Implementation support
chapter 8

- 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

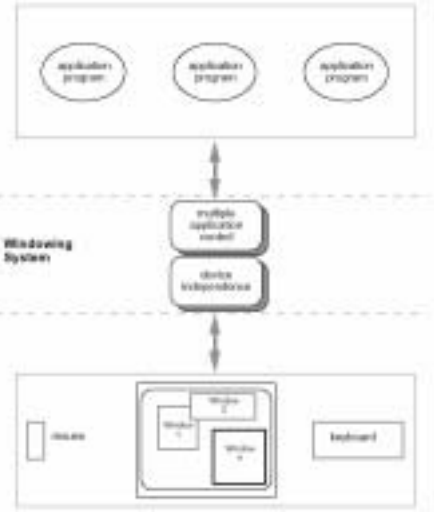
Layers of development tools
- windowing systems (operating systems)
- interaction toolkits
- user interface management systems

Elements of windowing systems

Device independence
programming the abstract terminal device drivers
image models for output and (partially) input

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

roles of a windowing system

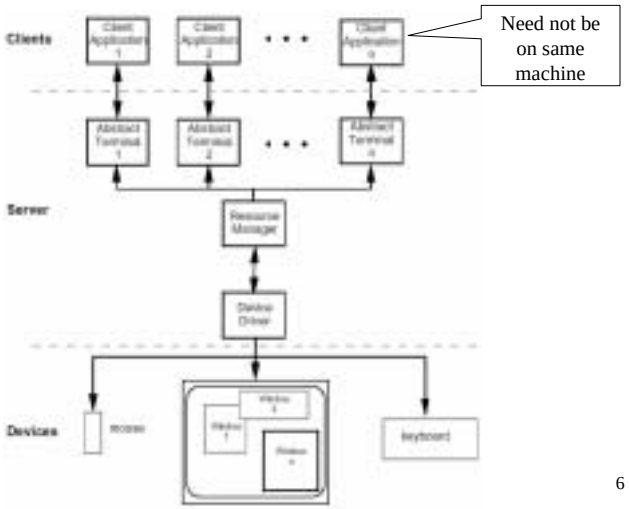


Architectures of windowing systems

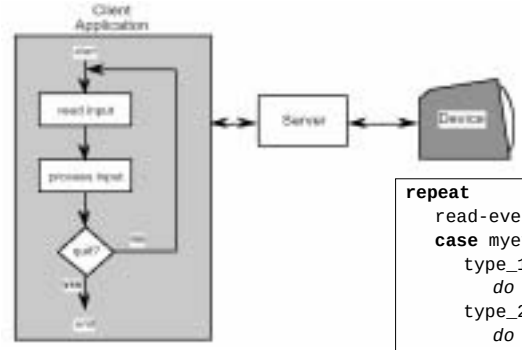
three possible software architectures
- all assume device driver is separate
- differ in how multiple application management is implemented

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



Programming the application
read-evaluation loop (macs)



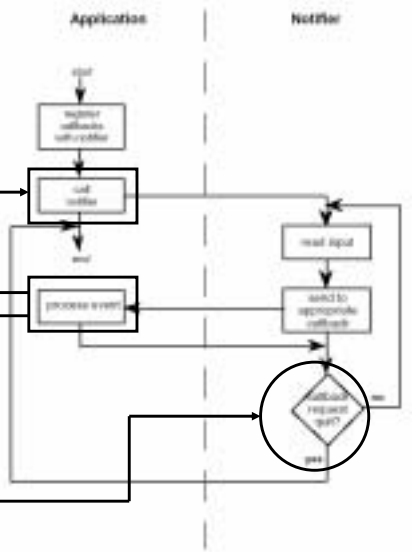

```
repeat
   read-event(myevent)
   case myevent.type
      type_1:
         do type_1 processing
      type_2:
         do type_2 processing
      ...
      type_n:
         do type_n processing
   end case
end repeat
```


Programming the application
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

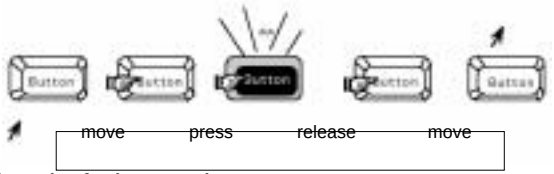
- system style affects the interfaces
  - modal dialogue box
    - easy with event-loop (just have extra read-event loop)
    - hard with notification (need lots of mode flags)
  - non-modal dialogue box
    - hard with event-loop (very complicated main loop)
    - easy with notification (just add extra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

UI development environment (UIDE)

- e.g. Visual Studio, Delphi
  - Provide high level of support for programmer
- but
  - Usually operating system specific

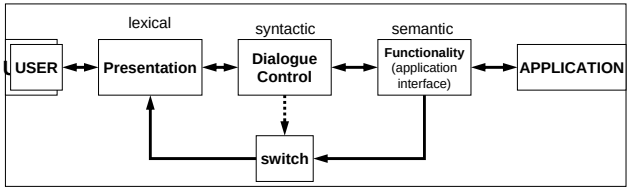
User Interface Management Systems (UIMS)

- UIMS add another level above toolkits
  - toolkits too difficult for non-programmers
- roles of UIMS
  - conceptual architecture
  - implementation techniques
  - support infrastructure

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
- These issues will be more important as 'anytime anywhere' computing becomes a reality

Seeheim model

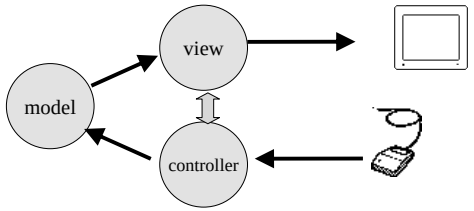


- arose out of implementation experience
- but principal contribution is conceptual
- concepts part of 'normal' UI language

e.g. the lower box, the switch
- needed for implementation
- but not conceptual

MVC

model - view - controller

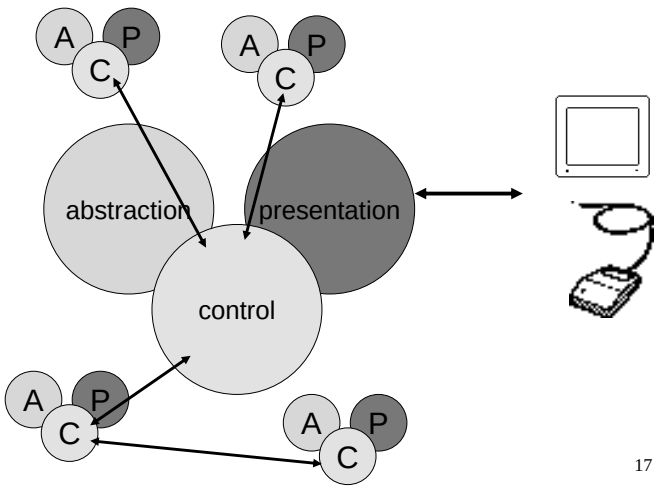


- MVC is largely pipeline model:
  input → control → model → view → output
- but in graphical interface
  - input only has meaning in relation to output

  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

presentation - abstraction - control



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)

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

Trend
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