



HUMAN-COMPUTER INTERACTION

THIRD
EDITION

DIX
FINLAY
ABOWD
BEALE

chapter 16

dialogue notations and design

Dialogue Notations and Design

- Dialogue Notations
 - Diagrammatic
 - state transition networks, JSD diagrams, flow charts
 - Textual
 - formal grammars, production rules, CSP
- Dialogue linked to
 - the semantics of the system – what it does
 - the presentation of the system – how it looks
- Formal descriptions can be analysed
 - for inconsistent actions
 - for difficult to reverse actions
 - for missing actions
 - for potential miskeying errors

what is dialogue?

- conversation between two or more parties
 - usually cooperative
- in user interfaces
 - refers to the *structure* of the interaction
 - syntactic level of human–computer ‘conversation’
- levels
 - lexical – shape of icons, actual keys pressed
 - syntactic – order of inputs and outputs
 - semantic – effect on internal application/data

structured human dialogue

- human-computer dialogue very constrained
- some human-human dialogue formal too ...

Minister: do you *man's name* take this woman ...

Man: I do

Minister: do you *woman's name* take this man ...

Woman: I do

Man: With this ring I thee wed

(places ring on womans finger)

Woman: With this ring I thee wed *(places ring ..)*

Minister: I now pronounce you man and wife

lessons about dialogue

- wedding service
 - sort of script for three parties
 - specifies order
 - some contributions fixed – “I do”
 - others variable – “do you *man’s name* ...”
 - instructions for ring
concurrent with saying words “with this ring ...”
- if you say these words are you married?
 - only if in the right place, with marriage licence
 - syntax not semantics

... and more

- what if woman says "I don't"?
- real dialogues often have alternatives:

Judge: How do you plead guilty or not guilty?

Defendant: *either* Guilty *or* Not guilty

- the process of the trial depends on the defendants response
- focus on normative responses
 - doesn't cope with judge saying "off with her head"
 - or in computer dialogue user standing on keyboard!

dialogue design notations

- dialogue gets buried in the program
- in a big system can we:
 - analyse the dialogue:
 - can the user always get to see current shopping basket
 - change platforms (e.g. Windows/Mac)
 - dialogue notations helps us to
 - analyse systems
 - separate lexical from semantoc
- ... and before the system is built
 - notations help us understand proposed designs

graphical notations

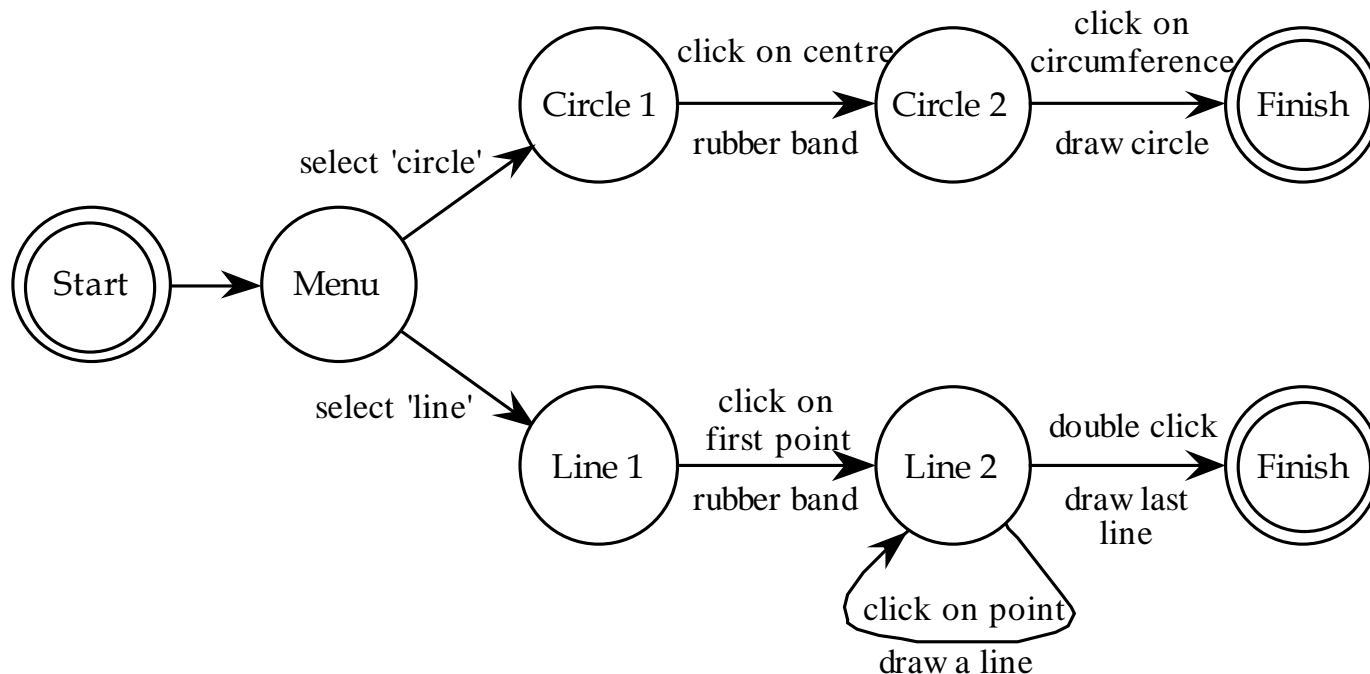
state-transition nets (STN)

Petri nets, state charts

flow charts, JSD diagrams

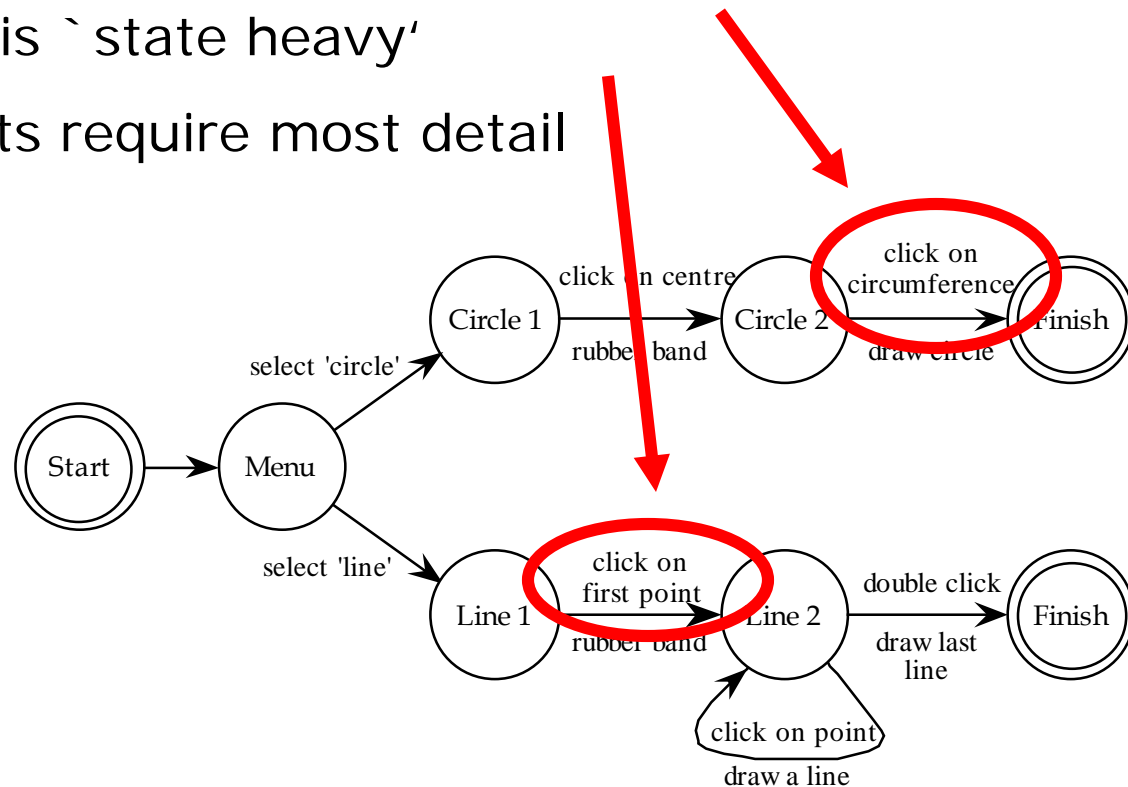
State transition networks (STN)

- circles - states
- arcs - actions/events



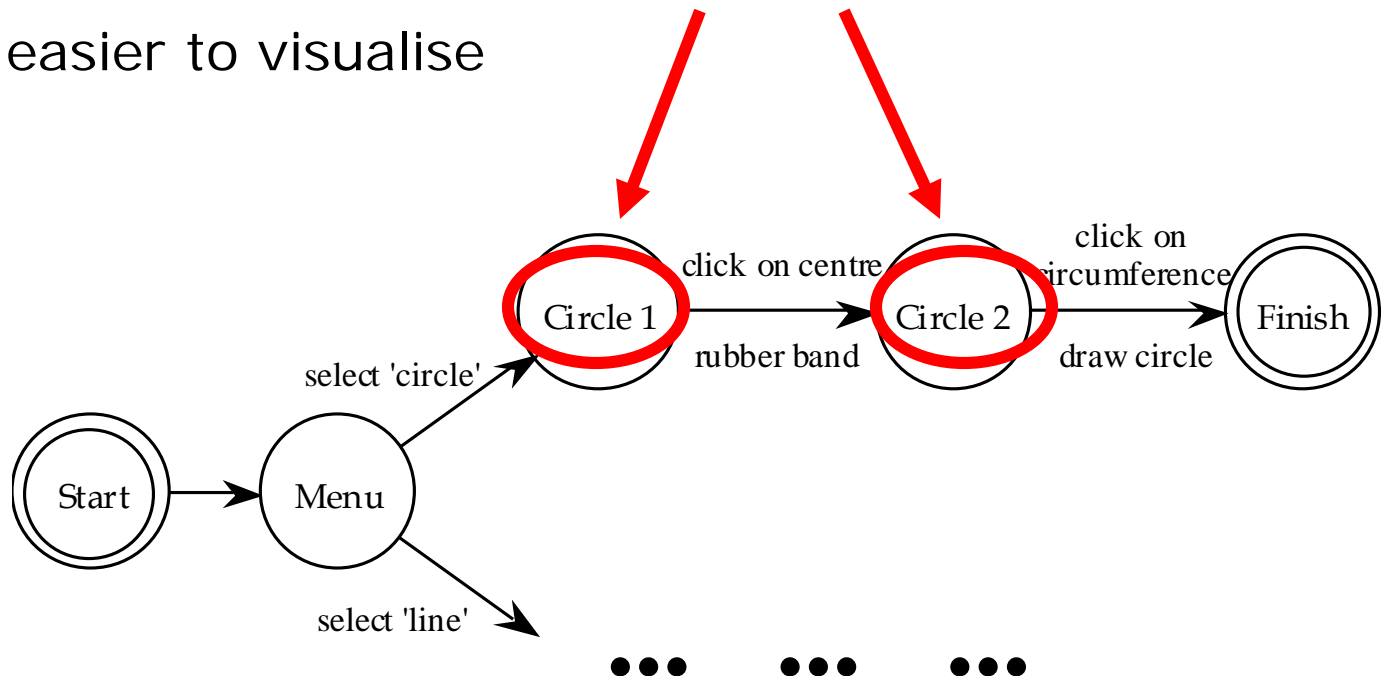
State transition networks - events

- arc labels a bit cramped because:
 - notation is 'state heavy'
 - the events require most detail



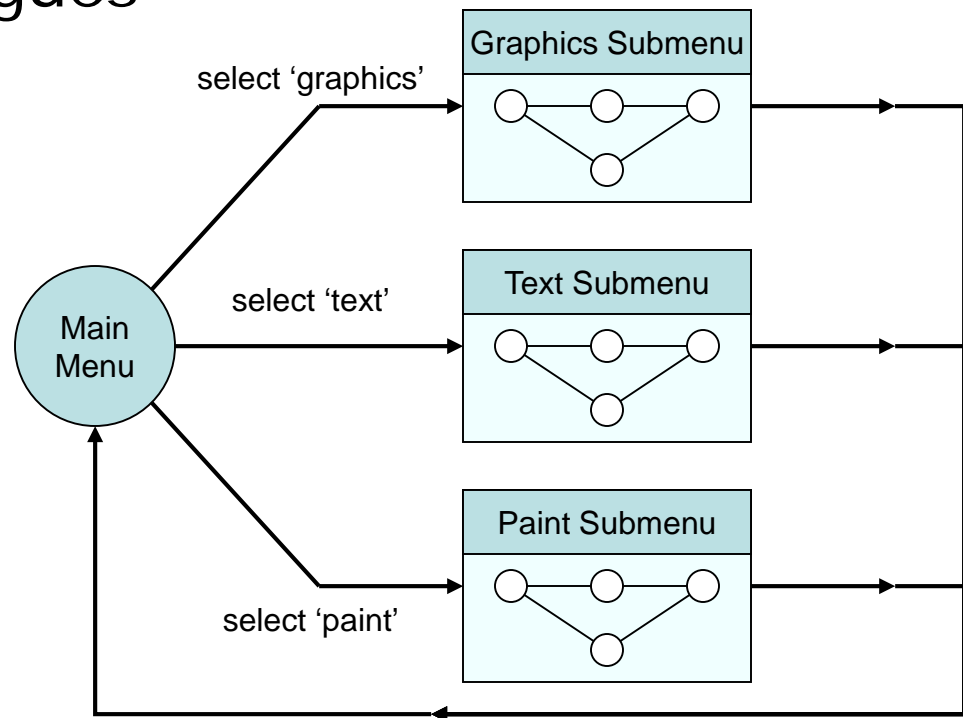
State transition networks - states

- labels in circles a bit uninformative:
 - states are hard to name
 - but easier to visualise



Hierarchical STNs

- managing complex dialogues
- named sub-dialogues



Concurrent dialogues - I

simple dialogue box

Text Style

☐ **bold**

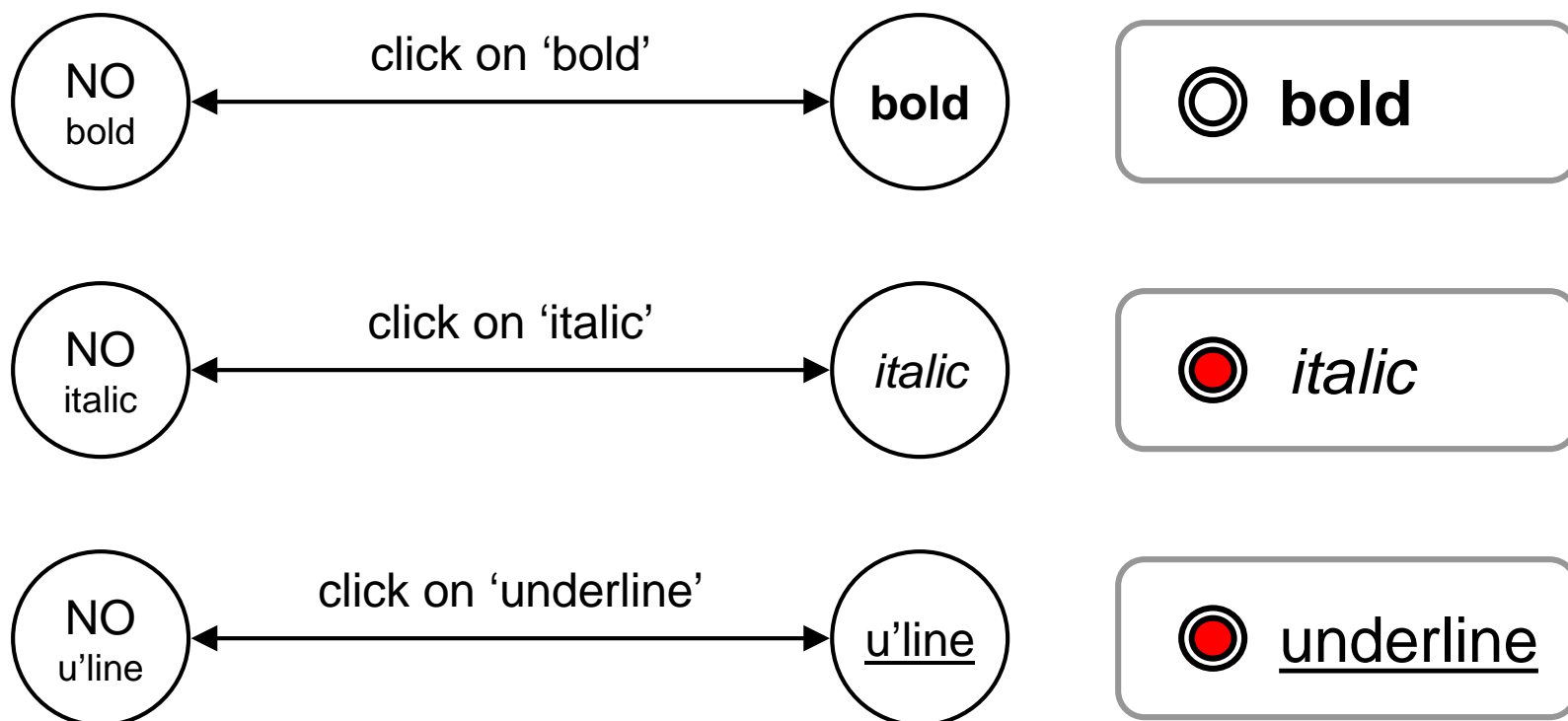
example

☒ *italic*

☒ underline

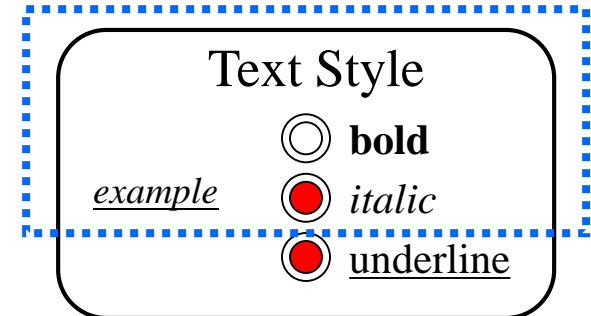
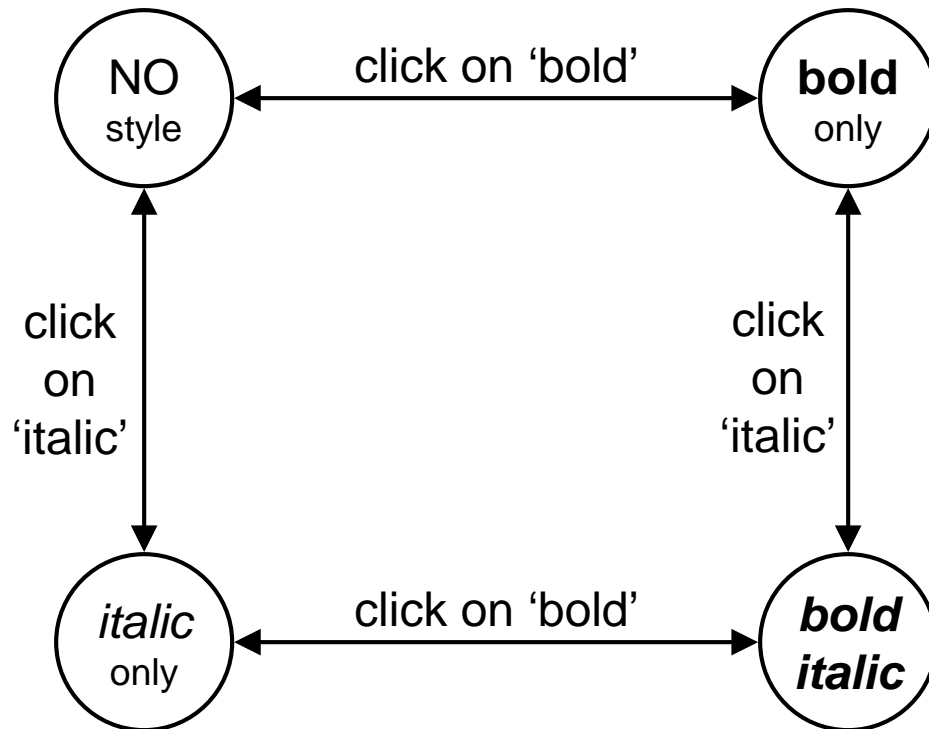
Concurrent dialogues - II

three toggles - individual STNs



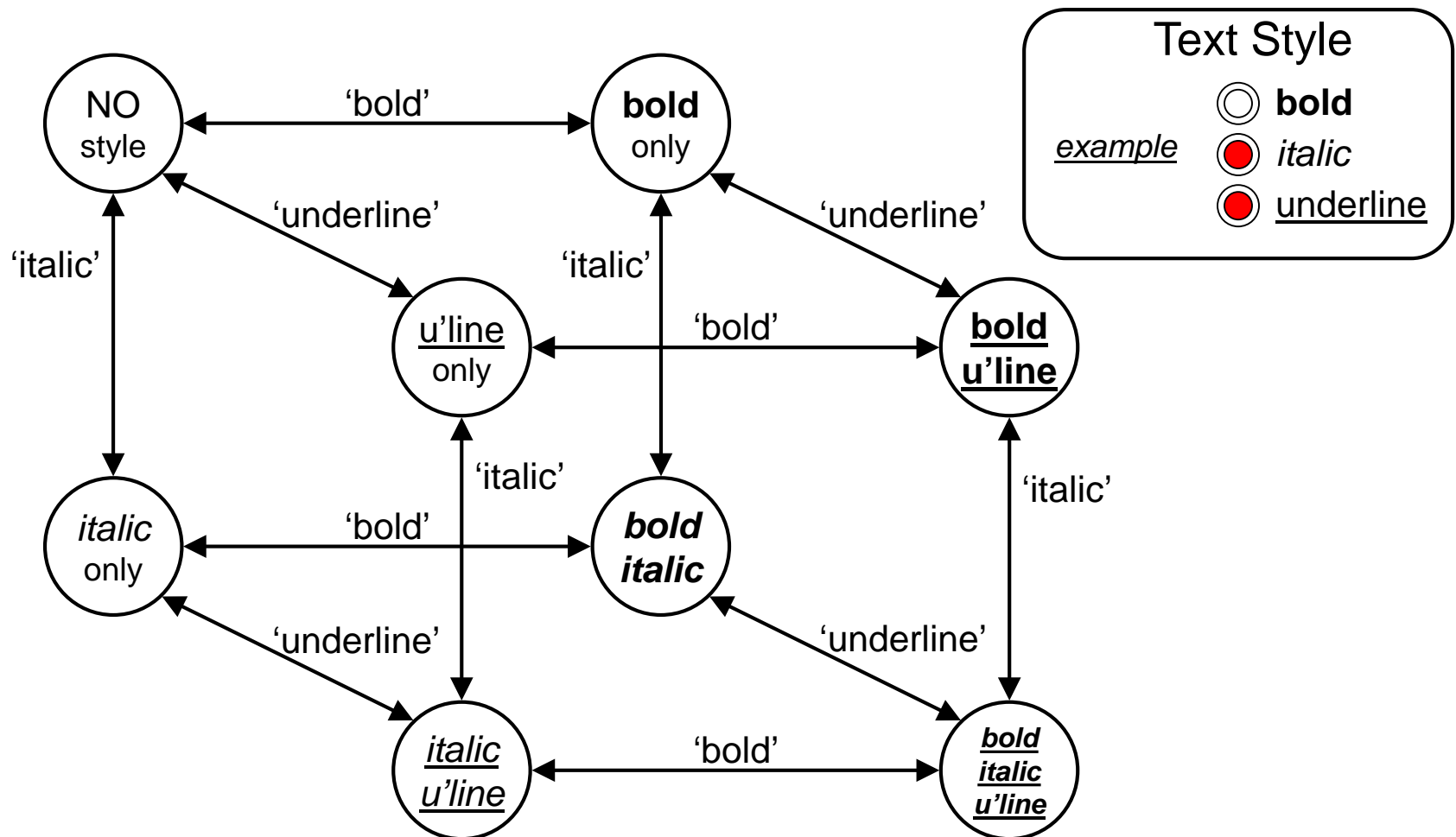
Concurrent dialogues - III

bold and italic combined



Concurrent dialogues - IV

all together - combinatorial explosion



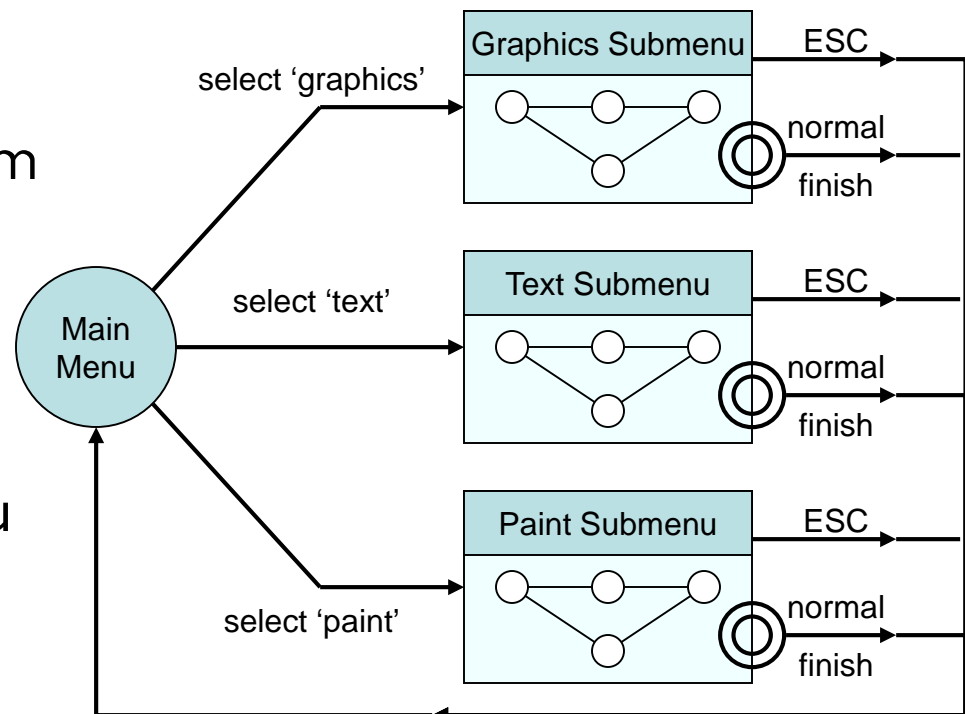
escapes

- 'back' in web, escape/cancel keys
 - similar behaviour everywhere
 - end up with spaghetti of identical behaviours
- try to avoid this

e.g. on high level diagram

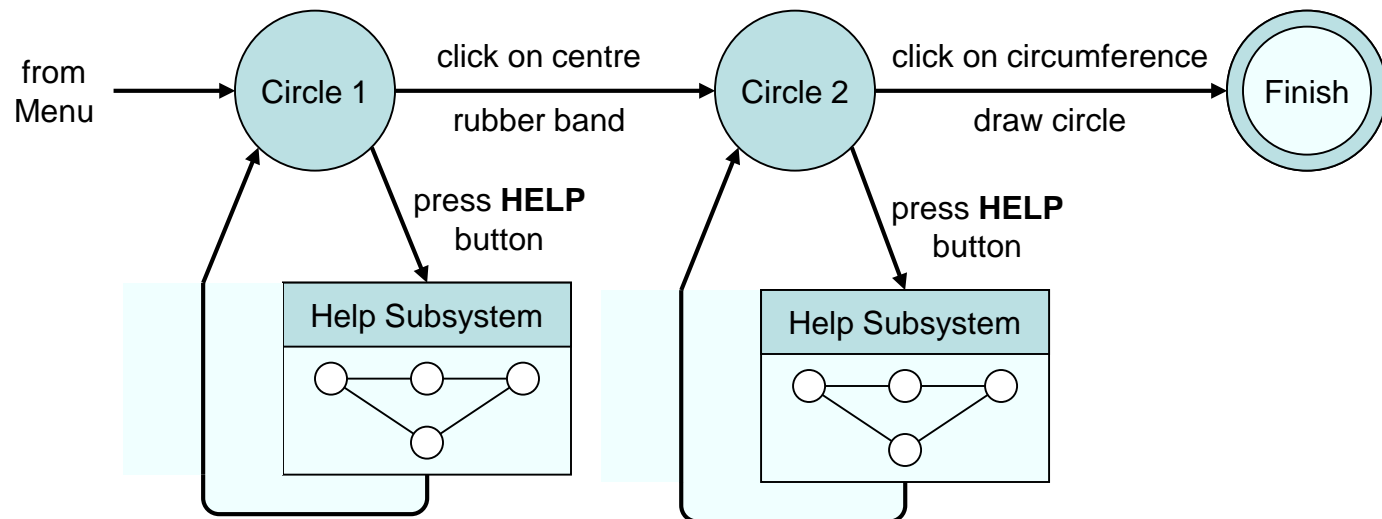
'normal' exit for
each submenu

plus separate
escape arc active
'everywhere' in submenu



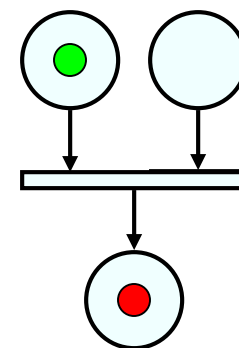
help menus

- similar problems
 - nearly the same everywhere
 - but return to same point in dialogue
 - could specify on STN ... but very messy
 - usually best added at a 'meta' level

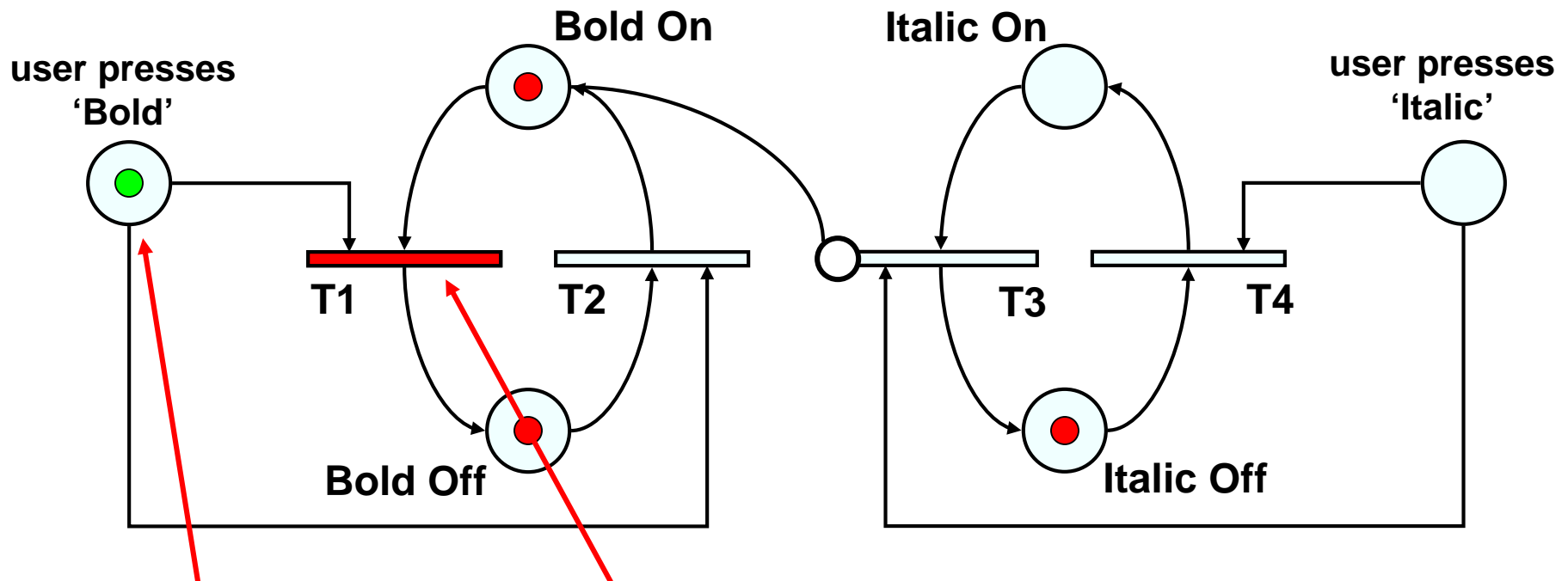


Petri nets

- one of the oldest notations in computing!
- flow graph:
 - places
 - transitions
 - counters
- several counters allowed
 - concurrent dialogue states
- used for UI specification (ICO at Toulouse)
 - tool support – Petshop



Petri net example

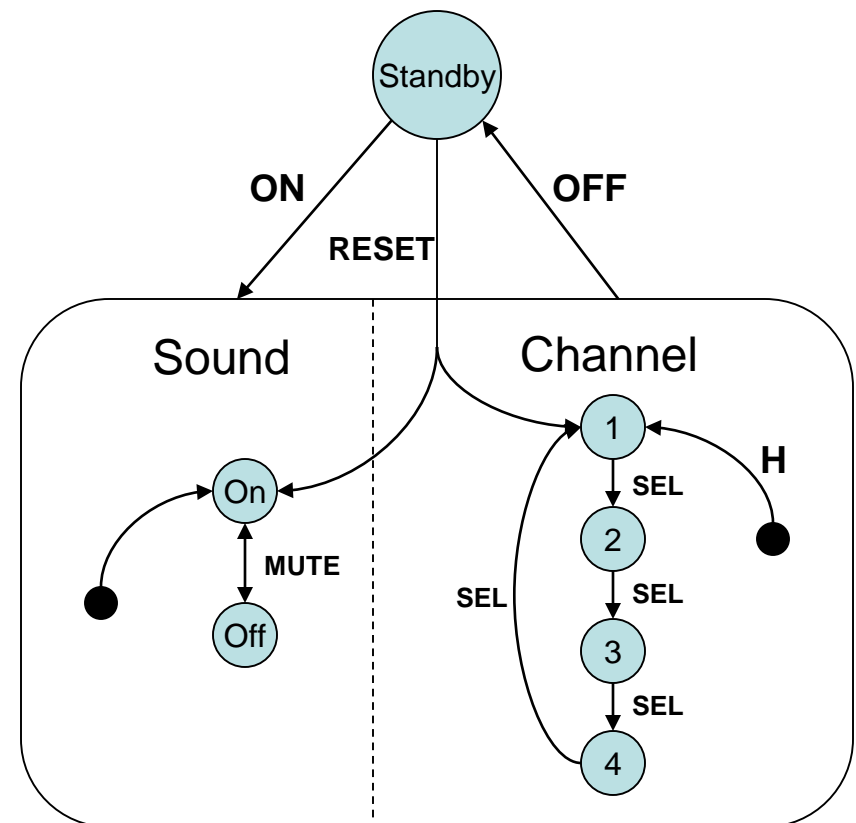


user actions
represented
as a new counter

transition 'fires'
when all input
places have counters

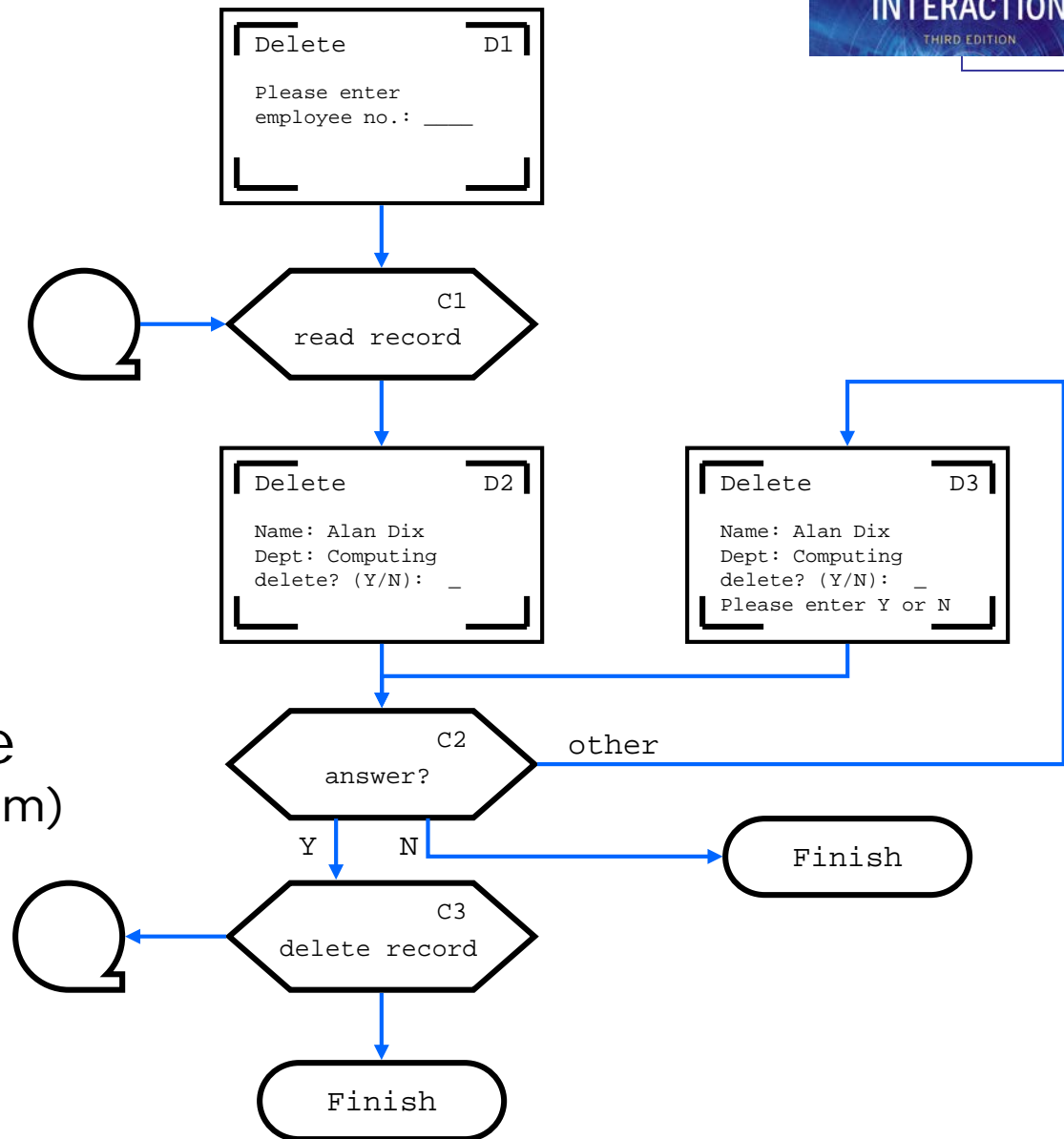
State charts

- used in UML
- extension to STN
 - hierarchy
 - concurrent sub-nets
 - escapes
 - OFF always active
 - history
 - link marked H goes back to last state on re-entering subdialogue



Flowcharts

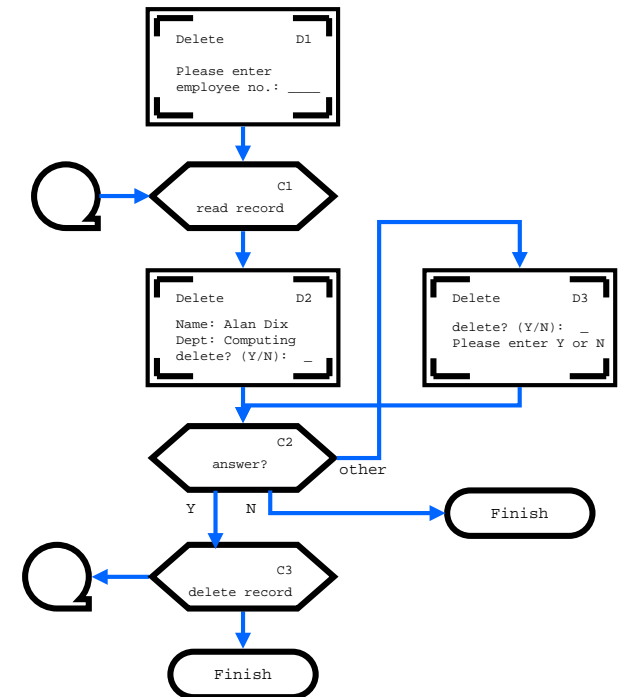
- familiar to programmers
- boxes
 - process/event
 - not state
- use for dialogue (not internal algorithm)





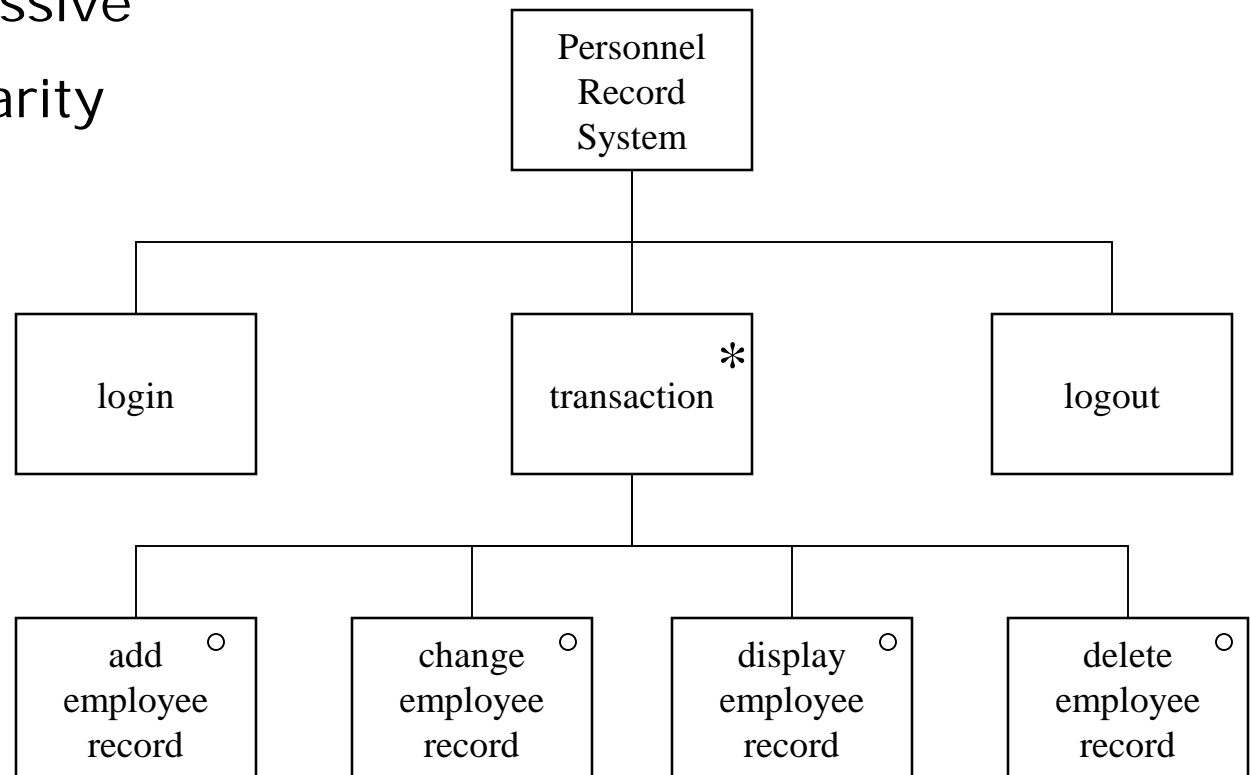
it works!

- formal notations – too much work?
- COBOL transaction processing
 - event-driven – like web interfaces
 - programs structure
≠ dialogue structure
- used dialogue flow charts
 - discuss with clients
 - transform to code
 - systematic testing
 - 1000% productivity gain
- formalism saves time!!



JSD diagrams

- for tree structured dialogues
 - less expressive
 - greater clarity



textual notations

grammars
production rules
CSP and event algebras

Textual - Grammars

- Regular expressions

`sel-line click click* dble-click`

- compare with JSD

- same computational model
- different notation

- BNF

```
expr ::= empty
      | atom expr
      | '(' expr ')' expr
```

- more powerful than regular exp. or STNs
- Still NO concurrent dialogue

Production rules

- Unordered list of rules:

if condition then action

- condition based on state or pending events
 - every rule always potentially active
- Good for concurrency
 - Bad for sequence

Event based production rules

Sel-line \rightarrow first

C-point first \rightarrow rest

C-point rest \rightarrow rest

D-point rest \rightarrow < draw line >

- Note:
 - events added to list of pending events
 - 'first' and 'rest' are internally generated events
- Bad at state!

Prepositional Production System

- State based
- Attributes:
 - Mouse: { mouse-off, select-line, click-point, double-click }
 - Line-state: { menu, first, rest }
- Rules (feedback not shown):
 - select-line → mouse-off first
 - click-point first → mouse-off rest
 - click-point rest → mouse-off
 - double-click rest → mouse-off menu
- Bad at events!

CSP and process algebras

- used in Alexander's SPI, and Agent notation
- good for sequential dialogues

Bold-tog = select-bold? → bold-on → select-bold? →
bold-off → Bold-tog

Italic-tog = . . .

Under-tog = . . .

- and concurrent dialogue

Dialogue-box = Bold-tog || Italic-tog || Under-tog

- but causality unclear

Dialogue Notations - Summary

- Diagrammatic
 - STN, JSD, Flow charts
- Textual
 - grammars, production rules, CSP
- Issues
 - event base vs. state based
 - power vs. clarity
 - model vs. notation
 - sequential vs. concurrent

Semantics Alexander SPI (i)

- Two part specication:
 - EventCSP - pure dialogue order
 - EventISL - target dependent semantics
- dialogue description - centralised
- syntactic/semantic trade-off - tollerable

Semantics Alexander SPI (ii)

- EventCSP

```
Login = login-mess -> get-name -> Passwd  
Passwd = passwd-mess -> (invalid -> Login [] valid -> Session)
```

- EventISL

```
event: login-mess  
  prompt: true  
  out: "Login:"  
event: get-name  
  uses: input  
  set: user-id = input  
event: valid  
  uses: input, user-id, passwd-db  
  wgen: passwd-id = passwd-db(user-id)
```

Semantics - raw code

- event loop for word processor
- dialogue description
 - very distributed
- syntactic/semantic trade-off
 - terrible!

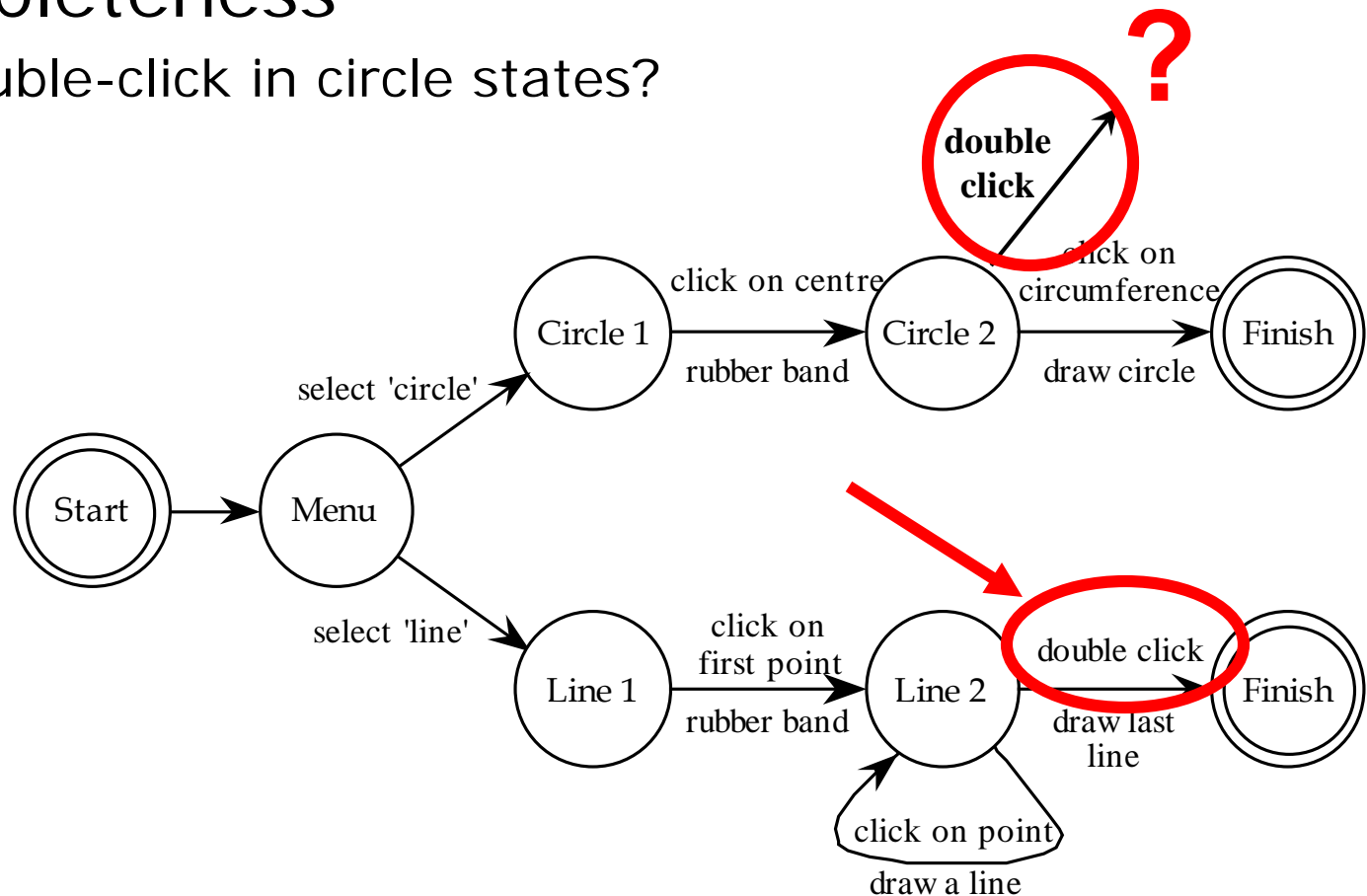
```
switch ( ev.type ) {  
    case button_down:  
        if ( in_text ( ev.pos ) ) {  
            mode = selecting;  
            mark_selection_start(ev.pos);  
        }  
        ...  
    case button_up:  
        if ( in_text ( ev.pos )  
            && mode == selecting ) {  
            mode = normal;  
            mark_selection_end(ev.pos);  
        }  
        ...  
    case mouse_move:  
        if (mode == selecting ) {  
            extend_selection(ev.pos);  
        }  
        ...  
} /* end of switch */
```

Action properties

- completeness
 - missed arcs
 - unforeseen circumstances
- determinism
 - several arcs for one action
 - deliberate: application decision
 - accident: production rules
- nested escapes
- consistency
 - same action, same effect?
 - modes and visibility

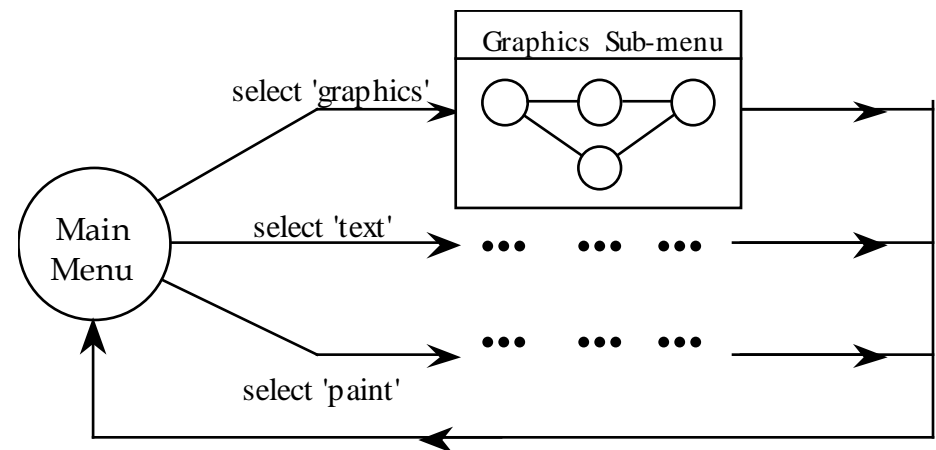
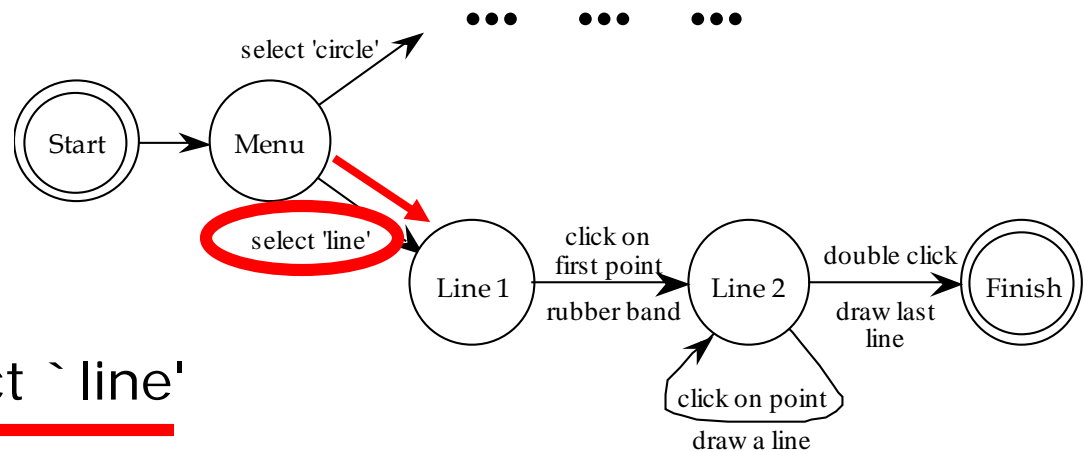
Checking properties (i)

- completeness
 - double-click in circle states?



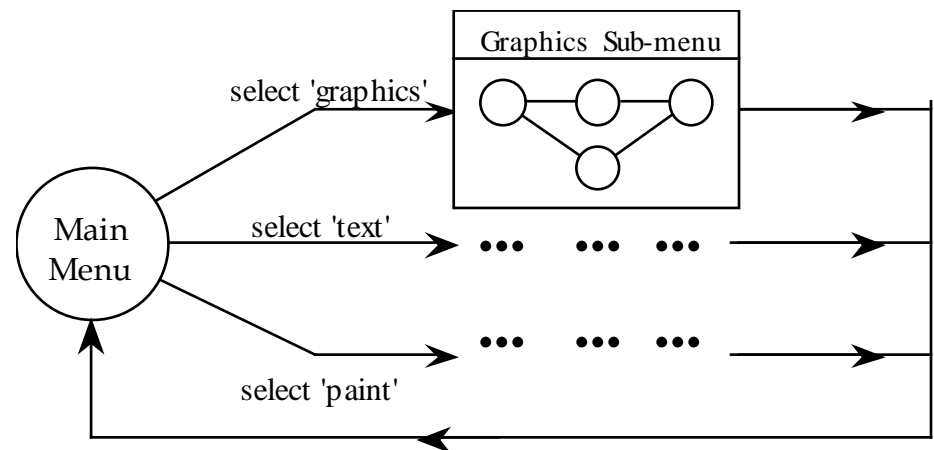
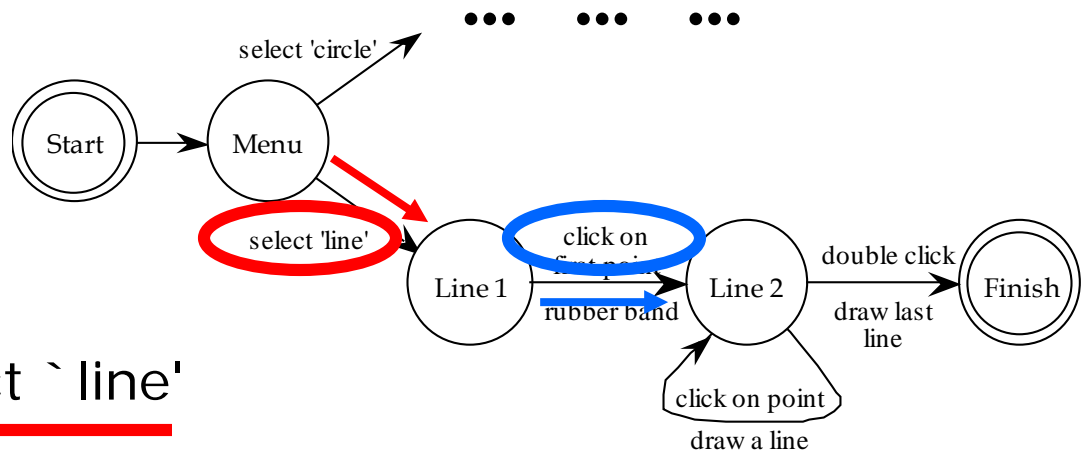
Checking properties (ii)

- Reversibility:
– to reverse select 'line'



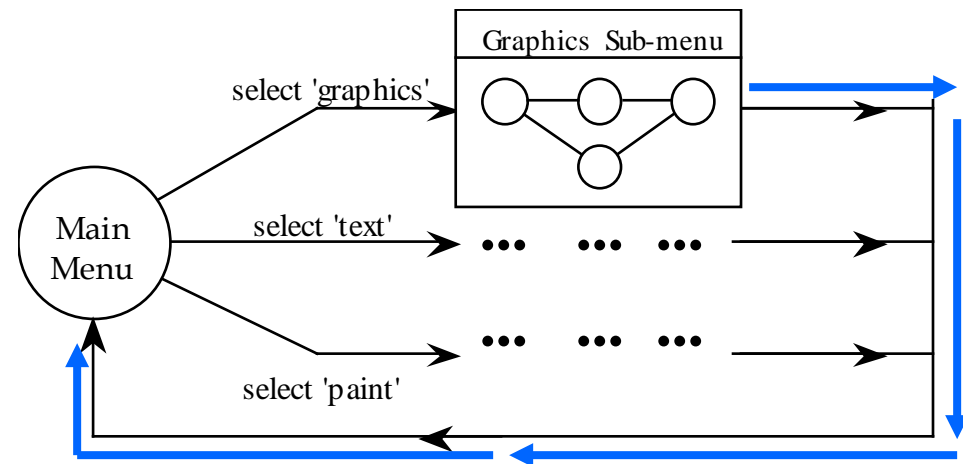
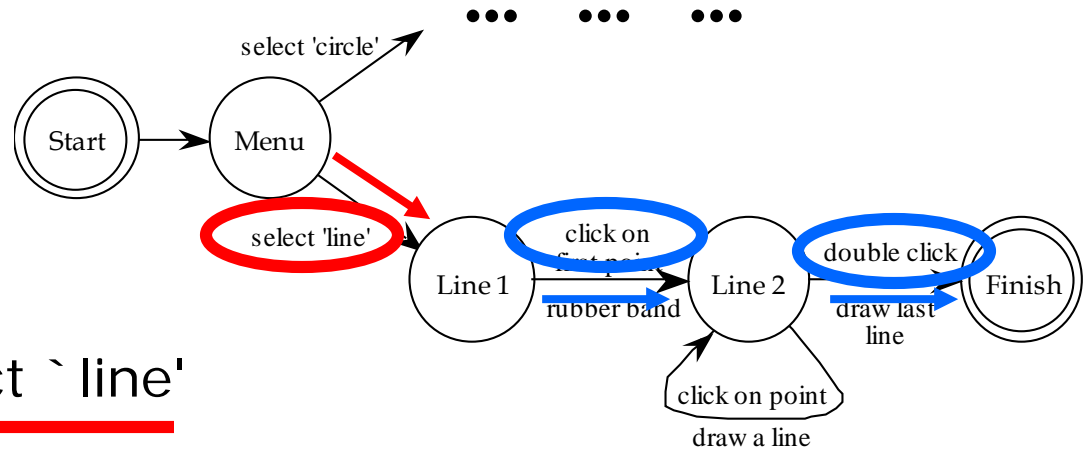
Checking properties (ii)

- Reversibility:
 - to reverse select 'line'
 - click



Checking properties (ii)

- Reversibility:
 - to reverse select 'line'
 - click - double click

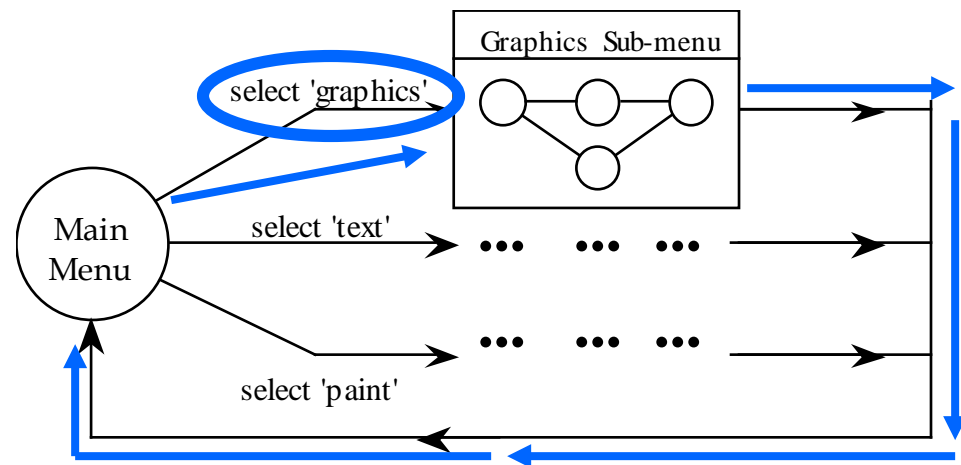
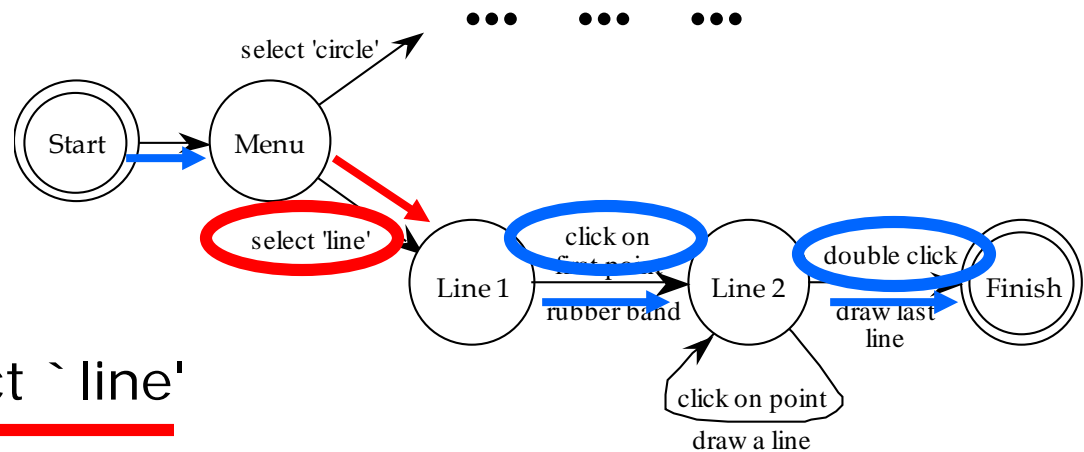


Checking properties (ii)

- Reversibility:

- to reverse select 'line'
- click - double click - select 'graphics'
- (3 actions)

- N.B. not undo

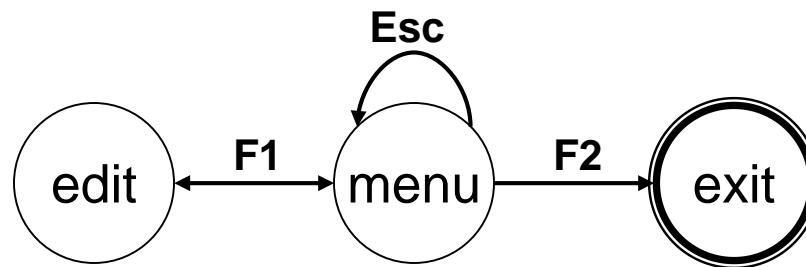


State properties

- reachability
 - can you get anywhere from anywhere?
 - and how easily
- reversibility
 - can you get to the previous state?
 - but NOT undo
- dangerous states
 - some states you don't want to get to

Dangerous States

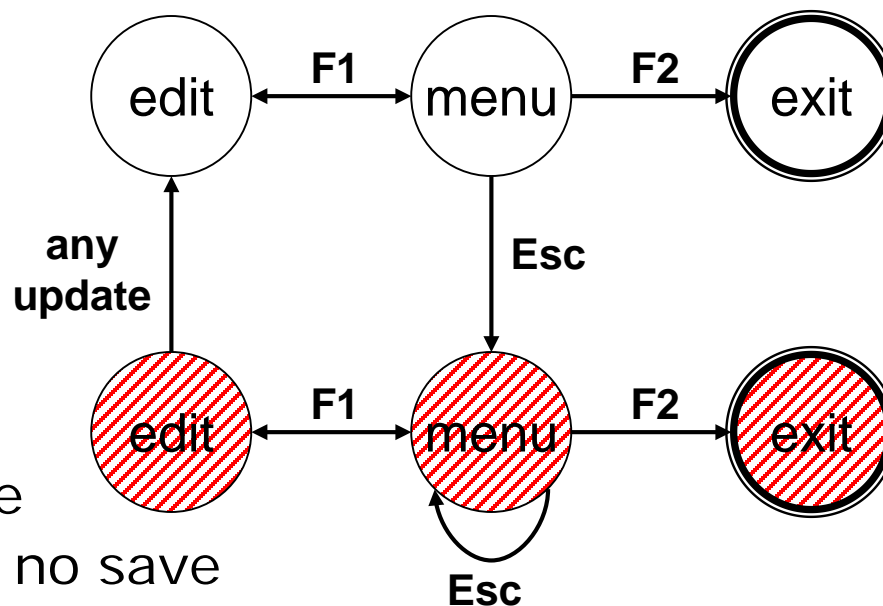
- word processor: two modes and exit
 - F1 - changes mode
 - F2 - exit (and save)
 - Esc - no mode change



but ... Esc resets autosave

Dangerous States (ii)

- exit with/without save \Rightarrow dangerous states
- duplicate states - semantic distinction



F1-F2 - exit with save

F1-Esc-F2 - exit with no save

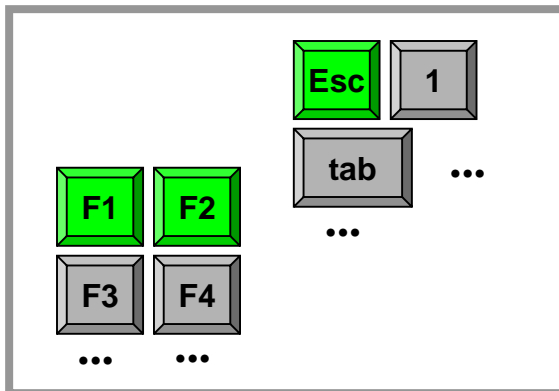
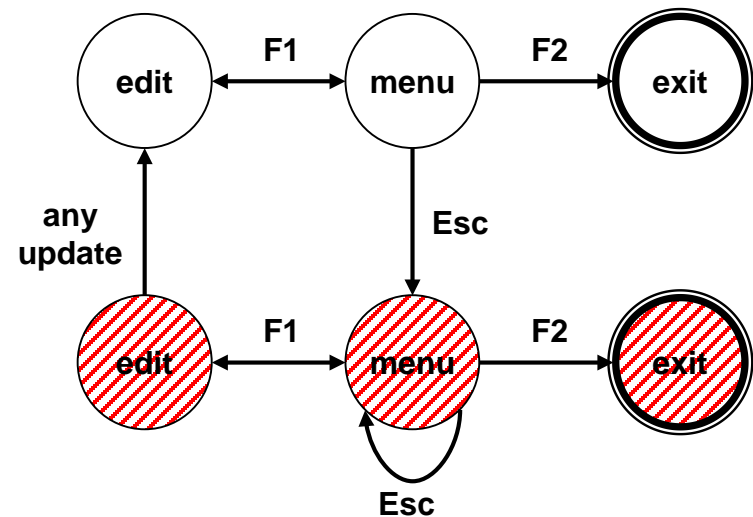
Lexical Issues

- visibility
 - differentiate modes and states
 - annotations to dialogue
- style
 - command - verb noun
 - mouse based - noun verb
- layout
 - not just appearance ...

layout matters

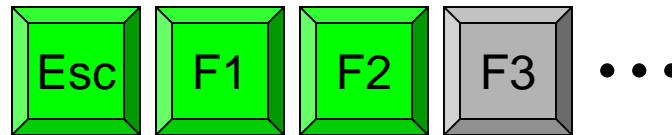
- word processor - dangerous states

- old keyboard - OK



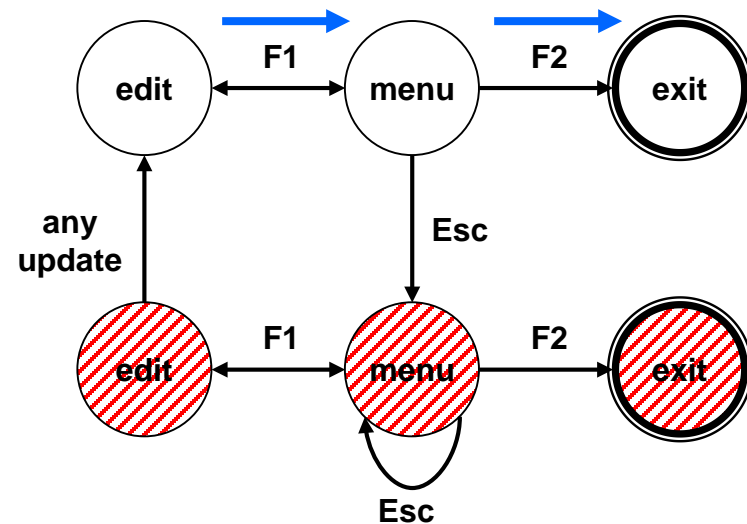
layout matters

- new keyboard layout



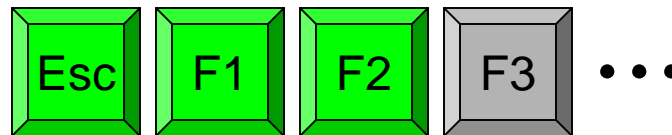
intend F1-F2 (save)

finger catches Esc



layout matters

- new keyboard layout

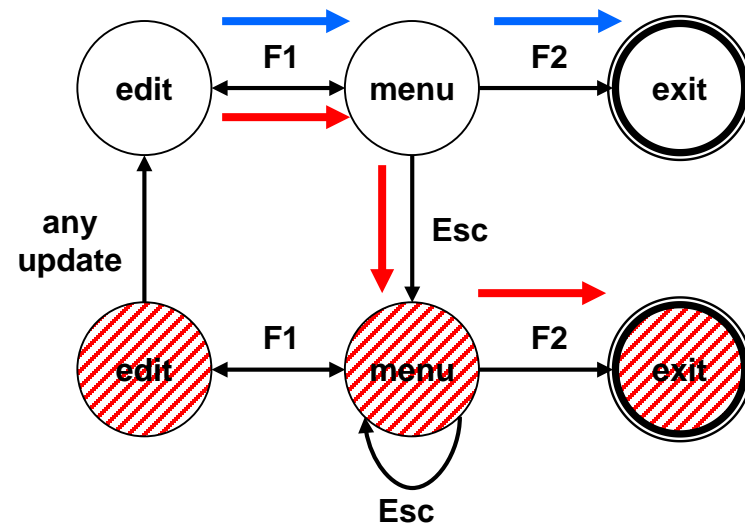


intend F1-F2 (save)



finger catches Esc

F1-Esc-F2 - disaster!



Dialogue Analysis - Summary

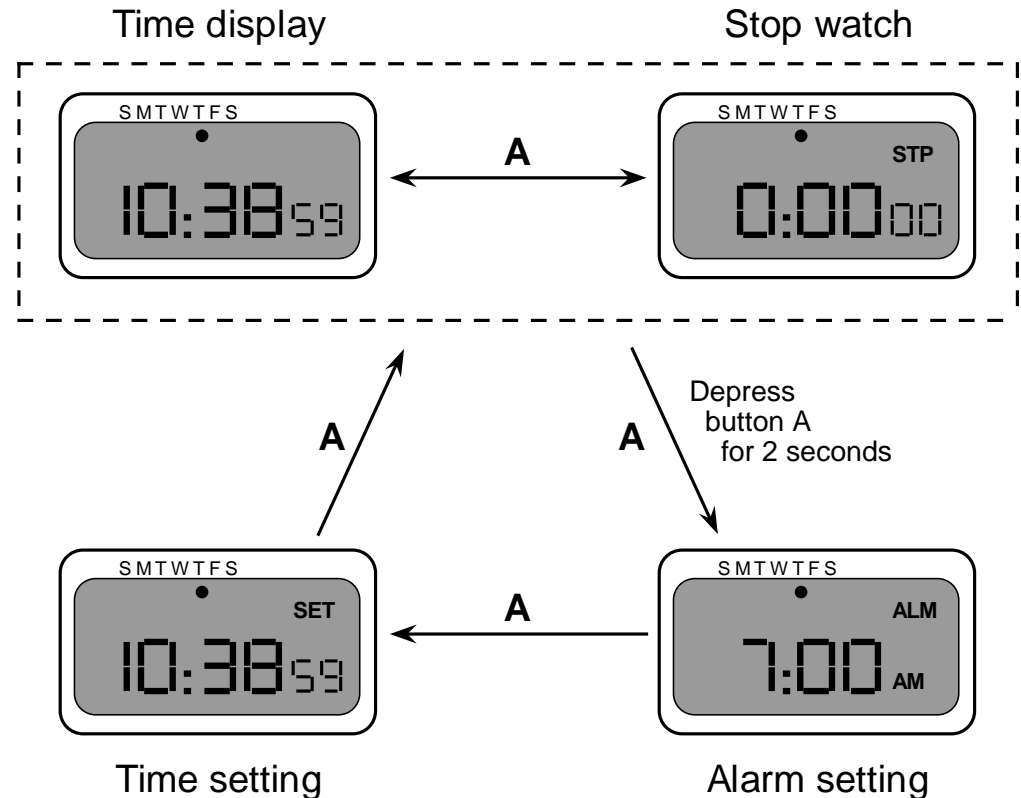
- Semantics and dialogue
 - attaching semantics
 - distributed/centralised dialogue description
 - maximising syntactic description
- Properties of dialogue
 - action properties: completeness, determinism, consistency
 - state properties: reachability, reversibility, dangerous states
- Presentation and lexical issues
 - visibility, style, layout
 - N.B. not independent of dialogue

Dialogue Analysis - Summary

- Semantics and dialogue
 - attaching semantics
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Digital watch - User Instructions

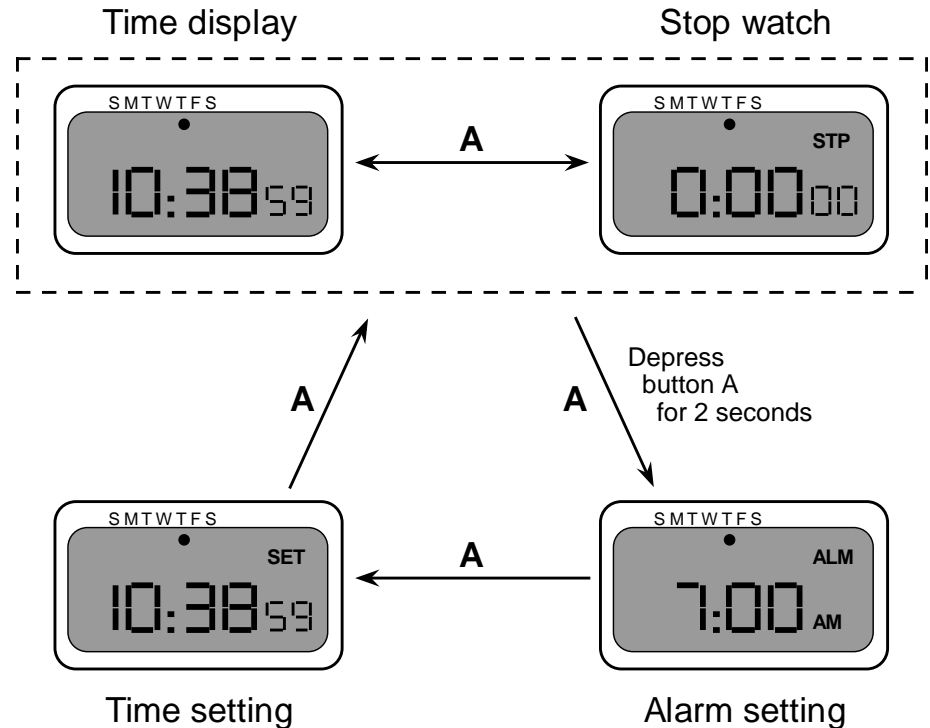
- two main modes
- limited interface
- 3 buttons
- button A
changes mode





Digital watch - User Instructions

- dangerous states
 - *guarded*
... by two second hold
- completeness
 - distinguish depress A and release A
 - what do they do in all modes?





Digital watch - Designers instructions

and ...

that's just
one button

