IIT Guwahati - Department of Computer Science & Engineering

CS343-Operating Systems- Quiz#2 [15.09.2021]

Q1: **Long answer [to type in text box], 2 marks.**

Consider 5 identical process P1, P2,..P5 that have to be scheduled on a processor. These processes can be context switched at any arbitrary time and in any order. The code of each process Pi, i=1,2...5, is given below. P and Q are binary semaphores initialized to 1 and 0, respectively. X is shared variable initialized to 0. Assume the operation specified on each line in the following code is atomic and context switching can happen only after completion of the current line of instruction.

```
Process Pi
{
        Wait (P);
        X=X +1;
        Print “B”;
        If (X==5)
        {
                Print “C”;
                Signal (Q);
        }
        Signal (P);
        Wait (Q);
        Print “A”;
        Signal (Q);
}
```

How many unique output patterns can get printed (based on possible context switch order) once all the process complete their execution? List all the patterns. Explain the logic used in finding the answer in 2 to 3 sentences.

Answer: only one pattern. BBBBBCAAAAA

Each process will print B. The fifth process only print C. Every process will reach and wait in the Wait (Q); till C is printed. Once Signal(Q) is done by the process that Print C, all processes will complete Wait (Q) one by one and Print A.

Q2: File Upload [make sure the scan and the calculations are clear, 3 marks]

Consider a system with 4 active processes A, B, C, and D and 3 resource types P, Q, and R. There are a total of 6 instances each for P and Q and 3 instances for R that are available initially. Consider the MAX and ALLOCATION matrices that are fed to Banker's algorithm module for deadlock avoidance. Two requests – R1: A[1 0 1] and R2: B[1 0 1] come to the deadlock management module of OS at the same time. Which of these requests can be granted now? Explain with necessary justifications and illustrations.

	MAX				ALLOCATION		
	P	Q	R		P	Q	R
A	4	2	1		1	1	0
B	3	2	2		2	0	1
C	3	4	0		1	2	0
D	2	3	2		1	1	1

	MAX				ALLOCATION				NEED		
	P	Q	R		P	Q	R		P	Q	R
A	4	2	1		1	1	0		3	1	1
B	3	2	2		2	0	1		1	2	1
C	3	4	0		1	2	0		2	2	0
D	2	3	2		1	1	1		1	2	1
Total					5	4	2				

INITIAL= [6 6 3] ; ALLOCATION = [5 4 2] ; AVAILABLE = [1 2 1]

R1: A[1 0 1] , If this is granted then the ALLOCATION and NEED will be as follows

	ALLOCATION				NEED		
	P	Q	R		P	Q	R
A	2	1	1		2	1	0
B	2	0	1		1	2	1
C	1	2	0		2	2	0
D	1	1	1		1	2	1

AVAILABLE = [0 2 0], we cannot satisfy the NEED of any process. Hence this state is unsafe and can lead to deadlock as there is no safe sequence.

R2: B[1 0 1] If this is granted then the ALLOCATION and NEED will be as follows

	ALLOCATION				NEED		
	P	Q	R		P	Q	R
A	1	1	0		3	1	1
B	3	0	2		0	2	0
C	1	2	0		2	2	0
D	1	1	1		1	2	1

AVAILABLE = [0 2 0], we can satisfy the NEED of all processes in any sequence starting with B and then A, C, D after that in any order. Hence request R2 can be granted.