Real-Time Operating System
Chapter 8

Embedded System Design

UCS614

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Real-time Tasks

- Performance is judged on the basis of time
- Result of computation is ‘correct’ only if correct output with in the specified time constraint.
- If fail to meet time constraint
  - System failure
  - Reduced ‘quality of service’

Real-time Tasks

Example

- Process control
- Air traffic control
- Telecommunications
- Weapon guidance system
- Life support systems
- Anti-lock breaking systems

Real-time Systems and Embedded Systems

Are Real-time Systems and Embedded Systems are same?

- No

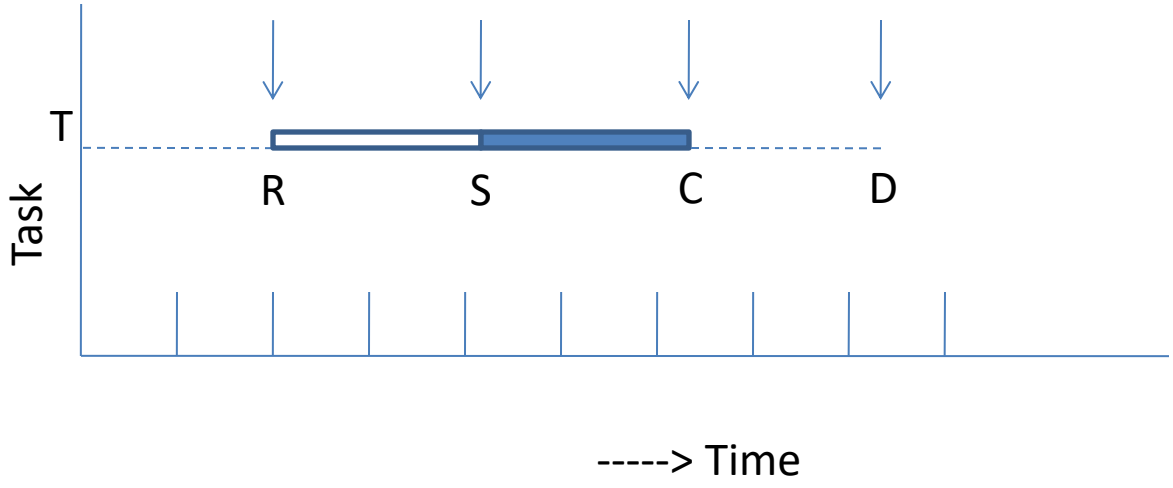
Definitions

- **Release Time:** Time instant at which a task is ready for execution
- **Scheduling Time:** Instant of time at which a task gets its chance to execute
- **Completion Time:** Instant of time at which a task completes execution
- **Deadline:** Instant of time by which a task should be completed
- **Run time:** Time taken without interruption to complete the task, after the task is released

Definitions

- **Tardiness:** Amount of time by which a task misses its deadline
- **Laxity:** Deadline – remaining completion time

  maximum amount of time task can wait with out missing its deadline



Types of Real-time Tasks

Based on Timing Constraint

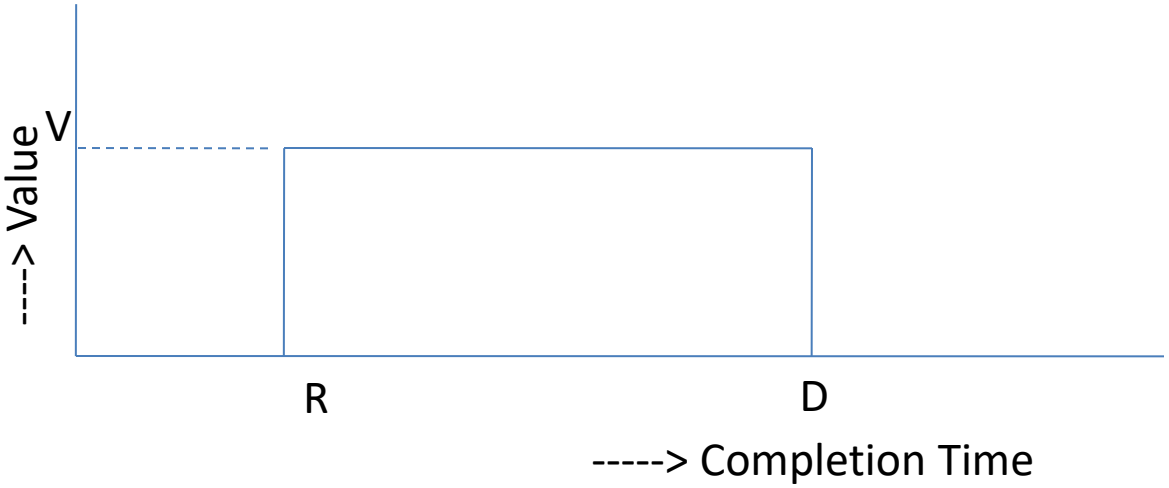
- Hard
- Soft
- Firm

Let n tasks	T1, T2, … Tn.
Completion Time	C1, C2, …Cn
Deadline	D1, D2, …Dn

Types of Real-time Tasks

- Hard Real-time Tasks

Tasks Ti is hard real-time task if Ci<=Di

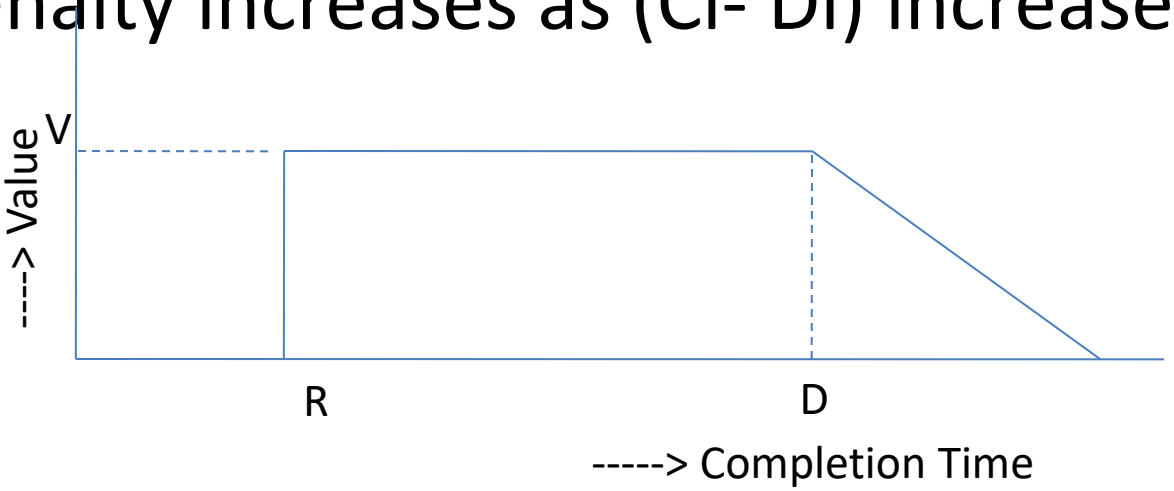


Types of Real-time Tasks

- Soft Real-time Tasks

Tasks Ti is soft real-time task, if Ci<=Di penalty is associated

Penalty increases as (Ci- Di) increases



Types of Real-time Tasks

- Firm Real-time Tasks

Value reduces to zero if deadline is not met.

Output of such task is discarded.

Dropping of task is allowed, once in a while.

Real-Time Systems

- System must contain at least one task of the types
  - Hard
  - Soft
  - Firm

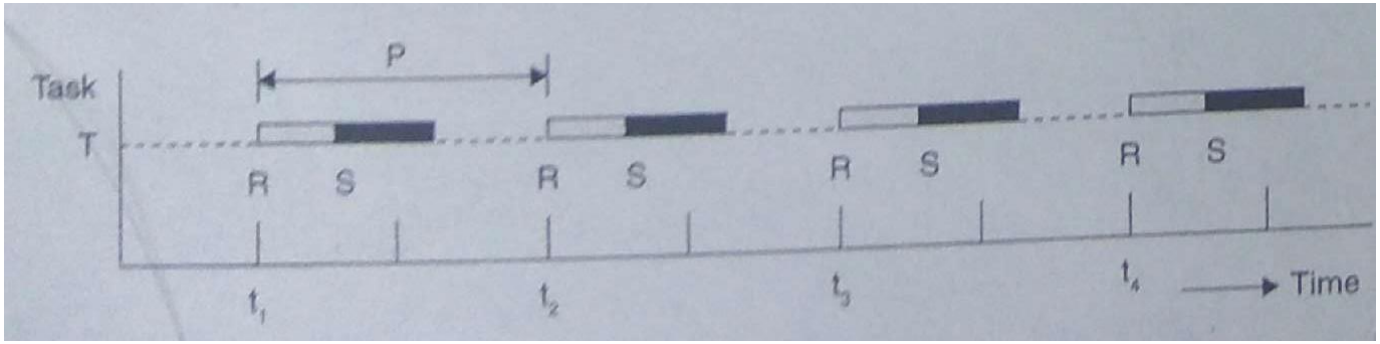
Types of Real-time Tasks

Based on Occurrence of task

- Periodic
- Aperiodic
- Sporadic

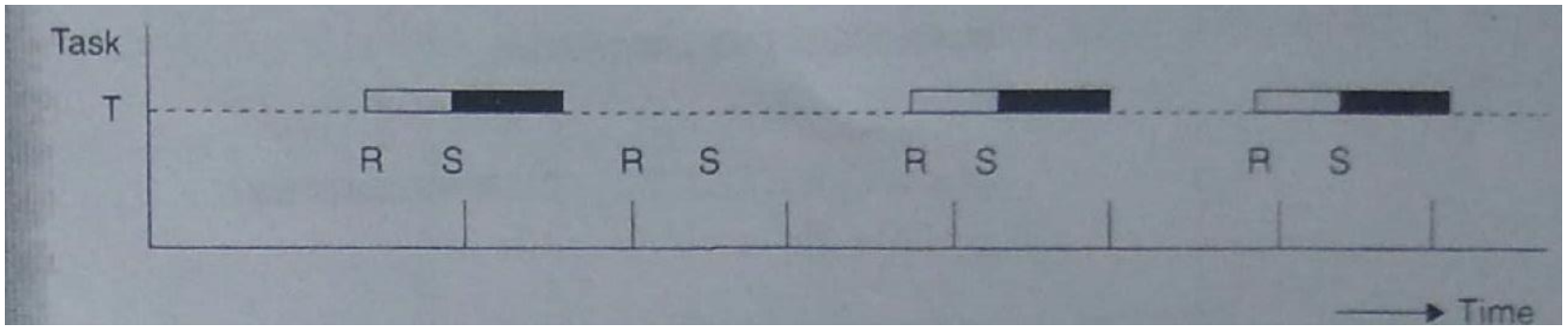
Types of Real-time Tasks

- Periodic
  - Real time tasks arrive(activated) at regular (fixed) intervals.
  - Execute once per time interval



Types of Real-time Tasks

- Aperiodic
  - Real time tasks arrive(activated) at irregular intervals.
  - Inter-arrival period between two such tasks can be zero
  - Generally have soft deadlines



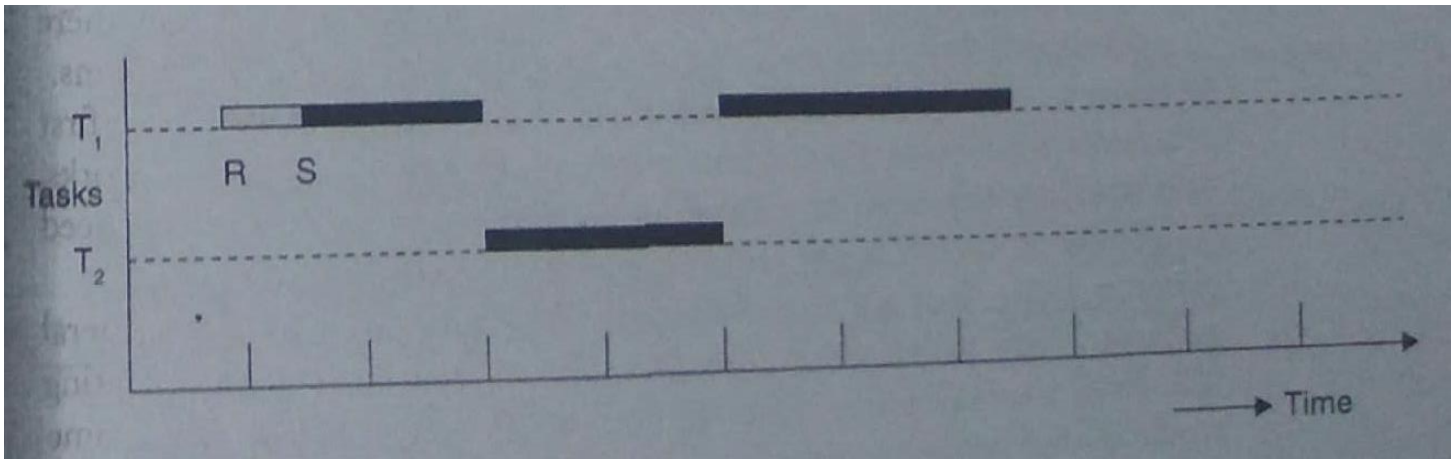
Types of Real-time Tasks

- Sporadic
  - Aperiodic task with minimum inter-arrival time
  - Hard deadline

Types of Real-time Tasks

Based on allowing interruption of running task

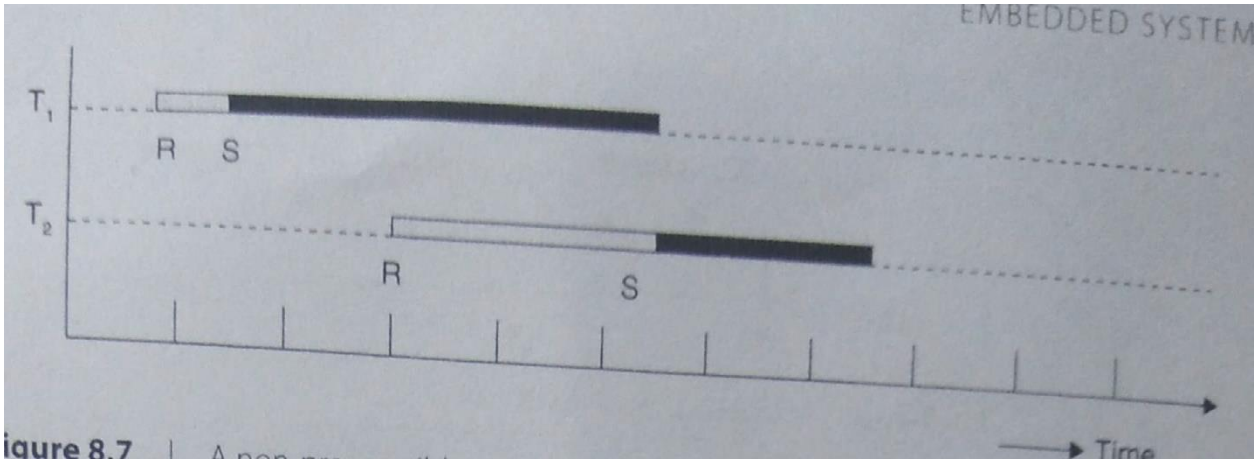
- Preemptible
  - Task can be preempted, if another task of higher priority becomes ready.



Types of Real-time Tasks

Based on allowing interruption of running task

- Non-Preemptible
  - Should continue execution without interruption, once started.



Real-time Operating System

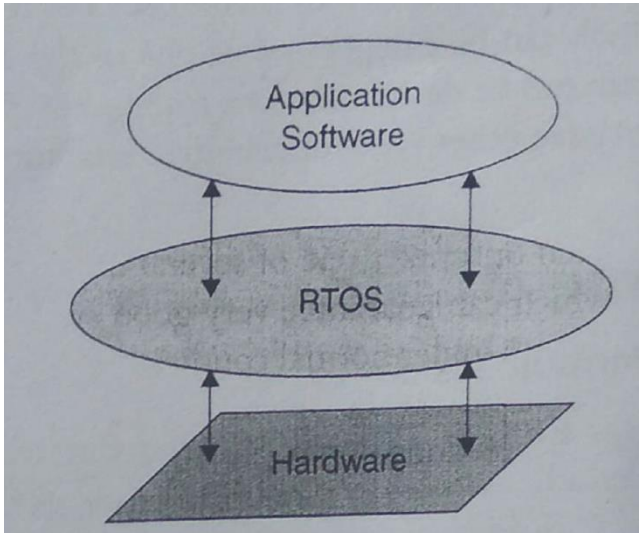
- Do embedded systems need an operating system?
  - Simple embedded applications like printer, scanners, sensor based home security systems need only hardware and firmware
    - Generally follow super loop based approach
    - Whole code is written as one loop which executes continuously

Real-time Operating System

- Do embedded systems need an operating system?
  - Complex systems need manager
  - But all embedded systems need not require real - time operating systems.
  - Require RTOS where time constraint is a factor

Real-time Operating System

- What does RTOS do?
  - Provides abstraction layer b/w embedded hardware and application software
  - Ensures that multiple tasks that comes in, are managed and done ‘on time’



Real-time Operating System

- Kernel services of RTOS