一、單選題(60%，每題 3%)

1. The Control Unit subsystem in von Neumann model is responsible for _____.

   (A) arithmetic and logic computation　(B) input/output processing

   (C) memory management　　　　　　　(D) controlling data flow among ALU, memory and I/O

   (E) none of the above.

2. Inside a function where int x =10; return x++; will return an integer of value _____.

   (A) 10　　　　　(B) 11　　　　　(C) 9　　　　　(D) 12　　　　　(E) none of the above.

3. $(1111\ 0110)_2$ is stored in two's complement format, its decimal value is _____.

   (A) -8　　　　　(B) -9　　　　　(C) 8　　　　　(D) 9　　　　　(E) none of the above

4. _____ is a technique to improve the throughput of computation by executing the three phases of fetch, decode, execute simultaneously.

   (A) Algorithm　　(B) Data Structure (C) P2P　　　　(D) Pipelining　　(E) none of the above

5. _____ sort is often used by card players.

   (A) Bubble　　　(B) Insertion　　(C) Selection　　(D) Quick　　　(E) none of the above

6. In the _____ key encryption, the secret key is shared by the sender and the receiver.

   (A) public　　　(B) secret　　　(C) private　　　(D) asymmetric　(E) none of the above

7. If all programs can be loaded into memory, then the performance of segmentation is ____ paging.

   (A) worse than　(B) better　　　(C) equivalent to (D) no worse than　(E) none of the above

8. Demand paging used the _____ method to load and offload pages in demand.

   (A) replacing　　(B) substituting　(C) rotating　　(D) swapping　　(E) none of the above

9. _____ is a computational paradigm where the computation is done by using a network of remote servers hosted on the internet to store, manage, and process data.

   (A) Parallel processing　　　　　(B) Multiprogramming　　　　(C) Cloud computing

   (D) Generative AI computing　　　(E) none of the above

10. In Java language, int x=5; if (x%2 = 1) return 1; else return 0; the returned value is _____.

    (A) 0　　　　　　　　　　(B) 1　　　　　　　　　　(C) compilation error

    (D) runtime error　　　　　(E) none of the above

11. The data model and the schema of a DBMS are often defined at the _____ level.

    (A) external　　(B) conceptual　(C) internal　　(D) physical　　(E) none of the above

12. In DBMS, a schedule is _____ if its result is the same as if the operations were executed in some sequential order.

(A) performable　　(B) serializable　　(C) executable　　(D) deadlock free　　(E) none of the above

13. The arithmetic right shift of a pattern is equal to the _____ of that value by 2.

(A) addition　　(B) subtraction　　(C) multiplication　(D) division　　(E) none of the above

14. The search time complexity in binary search is _____.

(A) $O(1)$　　(B) $O(N)$　　(C) $O(N^2)$　　(D) $O(N^3)$　　(E) none of the above

15. The device router has the ability to find the _____ for the data path.

(A) optimum speed　　　　(B) shortest route　　　　(C) best route

(D) optimum time　　　　(E) none of the above

16. HTTP protocol is used by _____ for exchanging documents.

(A) FTP　　(B) WWW　　(C) TELNET　　(D) Facebook　　(E) none of the above

17. The _____ has the smallest storage in a computer system.

(A) DRAM main memory　　　　(B) L1 cache memory　　　　(C)PCIe solid-state drive

(D) Blu-ray Disc　　　　(E) USB Type-C flash drive

18. The transmission of data from a remote computer to a local computer is called _____.

(A) upload　　(B) compile　　(C) bit rate　　(D) cookie　　(E) download

19. In computer graphics, the _____ algorithm can simulate the refraction effect of transparent object.

(A) ray tracing　　(B) flat shading　　(C) tessellation　　(D) toon shading　　(E) marching cubes

20. When we use k-nearest neighbor algorithm to classify the air quality as good or bad condition. The algorithm has the best result when $k = $ _____.

(A) 3　　(B) 4　　(C) 5　　(D) 2　　(E) none of above

二、問答題(40%)

21. Consider the max heap as the following.
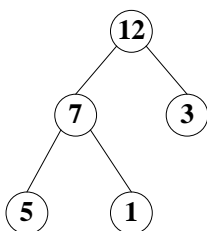
(1) Please simply demonstrate the heapify steps of heap sort algorithm after removing the element 12. (10%)

(2) Briefly analyze the time complexity of heap sort. (10%)

22. For the following pseudo-code function:

fun g(n, a) =
　　　if n = 0 then a
　　　else g(n-1, n*a)

(1) What is the result of g(3, 1)? You have to show detailed work of how you derive the answer. (10%)

Considering the following function:

fun f(n) =
　　　if n = 0 then 1
　　　else n * f(n-1)

(2) What is the most significant difference between the function g and the function f in terms of stack management? (10%)