Task Analysis

HCI Lecture 5

David Aspinall

Informatics, University of Edinburgh

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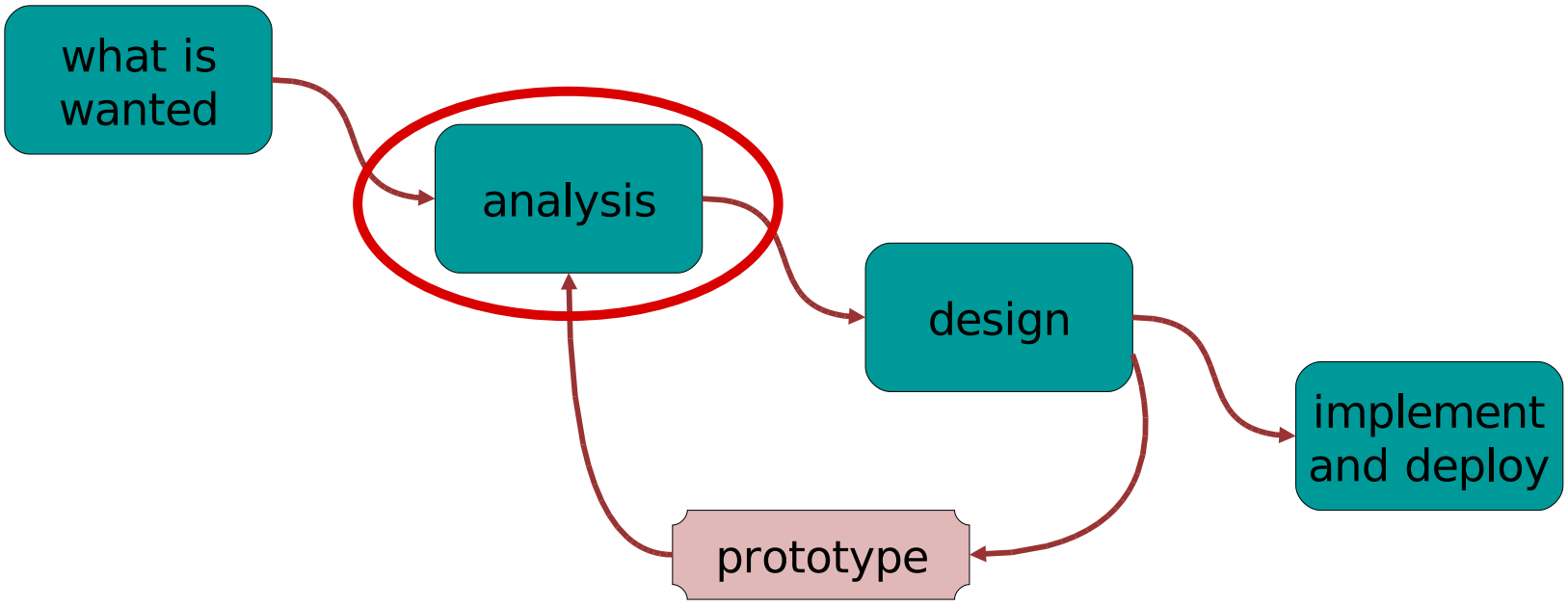
Outline

- Overview
- Task Decomposition
- Knowledge Based Analyses
- Conclusion
- Exercise
- References

Focus on Analysis



- Interaction design driven by what is wanted
- Analysis of tasks and knowledge informs:
  - functionality and objects offered in interface;
  - organisation (layout, grouping, navigation).

Task Analysis

- **Task Analysis** is the study of the way people perform their jobs. Aim is to determine:
  - what they do
  - what things they use
  - what they must know
- Task analysis gathers both *declarative* and *procedural* knowledge
  - Declarative: objects and relationships
  - Procedural: task sequences, goals and subgoals
  - Also dependencies and constraints
- Originally a tool for writing training manuals, now used more widely in business process analysis
- Emphasises users+existing tasks, rather than desired system as in **systems analysis**
- Emphasises observable behaviour and whole job, rather than internal mental state and “unit” tasks as in **cognitive models**

Example Task: Cleaning House

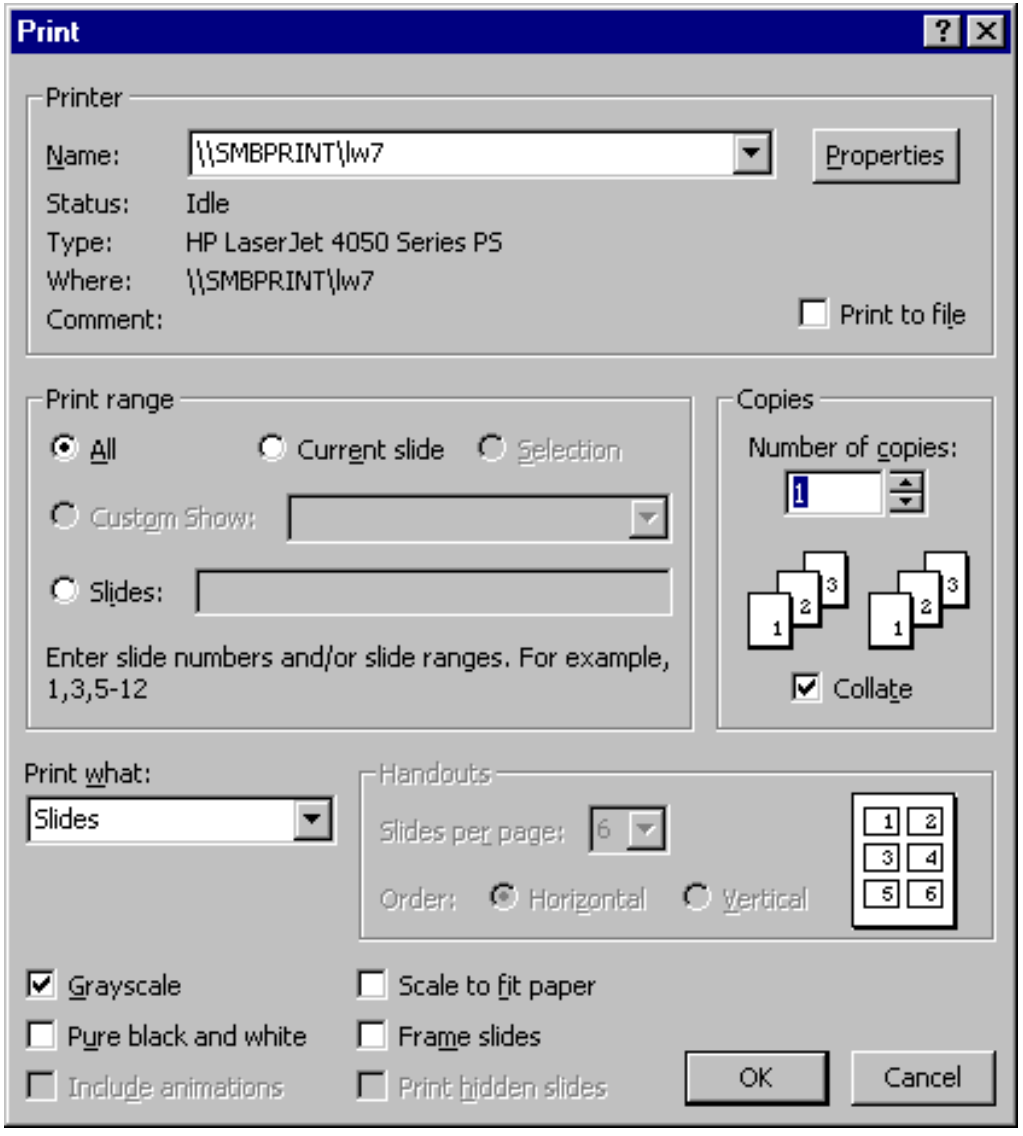
To clean the house:

get the vacuum cleaner out;
fix the appropriate attachments;
clean the rooms;
when the dust bag gets full, empty it;
put the vacuum cleaner and tools away.

We must know about:

- vacuum cleaners, their attachments, dust bags, cupboards, rooms.

Example Layout



- Items related by proximity and boundaries
- Layout suggests order, but doesn't impose it

Approaches

There are many different approaches, notations and techniques.

- **Task decomposition**
  - splitting task into (ordered) subtasks
- **Knowledge-based techniques**
  - what the user knows about the task
  - and how it is organised
- **Entity/object based analysis**
  - relationships between objects, actions and the people who perform them
  - gardener *digs* soil *using* spade
  - cf database design
  - not covered further here

General Method

The general method for Task Analysis is:

- observe
- collect unstructured lists of words and actions
- organize using notation or diagrams

Task Decomposition

- Aims:
  - describe the actions people do
  - structure them within task subtask hierarchy
  - describe order of subtasks
- Variants:
  - **Hierarchical Task Analysis (HTA)**
    – the most common
  - **ConcurTaskTrees (CTT)**, by Paternò (2000)
    – uses LOTOS temporal operators
- Procedural task knowledge elicitation techniques:
  - Observation, re-enactment
  - Ask about procedures and triggers (pre-conditions)
  - “What happens if X goes wrong?”
  - Sorting steps into appropriate orders

Textual HTA

Hierarchy description

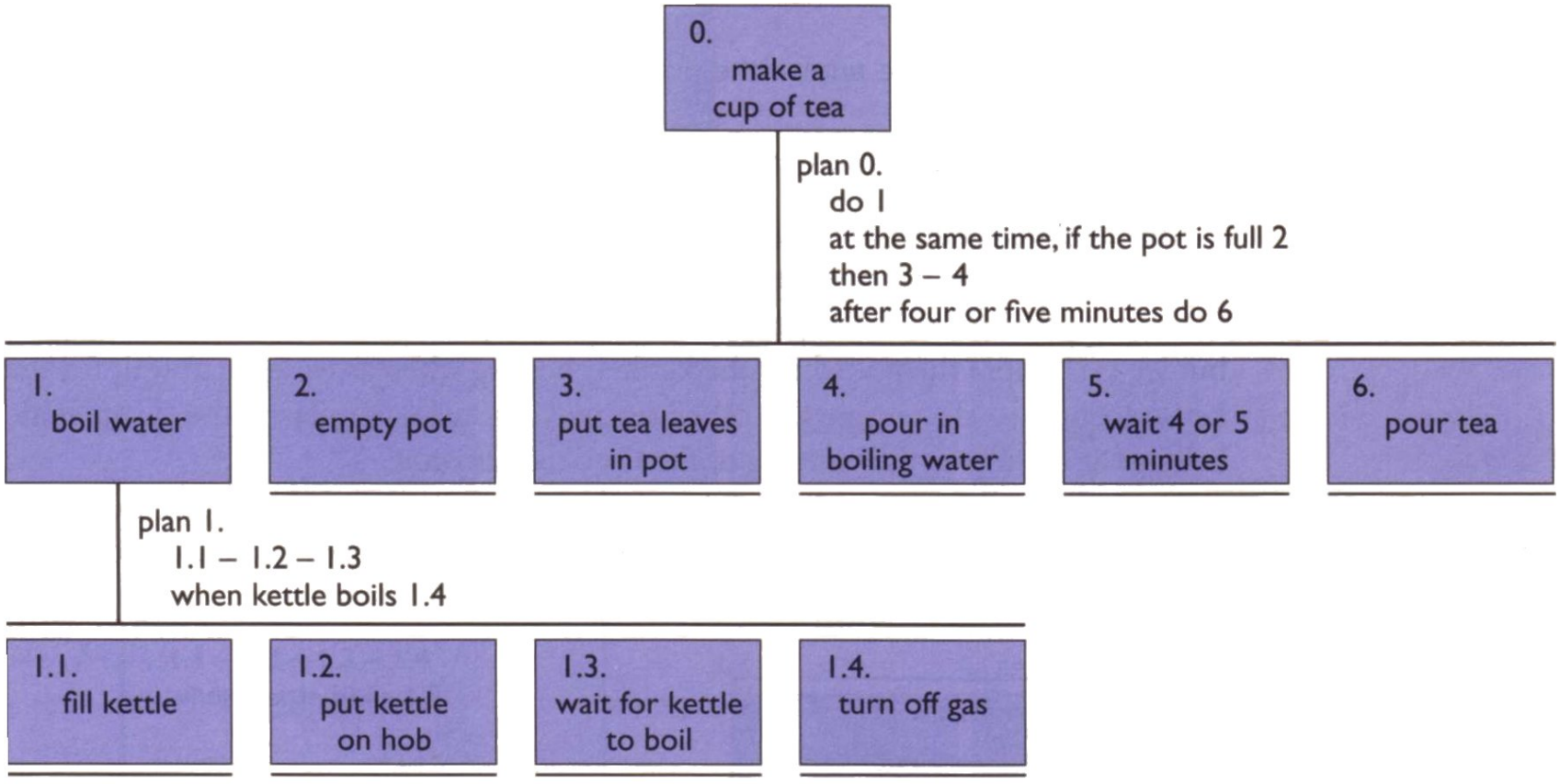
0. clean the house
    1. get the vacuum cleaner out
    2. get the appropriate attachment
    3. clean the rooms
        - 3.1 clean the hall
        - 3.2 clean the living rooms
        - 3.3 clean the bedrooms
    4. empty the dust bag
    5. put vacuum cleaner and attachments away

Plans

Plan 0: do 1, 2, 3, 5 in order;
when dust bag full, do 4

Plan 3: do 3.1, 3.2, 3.3 in any order, as needed

Diagrammatic HTA



[Dix et al, p. 515]

Refinement

How to check or improve the initial HTA?
Some heuristics are:

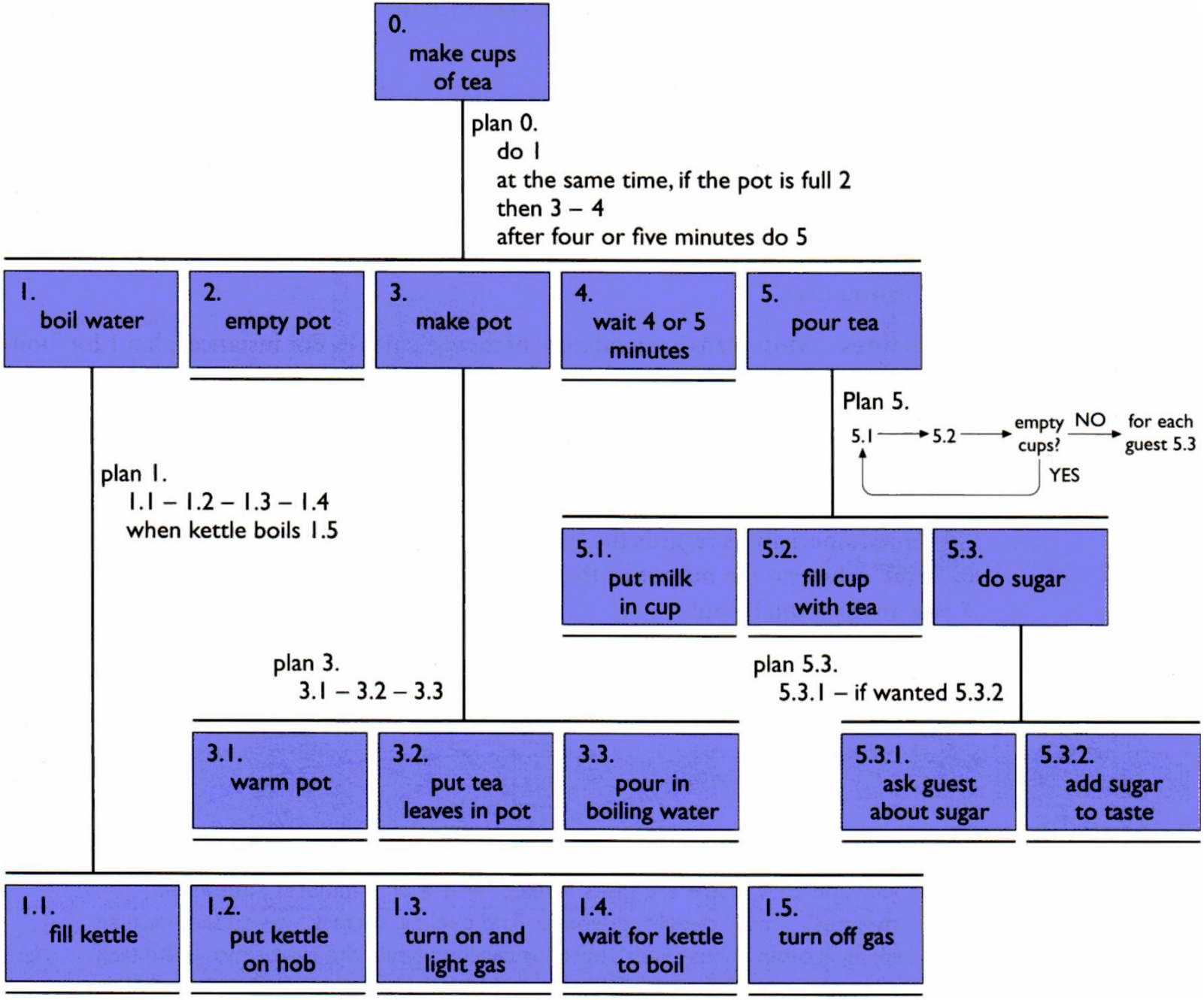
paired actions where is “turn on gas”?

restructure generate task “make pot”

balance is “pour tea” simpler than “make pot”?

generalise make one cup . . . or more

Refined HTA for making tea



Types of plan

- **sequence** 1.1 then 1.2 then 1.3
- **optional** if the pot is full 2
- **wait** when kettle boils, do 1.4
- **cycles** do 5.1 5.2 while there are still empty cups
- **parallel** do 1; at the same time ...
- **discretionary** do any of 1.3.1, 1.3.2 or 1.3.3 in any order

Most plans use several of these.

Waiting can be considered:

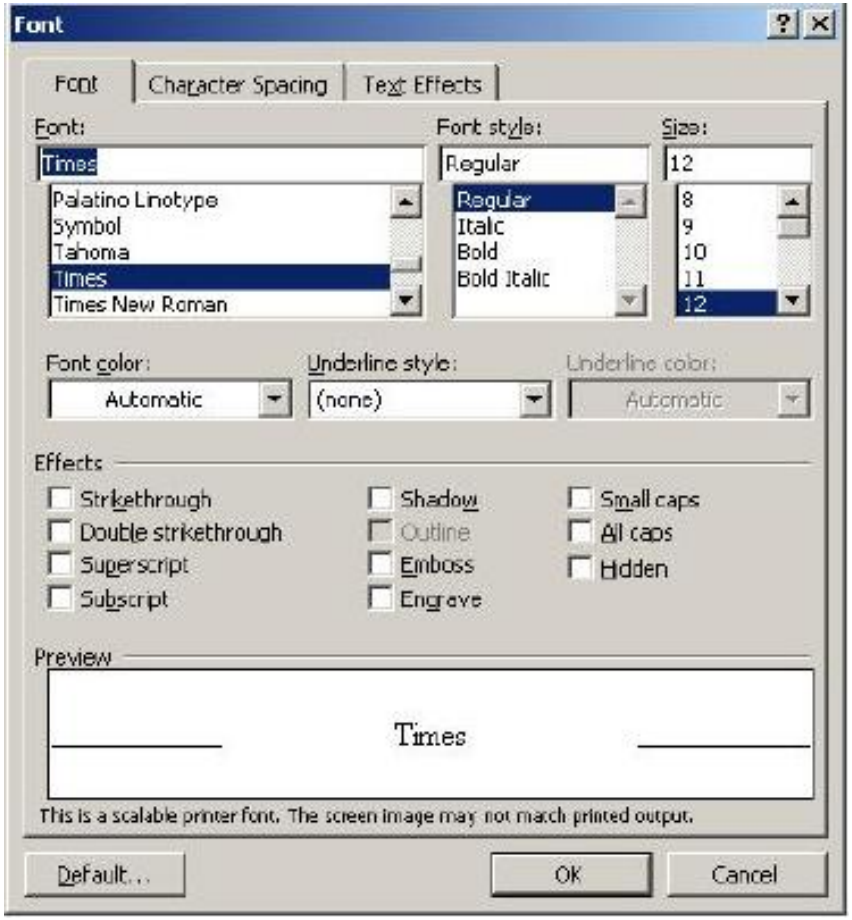
- a task — for “busy” waits, e.g. making tea
- part of the plan — end is the event, e.g. email reply received

Knowledge Based Analyses

- Aim to understand knowledge required for a task
  - provide training material, how-to manuals;
  - take advantage of common knowledge across tasks.
- Focus on:

  objects used in task
  actions performed
- Use **taxonomies**:
  - represent levels of abstraction
  - organisation (grouping) depends on purpose
- Declarative knowledge elicitation techniques:
  - established convention, existing documentation
  - asking users to list objects; card sorting
  - structured interviews, listing nouns and verbs

Laddering



1. Start subject off with a seed item: **type faces**
2. Move around task domain knowledge using prompts:
   - To move down: *Can you give examples of type faces?*
   - To move across: *What alternatives are there to type faces for changing the appearance of text?*
   - To move up: *What have Times Roman, Helvetica in common?*

Car Control Taxonomy

motor controls

steering		*steering wheel*, *indicators*
engine	direct	*ignition*, *accelerator*, *foot brake*
	gearing	*clutch*, *gear stick*
lights	external	*headlights*, *hazard lights*
	internal	*courtesy light*
wash/wipe	wipers	*front wipers*, *rear wipers*
	washers	*front washers*, *rear washers*
	front	*front wipers*, *front washers*
	rear	*rear wipers*, *rear washers*
heating		*temperature control*, *air direction*, *fan*, *rear screen heater*
parking		*hand brake*, *door lock*
radio		*numerous!*

Task Descriptive Hierarchy (TDH)

- **Task Analysis for Knowledge Description** (TAKD) uses three types of branches in TDH taxonomies:
  - **XOR** — object in exactly one branch
  - **AND** — object must be in both
  - **OR** — can be in one, many or none

wash/wipe **AND**

function **XOR**	wipers	*front wipers, rear wipers*
	washers	*front washers, rear washers*
position **XOR**	front	*front wipers, front washers*
	rear	*rear wipers, rear washers*

Larger TDH example

```
kitchen item AND
/____shape XOR
/    |____dished  mixing bowl, casserole, saucepan,
/    |            soup bowl, glass
/    |____flat    plate, chopping board, frying pan
/____function OR
     {____preparation    mixing bowl, plate, chopping board
     {____cooking    frying pan, casserole, saucepan
     {____dining XOR
          |____for food   plate, soup bowl, casserole
          |____for drink  glass
```

N.B. / | { indicates branch type; operator names AND, XOR, OR not usually used

Examining TDH taxonomies

- The **uniqueness rule**: can the diagram distinguish every object?
  - If not, may consider adding extra classifiers
- Taxonomies for actions are similar, e.g.

```
kitchen job XOR
|____ preparation  beating, mixing
|____ cooking frying, boiling, baking
|____ dining  pouring, eating, drinking
```

- Compare taxonomies to restructure/find omissions
- Objects often more easily observed than tasks!
- Notice: TDH decomposes by similarity, HTA by how-to.

Abstraction and cuts

- After producing detailed taxonomy, we can *cut* to yield an abstract view.
- e.g. cutting above shape and below dining, plate becomes:

```
   kitchen
item/function{preparation,dining}/
```

- This is a term in the **Knowledge Representation Grammar** (KRG)
- Composite KRG term: *beating in a mixing bowl* is

```
kitchen job(preparation) using
    a kitchen item/function{preparation}/
```

- Terms and sequences in KRG may provide tools for further analysis.

Applying Task Analysis

- For documentation: **How To** manual
  - useful for novices
  - assumes all tasks known
- Requirements capture and design
  - lifts focus from system to use
  - suggests candidates for automation
  - may uncover user's conceptual model
- Detailed interface design
  - taxonomies suggest menu layout
  - object/action lists suggest interface objects
  - task frequency guides default choices
  - existing task sequences guide dialogue design

Task analysis can be continually iterated to improve and enhance.

Exercise

1. Investigate the use of **cluster analysis** to classify objects into groups.
   - Cluster analysis works by constructing a matrix of object similarities using a distance measure.
   - The distance measure may be a psychological (user-driven) estimate of relatedness determined by experiment or interview.
2. Derive a taxonomy from existing menu and dialogue layouts in a common application (e.g., word processor, image editor)
3. Perform a cluster analysis on the basic tasks and objects, and examine whether it agrees with the application layout.

References

Fabio Paternò. *Model-Based Design and Evaluation of Interactive Applications*.

Springer-Verlag, 2000.

See also:

- Dix et al, Chapter 15, and further reading recommendations there.
- More about CTT at `http://giove.cnuce.cnr.it/ConcurTaskTrees.html`