[CE3002] Operating System -- Homework 02

(總分100分)

> CE3002 Operating System
>
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1. 是非題 (共 5 題，每題 3 分)

1. **[F]** All of deadlock necessary conditions (i.e. mutual exclusion, hold and wait, no preemptive and circular waiting) exist, the system must be in deadlock.
2. **[T]** The resources allocation graph has no cycle, the system must not be in deadlock.
3. **[F]** If Banker’s algorithm returns an unsafe, it means the resource request must make the system in deadlock.
4. **[F]** Dynamic linking must needs a support from the operating system.
5. **[T]** The copy-on-write technique decrease the time of the process creation.

2. 單選題 (共 15 題，每題 4 分)

6. Which one of the following is a correct statement about disk space allocation methods?

    - [ ] (A) Linked allocation may suffer from the external fragmentation problem
    - [ ] (B) Linked allocation can efficiently support direct accesses into a file.
    - [ ] (C) Contiguous allocation can be enhanced by using "extents" to solve its non-sequential access performance problem.
    - [x] (D) Indexed allocation does not suffer from the external fragmentation problem.
    - [ ] (E) None of the above.

7. Consider a tiny paging system that has 16 KB physical memory, and the frame size is $1 KB$. Let the logical address have 16 bits. The page table uses single-level direct index. Which one of the following is not correct?

    - [ ] (A) The frame number has 4 bits
    - [ ] (B) The page number has 6 bits
    - [x] (C) There are 16 entries in the page table.
    - [ ] (D) A page-table entry stores a frame number
    - [ ] (E) The page table requires 320 bits, including the valid-invalid bits.

8. Which of the following statements on the concept of deadlocks is not correct?

    - [x] (A) If we use banker's algorithm to control the resource request and allocation, and when we find the system is unsafe, and still grant the resource request, the system will enter the deadlock state.

- [ ] (B) If a deadlock situation arises, the four conditions of mutual exclusion, hold and wait, no preemption, and circular wait must hold simultaneously.
- [ ] (C) If there is a cycle of resource allocation graph for a system with single instance resource, it will be in a deadlock state.
- [ ] (D) If a system is in the safe state, it will not be in a deadlock state.
- [ ] (E) If there is a cycle of resource allocation graph for a system with resource of multiple instances, it may not be in a deadlock state.

9. Suppose that there is a machine with 32-bit addresses and a two-level page table. Note that the first 10 bits of an address is an index into the first level page table and the next 10 bits are an index into a second level page table. The page tables are stored in memory and each entry in the page tables is 4 bytes. Suppose the space allocated to a specific process is 64 Mbytes. How many pages are occupied by this process?

   - [ ] (A) $2^{26} pages$
   - [x] (B) $2^{14} pages$
   - [ ] (C) $2^{12} pages$
   - [ ] (D) $2^{10} pages$
   - [ ] (E) None of the above

10. (Continued from the previous question.) How much space is occupied in memory by the page tables for the specific process?

    - [x] (A) $68 kbytes$
    - [ ] (B) $64 kbytes$
    - [ ] (C) $16 kbytes$
    - [ ] (D) $4 kbytes$
    - [ ] (E) None of the above

11. Which of the following statements is incorrect?

    - [ ] (A) A spinlocks is a lock that will cause a requesting process to busy-wait to get it when it is in the locked state.
    - [x] (B) Using spinlocks will not cause deadlock on a multi-processor system.
    - [ ] (C) A spinlock should not be used on a uni-processor system.
    - [ ] (D) Compared with a non-spinlock, a spinlock allows a requesting process to get the lock more quickly because the process need not do a context switch.
    - [ ] (E) For a non-spinlock, its `wait()` and `signal()` operations must be executed atomically.

12. The following code fragments describe a solution of the bounded-buffer problem. The three variables S1, S2, and S3 are all semaphores. Suppose that the buffer initially has 10 empty slots. What are the correct initial values of the semaphores?

    Producer processes:

```
do {
    // produce an item
    wait(S2);
    wait(S1);
```

```
    // add the item to the buffer

    signal(S1);
    signal(S3);
} while(true);
```

Consumer processes:

```
do {
    wait(S3);
    wait(S1);
    // remove an item from buffer
    signal(S1);
    signal(S2);
    // consume the removed item
} while(true);
```

- ☐ (A) $S1=1; S2=1; S3=1$
- ☑ (B) $S1=1; S2=0; S3=0$
- ☐ (C) $S1=9; S2=1; S3=1$
- ☐ (D) $S1=1; S2=10; S3=0$
- ☐ (E) $S1=0; S2=10; S3=10$

13. Which of the following statements is incorrect?

- ☐ (A) The "TestAndSet()" instruction used for process synchronization must have hardware support so that the Test and Set operations can be done atomically.
- ☐ (B) The "TestAndSet()" instruction can be used to implement a lock.
- ☐ (C) An atomic "Swap()" instruction can be used to replace the "TestAndSet()" instruction.
- ☐ (D) A mutex lock is a special semaphore whose value ranges only between 0 and 1.
- ☑ (E) A mutex is used to protect a critical section of code. It cannot protect a shared variable.

14. Which of the following statements about memory management is correct?

- ☐ (A) To allocate contiguous memory from free boles, the best-fit algorithm is the optimum solution in memory utilization.
- ☐ (B) Pure segmentation suffers from internal fragmentation.
- ☐ (C) A system can detect thrashing by using a figure, in which CPU utilization is plotted against the execution time.
- ☐ (D) For first-in-first-out page replacement, the page-fault rate will definitely not increase as the number of frames increases.
- ☑ (E) None of the above is correct.

15. You have a $7200-rpm$ disk with a track-to-track seek time of 1 ms. The disk has 400 sectors on each track. Each sector has 1KB. What is the maximum date transfer rate in MB/sec?

- ☐ (A) 32
- ☑ (B) 48

- [ ] (C) 56
- [ ] (D) 64
- [ ] (E) None of the above.

16. Which of the requirements for a solution to the critical-section problem are not satisfied for the following program?

```
//lock is a shared data and initialized to 0
while(1){
    key=1;
    while(key){
        atomic_swap(lock,key);
        <Critical Section>
        Lock=0;
        <Remainder Section>
    }
}
```

- [ ] (A) Mutual Exclusion
- [ ] (B) Progress
- [ ] (C) No preemption
- [x] (D) Bounded Waiting

17. Which of the following descriptions regarding the multithread models are correct?

    1. In One-to-One model, only one thread can access the kernel at a time on multiprocessors.
    2. In Many-to-One model, the entire process will block if a thread makes a blocking system call.
    3. In Many-to-Many model, the number of kernel threads can be specific to either a particular application or a particular machine.
    4. In One-to-One model, developers can create as many user threads as necessary.
    5. The two-level model is a variation of the Many-to-Many model.

- [ ] (A) II and III
- [ ] (B) II, III, and IV
- [ ] (C) I, II, IV, and V
- [x] (D) II, III, and V
- [ ] (E) I, III, and V

18. Which of the following statements is false?

- [ ] (A) Working set theory can be used to control the level of multiprogramming.
- [ ] (B) System calls are only executed with privileged instructions which are not supposed to be used by user programs.
- [ ] (C) The memory hierarchy does not always guarantee efficiency in information retrieval.
- [ ] (D) In practice, the SJF scheduling algorithm may not be optimal in average waiting time.
- [x] (E) The technology of virtual memory system may fail for some specific CPU instruction sets.

19. The banker's algorithm is used for deadlock-avoidance. For a system with n processes and m types of resources, what is the order of complexity of this algorithm?

    - [ ] (A) m
    - [ ] (B) n
    - [ ] (C) $m \times n$
    - [ ] (D) $m^{2} \times n$
    - [x] (E) $m \times n^{2}$

20. Which of the following is not a necessary condition for the happening of a deadlock?

    - [ ] (A) Mutual exclusion to resources
    - [x] (B) Resources not released by a terminated process
    - [ ] (C) Resource hold and wait by processes
    - [ ] (D) Resource allocation without preemption
    - [ ] (E) Circular waiting in the resource allocation graph

3. 多選題 (共 5 題，每題 5 分)

21. Which of the following statements are correct about the virtual memory technique.

    - [x] (A) Increase the memory utilization.
    - [ ] (B) Decrease the I/O frequency.
    - [x] (C) Increase the Multiprogramming degree.
    - [ ] (D) Decrease the CPU utilization.
    - [ ] (E) None of the above.

22. Consider a system with five processes P0~P4 and three resource type A, B, C. Suppose at time T0, the resource allocation state is:

	Allocation	**Max**	**Need**	**Available**
	A B C	A B C	A B C	A B C
P0	2 1 1	3 1 3	1 0 2	
P1	0 1 1	3 2 1	3 1 0	
P2	1 0 0	1 0 4	0 0 4	
P3	0 1 2	2 1 2	2 0 0	
P4	1 0 0	1 1 0	0 1 0	

    Which of the following statements are correct?

    - [x] (A) `<P4,P3,P2,P0,P1>` is a safe sequence.
    - [x] (B) `<P3,P0,P1,P4,P2>` is a safe sequence.
    - [x] (C) `<P0,P1,P2,P3,P4>` is a safe sequence.
    - [ ] (D) `<P0,P2,P3,P4,P1>` is a safe sequence.
    - [ ] (E) There is no safe sequence.

23. Consider the page replacement algorithms FIFO (first-in first-out), LRU (least-recently used), and OPT (optimal). Which of the following cases are possible?

    - [ ] (A) FIFO outperforms LRU
    - [x] (B) LRU outperforms FIFO
    - [ ] (C) FIFO, LRU and OPT have the same number of page faults
    - [x] (D) LRU causes more page faults with a larger number of here frames
    - [ ] (E) Implementing OPT in real operating systems

24. Which of the following statements are correct?

    - [ ] (A) Spinlocks are appropriate for uni-processor systems.
    - [x] (B) The critical-section problem could be solved by disabling interrupts while accessing a shared variable in a uni-processor environment.
    - [ ] (C) Priority inheritance protocols can resolve race conditions in real time systems.
    - [x] (D) A non-preemptive kernel is free from race conditions on kernel data structures.
    - [ ] (E) The current Linux kernel is a non-preemptive kernel and a process running in a kernel mode could not be preempted.

25. Which of the following statements are correct? The less page size is,

    - [x] (A) the more page fault ratio is.
    - [ ] (B) The less page table size is
    - [x] (C) The more I/O frequency is.
    - [x] (D) The less internal fragmentation there is.
    - [ ] (E) None of the above.