Design of Parallel and High-Performance Computing

Fall 2016
Lecture: Amdahl's Law

Instructor: Torsten Hoefler & Markus Püschel
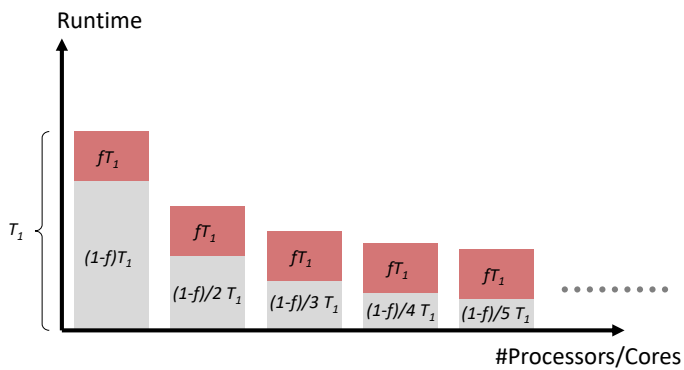**TA:** Salvatore Girolamo

ETH
Eidgenössische Technische Hochschule Zürich
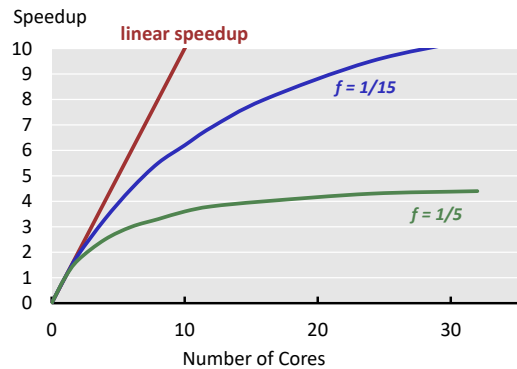Swiss Federal Institute of Technology Zurich

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Overview

- **Plots related to Amdahl's Law and variants**
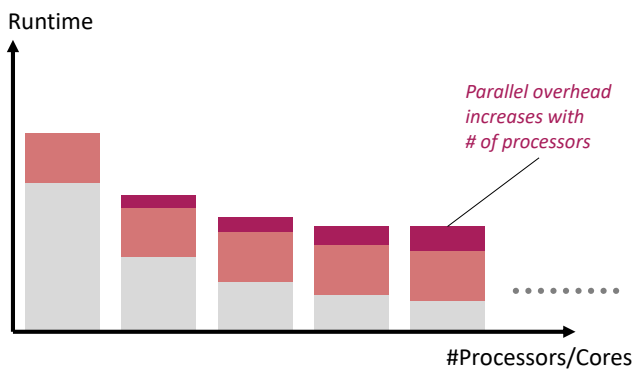- **See associated notes on course website**

Amdahl's Law: Runtime

Runtime

T_1

fT_1
$(1-f)T_1$

fT_1
$(1-f)/2\ T_1$

fT_1
$(1-f)/3\ T_1$

fT_1
$(1-f)/4\ T_1$

fT_1
$(1-f)/5\ T_1$

#Processors/Cores

Amdahl's Law: Speedup

Speedup

linear speedup

$f = 1/15$

$f = 1/5$

Number of Cores

Runtime With Parallel Overhead

Runtime

Parallel overhead increases with # of processors

#Processors/Cores
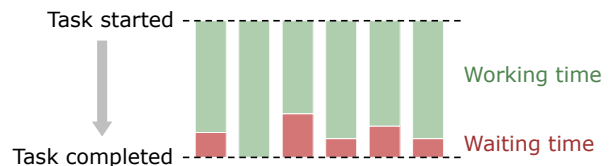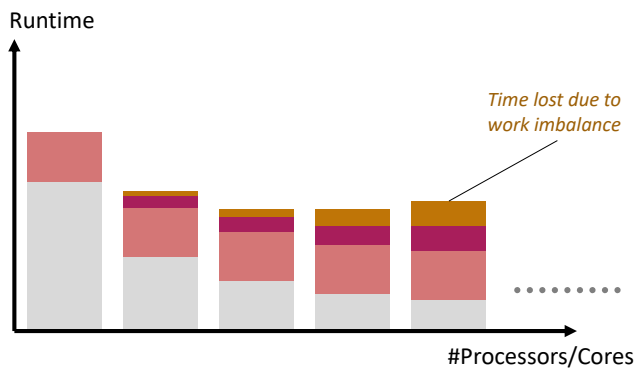

Other Issue: Load Balancing

- **Amdahl's Law assumes that the computation divides evenly among the processors**
- **Processor waiting time is another form of overhead**

Task started

Task completed

Working time

Waiting time

Runtime With Parallel Overhead And Work Imbalance

Runtime

Time lost due to work imbalance

#Processors/Cores

Real Speedup Graphs Look Often Like This

linear speedup

Speedup

Number of Processors