

# Task Model

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## Major References:

Real-Time Computing, 國立交通大學, 張立平教授

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## Terminologies (1/2)

- **Job**: a unit of work that is scheduled and executed by the system.
- **Task**: a set of related jobs which jointly provide some system function.
- The **release time** of a job: the instant of time at which the job becomes available for execution.
- **Response time**: the length of time from the release time of the job to the instant when it completes.

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## Terminologies (2/2)

- The **deadline** of a job: the instant of time by which its execution is required to be completed.
  - **Relative deadline**: the maximum allowable response time of a job.
  - **Absolute deadline**: release time + relative deadline
- **Scheduler**: a scheduler is a module that allocates processors and resources to jobs and tasks.
- **Schedule**: an assignment of all the jobs in the system on the available processors produced by the scheduler.

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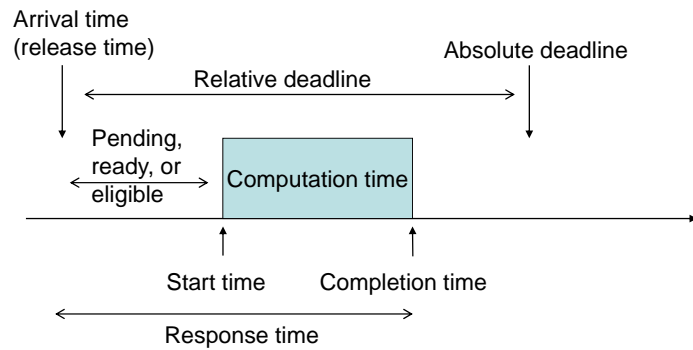
## Feasible vs. Schedulable

- A valid schedule is a **feasible schedule** if every job completes by its deadline (or, in general, meets its timing constraints).
- A set of jobs is **schedulable** according to a scheduling algorithms if when using the algorithm the scheduler always produces a feasible schedule.

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## System Model

- A job with real-time constraints

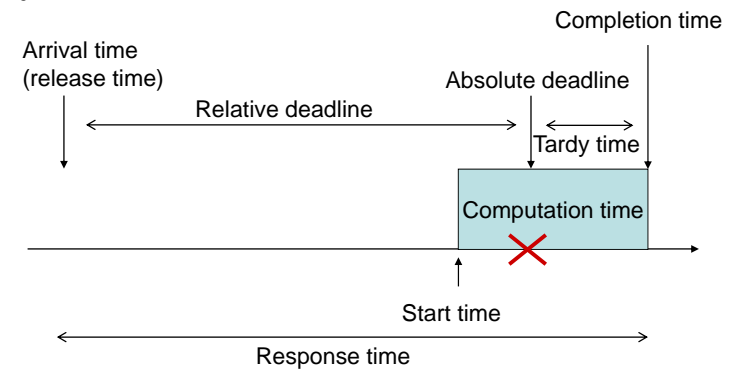


The job completes before its deadline, that means the deadline is satisfied.

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## System Model

- A job with real-time constraints



The job completes after its deadline, that means the deadline is **violated** or an **overflow** occurs.

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## Periodic Task Model (1/2)

- Each periodic task, denoted by  $T_i$ , is a sequence of jobs.
  - The **period** ( $p_i$ ) of the periodic task  $T_i$  is the minimum length of all time intervals between release times of consecutive jobs in  $T_i$ .
  - The **execution time** ( $e_i$ ) is the maximum execution time of all the jobs in it.
  - The release time  $r_{i,1}$  of the first job  $J_{i,1}$  in each task  $T_i$  is called the **phase** ( $\phi_i$ ) of  $T_i$ .
  - A job in  $T_i$  that is released at  $t$  must complete  $D_i$  units of time after  $t$ ;  $D_i$  is the **relative deadline** of the task  $T_i$ .

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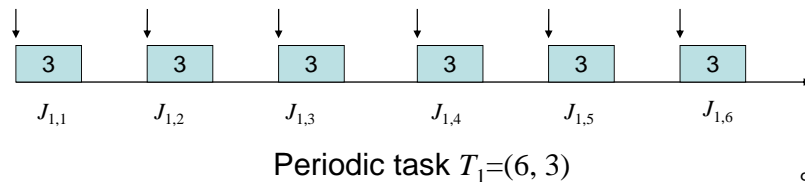
## Periodic Task Model (2/2)

- Priority**
  - Reflect the urgency of jobs
  - Any job inherits its task's priority
- Preemptivity**
  - As a high-priority task arrives, it preempts the execution of any low-priority tasks

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## A Purely Periodic Task

- Jobs of a task  $T$  recur every fixed time interval  $p$
- A job must be completed before the next job arrives
  - Relative deadlines for jobs are, implicitly, the period
- $T$  is defined as  $(p, c)$



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## Hard/Soft/Firm Real-Time Systems (1/2)

- Hard Real Time
  - Hard real-time systems require a guarantee that **all** processing is completed within a given time constraint **every time**.
  - A late response may result in catastrophic consequences.
  - Examples of hard real-time systems include nuclear power plants and avionics control systems.
- Soft Real-Time
  - Soft real-time systems have a less rigorous notion of temporal correctness and the consequences of a late response are not catastrophic.
  - Examples of soft real-time systems include telephone switches and electronic games.

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## Hard/Soft/Firm Real-Time Systems (2/2)

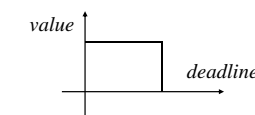
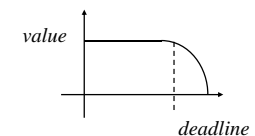
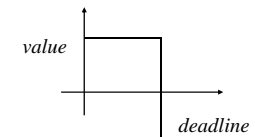
- Firm Real Time
  - Firm real-time has been used to describe applications that require deterministic performance but not hard guarantees of performance.
  - Examples of firm real-time systems include video conferencing systems and network servers such as Web Service Providers (WSPs), Application Service Providers (ASPs), and those that support e-commerce.

<http://csce.unl.edu/~goddard/ResearchProjects/VariableRateResourceAllocation.html>

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## Types of Real-Time Systems

- Hard real-time
  - No deadline violation
- Soft real-time
  - Low miss ratio or average/worst-case response time
- Firm real-time
  - No value after deadlines expire



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