3a. (12 points) Priority inversion Three real-time tasks bus manager (t1: frequent: high priority), communication task (t2: medium priority) and meteorological task (t3: low priority) run on the NASA Mars Pathfinder. NASA has sent out an urgent request to solve a problem that PathFinder is frequently resetting spontaneously losing all the data. Can you diagnose the problem and solve the problem for NASA?

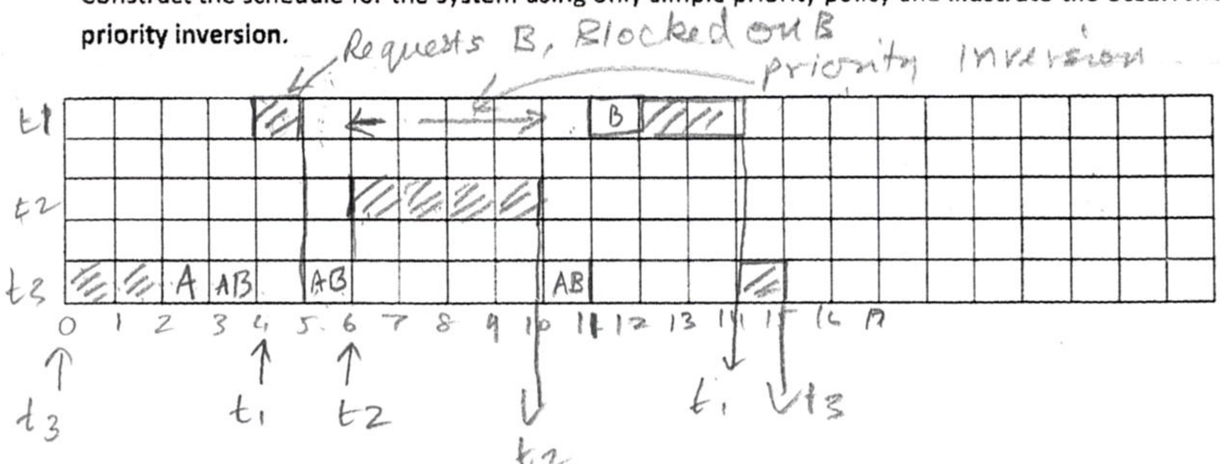
Assume that the tasks with their resource requirements as given below: **{arrival time, execution time, priority (1 highest), resource need}** provide the definition of the items specified for each task.

(a) t1: { 4, 4, 1:[B:1]} where the task executes for 1 time unit, then requests resource B for 1 time unit.

(b) t2: { 6, 4, 2:[none]} where the task executes for 4 times units and has no resource request.

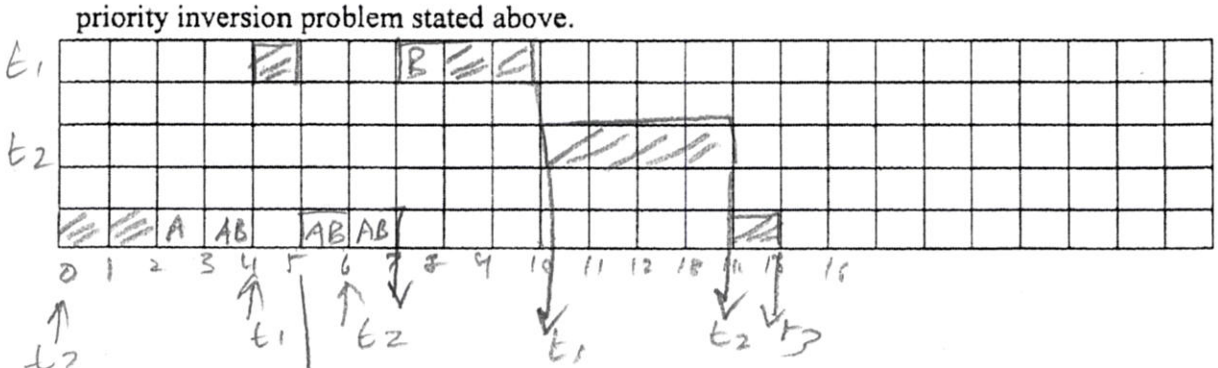
(c) t3: { 0, 7, 3:[A:4[B:3]]} where the task executes for 2 units, then requests resource A, and after 1 time unit requests resource B for 3 times units. (totally 4 time units of resource A)

Construct the schedule for the system using only simple priority policy and **illustrate the occurrence of priority inversion.**



3b. (10 points) Priority Inheritance lower priority task temporarily

Construct the schedule for the system using priority inheritance and illustrate how it solves the priority inversion problem stated above.



3c. (3 points) Why is t1 blocked by t3 even though its priority is higher than t3? Be precise.

Block on B

t3 inherits t1's priority temporarily

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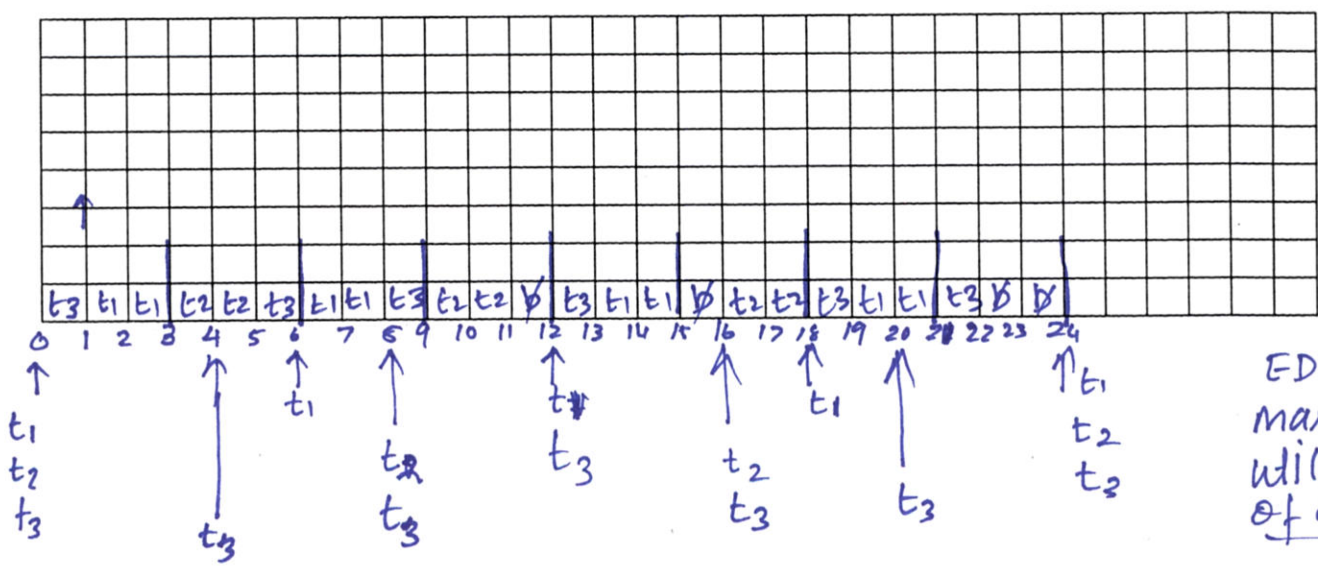
2. (25 points) Cyclic Executive: Cyclic executives offer a simple model for realtime and/or embedded operating systems: For the task set given below design a cyclic schedule: (i) determine the hyper-period (ii) determine frame size, (iii) provide a timing chart and (iv) **a cyclic (executive) schedule** - pseudo code. Show all you derivations/work for full credit. {task#, arrival time, execution time, period, relative deadline}; Use EDS for breaking ties. Show the arrival times and completion times.

ti	ri	ei	pi	Di
t1	0	2	6	6
t2	0	2	8	8
t3	0	1	4	4

0. $\sum \frac{e_i}{p_i} \leq 1$



EDS maximize utilization of a frame.

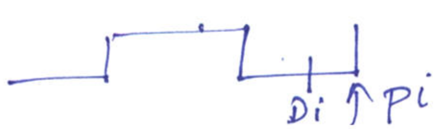
1. H - Hyperperiod lcm(pi) lcm(6, 8, 4) = 24
2. f - frame size f ≥ max(ei) ≥ (2, 2, 1) = 2, 3, 4 ....

2 frame size did not work - see friday's notes.
4 " " " "
3 f f = 3

3. ~~Di's~~ verify that f evenly divides H
4. verify relative deadline is satified.

2f - gcd(pi, f) ≤ Di for every task
6 - gcd(6, 3) ≤ 6
6 - gcd(8, 3) ≤ 8
6 - gcd(4, 3) ≤ 4 ×

pi = Di
no need for this rule



Oct 12 2015 (2)

cyclic execute schedule is: frame by frame

{ t3 (1); t1 (2) } — "function"

{ t2 (2); t3 (1) }

{ t1 (2); t3 (1) }

{ t2 (2); b (1) }

{ t3 (1); t1 (2) }

{ b (1); t2 (2) }

{ t3 (1); t1 (2) }

{ t3 (1); b (2) }