請按照題號依序作答

## PART 1. Introduction to Computer Science

### a. Multiple Choice (3 points each)

1. Using the binary notation 10000101 to represent the exponent item on Excess_127, what is the decimal representation of the answer?
   (a) 6 (b) 7 (c) 8 (d) 9

2. The program can be divided into the same size units in the operating system. The program needed to be loaded into the memory when the program is running. What kind of concept is used?
   (a) Segmentation (b) Paging (c) Demand segmentation (d) Demand paging

3. A sender and a receiver need to exchange the key before transmission data. What kind of data security mechanism is used?
   (a) Firewall (b) Intrusion detection system (c) Access control list (d) Internet protocol security (IPsec)

4. In the data link layer, what is its basic transmission unit?
   (a) Packet (b) Frame (c) Bit (d) Flow

5. In the data storage, floating-point representation can be divided into three parts. Which the item is not included?
   (a) Mantissa (b) Signed bit (c) Biased exponent (d) Most significant bit

6. Which the function declaration is not a valid function declaration?
   (a) char a(x, int y); (b) void b(void); (c) int c(int, float); (d) float d(int x, int);

7. CPI represents the average number of required clock cycles for each instruction execution. There are PCount instructions in one program and the operating frequency of the CPU is T (Hz). How much time does the CPU execute this program?
   (a) CPI × PCount / T (b) (CPI + PCount) × T (c) CPI × PCount × T (d) (CPI + PCount) /T

### b. Short Answer Questions

1. According to the following code segment of C language, please show the print results? (6 pts)

```
int x = 0;
if (x = 0 || x == 0) printf("%d\n", x);
printf("%d\n", x);
```

2. According to the following code segment of C language, please show the print results? (9 pts)

```
#include <stdio.h>
#include <stdlib.h>
int main( )
```

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```
{
    int i , *ptr;
     int array[4][3]={{1,2,3},{4,5,6},{7,8,9},{10,11,12}};
    ptr=(int *)array;
    printf("%d\n",array[3][2]);
    printf("%d\n %d\n",(*(array+1))[1],*((array+1)[1]));
    system("pause");
    return 0;
}
```

3. Show the result of the following floating-point operations using IEEE _127 as 33.1875-0.4375. (8 pts)

4. What is the status of a process in each of the following situations? (6 pts)
   a. The process is using the CPU.
   b. The process has finished printing and needs the attention of the CPU again.
   c. The process is reading data from the keyboard.

## PART 2. Operating Systems

1. Please fill the following blanks in **English** (8%).
   (a) If a process does not have the number of frames it needs to support pages in active use, it will quickly page-fault, and again, and again. This process is ____ since it is spending more time paging than executing.
   (b) The page table is often kept in memory. As a result, two memory accesses are needed to access a byte. The standard solution to this problem is to use a special hardware cache, called a ___(please give the full name).
   (c) When you major the assembly language, you need the ___ for translating the assembly language file to an object file or machine language format. Furthermore, you need the ___ that takes one or more object files and combines them into a single executable file.
2. In certain situations, a single application may be required to perform several similar tasks. For example, a web server accepts client requests for web pages, images, sound and so forth. A busy web server may have several clients concurrently accessing it. If the web server ran as a traditional single-threaded process, it would be able to service only one client at a time, and a client might have to wait a very long time for its request to be serviced. One solution is to have the server run as a single process that accepts requests. When the server receives a request, it creates a separate process to service that request. Process creation is time consuming and resource intensive, however. If the new process will perform the same tasks as the existing process, why incur all that overhead. It is generally more efficient to use one process that contains multiple threads. If the web-server process is multithreaded, the server will create a separate thread that listens for client requests. When a request is made, rather than creating another process, the server creates a new thread to service the request and resume listening for additional requests. (a) From above descriptions, if new task is not the same as the existing tasks, we must use processes, rather than threads. Why? (b) In Linux, which system call is used to create a new process? (c) However, many applications require the child process to execute code that is different from that of the parent. Thus, Linux provides another system call for the child process to overlay its process image with a new image. In other words, this system call enables the child process to load a new binary file into memory. What is this system call? (d). From above descriptions, compared with threads, process creation is time consuming and resource

intensive. Why? ( 12 pts)

3. Theoretically, some programs could access several new pages of memory with each instruction execution (for example, one page for the instruction and many for the data), possibly causing multiple page faults per instruction. This situation would result in unacceptable system performance. Fortunately, analysis of running processes shows that this behavior is exceedingly unlikely. Program tend to have locality of references, which results in reasonable performance from demand paging. (a) What is the locality of reference? (b) Why the demand paging would result in reasonable performance if program tend to have locality of reference? (5 pts)

## PART 3. Computer Organizations

1. True or False (10%)

(1) An Interrupt is an event that causes an unexpected change in control flow but comes from outside of the processor.

(2) Pipelining improves instruction throughput rather than individual instruction execution time.

(3) DMA is implemented with a specialized controller that transfers data between an I/O device and memory dependent on the processor.

(4) The forwarding technique can eliminate all pipeline stalls caused by data dependency.

(5) There are six data hazards in this program:

```
add R2, R4, R4
sub R1, R2, R1
add R3, R1, R2
add R1, R1, R3
```

2. We assume that there is a computer having the characteristics as Table 1 shows, where the X denotes the stage is not required. What is its CPI with variable clock design? (5%) If this computer is implemented with single clock design, what is its CPI? (2%) What is the improvement in performance? (3%)

Table 1

| | Distribution | IF | ID | EXE | MEM | WB |
|---|---|---|---|---|---|---|
| Load | 30% | 2ns | 1ns | 3ns | 1ns | 1ns |
| Store | 15% | | | 3ns | 2ns | X |
| Arithmetic | 40% | | | 1ns | X | 1ns |
| Branch | 15% | | | 2ns | X | X |

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3. Assume that there is processor with a CPI of 3 without memory stall and the memory stall penalty is 150 clock cycles. If there have 8% instructions of program require to accessing memory and the miss rate of cache is 0.5, please find the CPI with memory stalls. (5%)