BIT 1st Year
Semester 3
IT 3405

User Interface Design
Chapter 8 – Task Analysis

INTENDED LEARNING OUTCOMES

- Recognize the importance of task analysis for the design
- Identify the differences among goal, tasks and actions
- Carry out the hierarchical task analysis for a given description

SUB TOPICS

8.1. Importance of task analysis

8.2. Goals, Tasks and Actions

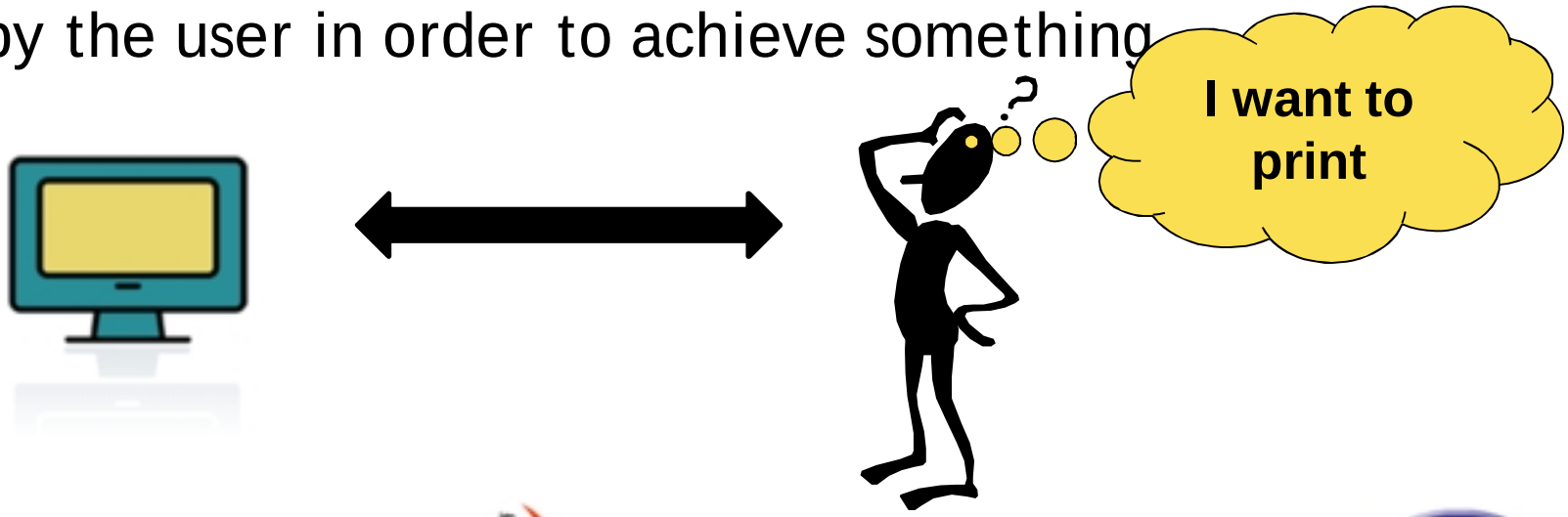
8.3. Different Methods

8.4. Designing the menu structure

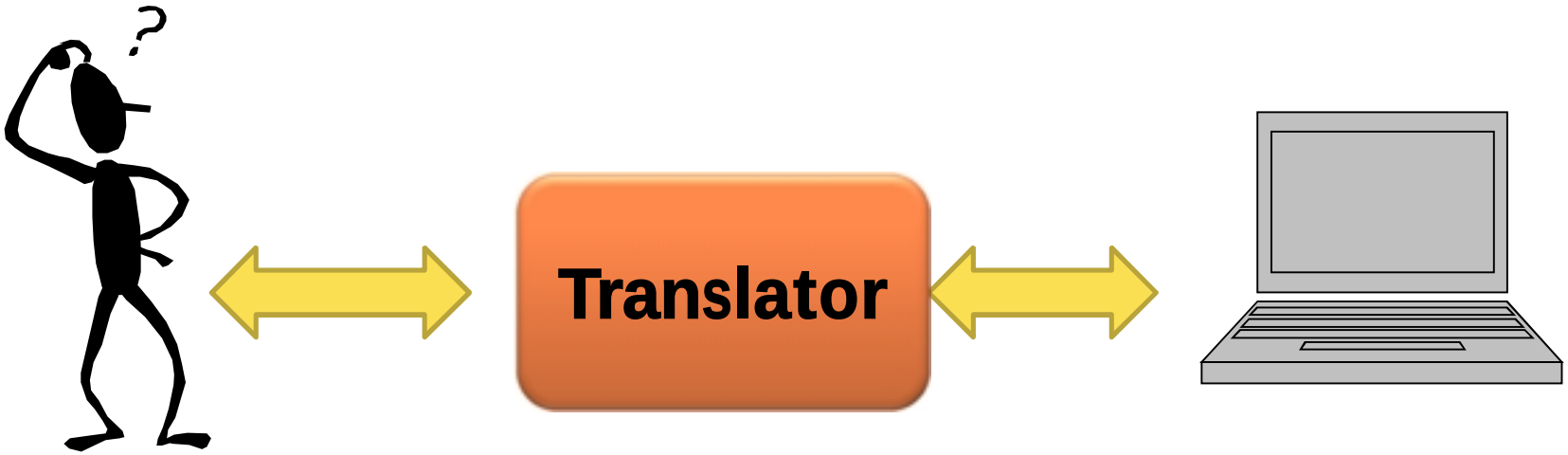
8.1. IMPORTANCE OF TASK ANALYSIS

Importance of Interaction in Computing

- Any communication between a user and a computer, direct or indirect, has some objectives linked to task.
- Both Computer and Human are complex and very different from each other in interpreting those tasks/objectives.
- Interaction will be based on the task to be completed by the user in order to achieve something

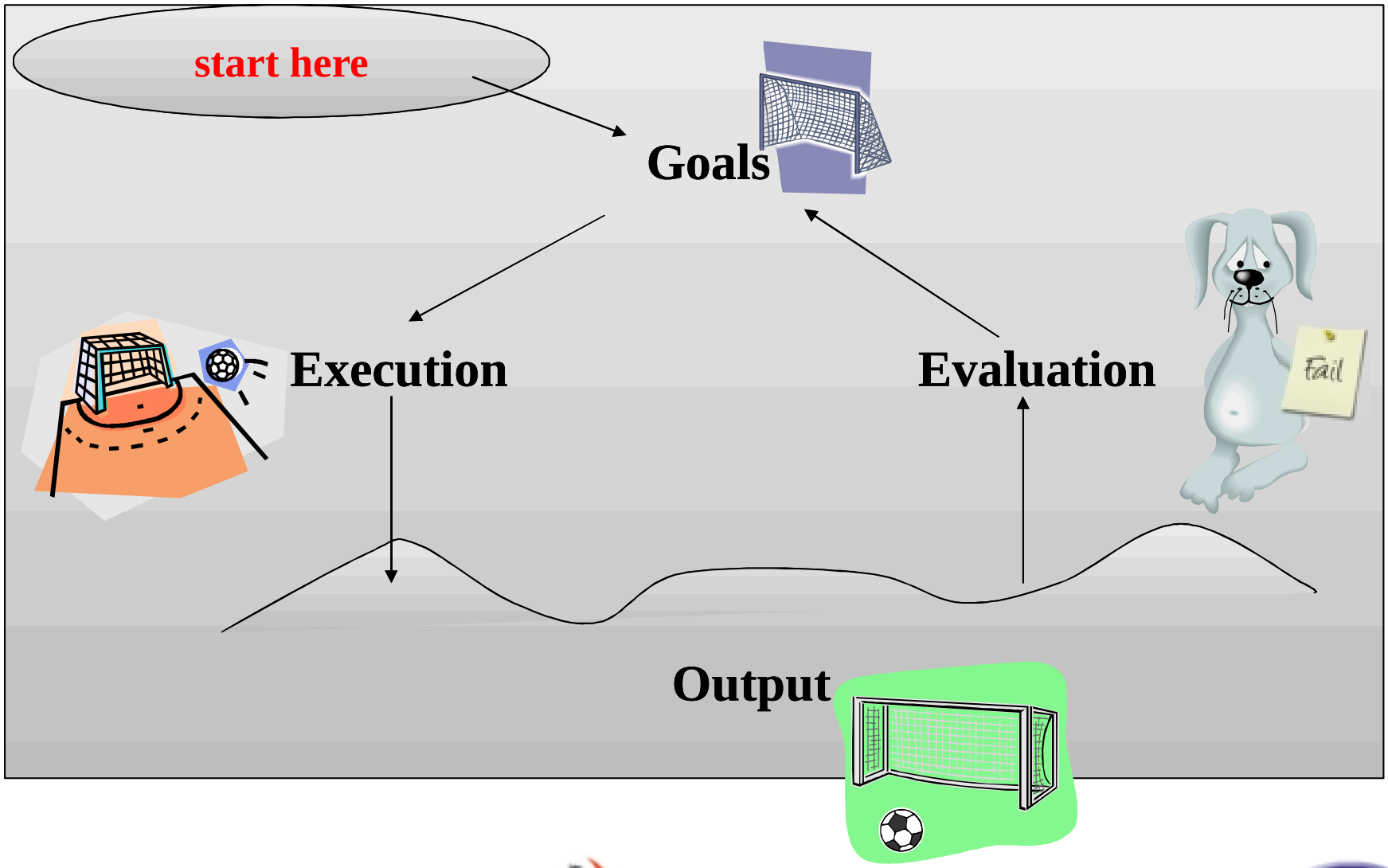


How to communicate your task



Who is this translator? **Interface**

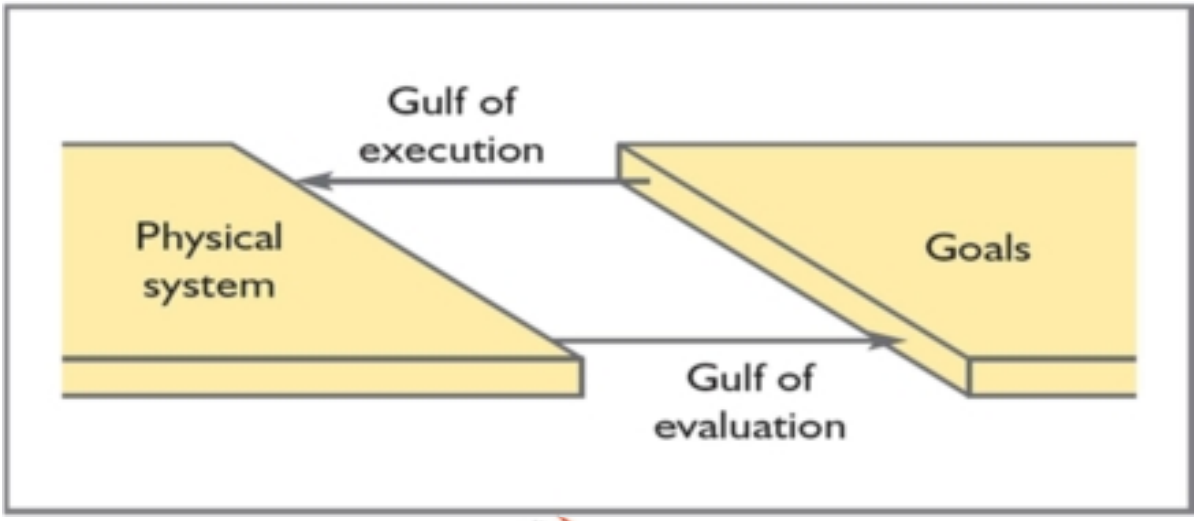
Steps in the process of communication



Problems in execution and evaluation

User carry out series of actions based on the feedback to achieve the objectives/complete the tasks

- gulf of execution : difference between user determined action formulation and the actions allowed by system
- gulf of evaluation : difference between physical presentation of system state and user expectation



How a task is carried out

- The user has to communicate actions in the input language to execute them based on the task in hand
- The user will have to evaluate the messages in the output languages to understand the progress/status of actions carried out.
- Success of a task depends on identifying the correct actions , tools to execute actions and interpreting messages
- Task analysis (TA) - the study of the way people perform their jobs.
  - what user do,
  - what objects user interact with
  - what user need to know.
  - A task is defined in terms of the user not the system.

How and Why - Task Analysis (TA)

- The main tool of task analysis is observation
- Task analysis gathers both *declarative and procedural knowledge*
  - Declarative: objects, relationships, dependencies and constraints
  - Procedural: task sequences, goals and sub-goals
- Task analysis contributes primarily to
  - Identify system requirements
  - Prepare training materials and
  - Write documentation

Task analysis with respect to user

- Three different approaches to do task analysis
  - Task decomposition
  - Knowledge-based techniques
  - Entity-relation-based analysis

- Originally a tool for writing training manuals, now used more widely in business process analysis in terms of HCI
- Emphasizes on users + existing tasks, rather than desired system as in **systems analysis**
- Emphasizes observable behavior and whole job, rather than internal mental state and "unit" tasks as in **cognitive models**

TA Example: Cleaning a house

To clean the house using vacuum cleaner:

- 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.

8.2.
GOALS, TASKS AND ACTIONS

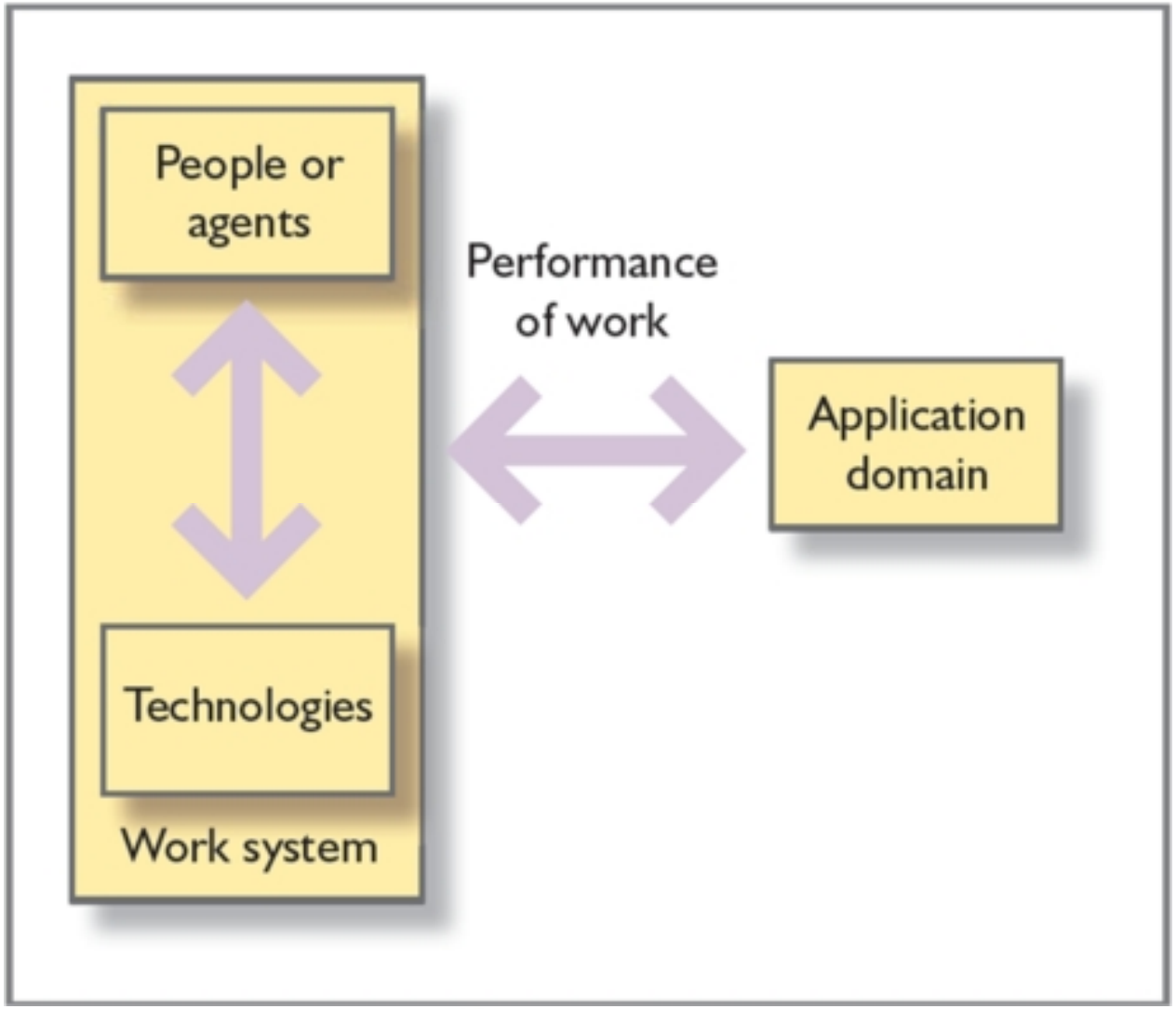
Tasks, Goals and Actions

- "A task has a goal together with some ordered set of actions"

- The concept of task derives from a view of people, who are trying to achieve some change in an application domain, with some tools/technologies.

- Taken together the people and technology constitute what is called a 'work system', which is separate from the 'application domain' but used to perform a task in the domain
- Example: Application domain – travelling, Tools – car, cycle, Task: Traveling from one place to another

Goals, tasks and actions cont...



Task analysis and performance

- Importantly task analysis is concerned with some aspects of the performance of a work system with respect to a domain.
  - Example: Travel to Kandy from Colombo by Car, Cycle and Bus

- This performance may be
  - the amount of effort to learn a system,
  - to reach a certain level of competence with a system,
  - the time taken to perform certain tasks, and so on

Goals

- A goal is a state of the application domain that a work system wishes to achieve.
  - Example – Goal: Reach Kandy
- Goals are specified at particular levels of abstraction
- For example,
  - the organizational goals of a company,
  - the behaviour of a software system in terms of its goals.
- It is not just people who have goals; the work system as a whole may have goals.
  - In other words, goal is defined considering both people and technology

Goals Example

- Expected/Final Goals
  - write a letter,
  - record a programme on TV,
  - find the strongest mobile phone signal.
- Start State
  - no letter written,
  - the TV programme not recorded,
  - the signal not confirmed as the strongest
- The agent has to undertake some activities, i.e. some tasks, in order to get it into the required state. Usually a goal can be achieved in a variety of different ways.

Goals Example cont...

- The first thing the agent has to decide is **which technology and activities to use to achieve the goal**. For recording a TV programme, for example, an agent could select the following activities:
  - Ask a friend to record it
  - Press ‘Rec’ on the PVR
  - Set the timer using a manual setting
  - Set the timer using an on-screen TV guide .

Goals - Issues

- Agent (person or entity) knowledge and experience about the technology (pros and cons) will affect his decision depending on the circumstances.
  - The agent may misunderstand some of the technologies and so may not take the optimum course of action.
  - The agent may make erroneous mistakes
- Task/activities depend on the selected technology
- User task has a goal. This task could be described considering a set of activities with respect to given technology

Definition - Tasks

- A task is a structured set of activities required, used, or believed to be necessary by an agent to achieve a goal using a particular technology.
- A task will often consist of subtasks where a subtask is a task at a more detailed level of abstraction.
- The structure of an activity may include selecting between alternative actions, performing some actions a number of times and sequencing of actions.
- The task is broken down into more and more detailed levels of description until it is defined/described in terms of actions.

Actions

- Actions are ‘simple tasks’.
- Whereas a task might include some structure such as doing things in a particular sequence, making decisions as to alternative things to do (selection) and doing things several times (iteration), an action does not.
- This structure is often called a plan or method.
- *An action is a task that has no problem solving associated with it and which does not include any control structure.*
- *Actions and tasks will be different for different people.*

Textual Hiearchical Task Anslysis (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

8.3. DIFFERENT METHODS

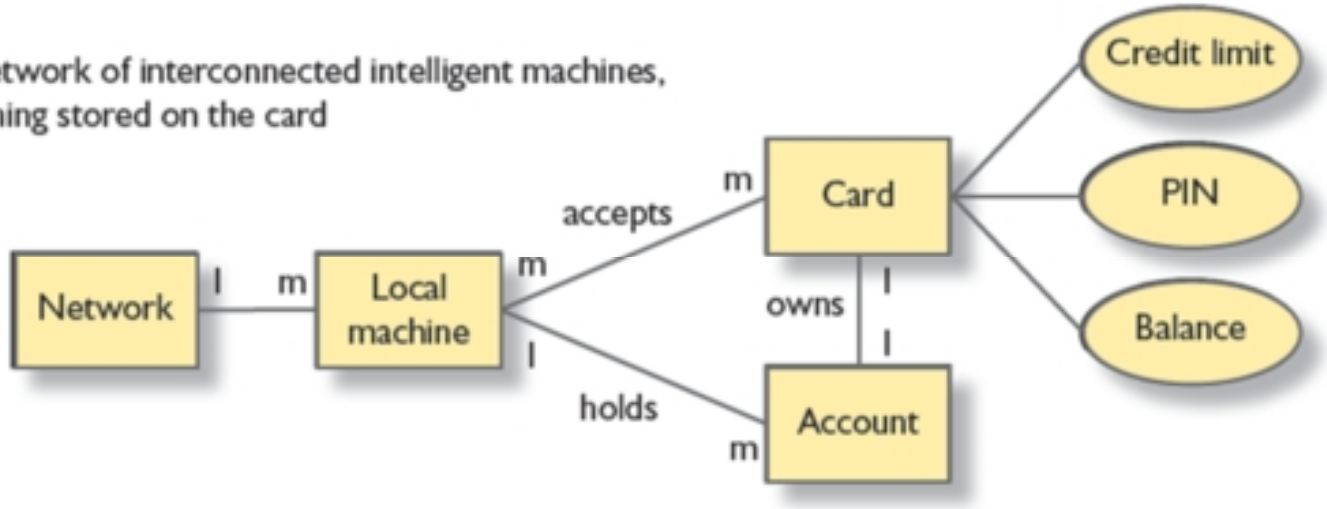
Mental models and cognitive TA

- Cognition is concerned with thinking, solving problems, learning, memory, and their mental models
- Cognitive Process
  - General Knowledge how to do things
  - How to do things with specific technologies
- Cognitive Process help to identify task
- The development of mental Model is affected by the task analysis
- Example: You want to draw a picture (task), You can use Photoshop (tool), your experience in Photoshop (mental model) help to identify activities and plan

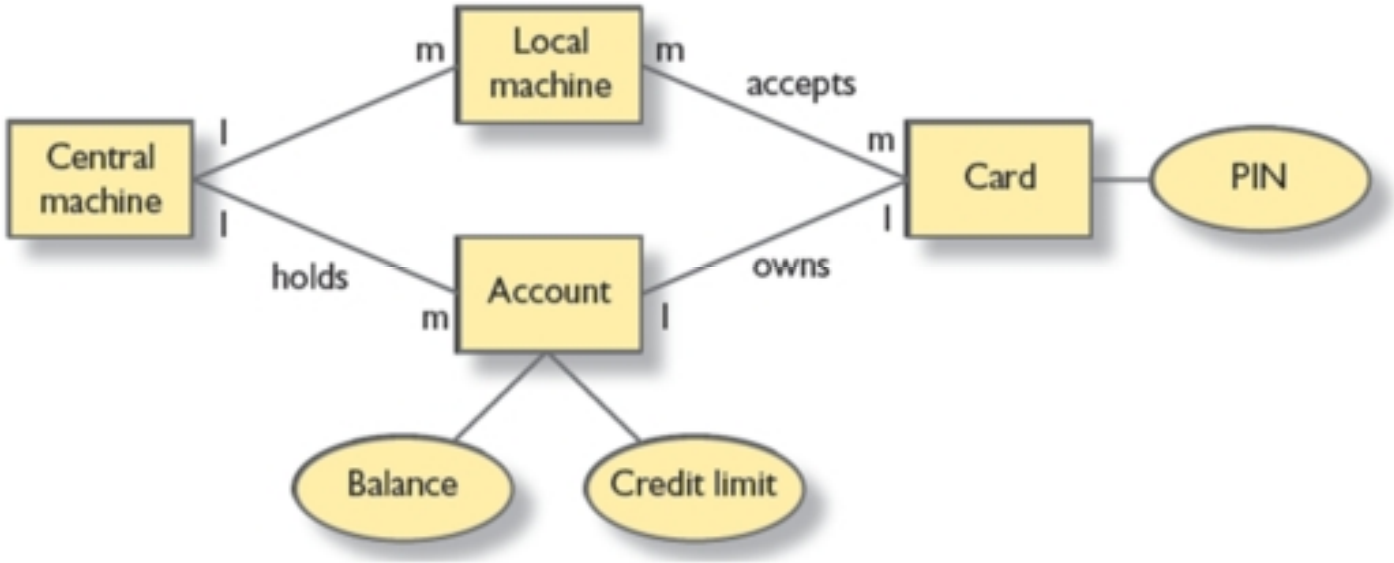
Mental models and cognitive TA cont…

- Two broad categories:
  - those concerned with the logic of the task – the sequence of steps that need to be undertaken by a work system to achieve a goal – (Hierarchical TA)
  - those concerned with cognitive aspects (Cognitive TA).
- Cognitive task analysis is concerned with understanding what cognitive processes the work system will have to undertake in order to achieve a goal.

S14: network of interconnected intelligent machines, everything stored on the card



S15: central machine with local 'dumb' clients, nothing on the card except the PIN



Mappings

- Two mappings
  - the goal–task mapping (knowing what to do to achieve some goal)
  - the task–action mapping (knowing how to do it)
- Based on the **Procedural knowledge**
- Goal Formation Vs Start State
- the goal formation stage (knowing that you can do something in the first place)
- Consider example, you want to record a scenery using a video camera
  - Start the camera
  - Focus the scenery
  - Press record button to start
  - Press record button again to stop

Task analysis and systems design

- **task analysis may affect the whole of systems development**.
- Requirement analysis and evaluation may affect the **task analysis**
- **task analysis** (understanding existing tasks) **Vs. task design** (envisioning future tasks)
- **a task analysis will result in a task model**

Task analysis in systems development

- Task analysis should aim to be as independent as possible from the device (or technology),
  - understand the essential nature of the work
  - focuses on the achievement of work based on a particular design (hence is device dependent)
- Understanding task analysis
  - the practice of work,
  - the current allocation of functions between people and technologies
  - existing problems and opportunities for improvement
- Design and evaluation - task analysis
  - the cognition demanded by a particular design,
  - the logic of a possible design
  - the future distribution of tasks and actions across people and technologies

Doing task analysis

- Task analysis is similar to scenario-based design
  - Tasks are just scenarios in which the context and other details have been stripped away.
- Task analysis is best applied to one or two key activities in a domain
- Task analysis is not quick or cheap to do,
  - it should be used where there is likely to be the best pay-off.

Different methods

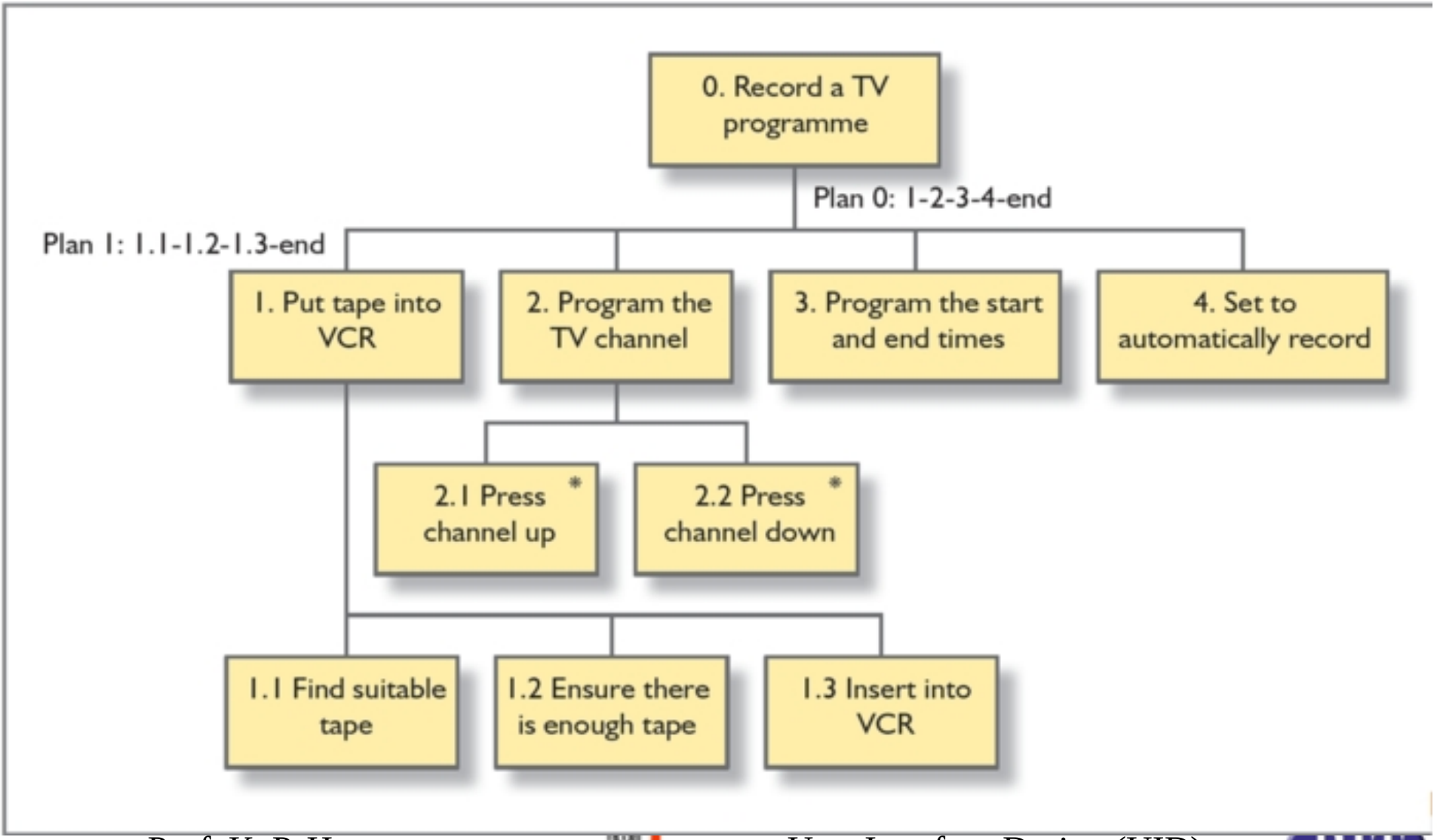
Three Methods

- Hierarchical Task Analysis (HTA)
  - the logic of a task
- Cognitive Task Analysis
  - based on the goals, operators, methods, selection rules (GOMS)
  - cognitive analysis of tasks, focusing on the procedural knowledge needed to achieve a goal
    - 'how to do it' knowledge.
- Structural knowledge based Analysis
  - 'what it is' knowledge.

Hierarchical Task Analysis (HTA)

- a graphical representation of a task structure based on **a structure chart notation**
  - a sequence of tasks, subtasks and actions as a hierarchy and include notational conventions to show whether an action can be repeated a number of times (iteration) and the execution of alternative actions (selection)
- Sequence is usually shown by ordering the tasks, subtasks and actions from left to right
- Annotations can be included to indicate *plans*
- Structured paths through the hierarchy to achieve particular goals

Example – TV Recording



Exercise – Marking a call

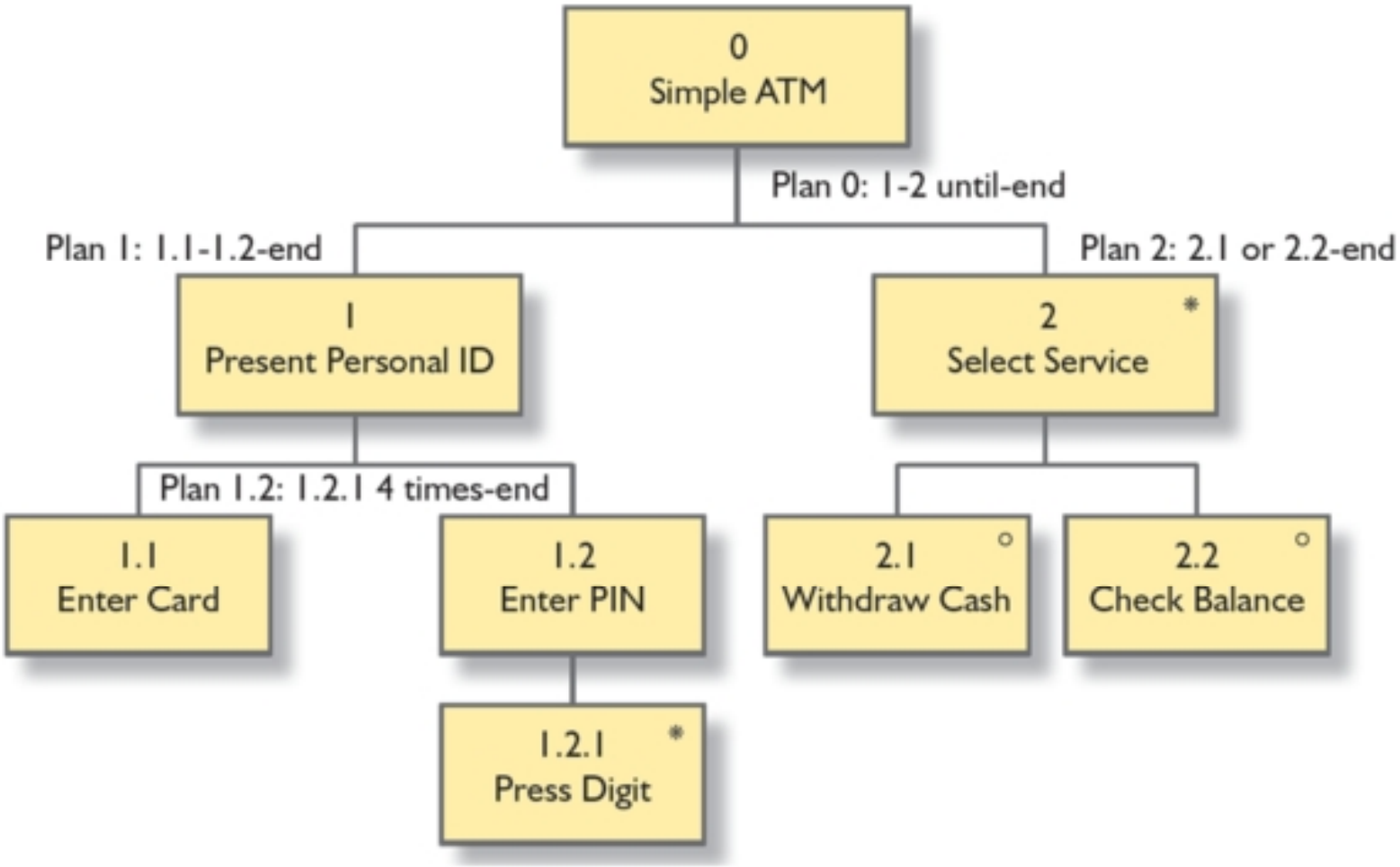
- Making a call using a mobile phone has two main routes through the hierarchy of tasks and subtasks.
- If the person's number is in the phone's address book then the caller has to find the number and press 'call'.
- If it is not, the caller has to type the number in and press 'call'.

HTA: A step-by-step guide

1. Decide on the purpose of the analysis. This is typically to help with systems design or to design training materials.
2. Define the task goals.
3. Data acquisition. How are you going to collect data? Observation, getting people to use a prototype, etc.
4. Acquire data and draft a hierarchical diagram.
5. Recheck validity of decomposition with stakeholders.
6. Identify significant operations and stop when the effects of failure are no longer significant.
7. Generate and test hypotheses concerning factors affecting learning and performance.

HTA is not easy !.
You will not get it right first time. Repeat the process to verify the hierarchy.

Hierarchical Task Model: ATM



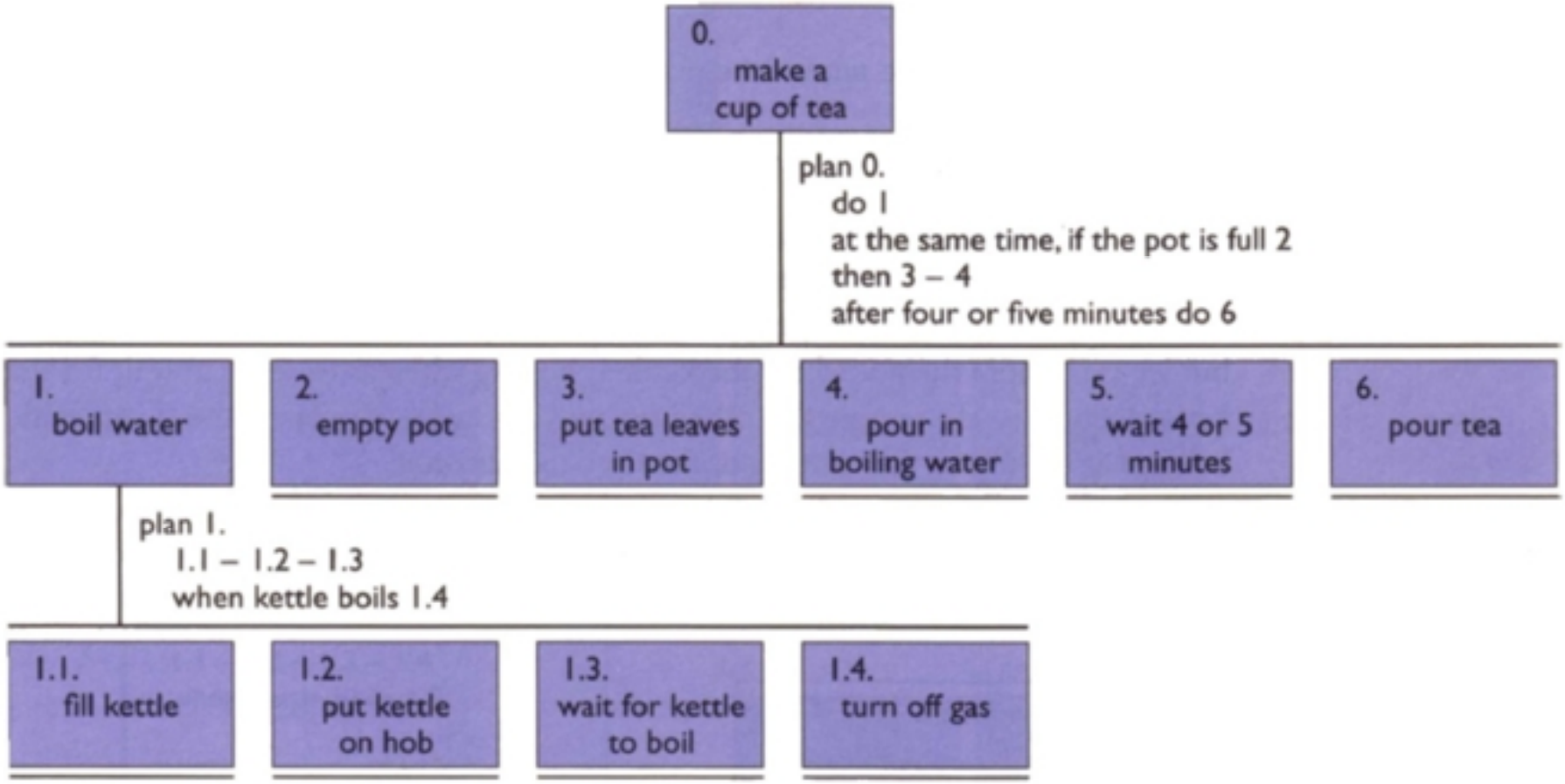
User Action Notation (UAN)

Task: Present personal ID	
User Actions	*Interface Feedback*
	Welcome message
Insert card	'Please enter PIN' message
Press digit	Beep + display *

User Action Notation (UAN) cont...

- HTA can be highly effective in helping people to really understand the structure of tasks – either existing tasks or new, proposed task structures.
- This type of analysis can be represented in ways other than the structure chart. For example, the user action notation (UAN) (Hix and Hartson, 1993) represents each task as a separate box with the overall goal at the top of the box and the actions listed underneath with the distribution of user and system tasks shown in two columns.
- Other columns can be included in the table such as showing the interface state and when the system connects to background computation.

HTA: Making a cup of tea



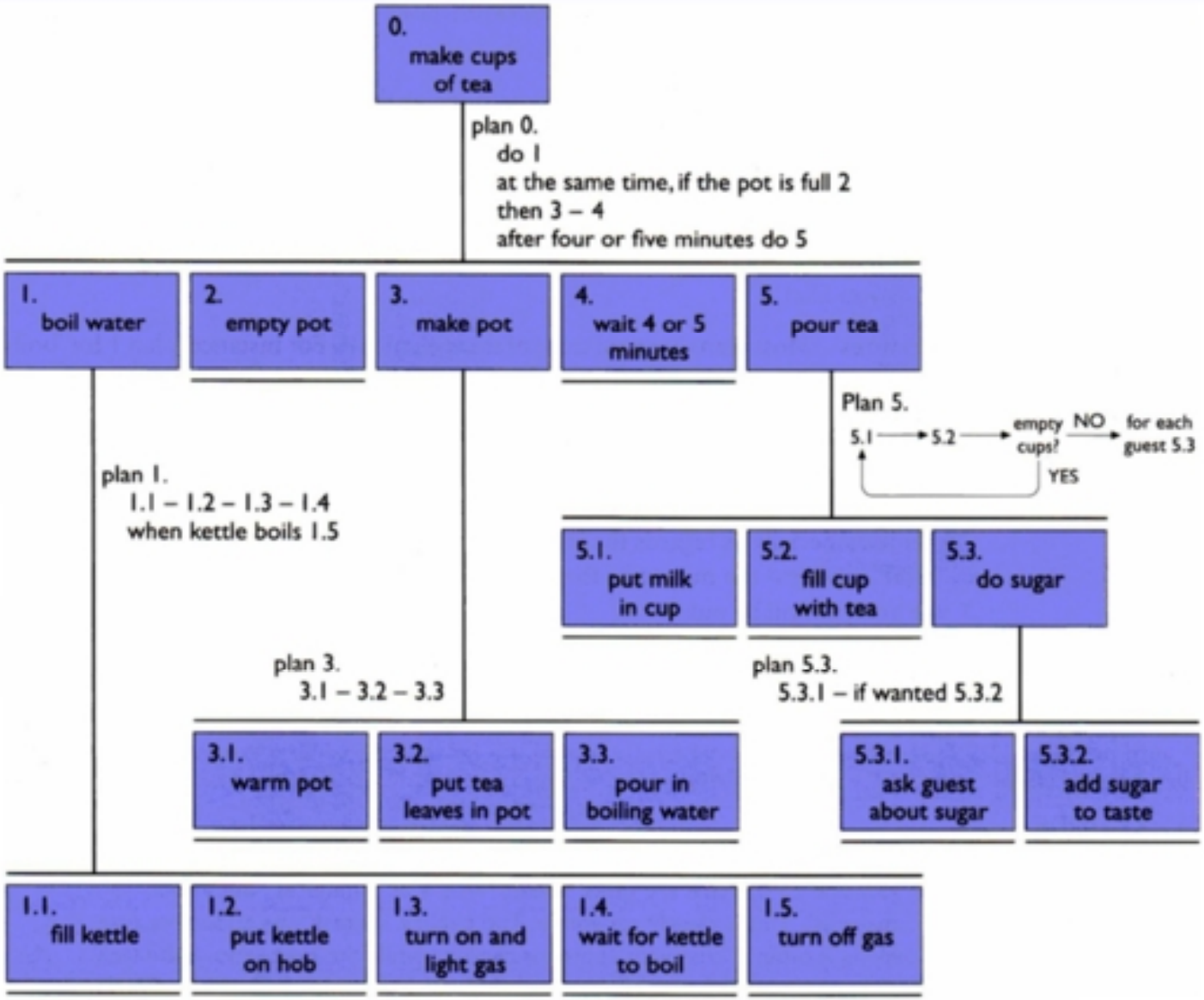
Refinement

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”?
- generalize make one cup . . . or more

Refined HTA


0.
make cups of tea
plan 0.
do 1
at the same time, if the pot is full 2
then 3 – 4
after four or five minutes do 5
1.
boil water
2.
empty pot
3.
make pot
4.
wait 4 or 5 minutes
5.
pour tea
Plan 5.
5.1
5.2
empty cups?
NO
for each guest 5.3
YES
plan 1.
1.1 – 1.2 – 1.3 – 1.4
when kettle boils 1.5
5.1.
put milk in cup
5.2.
fill cup with tea
5.3.
do sugar
plan 3.
3.1 – 3.2 – 3.3
plan 5.3.
5.3.1 – if wanted 5.3.2
3.1.
warm pot
3.2.
put tea leaves in pot
3.3.
pour in boiling water
5.3.1.
ask guest about sugar
5.3.2.
add sugar to taste
1.1.
fill kettle
1.2.
put kettle on hob
1.3.
turn on and light gas
1.4.
wait for kettle to boil
1.5.
turn off gas

Types of Plans

- sequence 1.1 then 1.2 then 1.3
- optional if the pot is full, do 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

GOMS: Cognitive Model for TA

- Cognitive Process for Task Analysis
- Describe tasks in following terms
  - Goals
  - Operators
  - Methods
  - Selection Rules
- Good only when people know what they are going to do
  - Not good for problem-solving

GOMS: Cognitive Model for TA cont…

- **Goals** – what people are trying to do using some system
- **Operators** – the actions that the system allows people to make, such as *clicking on menus*
- **Methods** – sequences of subtasks and operators. Subtasks are described at a more abstract level than operators – things such as '*select name from address book*' or '*enter phone number*'.
- **Selection rules** – the rules that people use to choose between methods of achieving the same subtask (if there are options). For example, *to select a name from an address book*

Structural Knowledge based Analysis for Task Design

- Structural Knowledge helps in problem solving when someone encounters a new problem
- need to know what types of things can be accomplished in a domain
- For example, In a drawing package I need to know that there is a facility for changing the thickness of a line, before working out how to do it.
- This can help in designing better systems.

8.4.
DESIGNING THE MENU STRUCTURE

Menu Structures

- What is the relationship between Task Analysis & Menu Structures?
  - You have to access menu items through a menu header; every item must be associated with a heading.
  - Each menu item is defined with respect to a menu heading.
  - There are the various menu headings, such as File, Edit, and Arrange, and there are the various items that are found under the headings, such as Save, Open, Cut and Paste.
  - Mapping HTA to the menu structure.

Summary

- Task analysis is a key technique in interactive system design.
- The focus may be on the logical structure of tasks, or the cognitive demands made by tasks procedurally or structurally.
- Task analysis encompasses task design and it is here that it is probably most useful, as an analysis of a future design is undertaken to reveal difficulties.