Fundamentals of Real-time Systems

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COURSE OUTLINES

- **Course Meeting Time:**

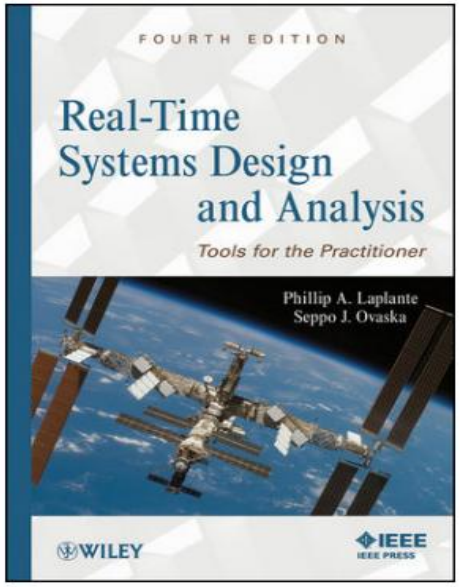
  Monday, 10.20 am – 11:50 am

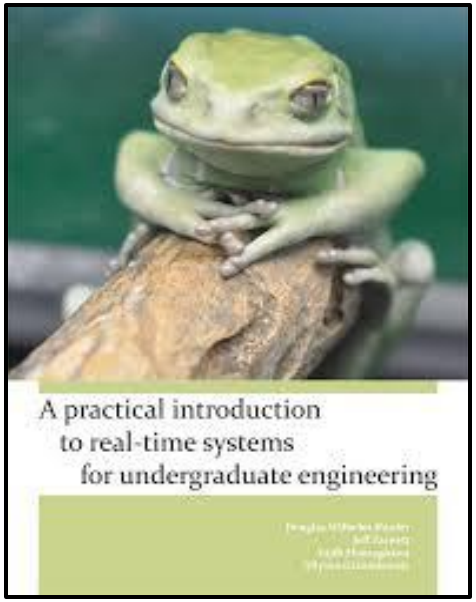
- **Grading :**

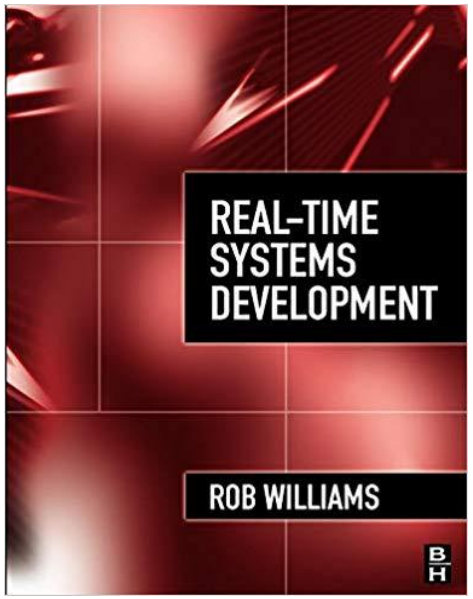
Activities	Percentages
Midterm	10%
Practical	20%
Oral	10%
Final	60%

COURSE OUTLINES

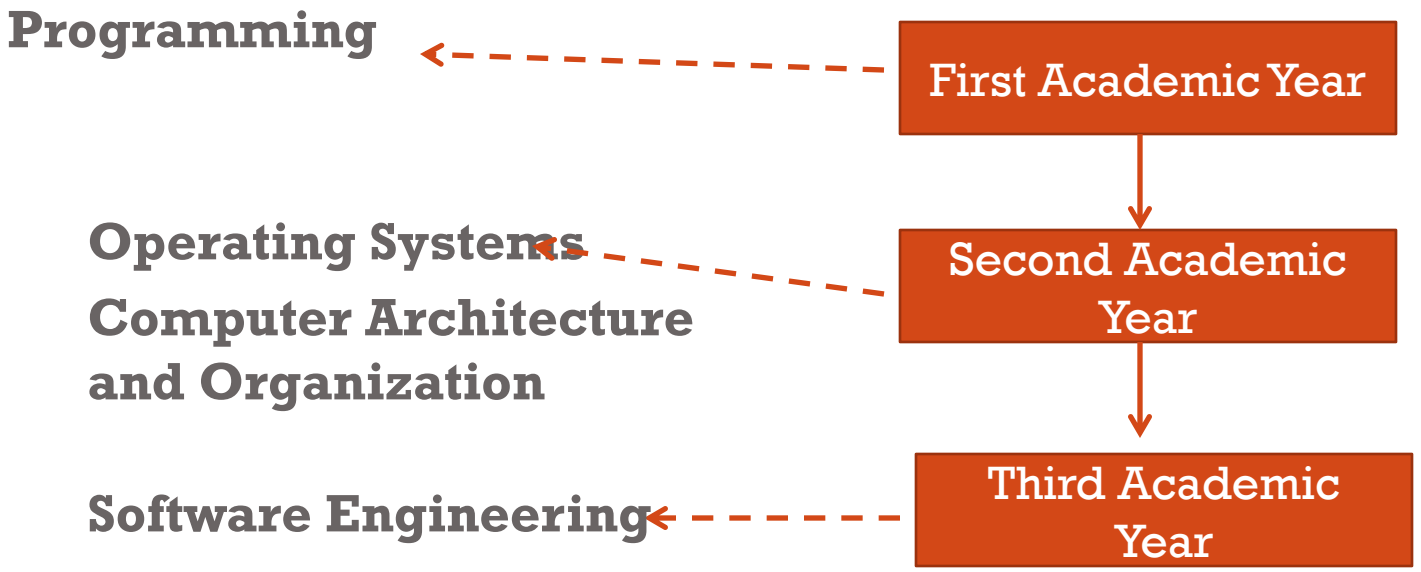
- **Course Textbooks:**







COURSE REQUIREMENTS



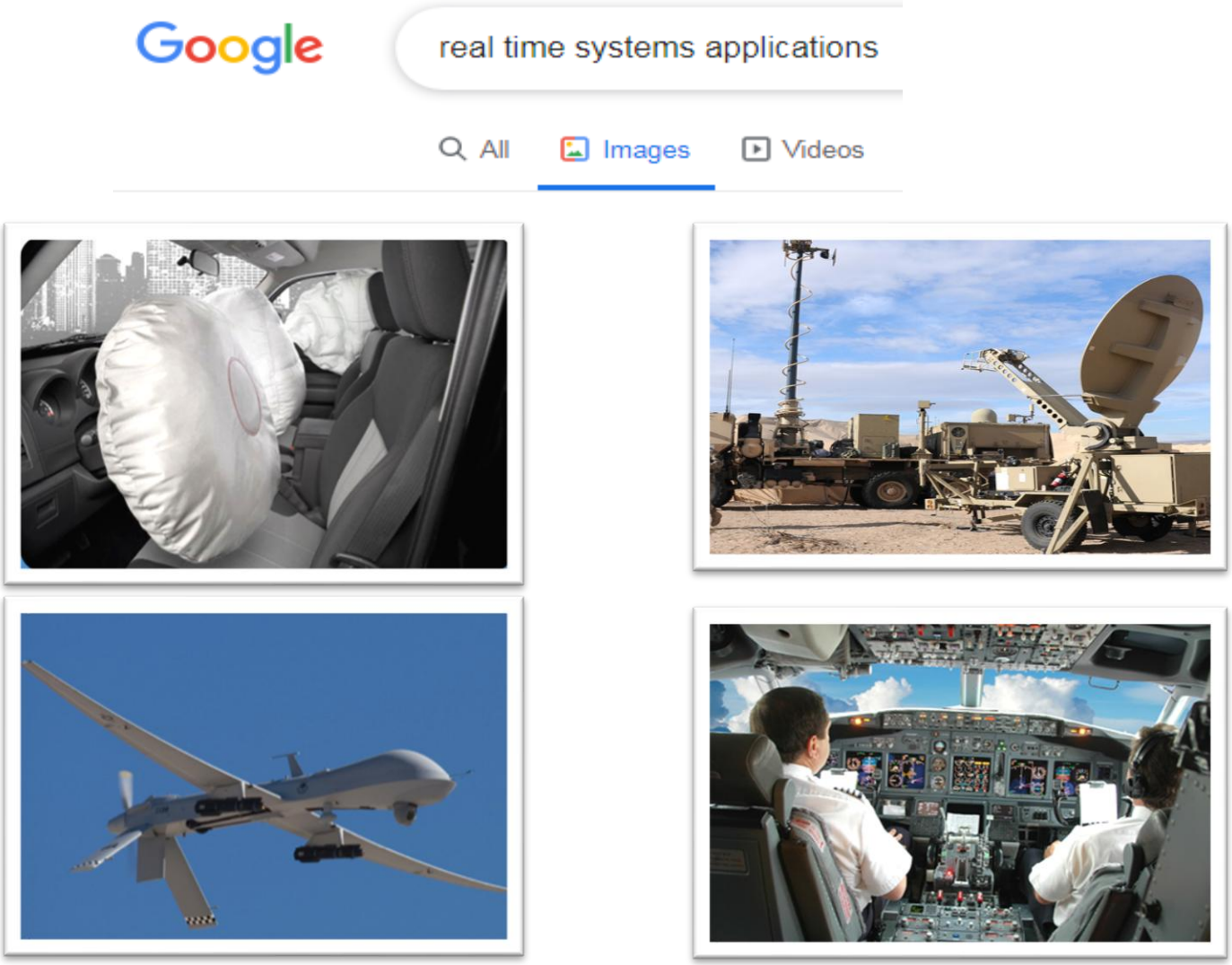
COURSE OBJECTIVES

- **Understand the concepts of real-time process and control.**
- **Understand the role of the computer as a real-time machine.**
- **Understand the concepts of multitasking and inter-task communication.**
- **Understand issues of time-critical computing.**
- **be familiar with a real-time operating system and application software.**
- **have hands-on experience with development of time-critical real-time systems especially for IoT.**

WHY REAL-TIME SYSTEMS COURSE ?

- **Develop faster and more efficient programs**
  - By understanding the low-level details of your computer system (CPU, memory, and I/O), you learn **how to manage and allocate resources effectively**.
- **Learn to code and design critical-time applications**
  - Gain skills to **develop applications that must meet strict timing requirements**, such as medical devices, industrial automation, or flight control systems.
- **Prepare for career and interviews**
  - Knowledge of real-time concepts makes you **stand out as a graduate from FCI**.
- **Industry relevance and future growth**
  - IoT, smart devices, and autonomous systems are booming.
  - **Estimates predict over 30 Billion IoT devices** will be in use by 2030.
  - Most IoT devices require **network connectivity** (WiFi, Bluetooth LE, Zigbee, Ethernet) and efficient **real-time data processing**.

Google for “ Real-Time Systems “



Real-Time Vs. Non-Real-Time

Non-Real-Time Systems

The system does the right thing 

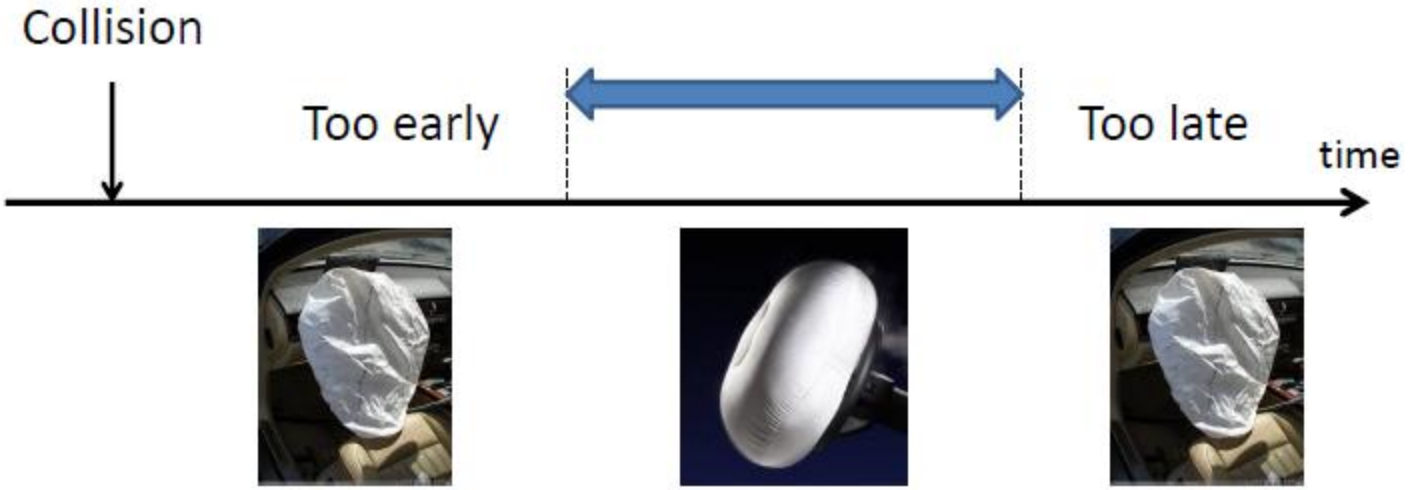
Real-Time Systems

 & 

The system does the right thing

It is on-time

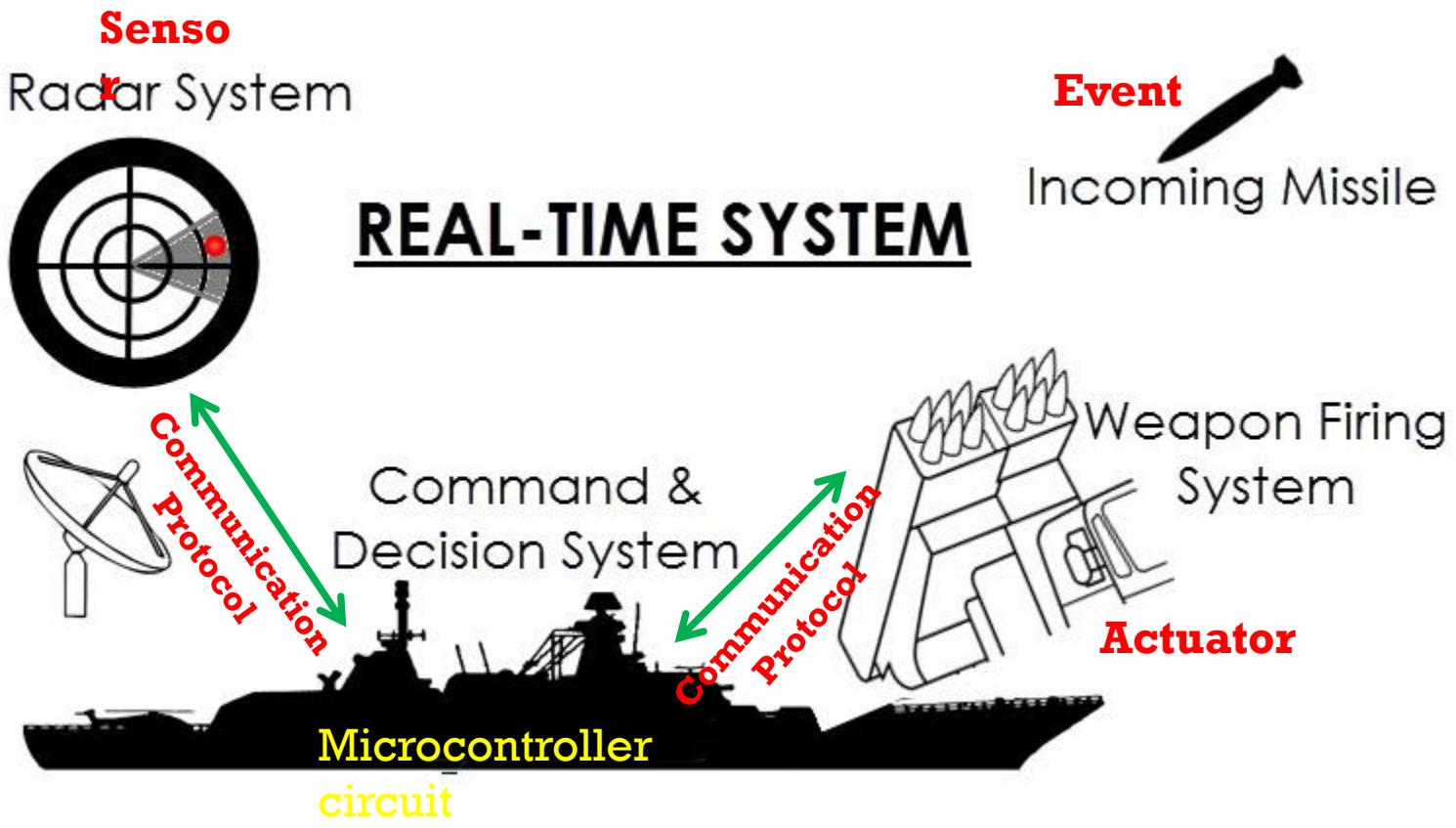
Real-Time classical example (Airbag)



Real-Time ≠ Fast

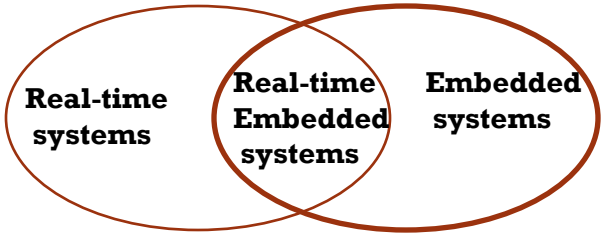
Real-Time = Predictable

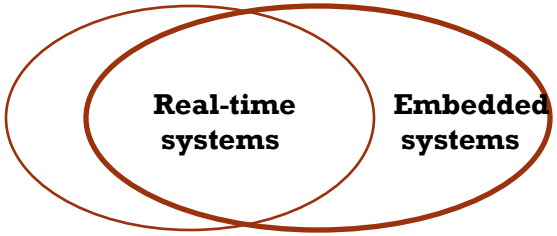
REAL-TIME COMPLEX SYSTEM (SIMPLE VIEW)



Real-Time Vs. Embedded Systems

Real-Time System	Embedded System
Produce correct results in a timely manner.	**Computer hardware and software embedded as part of complete device to perform one or a few dedicated functions; often with real-time requirements.**

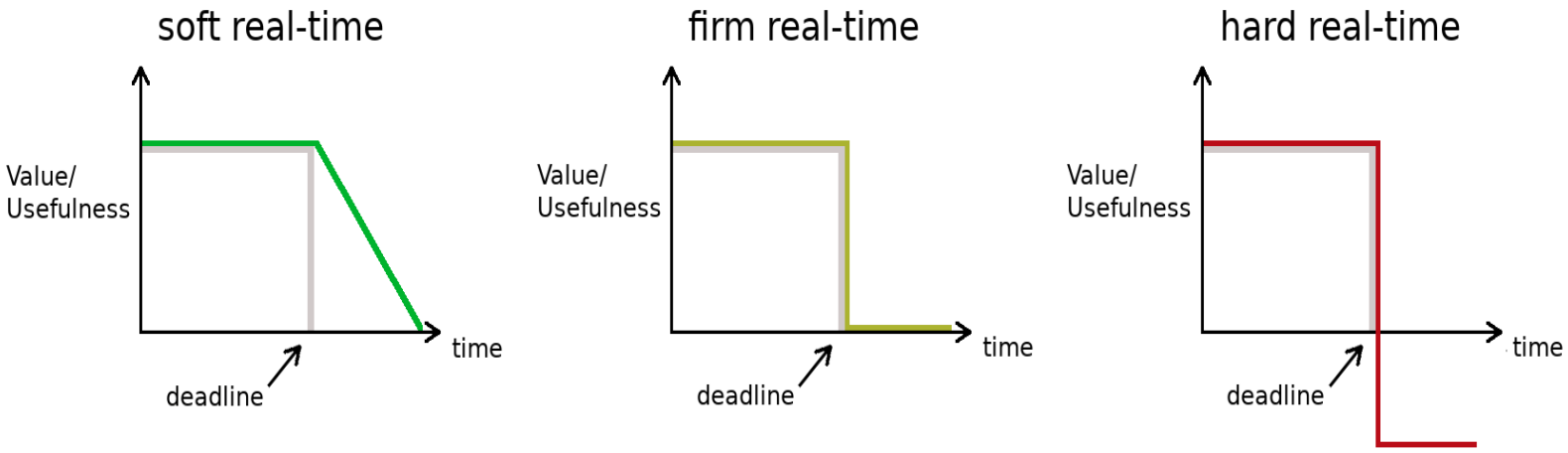




Real-Time Systems Types

Hard	Firm	Soft
❑Systems where the responses occur within the required deadline. ❑ Missing on a deadline can have catastrophic affects (system failure). ✓Nuclear Systems. ✓medical applications such as pacemakers. ✓Avionics.	❑Systems must try to meet the deadlines. ❑ Results has no use outside the deadline window and the failed tasks are discarded. (missing a deadline may not cause a catastrophic affect but could cause undesired affects) ✓Navigation controller for an autonomous weed - killer robot. ✓Satellite-based surveillance applications	❑Systems must try to meet the deadlines. ❑System does not fail if a few deadlines are missed. (missing a deadline is acceptable and the system still able to give you correct results with degraded performance) ✓Video /Audio Streaming ✓Interactive online games

Real-Time Systems Types



Tasks in real-time systems

There are two types of tasks in real-time systems:

1. **Periodic tasks:** a process that has to carry out its task in regular time intervals, The event for periodic process is driven by a clock.

2. **Dynamic tasks:**
   a. **Aperiodic tasks:** a process that has a constraint on the start or the stop time, have soft deadlines or no deadlines.
   b. **Sporadic tasks:** a process that has a constraint on the start or the stop time, have hard deadlines.