A Single Program Multiple Data Algorithm for Feature Selection

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Agenda

- Introduction
- mRMR Feature Selection Technique
- A Data Parallel Approach to mRMR Feature Selection
- Results
- Conclusion

Introduction

Feature Selection is the process of selecting a subset of crucial features from a given set of features, for efficient model construction.

Below are few types of feature selection techniques:

- ❏ Filter
- ❏ Wrapper
- ❏ Embedded

mRMR Feature Selection Techniques

The mRMR (**m**inimum **R**edundancy **M**aximum **R**elevance) procedure, proposed by Peng et al. [1], is an algorithm to perform feature selection by trading-off between *relevance* and *redundancy* (by taking the ratio).

Below are few earlier approaches to improve mRMR:

- ❏ Distributed version using Scala [Gellego et al., 2017]
- ❏ MapReduce [Reggiani et al., 2017]
- ❏ Artificial Bee Colony [Alshamlan et al., 2015]
- ❏ Task parallel approach [LeKhac et al., 2013]

A Data Parallel Approach to mRMR Feature Selection

To overcome the dependency on distributed systems for effective modeling and subset selection, we propose a **data parallel approach** for mRMR feature selection.

- Initialize an empty set denoting the set of features selected
- Pre-calculate the relevance of each feature with the class (can be done in parallel in the number of features is large)
- Select the feature that has highest relevance with the class
- Calculate in parallel the redundancy of each feature with this newly added feature

A Data Parallel Approach to mRMR Feature Selection
(contd.)

- Select the feature that has the highest relevance with the class and minimum redundancy with the selected feature (done in parallel)
- Repeat the above step in parallel to select the features
- When a feature is selected, calculate redundancies of all other features with this feature

If N denotes the total number of features in the dataset:

Space Complexity : $O(N^2)$ Time Complexity : $O(N^2)$

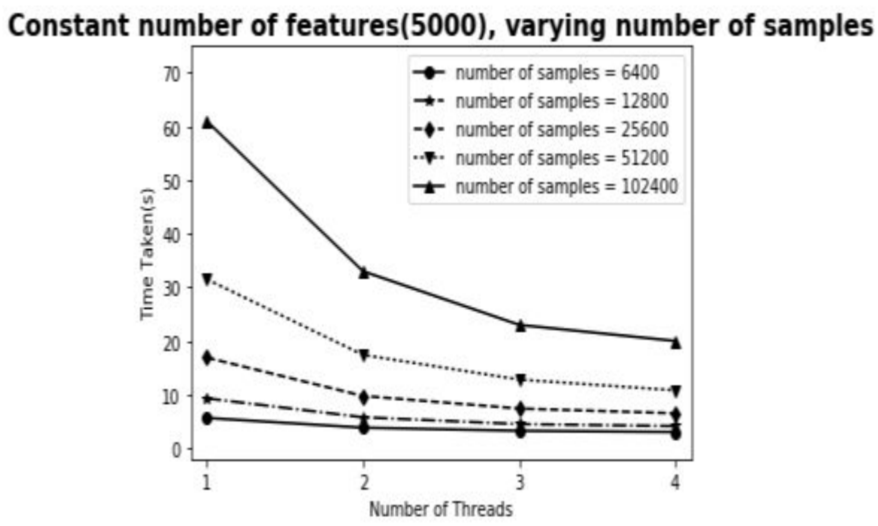
Results

Speed-up: Ratio of sequential execution time and parallel execution time

$$S = \frac{T_{sequential}}{T_{parallel}}$$

Performance Scalability on Number of Samples

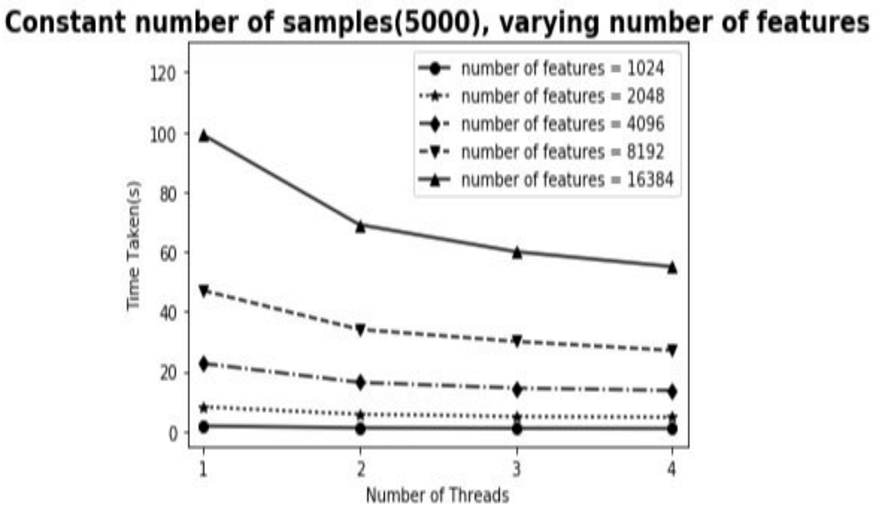
With increasing number of samples, the speed-up obtained with increasing number of threads is more



Results (contd.)

Performance Scalability on Number of Features

With increasing number of features, the speed-up obtained with increasing number of threads is more



Conclusion

- The time complexity has been reduced from cubic to quadratic
- The effect of parallelization is more pronounced for larger, higher dimensional datasets

In the future, approaches to reduce the space complexity will be explored

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