chapter 18

modelling rich interaction

Modelling Rich Interaction

- status–event analysis
- rich environments in task analysis
- sensor-based systems

status–event analysis

- events – things that happen
  - e.g. alarm bell, beeps, keystrokes
- status – things that are
  - e.g. screen display, watch face, mouse position

- unifying framework – system (formal analysis)
  – user (psychology & heuristics)
- time behaviour – detect delays, select feedback
- transferable phenomena

  e.g. polling – active agent discovers status change

rich set of phenomena

	events	status
input	keypress	mouse position
output	beep	display
internal	interrupt	document state
external	time	temperature

Most notations only deal with subset of these

e.g.STNs: event-in/event-out

- $\Rightarrow$ may need awkward work-arounds

rich set of behaviour

❶ actions:
- state change at (user initiated) event

❷ status change events:
- e.g. stock drops below re-order level

❸ interstitial behaviour:
- between actions – e.g. dragging an icon

standard notations:

❶ usually, ❷ sometimes, ❸ never!

Properties of events

- status change event
  - the passing of a time
- actual and perceived events
  - usually some gap
- polling
  - glance at watch face
  - status change becomes perceived event
- granularity
  - birthday – days
  - appointment – minutes

Design implications

- actual/perceived lag…
  matches application timescale?

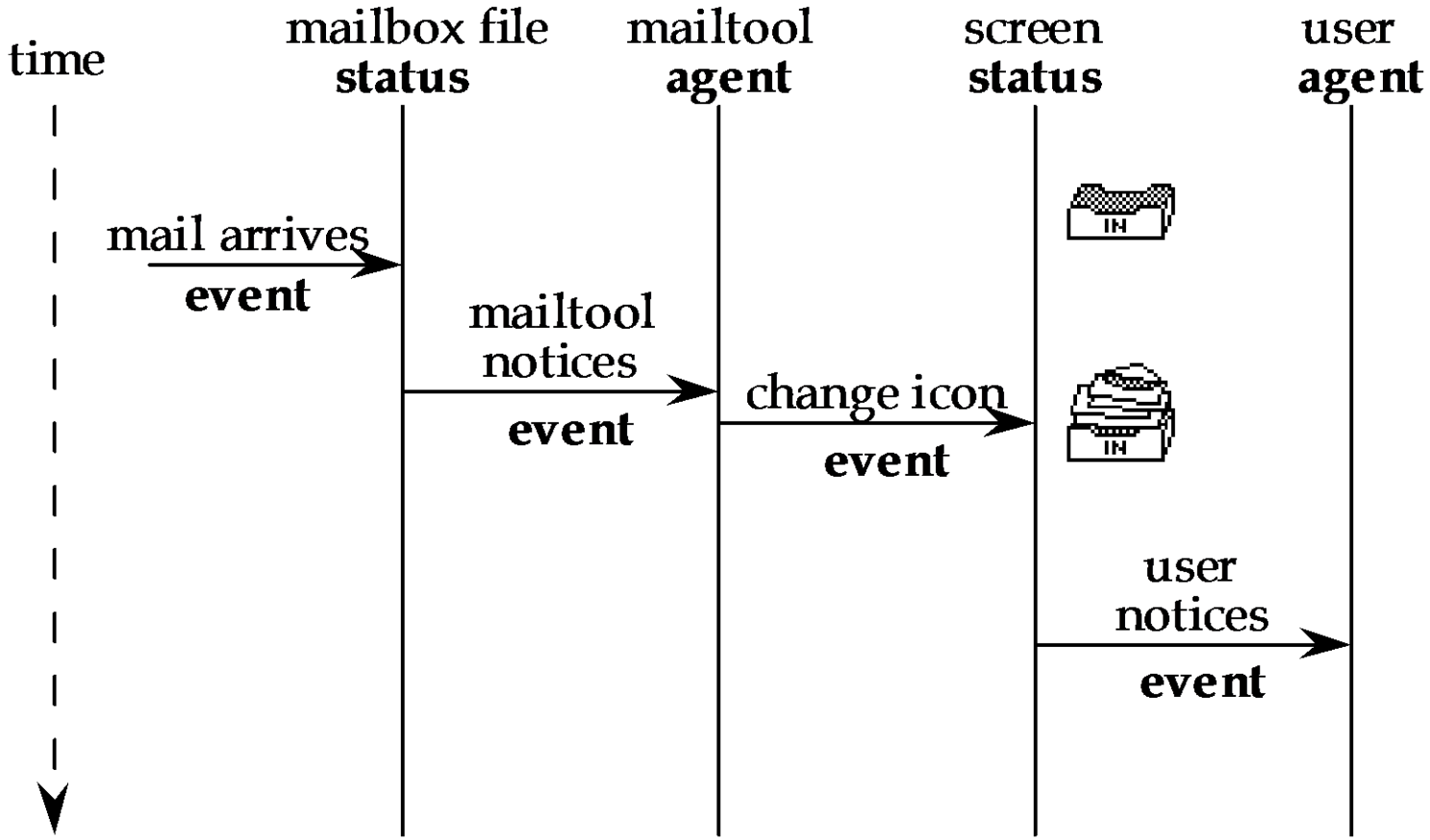
- too slow
  - response to event too late
    e.g., power plant emergency

- too fast
  - interrupt more immediate task
    e.g., stock level low

Naïve psychology

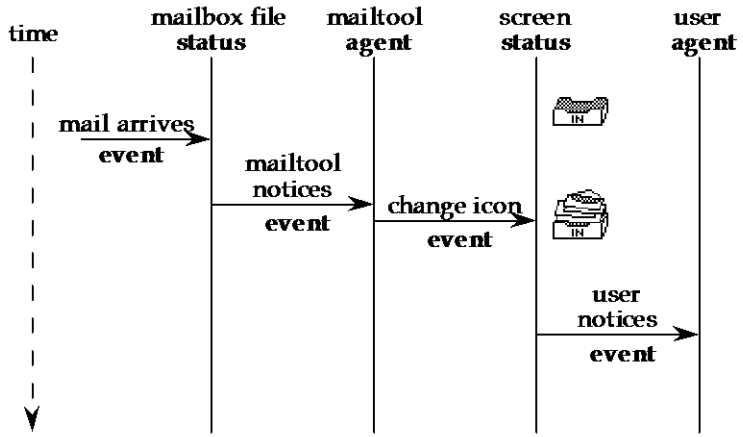
- Predict where the user is looking
  - mouse – when positioning
  - insertion point – intermittently when typing
  - screen – if you're lucky
- Immediate events
  - audible bell – when in room (and hearing)
  - peripheral vision – movement or large change
- Closure
  - lose attention (inc. mouse)
  - concurrent activity

email delivery



email delivery (ctd)

- mail has arrived!
- timeline at each level

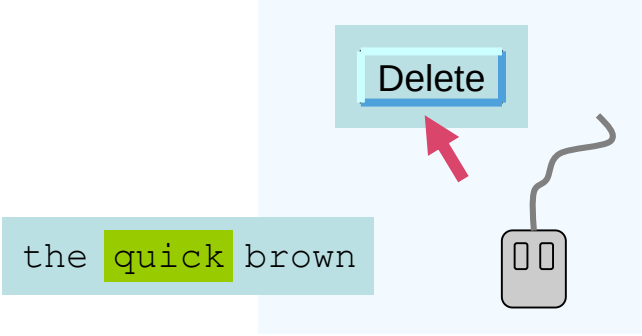


- Perceived event in minutes – not guaranteed

alternative		timescale
explicit examination	–	hours/days
audible bell	–	seconds

but want minutes – guaranteed

screen button widget



screen button often missed, …
but, error not noticed

a common widget, a common error: Why?

Closure

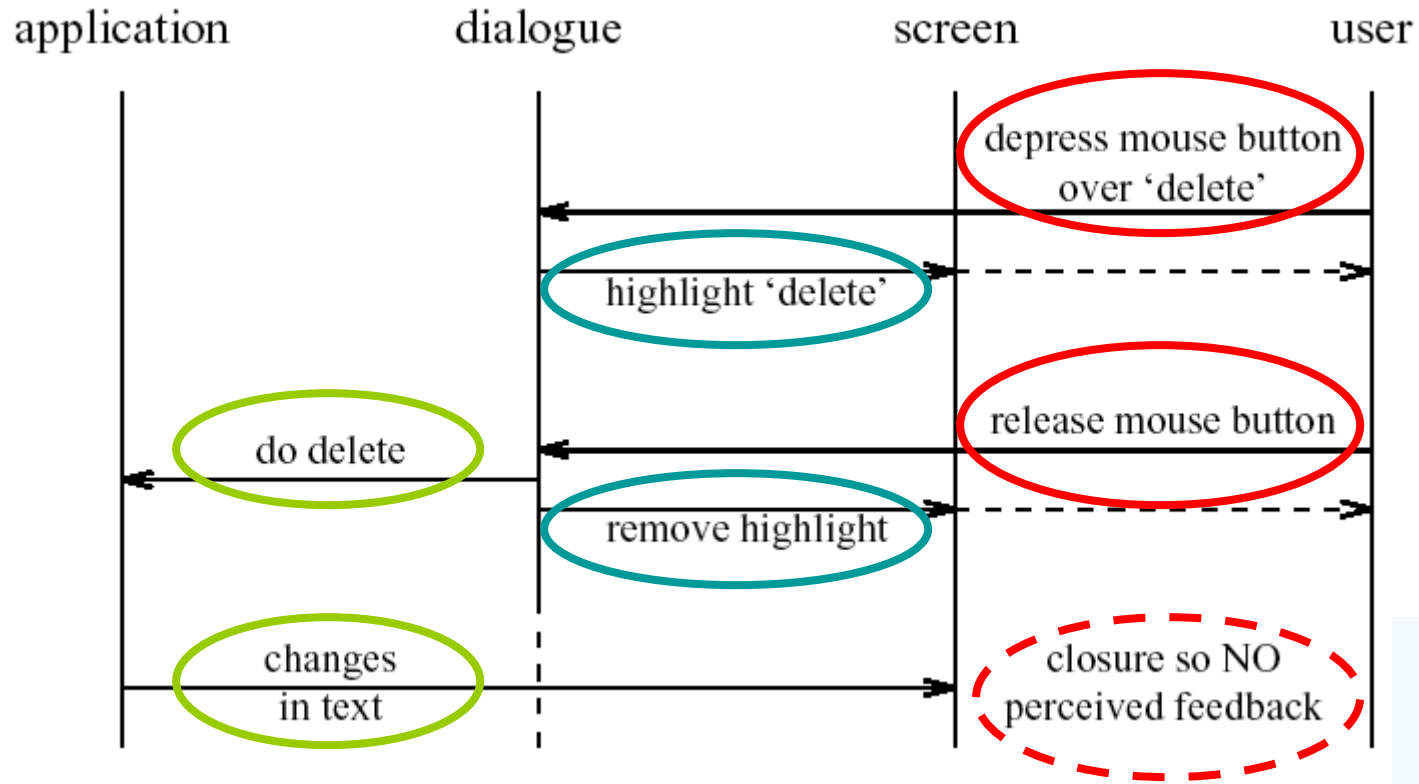
- mistake likely – concurrent action
- not noticed – semantic feedback missed

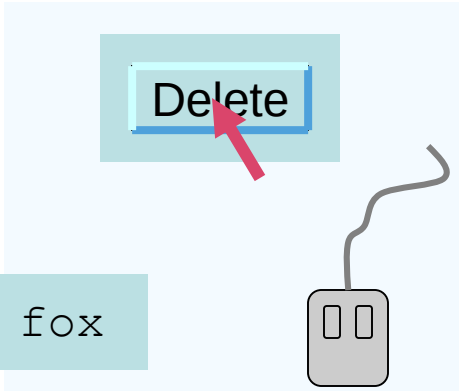
Solution

- widget feedback for application event
- a *perceived event* for the user

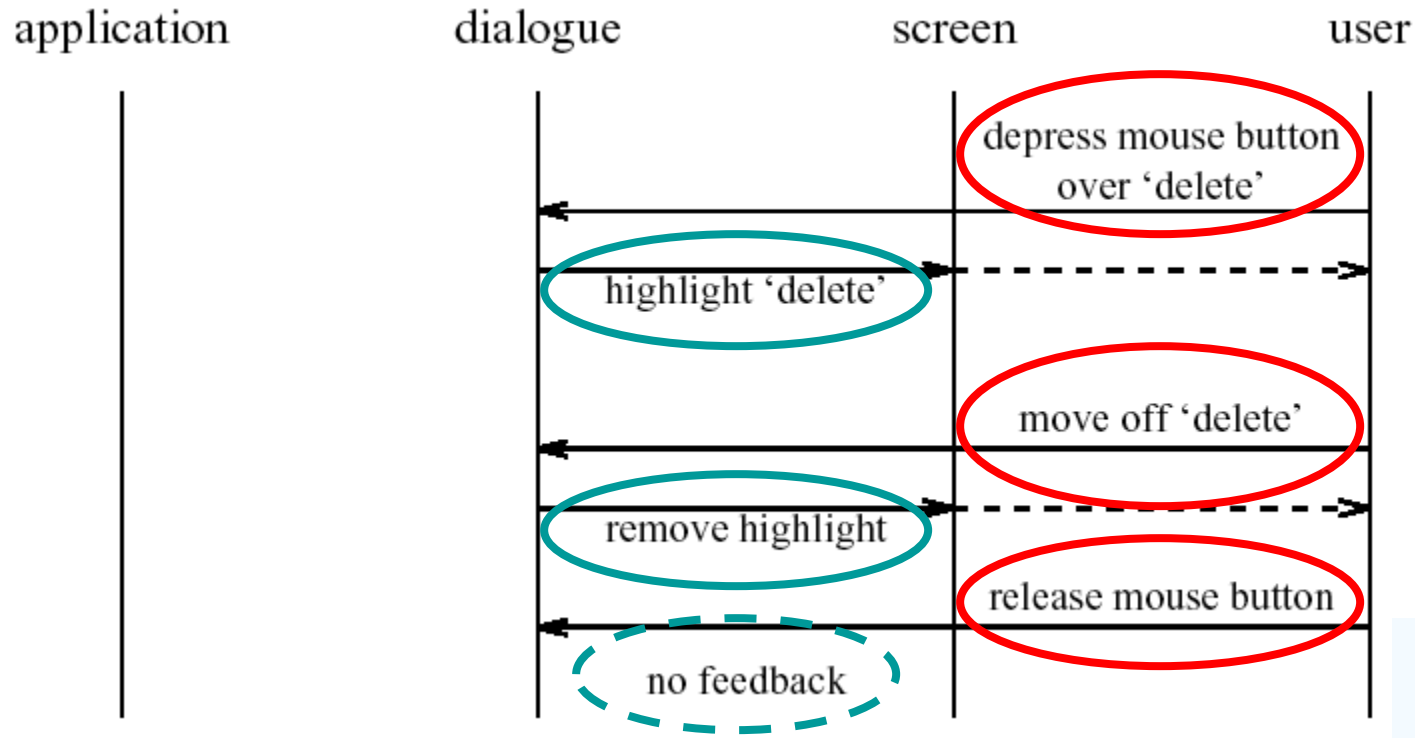
N.B. an expert slip – testing doesn't help

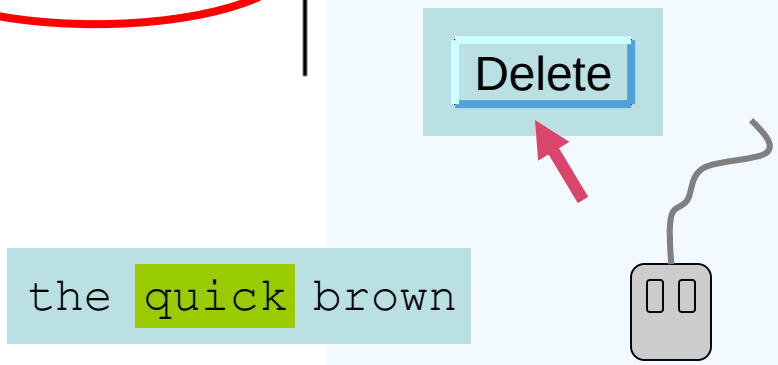
Screen-button – HIT



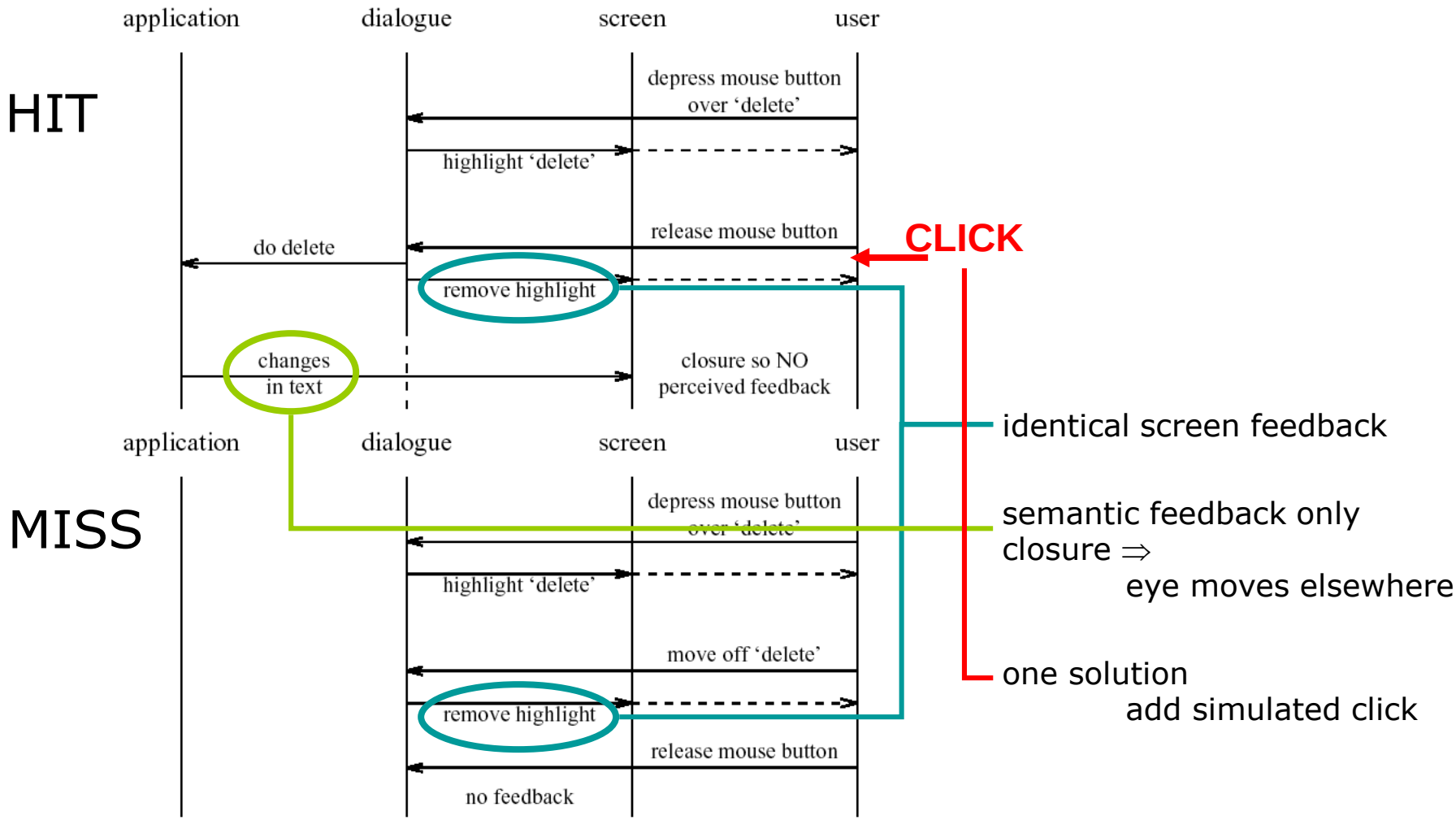


Screen button – MISS





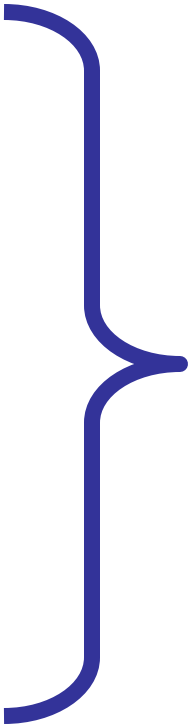
HIT or a MISS?


HIT
application
dialogue
screen
user
depress mouse button over 'delete'
highlight 'delete'
release mouse button
CLICK
do delete
remove highlight
changes in text
closure so NO perceived feedback
identical screen feedback
MISS
application
dialogue
screen
user
depress mouse button over 'delete'
semantic feedback only
closure ⇒
eye moves elsewhere
highlight 'delete'
move off 'delete'
remove highlight
release mouse button
one solution
add simulated click
no feedback

rich contexts

the problem

- task models
  - formal description
- situatedness
  - unique contexts
- ethnography
  - rich ecologies



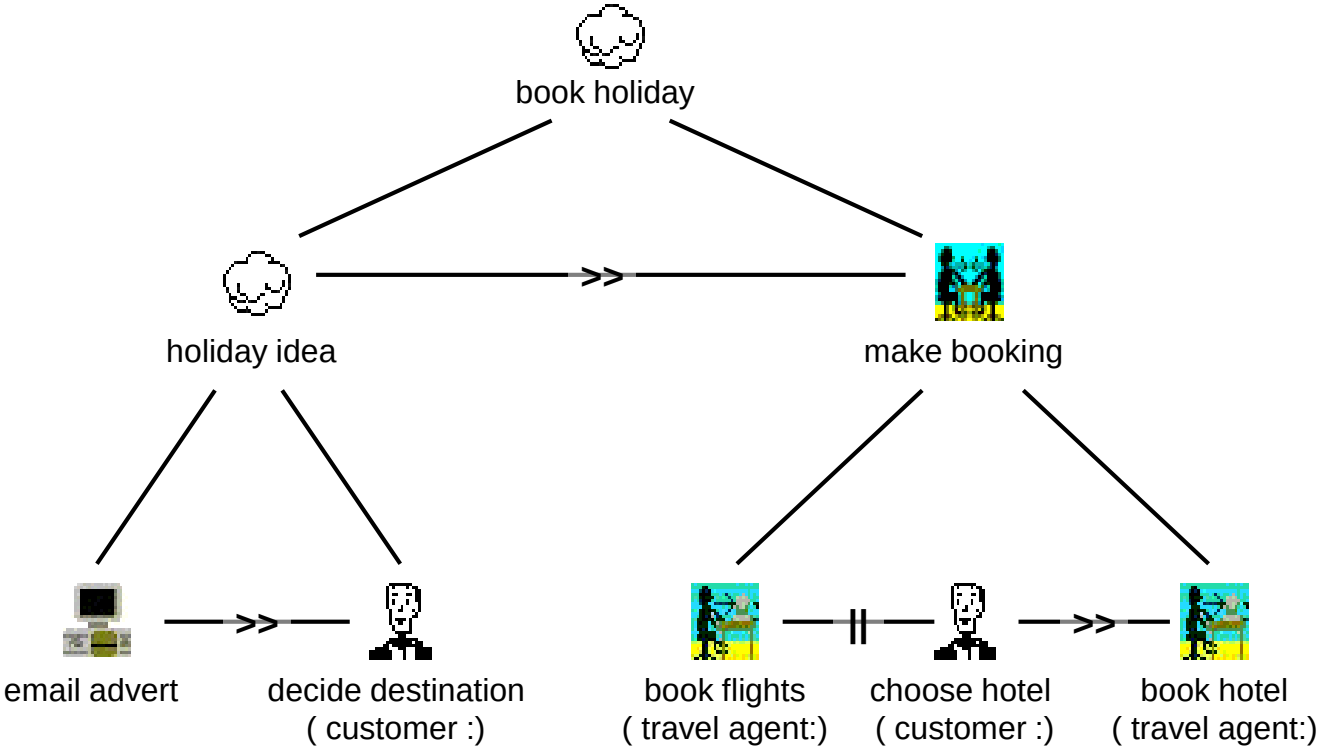
bringing them together?

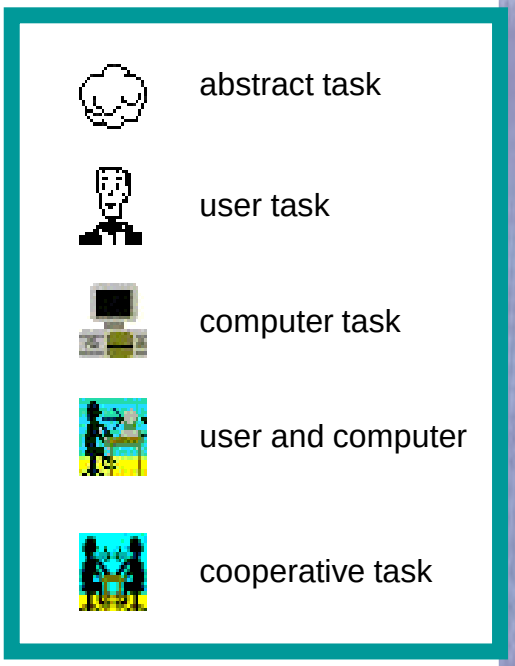
collaboration

- already in several notations
  - e.g. CTT, GTA
- add artefacts too ?

ConcurTaskTrees (CTT)

Paterno et al. CNUCE, Pisa





Groupware Task Analysis

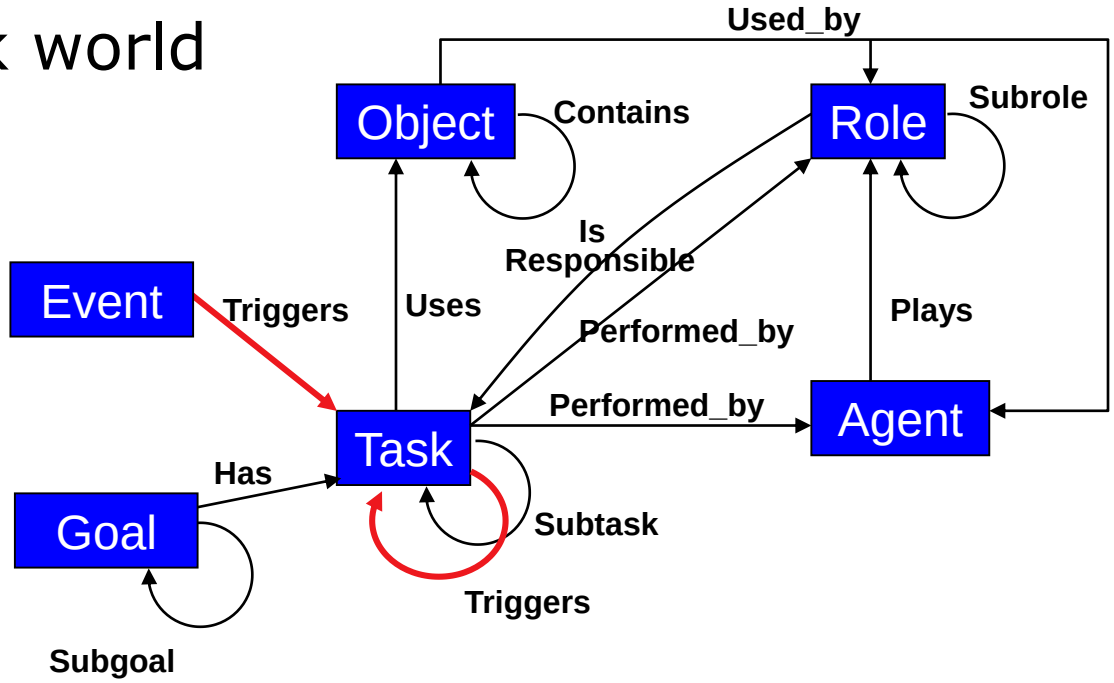
GTA

- conceptual framework, tools, elicitation techniques

rich model of task world

rich ontology

- human roles for collaboration
- physical and electronic objects



information

pre-planned cognitive model

goal ➲ action

situated action

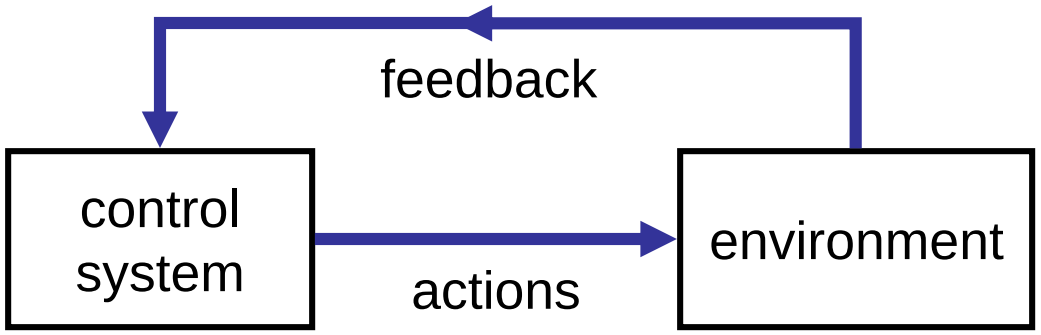
environment ➲ action

control

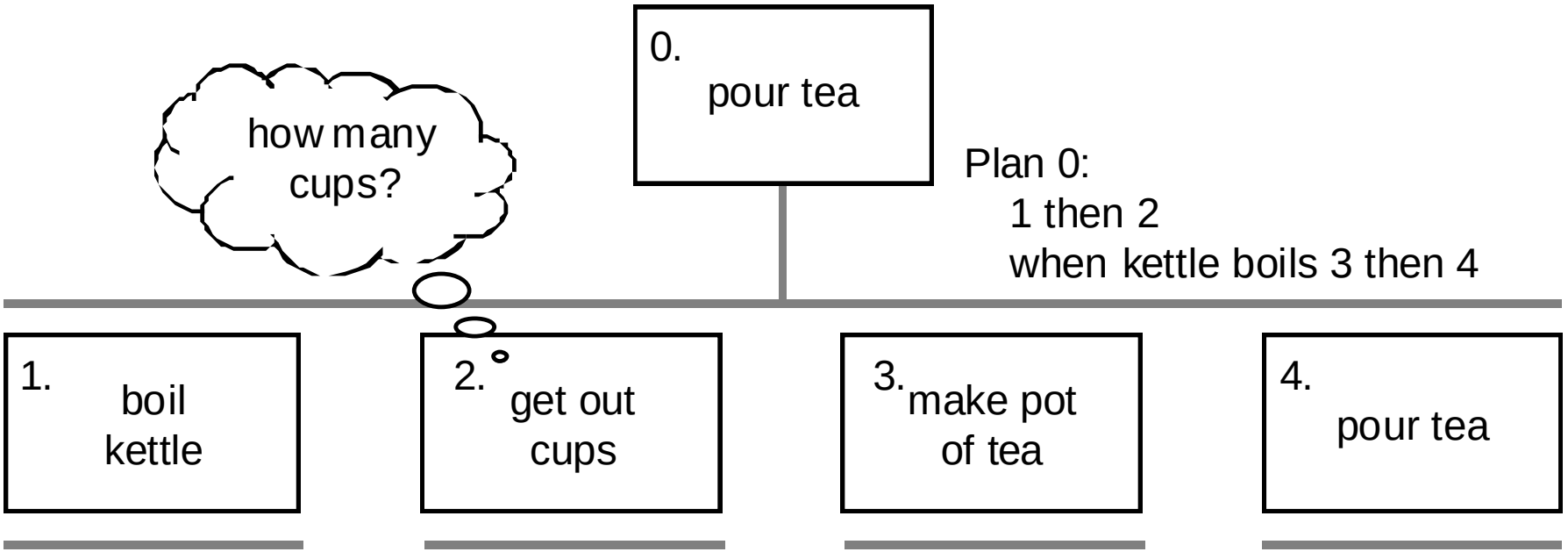
- open loop control
  - no feedback
  - fragile

control

- open loop control
  - no feedback
  - fragile
- closed loop control
  - uses feedback
  - robust



adding information



adding information (ctd)

information required when

- subtask involves input (or output)
- some kind of choice (how to know what to do)
- subtask repeated (but iterations unspecified)

sources of information

i. part of existing task (e.g. phone number entered)
ii. user remembers it (e.g. recall number after directory enquiry)
iii. on device display (e.g. PDA address book, then dial)
iv. in the environment
    - pre-existing (e.g. phone directory)
    - created in task (e.g. write number down on paper)

GUI easy (lots of space) mobile/PDA need to think

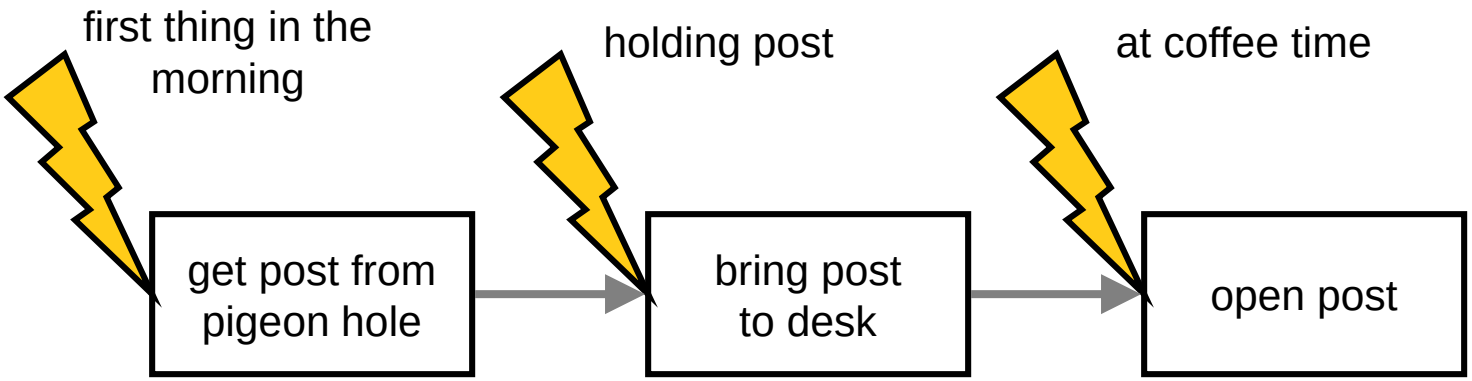
triggers

process – what happens and order

triggers

process – what happens and order

triggers – when and why

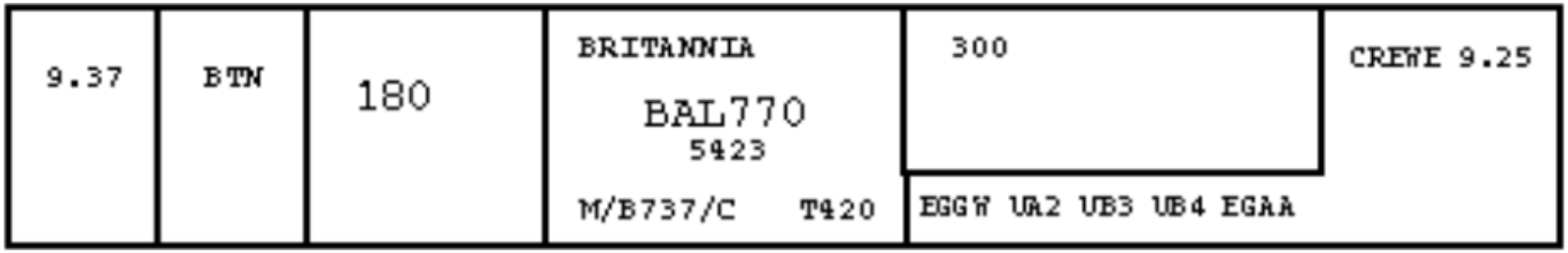


common triggers

- immediate
  - straight after previous task
- temporal
  - at a particular time
- sporadic
  - when someone thinks of it!
- external event
  - when something happens, e.g. phone call
- environmental cue
  - something prompts action … artefacts

artefacts

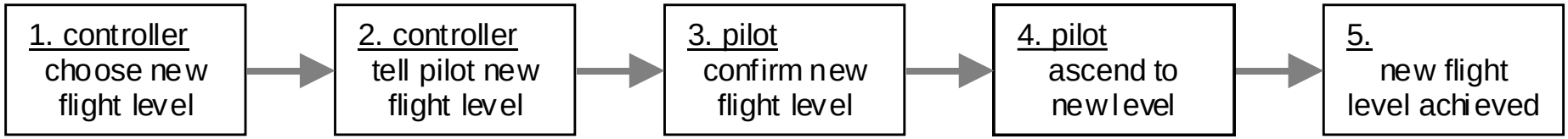
- ethnographic studies
- as shared representation
- as focus of activity
- act as triggers, information sources, etc.



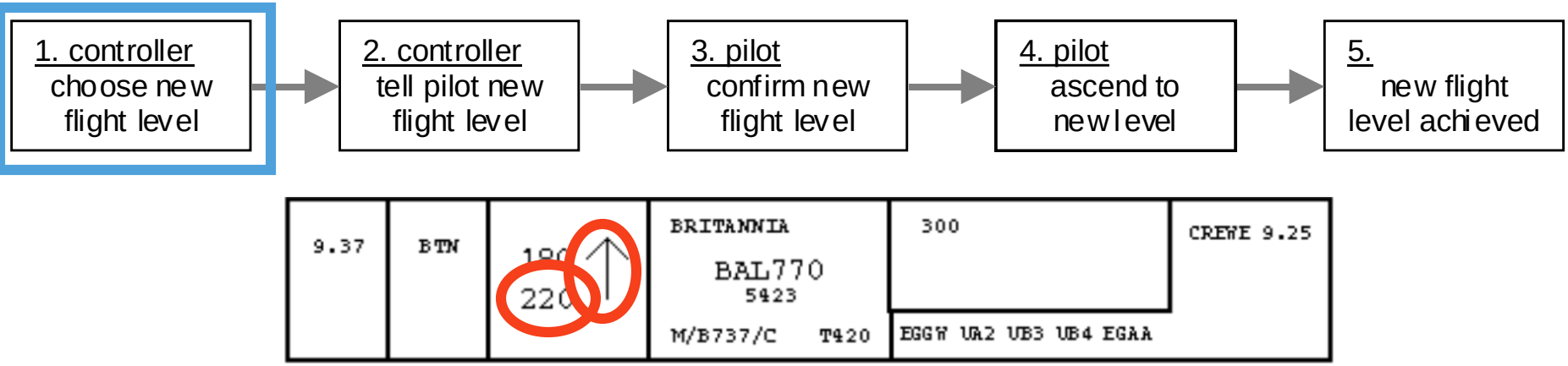
placeholders

- knowing where you are in a process
  - like a program counter
- coding:
  - memory
  - explicit (e.g. to do list)
  - in artefacts

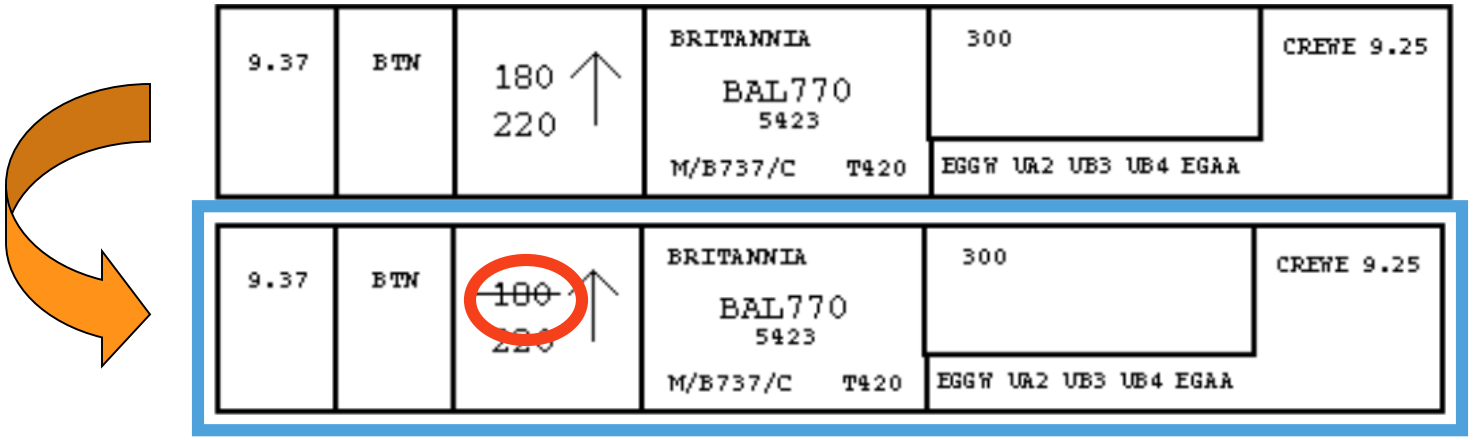
where are you?



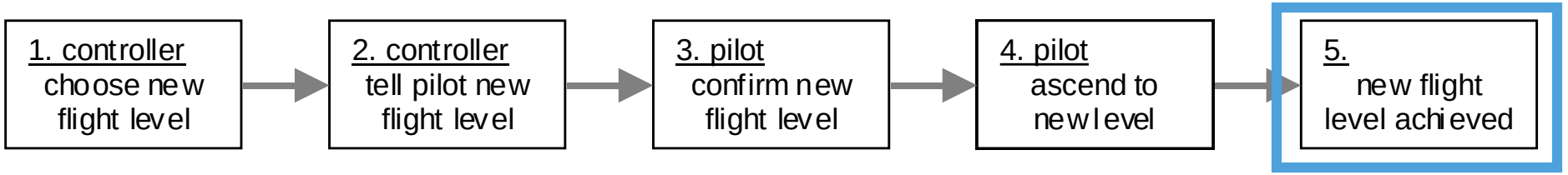
step 1. choose new flight level

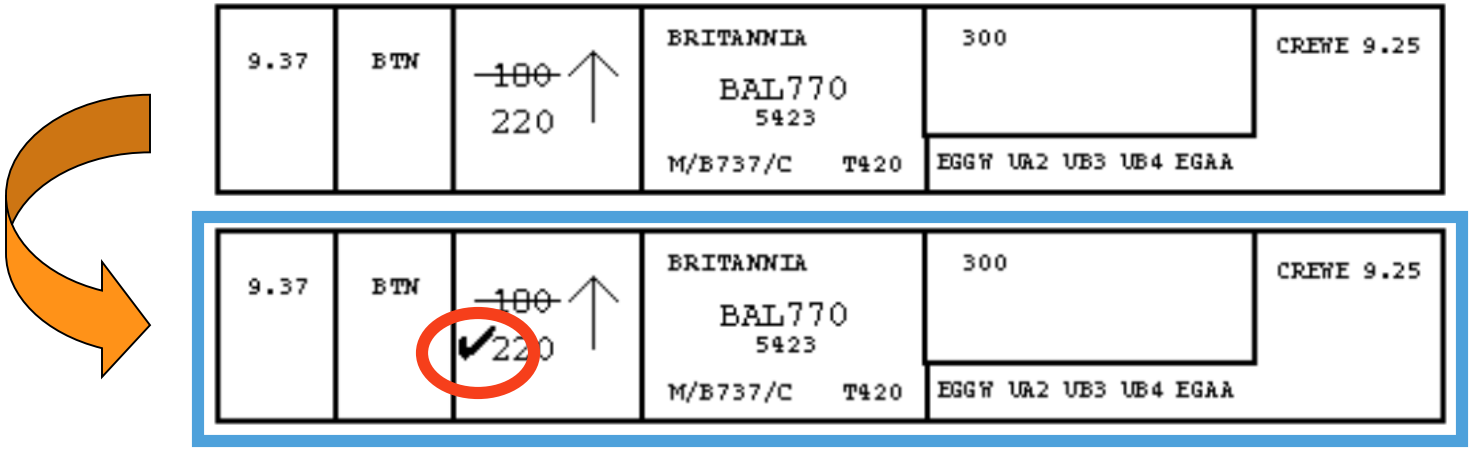


step 3. flight level confirmed



step 5. new flight level acheived





tracing placeholders

a form of information, may be …

- in people's heads
  - remembering what to do next
- explicitly in the environment
  - to-do lists, planning charts, flight strips, workflow
- implicitly in the environment
  - location and disposition of artefacts

electronic environments …

- fewer affordances for artefacts
- danger for careless design!

papers tidy or skewed
letter open or closed

low intention and sensor-based interaction

car courtesy lights

- turn on
  - when doors unlocked/open
- turned off
  - after time period
  - when engine turned on

driver's *purpose* is to get into the car

incidentally the lights come on

Pepys

- Xerox Cambridge (RIP)
- active badges
- automatic diaries

Allan's *purpose* to visit Paul's office

incidentally diary entry created

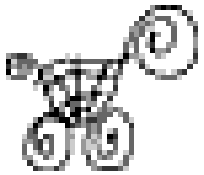
MediaCup

- cup has sensors
  - heat, movement, pressure
- broadcasts state (IR)
- used for awareness
  - user is moving, drinking, …

Han's *purpose* to drink coffee

incidentally colleagues are aware

shopping cart



- goods in shopping cart analysed
  - e.g. Amazon books
- used to build knowledge about books
  - people who like X also like Y
- used to give you suggestions
  - "you might like to look at …", "special offer …"

my *purpose* to buy a book

incidentally shown related titles

onCue

- 'intelligent' toolbar
  - appropriate intelligence
    - make it good when it works
    - don't make it hard of it doesn't
- analyses clipboard contents
- suggests things to do with it

user's *purpose* to copy text elsewhere

incidentally alternative things to do

the intentional spectrum

intentional — press light switch

expected — walk into room expecting lights to switch on

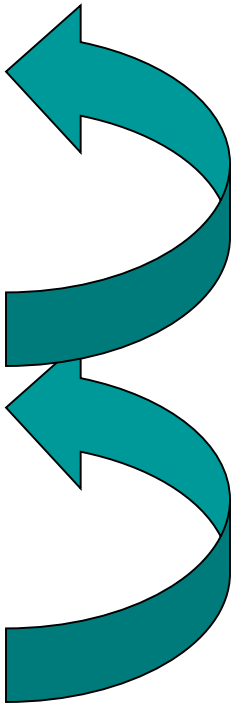
incidental — walk into room … unbeknown to you
… air conditioning increases

fluidity

intentional

expected

incidental



co-option

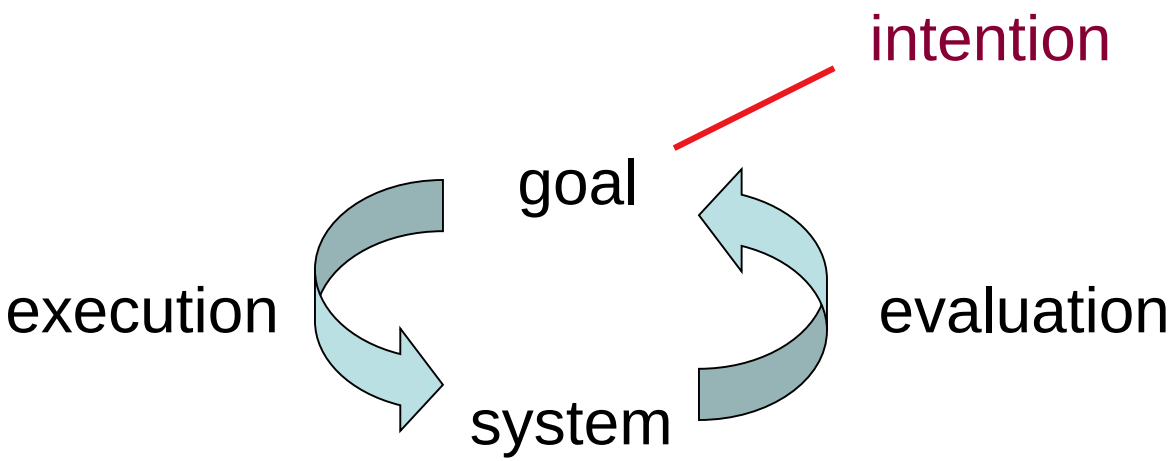
users explicitly use behaviour
e.g. open door for lights

comprehension

users notice, form model
then rely on behaviour

interaction models

- intentional cycle
  - Norman execution/evaluation loop
- some exceptions
  - multiple goals, displays, opportunistic
- guidelines
  - feedback, transparency



cognition

- physical things (inanimate)
  - directness of effect
  - locality of effect
  - visibility of state
- computational things (also animate)
  - complex effects
  - non locality of effect

    distance – networks; time – delays, memory
  - large hidden state

cognition

- understanding
  - innate intelligences
    - physical, natural/animal, social, physiological
  - rational thought
  - imagination
- interfaces
  - GUI, VR, AR, tangible
    - recruit physical/tangible intelligence
  - ubicomp, ambient, incidental
    - ? ? ?

homunculi, haunted houses

designing incidental interaction

- need richer representations
  - of the world, of devices, of artefacts
  - wider ecological concerns

- two tasks
  - purposeful task – for interpretation
  - supported task – for actions

issues and process

- no accepted methods but … general pattern
- uncertainty
  - traditional system due to errors
  - sensor-based intrinsic to design
    - uncertain readings, uncertain inference
    - usually control non-critical aspects of environment
- process … identify
  - input – what is going to be sensed
  - output – what is going to be controlled
  - scenarios – desired output and available input

designing a car courtesy light

- available input
  - –door open, car engine
- desired output
  - –light!
- identify scenario
- label steps
  - 0 don't care
  - +, ++, … want light
  - –, ––, … don't want it
- legal requirements
  - light off whilst driving
- safety
  - approaching car??

1.	deactivate alarm	0
2.	walk up to car	
3.	key in door	–
4.	open door & take key	+
5.	get in	++
6.	close door	0
7.	adjust seat	+
8.	find road map	++
9.	look up route	+++
10.	find right key	+
11.	key in ignition	–
12.	start car	0
13.	seat belt light flashes	0
14.	fasten seat belt	+
15.	drive off	–––––

safe? light advertises presence

illegal to drive with interior light on

implementation

- sensors not used for original purpose
  - open architectures, self-discovering, self-configuring
- privacy
  - internet–enables kettle broadcasts to the world!
- context
  - inferring activity from sensor readings – status not event
- data filtering and fusion
  - using several sensors to build context
- inference
  - hand-coded or machine-learning
- must be used
  - control something (lights) or modify user actions (TV on)

architectures for sensor-based systems?