Design of Parallel and High Performance Computing
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Homework 7

Broadcast in the $\alpha\beta$ model

Task 1

The time taken to send a message of size s from one process to another is $T(s) = \alpha + s\beta$. In the $\alpha\beta$ model, if a process sends a message of size s at the time t it cannot send another message before $t + T(s)$. In the lecture we have seen the analysis of a broadcast over a binary and a binomial tree. However, we can also define a k-ary as well as a k-nomial tree broadcast.

In a k-ary tree broadcast every node forwards the received message to k children. A k-nomial tree is produced by forwarding the message to $k - 1$ children every round, until all processes are reached.

- What is the runtime of a k-ary tree broadcast in the $\alpha\beta$ model if we assume small messages, i.e., $s = 1$?

In a binomial tree (k=2), at every step each process that already received the data sends it to another process that did not receive it yet. In general, in a k-nomial tree, each process sends to $k - 1$ other processes at each step.

- What is the runtime of a k-nomial tree broadcast in the $\alpha\beta$ model if we assume small messages, i.e., $s = 1$?

Task 2

Assume P processors perform a broadcast operation by sending data in a ring (processor i receives from $(i-1+P) \mod P$ and sends to $(i + 1)modP$). Give a closed-form expression for the runtime of the broadcast in the $\alpha\beta$ model. Assume the data is of size m.