## CS & IT ENGINEERING

Operating System

**Process Synchronization** 

Lecture No. 6









TOPICS TO BE COVERED Synchronization Hardware

**TSL Instruction** 

**Swap Instruction** 

telerson Sohn - 2- process Solution Busy-waiting (wastage of cpu lime) La u/m Jompl. [->(L.V+3.A) -> 3 Step Process + lag (N)= F; tum-ilj

a) Guarantee m/E b) 11 Rogress Bounded Waiting

(HIW)

Process (int i)

int j = NOT(i); While(i)

a) Mon-CS()

- 6) While (turn!=i)
- c) twm= 1;
- g) (cs)
- (e) twm=j;

a) M/ is not Guaranteed

```
Variation
                 turn=0
                                            F(g(N); PETERSON'S SOLN
      void Dekkers_Algorithm (inti)
                                                While (1
        int j = ! (i);
        while (1)
                           2-Proton
                                                  a) Non-CS();
             (a) Non_CS();
             (b) flag[i] = TRUE;
                                                     flag [i]=TRUE;
             (c) while (flag [j] = = TRUE)
Logrens
                                                  c) tum=i;
             if(turn = = j)
                                                   d) While (f(55))==TRUE &R
                  flag[i] = FALSE;
                  while (turn = = j);
                                                                    Jum==i
                  flag [i] = TRUE;
                                                     4) flag [i]=FALSE
             (d) <CS>
             (e) flag [i] = FALSE;
             turn = j;
```

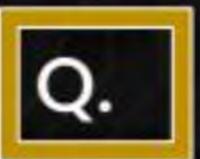


Processes P<sub>1</sub> and P<sub>2</sub> use critical\_flag in the following routine to achieve mutual exclusion. Assume that critical\_flag is initialized to FALSE in the main program.



Consider the following statements.

- (i) It is possible for both P1 and P2 to access critical region concurrently.
- (ii) This may lead to a deadlock. X
  Which of the following holds?
- A. (i) is false and (ii) is true
- B. Both (i) and (ii) are false
- (i) is true and (ii) is false
- D. Both (i) and (ii) are true



Two processes, P<sub>1</sub> and P<sub>2</sub>, need to access a critical section of code. Consider the following synchronization construct used by the processes:



```
/*P<sub>1</sub>*/
while (true)
{

wants1 = true;
while (wants2 == true);
/* Critical Section */
wants 2 = false;
}

/*P<sub>2</sub>*/
while (true)
{

wants2 = true;
while (wants1 == true);
/* Critical Section */
wants 2 = false;
}

/* Remainder section */

/* Remainder section */
```

Here, wants1 and wants2 are shared variables/ which are initialized to false. Which one of the following statements is TRUE about the above construct?

- A. It does not ensure mutual exclusion. MCA
  - B. It does not ensure bounded waiting.
  - C. It requires that processes enter the critical section in strict alternation.
- D. It does not prevent deadlocks but ensures mutual exclusion.



Two processes X and Y need to access a critical section. Consider the following synchronization construct used by both the processes



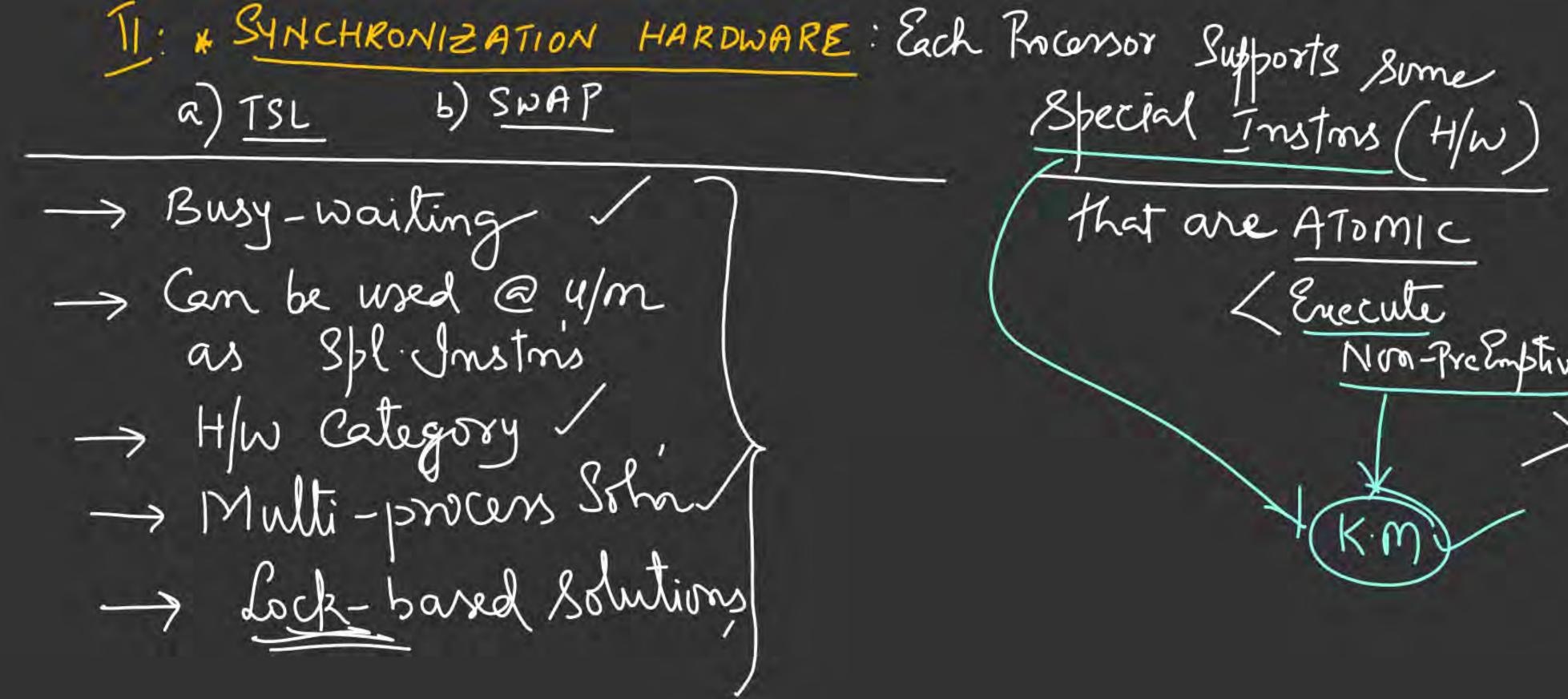
```
Process X
                                           Process Y
      /* other code for process X */
                                                       /* other code for process Y */
      while (true)
                                                       while (true)
         varP = true;
                                                           varQ = true;
         while (varQ == true)
                                                           while (varP == true)
                 /* critical section */
                                                              /* critical section */
                 varP = false:
                                                               varQ = false;
      /* other code for process X */
                                                       /* other code for process Y */
(Cont....)
```



Here, varP and varQ are shared variables and both are initialized to false. Which one of the following statements is true?



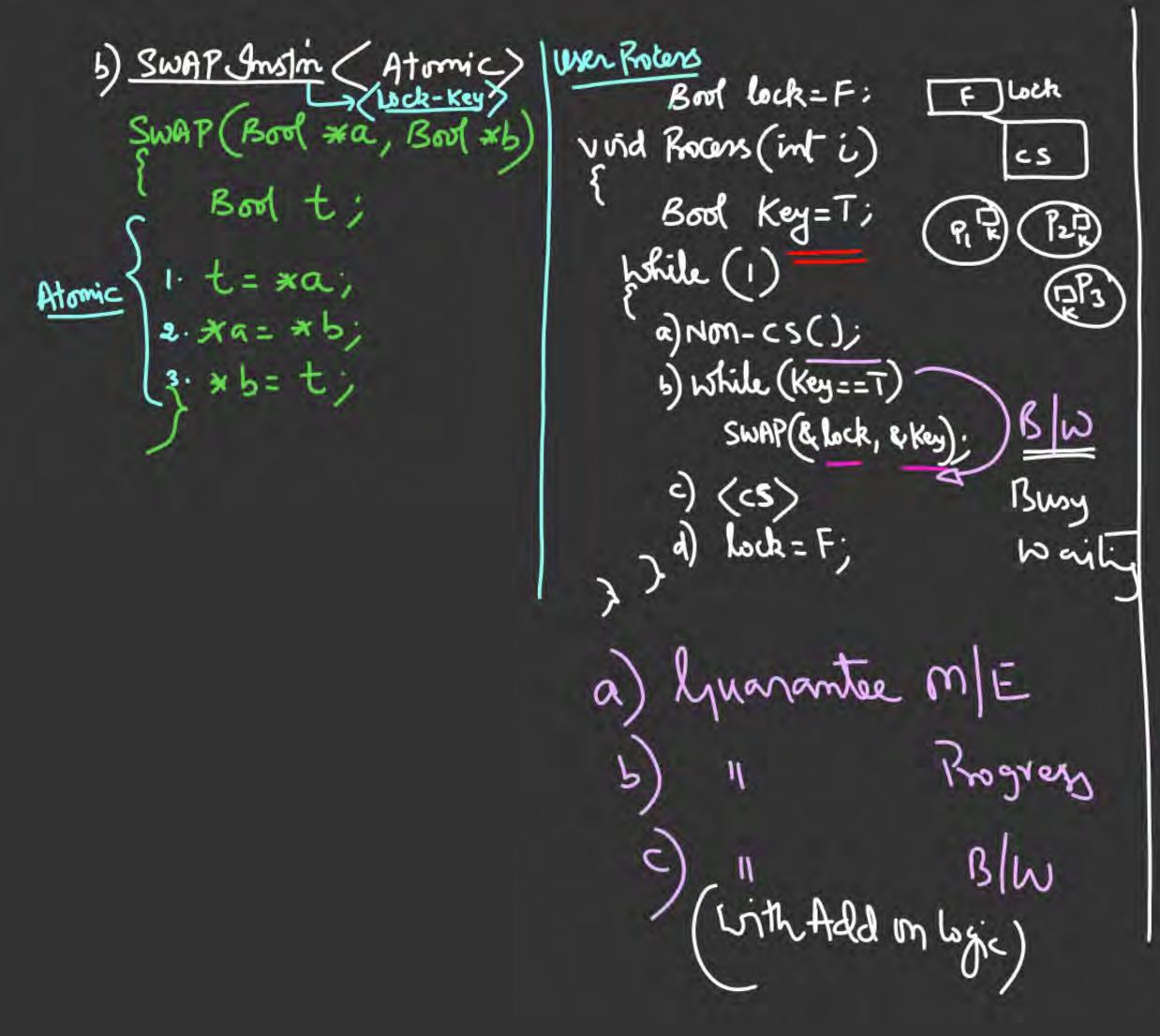
- A. The proposed solution prevents deadlock but fails to guarantee mutual exclusion
- B. The proposed solution guarantees mutual exclusion but fails to prevent deadlock
- C. The proposed solution guarantees mutual exclusion and prevents deadlock
- D. The proposed solution fails to prevent deadlock and fails to guarantee mutual exclusion

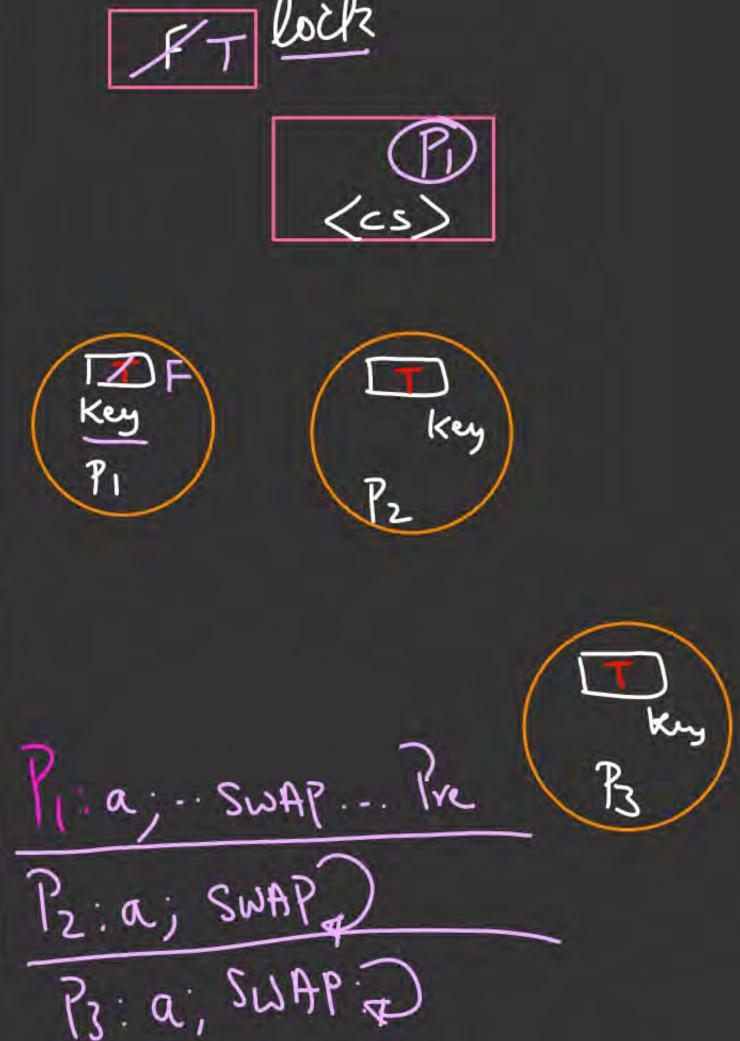


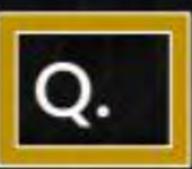
that are ATOMIC Enecute
Non-PreEmptively

a) TSL: Test and Set Lock; Call: TSL (& lock); ( Process executing TSL, Heturns the Current value of lock & Sets with Value of lock always to TRUE Bood TSL (Bood \* target) return Value VV = \* target return (rv) > Setting the value of buck to TRUF\_

Solving CS Problem thru TSL Lock Lock = F; (J&N Kngram virid Process (inti) Quarantee (Gurrantee M/E Wing ti: (Pi): a; TSL: F; Pre Galuin Tent Book 5) While (TSL(Rlock) == (P2): a; TSL:1 Synchronization Does not Guarantee Lock=F; Suit Bounded west In The entry Sec (Additional logic)







The enter\_CS () and leave\_CS () functions to implement critical section of a process are realized using test-and-set instruction as follows:



```
void enter_CS(X)
while (test-and-set(\underline{X}); while (TSL(&lock)==T); while (TSL(&lock)==T); while (TSL(&lock)==T); without Add m
X=0;
In the above solution, X is a memory location associated with the CS and is initialized
to 0. Now consider the following statements:

    The above solution to CS problem is deadlock-free.

    The solution is starvation free. X Does not Guarantee Burnd wait
III. The processes enter CS in FIFO order. ×
```

A. I only

B. I and II

Which of the above statements are TRUE?

IV. More than one process can enter CS at the same time.

C. II and III

D. IV only

Providy-Inversion Problem: (All Correct Busy-wait
86th Suffers from Priority : Pre Emplive Priority based Scheduting 96 (PH) is NOT Introd in CS Then there is no Broklem) Pet Dek TSUSWAP Proprity-Inheritance

Fetch\_And\_Add (X, i) is an atomic Read-Modify-write instruction that reads the value of memory location X, increments it by the value i and returns the old value of X, It is used in the pseudocode shown below to implement a busy-wait lock. L is an unsigned integer shared variable initialized to 0. The value of 0 corresponds to lock being available, while any non-zero value corresponds to the lock being not available. AcquireLock(L) Atomics

Atomics

Int Tru;

Inv = X;

X = X + i;

Trutum (Trv); Entry While (Fetch\_And\_Add (L,1)) L=1; ReleaseLock(L) This implementation (MSQ)Pi: FA: 0 fails as L can overflow fails as L can take on a non-zero value when the lock is actually available 2: FA: 1; FA: 1 works correctly but may starve some processes works correctly without starvation



