Mälardalen University

ML Opportunities in Design and Scheduling of Real-Time Systems

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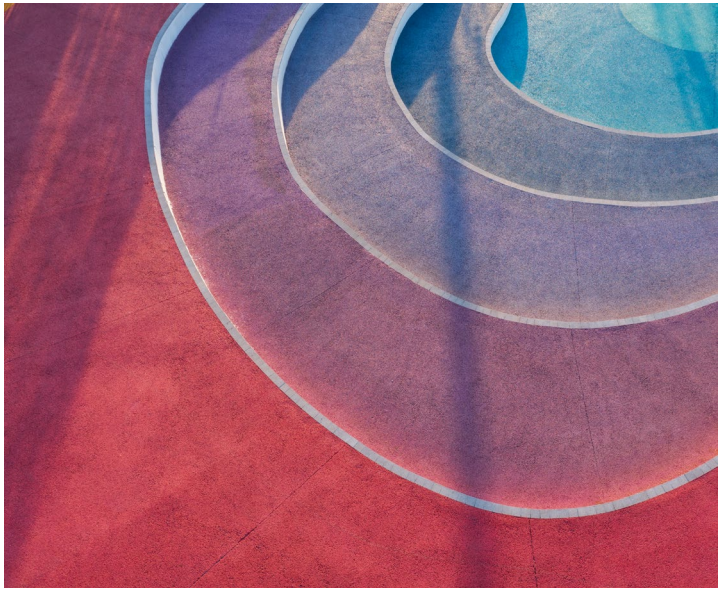
Timing-related guarantees



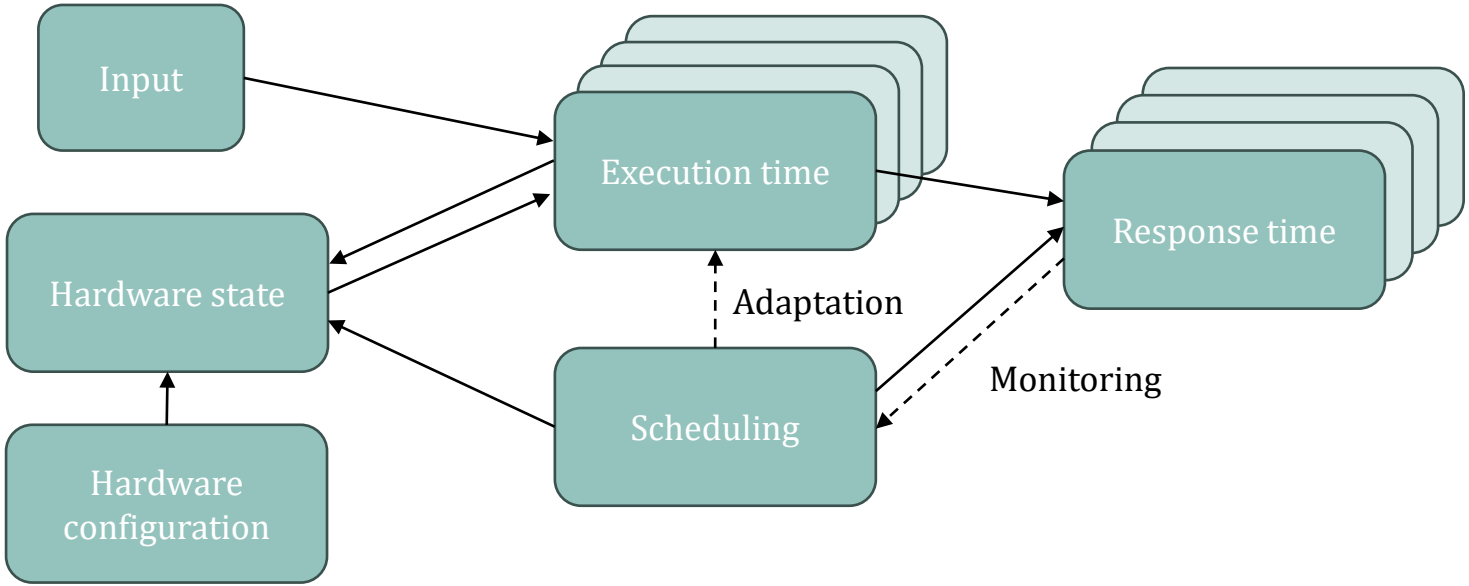
- Probabilistic guarantees
- Weakly-hard guarantees
- Quality of Service (QoS)/ Quality of Control (QoC)
- Data age

- ”Each job must meet its deadline” is often too simplistic

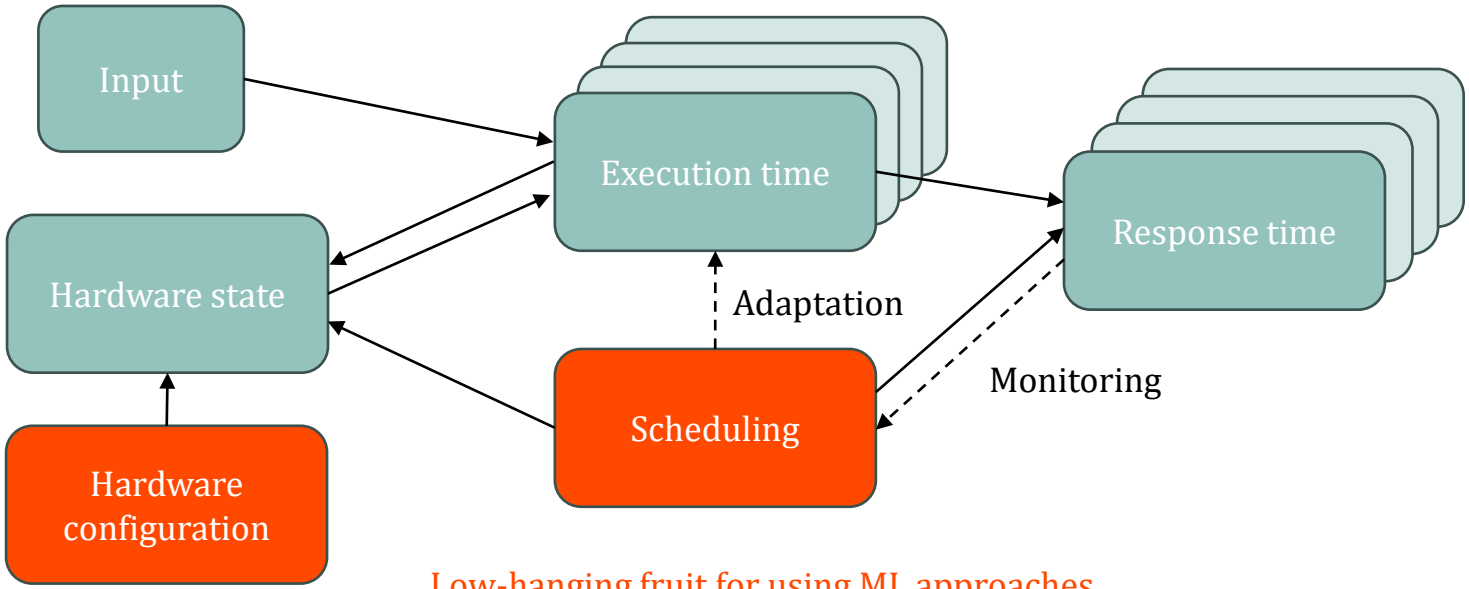
Orthogonal objectives

- Lower cost
- Lower energy consumption
- Better performance
  - QoS
  - QoC
  - Resolution
  - Redundancy
- Design objective
- Runtime objective

Timing behavior and scheduling



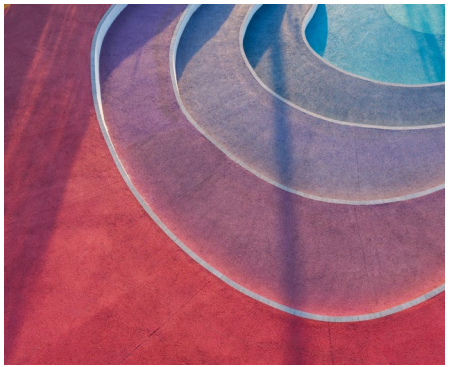
Real-time systems design



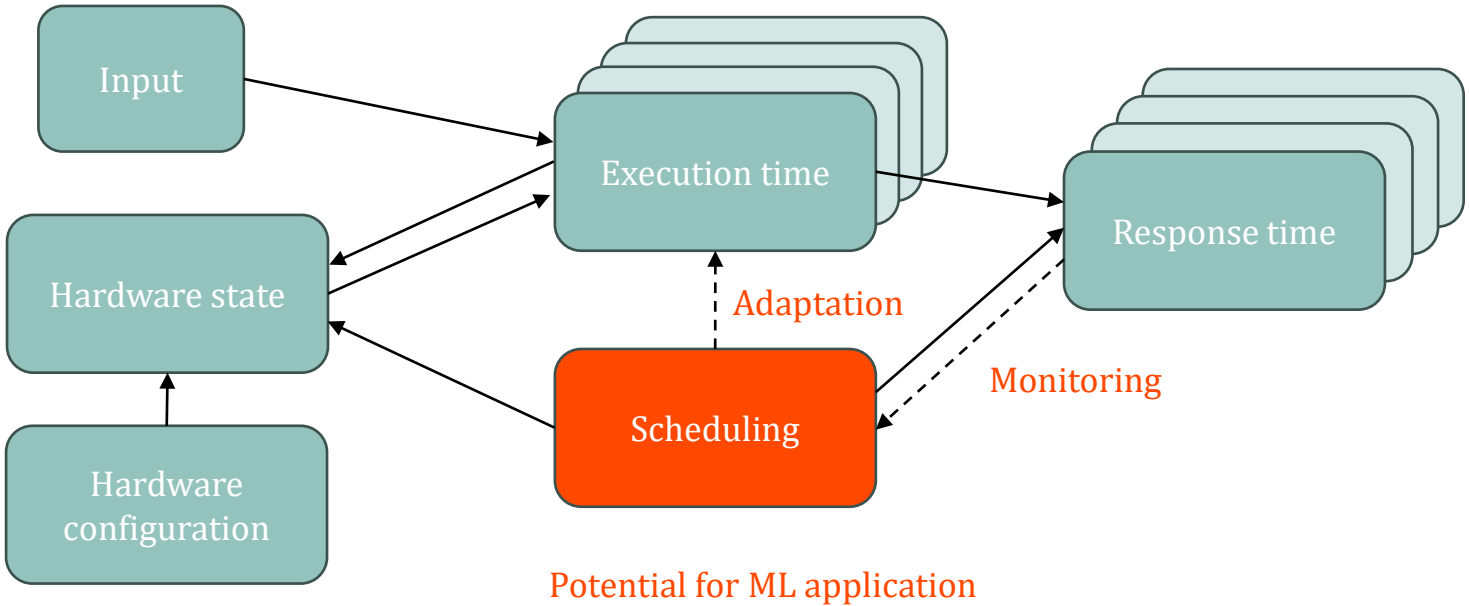
Low-hanging fruit for using ML approaches for HW/ SW codesign

ML for real-time systems design

- ML approaches can help in HW/ SW codesign
  - Respect timing-related constraints
  - Optimize with regard to orthogonal objectives
- At design time we can use the full ML toolbox and validate the system
- Need data/ simulation for training



Adaptive scheduling

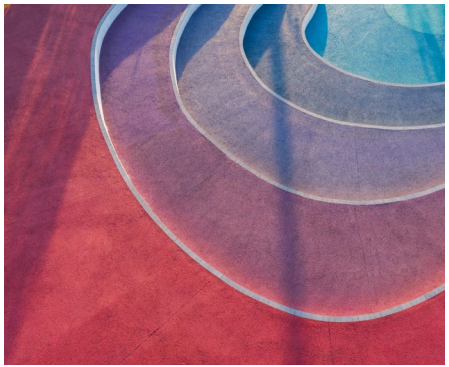


Adaptive scheduling and games

- The scheduling decisions at one point in time affect the schedulability at future time steps.
- In this way, scheduling is analogous to playing a game – each decision affects the future options.
- Guarantees! May not be allowed to lose the game.

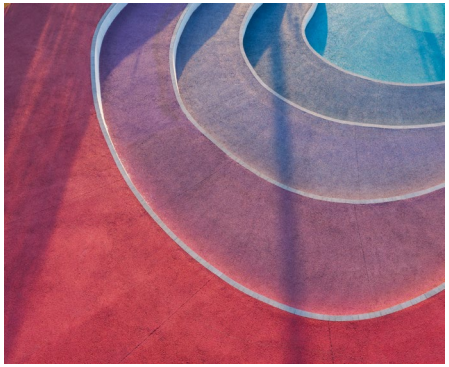
ML for adaptive scheduling

- ML approaches can help to monitor execution modes, and make appropriate scheduling choices/ adaptation of QoS
- Many ML approaches are black-box, not sufficiently explainable



ML for adaptive scheduling

- Use ML approaches for better performance/ lower energy consumption while fulfilling timing-related guarantees in other ways.
- Use explainable options
- Detect out-of-bounds choices and have a low QoS fallback



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