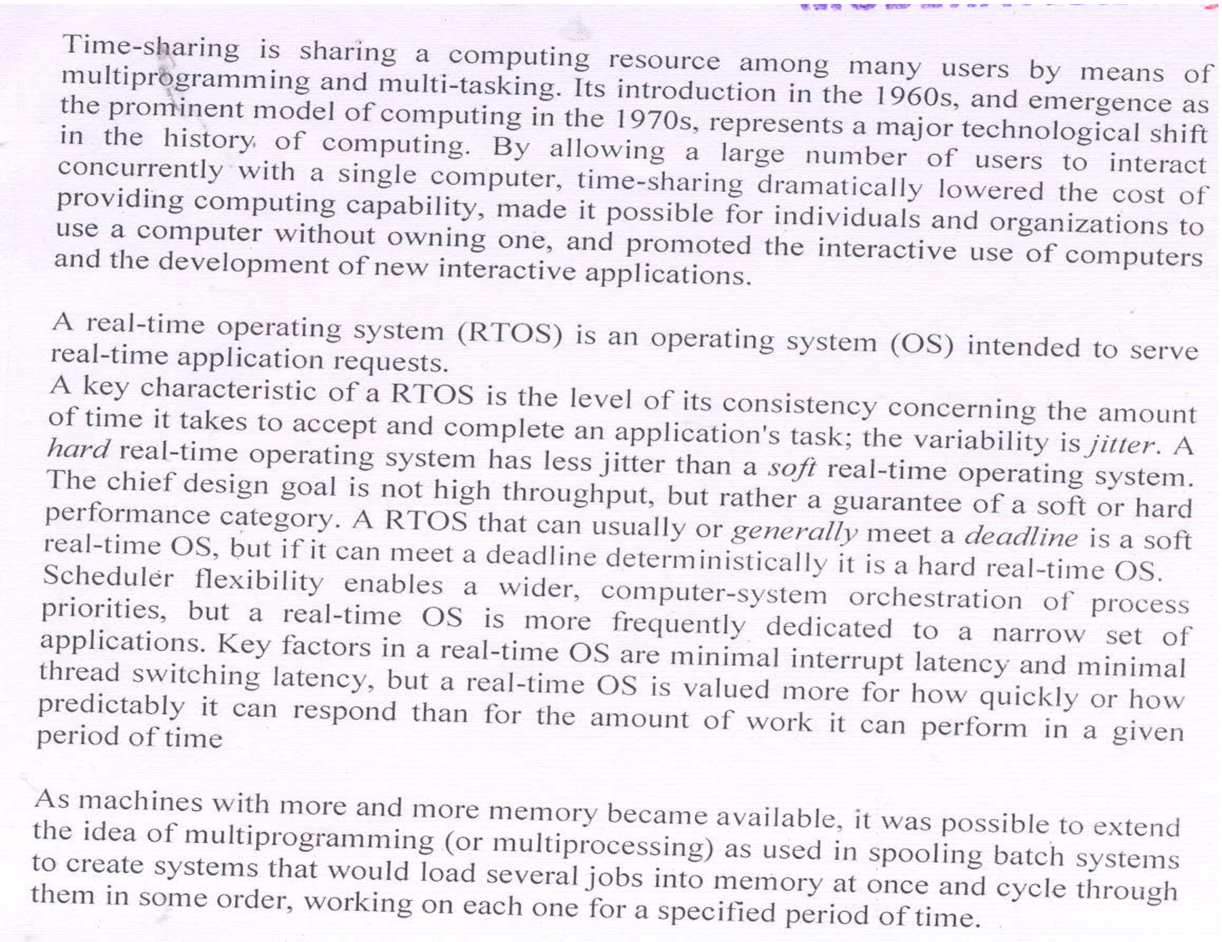
Q.2a. Define Process. With the help of figure explain the fundamental state transitions for a process.

Ans : Page 320, 322-323 of text book

b.Explain the following terms: (any three)

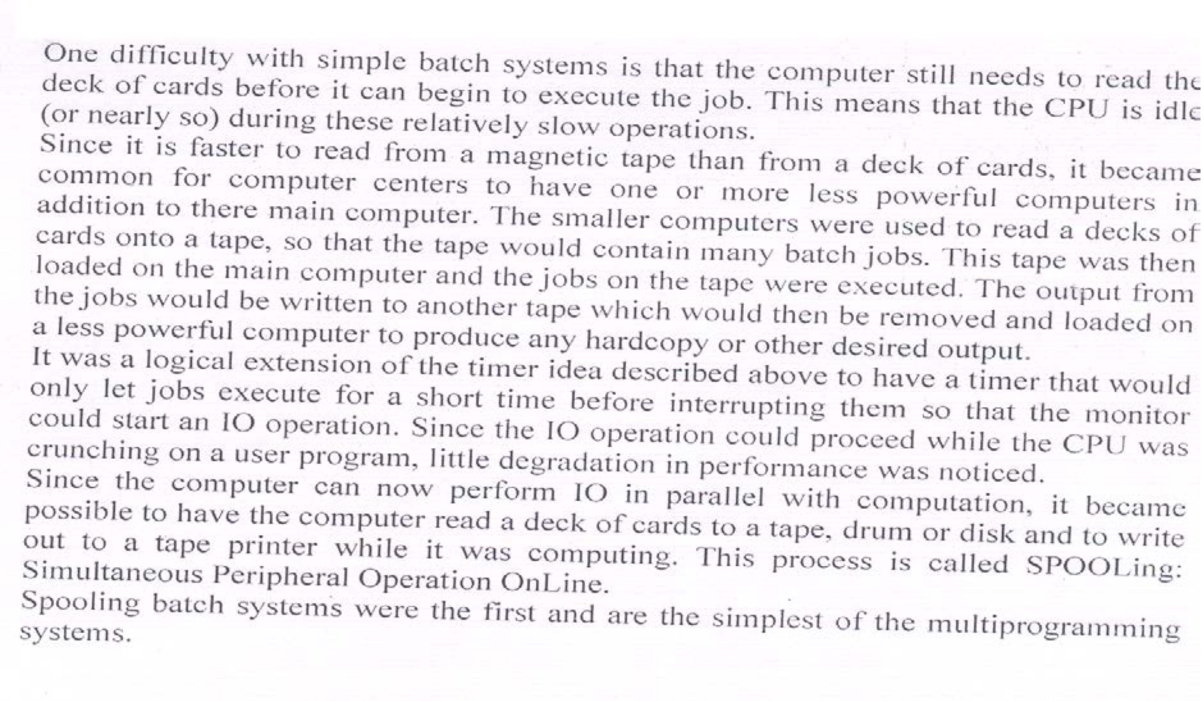
(i)Time sharing OS
(ii)Multiprogramming systems
(iii)Real time OS
(iv)SPOOLING



Time-sharing is sharing a computing resource among many users by means of multiprogramming and multi-tasking. Its introduction in the 1960s, and emergence as the prominent model of computing in the 1970s, represents a major technological shift in the history of computing. By allowing a large number of users to interact concurrently with a single computer, time-sharing dramatically lowered the cost of providing computing capability, made it possible for individuals and organizations to use a computer without owning one, and promoted the interactive use of computers and the development of new interactive applications.

A real-time operating system (RTOS) is an operating system (OS) intended to serve real-time application requests.
A key characteristic of a RTOS is the level of its consistency concerning the amount of time it takes to accept and complete an application's task; the variability is *jitter*. A *hard* real-time operating system has less jitter than a *soft* real-time operating system. The chief design goal is not high throughput, but rather a guarantee of a soft or hard performance category. A RTOS that can usually or *generally* meet a *deadline* is a soft real-time OS, but if it can meet a deadline deterministically it is a hard real-time OS. Scheduler flexibility enables a wider, computer-system orchestration of process priorities, but a real-time OS is more frequently dedicated to a narrow set of applications. Key factors in a real-time OS are minimal interrupt latency and minimal thread switching latency, but a real-time OS is valued more for how quickly or how predictably it can respond than for the amount of work it can perform in a given period of time

As machines with more and more memory became available, it was possible to extend the idea of multiprogramming (or multiprocessing) as used in spooling batch systems to create systems that would load several jobs into memory at once and cycle through them in some order, working on each one for a specified period of time.



One difficulty with simple batch systems is that the computer still needs to read the deck of cards before it can begin to execute the job. This means that the CPU is idle (or nearly so) during these relatively slow operations.

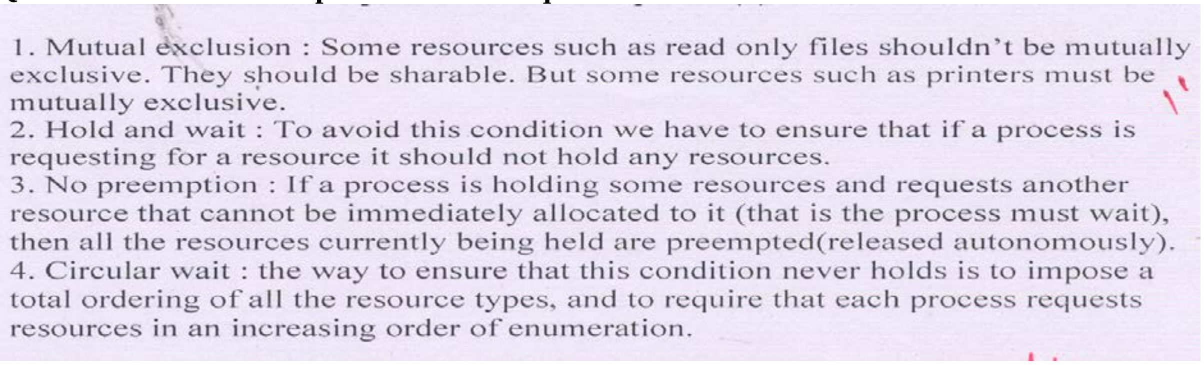
Since it is faster to read from a magnetic tape than from a deck of cards, it became common for computer centers to have one or more less powerful computers in addition to there main computer. The smaller computers were used to read a decks of cards onto a tape, so that the tape would contain many batch jobs. This tape was then loaded on the main computer and the jobs on the tape were executed. The output from the jobs would be written to another tape which would then be removed and loaded on a less powerful computer to produce any hardcopy or other desired output.

It was a logical extension of the timer idea described above to have a timer that would only let jobs execute for a short time before interrupting them so that the monitor could start an IO operation. Since the IO operation could proceed while the CPU was crunching on a user program, little degradation in performance was noticed.

Since the computer can now perform IO in parallel with computation, it became possible to have the computer read a deck of cards to a tape, drum or disk and to write out to a tape printer while it was computing. This process is called SPOOLing: Simultaneous Peripheral Operation OnLine.

Spooling batch systems were the first and are the simplest of the multiprogramming systems.

Q.3a. What are deadlock prevention techniques?



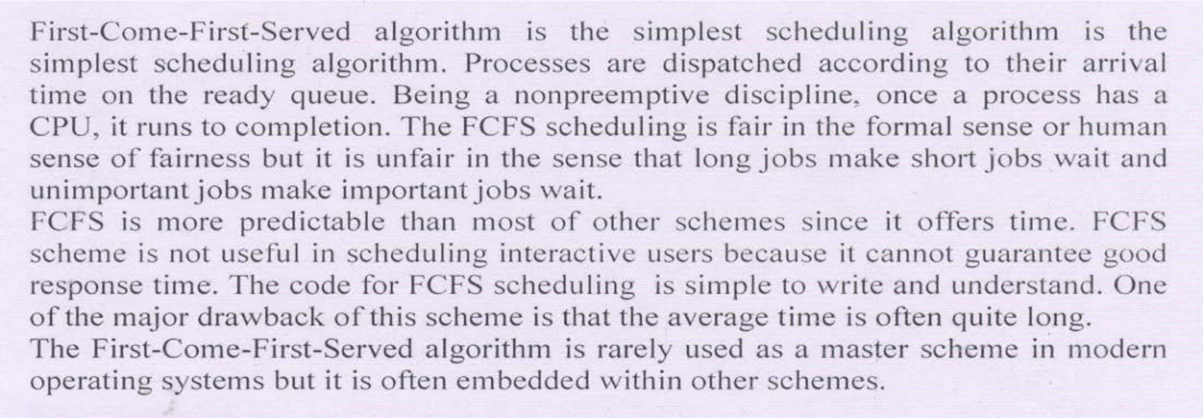
1. Mutual exclusion : Some resources such as read only files shouldn't be mutually exclusive. They should be sharable. But some resources such as printers must be mutually exclusive.

2. Hold and wait : To avoid this condition we have to ensure that if a process is requesting for a resource it should not hold any resources.

3. No preemption : If a process is holding some resources and requests another resource that cannot be immediately allocated to it (that is the process must wait), then all the resources currently being held are preempted(released autonomously).

4. Circular wait : the way to ensure that this condition never holds is to impose a total ordering of all the resource types, and to require that each process requests resources in an increasing order of enumeration.

b.Describe the FCFS scheduling algorithm.



First-Come-First-Served algorithm is the simplest scheduling algorithm is the simplest scheduling algorithm. Processes are dispatched according to their arrival time on the ready queue. Being a nonpreemptive discipline, once a process has a CPU, it runs to completion. The FCFS scheduling is fair in the formal sense or human sense of fairness but it is unfair in the sense that long jobs make short jobs wait and unimportant jobs make important jobs wait.

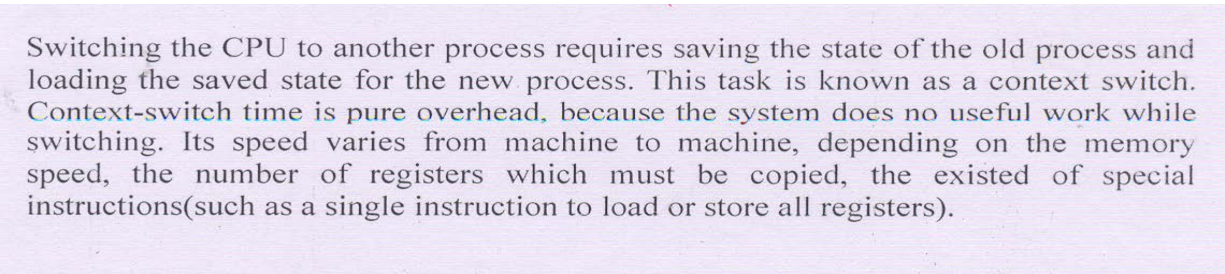
FCFS is more predictable than most of other schemes since it offers time. FCFS scheme is not useful in scheduling interactive users because it cannot guarantee good response time. The code for FCFS scheduling is simple to write and understand. One of the major drawback of this scheme is that the average time is often quite long.

The First-Come-First-Served algorithm is rarely used as a master scheme in modern operating systems but it is often embedded within other schemes.

c.Write the algorithm for deadlock detection? Also give the data structures used in the algorithm.

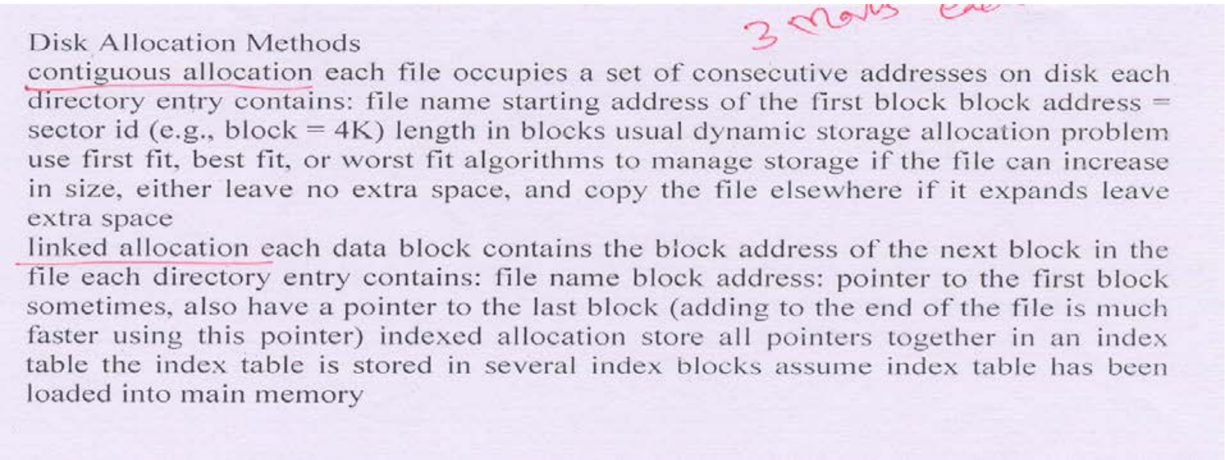
Ans : Page 384 & 385 of text book

Q.4a. What is Context Switch?



Switching the CPU to another process requires saving the state of the old process and loading the saved state for the new process. This task is known as a context switch. Context-switch time is pure overhead, because the system does no useful work while switching. Its speed varies from machine to machine, depending on the memory speed, the number of registers which must be copied, the existed of special instructions(such as a single instruction to load or store all registers).

b.Explain the allocation method of disk space.



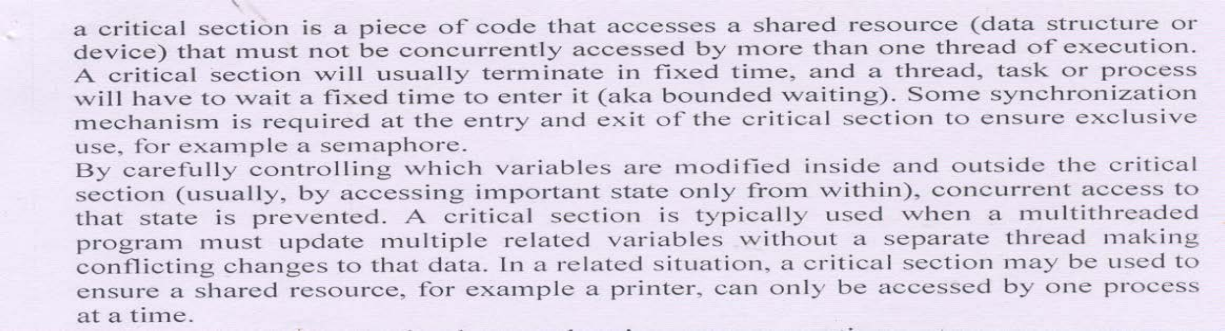
3 Marks ea

Disk Allocation Methods

contiguous allocation each file occupies a set of consecutive addresses on disk each directory entry contains: file name starting address of the first block block address = sector id (e.g., block = 4K) length in blocks usual dynamic storage allocation problem use first fit, best fit, or worst fit algorithms to manage storage if the file can increase in size, either leave no extra space, and copy the file elsewhere if it expands leave extra space

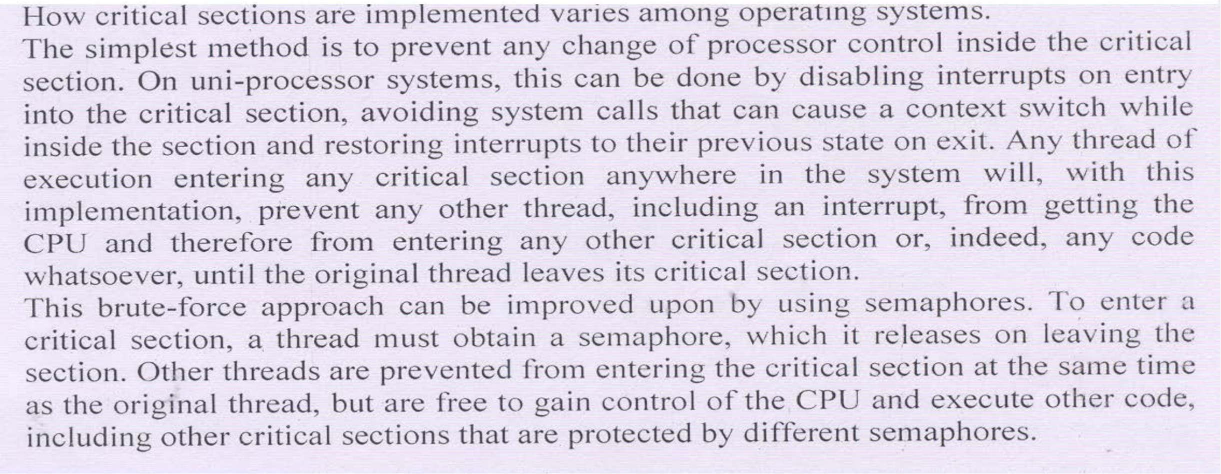
linked allocation each data block contains the block address of the next block in the file each directory entry contains: file name block address: pointer to the first block sometimes, also have a pointer to the last block (adding to the end of the file is much faster using this pointer) indexed allocation store all pointers together in an index table the index table is stored in several index blocks assume index table has been loaded into main memory

c.What is the critical section (CS) problem? Write the properties of CS implementation



a critical section is a piece of code that accesses a shared resource (data structure or device) that must not be concurrently accessed by more than one thread of execution. A critical section will usually terminate in fixed time, and a thread, task or process will have to wait a fixed time to enter it (aka bounded waiting). Some synchronization mechanism is required at the entry and exit of the critical section to ensure exclusive use, for example a semaphore.

By carefully controlling which variables are modified inside and outside the critical section (usually, by accessing important state only from within), concurrent access to that state is prevented. A critical section is typically used when a multithreaded program must update multiple related variables without a separate thread making conflicting changes to that data. In a related situation, a critical section may be used to ensure a shared resource, for example a printer, can only be accessed by one process at a time.

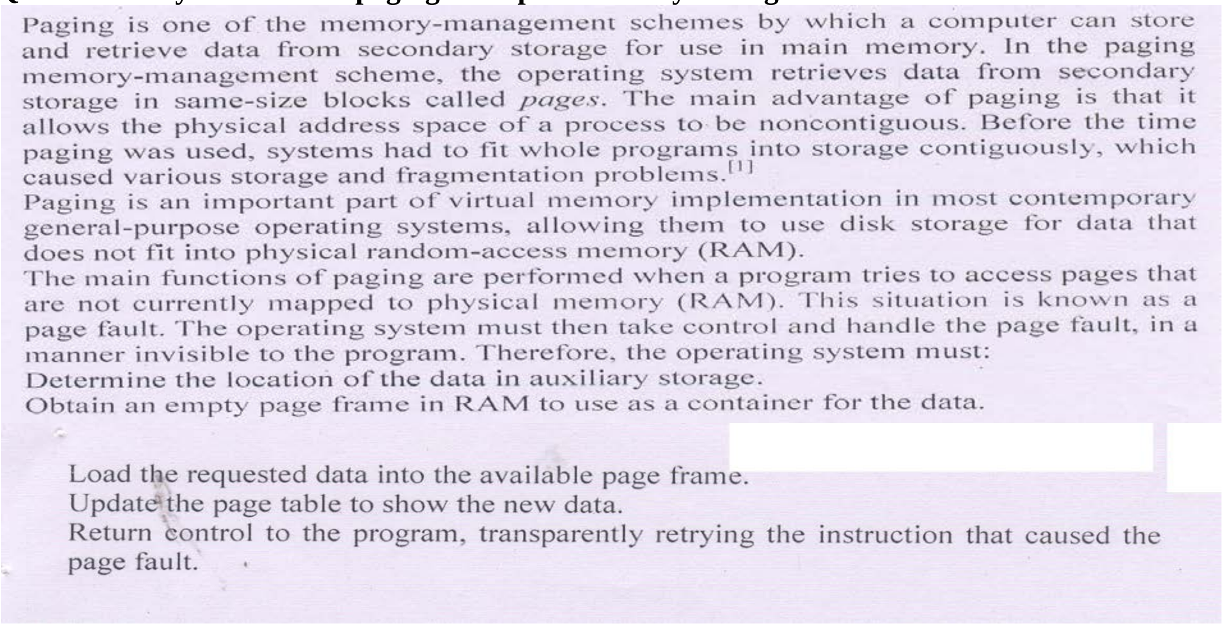


How critical sections are implemented varies among operating systems.

The simplest method is to prevent any change of processor control inside the critical section. On uni-processor systems, this can be done by disabling interrupts on entry into the critical section, avoiding system calls that can cause a context switch while inside the section and restoring interrupts to their previous state on exit. Any thread of execution entering any critical section anywhere in the system will, with this implementation, prevent any other thread, including an interrupt, from getting the CPU and therefore from entering any other critical section or, indeed, any code whatsoever, until the original thread leaves its critical section.

This brute-force approach can be improved upon by using semaphores. To enter a critical section, a thread must obtain a semaphore, which it releases on leaving the section. Other threads are prevented from entering the critical section at the same time as the original thread, but are free to gain control of the CPU and execute other code, including other critical sections that are protected by different semaphores.

Q.5 a. Briefly describe the paging concept in memory management.



Paging is one of the memory-management schemes by which a computer can store and retrieve data from secondary storage for use in main memory. In the paging memory-management scheme, the operating system retrieves data from secondary storage in same-size blocks called *pages*. The main advantage of paging is that it allows the physical address space of a process to be noncontiguous. Before the time paging was used, systems had to fit whole programs into storage contiguously, which caused various storage and fragmentation problems.[1]

Paging is an important part of virtual memory implementation in most contemporary general-purpose operating systems, allowing them to use disk storage for data that does not fit into physical random-access memory (RAM).

The main functions of paging are performed when a program tries to access pages that are not currently mapped to physical memory (RAM). This situation is known as a page fault. The operating system must then take control and handle the page fault, in a manner invisible to the program. Therefore, the operating system must:

Determine the location of the data in auxiliary storage.

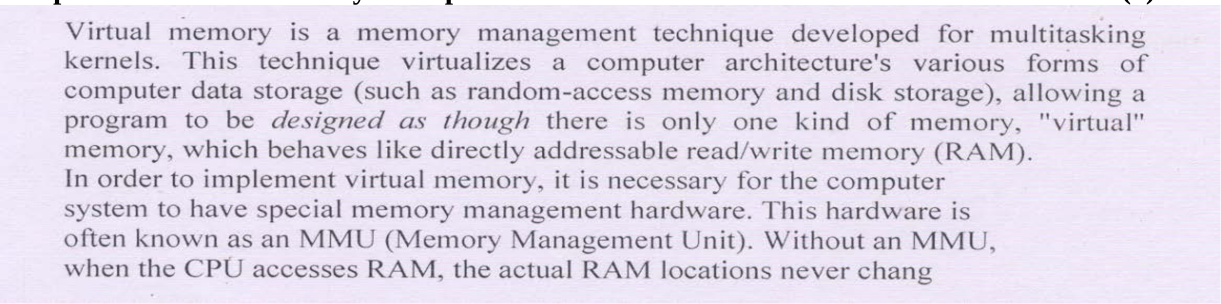
Obtain an empty page frame in RAM to use as a container for the data.

Load the requested data into the available page frame.

Update the page table to show the new data.

Return control to the program, transparently retrying the instruction that caused the page fault.

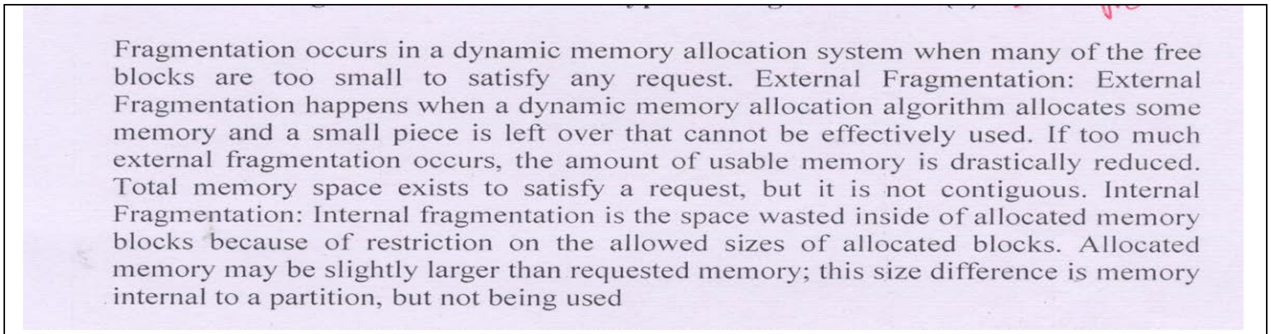
b.Explain the virtual memory concept. (5)



Virtual memory is a memory management technique developed for multitasking kernels. This technique virtualizes a computer architecture's various forms of computer data storage (such as random-access memory and disk storage), allowing a program to be *designed as though* there is only one kind of memory, "virtual" memory, which behaves like directly addressable read/write memory (RAM).

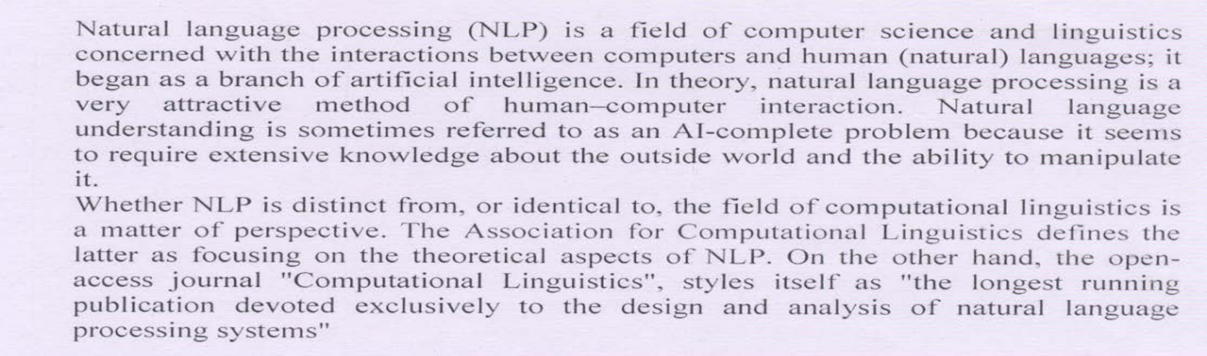
In order to implement virtual memory, it is necessary for the computer system to have special memory management hardware. This hardware is often known as an MMU (Memory Management Unit). Without an MMU, when the CPU accesses RAM, the actual RAM locations never chang

c.What is fragmentation? Describe different types of fragmentation.



Fragmentation occurs in a dynamic memory allocation system when many of the free blocks are too small to satisfy any request. External Fragmentation: External Fragmentation happens when a dynamic memory allocation algorithm allocates some memory and a small piece is left over that cannot be effectively used. If too much external fragmentation occurs, the amount of usable memory is drastically reduced. Total memory space exists to satisfy a request, but it is not contiguous. Internal Fragmentation: Internal fragmentation is the space wasted inside of allocated memory blocks because of restriction on the allowed sizes of allocated blocks. Allocated memory may be slightly larger than requested memory; this size difference is memory internal to a partition, but not being used

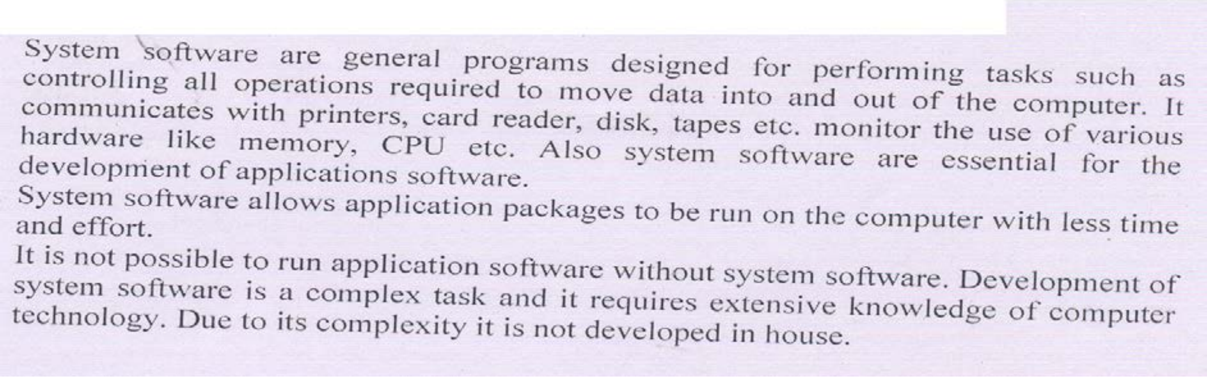
Q.6a. What are the benefits of using "language processors"?



Natural language processing (NLP) is a field of computer science and linguistics concerned with the interactions between computers and human (natural) languages; it began as a branch of artificial intelligence. In theory, natural language processing is a very attractive method of human–computer interaction. Natural language understanding is sometimes referred to as an AI-complete problem because it seems to require extensive knowledge about the outside world and the ability to manipulate it.

Whether NLP is distinct from, or identical to, the field of computational linguistics is a matter of perspective. The Association for Computational Linguistics defines the latter as focusing on the theoretical aspects of NLP. On the other hand, the open-access journal "Computational Linguistics", styles itself as "the longest running publication devoted exclusively to the design and analysis of natural language processing systems"

b.What do you understand by the term System Software?

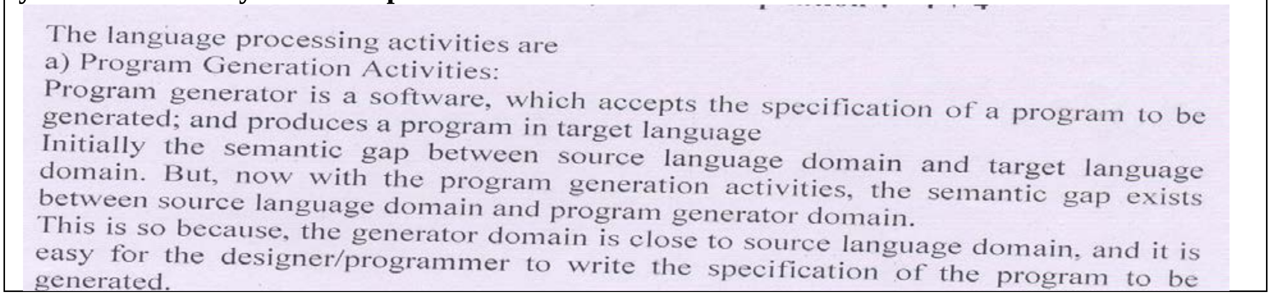


System software are general programs designed for performing tasks such as controlling all operations required to move data into and out of the computer. It communicates with printers, card reader, disk, tapes etc. monitor the use of various hardware like memory, CPU etc. Also system software are essential for the development of applications software.

System software allows application packages to be run on the computer with less time and effort.

It is not possible to run application software without system software. Development of system software is a complex task and it requires extensive knowledge of computer technology. Due to its complexity it is not developed in house.

c. What are the various language processing activities in the domain of system software? What do you understand by cross-compilation?



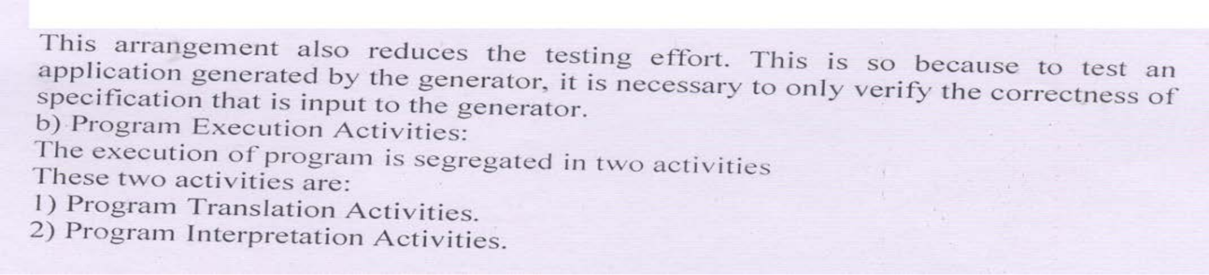
The language processing activities are

a) Program Generation Activities:

Program generator is a software, which accepts the specification of a program to be generated; and produces a program in target language

Initially the semantic gap between source language domain and target language domain. But, now with the program generation activities, the semantic gap exists between source language domain and program generator domain.

This is so because, the generator domain is close to source language domain, and it is easy for the designer/programmer to write the specification of the program to be generated.



This arrangement also reduces the testing effort. This is so because to test an application generated by the generator, it is necessary to only verify the correctness of specification that is input to the generator.

b) Program Execution Activities:

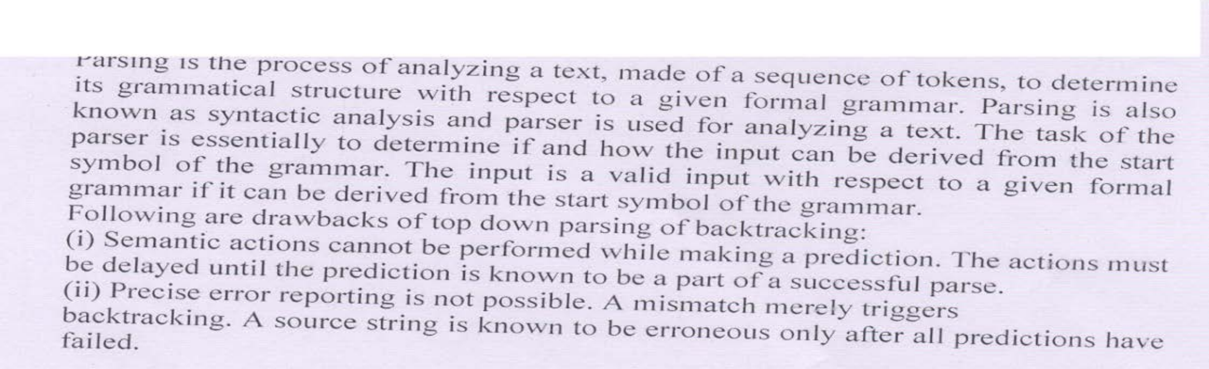
The execution of program is segregated in two activities

These two activities are:

1) Program Translation Activities.

2) Program Interpretation Activities.

Q.7 a. What is parsing? Write down the drawback of top down parsing of backtracking.



Parsing is the process of analyzing a text, made of a sequence of tokens, to determine its grammatical structure with respect to a given formal grammar. Parsing is also known as syntactic analysis and parser is used for analyzing a text. The task of the parser is essentially to determine if and how the input can be derived from the start symbol of the grammar. The input is a valid input with respect to a given formal grammar if it can be derived from the start symbol of the grammar.

Following are drawbacks of top down parsing of backtracking:

(i) Semantic actions cannot be performed while making a prediction. The actions must be delayed until the prediction is known to be a part of a successful parse.

(ii) Precise error reporting is not possible. A mismatch merely triggers backtracking. A source string is known to be erroneous only after all predictions have failed.

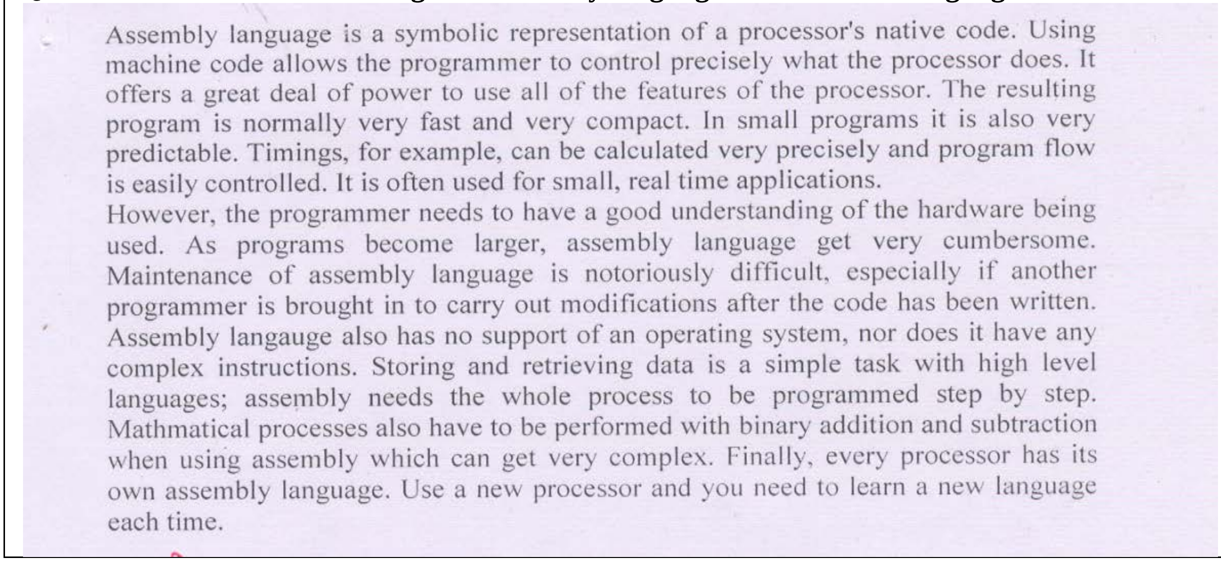
b.Define Macro expansion. What do you mean by positional parameters and how the value of a positional, formal parameter is determined?

Ans. Page 133-134 of Text book

c.Compare and contrast non-relocatable, relocatable and self-relocatable programs.

Ans. Page 232 of Text book

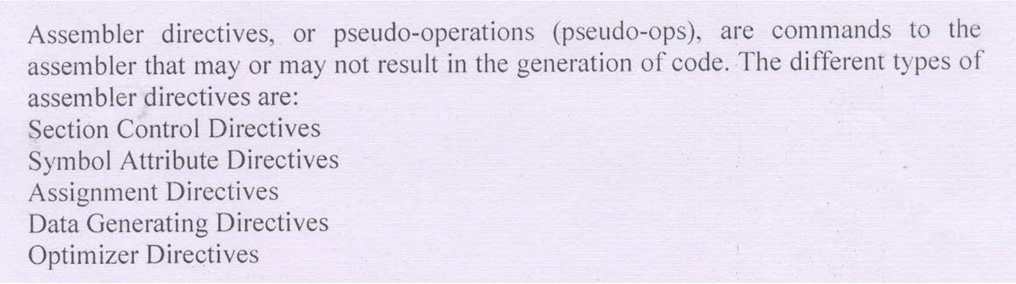
Q.8 a. Mention some advantages of assembly language over machine language.



Assembly language is a symbolic representation of a processor's native code. Using machine code allows the programmer to control precisely what the processor does. It offers a great deal of power to use all of the features of the processor. The resulting program is normally very fast and very compact. In small programs it is also very predictable. Timings, for example, can be calculated very precisely and program flow is easily controlled. It is often used for small, real time applications.

However, the programmer needs to have a good understanding of the hardware being used. As programs become larger, assembly language get very cumbersome. Maintenance of assembly language is notoriously difficult, especially if another programmer is brought in to carry out modifications after the code has been written. Assembly langauge also has no support of an operating system, nor does it have any complex instructions. Storing and retrieving data is a simple task with high level languages; assembly needs the whole process to be programmed step by step. Mathmatical processes also have to be performed with binary addition and subtraction when using assembly which can get very complex. Finally, every processor has its own assembly language. Use a new processor and you need to learn a new language each time.

b.What are assembler directives in assembly languages? Illustrate with an example the importance of assembler directives.

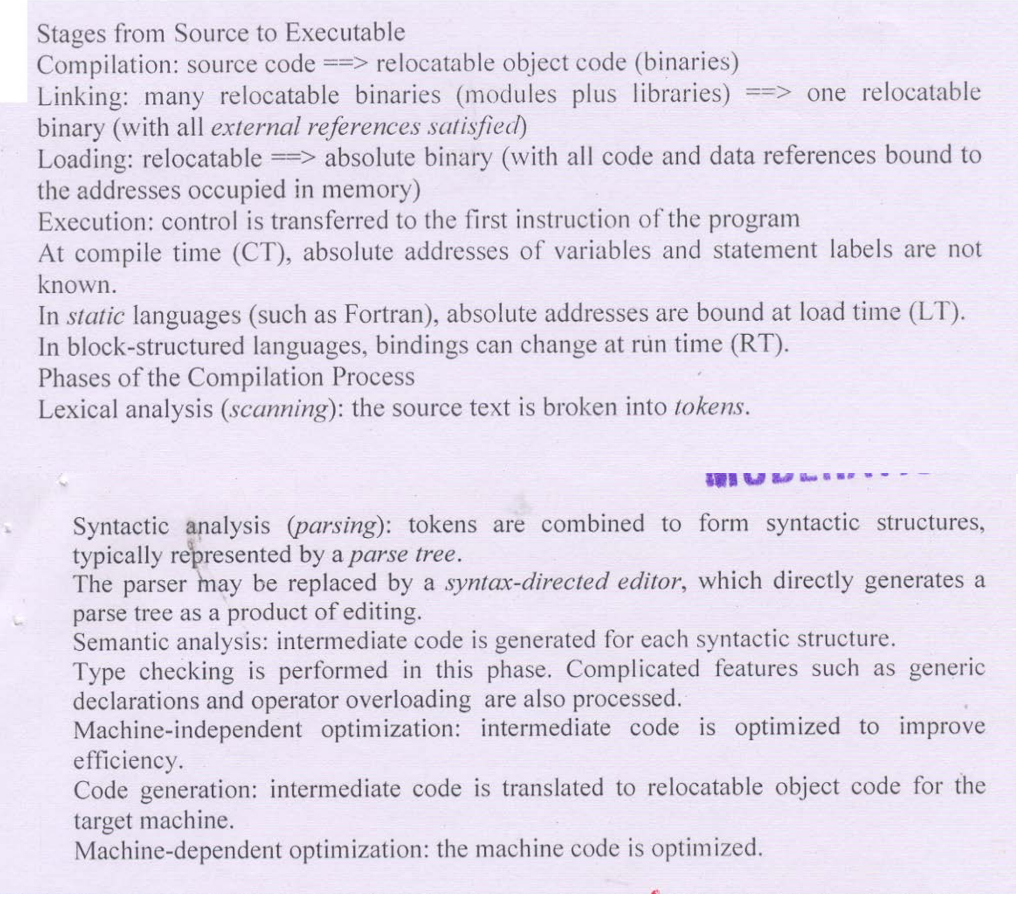


Assembler directives, or pseudo-operations (pseudo-ops), are commands to the assembler that may or may not result in the generation of code. The different types of assembler directives are:
Section Control Directives
Symbol Attribute Directives
Assignment Directives
Data Generating Directives
Optimizer Directives

c.What are the data structures used during pass I of the Assembler?

Ans Page 98 of text book

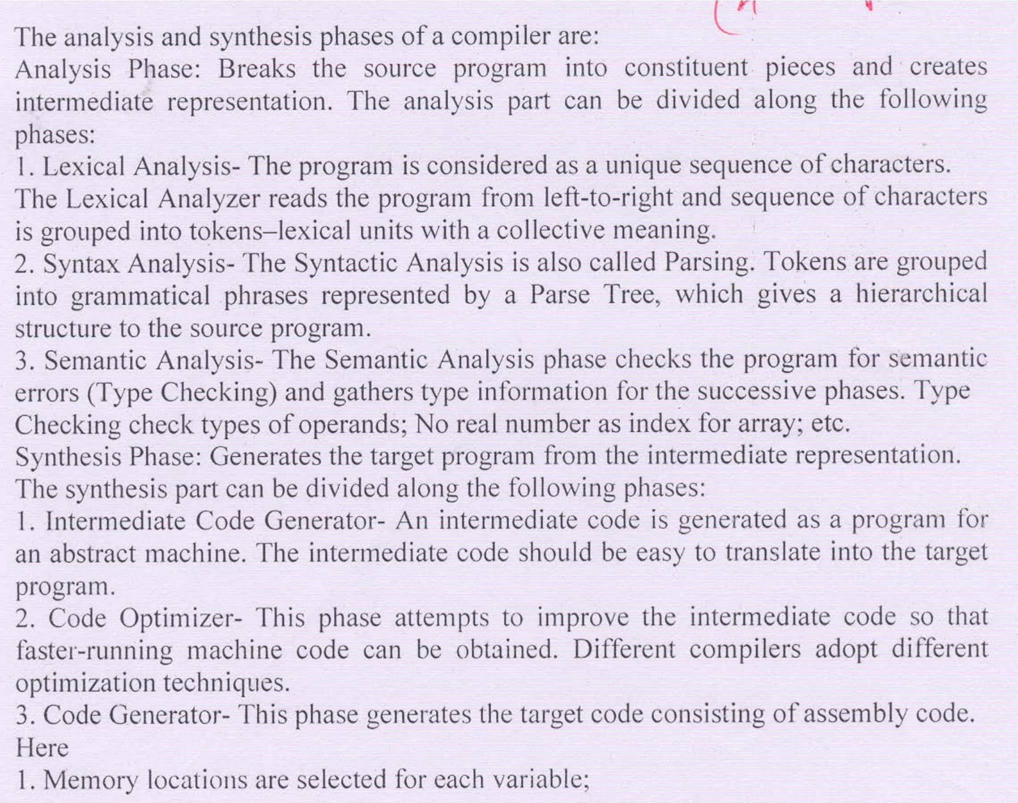
Q.9 a. What are the major stages in the process of compilation?



Stages from Source to Executable
Compilation: source code ==> relocatable object code (binaries)
Linking: many relocatable binaries (modules plus libraries) ==> one relocatable binary (with all *external references satisfied*)
Loading: relocatable ==> absolute binary (with all code and data references bound to the addresses occupied in memory)
Execution: control is transferred to the first instruction of the program
At compile time (CT), absolute addresses of variables and statement labels are not known.
In *static* languages (such as Fortran), absolute addresses are bound at load time (LT).
In block-structured languages, bindings can change at run time (RT).
Phases of the Compilation Process
Lexical analysis (*scanning*): the source text is broken into *tokens*.

Syntactic analysis (*parsing*): tokens are combined to form syntactic structures, typically represented by a *parse tree*.
The parser may be replaced by a *syntax-directed editor*, which directly generates a parse tree as a product of editing.
Semantic analysis: intermediate code is generated for each syntactic structure.
Type checking is performed in this phase. Complicated features such as generic declarations and operator overloading are also processed.
Machine-independent optimization: intermediate code is optimized to improve efficiency.
Code generation: intermediate code is translated to relocatable object code for the target machine.
Machine-dependent optimization: the machine code is optimized.

b.Explain analysis and synthesis phase of a compiler.



The analysis and synthesis phases of a compiler are:
Analysis Phase: Breaks the source program into constituent pieces and creates intermediate representation. The analysis part can be divided along the following phases:
1. Lexical Analysis- The program is considered as a unique sequence of characters. The Lexical Analyzer reads the program from left-to-right and sequence of characters is grouped into tokens–lexical units with a collective meaning.
2. Syntax Analysis- The Syntactic Analysis is also called Parsing. Tokens are grouped into grammatical phrases represented by a Parse Tree, which gives a hierarchical structure to the source program.
3. Semantic Analysis- The Semantic Analysis phase checks the program for semantic errors (Type Checking) and gathers type information for the successive phases. Type Checking check types of operands; No real number as index for array; etc.
Synthesis Phase: Generates the target program from the intermediate representation. The synthesis part can be divided along the following phases:
1. Intermediate Code Generator- An intermediate code is generated as a program for an abstract machine. The intermediate code should be easy to translate into the target program.
2. Code Optimizer- This phase attempts to improve the intermediate code so that faster-running machine code can be obtained. Different compilers adopt different optimization techniques.
3. Code Generator- This phase generates the target code consisting of assembly code. Here
1. Memory locations are selected for each variable;

2. Instruction are translated into a sequence of assembly instructions;
3. Variables and intermediate results are assigned to memory registers;

c.Differentiate between static & dynamic memory allocation.

Ans. Page 166 of Text book

Textbook

I. Fundamentals of Database Systems, Elmasri, Navathe, Somayajulu, Gupta, Pearson Education, 2006