

EECS 3221E Fall 2020
Sample Questions

1. For each of the statements below, circle the “T” letter following the statement if the statement is true; circle the “F” letter following the statement if the statement is false.

(a) The *store* instruction moves the content of a *register* to *main memory*.

T F

(b) With *symmetric multiprocessing*, no *master-slave relationship* exists between processors.

T F

(c) The *operating system kernel* is normally pre-loaded into memory and ready to be executed immediately after the power is turned on.

T F

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(d) The *many-to-one* multithreading model provides more concurrency than the *one-to-one* multithreading model.

T F

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(e) In the *Storage-Device Hierarchy* in a computer system, the *cost per bit* of a storage device at a *higher level* should never be *cheaper* than the *cost per bit* of a storage device at a *lower level*.

T F

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(f) With *indirect communication*, a communication link is established automatically when processes *send or receive messages*.

T F

(g) With *Direct Memory Access (DMA)*, the device controller can transfer any amount of data from buffer storage directly to main memory without using any *interrupts*.

T F

(h) In modern general purpose operating systems, an *interrupt* always causes the system to execute in *kernel mode*.

T F

(i) *Application programs* can modify the content of the *timer* in *user mode*.

T F

2. Answer the following questions.

2.1. Assume that `BUFFER_SIZE = 9` in the Bounded Buffer – Shared Memory Solution *that does not require the use of semaphores* for the Producer-Consumer Problem.

Assume the following sequence of executions:

- (a) The Producer process performs six (6) executions of *all* the code in the body of the while loop for the Producer process;
- (b) After (a), the Consumer process performs two (2) executions of *all* the code in the body of the while loop for the Consumer process;
- (c) After (b), the Producer process attempts to execute *as many times as possible all* the code in the body of the while loop for the Producer process while the Consumer process does not execute any further.

You are required to fill in the answer for each of the following questions:

- (1) In (c) above, *the total number of times* that the Producer process will be able to execute *all* the code in the body of the while loop for the Producer process is _____.

- (2) After (c), the value for the integer variable “*in*” will be _____.

- (3) After (c), the value for the integer variable “*out*” will be _____.

2.2. Assume that $BUFFER_SIZE = 9$ in the Bounded Buffer – Shared Memory Solution *that does not require the use of semaphores* for the Producer-Consumer Problem. Assume the following sequence of executions:

- (a) The Producer process performs six (6) executions of *all* the code in the body of the while loop for the Producer process;
- (b) After (a), the Consumer process performs two (2) executions of *all* the code in the body of the while loop for the Consumer process;
- (c) After (b), the Producer process attempts to execute *as many times as possible all* the code in the body of the while loop for the Producer process while the Consumer process does not execute any further.
- (d) After (c), the Consumer process attempts to execute as many times as possible *all* the code in the body of the while loop for the Consumer process while the Producer process does not execute any further.

You are required to fill in the answer for each of the following questions:

- (1) In (d) above, the *total number of times* that the Consumer process will be able to execute *all* the code in the body of the while loop for the Consumer process is _____

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- (2) After (d), the value for the integer variable “*in*” will be _____.

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- (3) After (d), the value for the integer variable “*out*” will be _____.

3. Answer the following questions.

Calculate the (a) *average waiting time*; and (b) *average turnaround time*, respectively, when the following scheduling algorithms are used to schedule the set of processes with corresponding burst times below. (You may assume that the context switch time is 0.)

(1) *Round Robin (RR) Scheduling* (you may assume that the time quantum is 2)

(2) *SJF Nonpreemptive Scheduling*

(3) *SJF Preemptive Scheduling*

<u>Process</u>	<u>Arrival Time</u>	<u>Burst Time</u>
P ₁	0.0	8
P ₂	2.0	4
P ₃	5.0	2
P ₄	7.0	4

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4. Draw a diagram of *process state*. The diagram should include the different process states, and should also include the event(s)/circumstance(s) which cause a process to change from one state to another state.

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5. Write the pseudo code for the Bounded Buffer – Shared Memory Solution *that does not require the use of semaphores* for the Producer-Consumer Problem.

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Answers to Sample Questions

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(e) In the *Storage-Device Hierarchy* in a computer system, the *cost per bit* of a storage device at a *higher level* should never be *cheaper* than the *cost per bit* of a storage device at a *lower level*.

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(i) *Application programs* can modify the content of the *timer* in *user mode*.

T F

2. Answer the following questions.

2.1. Assume that $BUFFER_SIZE = 9$ in the Bounded Buffer – Shared Memory Solution *that does not require the use of semaphores* for the Producer-Consumer Problem. Assume the following sequence of executions:

- (a) The Producer process performs six (6) executions of *all* the code in the body of the while loop for the Producer process;
- (b) After (a), the Consumer process performs two (2) executions of *all* the code in the body of the while loop for the Consumer process;
- (c) After (b), the Producer process attempts to execute *as many times as possible all* the code in the body of the while loop for the Producer process while the Consumer process does not execute any further.

You are required to fill in the answer for each of the following questions:

- (1) In (c) above, *the total number of times* that the Producer process will be able to execute *all* the code in the body of the while loop for the Producer process is

_____4_____

- (2) After (c), the value for the integer variable “*in*” will be _____1_____.

- (3) After (c), the value for the integer variable “*out*” will be _____2_____.

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2.2. Assume that `BUFFER_SIZE = 9` in the Bounded Buffer – Shared Memory Solution *that does not require the use of semaphores* for the Producer-Consumer Problem. Assume the following sequence of executions:

- (a) The Producer process performs six (6) executions of *all* the code in the body of the while loop for the Producer process;
- (b) After (a), the Consumer process performs two (2) executions of *all* the code in the body of the while loop for the Consumer process;
- (c) After (b), the Producer process attempts to execute *as many times as possible all* the code in the body of the while loop for the Producer process while the Consumer process does not execute any further.
- (d) After (c), the Consumer process attempts to execute as many times as possible *all* the code in the body of the while loop for the Consumer process while the Producer process does not execute any further.

You are required to fill in the answer for each of the following questions:

- (1) In (d) above, the *total number of times* that the Consumer process will be able to execute *all* the code in the body of the while loop for the Consumer process is

_____8_____

- (2) After (d), the value for the integer variable “*in*” will be _____1_____.

- (3) After (d), the value for the integer variable “*out*” will be _____1_____.

3. Answer the following questions.

Calculate the (a) *average waiting time*; and (b) *average turnaround time*, respectively, when the following scheduling algorithms are used to schedule the set of processes with corresponding burst times below. (You may assume that the context switch time is 0.)

(4) *Round Robin (RR) Scheduling* (you may assume that the time quantum is 2)

(5) *SJF Nonpreemptive Scheduling*

(6) *SJF Preemptive Scheduling*

<u>Process</u>	<u>Arrival Time</u>	<u>Burst Time</u>
P ₁	0.0	8
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P ₃	5.0	2
P ₄	7.0	4

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ANSWERS:

(1) RR:

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(a) *average waiting time*: $(8+2+3+7)/4 = 5$

(b) *average turnaround time* $(16+6+5+11)/4 = 9.5$

(2) *SJF Nonpreemptive Scheduling*

(a) *average waiting time*: $(0+8+3+7)/4 = 4.5$

(b) *average turnaround time* $(8+12+5+11)/4 = 9$

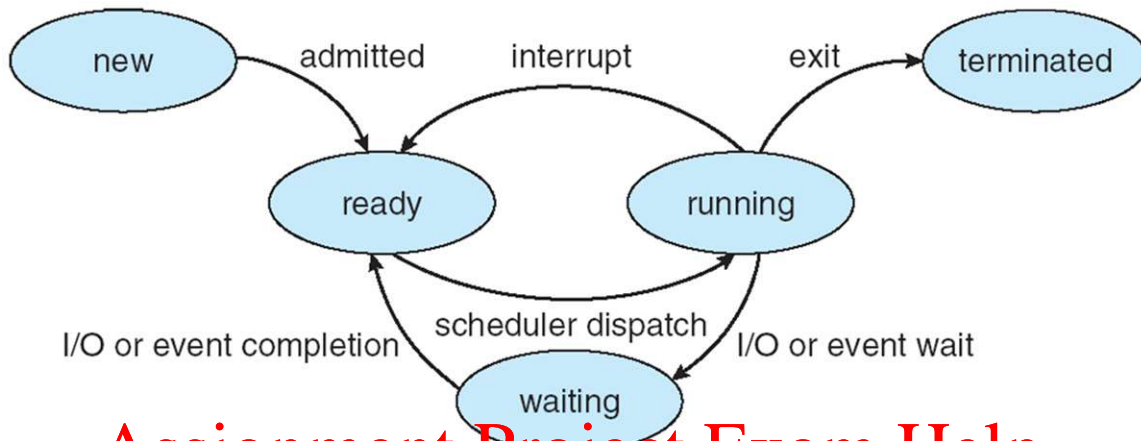
(2) *SJF Preemptive Scheduling*

(a) *average waiting time*: $(0+10+1+1)/4 = 3$

(b) *average turnaround time* $(18+4+3+5)/4 = 7.5$

4. Draw a diagram of *process state*. The diagram should include the different process states, and should also include the event(s)/circumstance(s) which cause a process to change from one state to another state.

ANSWER:



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5. Write the pseudo code for the Bounded Buffer – Shared Memory Solution *that does not require the use of semaphores* for the Producer-Consumer Problem.

ANSWER:

```
#define BUFFER_SIZE 10
typedef struct {
    ...
} item;
item buffer[BUFFER_SIZE];
int in = 0;
int out = 0;
```

Producer Process pseudo code:

```
item next_produced;
while (true) {
    /* produce an item in next produced */
    while (((in + 1) % BUFFER_SIZE) == out)
        /* do nothing */
    buffer[in] = next_produced;
    in = (in + 1) % BUFFER_SIZE;
}
```

Consumer Process pseudo code:

```
item next_consumed;
while (true) {
    while (in == out)
        /* do nothing */
    next_consumed = buffer[out];
    out = (out + 1) % BUFFER_SIZE;

    /* consume the item in next consumed */
}
```