

Real Time Systems – SS2016

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Introduction to concurrency and scheduling

- How to divide an application specification into concurrent tasks or processes?

Example: $(a+b)*(a-b) = a*a - b*b$

Sequential:

calculate $c=(a+b)$; calculate $d=(a-b)$; calculate $erg=c*d$

Alternative: calculate $c=(a*a)$; calculate $d=b*b$; calculate $erg=c - d$

Parallel:

	calculate $c=(a+b)$		
			calculate $erg= c - d$
	calculate $d=(a-b)$		

Block design

- Which HW-Block (e.g. Co-processor) or SW-algorithm (executed on a standard processor) should be used for implementation.

Communication design

- Which and how many communication channels are needed between the design blocks?

What are issues with concurrency:

deadlocks

one waits for another

livelocks

one triggers the other (distributed endless loop)

race conditions

the output is dependent on the sequence or
timing of other uncontrollable events

Scheduling = decision how the processes
are assigned to run
on available CPU(s)/Core(s)

Goals of Scheduling:

- Minimizing the average response time:
e.g. interactive systems
- Maximizing throughput: e.g. server
- Maximizing processor load: e.g. super computer
- Fairness: fair utilization of resources
- Compliance with deadlines

Particular Real Time constraints:

- **Deadlines have to be met**
- Tasks have different importance ! no fairness
- Low response time is not enough,
deadline has to be guaranteed
- Other important parameters:
- Period
- Inter task dependencies (task graph)

Schedule can be generated:

Before execution of system: offline-scheduling

- Inflexible (changes)
- Always maximum utilization
- Low costs at execution

During execution of system: online-scheduling

- Flexible (changes)
- Utilization depends on scheduling algorithm
- Higher cost at execution
- Normally priority based

Classification of Real Time scheduling algorithms

1. Point of time

- during execution (online scheduling)
- before execution (offline scheduling)

2. Interruptibility

- Non-interruptible
- Cooperative scheduling
- Preemptive scheduling

3. Time- or event-driven

- Time-driven scheduling
- Event-driven scheduling

Real Time scheduling:

- **Without Priority**
 - FIFO (First in First Out)
 - Round Robin
 - SJF (Shortest Job First)
 - SRT (Shortest Remaining (Execution-)Time)
- **Static Priority**
 - RMS (Rate Monotonic Scheduling)
 - DMS (Deadline Monotonic Scheduling)
- **Dynamic Priority**
 - EDF (Earliest Deadline First)
 - LRT (Latest Release Time)