



# Performance Engineering

## Assignment 2: Analytical Modeling and Microbenchmarking

In this assignment we focus on analytical modeling and microbenchmarking.

### Assignment 2.1: Analytical modeling: Matrix Multiplication (2p)

For your best sequential version and one of your parallel implementations (either for the multi-core CPU or for the GPU), build an analytical performance model, aiming to predict the performance of matrix multiplication for an arbitrary matrix size. Clearly identify the parameters of the model. Leave the model in its symbolic form. *Note: If you build analytical models for both your parallel implementations (multi-core CPUs and GPU), you get a bonus of 1p.*

### Assignment 2.2: Calibration and validation: Matrix Multiplication model (2p)

Calibrate your matrix multiplication models through microbenchmarking. You are allowed to use existing microbenchmarks (examples on Canvas - see "Files") or build your own (ideally, this choice depends on the parameters of your model). Please use (at least) the same provided matrices to validate the accuracy of your models. How do they compare to the models from assignment 1? Where are the differences coming from? *Note: If you calibrate both your CPU and GPU models you get a bonus of 1p.*

### Assignment 2.3: Analytical modeling: Histogram (2p)

Build *\*two\** parallel solution for calculating the histogram of a gray-scale image represented as an array of integer numbers (0-255). Target either a multi-core CPU or a GPU. Build analytical models for these implementations (but leave them in symbolic form). Clearly identify the parameters of the models. Can you already determine which one is the fastest implementation? *Note: If you build analytical models for both the multi-core CPU and the GPU, you get a bonus of 1p.*

### Assignment 2.4: Calibration and validation: Histogram model (2p)

Use (and extend, if needed), your microbenchmarking suite to calibrate your models for the parallel histogram. Validate the models empirically and discuss their accuracy. *Note: If you calibrate both your CPU and GPU models you get a bonus of 1p.*

### Assignment 2.5: Reflection on analytical modeling (1p)

Based on the several analytical models you developed, discuss the advantages and limitations of analytical modeling.

**Submission due date: May 6th, 2022, 20:00**