## Intro - Chapter 1

**Dual Processor" Theory:**
– Every interactive system is a distributed system running on two processors:
**Usability goals:** Effective to use, efficient to use, safe to use, good utility, easy to learn, easy to remember how to use.

**Interaction design:** Is concerned with designing interactive products to support the way people communicate and interact in their everyday and working lives: Establishing req. -> Developing Alternatives -> Prototyping -> Evaluating

**Design principles:** Visibility, Feedback (send info back to user), Constraints(restrict possible actions tht can be performed), Logical vs Ambiguous, Consistency (**external**: across applications/devices, **internal**: within app)

**Conceptual Model of UI:**
**1**. **Task Level**
· What is to be done by the user
**2**. **Conceptual Level**
· User's intended mental model of the system
**3**. **Interaction Style Level**
· Command-driven, menu-driven, direct manipulation, hypermedia · Design elements that are repeated throughout the system
**4**. **Interaction Element Level** · Specific windows, dialogs, commands, menus
**5**. **Physical Element Level** · Bitmaps, characters, data structures, callbacks

**Human Computer Interaction:**
Visibility,Feedback,Goal,Affordance: Give a clue how to use,Task

**Generic Design Process**
**Discovery:** Task analysis, storyboard
**Design:** Low fidelity prototypes, wireframes
**Evaluation:** Usability Testing

**Evaluation - Chapter 2**
**A malfunction** is a usability defect.

**Malfunction Analysis:**
1. Play protocol, searching for malfunctions
2. Answer four distinct questions:
· Q1. How is the malfunction manifested?
– What do you notice and who noticed it?
· Q2. At what stage in the interaction is it occurring?
– Goal forming, action decision, action execution, interpretation of results
· Q3. At what level of the user interface is it occurring?
– Physical element level to task level
· Q4. Why is it occurring?
– What is its root cause
3. List and prioritize possible cures

**Formative evaluations:** When evaluations are done during design to check if product continues to meet user's need.

**Summative evaluations:** when evaluations are done to assess the success of a finished product.

**Controlled settings involving users:**
- Main methods are usability testing & experiments in laboratories and living labs
-Control what users do, when they do it, and for how long.
-**Good** at revealing usability problems but **Bad** at capturing context of use.

**Natural settings involving users:**
-Field studies in public places or online communities
-**Good** at demonstrating how people use technologies in their intended setting, but are expensive and difficult to conduct.

**Any settings not involving users**,
-Inspections, heuristics, walkthroughs, models, and analytics → predict user's behavior
-Cheap and quick to perform, but can miss unpredictable usability problems and subtle aspects of the user experience

## Data Gathering and Analysis- Chapter 4

**Setting goals**
·Decide how to analyze data once collected
·Goals influence data gathering sessions, techniques and analysis of data.
**Identifying participants**
·Done via sampling of population who fits profile.
·Probability sampling (random sampling) and non-probability sampling (convenience sampling or volunteer panels)
**Relationship with participants**
·Informed consent when appropriate
·Consent not needed when collecting data for requirements activity
**Triangulation**
·Look at data from more than one perspective
·Triangulation of data – data drawn from different sources or people or places
·Investigator triangulation – different researchers
·Triangulation of theories or frameworks through which to view data or findings
·Methodological triangulation – looking at different data gathering techniques.
**Pilot studies**
·Ensure proposed method is viable before embarking on real study
·Plans should be tested and validated (e.g valid questionnaires)

**Raw Data** (data collected) → **Information** (analyzed/interpreted) → **Conclusions** (actions to be taken based on info)

**Unstructured interviews:** More like a convo. Generate rich data.
**Structured:** Like questionnaire
**Focus groups:**Interviewing people in groups

**Closed question**(yes/no) vs. **Open questions(more feedback)**

**Three main data gathering methods:** interviews, questionnaires, observation
**Ethnography:** Ethnography is a philosophy with a set of techniques that include participant observation and interviews Debate about differences between participant observation and ethnography Ethnographers immerse themselves in the culture that they study · Cooperation of people being observed is required · Informants are useful · Data analysis is continuous · Interpretivist technique · Questions get refined as understanding grows · Reports usually contain examples

**Quantitative data** – expressed as numbers
**Qualitative data** – difficult to measure sensibly as numbers, e.g. count number of words to measure dissatisfaction

## User Involved Evaluation - Chapter 5

**Usability testing:** evaluate desktop apps such as websites - To test if product is usable by the intended user population to achieve the tasks for which it was designed - Control users, environmental and social influences that might impact users performances

**Usability testing (methods):** Involves recording performance of typical users doing typical tasks. · **Done in Controlled settings**. · Users are observed and timed. · Data is recorded on video & key presses are logged. -- ADAPTED form of experimentation

**Usability testing (tasks):** Goals & questions focus on how well users perform tasks with the product. · Comparison of products or prototypes common. · Focus is on time to complete task & number & type of errors. · Data collected by video & interaction logging. · Testing is central. · User satisfaction questionnaires & interviews provide data about users' opinions.

**Usability engineering orientation:**Improvement with each version. Current level of performance. Minimum acceptable level of performance. Target level of performance.

**5-10 participants** is enough for user testing and testing should continue until no new insights are gained.

**Usability Testing Procedure** Select the participants → Identify the tests (set of tasks) → Setup the equipments → Perform tests → Identify usability problems → Interpret and present the data

## Analytical Evaluation - Chapter 6

**Discount Evaluation:** Heuristic evaluation is referred to as (Benefits outweigh costs) · Empirical evidence suggests that on average 5 evaluators identify 75-80% of usability problems.

**3 stages of heuristic eval:**
Briefing session to tell experts what to do. Evaluation period of 1-2 hours in which:
– Each expert works separately;
– Take one pass to get a feel for the product;
– Take a second pass to focus on specific features. Debriefing session in which experts work together to prioritize problems.

**Problems…:** Users not involved, can be hard to find experts. Important problems can be missed and trivial ones identifies. Experts have a bias.

**Cognitive walkthroughs:** Focus on ease of learning - Designer presents an aspect of the design & usage scenarios.
**3 Qs:**
-Will the correct action be sufficiently evident to the user? - Will the user notice that the correct action is available? - Will the user associate and interpret the response from the action correctly?

**Pluralistic walkthrough:** Experts work separately, managed discussion leads to agree decisions

**Predictive models:** A way to evaluate without involving users. Derive various measures of user performance. Useful for limited systems like telephone answering… Based on expert error-free behavior

**GOMS**
·Goals – what the user wants to achieve eg. find a website.
·Operators - the cognitive processes & physical actions needed to attain goals, eg. decide which search engine to use.
·Methods - the procedures to accomplish the goals, eg. drag mouse over field, type in keywords, press the go button.
·Selection rules - decide which method to select when there is more than one.
**Ties in with keystroke model** that allows predictions to be made about how long it takes an expert user to perform a task

**Fitts' Law**
Fitts' Law predicts that the time to point at an object using a device is a function of the distance from the target object & the object's size.
·T = k*log2 (D/S+1.0) (T =time to move the pointer to a target, D = distance between a pointer and a target, S = size of the target and k = 200ms/bit)
·Useful for evaluating systems for which the time to locate an object is important, e.g., a cell phone, a handheld devices.

## Heuristic Evaluation - Chapter 7

Helps find usability problems in UI design.
**Process:**
- Small set (3-5) of evaluators examine UI independently check for compliance with usability principles ("heuristics")
- Different evaluators will find different problems evaluators only communicate afterwards findings are then aggregated
**Phases:**
-Pre-evaluation training give evaluators needed domain knowledge and information on the scenarios
-Evaluation individuals evaluate and then aggregate results
-Severity rating determine how severe each problem is (priority)
-Debriefing discuss the outcome with design team
2 passes for each evaluator → evaluator then provides list of problems.**Heuristics:**
H1-1: Simple and natural dialog
H1-2: Speak the users' language
H1-3: Minimize users' memory load
H1-4: Consistency
H1-5: Feedbac
H1-6: Clearly marked exits
H1-7: Shortcuts
H1-8: Precise and constructive error messages H1-9: Prevent errors
H1-10: Help and documentation

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**H2-1:** Visibility of system status: keep users informed about what is going on:
0.1 sec: no special indicators needed
1.0 sec: user tends to lose track of data
10 sec: max. duration if user to stay focused on 1 action for longer delays, use percent-done progress bars
**H2-2:** Match between system and real world (speak the users' language)
**H2-3:** User control and freedom (exits clear, redo, undo, don't force down path)
**H2-4:** Consistency & standards
**H2-5:** Error prevention
**H2-6:** Recognition rather than recall (actions, buttons, options easily retrievable)
**H2-7:** Flexibility and efficiency of use (accelerators for experts, frequent actions)
**H2-8:** Aesthetic and minimalist design(nothing irrelevant)
**H2-9:** Help users recognize, diagnose, and recover from errors (error in plain language, indicate problem, suggest solution)
**H2-10:** Help and documentation (easy to find, concrete steps to carry out, not loo large)

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**Severity Rating:**
0 - don't agree that this is a usability problem
1 - cosmetic problem
2 - minor usability problem
3 - major usability problem; important to fix
4 - usability catastrophe; imperative to fix
*Eg.* [H1-4 Consistency] [Severity 3][Fix 0]

## Conceptual Models - Chapter 8

Assumption- needs further investigation, taken for granted
Claim- stating its true, open to question. Both part of problem space
**Benefits of conceptualization design space:**
Orientation – enables design teams to ask specific questions about how the conceptual model will be understood by targeted users.
Open-minded – prevents design teams from becoming narrowly focused early on
Common ground – allows design teams to establish a set of commonly agreed terms, reducing the chance of misunderstandings
**Conceptual Model:** A high-level description of how a system is organized/operate. Have activities, objects, interface metaphors
**Components:**
Interface metaphors: Interface designed to be similar to a physical entity but also has own properties (ex: desktop)... can be an activity or object or a combo. (makes learning new sys easier /accessible vs. breaks conventional & cultural rules & constrain designer)
**Interaction types:**
Instructing: Issuing commands and selecting options. Repetitive tasks
Conversing: Interacting with a system as if having a conversation (allows users to interact with system in a way that is familiar **vs.** missunstdings can arise if the it can't parse what the user says).
Manipulating Interacting with objects in a virtual or physical space by manipulating them (noice can learn basic functionality quick vs. moving mouse around may be slower then pressing function keys)
Exploring: Moving through a virtual environment or a physical space
**Direct Manipulation:** for "doing" type tasks
-Continuous representation of objects and actions of interest
-Physical actions and button pressing instead of issuing commands with complex syntax –Rapid reversible actions with immediate feedback on object of interest (like physical objects)
**Interaction type:** what the user is doing when interacting with system
**Interface type:** the kind of interface used to support the mode (command, speech, query, data-entry, web, graphical, pen)
**Paradigm:** Follow a paradigm means adopting a set of practices agreed upon by a community (new paradigms: ubiquitous computing, pervasive computing, cloud computing, transparent computing)... develop a new set of questions every shift.
**Theory:** Explanation of a phenomenon that is well substantiated
**Models:** A simplification of an HCI phenomenon
**Framework**: Set of interrelated concepts and/or 'what to look for'

[Summary - Ch8.]: Important to have a good understanding of the problem space · Fundamental aspect of interaction design is to develop a conceptual model · Interaction modes and interface metaphors provide a structure for thinking about which kind of conceptual model to develop · Interaction styles are specific kinds of interfaces that are instantiated as part of the conceptual model · Paradigms, theories, models and frameworks can also shape a conceptual model

**Process Interaction - Chapter 9**
**Basic Activities involved:**
Designing alternatives: – by getting a lot of ideas (Brainstorming)
Prototyping – Designs and potential solutions will need to be communicated to people other than designers. – must be captured and expressed in some suitable form to allow review, revision and improvement (sketches, natural language description, prototypes)
-extremely powerful approach to exploring ideas and checking reqs
Evaluating – by validating the ideas
**4 Approaches underlying Interaction Design:**
User-centered design: users are the only guide to designers. Designers translate users' goals and needs into a design solution
Activity-centered design: focuses on behavior surrounding particular tasks.
Systems design: structured, rigorous and holistic and focuses on context. The system (i.e. people, computers, devices, objects) are the center of attention of the designers.
Genius design: relies solely on the experience and creativity of designers. Users only validate ideas of designers. (e.g. Apple iPod)
**Important to involve users:** Expectation management (realistic, no surprises) and Ownership(make users active stakeholders)
*Problem: (users develop more sophisticated ideas to be incorporated, high level of users involvement can generate conflicts and increase reworking).
**User-centered approach:** real users and their goals are the driving force behind product development…empirical measurement (reactions and performance) and iterative design
**Three categories of user (Eason, 1987)**: **– primary:** frequent hands-on **– secondary:** occasional or via someone else **– tertiary:** affected by its introduction, or will influence its purchase
**Stakeholders:** are people or organizations who will be affected by the system and who have a direct or indirect influence on the system requirements. · Include: developers and their managers, direct users and their managers, recipients of the product's output, people who may lose their job because of the introduction of the new product.
**User-centered design rests on three principles**
1. Early focus on users and tasks 2. Empirical measurement using quantifiable & measurable usability criteria 3. Iterative design

## Establishing Requirements - Chapter 10

1. Understand users, activities, context of these activities so system can support them in achieving their goals.
2. Develop a set of stable requirements.

**Steps:** Gather some data -> Analyze and interpret it ->. Extract requirements from it .>- Iterate
**Volere Shell:** Project drivers/constraints/issues, (non) func reqs.
**Functional:** What the system should do
**Non-Functional:** Constraints on product and its development
**Data:** What kinds of data need to be stored
**Circumstances in which product will operate:**
physical - social - organizational - technical .
**Data gathering requirements:** Interviews (good for exploring issues), focus groups (good at gaining consensus view), questionnaires (can give quantitative or qualitative data), researching similar products (good for prompting requirements), direct observation (good for understanding nature/context of task), Indirect observation (good for logging current tasks), study documentation (good source of data about steps and regulations for a task)
**Contextual inquiry:** user is expert and designer is apprentice. AT user workplace 2-3 hours
**Principals**: context, partnership, interpretation, focus

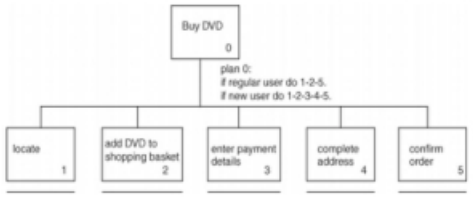
**Data gathering problems:** political problems, dominance of certain stakeholders, economic or business changes, balancing function and usability demands, identifying stakeholders, communication...
**Task analysis:** used to envision new systems or devices
Scenarios, use cases and essential use cases can be used to articulate existing and envisioned work practices
**User analysis:**
Users: Who are they? — **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 —
*Collection of user attributes is called user profile.

Task analysis techniques such as **Hierarchical Task Analysis** help to investigate existing systems and practices

## Design Prototypes - Chapter 11

**Why prototype:** · Useful aid when discussing ideas with stakeholders.· Evaluation and feedback are central to interaction design · You can test out ideas for yourself · Prototypes answer questions, and support designers in choosing between alternatives

**Principles for the anatomy of prototypes: fundamental principle** (filters in the qualities that interaction designers are interested in), **economic principle** (simple and most efficient, and makes the possibilities and limitations of ideas visible and measurable), **anatomy** (manifestation of design ideas)
**Low-fidelity Prototyping:** uses medium unlike final (quick, cheap)
**Storyboards:** used for scenarios, bringing more detail - series of sketches showing how a user might progress (used early in design)
**Sketching:** important to low fidelity prototyping




**Card-based prototypes:** each card represent part of screen - web
**'Wizard-of-Oz' prototyping:** user thinks they are interacting with computer but it's actually a developer behind
**High-fidelity prototyping:** uses material expected in final product - take too long to build, set expectations too high - superficial aspects - Conceptual design should not be tied to physical constraints too early.- Designer must balance between user, data, environmental requirements with functional requirements.
**Horizontal compromise**: lots of function, little detail vs. vertical
Conceptual design: user requirements -> concept. Model

| Filtering dimension | Example variables |
|---|---|
| Appearance | size; color; shape; margin; form; weight; texture; proportion; hardness; transparency; gradation; haptic; sound |
| Data | data size; data type (e.g., number; string; media); data use; privacy type; hierarchy; organization |
| Functionality | system function; users' functionality need |
| Interactivity | input behavior; output behavior; feedback behavior; information behavior |
| Spatial structure | arrangement of interface or information elements; relationship among interface or information elements – which can be either two-or three-dimensional, intangible or tangible, or mixed |

| Manifestation dimension | Definition | Example variables |
|---|---|---|
| Material | Medium (either visible or invisible) used to form a prototype | Physical media, e.g., paper, wood, and plastic; tools for manipulating physical matters, e.g., knife, scissors, pen, and sandpaper; computational prototyping tools, e.g., Macromedia Flash and Visual Basic; physical computing tools, e.g., Phidgets and Basic Stamps; available existing artifacts, e.g., a beeper to simulate a heart attack |
| Resolution | Level of detail or sophistication of what is manifested (corresponding to fidelity) | Accuracy of performance, e.g., feedback time responding to an input by a user (giving user feedback in a paper prototype is slower than in a computer-based one); appearance details; interactivity details; realistic versus faked data |
| Scope | Range of what is covered to be manifested | Level of contextualization, e.g., website color scheme testing with only color scheme charts or color schemes placed in a website layout structure; book search navigation usability testing with only the book search related interface or the whole navigation interface |

[Summary - Ch11.]
Different kinds of prototyping are used for different purposes and at different stages
· Prototypes answer questions, so prototype appropriately
· Construction: the final product must be engineered appropriately
· Conceptual design (the first step of design)
· Consider interaction types and interface types to prompt creativity
· Storyboards can be generated from scenarios
· Card-based prototypes can be generated from use cases

## Interaction Styles - Chapter 12

**Command Line:** fast and powerful, quick input, precise and flexible
**-->Good:**-suitable for repetitive tasks -for expert users -direct access to sys functionality -low visual load
**-->Bad: low command retention, steep learning curve, high error rates**

**WIMP and GUI:** accomplish tasks through window interface, dialog boxes, panes, frames and tabs
**Menu based interface:** flat-lists, drop-down, pop-up, contextual, expanding, scrolling(ipod), cascading, modal
*keeps menus short, keep hierarchies shallow
**Icon Design:** Icons are assumed to be easier to learn and remember than commands → most effective are smaller ones
***disadvantage:** ambiguity, dependency, cannot always completely replace words, cost
**Multimedia:** Combines different media within a single interface with various forms of interactivity (rapid access to multiple representations of info, easier learning, can be distracting)
**VR:** higher level of fidelity with objects, 1st 3rd person views, can be uncomfortable
**Information visualization:** Computer-generated interactive graphics of complex data
**Web:** striking design, clean and professional → used to sell and present… web apps too
**Mobile:** Have become pervasive, increasingly used in all aspects of everyday and working life
**Speech:** When person talks to system (alexa, siri) for specific information
**Pen:** enable people to write, draw, select, move using styluses.
*can easily edit documents, can lag and feel clunky
**Touch:** touch screens, tablets etc…
**Air-based gestures:** camera recognition and computer vision techniques → map movement to variety of gaming motions...etc
**Haptic:** Tactile feedback, can enrich user experience or nudge them to correct error (video game controller)
**Multimodal:** using different modalities ie. touch, sight, sound etc…
**Shareable:** smart board
**Tangible:** touch based
**Augmented and mixed reality:**
**Wearables:** comfort, hygiene, ease of wear, usability
**Robots:** remote, domestic,pet and sociable
**Brain-computer:** brain communicates directly with computer
[Summary - Ch12.]
-There is a wealth of resources now so do not have to draw or invent new icons from scratch guidelines, style guides, icon builders, libraries
-Text labels can be used alongside icons to help identification for small icon sets
-For large icon sets (e.g. photo editing or word processing) use rollovers
-Many innovative interfaces have emerged post the WIMP/GUI era, including speech, wearable, mobile, brain and tangible
-Many design and research questions need to be considered to decide which to use

-An important concern that underlies the design of any kind of interface is how information is represented to the user so they can carry out ongoing activity or task

## Cognitive aspects - Chapter 13

**Cognitive processes:**
· Attention
-Selecting things to concentrate on at a point in time from the mass of stimuli around us (display important info - involves audio or video: color, sound, flashing, reverse video..etc)
-Design implications for attention: make info salient when it needs attending to - use techniques to make things stand out.
· Perception and recognition
-how information is acquired from the world and transformed into experiences
-icons should enable users to readily distinguish their meaning
-bordering and spacing are effective visual ways of grouping info
-text should be legible and distinguishable
· Memory
-Involves first encoding and then retrieving knowledge
-We recognize things much better than being able to recall things
-Context affects the extent to which information can be subsequently retrieved
-Recognition vs. recall: GUIs provide visually-based options that users need only browse through until they recognize one - mp3 players with song titles, albums etc…
**-7+2 rule:** only 7 options on a menu, toolbar, list, pull down
-**Personal info management:**
· Memory involves 2 processes – recall-directed and recognition-based scanning
· File management systems should be designed to optimize both kinds of memory processes – e.g. Search box and history list\
· Learning
-People find it hard to learn by following instructions in a manual (people prefer to learn by doing)
-Speech-based menus and instructions should be short
- Accentuate the intonation of artificially generated speech voices
- Provide opportunities for making text large on a screen
· Reading, speaking and listening
-The ease with which people can read, listen, or speak differs
-Many prefer listening to reading
-Listening requires less cognitive effort than reading or speaking
Ex: Google voice search app
· Problem-solving, planning, reasoning and decision-making
-All involves reflective cognition (thinking about what to do, what the options are, and the consequences)
- Involves conscious processes, discussion with others (or oneself), and the use of artifacts (maps, books, pen and paper)
-Provide additional information/functions for users who wish to understand more about how to carry out an activity more effectively
-**Mental models:** Users develop an understanding of a system through learning about and using it
-Deep vs. shallow models: how to drive car vs. how it works
*Payne (1991) did a similar study and found that people frequently resort to analogies to explain how they work

**Gulfs of execution and evaluation:**
-The 'gulfs' explicate the gaps that exist between the user and the interface
-The gulf of execution: the distance from the user to the physical
-The gulf of evaluation: the distance from the physical system to the user
*bridging can reduce cognitive effort needed to perform tasks
**Information processings:** encoding->comparison->response selection->response execution.
**Model Human processor:** predicts which cognitive processes are involved when user interacts with a computer (can calculate how long user will take to carry out task)
***do not adequately account for how people interact**
**External cognition:** how we interact with external representations (e.g. maps, notes, diagrams) - how and why people interact with products
**Externalizing to reduce memory load:** diaries, post its, marked email: external representation: reminder to do something
**Computational offloading:** using external representation to carry out a computation (pen and paper)
**Annotation and cognitive tracing:** marking, crossing off, ticking