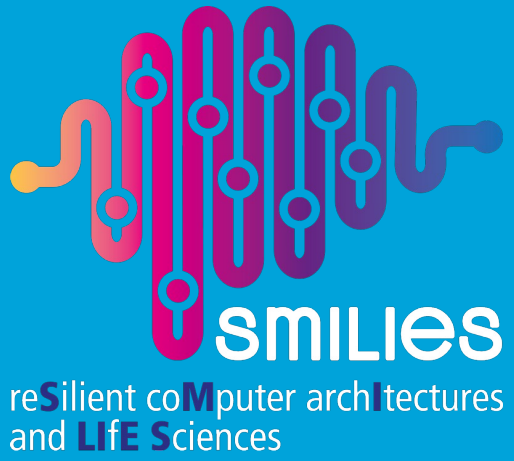


Politecnico di Torino

Department of Control and Computer Engineering

REAL-TIME SCHEDULING

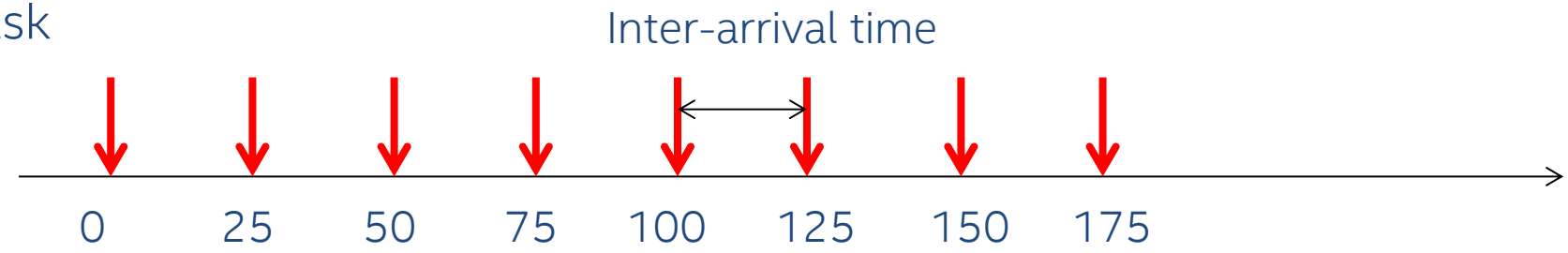
STEFANO DI CARLO

INTRODUCTION

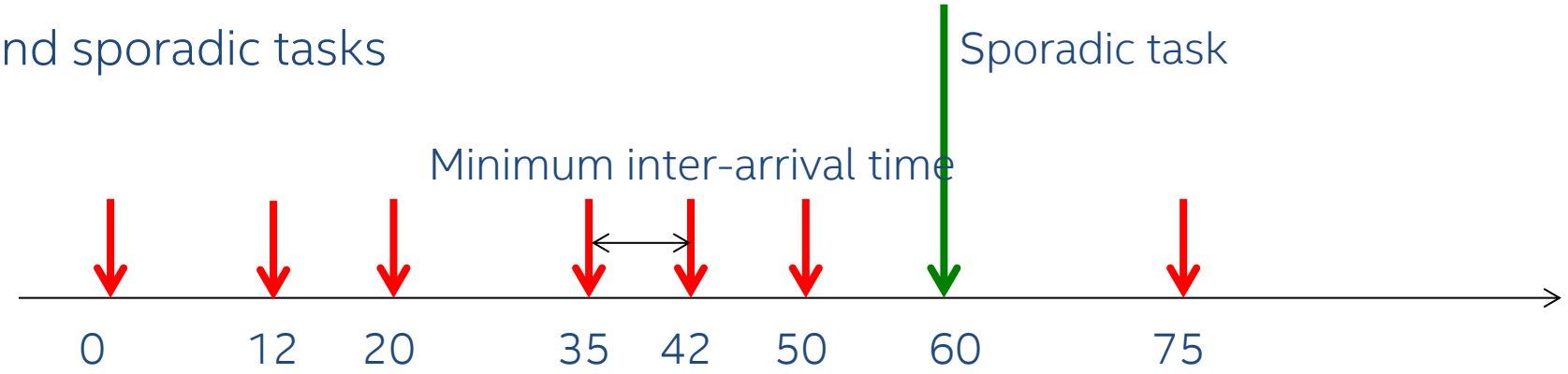
- Tasks can be
  - Periodic: it consists of an infinite sequence of identical activities called instances, or jobs, that are regularly activated, at a constant rate
  - Aperiodic: it consists of an infinite sequence of identical jobs, which are not activated at a regular rate
  - Sporadic: an aperiodic task for which it is not possible to determine a minimum inter-arrival time interval is called a sporadic task

EXAMPLES

- Periodic task

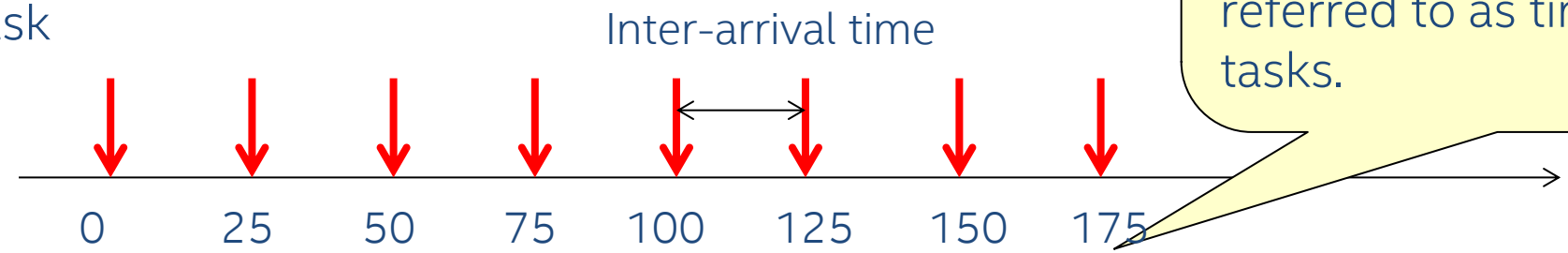


- Aperiodic and sporadic tasks



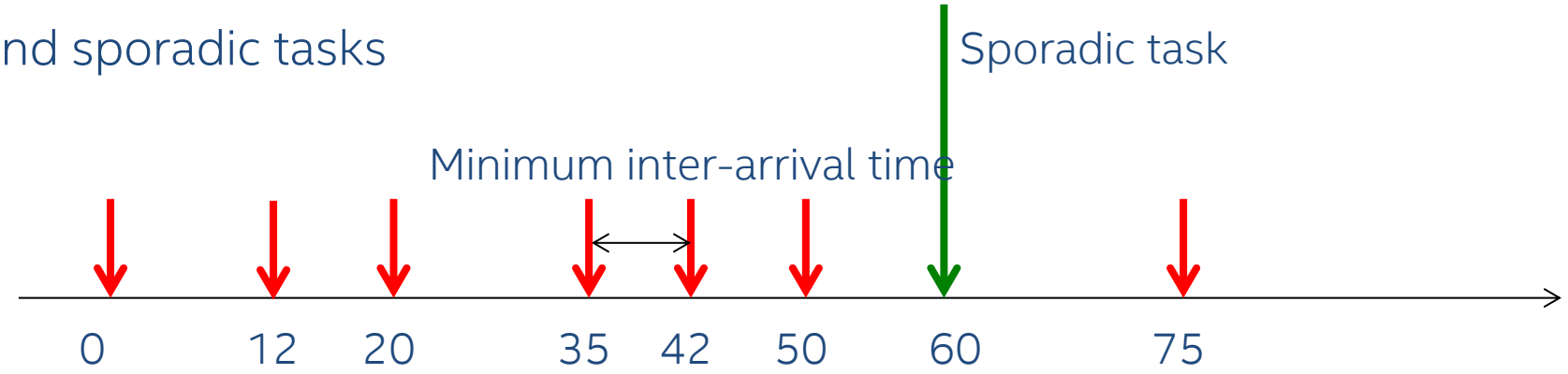
EXAMPLES

- Periodic task



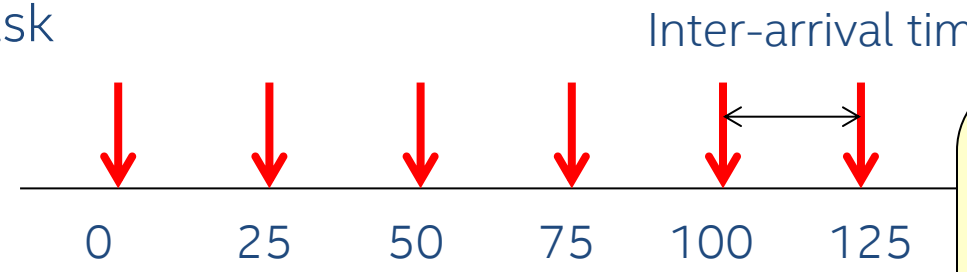
Periodic task: task to measure the in-take air temperature, which runs every 25 msec. Periodic tasks are often referred to as time-based tasks.

- Aperiodic and sporadic tasks

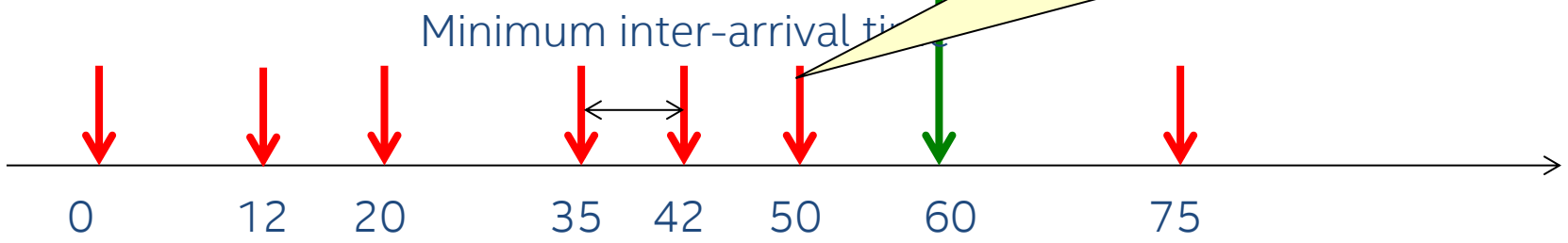


EXAMPLES

- Periodic task



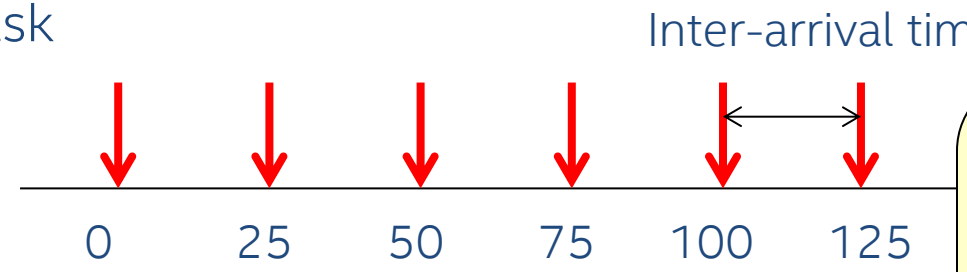
- Aperiodic and sporadic tasks



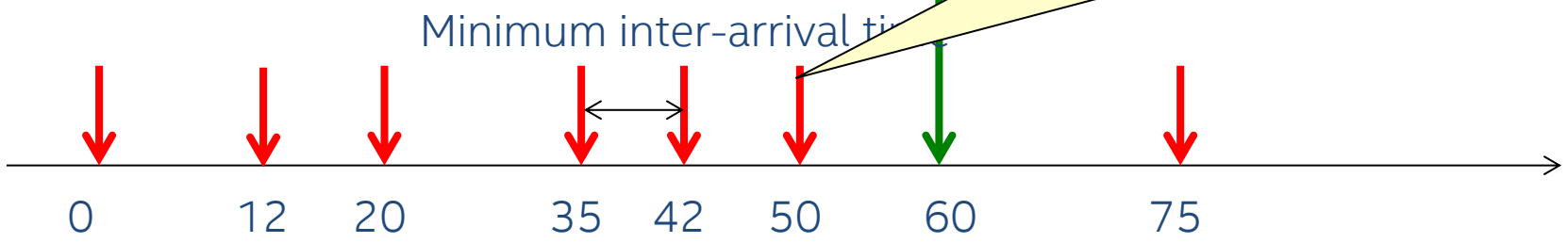
Aperiodic task: task to compute the center of combustion (MFB50), which runs every time the crank shaft turns by 1º.
1000 RPM → 25 msec
4000 RPM → 6,25 msec

EXAMPLES

- Periodic task



- Aperiodic and sporadic tasks



Aperiodic task: task to compute the center of combustion (MFB50), which runs every time the crank shaft turns by 1º.
1000 RPM → 25 msec
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ASSUMPTIONS

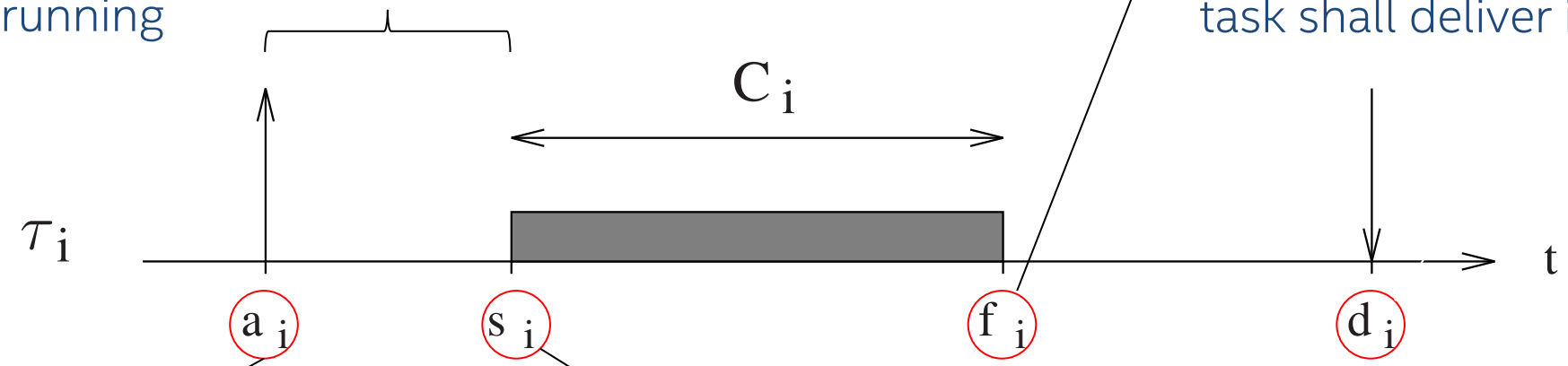
- Fixed number of tasks
- Periodic task with known period
- Independent task
- Hard deadline for each task equal to its period
- Known and fixed worst-case execution time
- All system's overheads, for example context switch times, are negligible

NOTATION

Finishing time = the time when the task actually delivers its outputs

Dispatch latency = time the task spends in the ready queue before running

Deadline time = the time when the task shall deliver its outputs



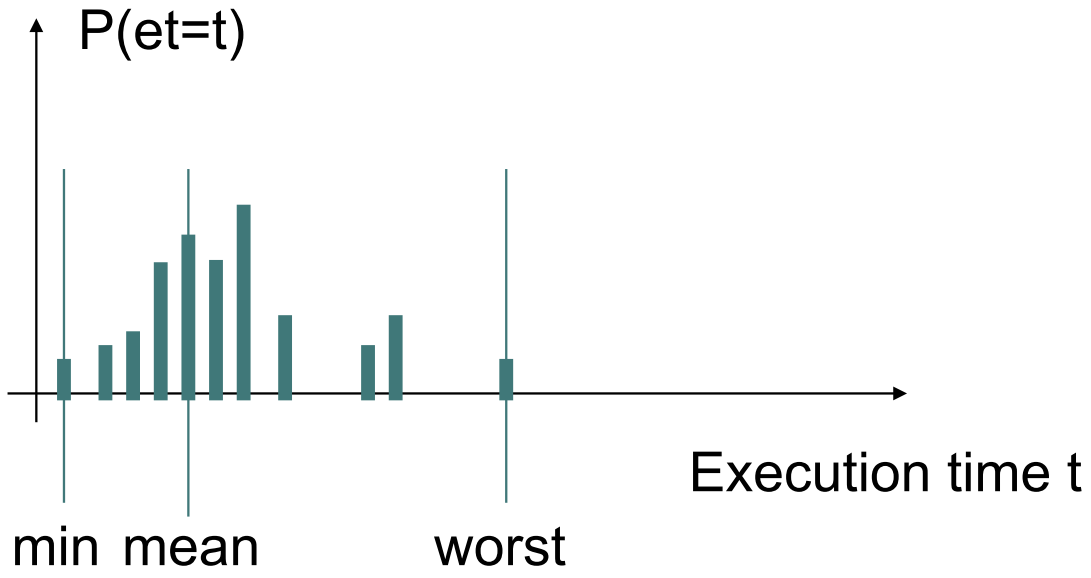
Activation time = the time when the task is needed

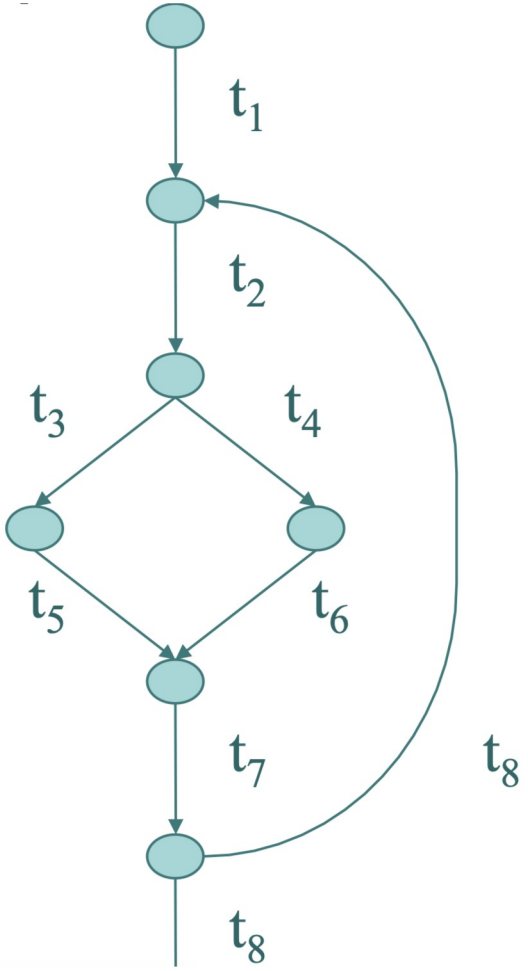
Start time = the time when the task starts running

Note: in general, $f_i \neq s_i + C_i$ due to preemption. Indeed, the task may be interrupted (due to I/Os or higher-priority tasks).

WHY WORST-CASE EXECUTION TIME?

- A task may be composed of different input-dependent execution paths
- Each execution path is composed of different actions, each with its own
- Depending on the input, the task may exhibit different execution times, l highest





NOTATION

- The processor utilization factor U is the fraction of processor time spent in the execution of the n tasks
- $\frac{C_i}{T_i}$ is the fraction of processor time spent in executing task τ_i

$$U = \sum_{i=1}^{n} \frac{C_i}{T_i}$$

- A scheduling is said to be feasible if it satisfies a set of constraints
  - Timing constraints such as activation period, deadline, …
  - Precedence in terms of order of execution of tasks
  - …

EXERCISE

- Given the following task set compute the processor utilization factor U

Task	T [ms]	WCET [ms]
A	4	2
B	8	1
C	12	1

SMILIES
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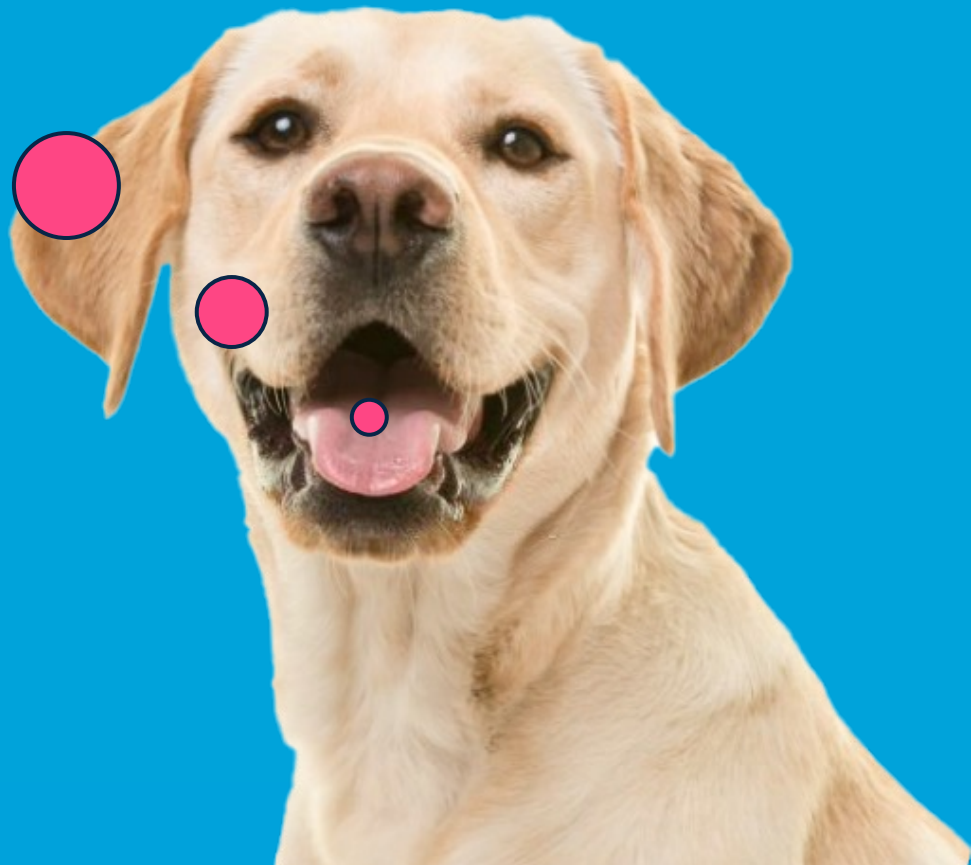
DAUIN

QUESTIONS?



THANK YOU!