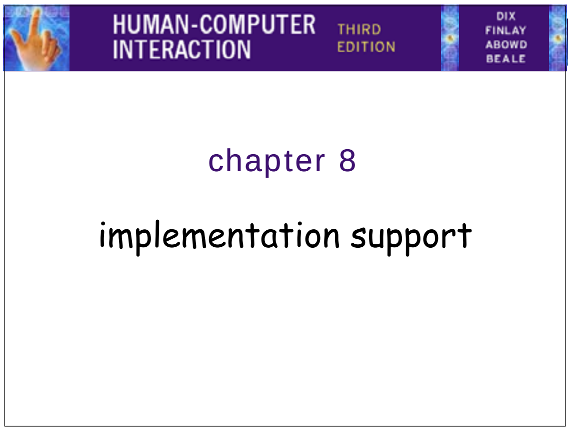
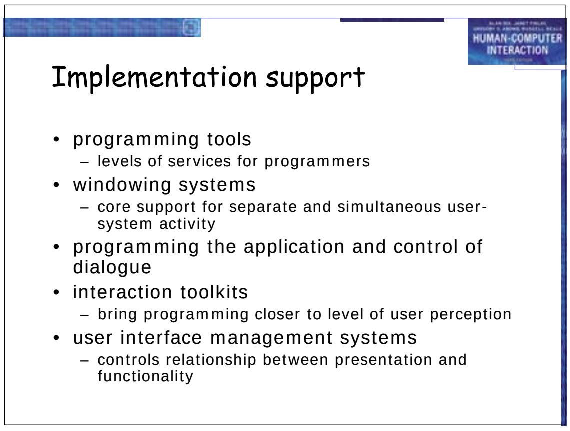


HUMAN-COMPUTER INTERACTION THIRD EDITION

DIX FINLAY ABOWD BEALE

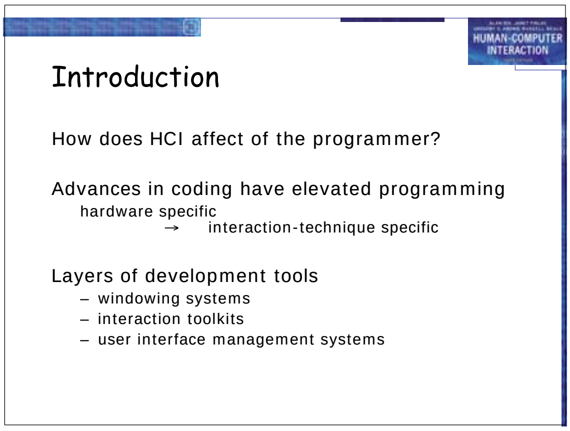
chapter 8

implementation support



Implementation support

- programming tools
  - levels of services for programmers
- windowing systems
  - core support for separate and simultaneous user-system activity
- programming the application and control of dialogue
- interaction toolkits
  - bring programming closer to level of user perception
- user interface management systems
  - controls relationship between presentation and functionality



Introduction

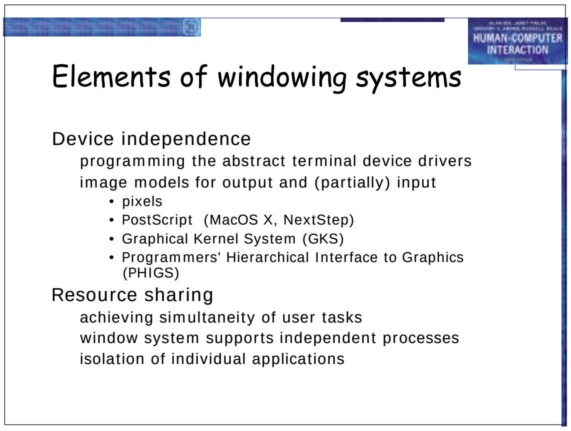
How does HCI affect of the programmer?

Advances in coding have elevated programming

hardware specific
→ interaction-technique specific

Layers of development tools

- windowing systems
- interaction toolkits
- user interface management systems



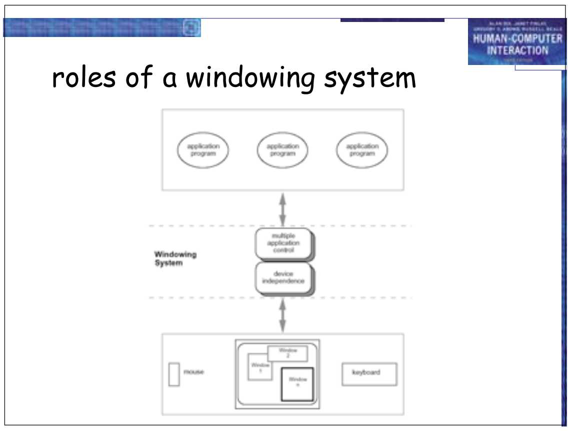
Elements of windowing systems

Device independence

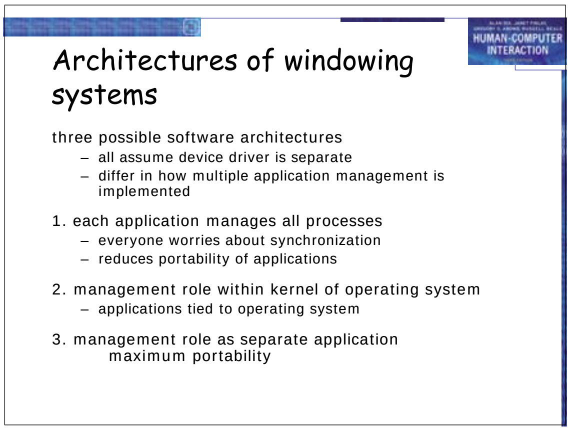
- programming the abstract terminal device drivers
- image models for output and (partially) input
  - pixels
  - PostScript (MacOS X, NextStep)
  - Graphical Kernel System (GKS)
  - Programmers' Hierarchical Interface to Graphics (PHIGS)

Resource sharing

- achieving simultaneity of user tasks
- window system supports independent processes
- isolation of individual applications



roles of a windowing system

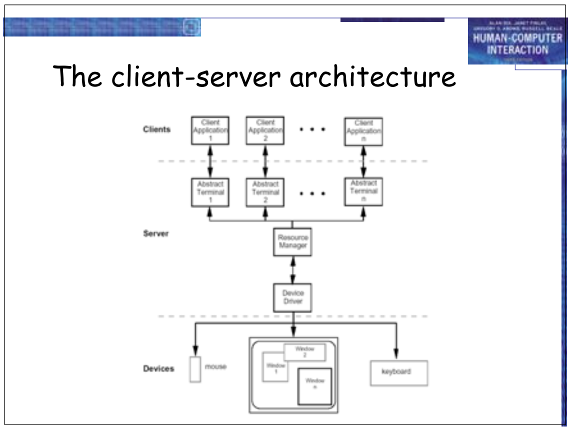


Architectures of windowing systems

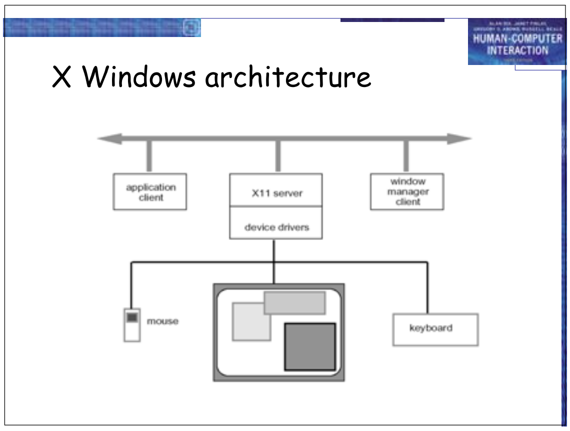
three possible software architectures

- all assume device driver is separate
- differ in how multiple application management is implemented

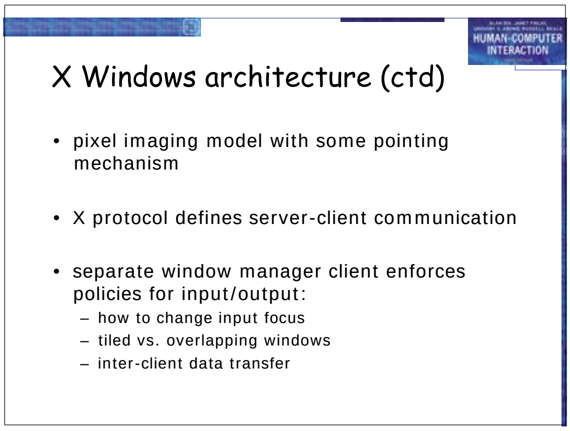
1. each application manages all processes
   - everyone worries about synchronization
   - reduces portability of applications
2. management role within kernel of operating system
   - applications tied to operating system
3. management role as separate application
   maximum portability



The client-server architecture

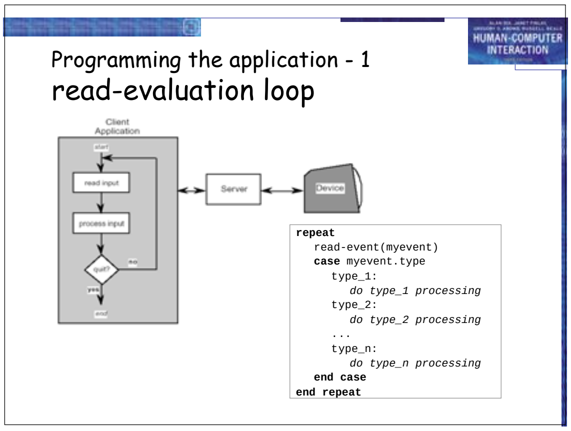


X Windows architecture



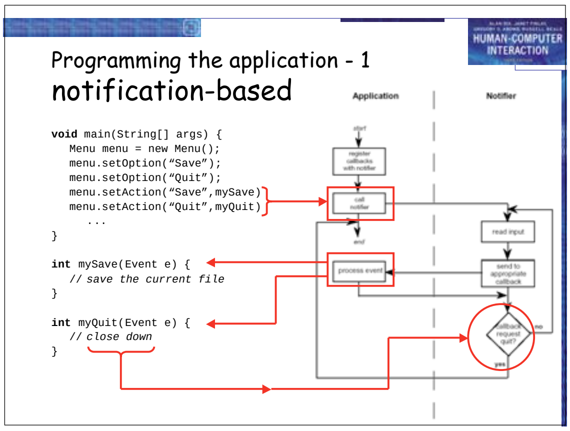
X Windows architecture (ctd)

- pixel imaging model with some pointing mechanism
- X protocol defines server-client communication
- separate window manager client enforces policies for input/output:
  - how to change input focus
  - tiled vs. overlapping windows
  - inter-client data transfer



Programming the application - 1
read-evaluation loop

```
repeat
   read-event(myevent)
   case myevent.type
      type_1:
         do type_1 processing
      type_2:
         do type_2 processing
      ...
      type_n:
         do type_n processing
   end case
end repeat
```

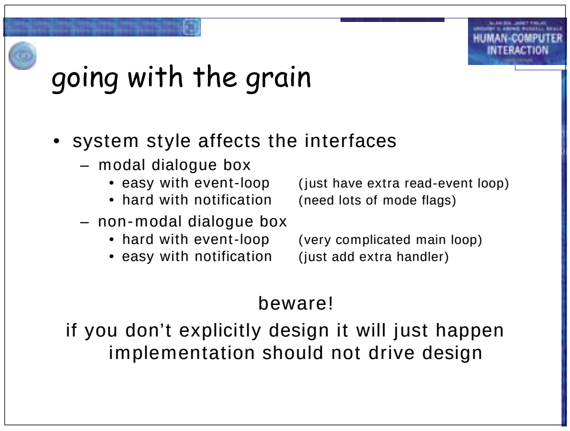


Programming the application - 1
notification-based

```
void main(String[] args) {
   Menu menu = new Menu();
   menu.setOption("Save");
   menu.setOption("Quit");
   menu.setAction("Save",mySave)
   menu.setAction("Quit",myQuit)
      ...
}

int mySave(Event e) {
   // save the current file
}

int myQuit(Event e) {
   // close down
}
```



going with the grain

- system style affects the interfaces
  - modal dialogue box
    - easy with event-loop (just have extra read-event loop)
    - hard with notification (need lots of mode flags)
  - non-modal dialogue box
    - hard with event-loop (very complicated main loop)
    - easy with notification (just add extra handler)

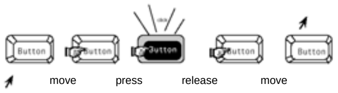
beware!

if you don't explicitly design it will just happen
implementation should not drive design

Using toolkits

Interaction objects

- input and output intrinsically linked



Toolkits provide this level of abstraction

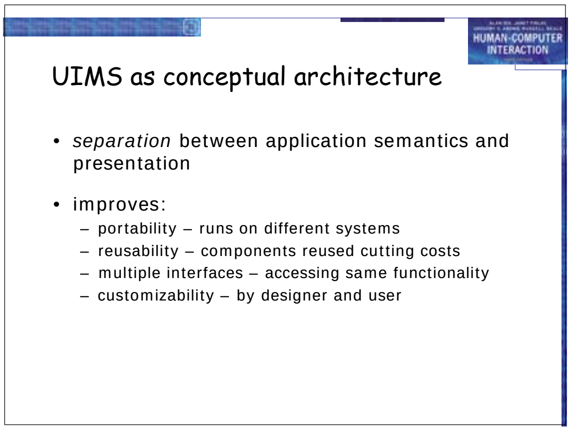
- programming with interaction objects (or
- techniques, widgets, gadgets)
- promote consistency and generalizability
- through similar look and feel
- amenable to object-oriented programming

interfaces in Java

- Java toolkit – AWT (abstract windowing toolkit)
- Java classes for buttons, menus, etc.
- Notification based;
  - AWT 1.0 – need to subclass basic widgets
  - AWT 1.1 and beyond -– callback objects
- Swing toolkit
  - built on top of AWT – higher level features
  - uses MVC architecture (see later)

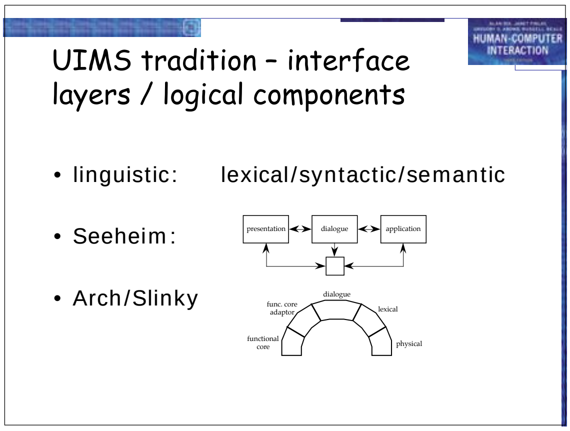
User Interface Management Systems (UIMS)

- UIMS add another level above toolkits
  - toolkits too difficult for non-programmers
- concerns of UIMS
  - conceptual architecture
  - implementation techniques
  - support infrastructure
- non-UIMS terms:
  - UI development system (UIDS)
  - UI development environment (UIDE)
    - e.g. Visual Basic



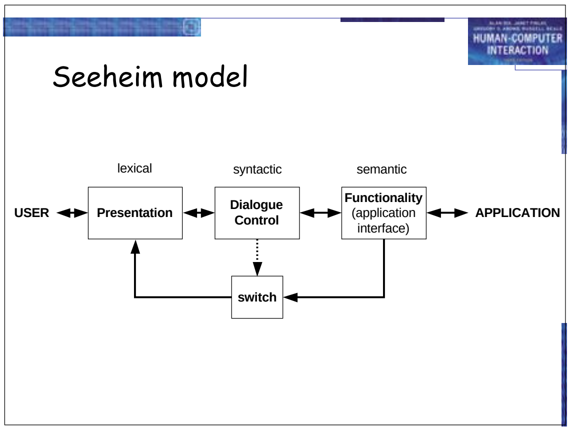
UIMS as conceptual architecture

- *separation* between application semantics and presentation
- improves:
  - portability – runs on different systems
  - reusability – components reused cutting costs
  - multiple interfaces – accessing same functionality
  - customizability – by designer and user

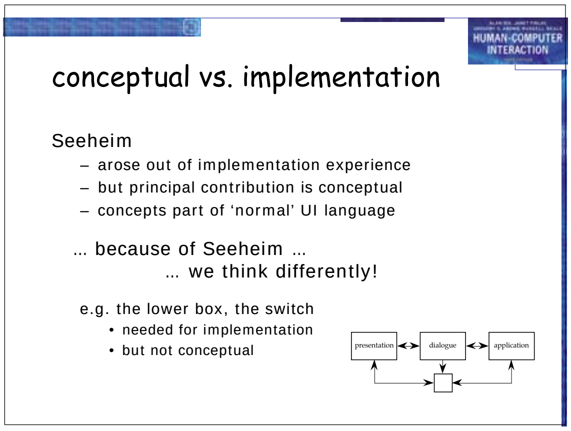


UIMS tradition – interface layers / logical components

- linguistic: lexical/syntactic/semantic
- Seeheim:
- Arch/Slinky



Seeheim model



conceptual vs. implementation

Seeheim

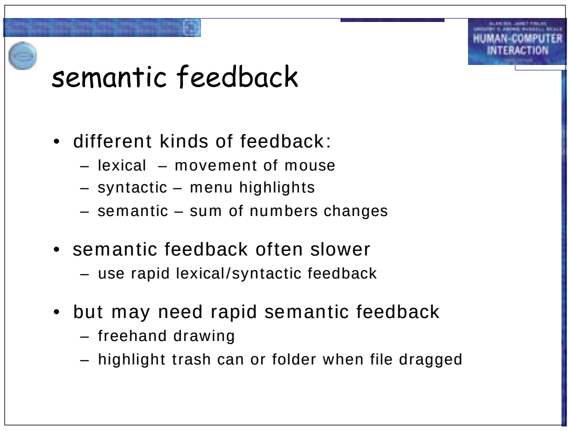
- arose out of implementation experience
- but principal contribution is conceptual
- concepts part of ‘normal’ UI language

… because of Seeheim …
… we think differently!

e.g. the lower box, the switch

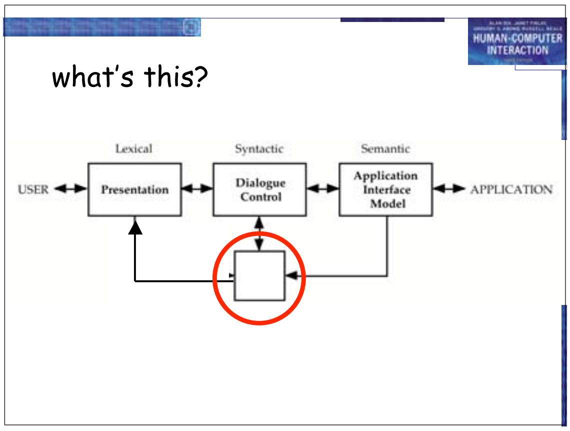
- needed for implementation
- but not conceptual

presentation
dialogue
application

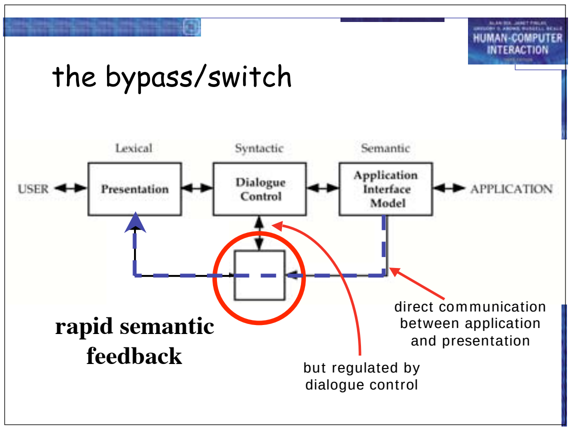


semantic feedback

- different kinds of feedback:
  - lexical – movement of mouse
  - syntactic – menu highlights
  - semantic – sum of numbers changes
- semantic feedback often slower
  - use rapid lexical/syntactic feedback
- but may need rapid semantic feedback
  - freehand drawing
  - highlight trash can or folder when file dragged



what’s this?



the bypass/switch

Lexical

Syntactic

Semantic

USER

Presentation

Dialogue Control

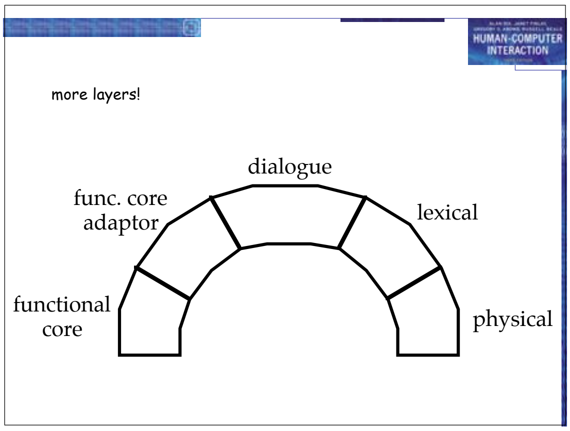
Application Interface Model

APPLICATION

rapid semantic feedback

direct communication between application and presentation

but regulated by dialogue control



more layers!

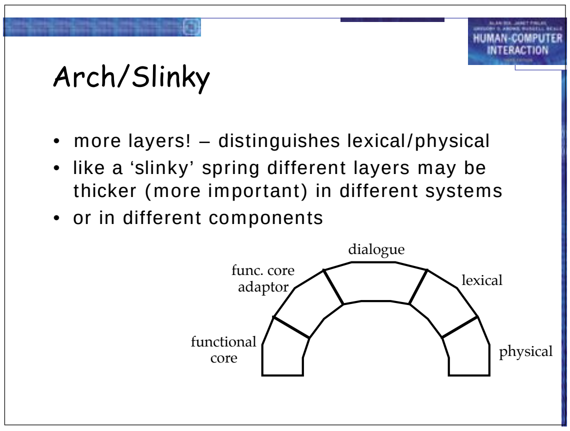
dialogue

func. core adaptor

lexical

functional core

physical



Arch/Slinky

- more layers! – distinguishes lexical/physical
- like a 'slinky' spring different layers may be thicker (more important) in different systems
- or in different components

dialogue

func. core adaptor

lexical

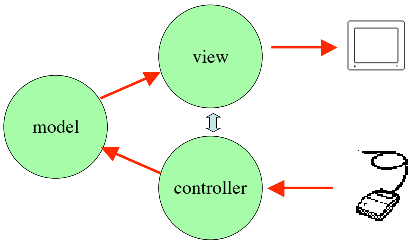
functional core

physical

monolithic vs. components

- Seeheim has big components
- often easier to use smaller ones
  - esp. if using object-oriented toolkits
- Smalltalk used MVC – model–view–controller
  - model – internal logical state of component
  - view – how it is rendered on screen
  - controller – processes user input

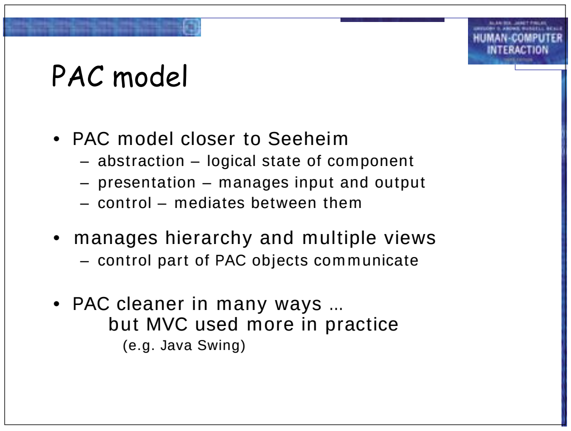
MVC
model - view - controller



MVC issues

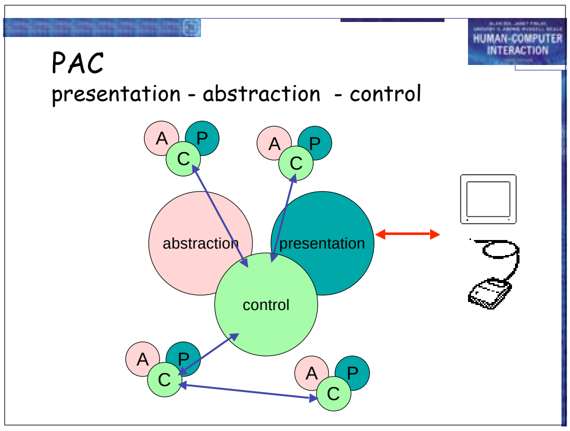
- MVC is largely pipeline model:
  input → control → model → view → output
- but in graphical interface
  - input only has meaning in relation to output

  e.g. mouse click
  - need to know *what* was clicked
  - controller has to decide what to do with click
  - but view knows what is shown where!
- in practice controller ‘talks’ to view
  - separation not complete

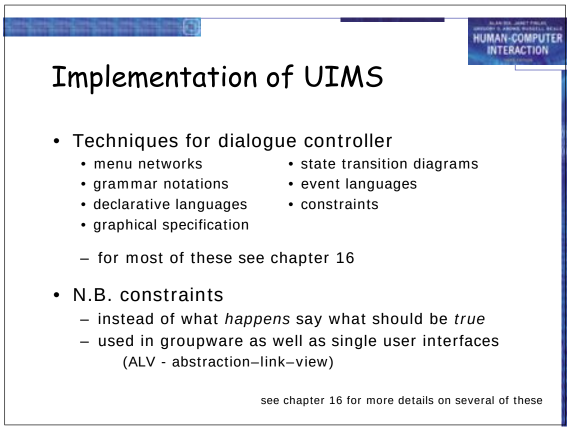


PAC model

- PAC model closer to Seeheim
  - abstraction – logical state of component
  - presentation – manages input and output
  - control – mediates between them
- manages hierarchy and multiple views
  - control part of PAC objects communicate
- PAC cleaner in many ways …
  but MVC used more in practice
  (e.g. Java Swing)



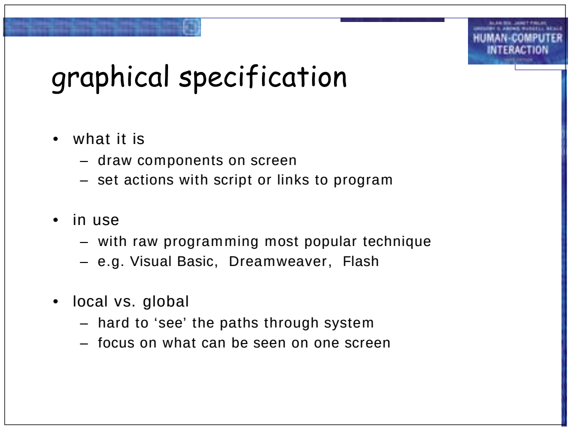
PAC
presentation - abstraction - control



Implementation of UIMS

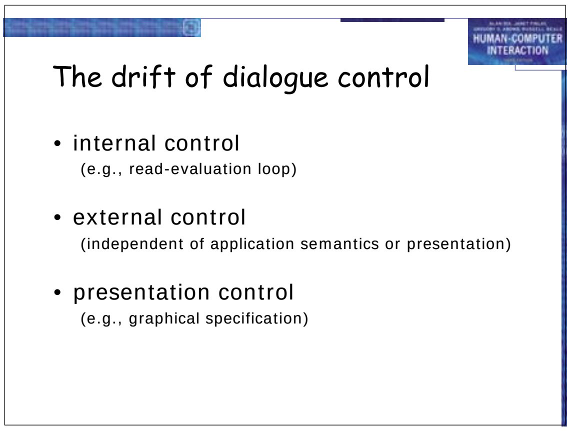
- Techniques for dialogue controller
  - menu networks
  - grammar notations
  - declarative languages
  - graphical specification
  - state transition diagrams
  - event languages
  - constraints
  - for most of these see chapter 16
- N.B. constraints
  - instead of what *happens* say what should be *true*
  - used in groupware as well as single user interfaces
    (ALV - abstraction–link–view)

see chapter 16 for more details on several of these



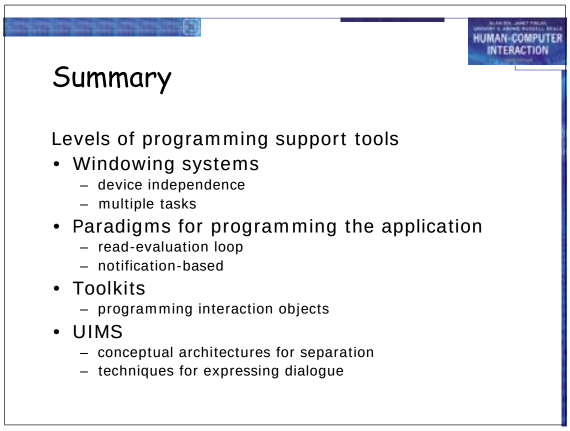
graphical specification

- what it is
  - draw components on screen
  - set actions with script or links to program
- in use
  - with raw programming most popular technique
  - e.g. Visual Basic, Dreamweaver, Flash
- local vs. global
  - hard to 'see' the paths through system
  - focus on what can be seen on one screen



The drift of dialogue control

- internal control
  (e.g., read-evaluation loop)
- external control
  (independent of application semantics or presentation)
- presentation control
  (e.g., graphical specification)



Summary

Levels of programming support tools

- Windowing systems
  - device independence
  - multiple tasks
- Paradigms for programming the application
  - read-evaluation loop
  - notification-based
- Toolkits
  - programming interaction objects
- UIMS
  - conceptual architectures for separation
  - techniques for expressing dialogue