

VIENNA UNIVERSITY OF TECHNOLOGY

184.725 HIGH PERFORMANCE COMPUTING

TU WIEN INFORMATICS

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## Exercise 2

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*Authors:*

Camilo TELLO FACHIN  
12127084

*Supervisor:*

Prof. Dr. Jesper Larsson TRÄFF

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TECHNISCHE  
UNIVERSITÄT  
WIEN

Vienna University of Technology

## Abstract

Here documented the results of exercise 2, the Programming part of High Performance Computing. A presentation for Marco Schmid MSc.

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## 1 Exercise 1 - Implement A Benchmark Framework

### 1.1 $\sum_{i=0}^d k^i$ for $k > 0$ (Ex1.1)

$$\begin{aligned} \sum_{i=0}^d k^i &= \sum_{i=0}^d k^i \\ \sum_{i=0}^d k^i - k \sum_{i=0}^d k^i &= \sum_{i=0}^d k^i - k \sum_{i=0}^d k^i \\ \sum_{i=0}^d k^i - k \sum_{i=0}^d k^i &= \sum_{i=0}^d k^i - \sum_{i=1}^{d+1} k^i \\ \sum_{i=0}^d k^i (1 - k) &= 1 - k^{d+1} \\ \sum_{i=0}^d k^i &= \frac{k^{d+1} - 1}{k - 1} \end{aligned} \tag{1}$$

## 2 Exercise 2 - Implement Linear Pipeline for MPI\_Bcast and MPI\_Reduce

Text for Ex2.

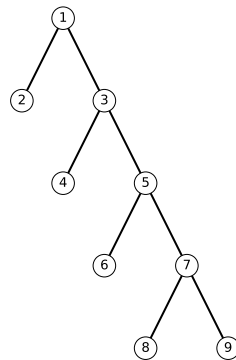


Figure 1: Complete (but unbalanced) binary tree of height  $d = 4$  with  $p = 9$  nodes.

### 3 Exercise 3 - Combining MPI Processes

Text for Ex3.

## 4 Exercise 4 - Binary Tree Algorithms for MPI\_Bcast and MPI\_Reduce

Text for Ex4.

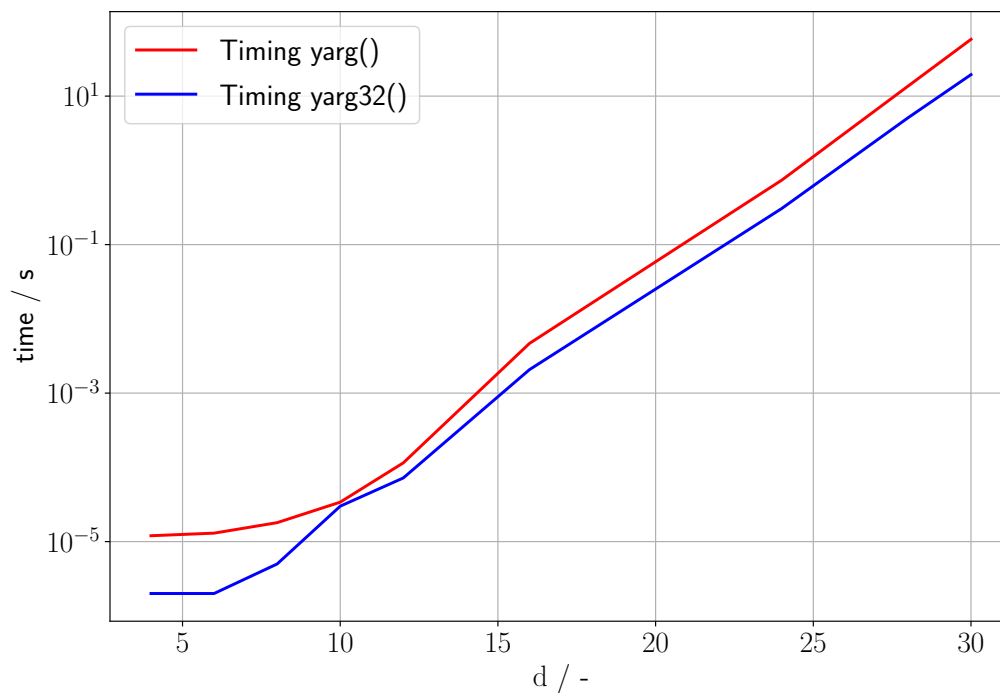


Figure 2: Benchmark both algorithms - `yarg32()` is faster than `yarg()` for all feasible values of  $d$

## 5 Exercise 5 - Integrated, Improved Binary Tree Algorithm

Text for Ex5.

$$\begin{aligned}
 \sum_{i=0}^d k^i &= \sum_{i=0}^d k^i \\
 \sum_{i=0}^d k^i - k \sum_{i=0}^d k^i &= \sum_{i=0}^d k^i - k \sum_{i=0}^d k^i \\
 \sum_{i=0}^d k^i - k \sum_{i=0}^d k^i &= \sum_{i=0}^d k^i - \sum_{i=1}^{d+1} k^i \\
 \sum_{i=0}^d k^i (1 - k) &= 1 - k^{d+1} \\
 \sum_{i=0}^d k^i &= \frac{k^{d+1} - 1}{k - 1}
 \end{aligned} \tag{2}$$



## 6 Exercise 6 - Improvement with Sibling Leave Communication (BONUS)

Text for Ex6.

## 7 Exercise 7 - Implementation and Benchmarking of Improved Version (BONUS)

Text for Ex7.