

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Systems Programming
Code No. : CS-331

Semester III

Total Lectures : 48

Aim : To understand the design and implementation issues of System programs that play an important role in program development.

Objectives :

- To understand the design structure of a simple editor.
- To understand the design structure of Assembler and macro processor for an hypothetical simulated computer.
- To understand the working of linkers and loaders and other development utilities.
- To understand Complexity of Operating system as a software.

1. Introduction

[4]

- 1.1. Types of program – System program and Application program.
- 1.2. Difference between system programming and application programming.
- 1.3. Elements of Programming environment - Editor, Preprocessor, Assembler, Compiler, Interpreter, Linker and Loader, Debugger, Device drivers, Operating System.
- 1.4. Simulation of simple computer smac0 (hypothetical computer) -Memory, Registers, Condition Codes, Instruction format, Instruction Set, smac0 programs.

2. Editors

[2]

- 2.1 Definition, need/purpose of editor.
- 2.2 Types of editor- Examples ed, sed, VIM & emacs
- 2.3 Structure of editor

3. Assembler

[10]

- 3.1 Definition.
- 3.2 Features of assembly language, advantages
- 3.3 Statement format, types of statements – Imperative, Declarative, Assembler Directive.
- 3.4 Constants and Literals.
- 3.5 Advanced assembler directives (LTORG, ORIGIN, EQU),
- 3.6 Design of assembler – Analysis Phase and Synthesis Phase.
- 3.7 Overview of assembling process
- 3.8 Pass Structure of Assembler – One pass, Two pass assembler.
- 3.9 Problems of 1-pass assembler - forward reference, efficiency, Table of Incomplete Instructions.
- 3.10 Design of 2-pass Assembler – Pass-I and Pass-II
- 3.11 Data structure of 2-pass assembler.
- 3.12. Intermediate Code – Need, Forms-variant I and Variant II

4. Macros and Macro Processors

[10]

- 4.1 Definition
- 4.2 Macro definition and call
- 4.3 Macro expansion – positional and keyword parameters
- 4.4 Design of Data structures to be used for Macro definition and use
- 4.5 Nested macro calls
- 4.6 Advanced macro facilities – alteration of flow of control during expansion, expansion time variable, conditional expansion, expansion time loops. (with examples)
- 4.7 Design of macro preprocessor – Design overview, data structure, processing of macro definition and macro expansion (Except algorithms)

4.8 Macro assembler – Comparison of macro preprocessor and macro assembler. Pass structure of macro assembler.

5. Compiler Design options [2]

5.1 Interpreter - Use of interpreter, definition, Comparison with compiler, Overview of interpretation, Pure and impure interpreter.

5.2 P-code compiler

6. Linker and Loader [6]

6.1 Introduction

6.2 Concept of bindings, static and dynamic binding, translated, linked and load time addresses.

6.3 Relocation and linking concept – program relocation, performing relocation, public and external references, linking, binary program, object module.

6.4 Relocatability - nonrelocatable, relocatable, and self relocating programs (no algorithms), Linking for Overlays.

6.5 Object file formats: a.out, ELF, COFF, EXE, PE and COM

7. Debuggers & Development utilities [6]

7.1 Debugging functions and capabilities

7.2 Types of debuggers: visual & console -Case study of ddd(visual) and gdb(console)

7.3 Development utilities on UNIX/Linux strip, make, nm, objdump, intermediate files in compilation process etc.

8. Operating System as System Software [6]

8.1 What Operating Systems Do – User View, System View, Defining OS

8.2 Computer System Architecture – Single processor system, Multiprocessor systems, Clustered Systems

8.3 Operating System Operations – Dual mode operation, Timer

8.4 Process Management

8.5 Memory Management

8.6 Storage Management – File system management, Mass storage management, Caching, I/O systems

8.7 Protection and Security

8.8 Distributed Systems

8.9 Special Purpose System – Real time embedded systems, Multimedia systems, Handheld systems,

8.10 Computer Environment – Traditional computing, Client server computing, Peer to peer Computing

9. System Structure [2]

9.1 Operating System Services

9.2 User Operating-System Interface – Command interpreter, GUI

9.3 System Calls

9.4 Types of System Calls – Process control, File management, Device management, Information maintenance, Communication, Protection

Reference Books:

1. Systems Programming and Operating Systems by D.M.Dhamdhare (Second Revised Edition). [Chapters: 2, 3, 4, 5, 7]

2. System Software - An introduction to Systems Programming - Leland L. Beck (Pearson Education) [Chapter: 1]

3. Linkers and Loaders – John R. Levine, Elsevier Morgan Kaufmann[chapter 6]

4. Operating System Concepts - Siberchatz, Galvin, Gagne (8th Edition).[chapter 8, 9]

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Operating Systems
Code No. : CS-341

Semester IV

Total Lectures : 48

Aim : To understand the design and implementation issues of Operating System.

Objectives :

- To understand design issues related to process management and various related algorithms
- To understand design issues related to memory management and various related algorithms
- To understand design issues related to File management and various related algorithms

1. Introduction **[2]**

- 1.1 Operating System Structure – Simple structure, Layered approach, Micro kernels, Modules
- 1.2 Virtual Machines – Introduction, Benefits
- 1.3 System Boot

2. Process Management **[4]**

- 2.1 Process Concept – The process, Process states, Process control block.
- 2.2 Process Scheduling – Scheduling queues, Schedulers, context switch
- 2.3 Operations on Process – Process creation with program using fork(), Process termination
- 2.4 Interprocess Communication – Shared memory system, Message passing systems.

3. Multithreaded Programming **[2]**

- 3.1 Overview
- 3.2 Multithreading Models

4. Process Scheduling **[8]**

- 4.1 Basic Concept – CPU-I/O burst cycle, CPU scheduler, Preemptive scheduling, Dispatcher
- 4.2 Scheduling Criteria
- 4.3 Scheduling Algorithms – FCFS, SJF, Priority scheduling, Round-robin scheduling, Multiple queue scheduling, Multilevel feedback queue scheduling
- 4.4 Thread Scheduling

5. Process Synchronization **[6]**

- 5.1 Background
- 5.2 Critical Section Problem
- 5.3 Semaphores: Usage, Implementation
- 5.4 Classic Problems of Synchronization – The bounded buffer problem, The reader writer problem, The dining philosopher problem

6. Deadlocks **[8]**

- 6.1 System model
- 6.2 Deadlock Characterization – Necessary conditions, Resource allocation graph
- 6.3 Deadlock Prevention
- 6.4 Deadlock Avoidance - Safe state, Resource allocation graph algorithm, Banker's Algorithm
- 6.5 Deadlock Detection
- 6.6 Recovery from Deadlock – Process termination, Resource preemption

7. Memory Management **[11]**

- 7.1. Background – Basic hardware, Address binding, Logical versus physical address space, Dynamic loading, Dynamic linking and shared libraries

7.2 Swapping

7.3 Contiguous Memory Allocation – Memory mapping and protection, Memory allocation, Fragmentation

7.4 Paging – Basic Method, Hardware support, Protection, Shared Pages

7.5 Segmentation – Basic concept, Hardware

7.6 Virtual Memory Management – Background, Demand paging, Performance of demand paging, Page replacement – FIFO, OPT, LRU, Second chance page replacement

8. File System

[7]

8.1 File concept

8.2 Access Methods – Sequential, Direct, Other access methods

8.3 Directory and Disk Structure – Storage structure, Directory overview, Single level directory, Two level directory, Tree structure directory, Acyclic graph directory, General graph directory

8.4 Allocation Methods – Contiguous allocation, Linked allocation, Indexed allocation

8.5 Free Space Management – Bit vector, Linked list, Grouping, Counting, Space maps

Reference Books:

1. Operating System Concepts - Silberchatz, Galvin, Gagne (8th Edition).

2. Operating Systems : Principles and Design – Pabitra Pal Choudhary (PHI Learning Private Limited)
