Implementation support

Overview

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

Introduction

Up to now, our concern has been slanted away from concerns of the actual programmer.

Advances in coding have elevated programming from hardware-specific to 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
- Graphical Kernel System (GKS)
- Programmers' Hierarchical Interface to Graphics (PHIGS)
- PostScript

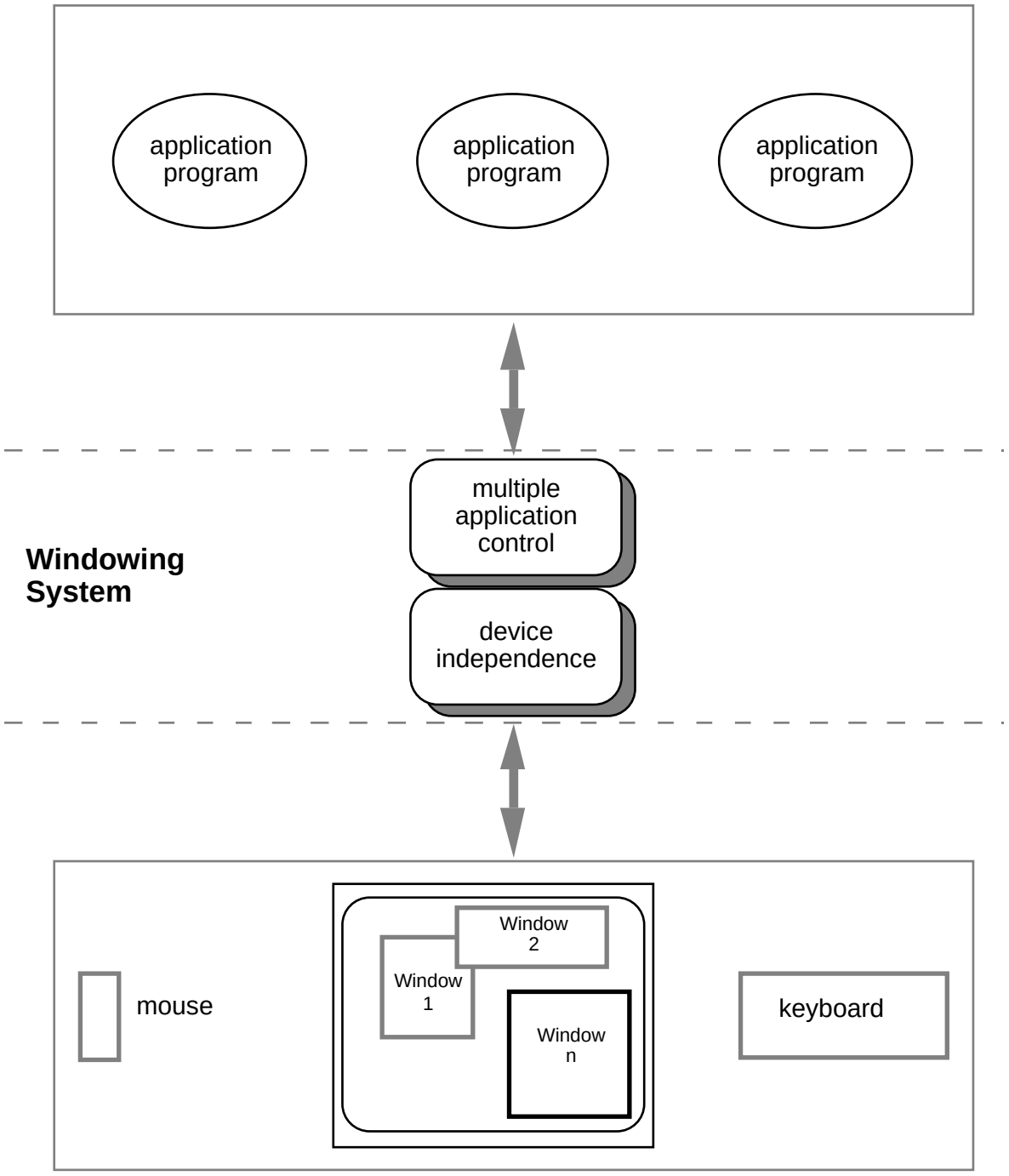
Resource sharing

achieving simultaneity of user tasks

window system supports independent processes

isolation of individual applications

The roles of a windowing system



Architectures of windowing systems

3 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

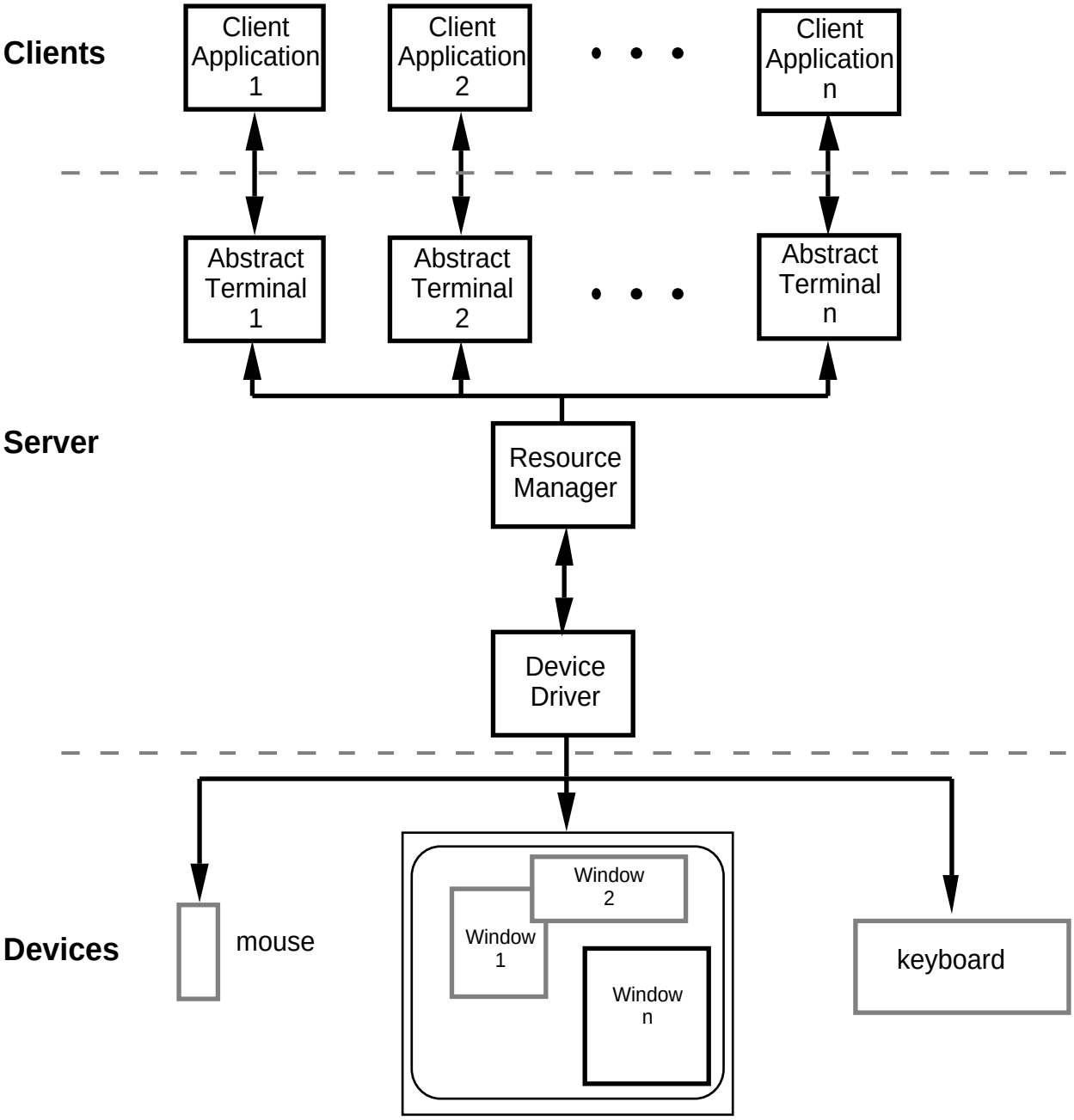
   applications tied to operating system

3. management role as separate application

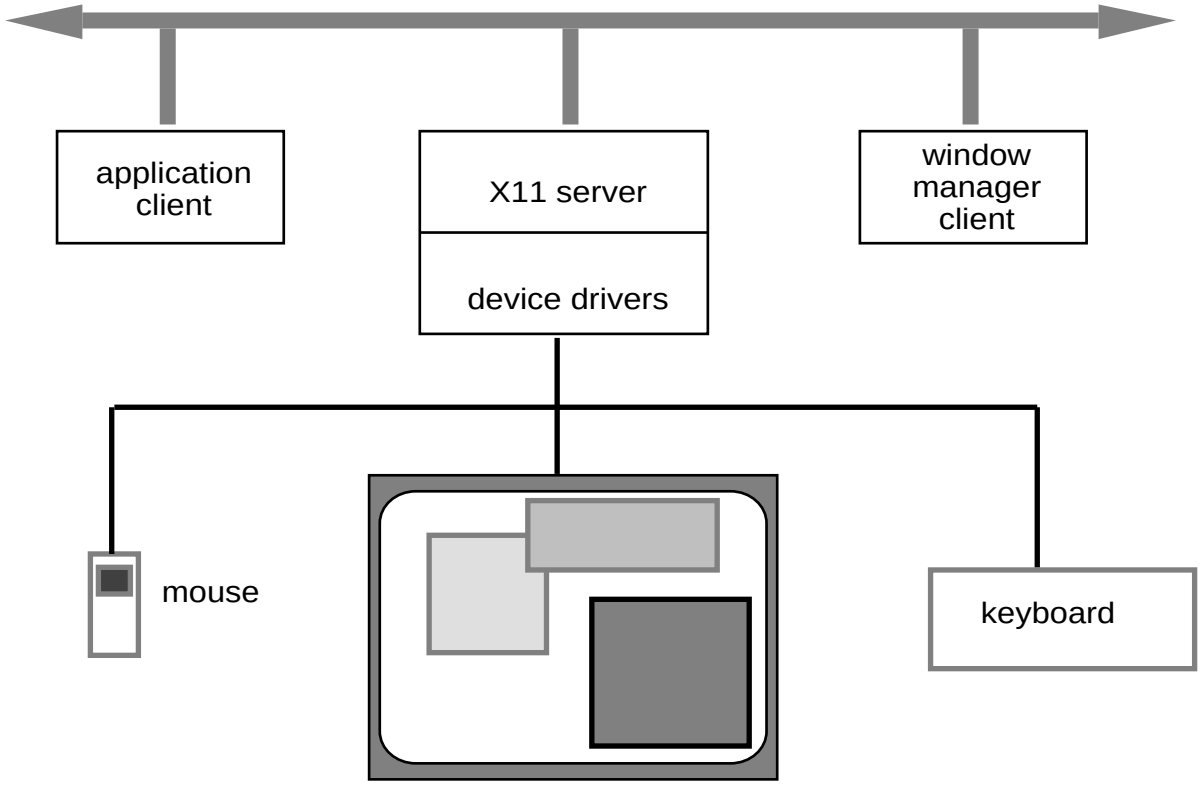
   maximum portability

   the client-server architecture

The client-server architecture



The X Window System architecture



pixel imaging model with some pointing mechanism

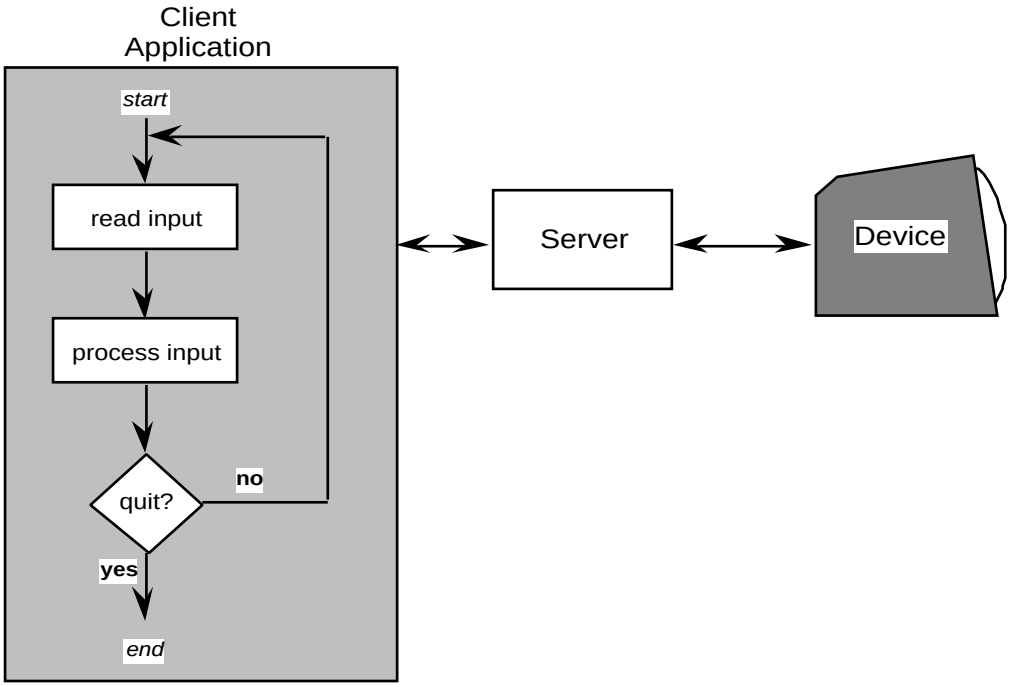
X protocol defines server-client communication

separate window manager client enforces policies for input/output:

- how to change input focus
- tiled vs. overlapping windows
- inter-client data transfer

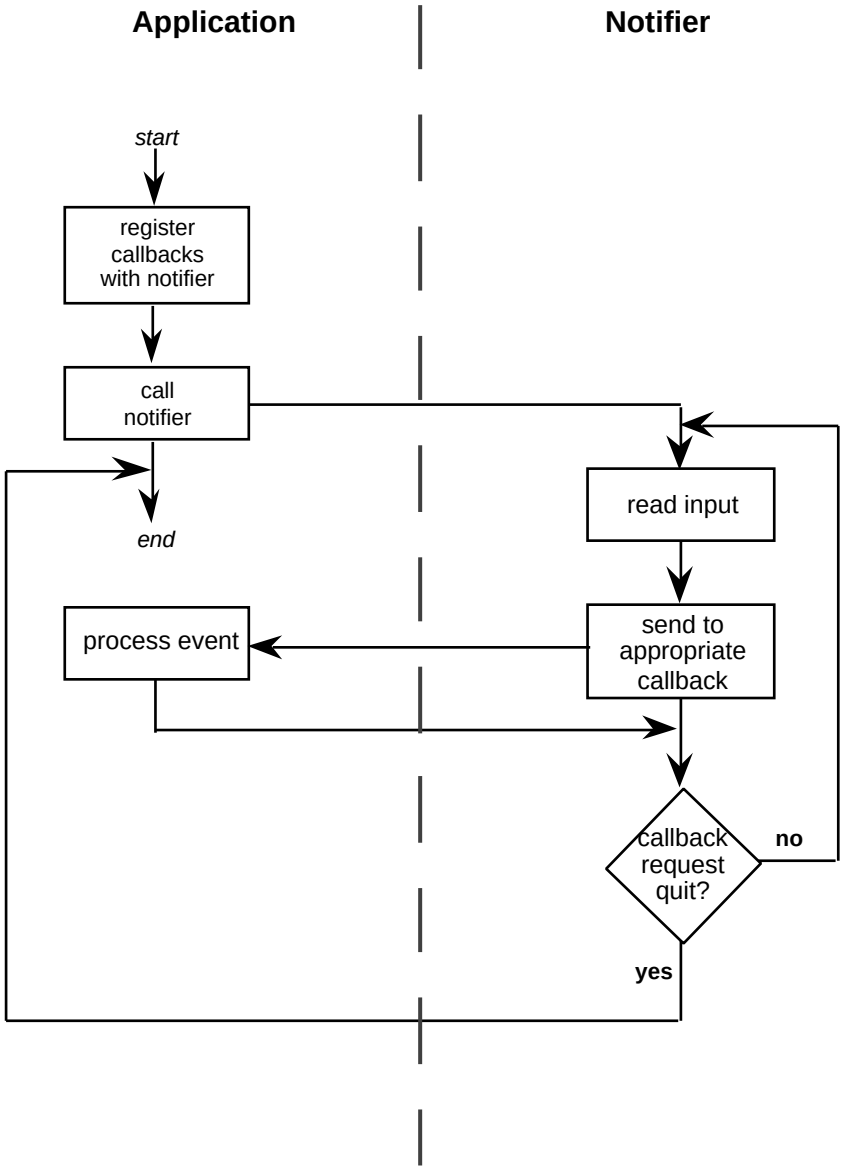
2 programming paradigms

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
```

2. notification-based

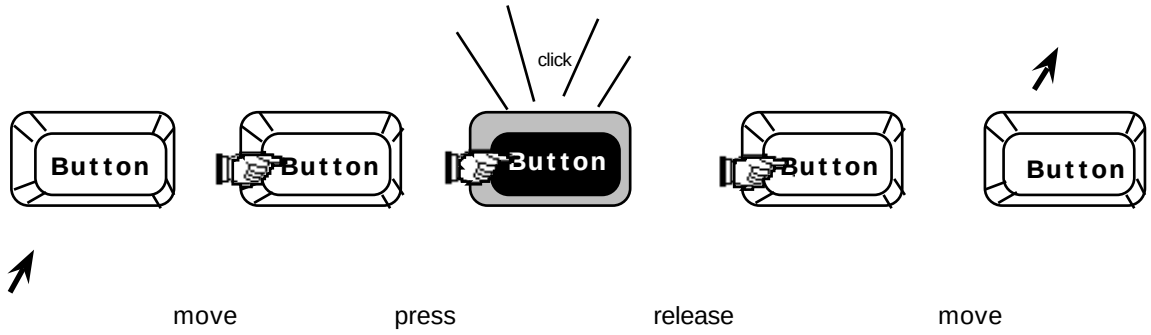


see Figure 10.6 for sample program

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

User Interface Management Systems

UIMS add another level above toolkits

toolkits too difficult for non-programmers

alternatively:

- UI development system (UIDS)
- UI development environment (UIDE)

As a conceptual architecture

provides separation between application semantics and presentation, improving:

- portability
- reusability
- multiple interfaces
- customizability

identifies roles (e.g., Seeheim)

- presentation component
- dialogue control
- application interface model

Implementation of UIMS

Techniques for dialogue controller

menu networks

grammar notations

state transition diagrams

event languages

declarative languages

constraints

graphical specification

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