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?

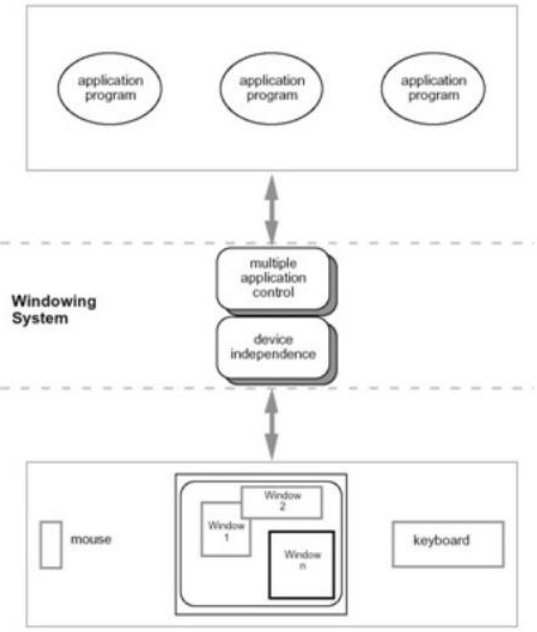
- Advances in coding have elevated programming
  - hardware specific
    → interaction-technique specific

- 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

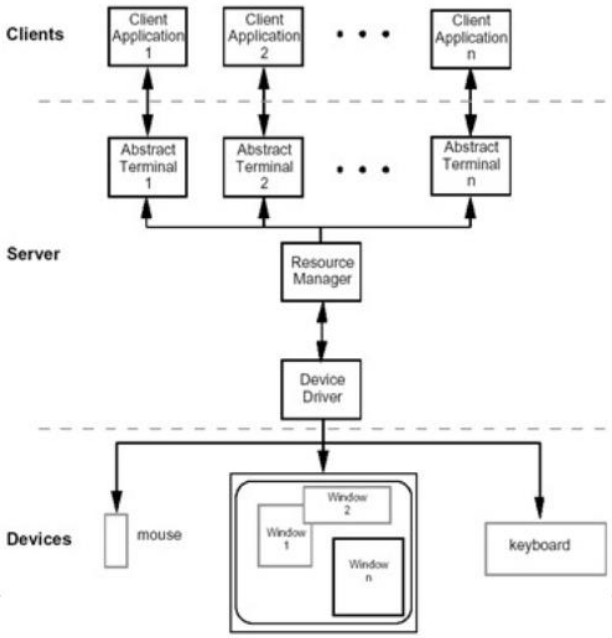
- three possible software architectures
  - all assume device driver is separate
  - differ in how multiple application management is implemented

- 1. each application manages all processes
  - everyone worries about synchronization
  - reduces portability of applications

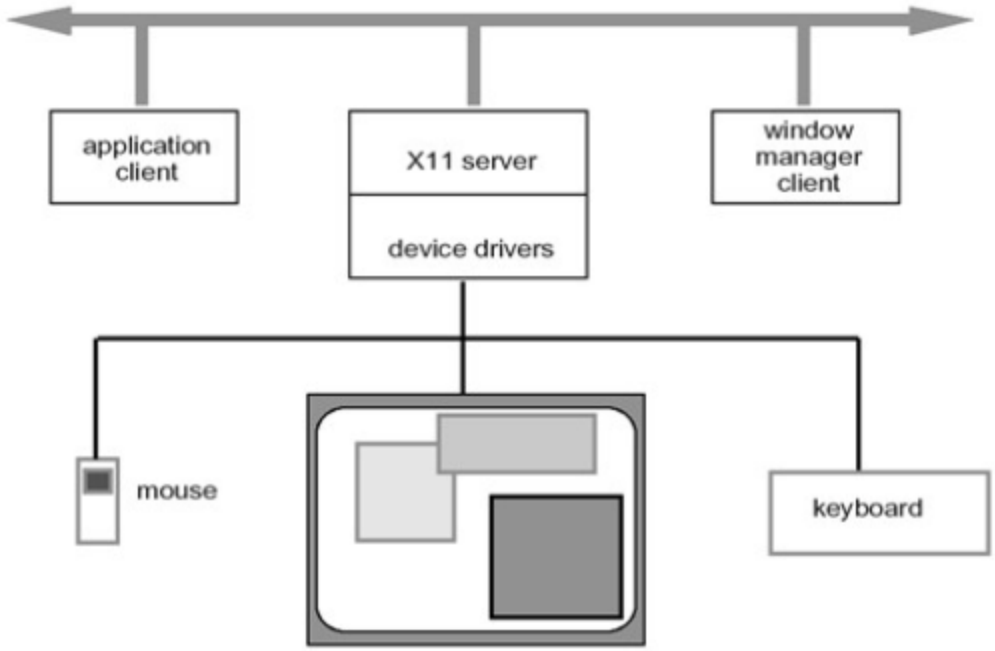
- 2. management role within kernel of operating system
  - applications tied to operating system

- 3. management role as separate application
  maximum portability

The client-server architecture

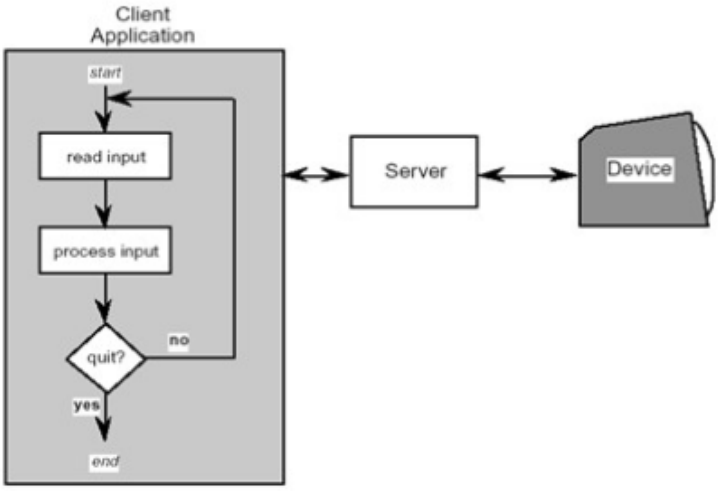


X Windows architecture



- 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

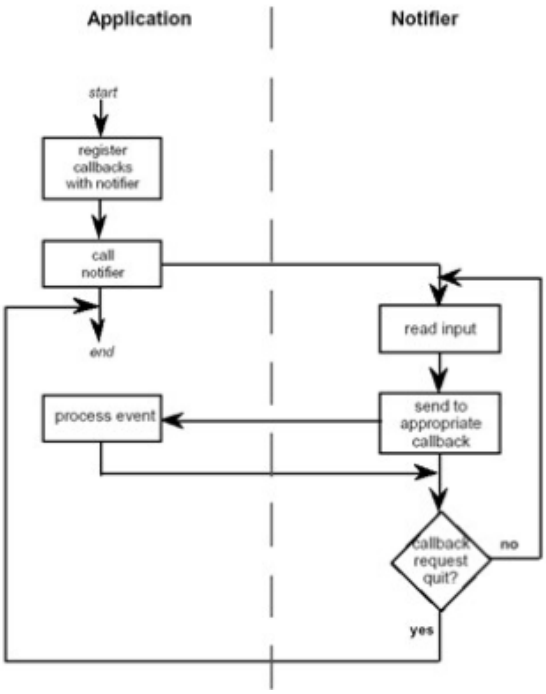
Programming the application - 1
read-evaluation loop




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

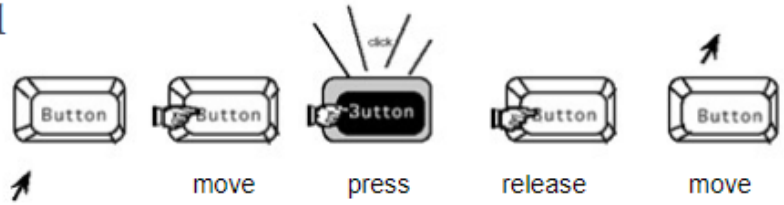
Programming the application - 1
notification-based

```
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
}
```



Using toolkits

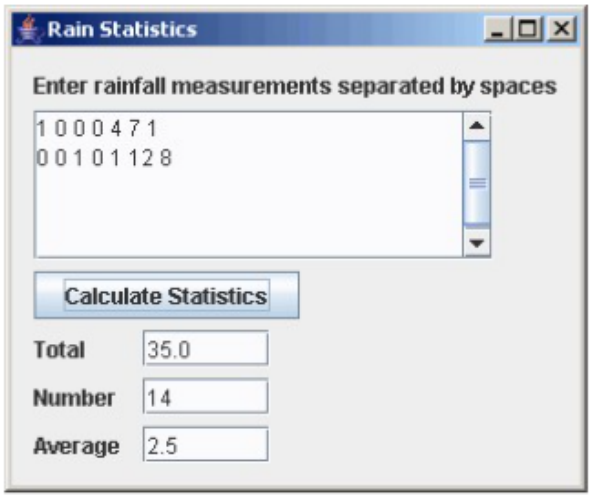
- Interaction objects
  - input and output intrinsically linked



- 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 System

- A UIMS (User Interface Management System) should be thought of as a software architecture "in which the implementation of an application's user interface is clearly separated from that of the application's underlying functionality" (Rosenberg 1988: p. 42)
- Examples:
  - Model-View-Controller
  - The linguistic model (Foley 1990),
  - the Seeheim model (first introduced in Green 1985),
  - the Higgins UIMS (described in Hudson and King 1988),
  - and the Arch model (a specialisation of the Seeheim model; see Coutaz et al. 1995, Coutaz 1987, and Coutaz 1997).

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

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