Programação Paralela e o Modelo Mestre-Escravo

Trabalho 1 - Programação Paralela e Distribuída

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*Abstract*—This paper presents the implementation of a parallel algorithm using the master-slave paradigm and the MPI libraries. It also compares the performance of algorithm when modifing the number of processes used to execute.

Keywords—Parallel Programming; MPI; Distributed Programming, Master-Slave Paradigm;

# Introdução

A construção de sistemas atuais se baseia em diferentes frentes. Dentre elas estão aspectos econômicos, legais e performáticos. Esta última, especificamente, é bastante relevante e é alvo de diversos estudos. Uma das alternativas que visa o aumento de desempenho é a aplicação de um modelo de programação paralela, que objetiva a realização de tarefas através de múltiplos processos executando em múltiplos processadores. Cabe ressaltar que o paradigma paralelo pode ser utilizado em sistemas com um único processador, contudo a execução das tarefas torna-se concorrente e o paralelismo é apenas aparente.

# Funcionamento

## Algoritmo

A fim de garantir a fidelidade dos resultados e visando medir o ganho de performance da mudança de paradigma exclusivamente, o algoritmo utilizado foi o Rank Sort. Este algoritmo é um algoritmo de ordenação de vetor e caracteriza-se por ter uma performance de ordem quadrática (O(n²)).

## Paradigma Paralelo

A programação paralela pode ser realizada de muitas formas. Especificamente à esse trabalho, usou-se o paradigma mestre-escravo. O modelo especifica uma hierarquia entre os processos de maneira que exista um processo “mestre” e diversos processos “escravos”. O processo “mestre” fica responsável pela divisão da tarefa total em sub-tarefas, pela distribuição das mesmas entre os processos “escravos” e pela integração dos resultados provenientes dos escravos. Aos processos escravos cabe realizar as sub-tarefas e, ao finalizarem-las, enviar as sub-tarefas completas ao mestre.

# Implementação

O trabalho foi desenvolvido em ambiente Linux e implementado em linguagem C, utilizando a biblioteca MPI para a distribuição dos processos e a criação das comunicações necessárias.

O programa implementado realiza a ordenação, em ordem crescente, de um vetor, este que é populado com valores contidos em um arquivo, o caminho deste arquivo deve ser passado por parametro, juntamente com o tamanho desejado para o vetor, além do parâmetro ‘np’ utilizado pela biblioteca MPI, este que informa o numero de processos que serão uitlizados para a realização da tarefa.

Caso o valor ‘np’ seja igual a um, o programa irá executar sua versão sequencial, caso contrário, será criado um processo mestre, que nesta implementação, é o processo cujo rank é igual a zero, os demais processos criados serão os escravos.

O processo mestre é encarregado de separar o vetor em diversas partes e entrega-las aos escravos, estes que serão encarregados de realizar a ordenação da parte que lhes foi recebida.

O número de partes em que o vetor será dividido é definido pela equação:

n° de partes = tamanho do vetor / n° de processos \* 4

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1. G. Eason, B. Noble, and I.N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

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