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LE19.1

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LE19.1.1: Going Bananas

0.0/1.0 point (ungraded)

The Chiquita Fruit Company has acquired a fancy multi-process machine that they want to use to print the word BANANA. The machine has two types of processes – called BA and NA – that can coordinate their execution via shared semaphores which respond to the standard signal(S) and wait(S) procedures. Since we need twice as many NAs as BAs, there’s **one BA process and two NA processes** running on the machine. Assume that execution may switch between any of the three processes at any point in time.

Their summer intern wrote many versions of the BA and NA code, then made a list of the first six characters they printed (any subsequent printed characters were not recorded) when run on the machine:

1. Select all possible strings that the following code could produce.

Process BA

Loop1:
 print("B")
 print("A")
 goto Loop1

Process NA

Loop2:
 print("N")
 print("A")
 goto Loop2

☐ BANANA

☐ ANANAB

☐ BNNAAA

☐ BANNAA

☐ BANBAN

☐ NABANA

2. Select all possible strings that the following code could produce.

```
Semaphore S = 0; Semaphore T = 0;    // Shared semaphores
```

Process BA


Loop1:
 print("B")
 print("A")
 signal(S)
 signal(S)
 wait(T)
 wait(T)
 goto Loop1

Process NA

Loop2:
 wait(S)
 print("N")
 print("A")
 signal(T)
 goto Loop2

☐ BANANA

☐ ANANAB

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☐ BNNAAA

☐ BANNAA

☐ BANBAN

☐ NABANA

3. A clever 6.004 student observes that interchanging two lines in the Process BA code of part (B) will ensure that only BANANA will be printed. Select the **two** commands from the loop of process BA that should be interchanged. Assume the "NA" process is untouched.

☐ print("B")

☐ print("A")

☐ signal(S)

☐ signal(S)

☐ wait(T)

☐ wait(T)

☐ goto Loop1

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LE19.1.2: Precedence Constraints

0.0/1.0 point (ungraded)
The following pair of processes share a common variable X:

Process A	Process B
int Y;	int Z;
A1: Y = X * 2;	B1: Z = X + 1;
A2: X = Y;	B2: X = Z;

X is set to 5 before either process begins execution. As usual, statements within a process are executed sequentially, but statements in process A may execute in any order with respect to statements in process B. There are four possible values for X. Here are the possible ways in which statements from A and B can be interleaved:

A1 A2 B1 B2: X = 11

A1 B1 A2 B2: X = 6

A1 B1 B2 A2: X = 10

B1 A1 B2 A2: X = 10


B1 A1 A2 B2: X = 6

B1 B2 A1 A2: X = 12

1. The programs are modified as follows to use a shared binary semaphore T:

semaphore T = 1; // shared semaphore

Process AProcess B

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```
int Y;
wait(T)
A1: Y = X * 2;
A2: X = Y;
signal(T)
```

```
int Z;
wait(T)
B1: Z = X + 1;
B2: X = Z;
signal(T)
```

Select all the possible values of X after both processes finish executing:

☐ 6

☐ 10

☐ 11

☐ 12

2. Using two semaphores, S and T, please specify the initial values of semaphores S and T, and add wait(S), wait(T), signal(S), and signal(T) statements as needed to modify the original procedures so that the only **possible value of X is 10**. To be considered correct, the solution must not introduce any unnecessary precedence constraints, and must execute all four pieces of code A1, A2, B1, and B2. *Note there are two execution orders that result in $X = 10$.* Indicate the initial value of any semaphores you use.

For each drop down, select the missing line of code. If a particular code region only requires one command, then select that command for the first drop down and select None for the second drop down. If no commands are needed in a region then select None for both answers. **Assume that semaphore T is required to execute A2.** Note that some drop downs may contain a subset of all the possibilities in order to ensure a single correct answer to the problem.

// Semaphore initial values

semaphore S = ;

semaphore T = ;

// Process A

int Y;

Select an option ▼

Select an option ▼

A1: Y = X * 2;

Select an option ▼

Select an option ▼

A2: X = Y;

Select an option ▼

Select an option ▼

// Process B

int Z;

Select an option ▼

Select an option ▼

B1: Z = X + 1;

Select an option ▼

Select an option ▼

B2: X = Z;

Select an option ▼

Select an option ▼

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Discussion

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<input checked="" type="checkbox"/>	<u>Should X be set to 5 before the start of Problem 19.1.2 (B)?</u>	3	▼
This knowledge would affect how I go about tackling it.			
<input checked="" type="checkbox"/>	<u>[STAFF] "We want B2 to run next but not before A2 has completed"</u>	2	▼
In Explanation of second problem shouldn't this line be "We want B2 to run before A2 has completed"?			

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