

# 國立中山大學資訊工程學系

## 98學年度第2學期博士班資格考試 作業系統

1. Given an *i*-node with eight direct blocks and three levels of indirect blocks and assuming that the sizes of a pointer and a block are, respectively, 8 bytes and 8 Kbytes, answer the following questions. *Hint: you may assume all the meta-information for a file has been read into the main memory and forget about the case where some buffers may need to be written back to disk first.*
  - (a) (10%) What would be the size of the smallest file allowed in bytes?
  - (b) (10%) What would be the size of the largest file allowed in bytes?
2. Consider the interprocess-communication scheme where mailboxes are used. Suppose a process *P* wants to wait for two messages, one from mailbox *A* and one from mailbox *B*. Answer the following questions.
  - (a) (10%) What sequence of `send` should it execute so that messages can be received in any order without from being blocked by each other?
  - (b) (10%) What sequence of `receive` should it execute so that the messages can be received in any order without from being blocked by each other?
3. Consider the two-dimensional array *A*:

```
int A[][] = new int[100][100];
```

where each integer occupies 4 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 page frame 1 has the process in it, the other two are initially empty, and the array is stored in memory column-major:

(a) (10%)

```
for (int i = 0; i < 100; i++)
  for (int j = 0; j < 100; j++)
    A[i][j] = 0;
```

(b) (10%)

```
for (int j = 0; j < 100; j++)
  for (int i = 0; i < 100; i++)
    A[i][j] = 0;
```

4. (20%) A disk has 8000 cylinders, each with 8 tracks of 512 blocks. A seek takes 1 ms per cylinder moved. If no attempt is made to put the blocks of a file close to each other, two blocks that are logically consecutive (i.e., follow one another in the file) will require an average seek, which takes 6 ms. If, however, the operating system makes an attempt to cluster related blocks, the mean interblock distance can be reduced to 2 cylinders and the seek time reduced to 1 ms. How long does it take to read a 100 block file in both cases, if the rotational latency is 10 ms and the transfer time is 20  $\mu$ s per block?
5. (20%) A small computer has four page frames. At the first clock tick, the R bits are 0111 (page 0 is 0, the rest are 1). At subsequent clock ticks, the values are 1011, 1010, 1101, 0010, 1010, 1100, 0001, 0101, 1011, and 1111. If the aging algorithm is used with an 6-bit counter, give the values of the four counters after the last ticks.