

ECEN 449: Microprocessor System Design  
 Department of Electrical and Computer Engineering  
 Texas A&M University

Assignment #3  
 Solutions

1. For the following set of tasks show how different scheduling algorithms will schedule the tasks. Each task is specified by a triple (arrival time  $a$ , deadline time  $d$ , length of task  $l$ ). The tasks are: A(0, 10, 5), B(0, 8, 3), C(2, 12, 4), D(3, 18, 5), E(4, 18, 1).
- (a) Round Robin scheduling, where each task is given 1 time unit each time it is scheduled
  - (b) Round Robin scheduling where each task is run to its completion
  - (c) Earliest deadline first scheduling
  - (d) First come first serve scheduling.

Show a timeline of what tasks are executed in each time unit for each policy. If there are two tasks eligible for scheduling at the same time (under a given policy), assume the tasks are scheduled in alphabetical order.

*Solution.* (a) The order in which tasks will be scheduled is shown in Table 1:

Time	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Task	A	B	A	B	C	A	D	B	E	C	A	D	C	A	D	C	D	D

Table 1: Task scheduling for part a

- (b) For Round Robin scheduling, the schedule is reported in Table 2.
- (c) The task schedule is as shown in Table 3.

Time	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Task	A	A	A	A	A	B	B	B	C	C	C	C	D	D	D	D	D	E

Table 2: Task scheduling for part b

Time	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Task	B	B	B	A	A	A	A	A	C	C	C	C	D	D	D	D	D	E

Table 3: Task scheduling for part c

(d) For first come first serve scheduling, the task schedule is shown in Table 4.

Time	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Task	A	A	A	A	A	B	B	B	C	C	C	C	D	D	D	D	D	E

Table 4: Task scheduling for part d

□

2. Assume a context switch in a system costs about 100us. What is the maximum number of interrupts the system can handle? Based on these results, can you think of a way to stage a Denial of Service attack on such a system if it acts as a web server?

*Solution.* Whenever there is an interrupt, the processor has to switch the context. Therefore, the maximum number of interrupts that can be handled by the system is 10000 ( $1/100\mu s$ ) per second. To implement a Denial of Service attack, an attacker needs to generate more than 10000 interrupts per second. To generate that many interrupts, the attacker needs to send that many requests to the web server per second. □

3. Consider a PCM communication paradigm. We want to be able to sample the input at 8K samples/sec (a reasonable choice for voice signals). Also, we want each sample to be at least 8bits.

- (a) What is the maximum period for the PCM signal?  
 (b) What would the maximum period be in case I want to multiplex 12 such PCM datastreams into a single PCM signal?

*Solution.* (a) With the sampling rate of 8K samples/sec and using 8bits for each sample, the data rate is 64Kbps. Thus, the maximum period of the PCM signal is  $15.625\mu s$  ( $=1/64\text{Kbps}$ ).

- (b) When 12 channels are multiplexed into a single PCM signal, the data rate increases to  $12 \times 64\text{Kbps}$  ( $=768\text{Kbps}$ ). Thus, the maximum period of the PCM signal is  $1.302\mu\text{s}$  ( $=1/768\text{Kbps}$ ).

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