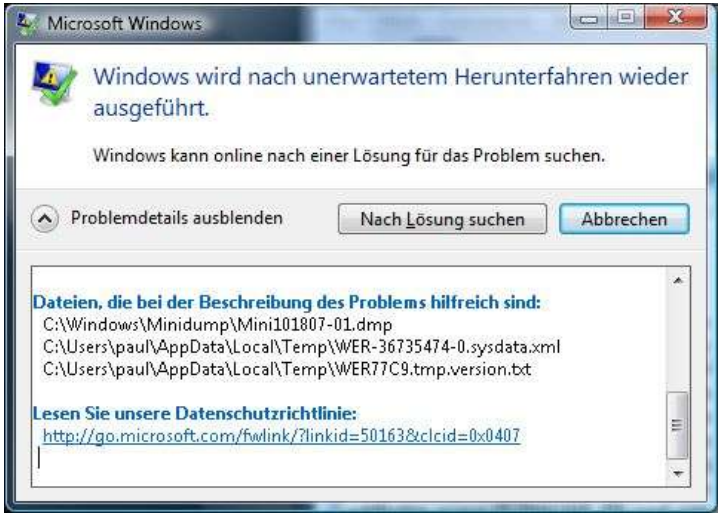
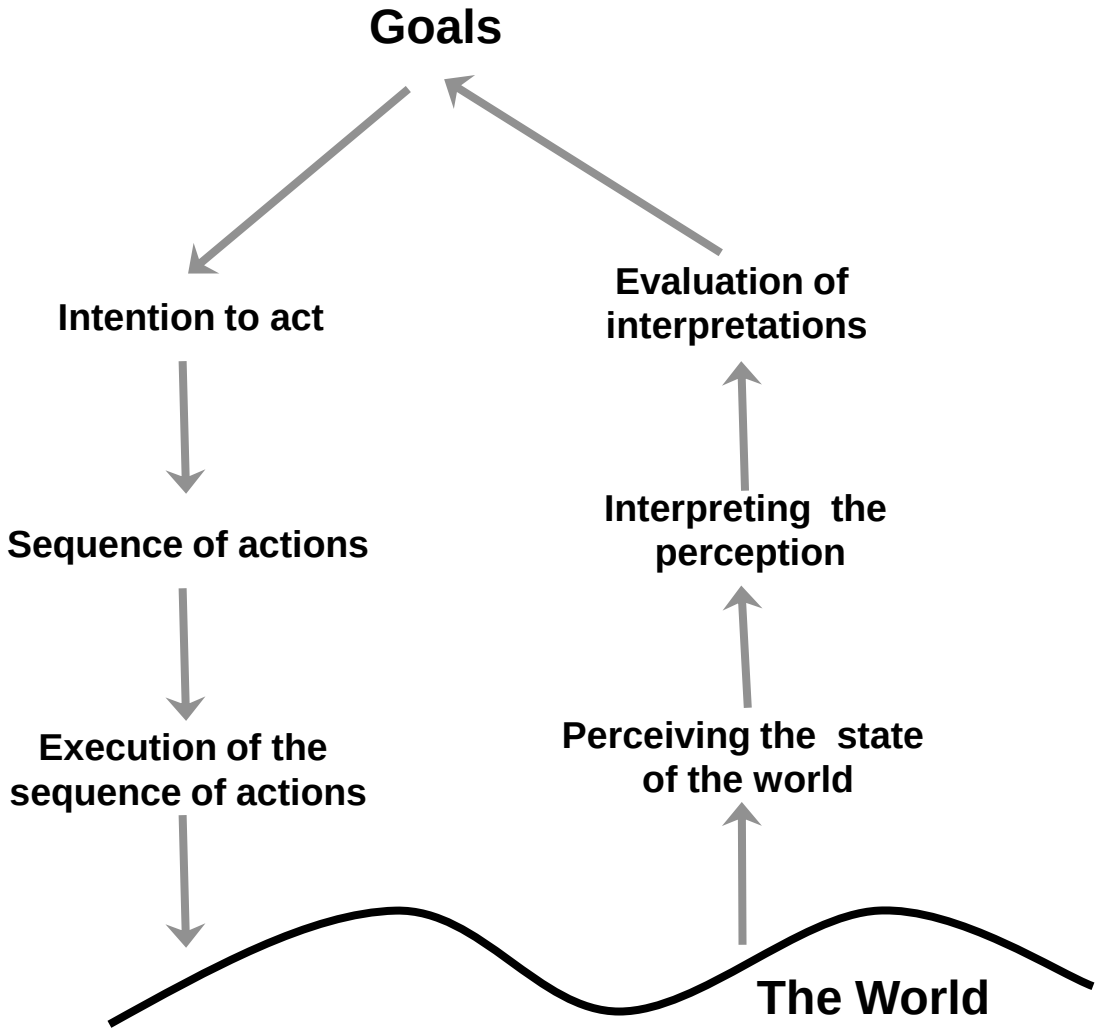
Looking Back



- (Human) Errors
  - Small mistakes can have large impact
  - What are errors / are they really the user's fault?
- Types of Errors
  - Mistakes and slips
- Preventing Errors
  - Documentation / manuals / user training
  - Formal methods / grammars / automated testing
  - Examples: make different things look different / reduce number of modes
- Design implications
  - Assume all possible errors will be made
  - Minimize the chance to make errors (constraints)
  - Minimize the effect that errors have (is difficult!)
  - Include mechanism to detect errors
  - Make actions reversible

Looking Back

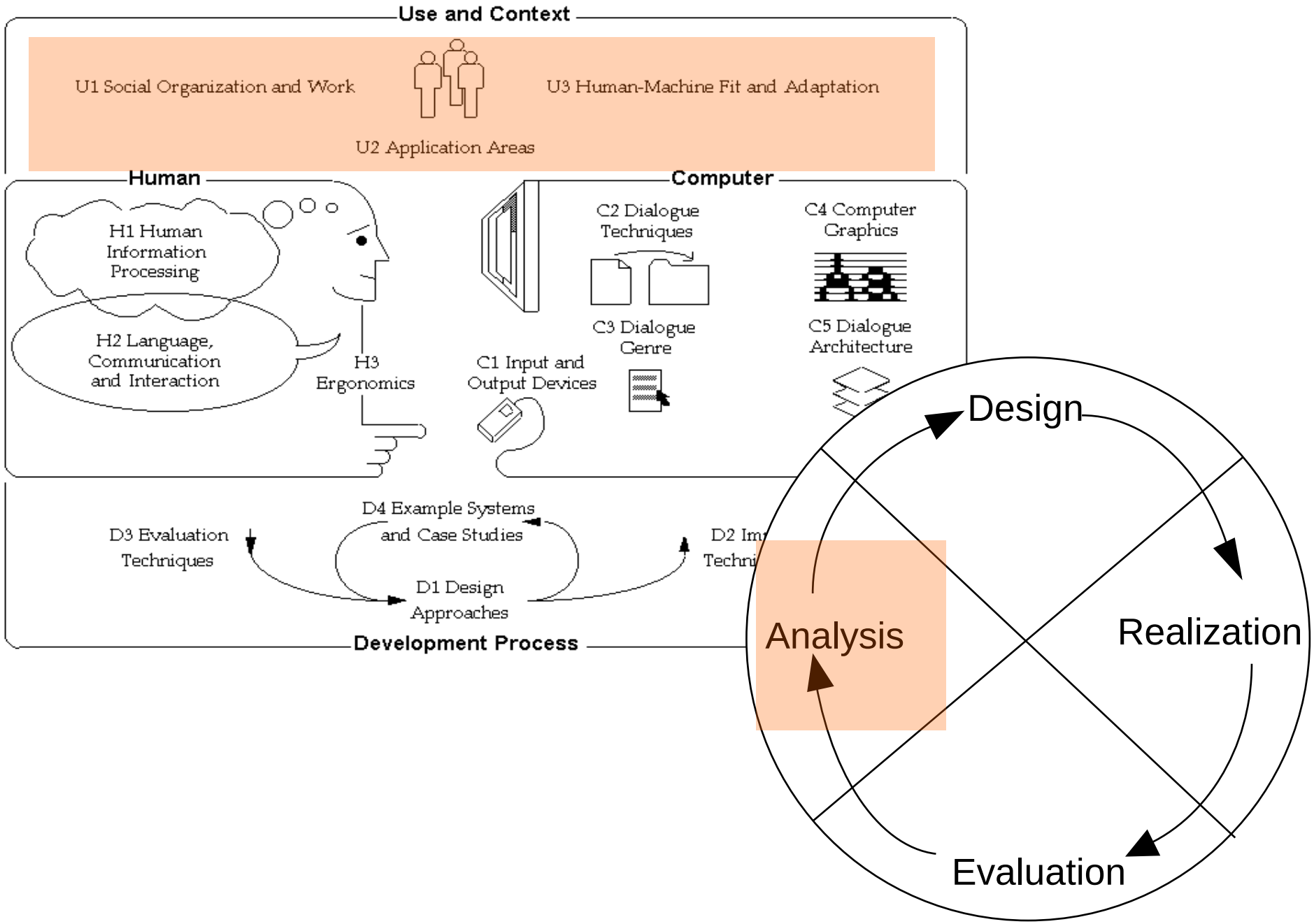
- Seven stages of action
  - Goals
  - Execution of actions
  - Evaluation of feedback
- Gulf of Execution
- Gulf of Evaluation
- Implications
  - Questions to find these gulfs
  - Some principles to avoid them



Looking Back

- Project / user requirements
  - User diversity
  - User groups and specific requirements
  - User modes
- Implications: 80/20 rule
- Requirements elicitation methods
  - Questionnaires
  - Interviews
  - Focus groups
  - Scenarios and prototyping
    - » Low-fidelity, e.g. video and paper prototyping
    - » High-fidelity, e.g. hardware toolkits
- Example project: specific radio solution for the elderly

4 Analyzing Requirements


Use and Context
U1 Social Organization and Work
U3 Human-Machine Fit and Adaptation
U2 Application Areas
Human
Computer
H1 Human Information Processing
H2 Language, Communication and Interaction
H3 Ergonomics
C1 Input and Output Devices
C2 Dialogue Techniques
C3 Dialogue Genre
C4 Computer Graphics
C5 Dialogue Architecture
D3 Evaluation Techniques
D4 Example Systems and Case Studies
D1 Design Approaches
Development Process
Design
Realization
Evaluation
Analysis

What Can Keep Projects From Failing?

- Study by Standish Group, 1995
- Interviews with IT executive managers
- What causes projects to succeed?

Project Success Factors	% of Responses
1. User Involvement	15.9%
2. Executive Management Support	13.9%
3. Clear Statement of Requirements	13.0%
4. Proper Planning	9.6%
5. Realistic Expectations	8.2%
6. Smaller Project Milestones	7.7%
7. Competent Staff	7.2%
8. Ownership	5.3%
9. Clear Vision & Objectives	2.9%
10. Hard-Working, Focused Staff	2.4%
11. Other	13.9%

What Do We Need to Analyze?

- Analysis Phase
  - Access and investigate everything that has a potential impact on the solution
- Most important aspects
  - Requirements imposed by the tasks to be supported
    - » **goals** of the project
  - Users, their strength and limitations
    - » **people** involved in the operation of the system that is to be build
  - Available options for the implementation of a system (e.g. technologies)
  - Border conditions for development and deployment
    - » **processes** that are improved, changed, or replaced
    - » **economic** constraints
    - » **organizational** constraints and company/customer policies

1. Identifying the Goals

- Why is a new software or system created? What is the main purpose?
  - Replace or improve on an existing system
  - Streamline operation and optimize work processes
  - Introduce a new process or a new option for a process
- In what context is this developed?
  - During continued operation
  - In a restructuring phase
  - In a start-up phase of a company or operation
- What is the role of the software/system?
  - Driver for restructuring
  - Only one issue within a set of changes made in the organization
- How important is the system to the customer?
  - Mission critical, essential for sustaining business
  - Just a nice additional piece to have

2. Understanding the People Involved

- Who are the people involved?
  - Who are the decision makers?
  - Who are the users?
  - What relationships exist between users?
  - What relationships exist between users and decision makers?
  - What roles do users have (customer, administrator, controller, supervisor, …)?
  - Which tasks (in the real world and in the system) are performed by the user?
  - Why do people use a system and what is their motivation?

- *Remember Shneiderman's 1st principle: "Recognize User Diversity"*

3. Identifying the Effect of Processes

- By introducing or changing software we affect processes in the real world, e.g.,
  - People will be able to do certain tasks they could not do before
  - Certain tasks will be automatically done without user involvement
  - Specific tasks will be speeded up and others may be slowed down
  - The quality of tasks and operations will be improved
  - **Certain processes become traceable and people can be made accountable**
  - Some operation will be made easier - others will be more complicated

- Often related to rationalization of the workflow
- Change is not always welcome by everyone

4 Analyzing the Requirements

Analyzing Existing Systems

- In most cases, some kind of system is already in use
  - Automated system
  - Incoherent combination of software tools
- Purpose of analysis
  - Understanding the work processes
  - Finding opportunities for improvement
  - Baseline data for the new system
- Analysis mainly through user studies
- Possible *manual* analysis steps
  - Observation of workflow
  - Creation of realistic example scenarios with real data
- Possible *automatic* analysis steps
  - Statistics about actual usage of various features
  - Statistics about data usage, data volume, …

Automated Analysis of Existing Systems

- Use functions/mechanism included in products, e.g.
  - Log files for using web applications
- Use additional software to monitor usage
  - Key logger
  - Proxy server
  - Screen capture tool
- Extend the software that is used to track/analyze usage
- Typical questions
  - What applications are used in the work process
  - How often is application X or function Y used
  - What files are accessed during the work process
- Tools, e.g.
  - analog - Website usage analysis software http://www.analog.cx
  - Process Monitor – logging file and process usage etc. http://technet.microsoft.com/en-us/sysinternals/bb896645.aspx

4 Analyzing the Requirements

How to Perform a Requirements Analysis?

(From a user-centred point of view...)

- General methods, before knowing user community in detail
  - Surveys, opinion polls, questionnaires
  - E.g. Internet polls

  Today
- Methods applicable when user groups are roughly known
  - Focus groups
  - Interviews

  Previous lecture
  - Diary studies

  Today
- Methods targeting very specific user groups
  - Ethnographic observation
  - Task analysis

  Today

Surveys and Questionnaires

- Find out about
  - Potentially interesting / interested user groups
  - General acceptance / desire for a certain idea or concept

- Gather details about users
  - Demographics
  - Previous knowledge
  - Actual usage of an existing system
  - Opinions on new ideas / concepts / applications

Possible structure

- Focus on subjective opinions
  - Data from a users' point of view
  - E.g. how is a process perceived
  - E.g. how much time users think they spend

Standardized Example: NASA Task Load Index

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	Task	Date

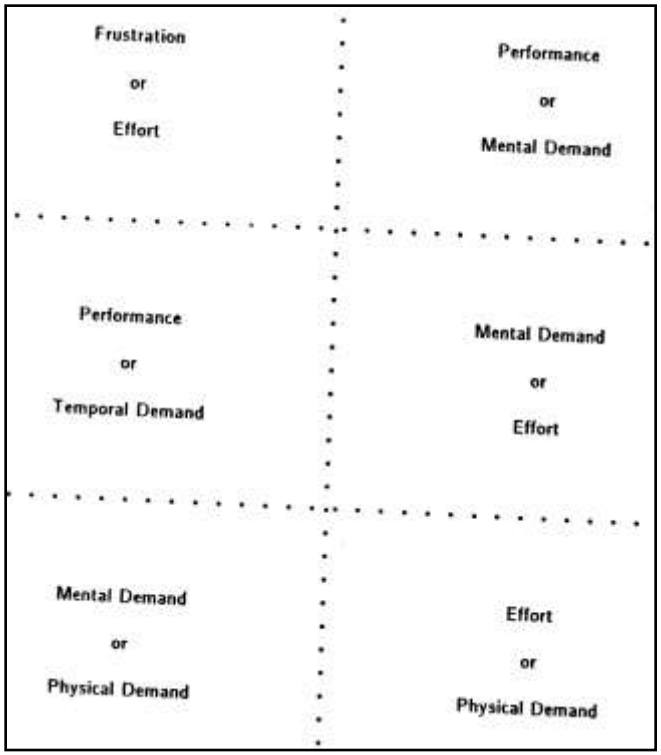
Mental Demand — How mentally demanding was the task?

Very Low — Very High

Physical Demand — How physically demanding was the task?

Very Low — Very High

Temporal Demand — How hurried or rushed was the pace of the task?



...

http://humansystems.arc.nasa.gov/groups/TLX/index.html

Hart, S. G., Staveland, L. E. Development of NASA-TLX (Task Load Index): Results of Empirical and Theoretical Research. In Human Mental Workload, 239-250, 1998.

Std. Example 2: IBM Usability Satisfaction Questionnaire

Please rate the usability of the system.

- Try to respond to all the items.
- For items that are not applicable, use: **NA**
- Make sure these fields are filled in: **System:** **Email to:**
- Add a comment about an item by clicking on its icon, or add comment fields for all items by clicking on **Comment All**.
- To mail in your results, click on: **Mail Data**

System: **Email to:**

Optionally provide comments and your email address in the box.

Mail Data | Comment All | RETURN TO REFERRING PAGE

		1	2	3	4	5	6	7		NA
1. Overall, I am satisfied with how easy it is to use this system	strongly disagree	○	○	○	○	○	○	○	strongly agree	○
2. It was simple to use this system	strongly disagree	○	○	○	○	○	○	○	strongly agree	○
3. I can effectively complete my work using this system	strongly disagree	○	○	○	○	○	○	○	strongly agree	○

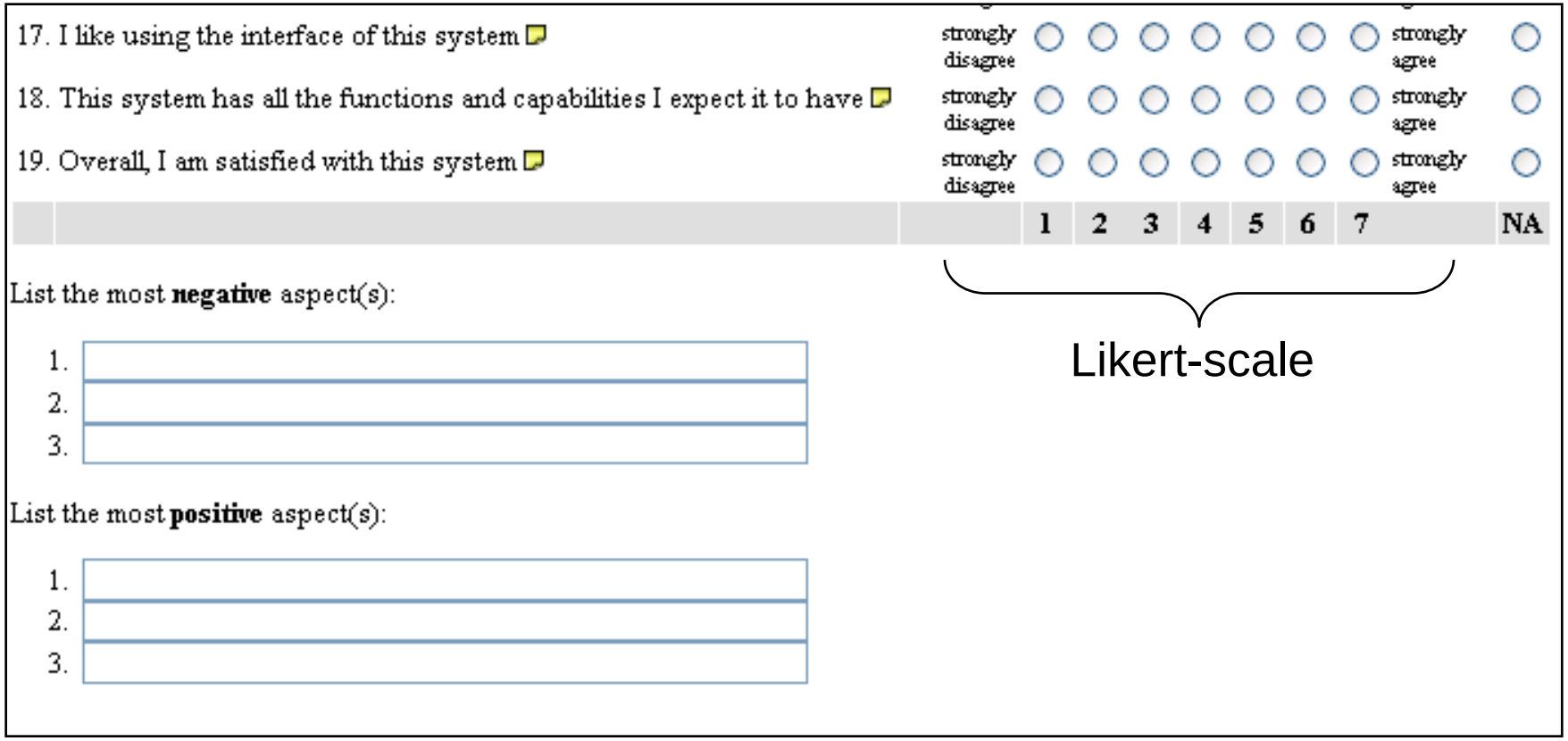
http://hcibib.org/perlman/question.cgi

Lewis, J. R. IBM Computer Usability Satisfaction Questionnaires: Psychometric Evaluation and Instructions for Use. In *International Journal of Human-Computer Interaction* 7 (1), 57-78, 1995.

Std. Example 2: IBM Usability Satisfaction Questionnaire

1. Overall, I am **satisfied** with how easy it is to use this system
2. It was **simple** to use this system
3. I can effectively **complete my work** using this system
4. I am able to complete my work **quickly** using this system
5. I am able to **efficiently** complete my work using this system
6. I feel **comfortable** using this system
7. It was **easy to learn** to use this system
8. I believe I became **productive** quickly using this system
9. The system gives **error messages** that clearly tell me how to fix problems
10. Whenever I make a mistake using the system, I **recover easily** and quickly
11. The **information** (such as online help, on-screen messages, and other documentation) provided with this system is clear
12. It is **easy to find** the information I needed
13. The information provided for the system is **easy to understand**
14. The information is effective in **helping me complete** the tasks and scenarios
15. The **organization** of information on the system screens is clear
16. The **interface** of this system is **pleasant**
17. I **like** using the interface of this system
18. This system **has all the functions** and capabilities I expect it to have
19. Overall, I am **satisfied** with this system

Std. Example 2: IBM Usability Satisfaction Questionnaire



Likert, R. (1932). "A Technique for the Measurement of Attitudes". *Archives of Psychology* 140: 1–55.

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  - Interviews
  - Diary studies

  Previous lecture
- Methods targeting very specific user groups
  - Ethnographic observation
  - Task analysis

Diary Study

- A study that asks people to keep a diary, or journal, of their interactions with a computer system, any significant events or problems during their use of a system, or other aspects of their working life.
- A diary typically asks a user to record the date and time of an event, where they are, information about the event of significance, and ratings about how they feel, etc.
- An interesting alternative for making diary entries is to give users a tape recorder (or a mobile phone...) and a list of questions, so that users don't need to write things down as they encounter them.

(Usability glossary from www.usabilityfirst.com)

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Examples for
real-world
work environments

Contextual Enquiry

- Investigating and understanding the users and their environment, tasks, issues, and preferences
  - Analyzing users' needs
  - Related to task analysis

- Observing and interviewing users in their environment while they do their work
  - Done by visits in context

http://www.infodesign.com.au/usabilityresources/contextualenquiry
http://www.sitepoint.com/article/contextual-enquiry-primer

Ethnographic Observation in HCI - Interviews

- Prepare a set of questions beforehand
  - What do you want to know from the user?
- Tell people what are you doing
- Use capture (audio/video) if your communication partners agree
- If applicable, capture (take photos/video) material they use in their work (e.g. a manual, a checklist, the post-its around the screen)
- If possible summarize what your interview partner told you (to minimize misunderstandings)

Collecting Ideas from People

Figure 1. A cultural probe package.

- Cultural Probes
- Package of materials, e.g.
  - Postcards
  - Disposable camera
  - Maps
  - Photo Album
  - Media diary
- Instructions for actions to be taken
- To provoke (contextual) inspirational responses from the users
- Over a period of time
- User centered inspiration

Gaver, W., Dunne, T., Pacenti, E.: Design: Cultural probes, ACM *interactions* 6(1), 1999

Cultural Probes (cont.)

- Be careful with trying to get concrete results
  - Summarizing collected data creates a non-existent average user
  - Summarizing removes unusual results that can be most inspiring
  - Open questions and tasks (even absurd ones) help getting surprising results
  - Analyses blur the connection between designer and user
  - Important aspects of cultural probes are imaginative engagement and story-telling which can be most useful for design

Gaver, W. W., Boucher, A., Pennington, S., and Walker, B. Cultural Probes and the Value of Uncertainty. *interactions* 11, 5 (Sep. 2004), 53-56. 2004

Frameworks to Guide Observation

- *The person*. Who?
- *The place.* Where?
- *The thing.* What?

The Goetz and LeCompte (1984) framework (“5W+H”):

- *Who* is present?
    - What is their role?
- *What* is happening?
- *When* does the activity occur?
- *Where* is it happening?
- *Why* is it happening?
- *How* is the activity organized?

Observations & Protocols

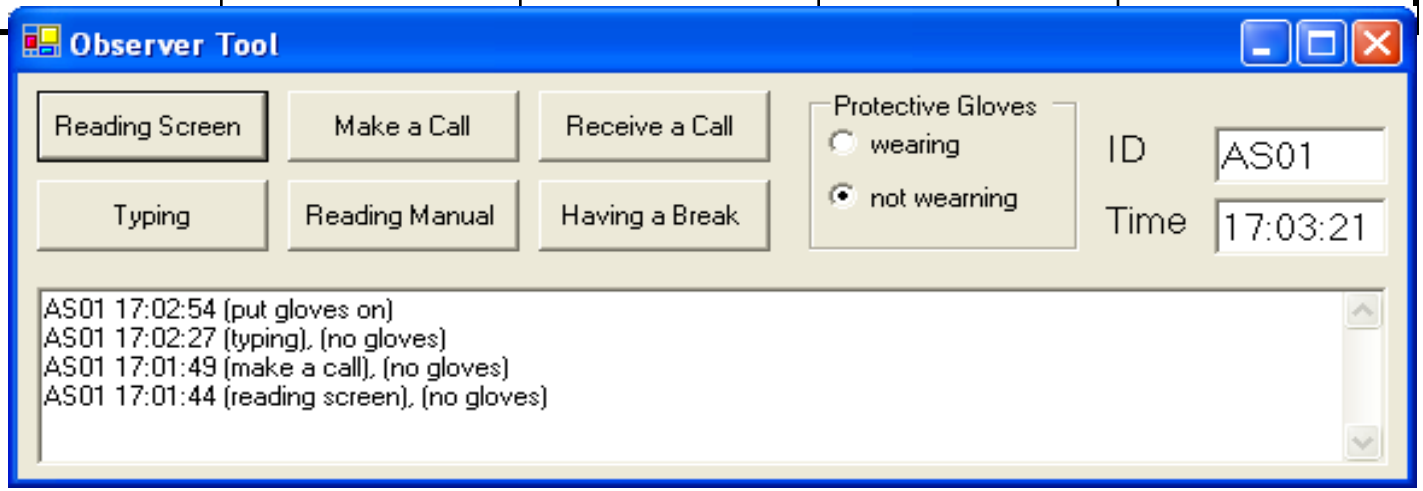
- Paper and pencil
  - Cheap and easy but unreliable
  - Make structured observations sheets / tool
- Audio/video recording
  - Including audio & still picture
  - Cheap and easy
  - Creates lots of data, potentially expensive to analyze
  - Good for review/discussion with the user
- Computer logging
  - Reliable and accurate
  - Limited to actions on the computer
  - Include functionality in the prototype / product
- User notebook/diary
  - Request to user to keep a diary style protocol

Structured Observations

- Observation sheet

time	typing	reading screen	consulting manual	phoning	…
14:00		X		X	
14:01	X		X		
14:02	X				
14:03	X				
14:04				X	
…					

- Electronic version



Wearable camera from
http://www.taserpromo.com/evidence-com/

Video Observation

- Observation is done with one or more camera
- Cameras provide pictures of regions importan to the task
- Camera attached to the user may be useful
  - Camera embedded into glasses
  - Allow the observer to see “through the eyes” of the user
- Different view points simultaneously
  - Camera overlooking the workplace
  - Camera looking from the screen to the user
  - Camera capturing what the user sees
- Analysis of raw material is very time consuming!
  - 3h to 20h for 1h recording
  - Automatically annotate video recordings (E.g. time stamps, possibly triggered by events)

Using Further Information Sources

- Sensors (e.g. motion, touch, RFID, …)
  - When did the person leave the room?
  - When did the person get something out of the shelf?
  - When did the person meet another person?
  - Where did the person go?

- Logfile of the interactive devices (e.g. key-logger, application logger)
- Log all the data (video, sensors, key input) with time stamps

- Use sensor information to find the video scenes that are of interest, e.g.
  - Get me all video scenes that show what the user is doing before she/he switches to application X
  - Show me all sequence where users have to input a password

Data Analysis for Observations

- Qualitative data - interpreted
  - Used to tell the ‘story’ about what was observed
  - Key events, patterns of behavior
  - Include quotes, pictures, anecdotes in report
- Qualitative data - categorized
  - Using techniques such as content analysis
  - “Triangulation” between different data sources
- Quantitative data
  - Collected from interaction & video logs.
  - Presented as values, tables, charts, graphs and treated statistically
  - To be used with care! (Is the information basis representative?)

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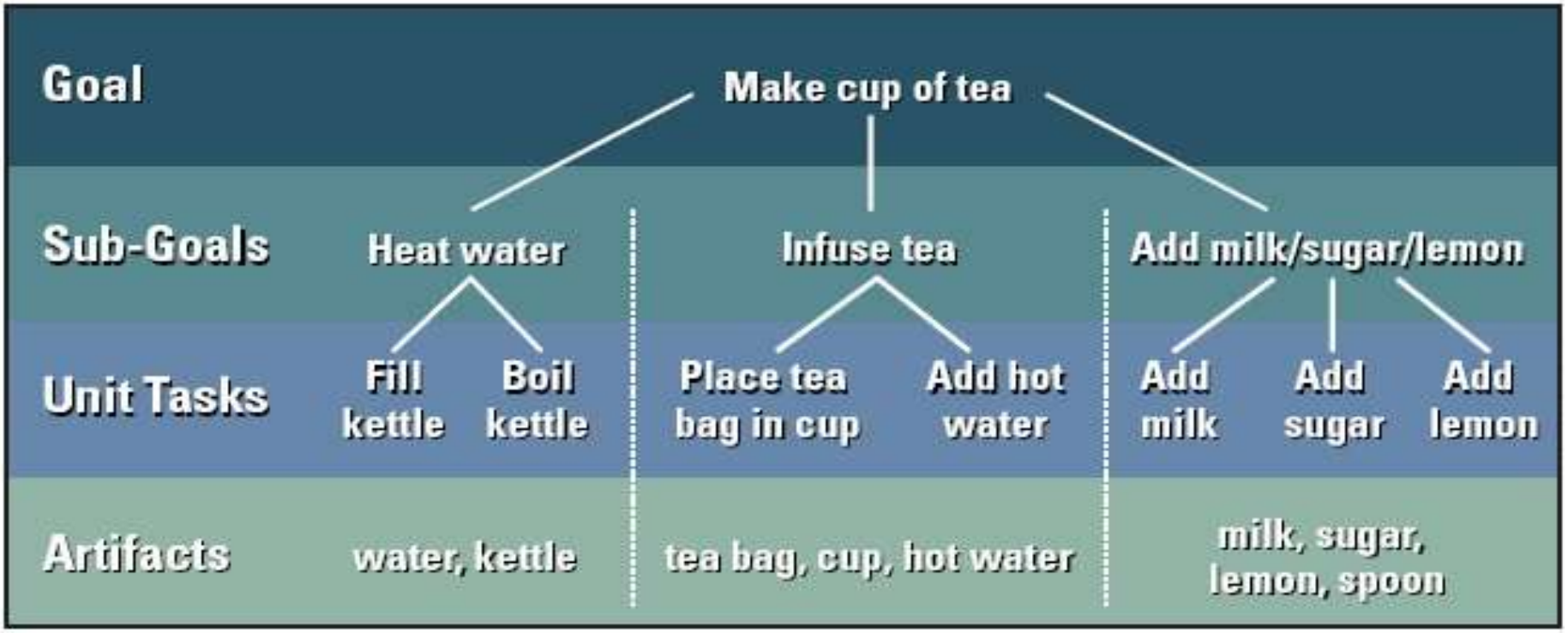
Task Analysis - Motivation

- Activities in daily life are driven by goals
  - E.g. “I want to show the pictures on my computer screen to the whole audience”
- Sequences of actions can be quite detailed
  - E.g. for setting up a video projector
    - » unpacking the projector and placing it on the table
    - » connecting the power cable to the projector and the socket
    - » connecting a data cable between projector and computer
    - » switching on the projector
    - » waiting for the projector to be ready
    - » switching the computer to dual screen mode
- Pure observation may miss key points
  - Equivalent sequences of actions, variants in order of actions, granularity ...

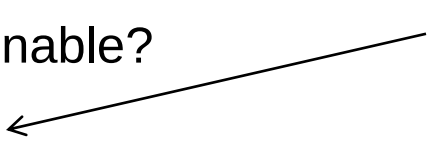
Task Analysis – Example



William Hudson. HCI and the Web: a Tale of Two Tutorials: a Cognitive Approach to Interactive System Design and Interaction Design Meets Agility. *ACM interactions* 12(1), 2005, 49-51

Task Analysis – High level Questions

- How do users know their goal is attainable?
- How do users know what to do?
  - Analyze what the user has (or users have) to do in order to get a job done
    - » What (physical) actions are done?
    - » What cognitive processes are required?
    - » What information is used?
    - » What information is created?
- How will users know they have done the right thing?
- How will users know they have attained their goal?
- Task analysis is usually in the context of an existing system or for a established procedure
- The analysis is most often hierarchical
  - Task → sub task → sub sub task …
  - Understand how a task is composed of sub tasks



Task Analysis – How To?

- Task decomposition is at the center of the method
  - Identify high level tasks
  - Break them down into the subtasks and operations
- Task flows and alternatives
  - Identify for elementary subtasks their order (task flow)
  - Identify alternative subtasks
  - Understand and document decision processes (how are alternative subtasks chosen?)
- Present the result of the task analysis as chart
  - Charts may have different levels (overview and detailed subtasks)
  - Show sequences, alternatives, ordering in the diagram
- Questions that help in decomposition of tasks
  - How is the task done?
  - Why is the user doing this task?

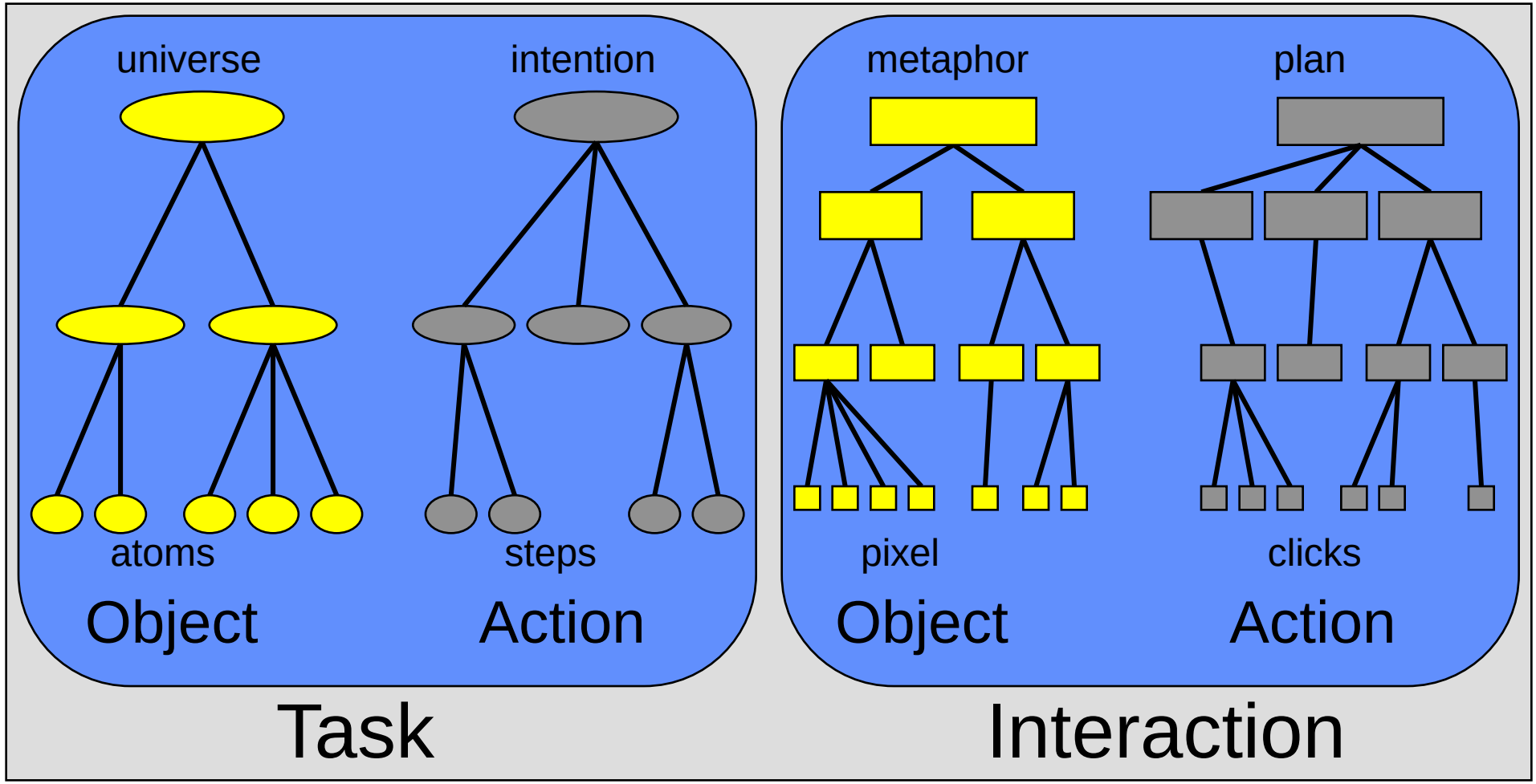
http://www.usabilitynet.org/tools/taskanalysis.htm

Action-Object vs. Object-Action

- Universal duality between Object & Action
  - Shall we name the *object* first and look for an adequate *action*?
  - Shall we name the *action* first and look for an adequate *object*?
  - Two different ways to structure the world ...
- For “task analysis”:
  - Implicit assumption of action-first approach?
  - More “object-oriented” alternative?
- Advantages of an object-based approach:
  - Easier to adapt to new tasks
  - Tasks are in general more easily changed/removed/added than objects we are working with
  - Better fit with human techniques for structuring complex situations
    - » Generalization/specialization, Part-of hierarchies

A. Khella: Objects-Actions Interface Model
http://www.cs.umd.edu/class/fall2002/cmsc838s/tichi/oai.html

Mapping Human Tasks to Man-Computer Interaction



From Shneiderman