Scheduling Directed Acyclic Graphs Multiprocessor Systems

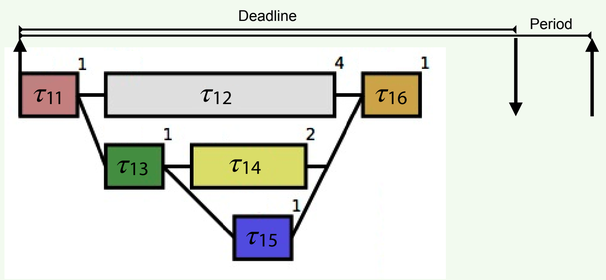
1. Real-time systems

A real-time system is the one that must process information and produce correct results within specified timing constraints, else severe consequences including failure will occur.

Time contraints: deadline, period, release jitters, … .

Applications: avionic and transportation systems, communication services, …

2. Task model: Directed Acyclic Graphs



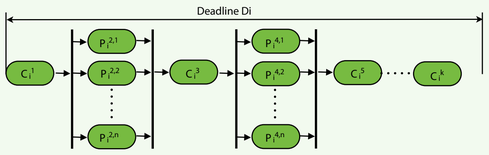
There are two types of parallelism in the DAG model:

- Inter-subtask parallelism between the subtasks because of dependencies.
- Intra-subtask parallelism inside subtasks which consists of parallel threads.

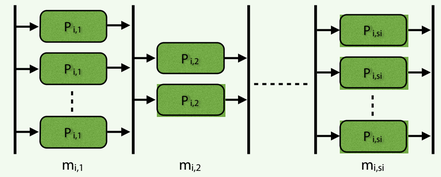
3.1. Scheduling using DAG transformation

Objective: to transform DAG tasks into others models with independent subtasks, in order to use classical scheduling algorithms for independent sequential tasks on multiprocessors, such as DM, EDF, LLF, …

Problem: the transformation uses approximations and it causes some generality loss of the original model.



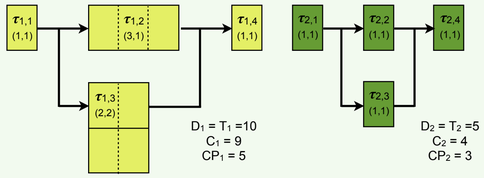
Fork-Join Model



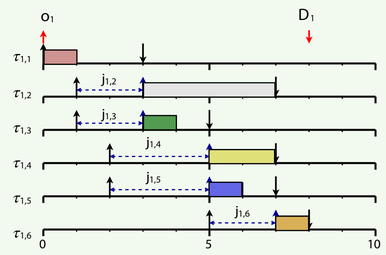
Multi-threaded Segment Model

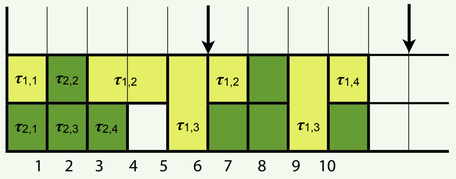
3.2. Direct DAG scheduling

Objective: to schedule DAG tasks directly on multiprocessor systems and propose adapted scheduling algorithms and schedulability tests that take into consideration the subtask dependencies and parallelism.



Problem: adapted algorithms are harder to be analyzed.
Extra local parameters for subtasks are added as shown in the figure.





An example of DAG scheduling using LLF algorithm

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