

國立中山大學 109 學年度

碩士暨碩士專班招生考試試題

科目名稱：作業系統與資料結構【資工系碩士班甲組】

—作答注意事項—

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，不得另攜帶紙張，請衡酌作答。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，其後果由考生自行負擔。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

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科目名稱：作業系統與資料結構【資工系碩士班甲組】

題號：434003

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 3 頁第 1 頁

INSTRUCTIONS: If any question is unclear or you believe some assumptions need to be made, state your assumptions clearly at the beginning of your answer.

1. (10%) Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:

Process	Burst Time	Priority
P_1	10	3
P_2	1	1
P_3	2	4
P_4	1	5
P_5	5	2

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4, P_5 , all at time 0.

- (a) (5%) What is the completion time of process P_1 using a nonpreemptive priority (a smaller priority number implies a higher priority) scheduling?
- (b) (5%) What is the average waiting time using shortest-job-first scheduling?
2. (10%) A machine has 64-bit virtual addresses and 32-bit physical addresses. Pages are 32 KB. How many entries are needed for the page table?
3. (10%) Consider the two-dimensional array a:

```
double a[] [] = new double[250][250];
```

where each double occupies 8 bytes and $a[0][0]$ is at location 200, in a paged system with pages of size 200 bytes. A small process is in page 0 (locations 0 to 199) for manipulating the matrix; thus, every instruction fetch will be from page 0. For three page frames, how many page faults are generated by the following array initialization loops, using LRU replacement and assuming (1) page frame 0 has the process in it, (2) the other two are initially empty, and (3) the array is stored in memory column-major.

- (a) (5%)

```
for (int i = 0; i < 250; i++)
    for (int j = 0; j < 250; j++)
        a[i][j] = 0;
```

- (b) (5%)

```
for (int j = 0; j < 250; j++)
    for (int i = 0; i < 250; i++)
        a[i][j] = 0;
```

4. (10%) What would be the output of the following C program that uses the Pthreads API? (Note that the line numbers are for reference only.)

```
1 #include <stdio.h>
2 #include <stdlib.h>
3 #include <unistd.h>
4 #include <pthread.h>
5 #include <sys/types.h>
6 #include <sys/wait.h>
7
8 static void *runner(void *param)
9 {
10     (* (int*) param)--;
11     pthread_exit(0);
12 }
```

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共 3 頁第 2 頁

```
13
14 int main(int argc, char **argv)
15 {
16     int value = 11;
17     pid_t pid = fork();
18     if (pid > 0) {
19         int status;
20         waitpid(-1, &status, 0);
21         printf("A=%d\n", value--);
22     }
23     else if (pid == 0) {
24         pid_t pid = fork();
25         if (pid > 0) {
26             int status;
27             waitpid(-1, &status, 0);
28             printf("B=%d\n", --value);
29         }
30         else if (pid == 0) {
31             pid_t pid = fork();
32             pthread_t tid;
33             pthread_create(&tid, NULL, runner, &value);
34             pthread_join(tid, NULL);
35             if (pid > 0) {
36                 int status;
37                 waitpid(-1, &status, 0);
38                 printf("C=%d\n", value++);
39             }
40             else {
41                 printf("D=%d\n", ++value);
42             }
43         }
44         else {
45             return 1;
46         }
47     }
48     else {
49         return 1;
50     }
51     return 0;
52 }
```

5. (10%) Given a UNIX *i*-node with ten direct blocks and three levels of indirect blocks (i.e., a single, a double, and a triple) and assuming that the sizes of a pointer and a block are, respectively, 8 bytes and 4 Kbytes, answer the following questions.

- (a) (5%) What would be the size of the smallest file allowed in bytes?
- (b) (5%) What would be the size of the largest file allowed in bytes?

6. (20%) Suppose that a disk drive has 1024 cylinders, numbered from 0 to 1023. The drive is currently serving a request at cylinder 200, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is

50, 500, 250, 800, 350, 550, 400, 600, 100.

Starting from the current head position, what is the *total distance* (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk scheduling algorithms?

- (a) (4%) SSTF
- (b) (4%) SCAN
- (c) (4%) LOOK

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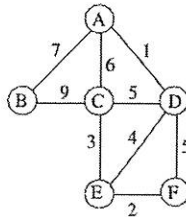
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共 3 頁 第 3 頁

(d) (4%) C-SCAN

(e) (4%) C-LOOK

7. (5%) Given the following weighted graph, show the order in which the edges are added to the minimum cost spanning tree using Kruskal's algorithm. (*Use weight to represent edges in your answer and just show the order.*)



8. (5%) Show the Huffman tree created from the following nodes arranged in a priority queue.

A	B	C	D	E	F	G	H	I	J
6	9	12	14	18	24	27	29	35	45

9. (10%) For any input of size n and assuming that k_1 denotes the maximum number of digits and k_2 the number of buckets, what is the average-case running time of each of the following sorting algorithms: (a) selection sort, (b) merge sort, (c) heap sort, (d) radix sort, and (e) bucket sort?
10. (10%) The Ackermann function $A(m, n)$ is defined recursively for non-negative integers m and n as follows:

$$A(m, n) = \begin{cases} n + 1 & \text{if } m = 0, \\ A(m - 1, 1) & \text{if } m > 0 \text{ and } n = 0, \\ A(m - 1, A(m, n - 1)) & \text{if } m > 0 \text{ and } n > 0. \end{cases}$$

Its value grows very quickly, even for small values of m and n . For instance, $A(4, 1) = 65533$. What would be the values of $A(3, 2)$ and $A(2, 4)$?