Overview

What is task analysis?

Task Analysis Methods

- task decomposition
- knowledge based analysis
- entity-relationship techniques

Sources of Information

Uses of Task Analysis

What is Task Analysis?

Methods of analysing people's jobs:

- what people do
- what things they work with
- what they must know

Example:

in order to clean the house

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

Must know about:

vaccum cleaners,their attachments,
dust bags, cupboards, rooms etc.

Approaches to task analysis

- **Task decomposition**
  splitting task into (ordered) subtasks
- **Knowledge based techniques**
  what the user knows about the task
  and how it is organised
- **Entity–relation based analysis**
  relationships between objects and actions
  and the people who perform them

General method:

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

Differences from other techniques

Systems analysis

focus — system design

Task analysis

focus — the user

Cognitive models

focus — internal mental state

granularity — practiced 'unit' task

Task analysis

focus — external actions

granularity — whole job

However

- much overlap in general
- differences have exceptions.

Task Decomposition

Aims:

- describe the actions people do
- structure them within task subtask hierarchy
- describe order of subtasks

Focus on *Hierarchical Task Analysis* (HTA)

It uses:

- text and diagrams to show hierarchy
- plans to describe order

Textual HTA description

Hierarchy description ...

0. in order to clean the house
   1. get the vacuum cleaner out
   2. fix 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

... and plans

Plan 0: do 1 – 2 – 3 – 5 in that order.
when the dust bag gets full do 4

Plan 3: do any of 3.1, 3.2 or 3.3 in any order
depending on which rooms need cleaning

N.B. *only* the plans denote order

Generating the hierarchy

- get flat list of tasks
- group tasks into higher level tasks
- decompose lowest level tasks further

Stopping rules How do we know when to stop?

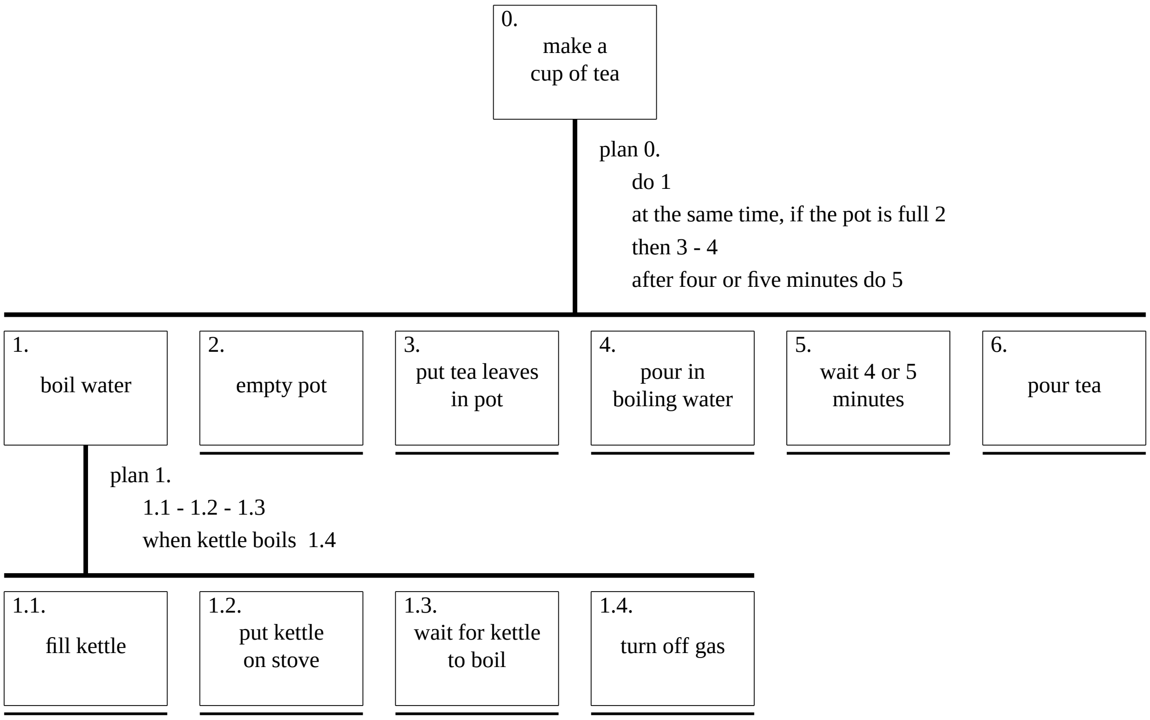
Is "empty the dust bag" simple enough?

Purpose: expand only relevant tasks

Error cost: stop when $P \times C$ is small

Motor actions: lowest sensible level

Diagrammatic HTA



- Line under box means no further expansion.
- Plans shown on diagram or written elsewhere.
- Same information as:

  0. make a cup of tea
     1. boil water

        ...

Refining the description

Given initial HTA (textual or diagram)

How to check/improve it?

Some heuristics:

paired actions

e.g., where is 'turn on gas'

restructure

e.g., generate task 'make pot'

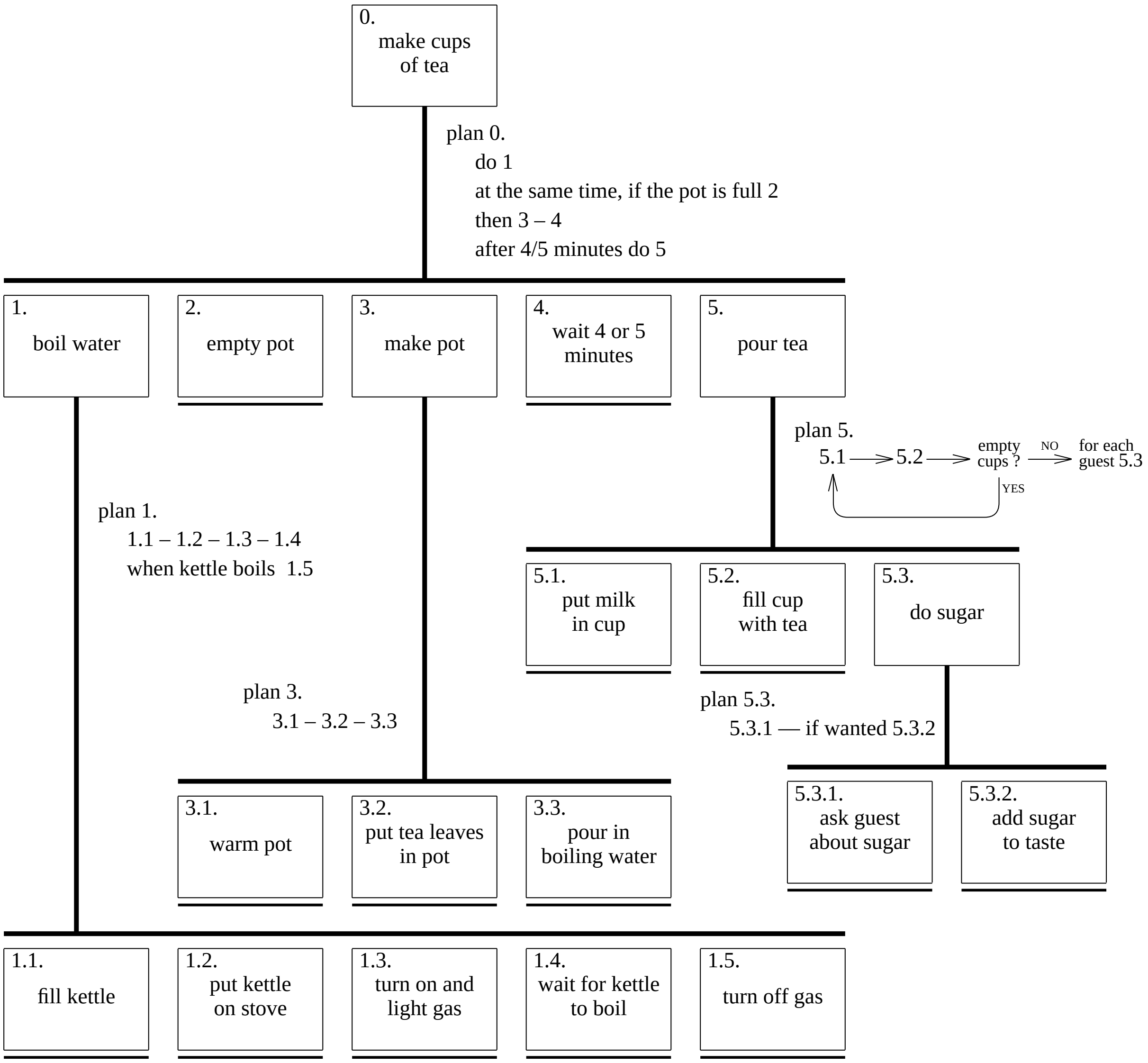
balance

e.g., is 'pour tea' simpler than making pot?

generalise

e.g., make one cup or two ... or more

Refined HTA for making tea



Types of plan

fixed sequence

e.g., 1.1–1.2–1.3

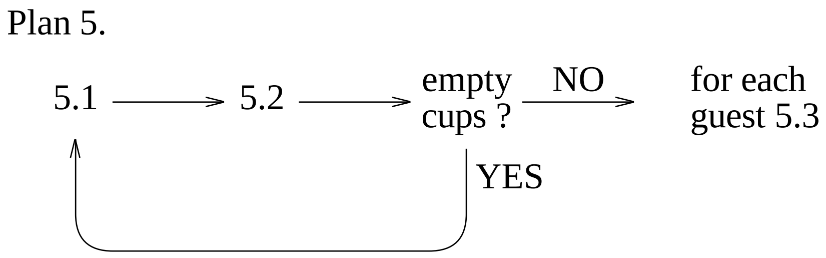
optional tasks

e.g., *if* the pot is full 2

waiting for events

e.g., *when* kettle boils 1.4

cycles



time-sharing

e.g., do 1; at the *same time* ...

discretionary

e.g., do any of 3.1, 3.2 or 3.3 in *any order*

mixtures

most plans involve several of the above

Knowledge Based Analyses

Focus on:

Objects — used in task
Actions — performed

Taxonomies represent levels of abstraction

Example:

motor controls
- steering *steering wheel, indicators*
- engine/speed
  - 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*
- heating *temperature control, air direction, fan, rear screen heater*
- parking *hand brake, door lock*
- radio
  numerous!

TDH notation

TDH – Task Description Hierarchy

Three types of branch point in taxonomy:

XOR	—	normal taxonomy object in one and only one branch
AND	—	object must be in both represents multiple classifications
OR	—	weakest case can be in one, many or none

Example:

wash/wipe **AND**
    function **XOR**
        wipe
            front wipers, rear wipers
        wash
            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. '/|{' used for branch types.

More on TDH

Uniqueness rule:

can the diagram distinguish all objects?

e.g., plate is:
kitchen item/shape(flat)/function{preparation,dining(for food)}/
nothing else fits this description

Actions have taxonomy too:

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

Abstraction and cuts

After producing detailed taxonomy 'cut' it to yield abstract view.

That is, ignore lower level nodes.

e.g., cutting above shape and below dining, plate becomes:

kitchen item/function{preparation,dining}/

This is a term in
Knowledge Representation Grammar (KRG)

These can be more complex:
'beating in a mixing bowl' becomes

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

Entity–Relationship Based Techniques

Emphasis on objects, actions
and their relationships

Similar to object-oriented analysis, but ...

- includes non-computer entities
- emphasises domain understanding
  not implementation

Running example:

'Vera's Veggies' – a market gardening firm

Owner/manager: Vera Bradshaw
Employees: Sam Gummage and Tony Peagreen
various tools including a tractor 'Fergie'
two fields and a glasshouse
new computer controlled irrigation system

Objects

Start with list of objects and classify them:

Concrete objects:

simple things: spade, plough, glasshouse

Actors:

human actors: Vera, Sam, Tony, the customers

what about the irrigation controller?

Composite objects:

sets: the team = { Vera, Sam, Tony }

tuples: tractor may be < Fergie, plough >

To the objects add *attributes*:

Object Pump3 **simple** — *irrigation pump*

Attributes:

status:	on/off/faulty
capacity:	100 litres/minute

N.B. need not be computationally complete

Actions

List actions and associate with each:

agent — who performs the actions
patient — which is changed by the action
instrument — used to perform action

Examples:

Sam (*agent*) planted (*action*) the leeks (*patient*)

Tony dug the field *with* the spade (*instrument*)

Note:

implicit agents — *read behind the words*

'the field was ploughed' — by whom?

indirect agency — *the real agent?*

'Vera programmed the controller to irrigate the field'

messages — a special sort of action

'Vera *told* Sam to ...'

rôles — an agent acts in several rôles

Vera as *worker* or as *manager*

E/R Example I – objects and actions

Object Sam **human actor**
  Actions:
    S1: drive tractor
    S2: dig the carrots

Object Vera **human actor** — the proprietor
  Actions: as worker
    V1: plant marrow seed
    V2: program irrigation controller
  Actions: as manager
    V3: tell Sam to dig the carrots

Object the men **composite**
  Comprises: {Sam, Tony}

Object glasshouse **simple**
  Attribute:
    humidity: 0–100%

Object Irrigation Controller **non-human actor**
  Actions:
    IC1: turn on Pump1
    IC2: turn on Pump2
    IC3: turn on Pump3

Object Marrow **simple**
  Actions:
    M1: germinate
    M2: grow

Events

Events are when something *happens*

- performance of action

  'Sam dug the carrots'

- spontaneous events

  'the marrow seed germinated'
  'the humidity drops below 25%'

- timed events

  'at midnight the controller . . . '

Relationships

object–object

social — Sam is subordinate to Vera

spatial — pump 3 is in the glasshouse

action–object

agent — (listed with object)

patient and instrument

actions and events

temporal and causal

'Sam digs the carrots *because* Vera told him'

Temporal relations

- also use HTA or dialogue notations.
- show task sequence (normal HTA)
- show object lifecycle (see page 241)

E/R example II – events and relations

Events

Ev1: humidity drops below 25%
Ev2: midnight

Relations: object–object

location (Pump3, glasshouse)
location (Pump1, Parker's Patch)

Relations: action–object

patient (V3, Sam)
- Vera tells *Sam* to dig

patient (S2, the carrots)
- Sam digs the *carrots* ...

instrument (S2, spade)
- ... *with* the spade

Relations: action–event

before (V1, M1)
- the marrow must be sown before it can germinate

triggers (Ev1, IC3)
- *when* humidity drops below 25%, the controller turns on pump 3

causes (V2, IC1)
- the controller turns on the pump *because* Vera programmed it

Sources of Information

- Documentation

  N.B. manuals say what is *supposed* to happen
  but, good for key words and prompting interviews

- Observation

  formal/informal, laboratory/field (see Chapter 11)

- Interviews

  the expert: manager or worker? (ask both!)

Early analysis

- Extraction from transcripts

  list nouns (*objects*) and verbs (*actions*)
  beware technical language and context
  'the rain *poured*'
  'I *poured* the tea'

- Sorting and classifying

  grouping or arranging words on cards
  ranking objects/actions for task relevance (see Ch. 11)
  use commercial outliner

Iterative process:

$$\text{data sources} \longleftrightarrow \text{analysis}$$

But costly, so use cheap sources where available

Uses of Task Analysis I

Manuals and Documentation

Procedural 'how to do it' manual

- from HTA description
- useful for extreme novices
  or when domain too difficult
- assumes all tasks known

Conceptual manual

- from knowledge or entity/relation
  based analyses
- good for open ended tasks

Example: tea making manual from HTA

To make cups of tea

boil water — *see page 2*
empty pot
make pot — *see page 3*
wait 4 or 5 minutes
pour tea — *see page 4*

— page 1 —

Make pot of tea
once water has boiled

warm pot
put tea leaves in pot
pour in boiling water

— page 3 —

Uses of Task Analysis II

Requirements capture and systems design

- lifts focus from system to use
- suggests candidates for automation
- uncovers 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

NOTE.

task analysis is *never* complete
rigid task based design $\Longrightarrow$ inflexible system