Graduate Program
Department of Computer Science
Comprehensive Examination – Practice Questions

CMPS 500 – Operating Systems

1. In what way is an operating system like a government?
A) It seldom functions correctly.
B) It creates an environment within which other programs can do useful work.
C) It performs most useful functions by itself.
D) It is always concerned primarily with the individual's needs.

2. ____ operating systems are designed primarily to maximize resource utilization.
A) PC
B) Handheld computer
C) Mainframe
D) Network

3. The most common secondary storage device is ____.
A) random access memory
B) solid state disks
C) tape drives
D) magnetic disk

4. Which of the following would lead you to believe that a given system is an SMP-type system?
A) Each processor is assigned a specific task.
B) There is a boss–worker relationship between the processors.
C) Each processor performs all tasks within the operating system.
D) None of the above

5. What statement concerning privileged instructions is considered false?
A) They may cause harm to the system.
B) They can only be executed in kernel mode.
C) They cannot be attempted from user mode.
D) They are used to manage interrupts.

6. Which of the following statements is false?
A) Mobile devices must be concerned with power consumption.
B) Mobile devices can provide features that are unavailable on desktop or laptop computers.
C) The difference in storage capacity between a mobile device and laptop is shrinking.
D) Mobile devices usually have fewer processing cores than a standard desktop computer.

7. A(n) ________ is the unit of work in a system.
A) process
B) operating system
C) timer
D) mode bit
8. The two separate modes of operating in a system are
A) supervisor mode and system mode
B) kernel mode and privileged mode
C) physical mode and logical mode
D) user mode and kernel mode

9. A _____ is an example of a systems program.
A) command interpreter
B) Web browser
C) text formatter
D) database system

10. If a program terminates abnormally, a dump of memory may be examined by a ____ to determine the cause of the problem.
A) module
B) debugger
C) shell
D) control card

11. A message-passing model is ____.
A) easier to implement than a shared memory model for intercomputer communication
B) faster than the shared memory model
C) a network protocol, and does not apply to operating systems
D) only useful for small simple operating systems

12. Policy ____.
A) determines how to do something
B) determines what will be done
C) is not likely to change across places
D) is not likely to change over time

13. ______ is a mobile operating system designed for the iPhone and iPad.
A) Mac OS X
B) Android
C) UNIX
D) iOS

14. The ________ provides a portion of the system call interface for UNIX and Linux.
A) POSIX

B) Java
C) Standard C library
D) Standard API

15. Which of the following statements is incorrect?
A) An operating system provides an environment for the execution of programs.
B) An operating system manages system resources.
C) Operating systems provide both command line as well as graphical user interfaces.
D) Operating systems must provide both protection and security.

16. _____ is/are not a technique for passing parameters from an application to a system call.
A) Cache memory
B) Registers
C) Stack
D) Special block in memory

17. The ____ of a process contains temporary data such as function parameters, return addresses, and local variables.
A) text section
B) data section
C) program counter
D) stack

18. A process control block ____.
A) includes information on the process's state
B) stores the address of the next instruction to be processed by a different process
C) determines which process is to be executed next
D) is an example of a process queue

19. The list of processes waiting for a particular I/O device is called a(n) ____.
A) standby queue
B) device queue
C) ready queue
D) interrupt queue

20. The _____________ refers to the number of processes in memory.
A) process count
B) long-term scheduler
C) degree of multiprogramming
D) CPU scheduler

21. Which of the following is not a process type in the Chrome browser?

A) Plug-in
B) Renderer
C) Sandbox
D) Browser

22. The ________ application is the application appearing on the display screen of a mobile device.
A) main
B) background
C) display
D) foreground

23. A process that has terminated, but whose parent has not yet called wait(), is known as a ________ process.
A) zombie
B) orphan
C) terminated
D) init

24. The _______ process is assigned as the parent to orphan processes.
A) zombie
B) init
C) main
D) renderer

25. ____ is a thread library for Solaris that maps many user-level threads to one kernel thread.
A) Pthreads
B) Green threads
C) Sthreads
D) Java threads

26. Pthreads refers to ____.
A) the POSIX standard.
B) an implementation for thread behavior.
C) a specification for thread behavior.
D) an API for process creation and synchronization.

27. The ____ multithreading model multiplexes many user-level threads to a smaller or equal number of kernel threads.
A) many-to-one model
B) one-to-one model
C) many-to-many model

D) many-to-some model

28. Cancellation points are associated with ____ cancellation.
A) asynchronous
B) deferred
C) synchronous
D) non-deferred

29. _________ involves distributing tasks across multiple computing cores.
A) Concurrency
B) Task parallelism
C) Data parallelism
D) Parallelism

30. ___________ is a formula that identifies potential performance gains from adding additional computing cores to an application that has a parallel and serial component.
A) Task parallelism
B) Data parallelism
C) Data splitting
D) Amdahl's Law

31. When OpenMP encounters the #pragma omp parallel directive, it
A) constructs a parallel region
B) creates a new thread
C) creates as many threads as there are processing cores
D) parallelizes for loops

32. Grand Central Dispatch handles blocks by
A) placing them on a dispatch queue
B) creating a new thread
C) placing them on a dispatch stack
D) constructing a parallel region

33. A race condition ____.
A) results when several threads try to access the same data concurrently
B) results when several threads try to access and modify the same data concurrently
C) will result only if the outcome of execution does not depend on the order in which instructions are executed
D) None of the above

34. An instruction that executes atomically ____.
A) must consist of only one machine instruction
B) executes as a single, uninterruptible unit
C) cannot be used to solve the critical section problem

D) All of the above

35. A counting semaphore ____.
A) is essentially an integer variable
B) is accessed through only one standard operation
C) can be modified simultaneously by multiple threads
D) cannot be used to control access to a thread's critical sections

36. A mutex lock ____.
A) is exactly like a counting semaphore
B) is essentially a boolean variable
C) is not guaranteed to be atomic
D) can be used to eliminate busy waiting

37. A ___ type presents a set of programmer-defined operations that are provided mutual exclusion within it.
A) transaction
B) signal
C) binary
D) monitor

38. ____________ occurs when a higher-priority process needs to access a data structure that is currently being accessed by a lower-priority process.
A) Priority inversion
B) Deadlock
C) A race condition
D) A critical section

39. What is the correct order of operations for protecting a critical section using mutex locks?
A) release() followed by acquire()
B) acquire() followed by release()
C) wait() followed by signal()
D) signal() followed by wait()

40. What is the correct order of operations for protecting a critical section using a binary semaphore?
A) release() followed by acquire()
B) acquire() followed by release()
C) wait() followed by signal()
D) signal() followed by wait()

41. Which of the following is true of cooperative scheduling?
A) It requires a timer.

B) A process keeps the CPU until it releases the CPU either by terminating or by switching to the waiting state.
C) It incurs a cost associated with access to shared data.
D) A process switches from the running state to the ready state when an interrupt occurs.

42. ____ is the number of processes that are completed per time unit.
A) CPU utilization
B) Response time
C) Turnaround time
D) Throughput
43. ____ scheduling is approximated by predicting the next CPU burst with an exponential average of the measured lengths of previous CPU bursts.
A) Multilevel queue
B) RR
C) FCFS
D) SJF

44. The ____ scheduling algorithm is designed especially for time-sharing systems.
A) SJF
B) FCFS
C) RR
D) Multilevel queue

45. The rate of a periodic task in a hard real-time system is ____, where *p* is a period and *t* is the processing time.
A) $1/p$
B) p/t
C) $1/t$
D) pt

46. Which of the following is true of the rate-monotonic scheduling algorithm?
A) The task with the shortest period will have the lowest priority.
B) It uses a dynamic priority policy.
C) CPU utilization is bounded when using this algorithm.
D) It is non-preemptive.

47. Which of the following is true of earliest-deadline-first (EDF) scheduling algorithm?
A) When a process becomes runnable, it must announce its deadline requirements to the system.
B) Deadlines are assigned as following: the earlier the deadline, the lower the priority; the later the deadline, the higher the priority.
C) Priorities are fixed; that is, they cannot be adjusted when a new process starts running.
D) It assigns priorities statically according to deadline.

48. The two general approaches to load balancing are __________ and ____________.
A) soft affinity, hard affinity
B) coarse grained, fine grained
C) soft real-time, hard real-time
D) push migration, pull migration

49. A deadlocked state occurs whenever ____.
A) a process is waiting for I/O to a device that does not exist
B) the system has no available free resources
C) every process in a set is waiting for an event that can only be caused by another process in the set
D) a process is unable to release its request for a resource after use
50. One necessary condition for deadlock is ____, which states that at least one resource must be held in a nonsharable mode.
A) hold and wait
B) mutual exclusion
C) circular wait
D) no preemption

51. One necessary condition for deadlock is ______, which states that a process must be holding one resource and waiting to acquire additional resources.
A) hold and wait
B) mutual exclusion
C) circular wait
D) no preemption

52. One necessary condition for deadlock is ______, which states that a resource can be released only voluntarily by the process holding the resource.
A) hold and wait
B) mutual exclusion
C) circular wait
D) no preemption

53. One necessary condition for deadlock is ______, which states that there is a chain of waiting processes whereby P_0 is waiting for a resource held by P_1, P_1 is waiting for a resource held by P_2, and P_n is waiting for a resource held by P_0.
A) hold and wait
B) mutual exclusion
C) circular wait
D) no preemption

54. The *witness* software product is a ____.
A) lock-order verifier that uses mutual-exclusion locks to protect critical sections
B) modeler to develop resource allocation graphs

C) driver that can be used to prevent mutual exclusion for nonsharable resources
D) implementation of the banker's algorithm available for most operating systems

55. In a system resource-allocation graph, ____.
A) a directed edge from a process to a resource is called an assignment edge
B) a directed edge from a resource to a process is called a request edge
C) a directed edge from a process to a resource is called a request edge
D) None of the above

56. A cycle in a resource-allocation graph is ____.
A) a necessary and sufficient condition for deadlock in the case that each resource has more than one instance
B) a necessary and sufficient condition for a deadlock in the case that each resource has exactly one instance
C) a sufficient condition for a deadlock in the case that each resource has more than once instance
D) is neither necessary nor sufficient for indicating deadlock in the case that each resource has exactly one instance

57. Absolute code can be generated for ____.
A) compile-time binding
B) load-time binding
C) execution-time binding
D) interrupt binding

58. _____ is the method of binding instructions and data to memory performed by most general-purpose operating systems.
A) Interrupt binding
B) Compile time binding
C) Execution time binding
D) Load-time binding

59. An address generated by a CPU is referred to as a ____.
A) physical address
B) logical address
C) post relocation register address
D) Memory-Management Unit (MMU) generated address

60. Suppose a program is operating with execution-time binding and the physical address generated is 300. The relocation register is set to 100. What is the corresponding logical address?
A) 199
B) 201

C) 200
D) 300

61. Consider a logical address with a page size of 8 KB. How many bits must be used to represent the page offset in the logical address?
A) 10
B) 8
C) 13
D) 12

62. Consider a logical address with 18 bits used to represent an entry in a conventional page table. How many entries are in the conventional page table?
A) 262144
B) 1024
C) 1048576
D) 18

63. Assume a system has a TLB hit ratio of 90%. It requires 15 nanoseconds to access the TLB, and 85 nanoseconds to access main memory. What is the effective memory access time in nanoseconds for this system?
A) 108.5
B) 100
C) 22
D) 176.5

64. Given the logical address 0xAEF9 (in hexadecimal) with a page size of 256 bytes, what is the page number?
A) 0xAE
B) 0xF9
C) 0xA
D) 0x00F9

65. Which of the following is a benefit of allowing a program that is only partially in memory to execute?
A) Programs can be written to use more memory than is available in physical memory.
B) CPU utilization and throughput is increased.
C) Less I/O is needed to load or swap each user program into memory.
D) All of the above

66. In systems that support virtual memory, ____.
A) virtual memory is separated from logical memory.
B) virtual memory is separated from physical memory.
C) physical memory is separated from secondary storage.
D) physical memory is separated from logical memory.

67. The vfork() system call in UNIX ____.
A) allows the child process to use the address space of the parent
B) uses copy-on-write with the fork() call
C) is not intended to be used when the child process calls exec() immediately after creation
D) duplicates all pages that are modified by the child process

68. Suppose we have the following page accesses: 1 2 3 4 2 3 4 1 2 1 1 3 1 4 and that there are three frames within our system. Using the FIFO replacement algorithm, what is the number of page faults for the given reference string?
A) 14
B) 8
C) 13
D) 10

69. Suppose we have the following page accesses: 1 2 3 4 2 3 4 1 2 1 1 3 1 4 and that there are three frames within our system. Using the FIFO replacement algorithm, what will be the final configuration of the three frames following the execution of the given reference string?
A) 4, 1, 3
B) 3, 1, 4
C) 4, 2, 3
D) 3, 4, 2

70. Suppose we have the following page accesses: 1 2 3 4 2 3 4 1 2 1 1 3 1 4 and that there are three frames within our system. Using the LRU replacement algorithm, what is the number of page faults for the given reference string?

A) 14
B) 13
C) 8
D) 10

71. Given the reference string of page accesses: 1 2 3 4 2 3 4 1 2 1 1 3 1 4 and a system with three page frames, what is the final configuration of the three frames after the LRU algorithm is applied?
A) 1, 3, 4
B) 3, 1, 4
C) 4, 1, 2
D) 1, 2, 3

72. Belady's anomaly states that ____.
A) giving more memory to a process will improve its performance
B) as the number of allocated frames increases, the page-fault rate may decrease for all page replacement algorithms

C) for some page replacement algorithms, the page-fault rate may decrease as the number of allocated frames increases
D) for some page replacement algorithms, the page-fault rate may increase as the number of allocated frames increases

73. In the UNIX operating system, a domain is associated with the ____.
A) user
B) process
C) procedure
D) task

74. In MULTICS, the protection domains are organized in a _____.
A) star structure
B) linear structure
C) ring structure
D) directory structure

75. In an access matrix, the ____ right allows a process to change the entries in a row.
A) owner
B) copy
C) control.
D) switch

76. The ____ implementation of an access table consists of sets of ordered triples.
A) global table
B) access list for objects
C) lock-key mechanism
D) capability list

77. In capability lists, each object has a ____ to denote its type.
A) gate
B) tag
C) key
D) lock

78. Which of the following implementations of the access matrix is a compromise between two other implementations listed below?
A) access list
B) capability list
C) global table
D) lock-key

79. In the reacquisition scheme for implementing the revocation of capabilities, ____.
A) a key is defined when the capability is created

B) the capabilities point indirectly, not directly, to the objects
C) a list of pointers is maintained with each object that point to all capabilities associated with that object
D) capabilities are periodically deleted from each domain

80. The most common method used by attackers to breach security is ____.
A) masquerading
B) message modification
C) session hijacking
D) phishing

81. A code segment that misuses its environment is called ____.
A) a backdoor
B) a trap door
C) a worm
D) a Trojan horse

82. Worms ____.
A) use the spawn mechanism to ravage system performance
B) can shut down an entire network
C) continue to grow as the Internet expands
D) All of the above

83. A denial of service attack is ____.
A) aimed at gaining information
B) aimed at stealing resources
C) aimed at disrupting legitimate use of a system
D) generally not network based

84. In a paired-password system, ____.
A) the user specifies two passwords
B) the computer supplies one part of a password and the user enters the other part
C) passwords must contain equal amounts of numbers and digits paired together
D) two users must enter their own separate password to gain access to the system

85. A ____ virus changes each time it is installed to avoid detection by antivirus software.
A) polymorphic
B) tunneling
C) multipartite
D) stealth

86. ____ is a symmetric stream cipher.
A) DES

B) AES
C) RC4
D) twofish

87. In a virtual machine, each program believes that it has ____.
A) multiple processors
B) its own memory
C) another "virtual" computer to assist in its operations
D) more memory than is physically available on the machine

88. ____ is a popular commercial application that abstracts Intel 80XXx86 hardware into isolated virtual machines.
A) .NET
B) JIT
C) JVM
D) VMware

89. _____ is not an example of a benefit of virtual machines.
A) The ability to run several different operating systems that all share the same hardware
B) The ability to concurrently run several different operating systems
C) Uses less physical memory than an actual operating system
D) Protects the host system from guest operating systems

90. ______ tricks an application by having it think it is the only process on the system.
A) Paravirtualization
B) Simulation
C) The Java virtual machine
D) The .NET framework

91. _________ allows a virtual machine to behave as if it is acting in kernel mode.
A) Paravirtualization
B) Live migration
C) Trap-and-emulate
D) The Java virtual machine

92. Microsoft .NET and the Java virtual machine are examples of __________.
A) Paravirtualization
B) Programming environment virtualization
C) Emulators
D) Type 0 hypervisors

93. Which of the following statements regarding a virtual CPU (VCPU) is considered false?
A) The VCPU does not execute code.
B) It represents the state of the physical CPU.

C) Each guest shares the VCPU.
D) The VCPU is found in most virtualization options.

94. In a distributed system, a ____ usually indicates the location of a machine.
A) node
B) host
C) site
D) resource

95. ____ involves the movement of jobs from one site to another to distribute processing more evenly across the network.
A) Computer migration
B) Load sharing
C) Resource sharing
D) Downsizing

96. The sftp ___ command transfers a file from the remote machine to the local machine.
A) copy
B) put
C) get
D) cd

97. Which of the following routing schemes cannot adapt to link failures or load changes?
A) virtual routing
B) fixed routing
C) dynamic loading
D) All of the above

98. Which of the following connection strategies involves breaking up a message into a number of packets that must be reassembled upon arrival?
A) message switching
B) packet switching
C) circuit switching
D) process switching

99. Which of the following layers of a communications network in the OSI protocol is used to handle frames, or fixed-length parts of packets?
A) network layer
B) physical layer
C) data-link layer
D) transport layer

100. Which of the following is not considered a benefit of process migration?
A) Load balancing

B) Software neutrality
C) Hardware preference
D) Computation speedup

CMPS 501 – Programming Languages

1. Which of the following are object oriented languages?
    a. Java
    b. Cobol
    c. C
    d. All of above
    e. None of above
2. In programming, a series of logically ordered steps that lead to a required result is called
    a. A compiler
    b. A program
    c. A data structure
    d. An algorithm
3. Which is a typical language for programming inside Web pages?
    a. javaScript
    b. HTML
    c. Cobol
    d. XML
4. Which of the following converts source code into machine code at each runtime?
    a. Linker
    b. Compiler
    c. Interpreter
    d. Objet encoder
5. Which of the following commonly happens to variables (in most languages)?
    a. Expansion
    b. Derivation
    c. Assignment
    d. All of above
    e. None of above
6. Assuming that + and * are arithmetic operators (addition and multiplication), to what does the expression 2 + 4 * 5 + 1 evaluate?
    a. 36
    b. 31
    c. 26
    d. 23
7. Assuming that = and / are the assignment and division operators, what will be the outcome of the following code in most programming languages:
    a. Syntax error
    b. Runtime error
    c. Logic error
    d. Compiler error
8. Which is a typical kind of variable for keeping an ordered set of values in memory, that can be referenced as e.g. A[3], A[n+1] etc. ?
    a. File

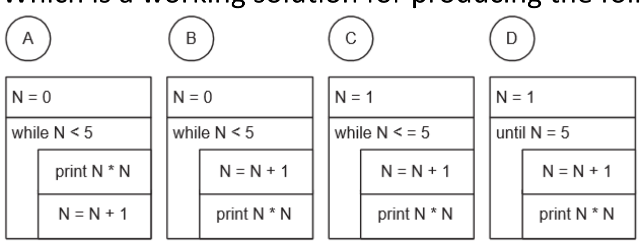
b. String
c. Array
d. container

9. AND, OR and NOT are logical operators. What data type is expected for their operands?
    a. Integer
    b. Boolean
    c. Decimal
    d. Character
10. In many programming languages, ‘otherwise’ and ‘else’ are part of which building block?
    a. Loop
    b. Counter
    c. Selection
    d. List structure
11. What building block does the following diagram represent?

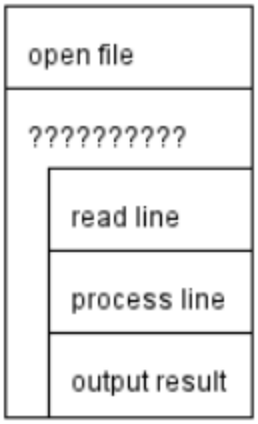
```
while x < 10
    print x
    x = x + 1
```

    a. Sequence
    b. Selection
    c. Function
    d. Iteration

12. Which is a working solution for producing the following output: 1 4 9 16 25 ?



    a. A
    b. B
    c. C
    d. D
13. The following is a typical pattern for reading and processing data from a sequential file. What is hidden behind the question marks?



a. while not EOF
b. if count = end
c. count until end
d. None of above

14. (In most programming languages), which statement would be used in the definition of a function, to indicate the resulting value when this function is called?
    a. result = x
    b. reply x
    c. send x
    d. return x
15. ‘Tracing’, ‘stepping’ and ‘breakpoint’ are typical terms belonging to which programming development aspect?
    a. project planning
    b. compilation
    c. debugging
    d. version control
16. Which term describes the mechanism of a function calling itself?
    a. encapsulation
    b. recursion
    c. inheritance
    d. polymorphism
17. What is the only language that a computer understands directly?
    a. English, as spoken in Boston, Mass.
    b. BASIC the Beginners’ All-purpose Symbolic Instruction Code
    c. machine language, different for every type of CPU
    d. none of above
18. What are the three main *types* of computer programming languages?
    a. Machine language, assembly language, high level language
    b. Imperative language, functional language, declarative language
    c. COBOL, Fortran-77, C++
    d. None of above
19. From the point of view of the programmer what are the major advantages of using a high-level language rather than internal machine code or assembler language?

   a. Efficiency
   b. Program portability
   c. Easy development
   d. None of above
20. Aliasing in the context of programming languages refers to
   a. multiple variables having the same memory location
   b. multiple variables having the same value
   c. multiple variables having the same identifier
   d. multiple uses of the same variable
21. What is printed by the print statements in the program P1 assuming call by value parameter passing?

```
Program Pl()
{
 x=10;
 y=3;
 func1(y, x, x);
 print x;
 print y;
}
func1 (x, y, z)
{
  y = y + 4;
  z = x + y + z;
}
```

   a. 10, 3
   b. 31, 3
   c. 27, 7
   d. None of the above

22. Consider the following program

```
Program P2
  var n: int:
   procedure W(var x: int)
   begin
     x=x+1;
     print x;
   end

   procedure D
   begin
     var n: int;
     n=3;
```

```
      W(n);
    end
begin //beginP2
  n=10;
  D;
end
```

If the language has dynamic scoping and parameters are passed by reference, what will be printed by the program?

a. 10
b. 11
c. 3
d. None of the above

23. The- results returned by functions under value-result and reference parameter passing conventions
    a. Do not differ
    b. Differ in the presence of loops
    c. Differ in all cases
    d. May differ in the presence of exceptions
24. What is printed by the print statements in the program P1 assuming call by value parameter passing?

```
Program Pl()
{
  x=10;
  y=3;
  func1(y, x);
  print x;
  print y;
}
func1 (x, y)
{
   y = y + 4;
   x = 2 * x + y;
}
```

a. 10, 3
b. 14, 20
c. 4, 4
d. None of the above

25. What is printed by the print statements in the program P1 assuming call by reference parameter passing?

```
Program Pl()
{
```

```
 x=10;
 y=3;
 func1(y, x);
 print x;
 print y;
}
func1 (x, y)
{
  y = y + 4;
  x = 2 * x + y;
}
```

a. 10, 3
b. 14, 20
c. 4, 4
d. None of the above

26. What is printed by the print statements in the program P1 assuming call by result parameter passing?

```
Program Pl()
{
 x=10;
 y=3;
 func1(y, x);
 print x;
 print y;
}
func1 (x, y)
{
  y = y + 4;
  x = 2 * x + y;
}
```

a. 10, 3
b. 14, 20
c. 4, 4
d. None of the above

27. What is printed by the print statements in the program P1 assuming call by value-result parameter passing?

```
Program Pl()
{
 x=10;
 y=3;
 func1(y, x);
 print x;
```

```
 print y;
}
func1 (x, y)
{
  y = y + 4;
  x = 2 * x + y;
}
```

  a. 10, 3
  b. 14, 20
  c. 4, 4
  d. None of the above

28. What is printed by the print statements in the program P1 assuming call by name parameter passing?

```
Program Pl()
{
 x=10;
 y=3;
 func1(y, x);
 print x;
 print y;
}
func1 (x, y)
{
  y = y + 4;
  x = 2 * x + y;
}
```

  a. 10, 3
  b. 14, 20
  c. 4, 4
  d. None of the above

29. Which following term(s) is not a PL programming paradigm?
  a. Imperative
  b. Functional
  c. Logical
  d. hierarchical
30. Which feature(s) is not a mistake made by a past PL?
  a. Spaces in variable names
  b. Non-reserved keywords
  c. Call b reference
  d. 2-digit representation of year
31. What is the full form of LISP?
  a. Light Processing
  b. List Processing

c. Like Processing
d. None of the above

32. What is the output of the following statement?
(CAR ‘(P H W))
a. P
b. H
c. W
d. PHW

33. What is the output of the following statement?
(CADAR ‘((a b) (c d)))
a. a
b. b
c. c
d. d

34. What is the output of the following statement?
(cdr ‘(a b c))
a. a
b. b
c. (b c)
d. None of the above

35. Which allow procedures to use themselves again?
a. Recursion
b. Reuse
c. Reinitiate
d. None of the above

36. The left side of an assignment statement will hold:
a. a variable
b. an object property
c. an expression
d. Both a and b
e. All of the above

37. The right side of an assignment statement will hold:
a. a variable
b. an object property
c. an expression
d. Both a and b
e. All of the above

38. What is a procedure that returns a value that signals true or false?
a. List
b. Predicates
c. Data
d. None of the above

39. What is the output of the given statement?
(equal (+ 2 2) 3)

a. T
b. NIL
c. F
d. Both b & c

40. Which notation facilitates uniformity in lisp?
    a. Prefix
    b. Postfix
    c. Infix
    d. None of the above
41. Which is a procedures supplied by user in terms of primitives?
    a. Custom
    b. User-defined
    c. Definite
    d. All of the above
42. What is the output of the following statement?
    (+ 3.14 2.71)
    a. 3.14
    b. 2.71
    c. 5.85
    d. None of the above
43. What is the output of the given statement?
    (progn (setf a 'x) (setf b 'y) (Setf c 'z))
    a. X
    b. Y
    c. Z
    d. XYZ
44. What is the output of the given statement?
    (setf precious '(time)
    '(Time is precious)
    a. Time is precious
    b. Time is time
    c. Time
    d. None of the above
45. Which of the following Scheme expressions would be interpreted as false when evaluated:
    a. NIL
    b. –1
    c. (CAR '(0 1))
    d. '()
    e. none of the above
46. Which of the following is not considered a functional programming language?
    a. ML
    b. Haskell
    c. Smalltalk

d. Scheme
e. Lisp

47. The main programming language used in the field of Numerical Analysis is:
    a. Java
    b. Haskell
    c. Fortran
    d. Assembler
48. A programming language used heavily in the field of Artificial Intelligence is:
    a. Snobol
    b. Lisp
    c. Fortran
    d. C++
49. Which of the programming styles or techniques is least well supported by Scheme?
    a. Functional programming
    b. Imperative programming
    c. Object oriented programming
    d. Recursive programming
50. Which of the following is not applications software?
    a. Word processing
    b. Spreadsheet
    c. UNIX
    d. Desktop publishing
51. Consider the grammar

    S -> ABSC/Abc

    BA -> AB

    Bb -> bb

    Ab -> ab

    Aa -> aa

    Which of the following sentences can be generated by this grammar?
    a. abc
    b. aab
    c. ab cc
    d. abbc
52. The most widely used logic programming language is
    a. BASIC
    b. COBOL
    c. PROLOG
    d. LOGO
53. (cons 'a '(b c d)) generates
    a. b c d a
    b. a b c d
    c. (b c d a)
    d. (a b c d)
54. (cons (2) (3 4 5)) generates

a. 2 3 4 5
b. (2 3 4 5)
c. (2) 3 4 5
d. ((2) 3 4 5)

55. (append ’(b c) ’(e f)) evaluates to
    a. b c e f
    b. (b c e f)
    c. b c (e f)
    d. ((b c) e f)
56. (cdr '(a b c d e f)) evaluates to
    a. a
    b. b c d e f
    c. f
    d. (b c d e f)
57. (car '(a b c d e f)) evaluates to
    a. a
    b. b c d e f
    c. f
    d. (b c d e f)
58. (list 'a '(b c) '(e f)) evaluates to
    a. a b c e f
    b. (a (b c) (e f))
    c. (a b c e f)
    d. ((a) (b c) (e f))
59. (cadadr '(a (c d) (e f g))) returns
    a. A
    b. C
    c. D
    d. E
    e. G
60. (caar (list (list 'a 'b) 'c)) returns
    a. A
    b. B
    c. C
    d. ABC
61. (cadr (list (list 1 2) (list 3 4))) returns
    a. 1 2
    b. (1 2)
    c. 3 4
    d. (3 4)
62. Which of the following is true of aliases?
    a. An alias changes the name of something
    b. An alias protects an existing value from being overwritten
    c. An alias provides an alternative way of accessing something

   d. An alias allows type inference
   e. Aliases should be avoided if at all possible
63. What happens in an assignment such as ``x := y''?
   a. The address of x is modified to be the address of y
   b. The address of y is modified to be the address of x
   c. x and y become aliases
   d. The object bound to y is copied and bound to x, and any previous binding of x to an object is lost
64. Which of the following is true of l-values and r-vlaues?
   a. An l-value is a logical value, and an r-value is a real value
   b. l-values are always to the left of r-values
   c. An l-value refers to a variable's location while an r-value to its current value
   d. L-values are local and r-values are relative
65. Which of these languages does not have a primitive data type for a character string:
   a. Common Lisp
   b. Pascal
   c. Ada
   d. Java
66. What distinguishes a purely ``functional'' programming language from an ``imperative'' one?
   a. There are no variables and hence no assignment operation in a purely functional language
   b. A purely functional language lacks the ``go to'' statement, but an imperative language always has such a command
   c. All subprograms must be declared with the keyword function in a purely functional language
   d. There is no real difference, only a difference in the recommended coding style
67. Prolog is a strongly typed language.
   a. True
   b. False
68. The scope of a variable in Prolog is a single clause (i.e., a fact or rule) or a single query.
   a. True
   b. False
69. One of Prolog strengths is its use of fuzzy logic.
   a. True
   b. False
70. Terms are to Prolog as s-expressions are to Lisp.
   a. True
   b. False
71. The empty list in Prolog is represented by the atomic symbol NIL.
   a. True
   b. False
72. A variable in Prolog must start with either an upper-case letter or an underscore (_).
   a. True

    b. False
73. All local variables must be declared before they are used in Prolog.
    a. True
    b. False
74. A Prolog variable can only be assigned to a value once.
    a. True
    b. False
75. In prolog, *hasTelephone(mutte).* is a
    a. Fact
    b. Rule
    c. Query
    d. None of the above
76. In prolog, *eavesdrops(X,Y):-controls(X, nsa), hasTelephone(Y), usesTelephone(Y).* is a
    a. Fact
    b. Rule
    c. Query
    d. None of the above
77. In prolog, *?-k(Y).* is a
    a. Fact
    b. Rule
    c. Query
    d. None of the above
78. In prolog, *?-jealous(X,Y).* is a
    a. Fact
    b. Rule
    c. Query
    d. None of the above
79. In prolog, *loves(Vincent, mia).* is a
    a. Fact
    b. Rule
    c. Query
    d. None of the above
80. In prolog, *jealous(A,B):-loves(A,C),loves(B,C).* is a
    a. Fact
    b. Rule
    c. Query
    d. None of the above
81. There may be many solutions to a Prolog query.
    a. True
    b. False
82. Given the following set of Prolog clauses
    father(X,Y) :-parent(X,Y),male(X).
    parent(sally,bob).
    parent(jim,bob).

parent(alice,jane),
parent(thomas,jane).
male(bob).
male(jim).
male(thomas).
female(sally).
female(alice).

How many atoms are matched to the variable X before the query father(X,jane) reports a result?

a. 1
b. 2
c. 3
d. 4

83. Given the following set of Prolog clauses

father(X,Y) :-parent(X,Y),male(X).
parent(sally,bob).
parent(jim,bob).
parent(alice,jane),
parent(thomas,jane).
male(bob).
male(jim).
male(thomas).
female(sally).
female(alice).

What will the variable X be bound with when the query father(X,jane) reports a result?

a. Bob
b. Jim
c. Thomas
d. jane

84. In logic programming, the program declares the goals of the computations, not the method for achieving them

a. True
b. False

85. For the PROLOG goal

?[[X,Y],Z|R]=[[a,b],[1,2],[c,d]] .

Which binding apply?

a. X=a Y=b Z=[1,2] R=[[c,d]]
b. none, because the goal fail
c. X=a Y=b Z=1 R=[2,c,d]
d. X=a Y=b Z=[c,d] R=[c,d]

86. In case of arguments passed by values when calling a function such as z=addidion(x,y),

a. Any modifications to the variables x & y from inside the function will not have any effect outside the function.

b. The variables x and y will be updated when any modification is done in the function
c. The variables x and y are passed to the function addition
d. None of above are valid

87. In case of pass by reference,
    a. The values of those variables are passed to the function so that it can manipulate them
    b. The location of variable in memory is passed to the function so that it can use the same memory area for its processing
    c. Both a and c
    d. None of a and b
88. A function may only be called at one place in a program.
    a. True
    b. False
89. Information can be passed into a function through parameters.
    a. Ture
    b. False
90. In Lisp, (+ 8 3) returns
    a. 8
    b. 3
    c. 83
    d. 11
91. In Lisp, (1 2 3 4) returns
    a. 1
    b. 2
    c. 3
    d. 4
    e. Error
92. In Scheme, (CAR '((I HATE) (PEANUT BUTTER) (AND JELLY))) returns
    a. I HATE
    b. (I HATE)
    c. I
    d. HATE
    e. NONE OF THE ABOVE
93. (CAR (CDR '(SAND WITCH))) returns
    a. SAND
    b. (SAND)
    c. WITCH
    d. (WITCH)
94. Given the following code,

```
int a;
procedure foo(int x){
        x = x + 10;
        a = a + x;
```

```
}
procedure fie( ){
        a = 5;
        foo(a);
        print (a);
}
```
What will be printed out if call by value is used?

a. 10
b. 15
c. 20
d. 30
e. None of the above

95. Given the following code,
```
int a;
procedure foo(int x){
        x = x + 10;
        a = a + x;
}
procedure fie( ){
        a = 5;
        foo(a);
        print (a);
}
```
What will be printed out if call by result is used?

a. 10
b. 15
c. 20
d. 30
e. None of the above

96. Given the following code,
```
int a;
procedure foo(int x){
        x = x + 10;
        a = a + x;
}
procedure fie( ){
        a = 5;
        foo(a);
        print (a);
}
```
What will be printed out if call by value-result is used?

a. 10
b. 15
c. 20

    d. 30
    e. None of the above

97. Given the following code,

```
int a;
procedure foo(int x){
        x = x + 10;
        a = a + x;
}
procedure fie( ){
        a = 5;
        foo(a);
        print (a);
}
```

What will be printed out if call by reference is used?

    a. 10
    b. 15
    c. 20
    d. 30
    e. None of the above

98. Given the following code,

```
int a;
procedure foo(int x){
        x = x + 10;
        a = a + x;
}
procedure fie( ){
        a = 5;
        foo(a);
        print (a);
}
```

What will be printed out if call by name is used?

    a. 10
    b. 15
    c. 20
    d. 30
    e. None of the above

99. Which variable has the longest scope?

```
#include <stdio.h>
int b;
int main()
{
   int c;
   return 0;
}
```

int a;

a. a
b. b
c. c
d. Both a and b

100. What is the programming style of the object oriented conceptual model?

a. Invariant relationships
b. Algorithms
c. Classes and objects
d. Goals, often expressed in a predicate calculus.

CMPS 502 Computer Organization

1. A desktop computer is designed for use by an individual, usually incorporating a graphics display, a keyboard, and a mouse.
   A. True
   B. False

2. A server computer is used for running larger programs for multiple users, often simultaneously and typically accessed only via a network.
   A. True
   B. False

3. Supercomputer is a class of computers with the highest performance and cost; they are configured as servers and typically cost millions of dollars.
   A. True
   B. False
4. Data center is a room or building designed to handle the power, cooling, and networking needs of large number of servers.
   A. True
   B. False

5. Embedded computers are the largest class of computers and span the widest range of applications and performance.
   A. True
   B. False

6. A program that translates high-level language statements into assembly language statements is called
   A. Assembler
   B. Compiler
   C. Interpreter
   D. Translator

7. A program that translates symbolic version of instructions into the binary version is called
   A. Assembler
   B. Compiler
   C. Interpreter

D. Translator

8. A binary representation of machine instructions is called
    A. Assembly language
    B. Machine language
    C. High-level language
    D. C language

9. A symbolic representation of machine language is called
    A. Assembly language
    B. Machine language
    C. High-level language
    D. C language

10. A command that computer hardware understands and obeys is called
    A. Logic
    B. Language
    C. Instruction
    D. Translator

11. A mechanism through which the computer is fed information, such as the keyboard or mouse is called
    A. Output device
    B. Input device
    C. I/O device
    D. Memory

12. A mechanism that conveys the result of a computation to a user or another computer is known as
    A. Output device
    B. Input device
    C. I/O device
    D. Networking

13. A transistor is simply an on/off switch controlled by electricity.
    A. True
    B. False

14. An integrated circuit (IC) combined dozens to hundreds of transistors into a single chip.
    A. True
    B. False

15. Gordon Moore’s law states that number of transistors (i.e., transistor capacity) in an integrated circuit doubles in every 18-24 months.
    A. True
    B. False

16. The active part of the computer, which contains the datapath and control, and which adds numbers, test numbers, signals I/O devices to activate is known as
    A. CPU (Central Processing Unit)
    B. Memory hierarchy
    C. I/O devices
    D. Motherboard

17. A plastic board containing packages of integrated circuits or chips, including processor, cache, memory, and connections for I/O devices such as networks and disks is known as
    A. CPU
    B. Memory hierarchy
    C. I/O devices
    D. Motherboard

18. The storage area in which programs are kept when they are running and that contains the data needed by the running programs is called
    A. CPU
    B. Motherboard
    C. Integrated circuits
    D. Memory

19. SRAM (static random access memory) is faster but less dense, and hence more expensive than DRAM (dynamic random access memory).
    A. True
    B. False

20. Magnetic tape is a sequential access memory.
    A. Ture
    B. False

21. In DRAM (dynamic random access memory), memory access take basically the same amount of time no matter what portion of the memory is read.
    A. True
    B. False

22. DRAM (dynamic random access memory) is a volatile storage that contains data only if it is receiving power.
    A. True
    B. False

23. Magnetic disk is a nonvolatile memory because it retains data even in the absence of power source and it is used to store programs between runs.
    A. True
    B. False

24. A memory that is used to hold programs while they are running is known as
    A. Slow memory
    B. Nonvolatile memory
    C. Main memory
    D. Secondary memory

25. A nonvolatile memory (eg., magnetic disk) used to store programs and data between runs is known as
    A. Slow memory
    B. Nonvolatile memory
    C. Main memory
    D. Secondary memory

26. Flash memory is a nonvolatile semiconductor memory, which is cheaper and slower than DRAM.
    A. True
    B. False

27. Flash memory is more expensive and faster than magnetic disks memory.
    A. True
    B. False

28. The relationship between performance and execution time can be defined as:
    A. Performance = 1/(Execution time)
    B. Performance = Execution time
    C. Performance = 2/(Execution time)
    D. Performance = 2 x (Execution time)

29. If the performance of computer X is greater than the performance of computer Y, we can write:
    A. Execution time of computer X > Execution time of Y
    B. Execution time of computer X = 3 x (Execution time of Y)
    C. Execution time of computer X = 1/(Execution time of Y)
    D. Execution time of computer Y > Execution time of X

30. If computer A runs a program in 10 seconds and computer B runs the same program in 15 seconds, how much faster is A than B?
    A. 1.5
    B. 2
    C. 3
    D. 3.5

31. The CPU execution time can be expressed as
    A. CPU execution time for a program = (CPU clock cycle for a program)/(Clock cycle time)
    B. CPU execution time for a program = (CPU clock cycle for a program) x (Clock rate)
    C. CPU execution time for a program = (CPU clock cycle for a program) x (Clock cycle time)
    D. CPU execution time for a program = (CPU clock cycle for a program) x 1/(Clock cycle time)

32. The execution time of the program after making the improvement is given by the following simple equation known as Amdahl's law:
    A. Execution time after improvement = (Execution time affected by improvement)/(Amount of improvement) + Execution time unaffected
    B. Execution time after improvement = (Execution time unaffected)/(Amount of improvement) + Execution time affected by improvement
    C. Execution time after improvement = (Amount of improvement)/(Execution time unaffected) + Execution time affected by improvement

D. Execution time after improvement = (Execution time unaffected)/(Execution time affected by improvement) + Amount of improvement

33. Suppose a program runs in 100 seconds on a computer, with multiply operations responsible for 80 seconds of this time. How much do I have to improve the speed of multiplication if I want my program to run five times faster? (Use Amdahl's law).
    A. 50%
    B. 10%
    C. Impossible
    D. 5%

34. Average number of clock cycles pr instruction for a program or program fragment is knows as
    A. Clock cycles
    B. Instruction count
    C. Clock cycles per instruction (CPI)
    D. Clock period

35. The number of clock cycles required for a program can be written as
    A. CPU clock cycles = (Instructions for a program) x (Average clock cycles per instruction)
    B. CPU clock cycles = (Instructions for a program) x (Number of clock cycles per instruction)
    C. CPU clock cycles = (Instructions for a program) x (Total clock cycles)
    D. CPU clock cycles = (Instructions for a program) x (Total clock cycles per instruction)

36. The classic CPU performance equation is written as
    A. Instruction count = (CPU time) x (CPI) x (Clock cycle time)
    B. Clock cycle time = (Instruction count) x (CPI) x (CPU time)
    C. CPI = (Instruction count) x (CPU time) x (Clock cycle time)
    D. CPU time = (Instruction count) x (CPI) x (Clock cycle time)

37. The classic CPU performance equation is written as
    A. CPU time = (Instruction count) x (CPI) /(Clock rate)
    B. CPU time = (Instruction count) x (Clock rate) /(CPI)
    C. CPU time = (CPI) x (Clock rate) /(Instruction count)
    D. CPU time = (CPI) / (Clock rate) x (Instruction count)

38. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts: CPI for R-type instruction is 1, CPI for I-type instruction is 2, and CPI for J-type instruction is 3. The two sequences have the following instruction counts:
    Code sequence 1: R-type (2), I-type (1), J-type (2)
    Code sequence 2: R-type (4), I-type (1), J-type (1)

    How many instructions code sequence 1 executes?
    A. 2
    B. 3
    C. 4
    D. 5

39. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts: CPI for R-type instruction is 1, CPI for I-type instruction is 2, and CPI for J-type instruction is 3. The two sequences have the following instruction counts:
    Code sequence 1: R-type (2), I-type (1), J-type (2)
    Code sequence 2: R-type (4), I-type (1), J-type (1)

    How many instructions code sequence 2 executes?
    A. 3
    B. 4
    C. 5
    D. 6

40. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts: CPI for R-type instruction is 1, CPI for I-type instruction is 2, and CPI for J-type instruction is 3. The two sequences have the following instruction counts:
    Code sequence 1: R-type (2), I-type (1), J-type (2)
    Code sequence 2: R-type (4), I-type (1), J-type (1)

    Which code sequence executes more instructions?
    A. Code sequence 1
    B. Code sequence 2
    C. Both code sequences execute same number of instructions

41. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts: CPI for R-type instruction is 1, CPI for I-type instruction is 2, and CPI for J-type instruction is 3. The two sequences have the following instruction counts:
Code sequence 1: R-type (2), I-type (1), J-type (2)
Code sequence 2: R-type (4), I-type (1), J-type (1)

How many clock cycles are required for code sequence 1?
A. 6
B. 9
C. 10
D. 12

42. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts: CPI for R-type instruction is 1, CPI for I-type instruction is 2, and CPI for J-type instruction is 3. The two sequences have the following instruction counts:
Code sequence 1: R-type (2), I-type (1), J-type (2)
Code sequence 2: R-type (4), I-type (1), J-type (1)

How many clock cycles are required for code sequence 2?
A. 6
B. 9
C. 10
D. 12

43. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts: CPI for R-type instruction is 1, CPI for I-type instruction is 2, and CPI for J-type instruction is 3. The two sequences have the following instruction counts:
Code sequence 1: R-type (2), I-type (1), J-type (2)
Code sequence 2: R-type (4), I-type (1), J-type (1)

Which code sequence needs more clock cycles?
A. Code sequence 2
B. Code sequence 1
C. Both code sequences need same amount of clock cycles

44. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts: CPI for R-type instruction is 1, CPI for I-type instruction is 2, and CPI for J-type instruction is 3. The two sequences have the following instruction counts:
Code sequence 1: R-type (2), I-type (1), J-type (2)
Code sequence 2: R-type (4), I-type (1), J-type (1)

    Which code sequence is faster?
    A. Code sequence 1
    B. Code sequence 2

45. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts: CPI for R-type instruction is 1, CPI for I-type instruction is 2, and CPI for J-type instruction is 3. The two sequences have the following instruction counts:
Code sequence 1: R-type (2), I-type (1), J-type (2)
Code sequence 2: R-type (4), I-type (1), J-type (1)

    What is the CPI for code sequence 1?
    A. 1
    B. 1.5
    C. 2.0
    D. 2.5

46. A compiler designer is trying to decide between two code sequences for a particular computer. The hardware designers have supplied the following facts: CPI for R-type instruction is 1, CPI for I-type instruction is 2, and CPI for J-type instruction is 3. The two sequences have the following instruction counts:
Code sequence 1: R-type (2), I-type (1), J-type (2)
Code sequence 2: R-type (4), I-type (1), J-type (1)

    What is the CPI for code sequence 2?
    A. 1
    B. 1.5
    C. 2.0
    D. 2.5

47. The MIPS processor paradigm was created at Stanford University by

A. J. L. Hennessy
B. D. Patterson
C. G. Moore
D. A. Tour

48. MIPS stands for

A. MIllions of Instruction Processing per Second
B. Microprocessor without Interlocked Pipeline Stages
C. Microprocessor Instruction Processing Style
D. Millions Instructions Program Set

49. MIPS is a

A. RISC processor
B. CISC processor

50. MIPS R2000 has how many temporary registers?

A. 10
B. 30
C. 32
D. 4

51. MIPS R2000 registers are _______ in length.

A. 32 bits
B. 16 bits
C. 64 bits
D. 8 bits

52. Register number zero is a reserved register.

A. True
B. False

53. If you want to exit the program, v0 register must be loaded with

A. 10
B. 7
C. 5
D. 0

54. If you want to read an integer value from console, v0 register must be loaded with
    A. 10
    B. 7
    C. 5
    D. 0
55. If you want to print a string, v0 register must be loaded with 4
    A. True
    B. False
56. What is the meaning of the instruction bne $s1, $s2, 25?
    A. If ($s2 >= 25) $s1=1; else $s1=0
    B. If ($s1 >= $s2) $s1=1; else $s1=0
    C. If ($s2 >= $s3) $s1=1; else $s1=0
    D. If ($s1!= $s2) go to PC+4+100

57. What is the meaning of the instruction slt $s1, $s2, $s3?
    A. If ($s2 >= $s3) $s1=1; else $s1=0
    B. If ($s2 <= $s3) $s1=1; else $s1=0
    C. If ($s2 < $s3) $s1=1; else $s1=0
    D. If ($s2 == $s3) $s1=1; else $s1=0

58. What is the meaning of the instruction slti $s1, $s2, 20?
    A. If ($s2 >= 20) $s1=1; else $s1=0
    B. If ($s2 <= 20) $s1=1; else $s1=0
    C. If ($s2 < 20) $s1=1; else $s1=0
    D. If ($s2 == $s1) $s1=1; else $s1=0

59. What is the meaning of the instruction sltu $s1, $s2, $s3?
    A. If ($s2 >= 20) $s1=1; else $s1=0
    B. If ($s2 <= 20) $s1=1; else $s1=0
    C. If ($s2 < $s3) $s1=1; else $s1=0
    D. If ($s2 == $s1) $s1=1; else $s1=0

60. What is the meaning of the instruction srl $s1, $s2, 10?
    A. $s1 = $s2 >> 10
    B. $s2 = $s1 >> 10
    C. $s1 = $s2 << 10
    D. $s2 = $s1 << 10

61. What is the meaning of the instruction sll $s1, $s2, 10?
    A. $s1 = $s2 << 10
    B. $s2 = $s1 << 10
    C. $s1 = $s2 >>10
    D. $s2 = $s1 >> 10

62. What is the meaning of the instruction sw $s1, 20($s2)?
    A. $s2 = Memory[$s1 + 20]
    B. $s1 = Memory[$s2 + 20]
    C. Memory[$s1 + 20] = $s2
    D. Memory[$s2 + 20] = $s1

63. What is the meaning of the instruction lw $s1, 20($s2)?
    A. $s2 = Memory[$s1 + 20]
    B. $s1 = Memory[$s2 + 20]
    C. Memory[$s1 + 20] = $s2
    D. Memory[$s2 + 20] = $s1

64. What is the meaning of the instruction jal 2500?
    A. $ra = PC + 4; go to 2500 x 1 = 2500
    B. $ra = PC + 4; go to 2500 x 2 = 5000
    C. $ra = PC + 4; go to 2500 x 3 = 7500
    D. $ra = PC + 4; go to 2500 x 4 = 10000

65. Assume that the variables f and g are assigned to registers $s0 and $s1 respectively. Assume that the base address of array A is in register $s6. What is the C code corresponding to the following MIPS code?

```
lw $s0, 16($s6)
sub $s0, $0, $s0
sub $s0, $s0, $s1
```

    A. f = -g - A[4]
    B. g = f - A[4]
    C. f = -g + A[16]
    D. f = -g - A[16]

66. Assume that the variables i and j are assigned to registers $s3 and $s4 respectively. Assume that the base address of arrays A and B are in registers $s6 and $s7, respectively. What is the MIPS code corresponding to the following C code?

    B[8] = A[4]+i-j

A. sub $t0, $s3, $s4
   lw $t1, 16($s6)
   add $t0, $t0, $t1
   sw $t0, 32($s7)
B. sub $t0, $s3, $s4
   lw $t1, 16($s6)
   add $t0, $t0, $t1
   sw $t1, 32($s7)
C. sub $t1, $s3, $s4
   lw $t1, 16($s6)
   add $t0, $t0, $t1
   sw $t0, 32($s7)
D. sub $t0, $s3, $s4
   lw $t1, 16($s7)
   add $t0, $t0, $t1
   sw $t0, 32($s6)

67. Assume that the variables f,g,h,i and j are assigned to registers $s0, $s1, $s2, $s3 and $s4 respectively. Assume that the base address of arrays A and B are in registers $s6 and $s7, respectively. What is the C code corresponding to the following MIPS code??

```
slli $s2, $s4, 1
add $s0, $s2, $s3
add $s0, $s0, $s1j
```

A. f = 2j+ i + g
B. g = 2i + f + j
C. i = 4 f + j + h
D. f = 4j + i + g

68. Consider the following MIPS assembly language code:

```
.data
        msg:    .asciiz  "Hello World\n"
```

```
        .text
        .globl
main:
        li $v0, 4
        li $a0, msg
        syscall

        li $v0, 10
        syscall
```

What will be the output of the above program?

A. There is an error in the program and no output
B. Hello Word
C. “Hello Word”
D. Nothing

69. Consider the following MIPS assembly language code:

```
        .data
                msg:    .asciiz  “Hello World\n”
                msg1    .asciiz  “Hello Class\n”
        .text
        .globl
main:
        li $v0, 4
        li $a0, msg
        li $a0, msg1
        syscall

        li $v0, 10
        syscall
```

What will be the output of the above program?

A. There is an error in the program and no output
B. Hello Word
C. “Hello Word”
D. Hello Class

70. A pipeline hazards occurs when the pipeline, or some portion of the pipeline, must stall because conditions do not permit continued execution.
    A. True
    B. False

71. A _____________ hazard occurs when two (or more) instructions that are already in the pipeline need the same resource.
    A. Resource
    B. Data
    C. Control

72. A _____________ hazard occurs when there is a conflict in the access of an operand location.
    A. Resource
    B. Data
    C. Control

73. A ___________ hazard occurs when the pipeline makes the wrong decision on a branch prediction and therefore brings instruction into the pipeline that must subsequently be discarded.
    A. Resource
    B. Data
    C. Control

74. In which of the following dependency, an instruction modifies a register or memory location and a succeeding instruction reads the data in that memory or register location?
    A. Read after write
    B. Write after read
    C. Write after write
    D. Read after read

75. In which of the following dependency, an instruction reads a register or memory location and a succeeding instruction writes to the location.
    A. Read after write
    B. Write after read
    C. Write after write
    D. Read after read

76. In which of the following dependency, two instructions both write to the same location.
    A. Read after write
    B. Write after read
    C. Write after write
    D. Read after read

77. In superscalar processor, out-of-order issue policy is done with a buffer referred to as a(n)
    A. Instruction window
    B. Forward memory
    C. Instruction label
    D. Forward memory

78. In superscalar processor, the term "instruction issue" refers to the process of initiating instruction execution in the processor's ________________ unit.
    A. Functional
    B. Decoding
    C. Write back
    D. Fetch

79. In superscalar processor, the term "instruction issue policy" refers to the protocol used to issue instruction.
    A. True
    B. False

80. In superscalar processor, out-of-order completion is used in scalar RISC processors to improve the performance of instructions that require multiple cycles.
    A. True
    B. False

81. The simplest instruction issue and completion policy is
    A. In-order issue and in-order completion
    B. In-order issue and out-of-order completion
    C. Out-of-order issue and out-of-order completion
    D. Out-of-order issue and in-order completion

82. One of the characteristics of Reduced Instruction Set Computers (RISC) is one instruction per cycle.

A. False
B. True

83. One of the characteristics of Reduced Instruction Set Computers (RISC) is register to register operations.
    A. True
    B. False

84. Reduced Instruction Set Computers (RISC) architecture has more instructions compared to Complex Instruction Set Computer (CISC) architecture.
    A. True
    B. False

85. Delayed branch, a way of increasing the efficiency of the pipeline, makes use of a branch that does not take effect until after execution of the following instruction.
    A. True
    B. False

86. Instruction level parallelism (ILP) refers to the degree to which, on average, the instructions of a program can be executed in parallel.
    A. True
    B. False

87. In register renaming, registers are allocated dynamically by the processor hardware, and they are associated with the values needed by instructions at various points in time.
    A. True
    B. False

88. Consider the following code sequence with superscalar processor:
    I1: R3 := R3 op R5
    I2: R4 := R3 + 1
    I3: R3 := R5 + 1
    I4: R7 := R3 op R4

    What types of dependency I2 and I3 have?
    A. True data dependency
    B. Antidependency
    C. Resource Conflict

D. Output dependency

89. Consider the following code sequence with superscalar processor:
    I1: R3 := R3 op R5
    I2: R4 := R3 + 1
    I3: R3 := R5 + 1
    I4: R7 := R3 op R4

    What types of dependency I1 and I3 have?
    A. True data dependency
    B. Antidependency
    C. Resource Conflict
    D. Output dependency

90. Consider the following code sequence with superscalar processor:
    I1: R3 := R3 op R5
    I2: R4 := R3 + 1
    I3: R3 := R5 + 1
    I4: R7 := R3 op R4

    Which of the following method will solve the dependencies in the above code segment?
    A. Speculative loading
    B. Prediction
    C. Forwarding
    D. Register renaming

91. Consider the following MIPS assembly language code sequence:
    I1: add $s3, $s4, $s2 15
    I2: sub $s5, $s3, $s1
    I3: lw $s6, 200($s3)
    I4: add $s7, $s3, $s6

    What types of dependency I1 and I2 have?
    A. True data dependency
    B. Antidependency
    C. Resource Conflict
    D. Output dependency

92. Consider the following MIPS assembly language code sequence:
    I1: add $s3, $s4, $s2
    I2: sub $s5, $s3, $s1
    I3: lw $s6, 200($s3)
    I4: add $s7, $s3, $s6

    What types of dependency I2 and I3 have?
    A. True data dependency
    B. Resource Conflict
    C. Output dependency
    D. No Dependency

93. Consider the following MIPS assembly language code sequence:
    I1: add $s3, $s4, $s2
    I2: sub $s5, $s3, $s1
    I3: lw $s6, 200($s3)
    I4: add $s7, $s3, $s6

    What types of dependency I3 and I4 have?
    A. True data dependency
    B. Antidependency
    C. Resource Conflict
    D. Output dependency

94. Consider the following MIPS assembly language code sequence:
    I1: add $s3, $s4, $s2
    I2: sub $s5, $s3, $s1
    I3: lw $s6, 200($s3)
    I4: add $s7, $s3, $s6

    Which of the following dependency will cause a stall?
    A. Dependency between I1 & I2
    B. Dependency between I2 & I3
    C. Dependency between I3 & I4
    D. Dependency between I1 & I3

95. Consider the following MIPS assembly language code sequence:
    I1: add $s3, $s4, $s2

I2: sub $s5, $s3, $s1
I3: lw $s6, 200($s3)
I4: add $s7, $s3, $s6

Which of the following dependency can be solve by forwarding or bypassing?

A. Dependency between I1 & I2
B. Dependency between I2 & I3
C. Dependency between I3 & I4
D. Dependency between I1 & I4

96. What are the four execution units that IA-64 processors have?

A. A-unit, B-unit, C-unit, D-unit
B. I-unit, M-unit, B-unit, F-unit
C. I-unit, C-unit, B-unit, F-unit
D. I-unit, D-unit, B-unit, F-unit

97. What is the instruction length of IA-64 processors?

A. 32-bit
B. 64-bit
C. 128-bit
D. 256-bit

98. What are the key mechanisms of IA-64 architecture?

A. Prediction, control speculation, data speculation, and software pipelining
B. Prediction, control speculation, data speculation, and hardware pipelining
C. Prediction, address speculation, data speculation, and software pipelining
D. Predication, control speculation, data speculation, and software pipelining

99. ______________ is a techniques used to optimize loops in a manner that parallels hardware pipelining.

A. Software pipelining
B. Hardware pipelining
C. Control speculation
D. Data speculation

100. With ______________ , all possible branch paths are executed, the correct one is kept and all other are throw away.

A. Software pipelining

B. Branch predication
C. Branch prediction
D. Control speculation

CMPS 512 Theory of Computing

1. For the following statements: (1). If S is a finite set, $|2^S| = 2^{|S|}$; (2). If S_1 and S_2 are finite sets with $|S_1| = n$ and $|S_2| = m$, then $|S_1 \cup S_2| \le n+m$; which of the following is right:
   (A). (1) is right.
   (B). (1) and (2) are right.
   (C). (2) is right.
   (D). None of (1) and (2) is right.

2. Which of the following statements can be right: (1). A grammar G can be a quadruple (V, T, S, P) and the production rules are the heart of a grammar. (2). An automaton can have three components: input file, control unit, and storage.
   (A). Only (1) is right.
   (B). Only (2) is right.
   (C). Both (1) and (2) are right.
   (D). Neither (1) nor (2) is right.

3. If S = {2, 5, 6, 8} and T = {2, 4, 6, 8}, then $|S \cup T| + |S \cap T| =$
   (A). 12.
   (B). 9.
   (C). 8.
   (D). 7.

4. Which of the following statements can be right: (1). $S_1 = S_2$ is equivalent to $S_1 \cup S_2 = S_1 \cap S_2$; (2). If S_1 and S_2 are finite sets, then $|S_1 \times S_2| = |S_1|\ |S_2|$.
   (A). (1) is right.
   (B). Both (1) and (2) are right.
   (C). (2) is right.
   (D). None of (1) and (2) is right.

5. Which of the following statements can be right: (1). If $x = O(n^4)$, $y = O(n^2)$, then $x/y = O(n^2)$. (2). If $x = \Theta(n^4)$, $y = \Theta(n^2)$, then $x/y = \Theta(n^2)$.
   (A). Only (1) is right.
   (B). Only (2) is right.
   (C). Both (1) and (2) are right.
   (D). Neither (1) nor (2) is right.

6. Which of the following statements can be right: If $f(n) = O(n^2)$, $g(n) = O(n^3)$, then (1). $f(n) + g(n) = O(n^3)$. (2). $f(n)g(n) = O(n^5)$.
   (A). Only (1) is right.
   (B). Only (2) is right.

(C). Both (1) and (2) are right.
(D). (1) is right and (2) is wrong.

7. Which of the following statements may be true: (1). $(w^R)^R = w$ for all $w \in \Sigma^*$. (2). If L = {ab, aa, baa}, then the string aaaabaaaa and baaaaabaa are in L^4.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

8. Which of the following statements may be true: (1). $(L^*)^* = L^*$ for all languages L. (2). $(L^R)^* = L^*$ for all languages L.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

9. Which of the following language is generated by the grammar with productions $S \rightarrow aaA$, $A \rightarrow bS$, and $S \rightarrow \lambda$:
(A). $L = \{(aa)^n b: n \geq 0\}$.
(B). $L = \{aa(b)^n: n \geq 0\}$.
(C). $L = \{(aab)^n: n \geq 0\}$.
(D). $L = \{(a)^n b: n > 0\}$.

10. The grammar $S \rightarrow aaSbb|aSb|ab|\lambda$ is equivalent to the following grammar:
(A). $S \rightarrow aaSb|ab|\lambda$.
(B). $S \rightarrow aSbb|ab|\lambda$.
(C). $S \rightarrow aSb|ab|\lambda$.
(D). $S \rightarrow aSb|aabb|\lambda$

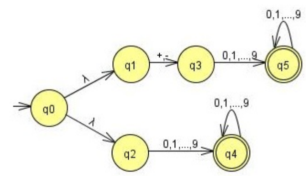
11. Which of the following statements may be right: (1). A deterministic finite automaton can have only quadruple $M = \{Q, \delta, q_0, F\}$; (2). Language $L = \{a^n: n \geq 3\}$ is regular.
(A). Only (1) is right.
(B). Both (1) and (2) are right.
(C). (1) is wrong and (2) is right.
(D). None of the above is right.

12. Which of the following statements may be right: (1). The language $L = \{a^n: n \geq 0, n \neq 3\}$ is regular. (2). Language $L = \{a^n$: n is either a multiple of 3 or a multiple of 5$\}$ is regular.
(A). Only (1) is right.

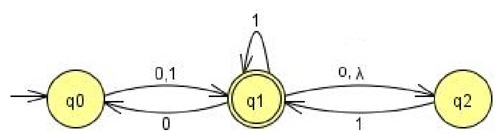
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

13. Which of the following statements may be right: (1). The language L = {a^n: n is a multiple of 3 but not a multiple of 5} is regular. (2). The set of all real number in C is not a regular language. (A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

14. Which of the following statements may be right: (1). The language L = {a^n: n is a multiple of 3 but not a multiple of 5} is regular. (2). The set of all real number in C is not a regular language. (A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.



15. Which of the following statements may be right: (1). If language L is regular then L – {λ} is also regular. (2). If language L is regular then for all a ∈ Σ, L U {aa} is also regular.
(A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.



16. For the following automaton, which of the following statements may be true: (1). It is a DFA. (2). It is a NFA that accepts all integer numbers in C.
(A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

17. Which of the strings 00, 01001, 10010, 000, and 0000 are accepted by the following NFA?
(A). 00 and 01001.
(B). 01001 and 000.
(C). 10010 and 0000.
(D). 000 and 0000.

18. Which of the following statements may be right: (1). If language L is regular then L^R is also regular. (2). A NFA can be converted to a DFA.
(A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

19. Which of the following statements may be right: (1). The automaton generated by procedure reduce is deterministic. (2). If L is a nonempty language such that any w in L has length at least n, then any DFA accepting L must have at least n+1 states.
(A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

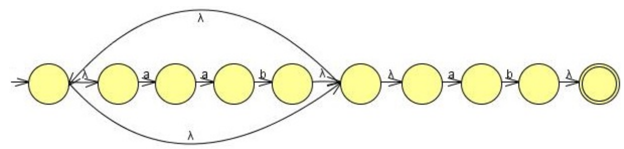
20. Which of the following statements may be right: (1). A regular language can be accepted by a Turing machine. (2). A regular language can be accepted by a pushdown automaton.
(A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

21. A regular expression for the set $\{a^n b^m: n \geq 3, m \text{ is odd}\}$ can be:
(A). aaab.
(B). aaabbb.
(C). aaaa*(bb)*b.
(D). None of the above is right.

22. A regular expression for the set $\{a^n b^m: (n + m) \text{ is odd}\}$ can be:
(A). aaab*.
(B). (aa)*(a+b)(bb)*.
(C). a(aa)*bbb.
(D). None of the above is right.

23. A regular expression for the language $L = \{a^n b^m: n \geq 3, m \leq 4\}$ can be:
(A). aaaa*(λ + b + bb + bbb + bbbb).
(B). aaabbb.
(C). aaab.
(D). None of the above is right.

24. Which of the following statements may be right: (1). λ is a regular expression denoting $\{\lambda\}$. (2). The L^R of L((ab + b)*b(a + ab)*) is (a + ba)*b(b + ba)*.
(A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.



25. A regular expression for L = $\{ab^n w: n \geq 4, w \in \{a, b\}^+\}$ can be:
(A). abbbb.
(B). abbbbb*.
(C). abbbbb*(a+b)(a+b)*.
(D). abbbbb*(a+b).

26. A regular expression for L = $\{w \in \{0, 1\}^*$: w has exactly one pair of consecutive zeros$\}$ can be:
(A). (1+01)*00(1+10)*.
(B). (1+01)*00.
(C). 00.
(D). (1+10)*00.

27. A regular expression for the language with all strings not ending in 10 on {0, 1} can be:
(A). 00 + 01 + 11 + 0 +1.
(B). 00 + 01 + 11 + 0 +1.
(C). (0 + 1)*(00 + 01 + 11) + λ + 0 + 1.
(D). 00 + 01 + 11 + 0 + 1 + λ.

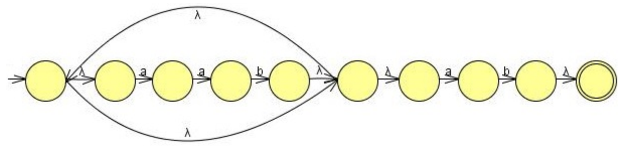
28. A regular expression for the language L = $\{w: n_a(w) \bmod 3 = 0\}$ on {a, b} can be:
(A). ab*ab*ab*.
(B). (ab*ab*ab*)*.
(C). (b*ab*ab*ab*)*.
(D). None of the above is right.

29. The language which accept the NFA below can be written as:
(A). L((aab)ab).
(B). L((aab)*ab).
(C). L($(aab)^+$ab).
(D). None of the above is right.

30. The regular grammar that generates the language L(aa*(ab + a)*) can be written as:

(A). S → aA, A → aA|B|λ.
(B). S → aA, A → aAb|B|λ.
(C). S → aA, A → aA|B, B → abB|aB|λ.
(D). None of the above is right.

31. If L_1 = L(ab*aa), L_2 = L(a*bba*), a regular expression of (L_1 U L_2)*L_2 is:



(A). ab*aa*bba*(a*bba*).
(B). ab*aa*bba* + a*bba*.
(C). ((ab*aa) + (a*bba*))*(a*bba*).
(D). None of the above is right.

32. Which of the following statements may be right: (1). If a language family is closed under union and complementation, it must be closed under intersection. (2). We can construct a NFA that accept L(ab*a*) ∩ L(a*b*a).
(A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

33. Which of the following statements may be right: (1). The family of regular language is closed under finite union and intersection. (2). Some NFAs cannot be converted to DFA.
(A). Only (1) is right.
(B). (1) is wrong and (2) is right.
(C). (1) is right and (2) is wrong.
(D). None of the above is right.

34. Which of the following are true for all regular languages and all homomorphism: (1). $h(L_1 \cup L_2) = h(L_1) \cup h(L_2)$. (2). $h(L_1 \cap L_2) = h(L_1) \cap h(L_2)$.
(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). None of the above is right.

35. If L_1 = L(a*baa*) and L_2 = L(aba*), then L_1/L_2 equals to
(A). a*b.
(B). ba*.
(C). a*.
(D). None of the above.

36. Which of the following are true: (1). For all languages L_1 and L_2, $L_1 = L_1L_2/L_2$. (2). If $L_1 \cup L_2$ is regular and L_1 is finite, then L_2 is regular.
    (A). Only (1) is true.
    (B). (1) is false and (2) is true.
    (C). (1) is true and (2) is false.
    (D). None of the above is right.

37. Which of the following are true: (1). If L is a regular languages, then $L_1 = \{uv: u \in L, |v| = 2\}$ is also regular. (2). If L is a regular languages, then $L_1 = \{uv: u \in L, v \in L^R\}$ is also regular.
    (A). Only (1) is true.
    (B). (1) is false and (2) is true.
    (C). (1) is true and (2) is false.
    (D). Both (1) and (2) are true.

38. Which of the following are true: (1). There exists an algorithm to determine whether or not $w \in L_1 - L_2$, for any given w and any regular language L_1 and L_2. (2). There exists an algorithm for determining if L_1 is a proper subset of L_2, for any regular language L_1 and L_2.
    (A). Only (1) is true.
    (B). (1) is false and (2) is true.
    (C). (1) is true and (2) is false.
    (D). Both (1) and (2) are true.

39. Which of the following are true: (1). There exists an algorithm for determining whether or not $\lambda \in L$ for any regular language L. (2). No algorithm exists for determining if $L \in \Sigma^*$ for any regular language L.
    (A). Only (1) is true.
    (B). (1) is false and (2) is true.
    (C). (1) is true and (2) is false.
    (D). Both (1) and (2) are true.

40. Which of the following are true: (1). There exists an algorithm for determining whether or not $|L| \geq 5$ for every regular language L. (2). There exists an algorithm for determining if a regular language L contains a finite number of even-length strings.
    (A). Only (1) is true.
    (B). (1) is false and (2) is true.
    (C). (1) is true and (2) is false.
    (D). Both (1) and (2) are true.

41. Which of the following are true: (1). The language L = $\{a^n b^k c^n: n \geq 0, k \geq 0\}$ is not regular. (2). The language L = $\{a^n b^k c^n: n \geq 0, k \geq n\}$ is not regular.

(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

42. Which of the following are true: (1). The language L = $\{a^n b^n: n \geq 1\} \cup \{a^n b^m: n \geq 1, m \geq 1\}$ is regular. (2). The language L = $\{a^n b^n: n \geq 1\} \cup \{a^n b^{n+2}: n \geq 1\}$ is regular.

(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

43. Which of the following are true: (1). The language L = $\{a^n b^n: n \geq 0\} \cup \{a^n b^{n+1}: n \geq 0\} \cup \{a^n b^{n+2}: n \geq 0\}$ is not regular. (2). The language L = $\{a^n b^{n+k}: n \geq 0, k \geq 1\} \cup \{a^{n+k} b^n: n \geq 0, k \geq 3\}$ is not regular.

(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

44. Which of the following are true: (1). The language L = $\{ww^R v: v, w \in \{a, b\}^+\}$ is not regular. (2). The language L = $\{w_1 c w_2: w_1, w_2 \in \{a,b\}^*, w_1 \neq w_2\}$ is regular.

(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

45. Which of the following are true: (1). The context-free grammar for language L = $a^n b^n$, n is odd, is $S \rightarrow aaSbb|\lambda$. (2). The context-free grammar for language L = $a^n b^n$, n is a multiple of 3, is $S \rightarrow aaaSbbb|\lambda$.

(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

46. Which of the following are true: (1). The context-free grammar for language L = $\{a^n b^n, n \leq m + 3, n \geq 0, m \geq 0\}$ is: odd, is $S \rightarrow aSb|A|B$, $A \rightarrow \lambda|a|aa|aaa$, $B \rightarrow bB|b$. (2). The

context-free grammar for language $L = \{a^n b^m: 2n \le m \le 3n\}$ is a multiple of 3, is $S \rightarrow aaaSb|aaaSb|\lambda$.
(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

47. Which of the following are true: (1). A context-free grammar for language $L = \{a^n w w^R b^n,: w \in \Sigma^*, n \ge 1\}$ for $\Sigma = \{a, b\}$ can be $S \rightarrow aSb|S_1$, $S_1 \rightarrow aS_1a|bS_1b|\lambda$. (2). If language $L = \{a^n b^n: n \ge 0\}$, then L^2 is not context-free.
(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

48. Which of the following are true: (1). The language $L = \{uvwv^R: u,v,w \in \{a, b\}^+, |u| = |w| = 2\}$ is context-free. (2). The language $L = \{w_1cw_2: w_1, w_2 \in \{a, b\}^+, w_1 \ne w_2^R\}$ with $\Sigma = \{a, b, c\}$ is context-free.
(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

49. Which of the following are true: (1). The grammar $S \rightarrow AB|aaaB$, $A \rightarrow a|Aa$, and $B \rightarrow b$ is ambiguous. (2). A regular language can be inherently ambiguous.
(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

50. Which of the following are true: (1). It's possible for a regular grammar to be ambiguous. (2). The grammar $S \rightarrow aSbS|bSaS|\lambda$ is ambiguous.
(A). Only (1) is true.
(B). (1) is false and (2) is true.
(C). (1) is true and (2) is false.
(D). Both (1) and (2) are true.

51. Simplify the grammar $S \rightarrow aS|AB|\lambda$, $A \rightarrow bA$, and $B \rightarrow AA$, we get: (1). $S \rightarrow aS|\lambda$. (2). $L(a^*)$. (3). $S \rightarrow aS|bb|\lambda$.
(A). Only (1) is right.

(B). Only (2) and (3) are right.
(C). Only (1) and (2) are right.
(D). All of (1), (2), and (3) are right.

52. Eliminate all λ-productions from S → aSSS and S → bb|λ, we get: (1). S → a|bb|bb|bb|a and S → bb. (2). S → a|SSS|aSS|aS|a and S → bb.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). Neither (1) nor (2) is right.

53. Eliminate all λ-productions from S → AaB|aaB, A → λ, B → bbA|λ, we get: (1). S → aB|aaB|a|aa and S → bb. (2). S → abb|aabb and B → bb.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). Neither (1) nor (2) is right.

54. Eliminate the variable B from the grammar S → aSB|bB and S → bb|λ, we get: (1). S → aSaA|aSb|baA|bb. (2). S → aSaA|b|baA|b.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). Neither (1) nor (2) is right.

55. Which of the following choice is right for the grammar
S → abAB|ba, A → aaa, B → aA|bb
and
S → abAaA|abAbb|ba, A → aaa.
(A). They are not equivalent.
(B). They are equivalent.
(C). The first is context free and the second is context sensitive.
(D). The first is context sensitive and the second is context free.

56. Which of the following statements may be true: (1). Both Chomsky normal form and Greibach normal form can be used to represent a context free grammar. (2). Every context free grammar without λ can be converted into Greibach normal form.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.

(D). None of the above is right.

57. The Chomsky normal form of the grammar $S \rightarrow aSS|a|b$ is: (1). $S \rightarrow V_aV_s|a|b$, $V_s \rightarrow SS$, $V_a \rightarrow a$. (2). $S \rightarrow V_aV_s|a|b$, $V_s \rightarrow SS|b$, $V_a \rightarrow a$.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). Neither (1) nor (2) is right.

58. The Greibach normal form of the grammar $S \rightarrow aSb|bSa|a|b|ab$ is: (1). $S \rightarrow aSb|V_bSV_a|a|b|V_aV_b$, $V_a \rightarrow a$, $V_b \rightarrow b$. (2). $S \rightarrow aSV_b|bSV_a|a|b|aV_b$, $V_a \rightarrow a$, $V_b \rightarrow b$.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). Neither (1) nor (2) is right.

59. The Greibach normal form of the grammar $S \rightarrow aSb|ab|bb$ is: (1). $S \rightarrow aSV_b|aV_b|bV_b$, $V_b \rightarrow b$. (2). $S \rightarrow aSV_b|aV_b|V_bV_b$, $V_b \rightarrow b$.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). Neither (1) nor (2) is right.

60. Which of the following statements can be true: (1). Every linear grammar can be converted to a regular grammar. (2). The Chomsky normal form of a context free language without λ can be converted into a Greibach form.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). Neither (1) nor (2) is right.

61. For pushdown automata, which of the following statements are correct: (1). Pushdown automata describe context free language, so they are equivalent to context free grammar. (2). Pushdown automata include every element of finite automata. (3). Pushdown automata follow leftmost derivation order, thus they need to use a stack as their unbounded storage.
(A). Only (1) is right.
(B). Only (2) and (3) are right.
(C). Only (1) and (2) are right.
(D). All of (1), (2), and (3) are right.

62. Which of the following statements are right: (1). Pushdown automata have seven elements: $M = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$, they are pattern model of context free languafe

For pushdown automata, which of the following statements are correct: (1). Pushdown automata describe context free language, so they are equivalent to context free grammar. (2). Pushdown automata include every element of finite automata. (3). Pushdown automata follow leftmost derivation order, thus they need to use a stack as their unbounded storage.

(A). Only (1) is right.
(B). Only (2) and (3) are right.
(C). Only (1) and (2) are right.
(D). All of (1), (2), and (3) are right.

63. Which of the following statements are right: (1). The states of pushdown automata represent the grammar variables of derivative sentences in corresponding regular language. (2). In a pushdown automata stack, the leftmost variable is put on top of the stack while the rightmost one on bottom. (3). Once the stack is empty, the sentence is generated.

(A). Only (1) is right.
(B). Only (2) and (3) are right.
(C). Only (1) and (2) are right.
(D). All of (1), (2), and (3) are right.

64. Pushdown automata have following basic components: (1). Input file tape. (2). Stack storage. (3). Control unit. (4). Read and write tape.

(A). (1) and (2).
(B). (3) and (4).
(C). (1), (2), and (3).
(D). (2), (3), and (4).

65. To construct a pushdown automaton that accept language $L = \{w2w^T \mid w \in \{0,1\}^*\}$, which of the following design can be right: (1). Two steps $M_1 = (\{q_0\}, \{0, 1, 2\}, \{S, A, B\}, \delta_1, q_0, S, \Phi)$ and $M_2 = (\{q_0, q_1\}, \{0, 1, 2\}, \{S, A, B, Z_0\}, \delta_2, q_0, Z_0, \{q_1\})$, where Z_0 is the top stack symbol, and then construct the machine by standard method. (2). $M = (\{q_0, q_1, q_2, q_f, q_t\}, \{0, 1, 2\}, \{A, B, Z_0\}, \delta, q_0, Z_0, \{q_f\})$, where q_t is the trap state.

(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

66. To construct a pushdown automaton that accept the language defined by the grammar $S \rightarrow aSSSab|\lambda$, we can do the following implementation: (1). Convert the grammar into a regular grammar. (2). Convert the grammar into Greibach form. $S \rightarrow aSSSA|\lambda$, $A \rightarrow aB$, and $B \rightarrow b$. (3). Follow the standard construction method to build the automaton. Which of the following choices are right:
(A). (1) and (2).
(B). (2) and (3).
(C). (1) and (3).
(D). (1), (2), and (3).

67. Which of the following statement on pushdown automata and context free language/grammar are right: (1). Pushdown automata is equivalent to context free grammar. (2). Context free language can be accepted by pushdown automata which can use empty stack to accept language. (3). The pushdown automata accepted language can be described by context free grammar. (4). Pushdown automata is equivalent to deterministic finite automata.
(A). Only (1) and (2) are right.
(B). Only (2) is right.
(C). (1), (2), and (3) are right.
(D). All (1), (2), (3), and (4) are right.

68. For the equivalence of pushdown automat and context free grammar, which of the following statements are right: (1). Context free grammar is equivalent to the pushdown automata which can accept a language with an empty state stack. (2). Context free grammar is equivalent to the pushdown automata which can accept a language with a final state. (3). (1) and (2) are equivalent.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). All (1), (2), and (3) are right.

69. Which of the following statements may be correct: (1). $L = \{a^n b^m, n < m\}$ is a deterministic context free language. (2). $L = \{a^n b^m, n > m\}$ is not a deterministic context free language.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

70. Which of the following statements may be correct: (1). If L_1 is deterministic context free and L_2 is regular, then $L_1 \cap L_2$ is not deterministic context free. (2). If L_1 is deterministic context free and L_2 is regular, then the union of L_1 and L_2 is deterministic context free.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

71. Which of the following statement are correct: (1). A context free language is a subset of a context
sensitive language. (2). It's easier to process regular grammar than context free grammar. (3). It's easier to process context free grammar than context sensitive grammar.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). All (1), (2), and (3) are right.

72. Which of the following statements for context free language pumping lemma may be right: (1). The pumping lemma is useful in showing that a language does not belong to the family of context free language. (2). The substring that precedes bounded string can be arbitrary long.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

73. Which of the following statements for linear language pumping lemma may be right: (1). The middle string can be of arbitrary length. (2). The substring that precedes middle string can be arbitrary long.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

74. Which of the following statements may be right: (1). The family of context free language is a proper subset of the family of linear language. (2). The family of linear language is a proper subset of the family of context free language.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.

(D). None of the above is right.

75. The family of context free language is closed under the following operations: (1). Union, (2). Intersection, (3). Concatenation, (4). Star-closure, (5). Complementation.
(A). (1), (2), and (3) are right.
(B). (2), (3), and (4) are right.
(C). (1), (3), and (4) are right.
(D). (3), (4), and (5) are right.

76. Which of the following statements may be right: (1). An intersection of a context free language and a regular language is a context free language. (2). The family of unambiguous context free languages is closed under union operation.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

77. Which of the following statements can be right: (1). An intersection of a context free language and a regular language may not be a regular language. (2). The family of linear languages is not closed under intersection.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

78. Which of the following statements can be right: (1).The language $L = \{a^n b^n: n \geq 0, n \text{ is not a multiple of } 5\}$ is context free. (2). If L_1 is a context free language and L_2 is a regular language, there exists an algorithm to determine whether L_1 and L_2 have a common element.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

79. Which of the following statements may be right: (1). The family of context free language is not closed under reversal. (2). There exists an algorithm to determine if a context free language contains any odd-length strings.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

80. Which of the following statement is correct: (1). The family of linear languages is closed under concatenation and not closed under union. (2). If L_1 is context free and L_2 is regular, then $L_1 - L_2$ is context free.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

81. Which of the following statements are correct: (1). A Turing machine is an abstract "machine" that manipulates symbols on a strip of tape according to a table of rules. (2). Turing machine is a mathematical model that defines such a device. (3). Turing machine operates on an infinite memory tape divided into cells: write, move left/right, and halt. (4). Instead of tape used in original Turing machine, modern computers use random access memory design to perform computation.
(A). (1) and (2) are correct.
(B). (1), (2), and (3) are correct.
(C). (1), (3), and (4) are correct.
(D). All (1), (2), (3), and (4) are correct.

82. For a Turing machine, which of the following statement is correct: (1). A Turing machine is defined by $M = (Q, \Sigma, \Gamma, \delta, q_0, \square, F)$, a 7-tuple, and we can think of a Turing machine as a simple computer. (2). The difference between a Turing machine and a pushdown automaton is in the temporary memory: a random access memory is used in Turing machine while a stack in the other.
(A). Only (1) is right.
(B). Only (2) is right.
(C). Both (1) and (2) are right.
(D). None of the above is right.

83. The functions which are computable by a Turing Machine are known as
(A). Partial Recursive Functions.
(B). Enumerable Functions.
(C). Partial Functions.
(D). Finite-Automata.

84. The Turing machine is computable if final state contains
(A). transition function.
(B). no transition function.
(C). halt state.
(D). both B and C.

85. The language L = { ωω: ω ∈ (0, 1)*} is

(A). not accepted by a Turing machine.

(B). accepted by some Turing machines, but by no pushdown automaton.

(C). accepted by some push down automaton, but not context free.

(D). context-free, but not regular.

86. For the definition of a standard Turing machine, which of the following statements are right:

(A). The Turing machine has a tape that is bounded in both left and right directions.

(B). The Turing machine is deterministic in the sense that δ defines at most one move for each configuration.

(C). Turing machines with a stay option are equivalent to Standard Turing Machines.

(D). All (A), (B), and (C).

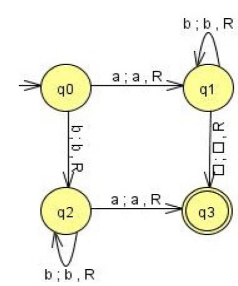
87. For standard Turing machines, which of the following statements are right:

(A). At each move of a Turing machine, the tape head may move either left or right.

(B). We can augment each move with a ‘stay’ option, i.e. we will add “don’t move” to the set {L, R}.

(C). Turing machines with a stay option are equivalent to Standard Turing Machines.

(D). All (A), (B), and (C).



88. What language is accepted by the Turing machine whose transition graph in the figure below:

(A). L =L(aabb* + bbbb*aa).

(B). L =L(aab*b* + bbb*b*aa).

(C). L =L(ab* + bb*a).

(D). L =L(ab*λ+ bb*a).

89. The “high-level” description for constructing the Turing machine that accept the language L = {$\omega\omega^R\omega$} on {a, b} can be: (1). Step 1: 3-split input; Step 2: reverse-compare ω against ω^R followed by reverse-compare ω^R against ω; Accept the input only when both steps are successful. (2). Step 1: 3-split input into $\omega_1 x \omega_2 x \omega_3$; Step 2: forward-

compare ω against ω^R and reverse-compare ω^R against ω; Accept the input only when both steps are successful.

(A). Only (1) is correct.

(B). Only (2) is correct.

(C). Both (1) and (2) are correct.

(D). None of the above is correct.

90. Which of the following statement can be correct: (1). For constructing a Turing machine that can perform addition of positive integers in decimal notation, carrying digit 1 to the higher digits is different from binary number addition. (2). A Turing machine for the multiplication of two integers m and n can be done by performing m times of addition to p = p + n with p = 0 to start with.

(A). Only (1) is correct.

(B). Only (2) is correct.

(C). Both (1) and (2) are correct.

(D). None of the above is correct.

91. Which of the following statements on Turing machine models can be correct: (1). A Turing machine can have a semi-infinite tape. (2). The Turing machine can be implemented off-line, read state from input file. (3). Turing machine can be implemented to have multidimensional storage.

(A). (1) and (2) are correct.

(B). (2) and (3) are correct.

(C). (1) and (3) are correct.

(D). (1), (2), and (3) are correct.

92. Suppose we make the requirement that a Turing machine can halt only in a final state, that is, we ask that $\delta(q, a)$ be defined for all pairs (q, a) with $a \in \Gamma$ and $q \notin F$. Which of the following are correct: (1). This will restrict the power of the Turing machine. (2) This will not restrict the power of the Turing machine. (3). Any non-final halting state can be put into an infinite loop. (4). $\delta(q, a) = (q, a, S)$ for all $a \in \Gamma$ and $q \notin F$.

(A). (1) and (3) are correct.

(B). (2) and (3) are correct.

(C). (1), (3), and (4) are correct.

(D). (2), (3), and (4) are correct.

93. If we make the restriction that a Turing machine must always write a symbol different from the one it reads, i.e. if $\delta(q_i, a) = (q_i, b, L \text{ or } R)$ then a and b must be different. Which of the following are right: (1). This will reduce the power of the automaton. (2). This will

not reduce the power of the automaton. (3). For each symbol a ϵ Γ, we can introduce a pseudo-symbol A. Whenever we (A). (1) and (3) are correct.

(B). (2) and (3) are correct.

(C). Only (3) is correct.

(D). None of above is correct.

94. Which of the following statements on nondeterministic Turing machine are correct: (1). A nondeterministic Turing machine is less useful since it is not deterministic, i.e. we may not be able to reach a fixed final computation state. (2). Whenever the nondeterministic machine performs a transition that involves more than one move, the deterministic machine will simulate it by creating an active configuration for each of the corresponding computations on the tape. (3). The deterministic machine will repeatedly execute a single step on each of these generated configurations in turn. (4). If any of the computations enter a halt state, the deterministic machine will identify it as inactive and remove from further consideration.

(A). (1), (2), and (3) are correct.

(B). (2), (3), and (4) are correct.

(C). (1), (3), and (4) are correct.

(D). (1), (2), (3), and (4) are correct.

95. To determine whether or not a string in $\{0, 1\}^+$ represents an encoded Turing machine, which of the following are correct: (1). To determine if a given string in $\{0, 1\}^+$ represents a transition function $\delta(q_i, a_k) = (q_j, a_l$, L or R) for an encoded Turning machine. (2). We can check that the input is of the form $0x_10x_20x_30x_40x_50$, where the x_i are strings of 1's, with the restriction that x_5 = 1 or 11. (3). We must use a predefined pushdown machine to guarantee the right grammar implementation.

(A). (1) and (2) are correct.

(B). (2) and (3) are correct.

(C). (1), (2), and (3) are correct.

(D). None of the above is correct.

96. Which of the following statements of recursively enumerable language are correct: (1). All recursive languages are context sensitive. (2). If L is a finite language, then L^+ is recursively enumerable. (3). If a language is not recursively enumerable, its complement cannot be recursive.

(A). (1) and (2) are correct.

(B). (2) and (3) are correct.

(C). (1), (2), and (3) are correct.

(D). None of the above is correct.

97. Which of the following are correct: (1). If an algorithm of a two-tape Turing machine has $O(n)$ complexity, then the best of we can get for a one-tape machine is $O(n^2)$. (2). Any computation that can be performed on a single-tape, off-line Turing machine in time $O(T(n))$ also can be performed on a standard Turing machine in time $O(T(n))$.
(A). Only (1) is correct.
(B). Only (2) is correct.
(C). Both (1) and (2) are correct.
(D). None of the above is correct.

98. Which of the following statements of the union of recursively enumerable languages are correct: (1). The family of recursively enumerable languages is closed under union. (2). When represented with an input ω, we can nondeterministically choose Turing machines M_1 or M_2 to process ω. The result is a Turing machine that accepts two languages $L_1 \cup L_2$.
(A). (1) is correct.
(B). (2) is correct.
(C). (1) and (2) are correct.
(D). None of the above is correct.

99. For sorting efficiency, which of the following are correct: (1). The choice of algorithm is important in sorting. (2). Simple methods, such as a bubble sort, have time-complexity $O(n^2)$. (3). The most efficient sorting algorithms have time-complexity O(logn).
(A). (1) and (2) are correct.
(B). (2) and (3) are correct.
(C). (1), (2), and (3) are correct.
(D). None of the above is correct.

100. Which of the following are NP-complete problems: (1). Graph coloring problem. (2). Hamiltonian path problem. (3). Knapsack problem. (4). Travelling salesman problem. (5). Problem of network shortest path finding between two routers.
(A). (1), (2), and (3).
(B). (2), (3), and (4).
(C). (1), (3), and (5).
(D). (1), (2), (3), and (4).