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

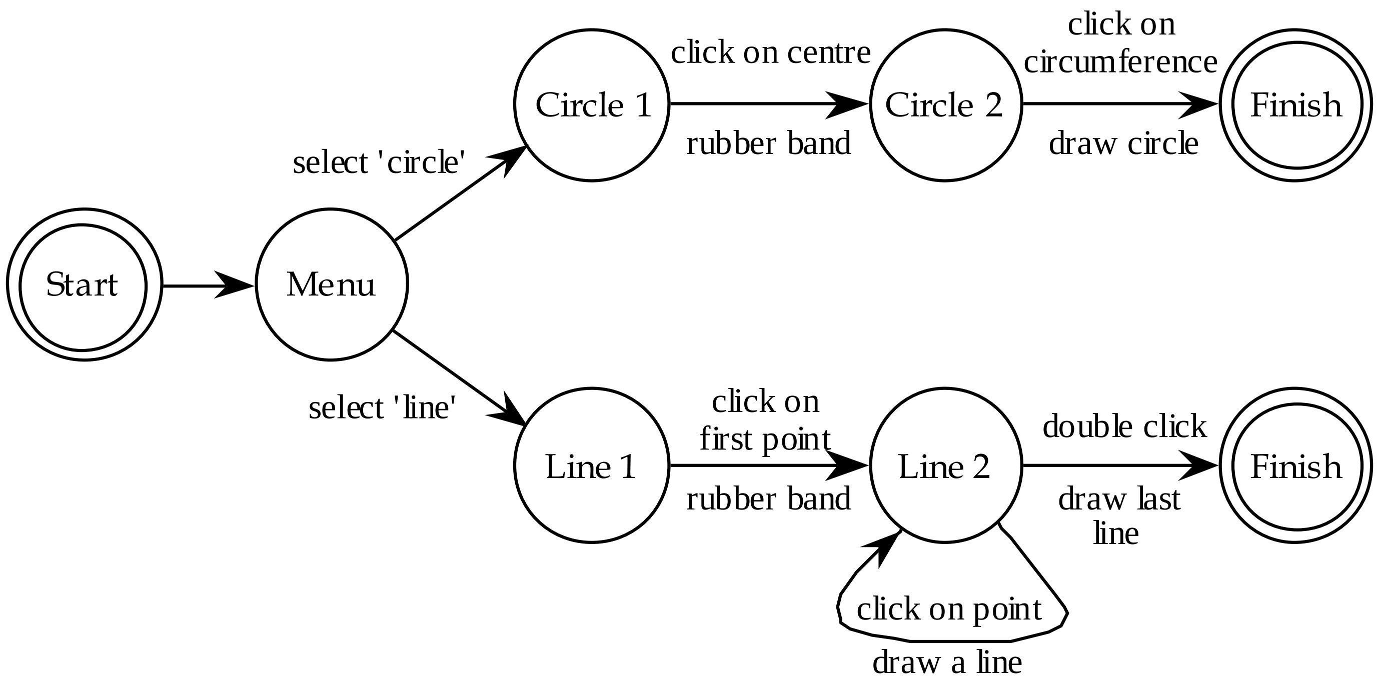
- dialogue gets buried in the program
- in a big system can we:
  - analyse the dialogue:
    - can the user always get to see current shopping basket
  - change platforms (e.g. Windows/Mac)
  - dialogue notations helps us to
    - analyse systems
    - separate lexical from semantoc
- … and before the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

graphical notations

state-transition nets (STN)
Petri nets, state charts
flow charts, JSD diagrams

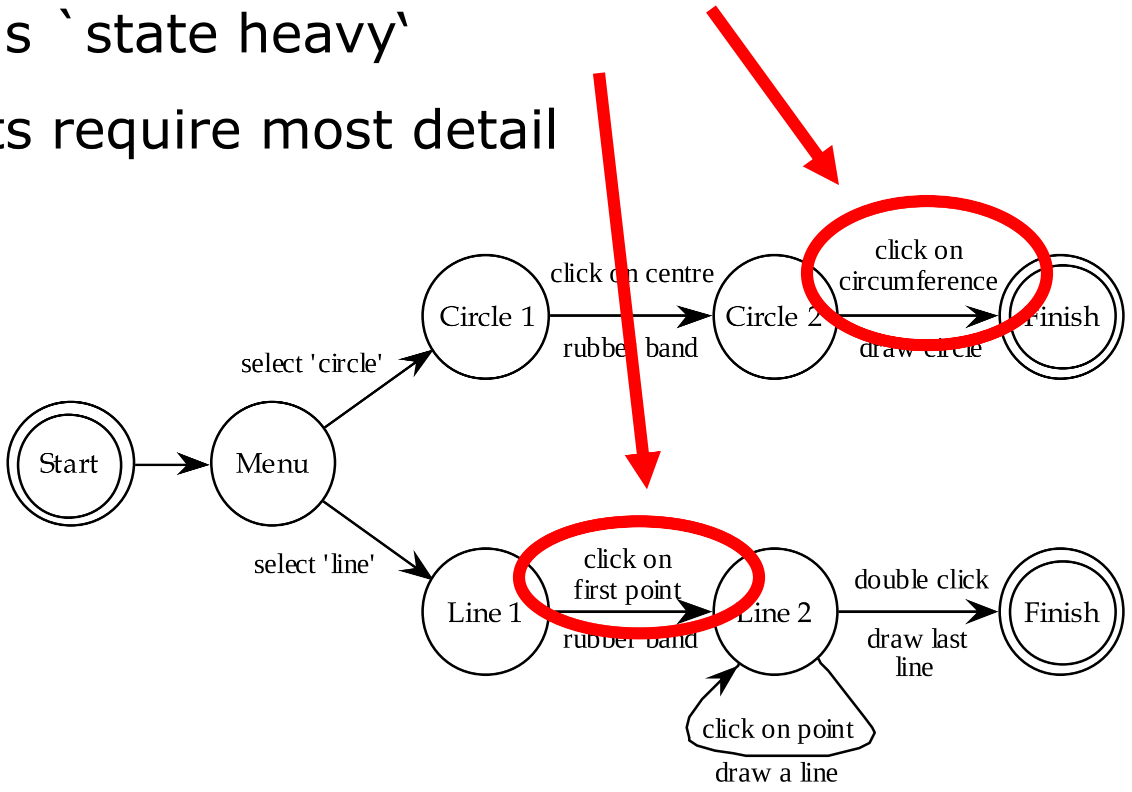
State transition networks (STN)

- circles - states
- arcs - actions/events



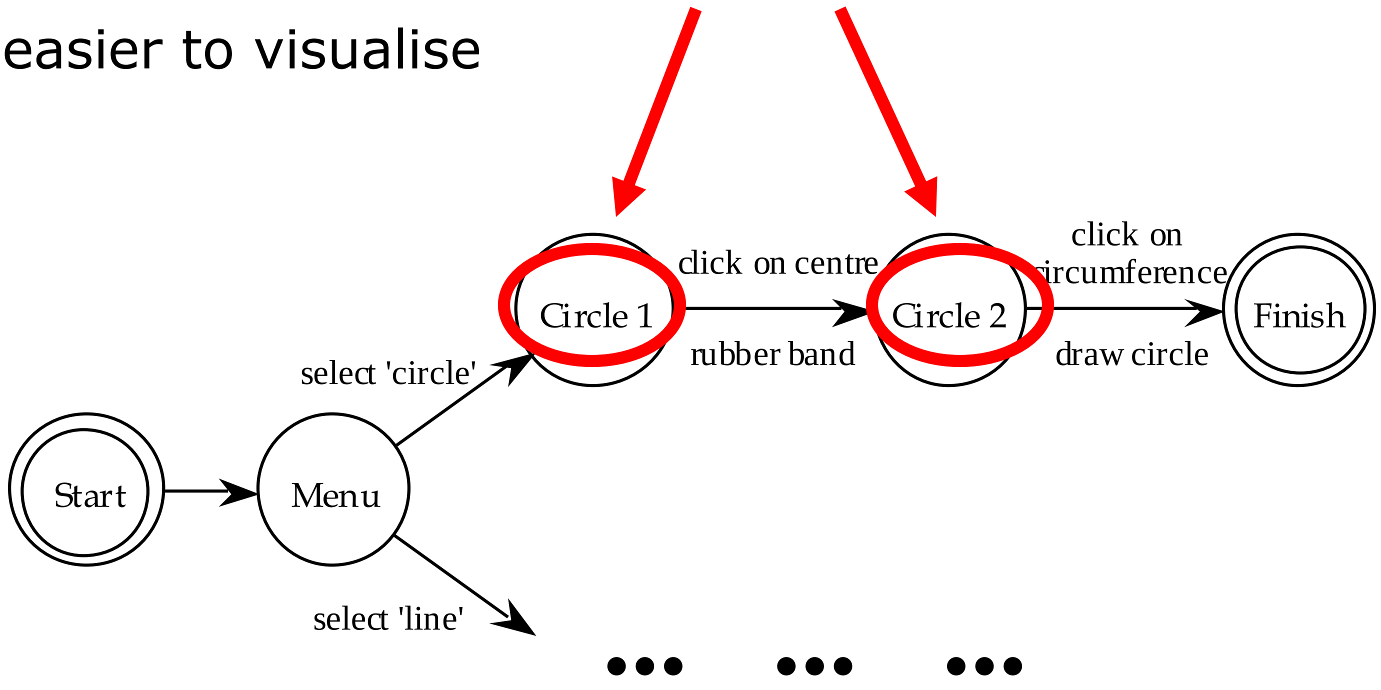
State transition networks - events

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



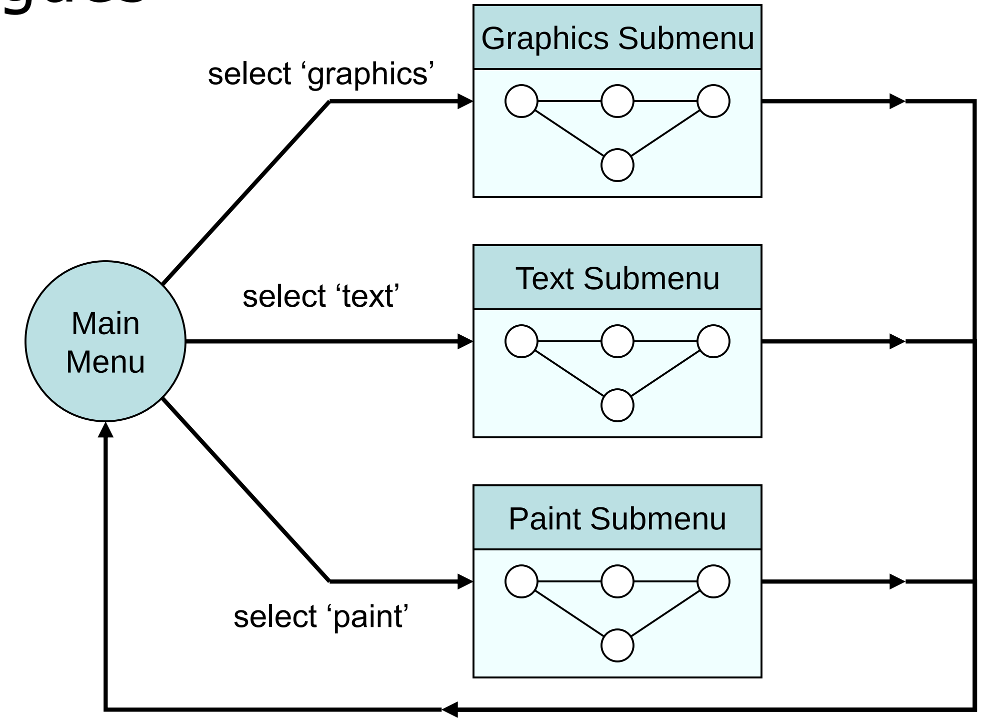
State transition networks - states

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

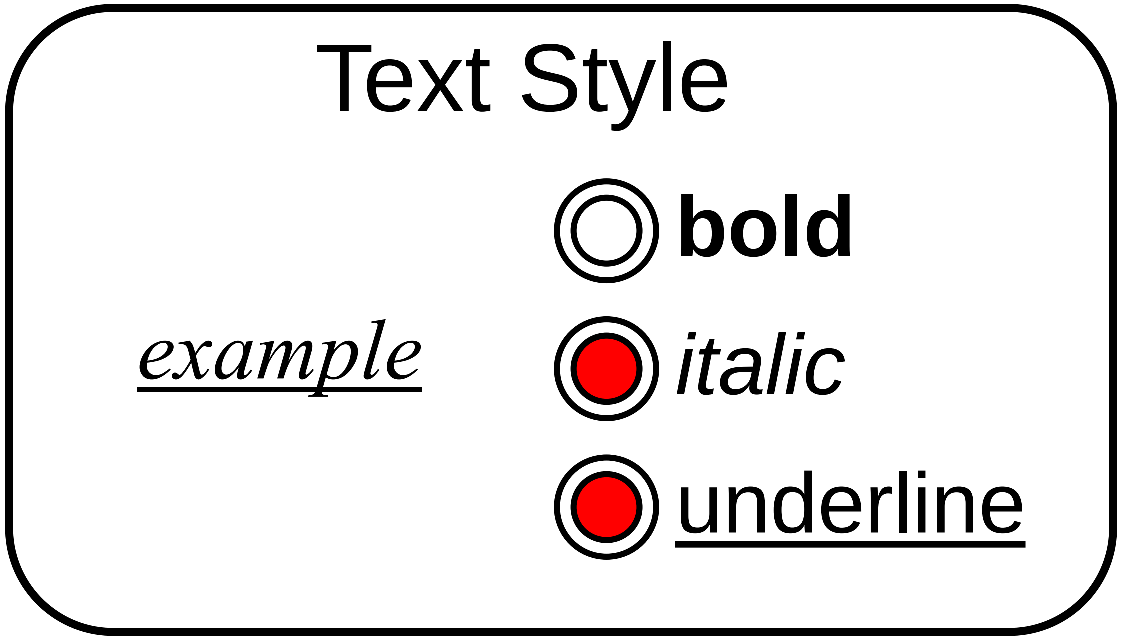


Hierarchical STNs

- managing complex dialogues
- named sub-dialogues

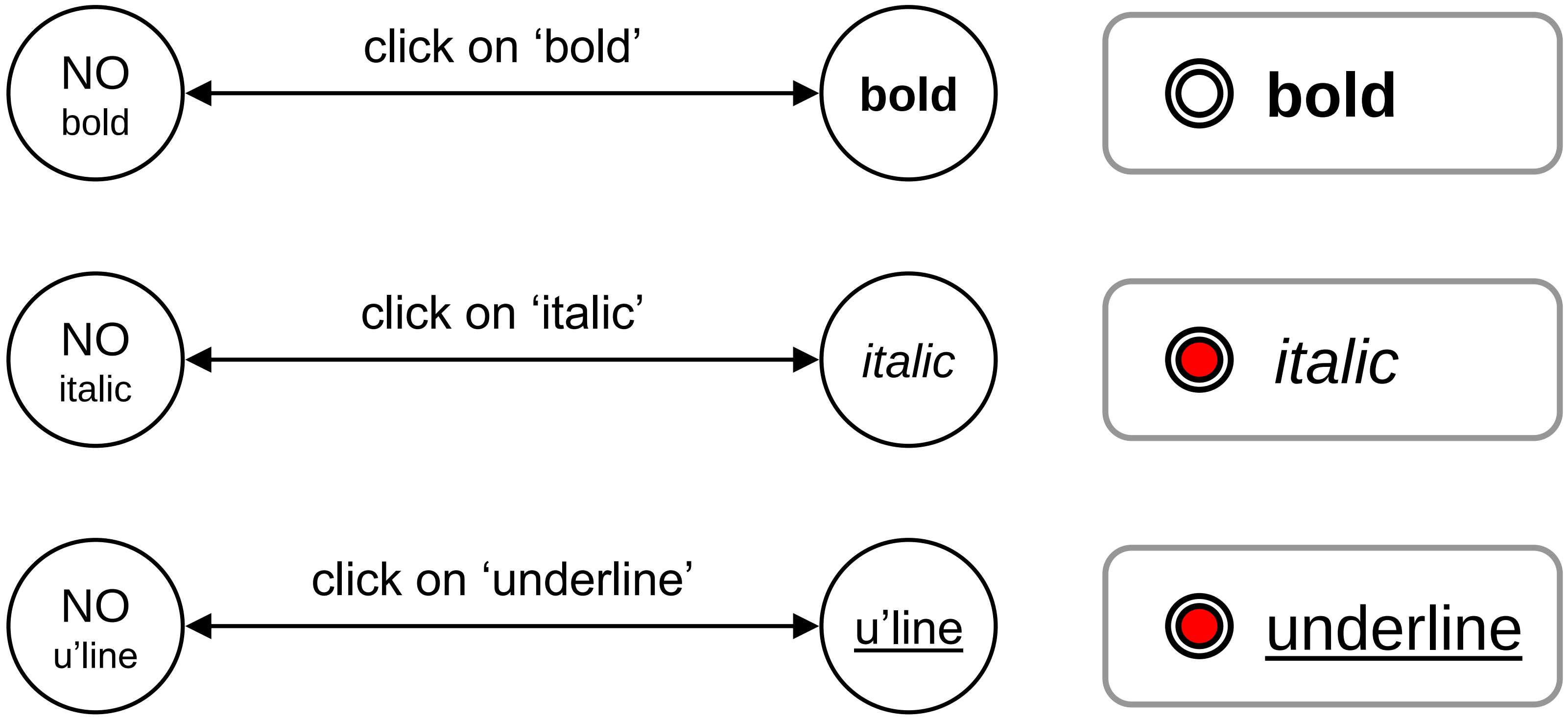


Concurrent dialogues - I
simple dialogue box



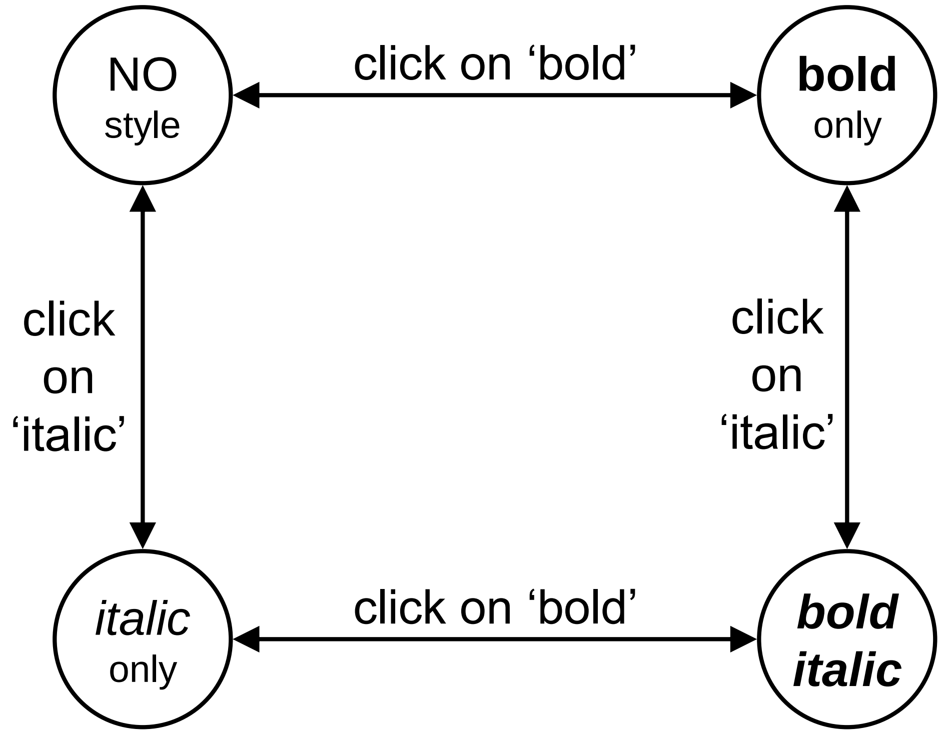
Concurrent dialogues - II

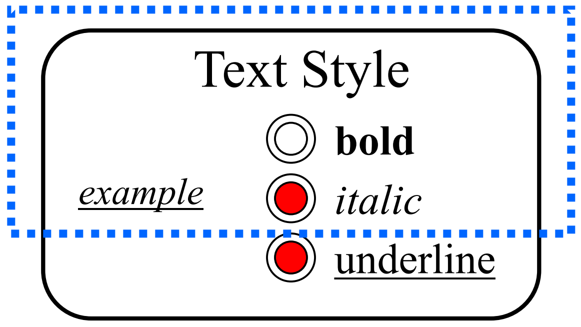
three toggles - individual STNs



Concurrent dialogues - III

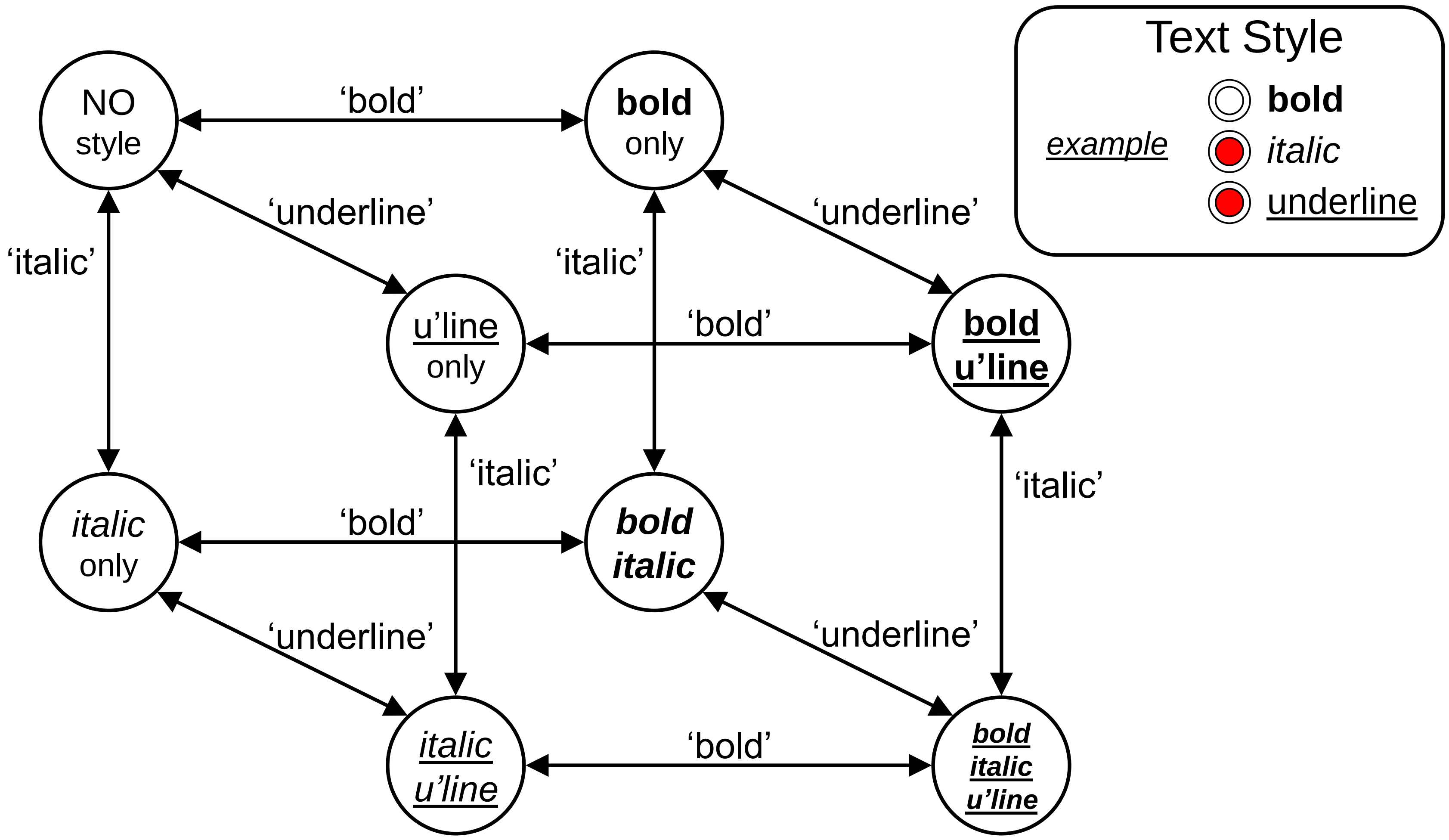
bold and italic combined





Concurrent dialogues – IV

all together – combinatorial explosion



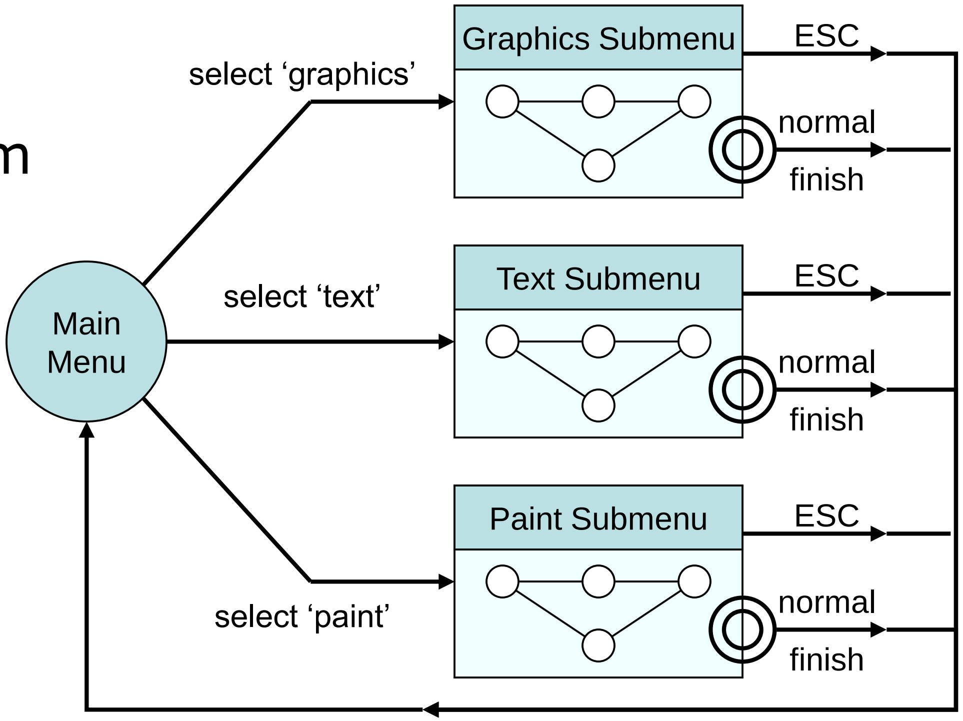
escapes

- ‘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

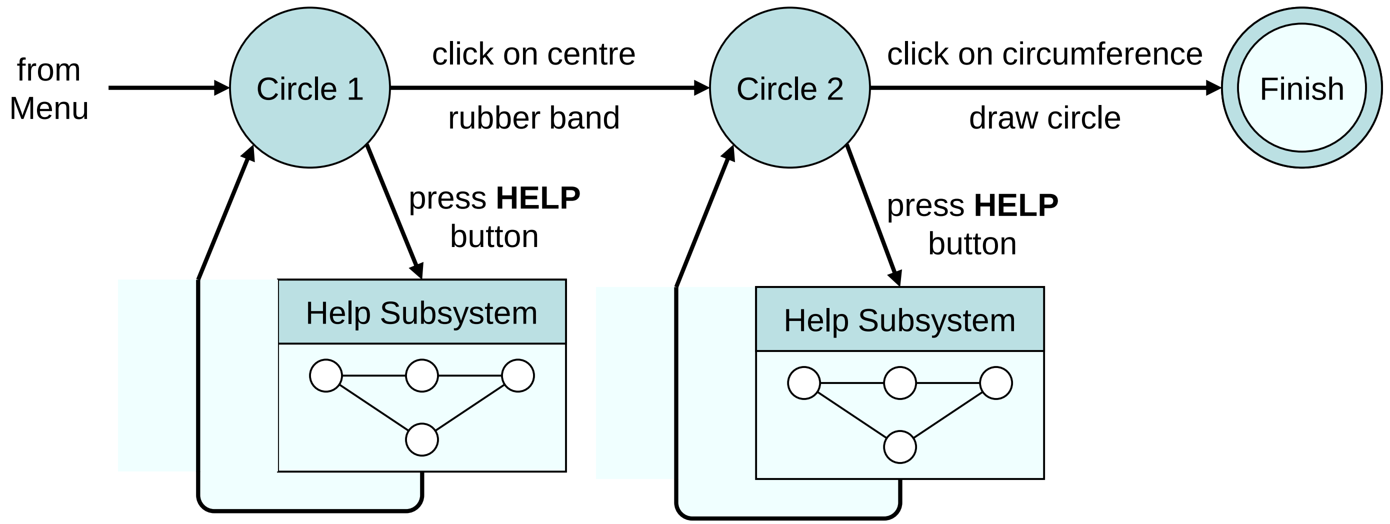
  ‘normal’ exit for each submenu

  plus separate escape arc active ‘everywhere’ in submenu



help menus

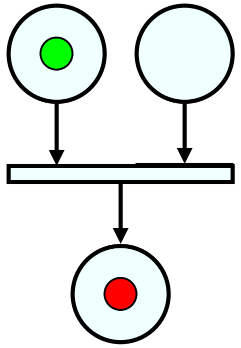
- similar problems
  - nearly the same everywhere
  - but return to same point in dialogue
  - could specify on STN … but very messy
  - usually best added at a 'meta' level



Petri nets

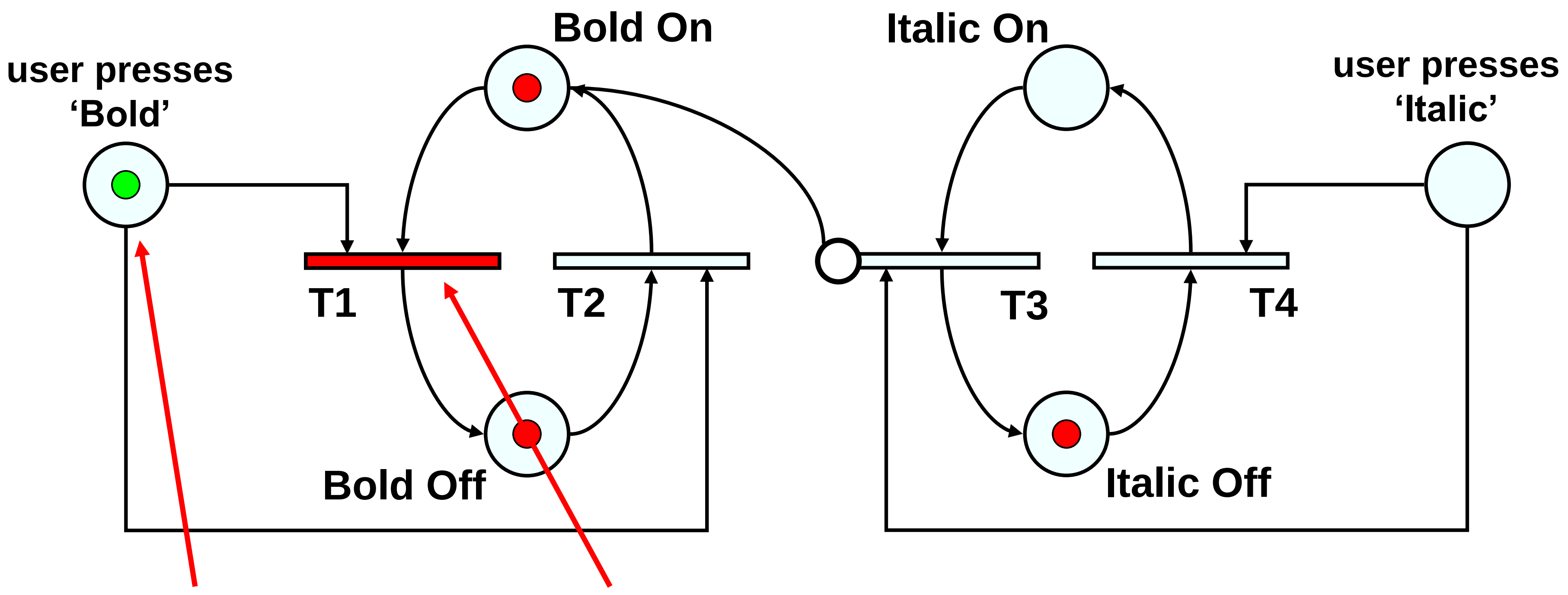
- one of the oldest notations in computing!
- flow graph:

– places	– a bit like STN states
– transitions	– a bit like STN arcs
– counters	– sit on places (current state)



- several counters allowed
  - concurrent dialogue states
- used for UI specification (ICO at Toulouse)
  - tool support – Petshop

Petri net example

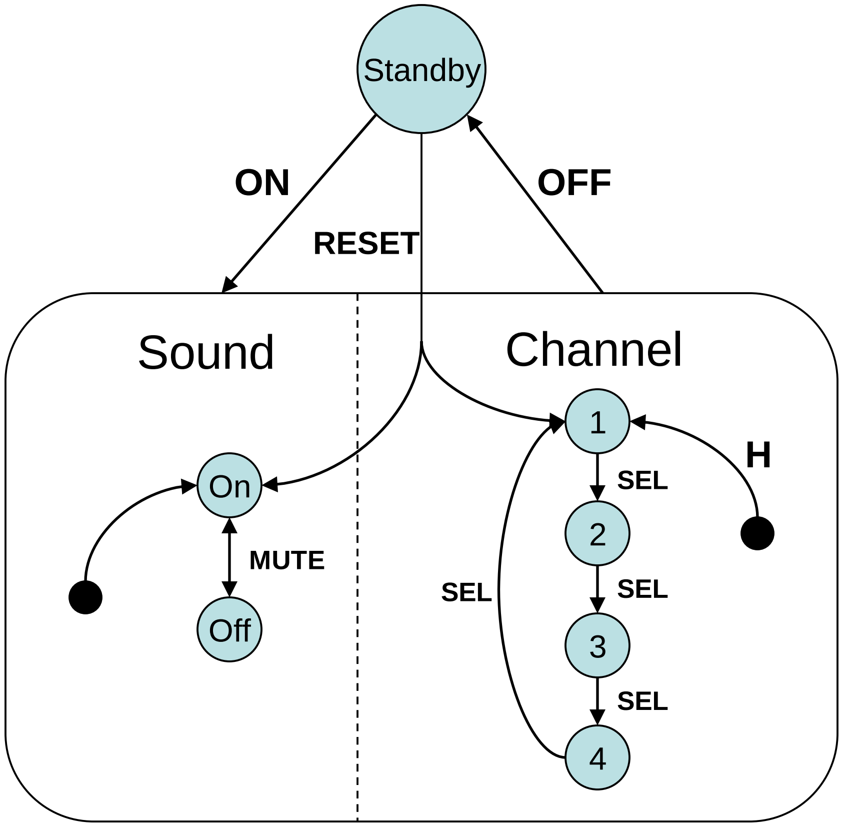


user actions represented as a new counter

transition 'fires' when all input places have counters

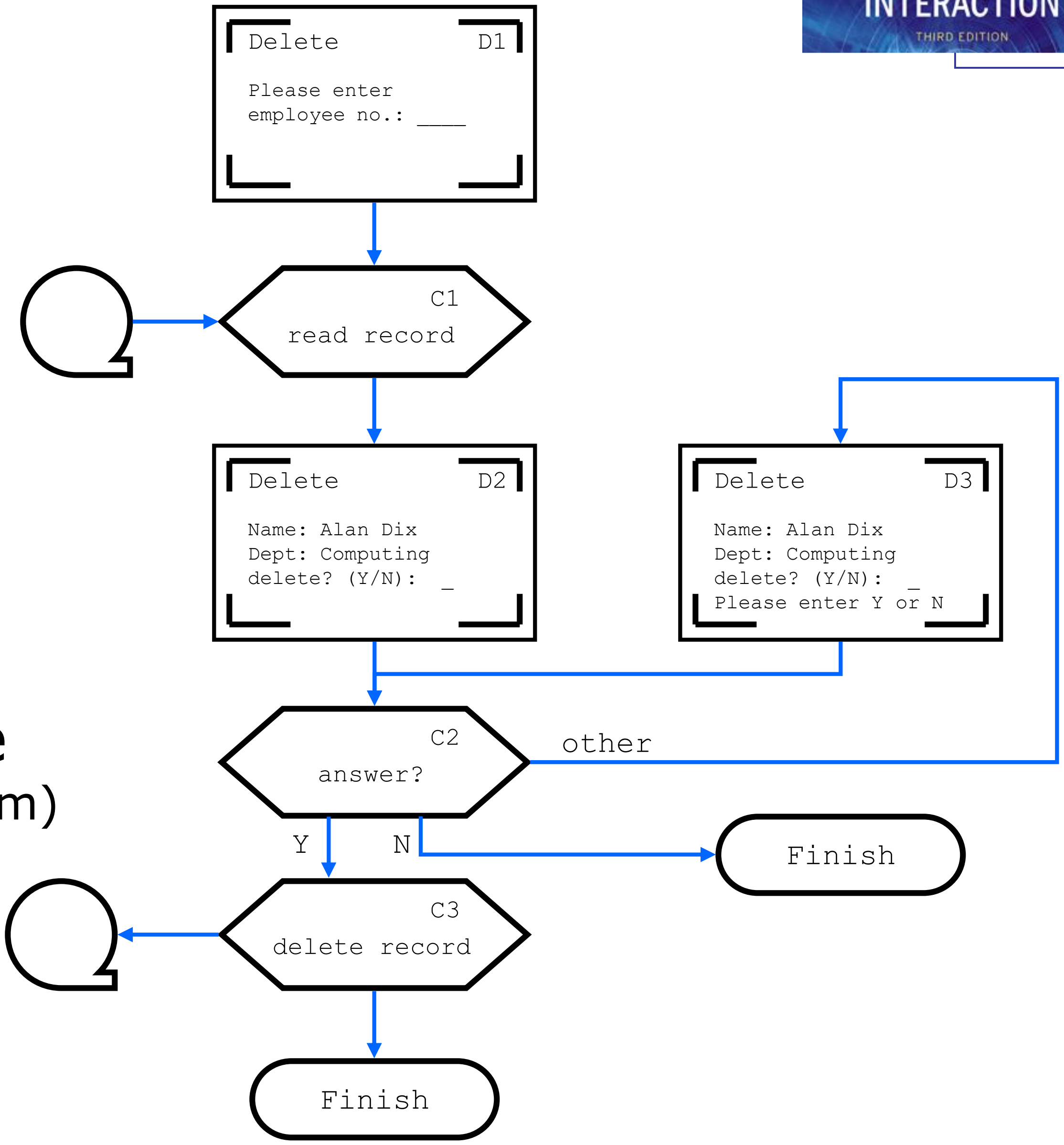
State charts

- 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



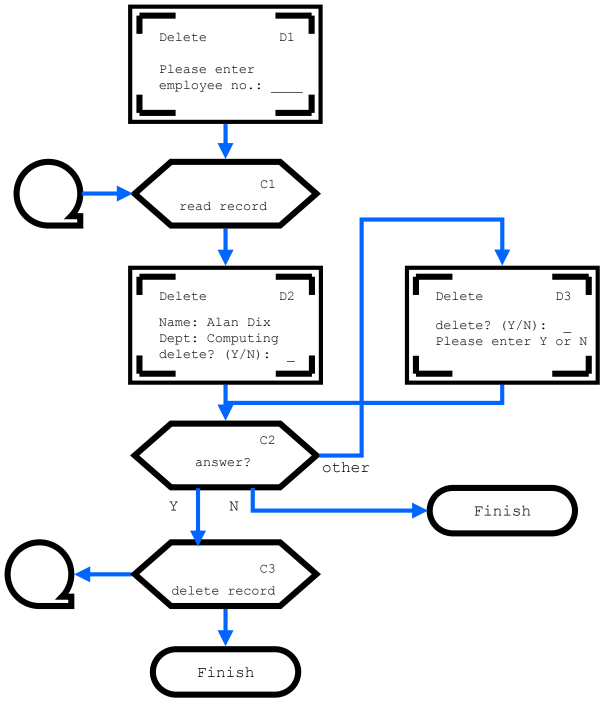
Flowcharts

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



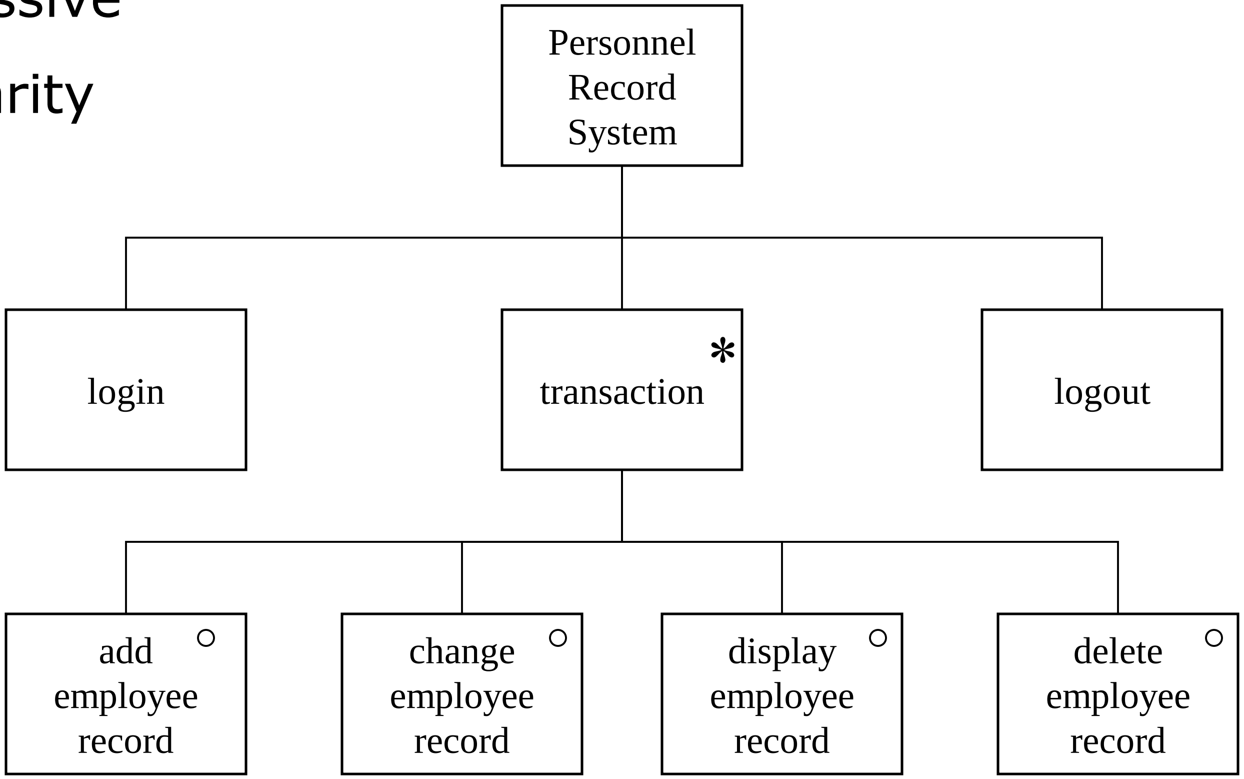
it works!

- 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 → first
C-point first → rest
C-point rest → rest
D-point rest → < 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!

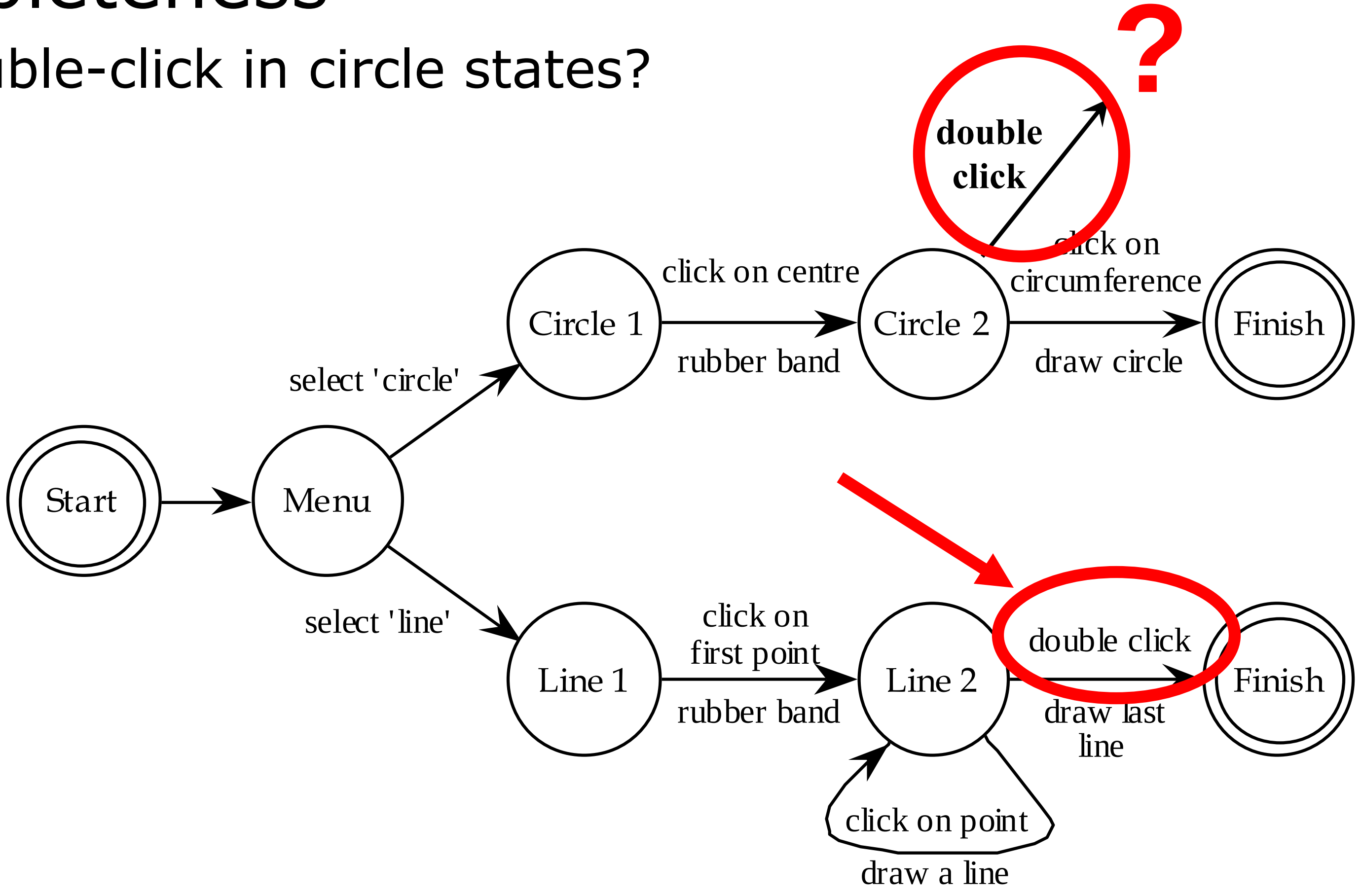
```
switch ( ev.type ) {
  case button_down:
    if ( in_text ( ev.pos ) ) {
        mode = selecting;
        mark_selection_start(ev.pos);
    }
    ...
  case button_up:
    if ( in_text ( ev.pos )
              && mode == selecting ) {
        mode = normal;
        mark_selection_end(ev.pos);
 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

Action properties

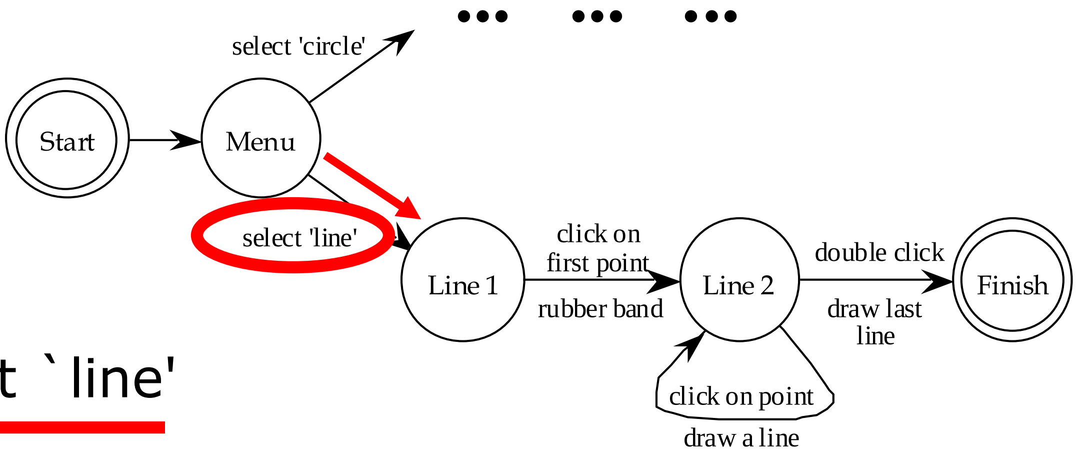
- completeness
  - missed arcs
  - unforeseen circumstances
- determinism
  - several arcs for one action
  - deliberate: application decision
  - accident: production rules
- nested escapes
- consistency
  - same action, same effect?
  - modes and visibility

Checking properties (i)

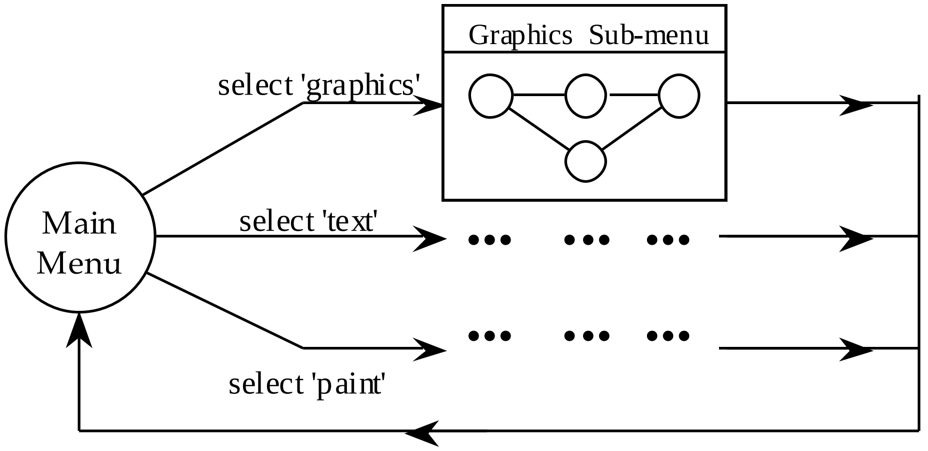
- completeness
  - double-click in circle states?



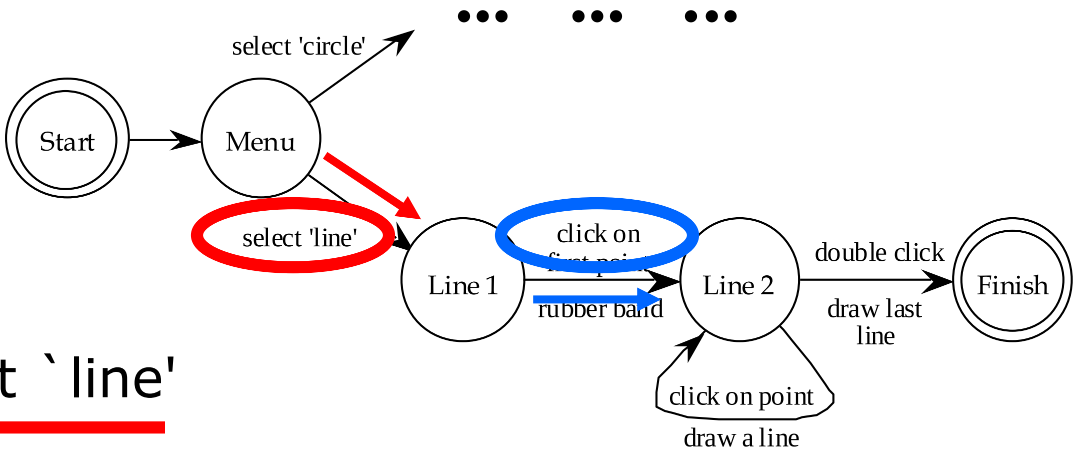
Checking properties (ii)



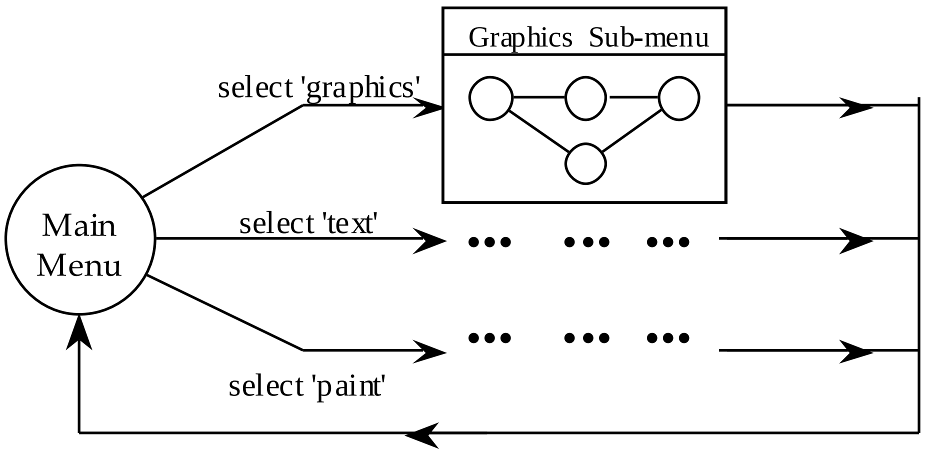
- Reversibility:
  - to reverse select `line'



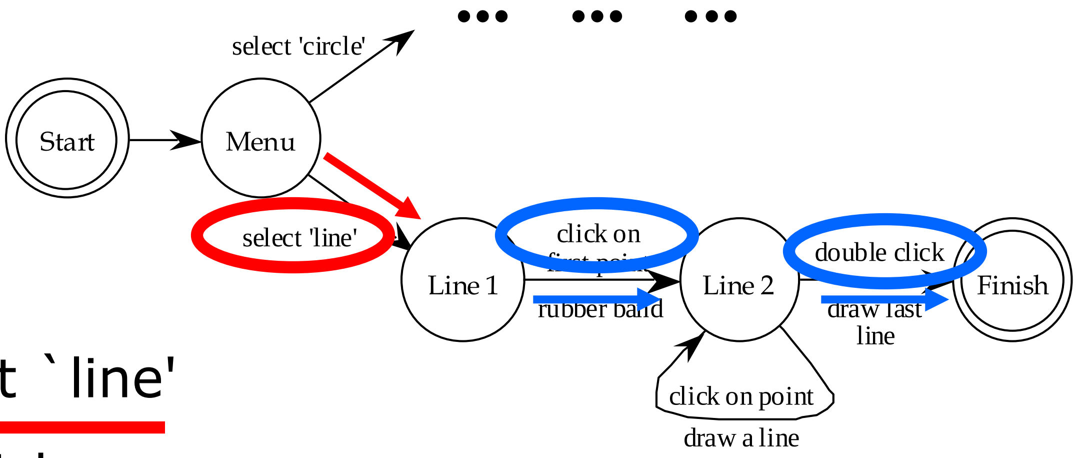
Checking properties (ii)



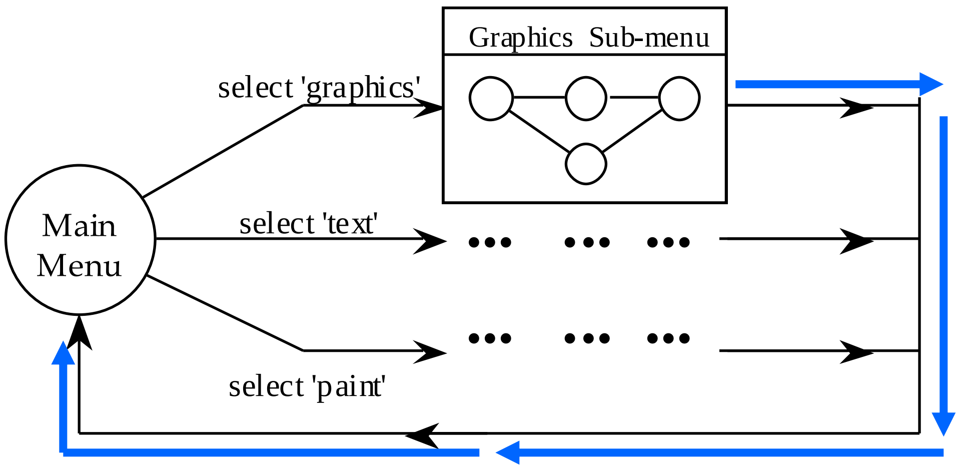
- Reversibility:
  - to reverse select `line'
  - click



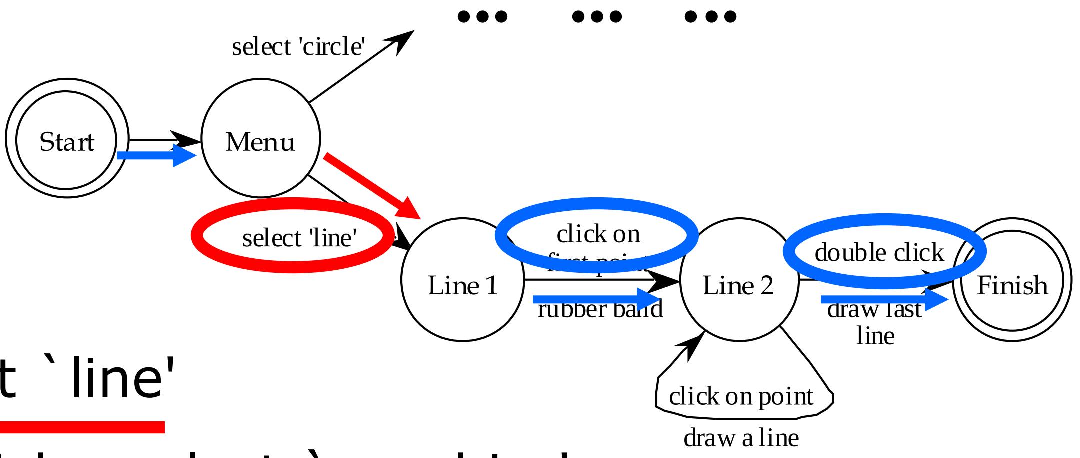
Checking properties (ii)



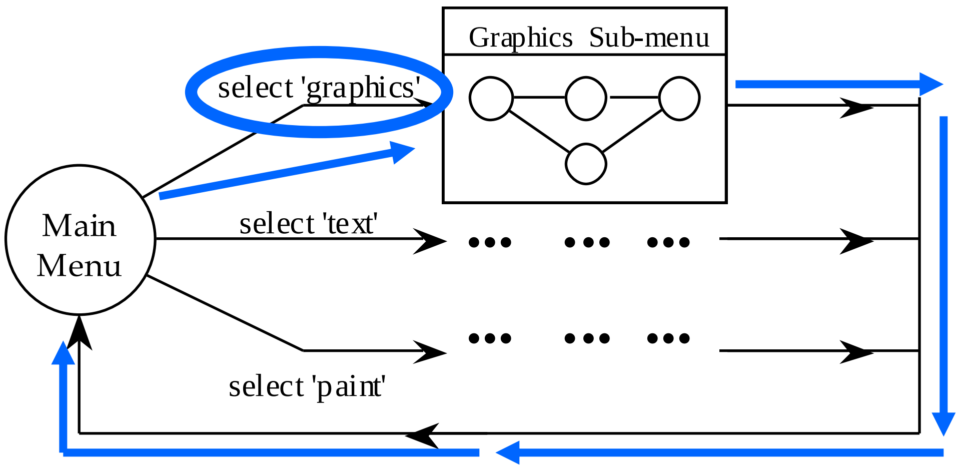
- Reversibility:
  - to reverse select `line'
  - click - double click



Checking properties (ii)



- Reversibility:
  - to reverse select `line'
  - click - double click - select `graphics'
  - (3 actions)
- N.B. not undo



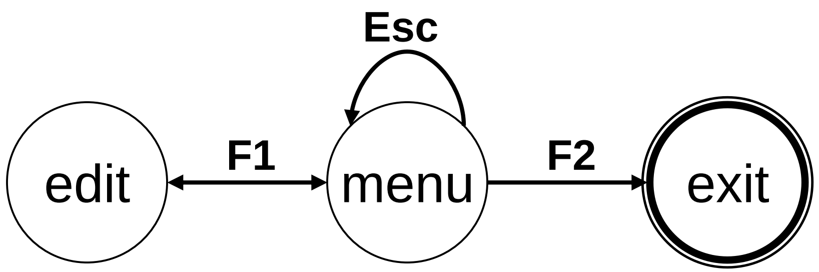
State properties

- 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

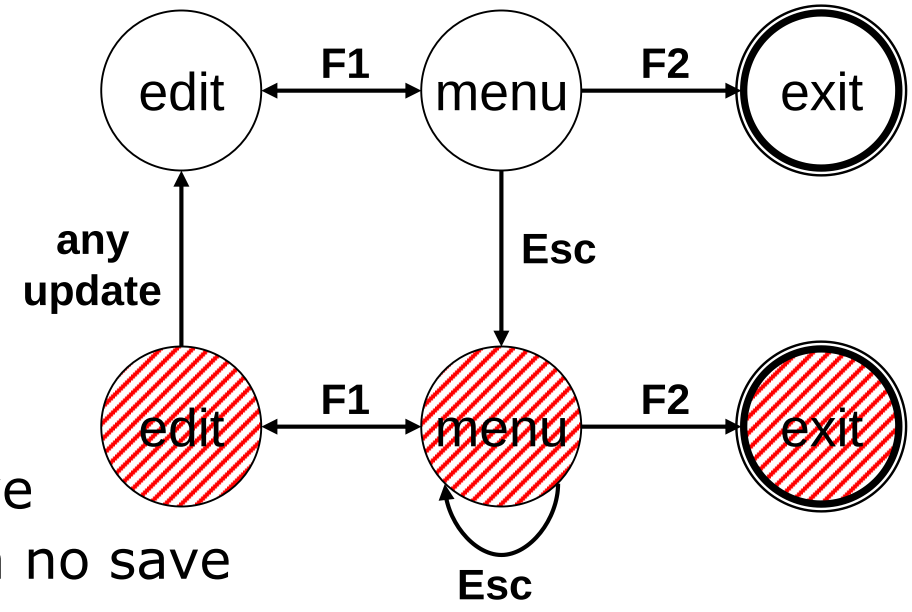
F1	-	changes mode
F2	-	exit (and save)
Esc	-	no mode change



but … Esc resets autosave

Dangerous States (ii)

- exit with/without save ⇒ dangerous states
- duplicate states - semantic distinction



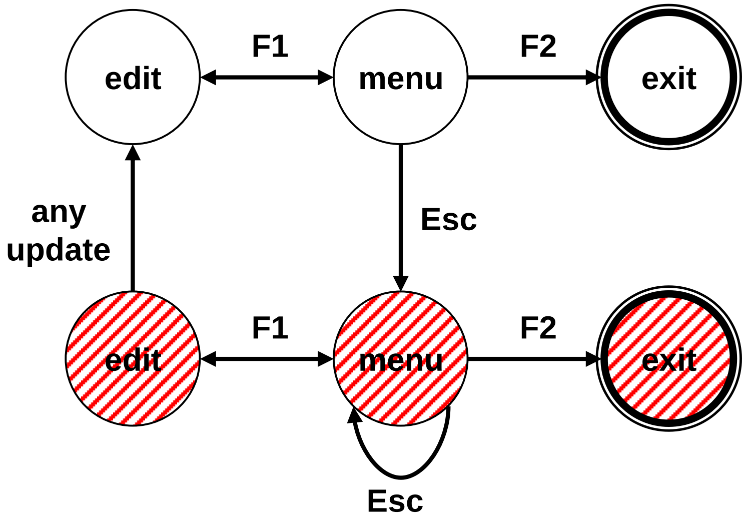
F1-F2 - exit with save
F1-Esc-F2 - exit with no save

Lexical Issues

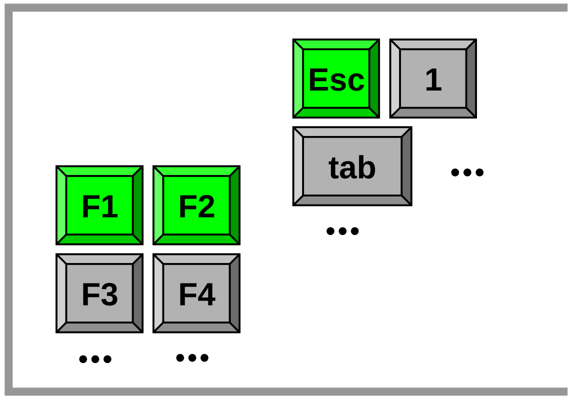
- visibility
    - differentiate modes and states
    - annotations to dialogue
- style
    - command - verb noun
    - mouse based - noun verb
- layout
    - not just appearance ...

layout matters

- word processor - dangerous states

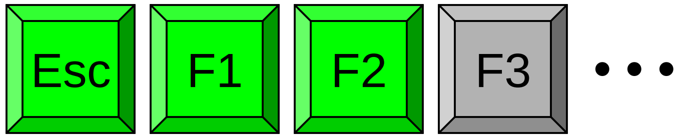


- old keyboard - OK



layout matters

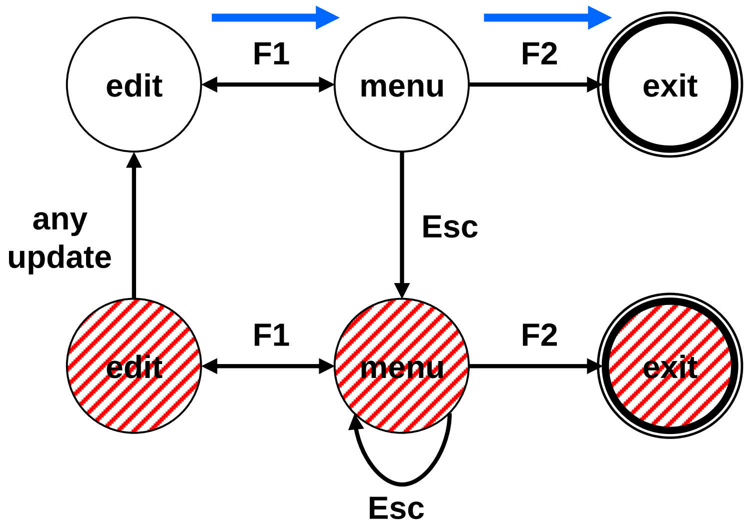
- new keyboard layout



intend F1-F2 (save)

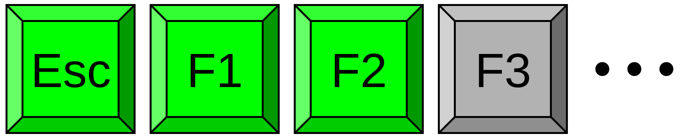
$\longrightarrow$

finger catches Esc



layout matters

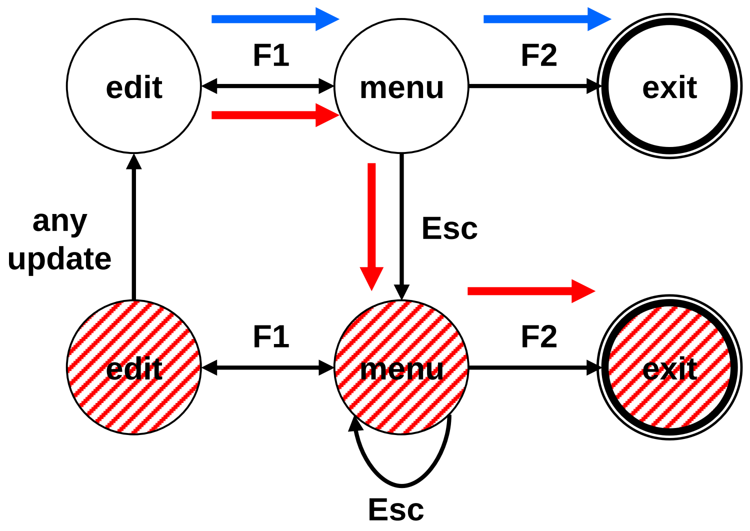
- new keyboard layout



intend F1-F2 (save)

finger catches Esc

F1-Esc-F2 - disaster!



Dialogue Analysis - Summary

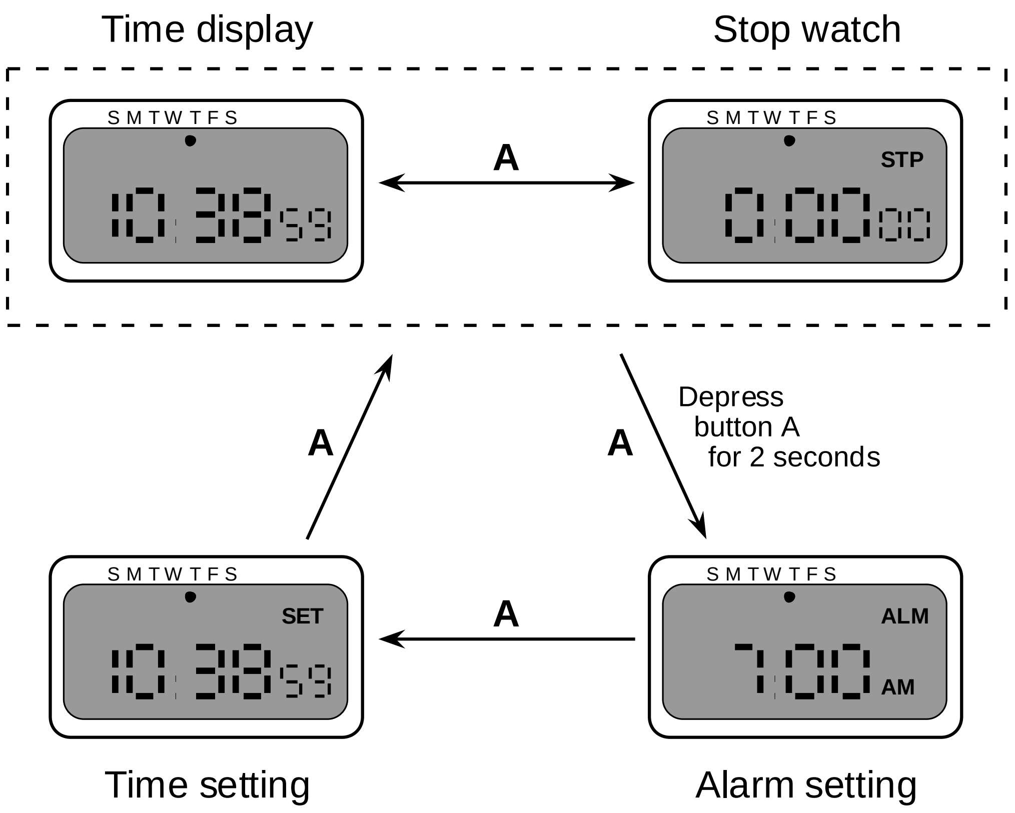
- Semantics and dialogue
    - attaching semantics
    - distributed/centralised dialogue description
    - maximising syntactic description
- Properties of dialogue
    - action properties: completeness, determinism, consistency
    - state properties: reachability, reversibility, dangerous states
-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

Dialogue Analysis - Summary

- Semantics and dialogue
  - attaching semantics
  - 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

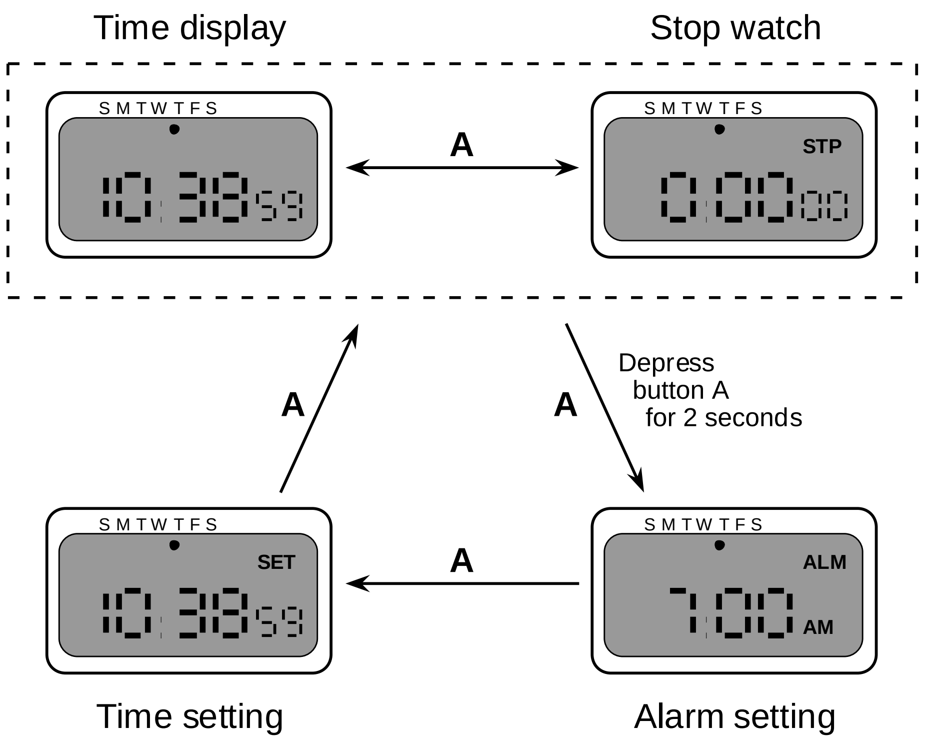
Digital watch – User Instructions

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



Digital watch – User Instructions

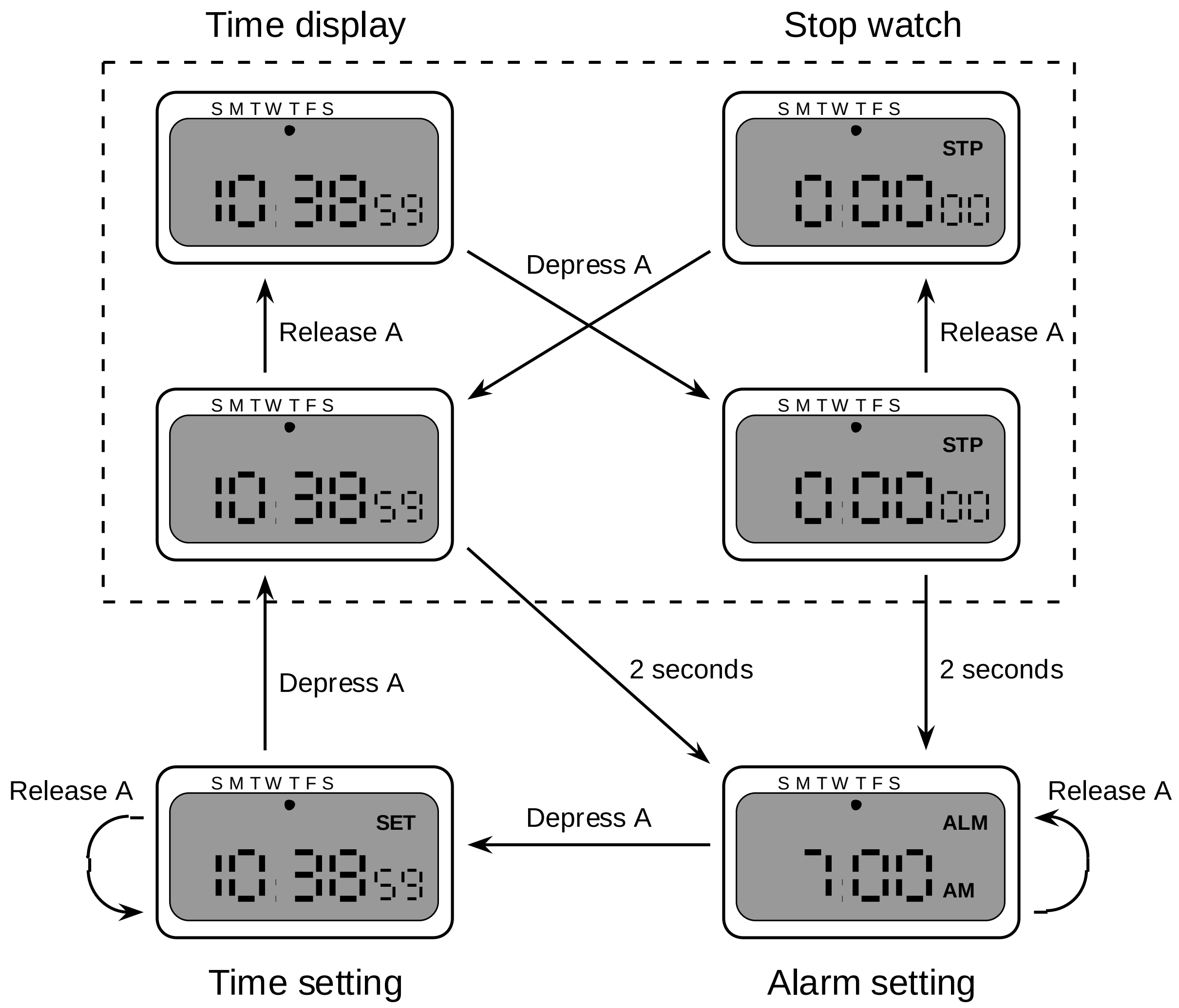
- dangerous states
  - *guarded*
    … by two second hold
- completeness
  - distinguish depress A and release A
  - what do they do in all modes?



Digital watch – Designers instructions

and …

that's just
one button


Time display
Stop watch
S M T W T F S
10:38 59
STP
0:00 00
Depress A
Release A
Release A
Depress A
2 seconds
2 seconds
Release A
Release A
Depress A
SET
ALM
7:00
AM
Time setting
Alarm setting