on the **What**

- Why tasks?
 - basis for system design
 - Geek: “Let's add this cool new feature!!!”
 - Usability Expert: “Why? Which task does it support?”
 - basis for comparative evaluation of different design alternatives
 - basis for user testing

Data analysis: defining tasks

- Concentrate on **frequent** and **infrequent-but-important** tasks
- 3-5 general-purpose tasks for a very simple system
- Separate tasks for special-purpose cases (maintenance, installation)
- 10+ tasks for complex systems
- Depth/quality more important than number of tasks

Data analysis: defining tasks

- What to look for?
 - How users perform their tasks now?
 - What language users employ in their work?
 - What objectives they might have for a product?
 - How users might actually use a product?
- We seek to understand work flow patterns
 - Who performs which tasks and how often?
 - What are the communication patterns among workers?

Data analysis: tasks

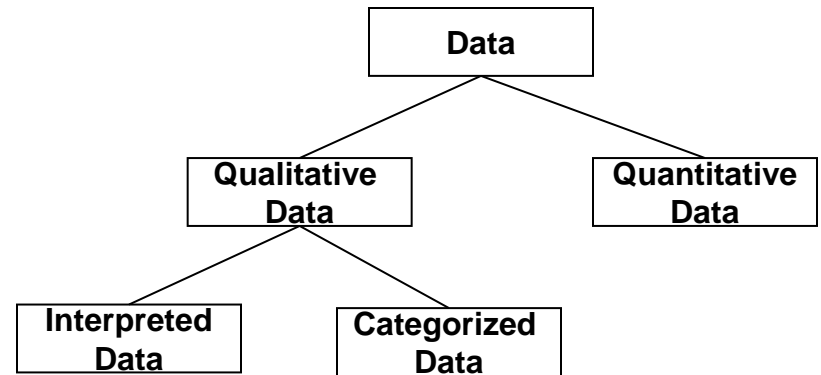
- We seek to understand relationships between tasks & artifacts
 - E.g. How specific forms and files are used in order entry?
- We seek to understand use of information in the environment in carrying out a task
 - Things perceived visually, e.g., materials on hand
 - Things perceived acoustically, e.g., conversations of co-workers, opening of door
- We seek to understand the use of other technologies, e.g., phones, voice mail, fax

Data analysis: tasks example

- Consider the student section of ROSI
<http://www.rosi.utoronto.ca/>
- Define 3 **tasks** students might try to accomplish with the site

Data analysis: tasks

- We use the data collection methods mentioned above...
 - Interviews
 - Questionnaires
 - Focus groups
 -



- ...in order to
 - Observe, describe, and understand current work practice
 - Observe, describe, and understand system usage
 - Listen to users thinking and talking about their work
 - Collect qualitative data, e.g., mental models, emotions
 - Collect quantitative data, e.g., how many? how often? how long?

Data Analysis: scenarios

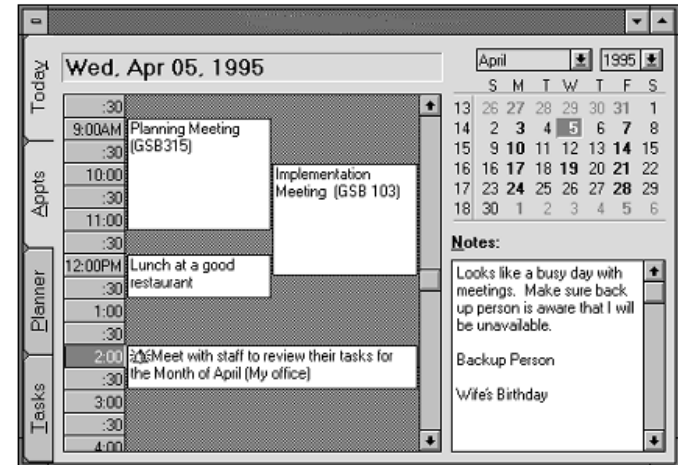
- Specific instances of system use
 - From the **what** to the **how**
 - A particular task
 - A particular interface
 - What the user do would, in detail
- A scenario is a description of users and stakeholders using artifacts within environments carrying out tasks or activities
- It is an informal narrative story, simple, ‘natural’, and personal
- More in tutorial next week

Data Analysis: scenarios

- Interface-dependent
- Detail appropriate to user, task, interface
- Make certain issues obvious
 - how components work together
 - design arguments
 - tricky parts of the interface
- First step in evaluation

Data Analysis: scenario example

Shared Calendar:



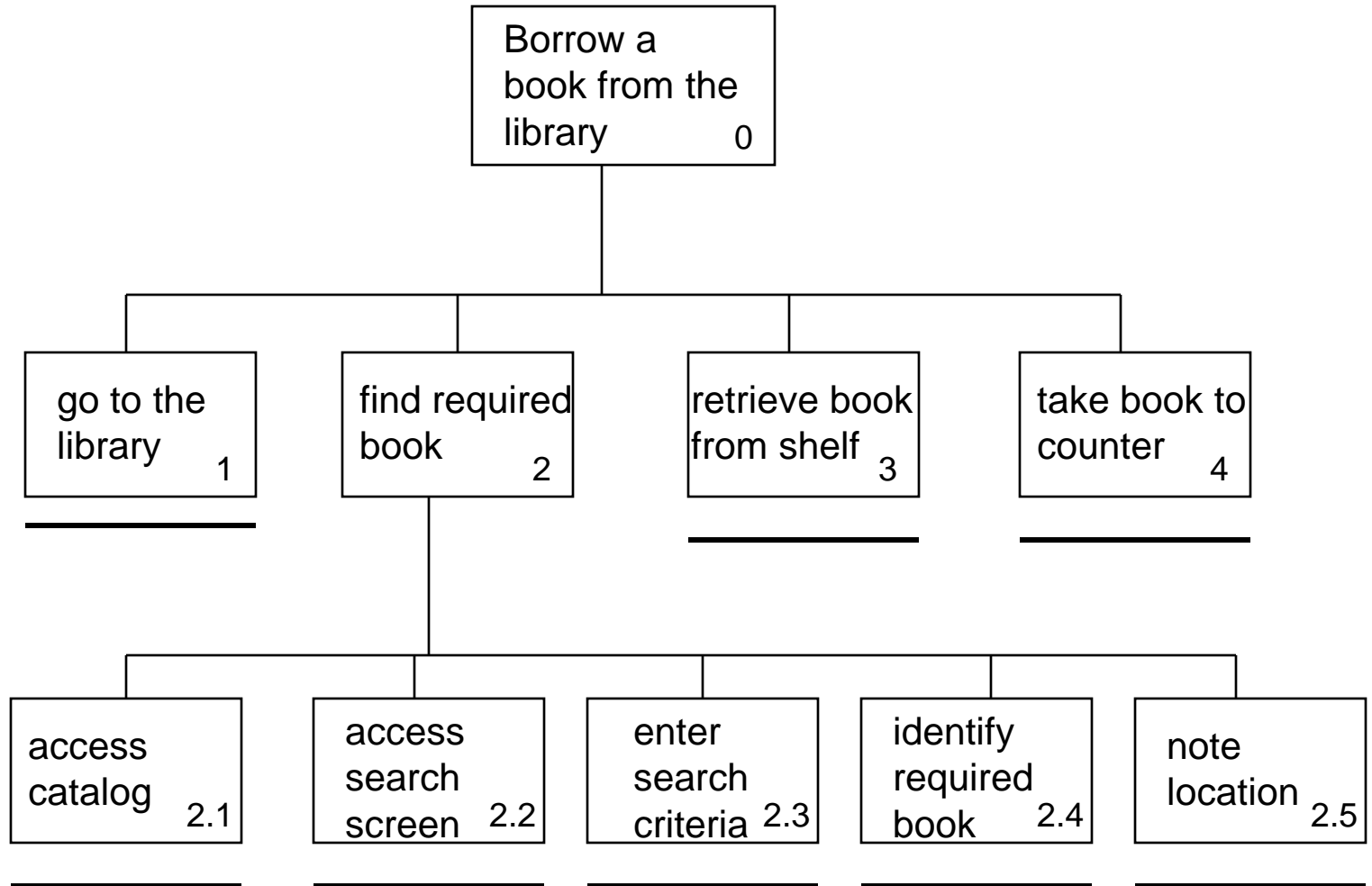
“(1) The user types in all the names of the meeting participants together with some constraints such as the length of the meeting, roughly when the meeting needs to take place, and possibly where it needs to take place. (2) The system then checks against the individuals’ calendars and the central departmental calendar and (3) presents the user with a series of dates on which everyone is free all at the same time. (4) Then the meeting could be confirmed and written into people’s calendars. Some people, though, will want to be asked before the calendar entry is made. Perhaps (5) the system could email them automatically and ask that it be confirmed before it is written in.”

Data analysis: notation for task analysis

- Hierarchical Task Analysis
 - Breaking a task down into subtasks, and then some of the subtasks into subsubtasks, etc.
 - See pp. 231-235 of text
 - More in tutorial next week

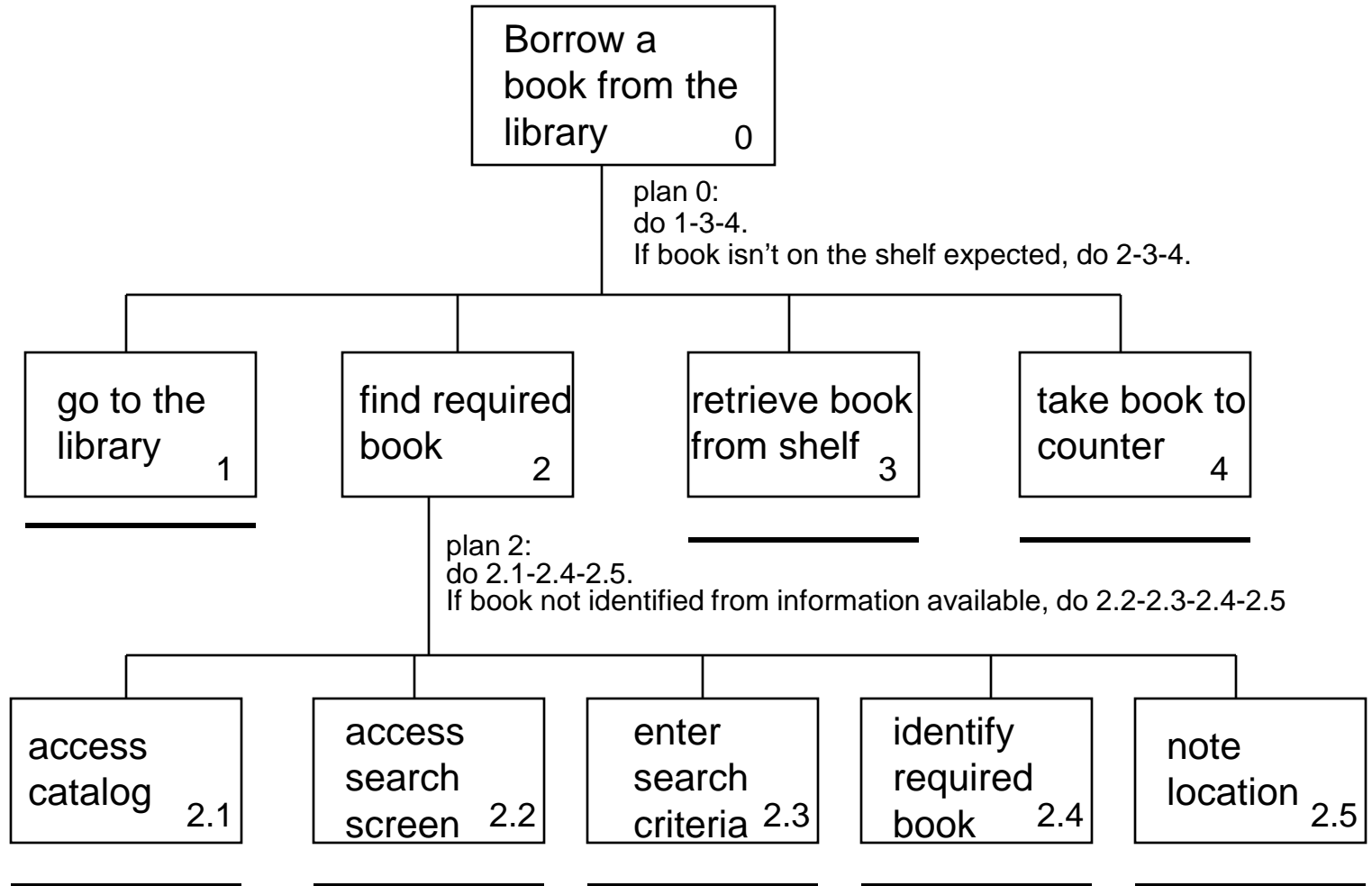
Data analysis: hierarchical task analysis

Borrow a book from the library



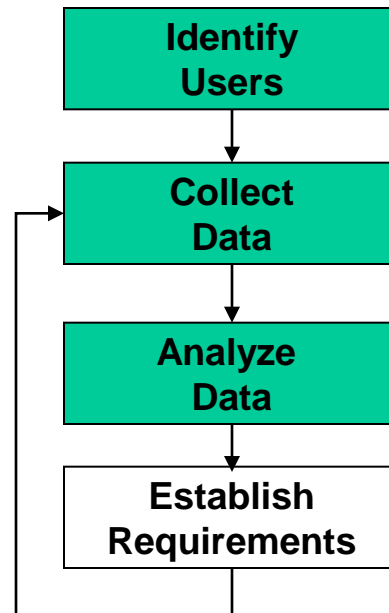
Data analysis: hierarchical task analysis

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Step 4: establishing requirements

- What do users want? vs. What do users 'need'?
 - Requirements need clarification, refinement, completion, re-scoping
 - Input: data analysis
 - Output: stable requirements



Requirements: taxonomy

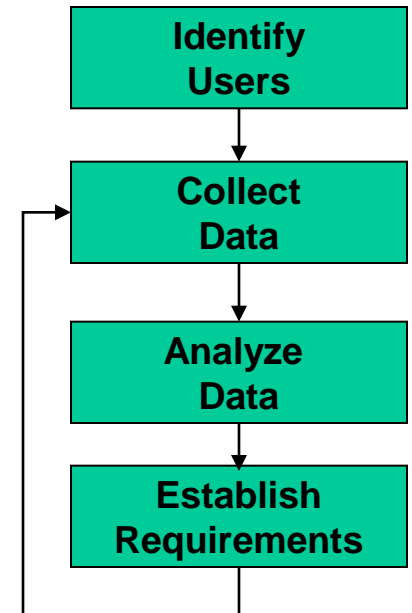
- Functional requirements:
 - What the new system is to do in general terms?
 - What the users do? how they do it (based on task analysis)?
 - What specific capabilities are therefore required?
- Data Requirements:
 - What kinds of data need to be stored and displayed?
- Environmental Requirements:
 - Physical: dusty? noisy? vibration? light? heat? humidity?
 - Social: sharing of files, of displays, in paper, across great distances, work individually, privacy for clients
 - Organizational: hierarchy, IT department's attitude and remit, user support, communications structure and infrastructure, availability of training
 - Technical: technological limitations....

Requirements: taxonomy

- User Requirements:
 - Characteristics:
 - ability, background, attitude to computers
 - System use:
 - novice, expert, casual, frequent
 - Novice:
 - step-by-step (prompted), constrained, clear information
 - Expert:
 - flexibility, access/power
 - Frequent:
 - short cuts
 - Casual/infrequent:
 - clear instructions, e.g. menu paths
- Usability Requirements:
 - What are the most important usability goals to be achieved? e.g. learnability, throughput, flexibility, attitude

Project

- ~~Phase 0: generating ideas~~
- Phase 1: establishing requirements ←
- Phase 2: designing prototype
- Phase 3: implementing prototype
- Phase 4: evaluating prototype



Videos

Examples of participatory Design

Working with children

<http://interliving.kth.se/>

Wearable