**并行与分布式计算导论 作业 4**

**PDC 2024s Homework 4**

**截止期限 2024 年 4 月 30 日 23:59**

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1. 回顾MPI的通信机制，根据假定的拓扑结构写出如下Collective Communication的伪代码。

Write the pseudo code for collective communication for MPI on given network topology.

a. 二叉树型网络的 One-to-all Broadcast.

One-to-all Broadcast on a Balanced Binary Tree network.

b. 超立方体型网络的 All-to-all Reduction.

All-to-all Reduction on a Hypercube network.

c. 环形网络的 Scatter.

Scatter on a Ring network.

2.考虑简化的通信开销模型，包括setup time ts和 pre-word transfer time tw, 计算 All-to-all Reduction 操作在超立方体型网络和二维网格型网络的通信开销。

Consider a simplified cost model of communication cost in parallel system, which includes setup time ts and pre-word transfer time tw. Calculate the cost of All-to-all reduction cost on Hypercube and 2-D Mesh networks.

3.假设有个大小为 n 的问题，它的串行实现需要 𝑂(𝑛𝑙𝑜𝑔𝑛) 内存以及 𝑂(𝑛2) 时间。使用 p 个处理器，我们可以设计出两种 MPI 的实现。第一个实现的计算复杂度为 𝑂(𝑛2/𝑝)、通信复杂度为 𝑂(𝑝𝑛)。第二个实现的计算复杂度为 𝑂(𝑛2/𝑝) 、通信复杂度为 𝑂(𝑛) ，但有一个需要每个进程串行计算的部分，计算复杂度为 𝑂(𝑛/𝑝)。(假设计算和通信的时间不能重叠，复杂度为假设值，不一定有对应实际应用)。

Assuming a problem with size n needs 𝑂(𝑛𝑙𝑜𝑔𝑛) memory and 𝑂(𝑛2) in sequential algorithm. We have two algorithms to parallel them with p processors in MPI. The first one takes 𝑂(𝑛2/𝑝) calculation and 𝑂(𝑝𝑛) for communication. The second one needs 𝑂(𝑛2/𝑝) calculation and 𝑂(𝑛) communication but with a serial part which needs 𝑂(𝑛/𝑝) calculation.

a. 请计算两种实现的等效率关系

calculate the iso-efficiency relations for these two implementations.

b. 请计算两种实现的可扩展函数

calculate the scalability functions for these two implementations.