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Homework 2 - CSE461 - Dr Tong, Yu   Yousef Jarrar
SID # 26

#1 (10 pts) - The following figure shows a resource graph for a system with consumable resources only. A resource is represented by a rectangle w/ thick lines and labeled as R_i. A process is represented by a circle, labeled P_i

(A) Is the graph a claim-limited graph? why?
-> Each resource has no available unit.
$P1$ is a consumer of $R1$ & P_2 and P_3 are consumers of R_2. ∴ making this graph claim-limited.

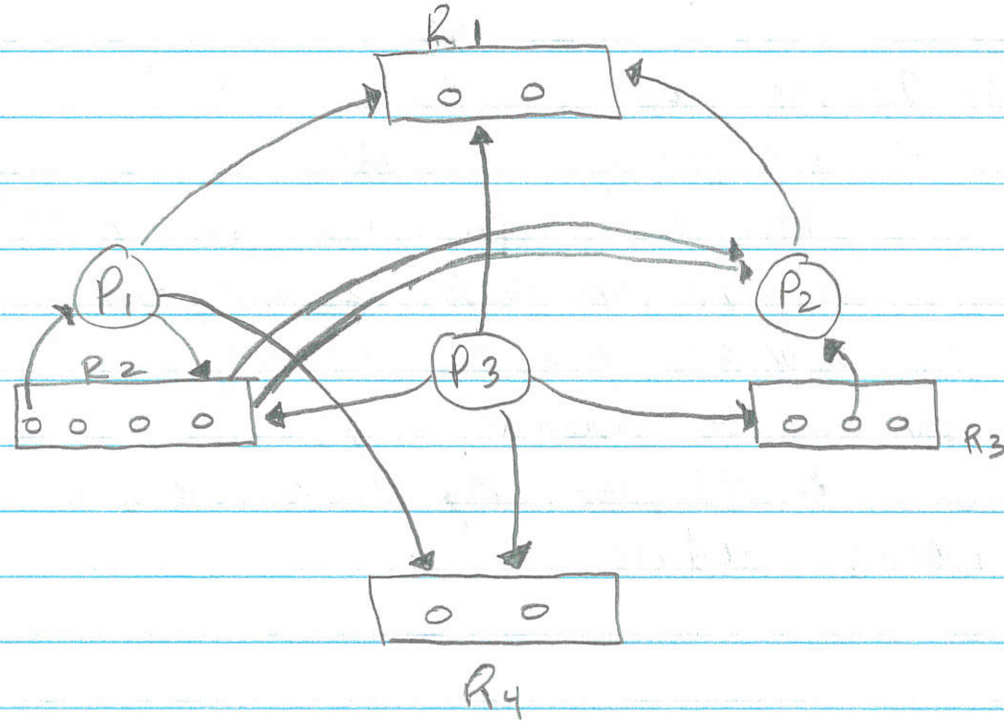
(b) Is the graph reducible? why?
-> This graph is reducible.
b/c $P1$ is a producer of $R2$ and b/c it is unblocked, $P1$ can produce 2 units, that P_2 and P_3 can consume. Since $P1$ needs only 1 unit of $R1$, this can be produced by P_2
∴ All process requests can be granted, and making it reducible

10 pts

#2 Assume a system has P processes and R identical units of a reusable resource. If each process can claim at most N units of the resource, determine whether each of the following is true of false and prove your claim.

(A) If the system is a deadlock free then $R \geq P(N-1)+1$.

-> Since each process can hold $N-1$ units, we can assume:



2a) Assume that there are 3 processes P_1, P_2, P_3 and $N=4$

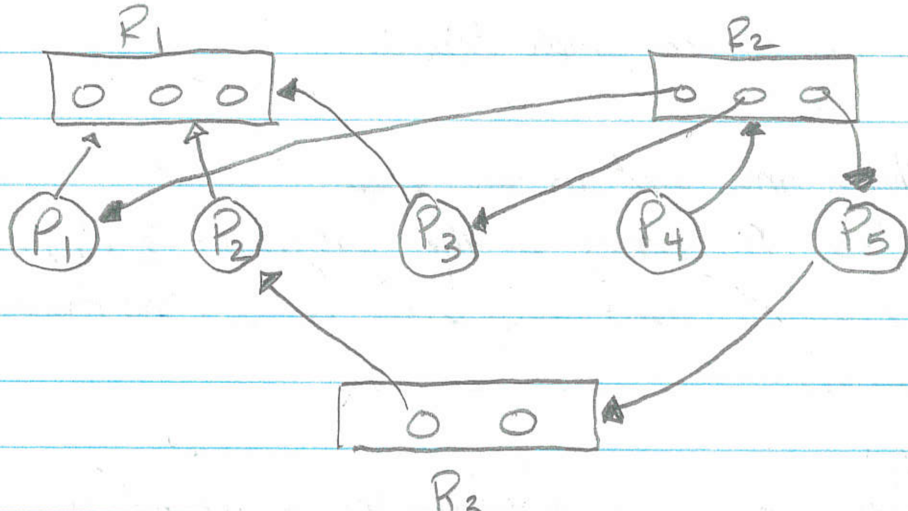
Based on the figure, # of resources are 11

↳ $P(N-1) = 3(4-1)+1 = 10$

which makes the graph a deadlock when

$R \geq P(N-1)+1$

(2b)



- R_1 is allocated to P_1, P_2, P_3

$R = 8$

$P = 5$ $\qquad 8 \geq 5(2-1)+1$

$N = 2$

- If R_1 is allocated to P_1, P_2, P_3. P_1 can finish working & release to R_2. R_2 can be allocated to P_4. P_5 can finish it's work as 2 resources are allocated. P_5 finishes, and releases R_1 & R_2. P_2, R1 and R_3 are assigned. When it finishes the work, P_4 can then continue.

#3 The following figure shows a resource graph for a system with reusable resources only. A resource is represented by a rectangle, in which a small square indicates a unit of the resource.

(A) Is the graph expedient? why?
→ Yes, All processes have requests that are blocked, which makes the graph expedient

(B) Is there any knot in the graph? why?
→ Yes, All nodes in the subgraph $\{P_1, P_2, P_3, P_4\}$ are reached from every other node. This makes it a knot.

(C) Is there any deadlock in the system? why?
→ Yes, Since there is a knot present; $\{P_1, P_2, P_3, P_4\}$ this is enough for a deadlock.

(4) In this problem you are to compare reading a file using a single-threaded server and a multi-threaded server. It takes 15 mseconds to get a request for work, dispatch it, and do the rest of the necessary processing assuming that the data needed are in a cache in main memory. If a disk operation is needed, as is the case one-third of the time, an additional 75 msec is required, during which time the thread sleeps. How many requests/sec can the server handle if it is single threaded? If it is multi-threaded?

→ In a single thread server, 15 mseconds to get a request for work. Does the rest of the "necessary" processing if the data is in the cache in main memory.

→ Takes an additional 1/3 of the time, an additional 75 mseconds, (90 mseconds if disk operation is needed)

∴ $1/3(90) + 2/3(15) = 40$ mseconds, which is the total time required for reading a file using a single thread. which can perform 25 requests/sec.

→ In multi threaded server, waiting for disk is overlapped.

∴ it takes 15 mseconds for reading a file. Hence, it can perform 1000/15 requests per second

$= 66(2/3)$ requests/second

(5) Consider the state of the system with processes P_1, P_2 and P_3, defined by the following matrices:

$$\text{max-Avail } A = \begin{pmatrix} 5 & 2 & 4 \end{pmatrix}$$

$$\text{max-Claim } B = \begin{pmatrix} 2 & 2 & 2 \\ 1 & 2 & 2 \\ 3 & 1 & 3 \end{pmatrix}$$

$$\text{Allocation } C = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{pmatrix}$$

(A) Find the available Matrix D and the need Matrix E in this state.

$$\text{Available Matrix } D = A - \sum_{k=1}^{n} C_k$$

$$D = (5\,2\,4) - (3\,2\,2)$$

$$D = (2\,0\,2)$$

$$E = B - C$$

$$\begin{pmatrix} 2 & 2 & 2 \\ 1 & 2 & 2 \\ 3 & 1 & 3 \end{pmatrix} - \begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{pmatrix} = \begin{pmatrix} 1 & 1 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 2 \end{pmatrix}$$

(B) Suppose now P_1 makes a request with $F_1 = (0\ 0\ 1)$

Available $D = D - F_1$

$= (2\,0\,2) - (0\,0\,1)$

$D = (2\,0\,1)$

Allocation $C = C_i + F_i$

$$= \begin{pmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{pmatrix} + (0\,0\,1)$$

$$= \begin{pmatrix} 1 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 1 \end{pmatrix}$$

$E = E_i + F_i$

$$= \begin{pmatrix} 1 & 1 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 2 \end{pmatrix} - (0\ 0\ 1) = \begin{pmatrix} 1 & 1 & 1 \\ 0 & 2 & 1 \\ 2 & 0 & 2 \end{pmatrix}$$

(c) If the request were granted, what would be D, C, and E in the resulted state?

- To Ensure the system be safe, should the request be granted? Why? Give your reasons in detail.

→ The request is granted when the next state is "safe" state.

- Use safe-state check algorithm

P_1 $(111) \le (201) \rightarrow$ false

P_2 $(021) \le (201) \rightarrow$ false

P_3 $(202) \le (201) \rightarrow$ False

∴ the system is not in safe state as available matrix doesn't have enough resources given by the matrix.