**ECEN5623**

Homework set – 1

1. Provide examples of real-time embedded systems you are familiar with and describe how these systems meet the common definition of real-time and embedded.

**Ans:** "Real-time" can be defined as a task that must be initiated upon request and completed while the requester waits for the output response.

"Embedded Systems" can be defined as special-purpose computers contained within the devices they control, not directly observable by the system's user.

A few examples of such systems include:

- Line follower robot

- Flight control

- Digital media processor

- Object tracking

- Medical monitoring

All the above applications involve embedded systems to process inputs and provide real-time output.

2. Find the Liu and Layland paper and read through Section 3. Why do they make the assumption that all requests for services are periodic? Why might this be a problem with a real application?

**Ans:** The reason they make this assumption is that periodic tasks provide a simple and tractable model for real-time systems. By assuming tasks occur periodically, it becomes easier to analyze the system behavior and predict its performance. This model allows them to derive the worst-case response time and utilization bound which is fundamental to real-time scheduling.

However, these assumptions might be problematic in the real-world because of task aperiodicity. It is difficult to predict the worst-case response time of each task, which can lead to missed deadlines and degraded system performance.

3. Define hard and soft real-time services and describe why and how they are different.

**Ans: “**Hard real-time services” can be defined as the output produced after deadline is considered as failure, which may cause catastrophic consequences.

“Soft real-time services” can be defined as the output generated after deadline is considered as degraded, where QoS decreases.

Not every system has catastrophic consequences and no strict deadlines, but there is some flexibility to accommodate the output received for such systems, due to these factors there are two kinds of services.

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| Characteristics | Hard real-time service | Soft real-time service |
| Timing Constraint | Strict and must be met within deadlines. | Flexible and occasional misses may be tolerated. |
| Consequences of missing deadlines | High | Low |
| Expectation | Highly predictable and deterministic | Less predictable and behavior vary depending on workload. |
| Example | Medical monitoring | Video broadcast |