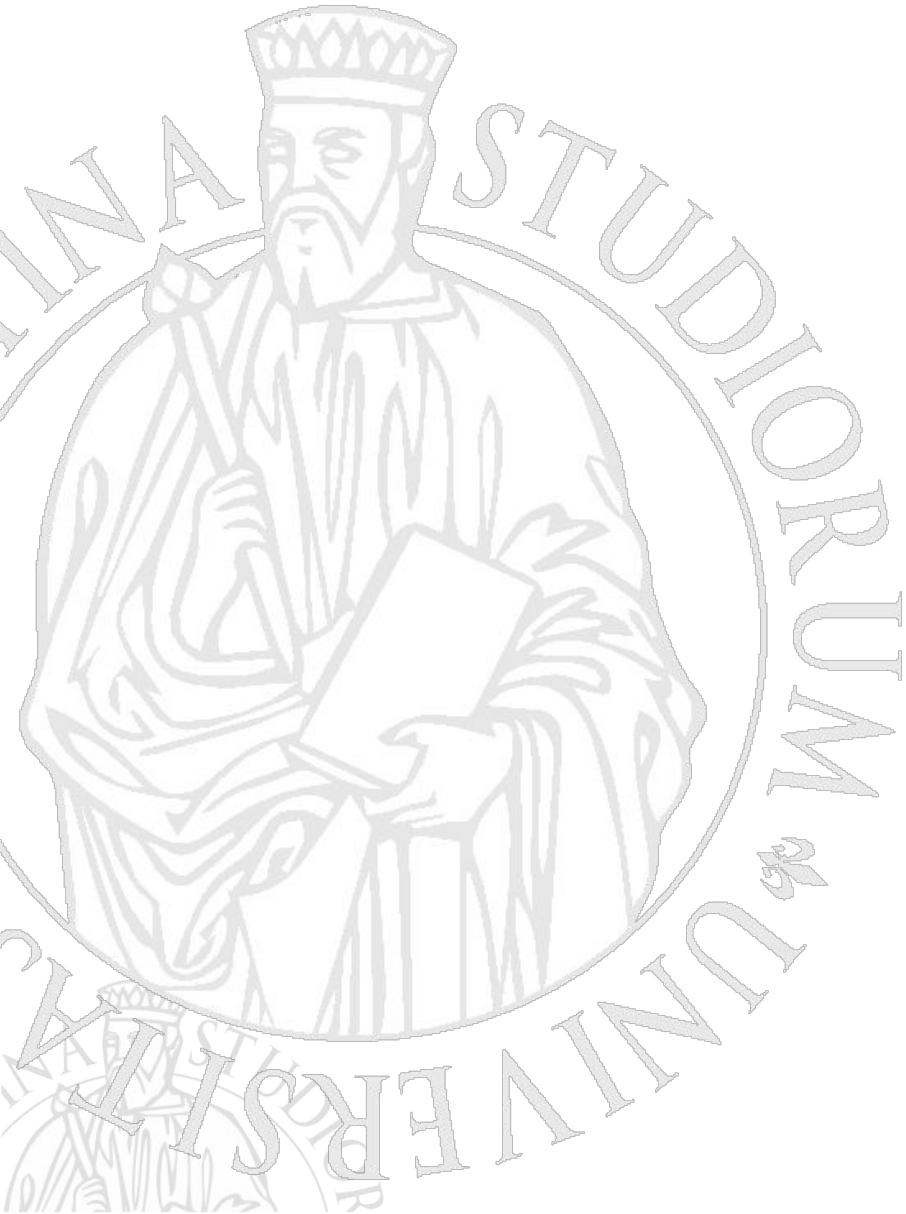
UNIVERSITÀ DEGLI STUDI FIRENZE
DIEF
Dipartimento di Ingegneria Industriale



Bigram/Trigram Generation

Parallel Computing Course

Antonio Castellucci
Michela Crulli

Overview

1. Introduction
   - What are n-grams
   - What we have done
   - Hadoop & Amazon Web Service (AWS)
2. Dataset
3. Implementation
   - Sequential implementation
   - Parallel implementation
   - Distributed implementation
4. Results
   - Test platform
     - Parallel implementation setup
     - AWS
   - Tests
5. Conclusions

Introduction

In this project, we realize a program which generates **bigrams** and **trigrams** with three different approaches:

- a **sequential** implementation (Java)
- a **parallel** implementation (Java threads)
- a **distributed** implementation (Hadoop)

Introduction

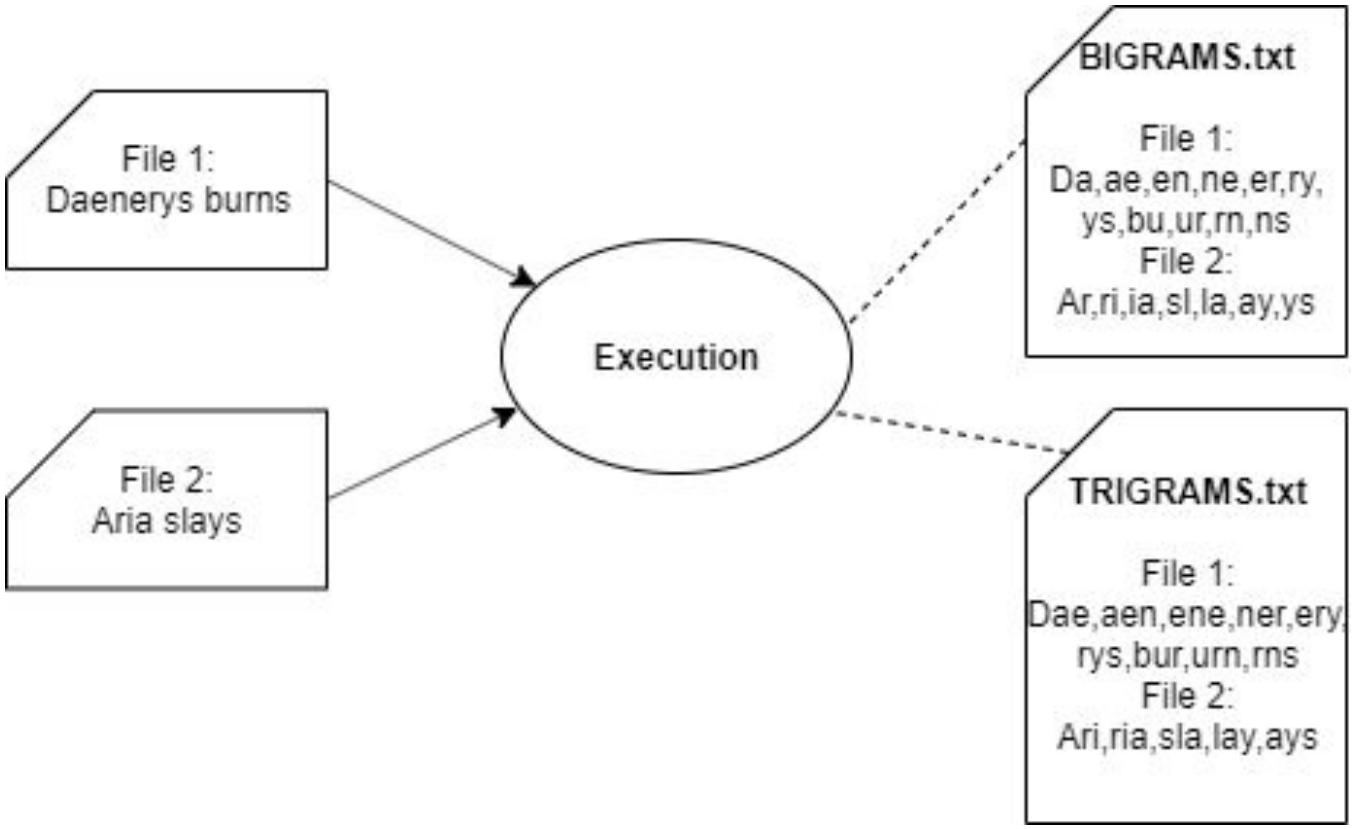
- What are n-grams?

  An n-gram is a **contiguos sequence** of n items (letters, words, syllables or phonemes) from a given text or speech

- Why?
  - make new **word predictions**
  - make **spelling error corrections**

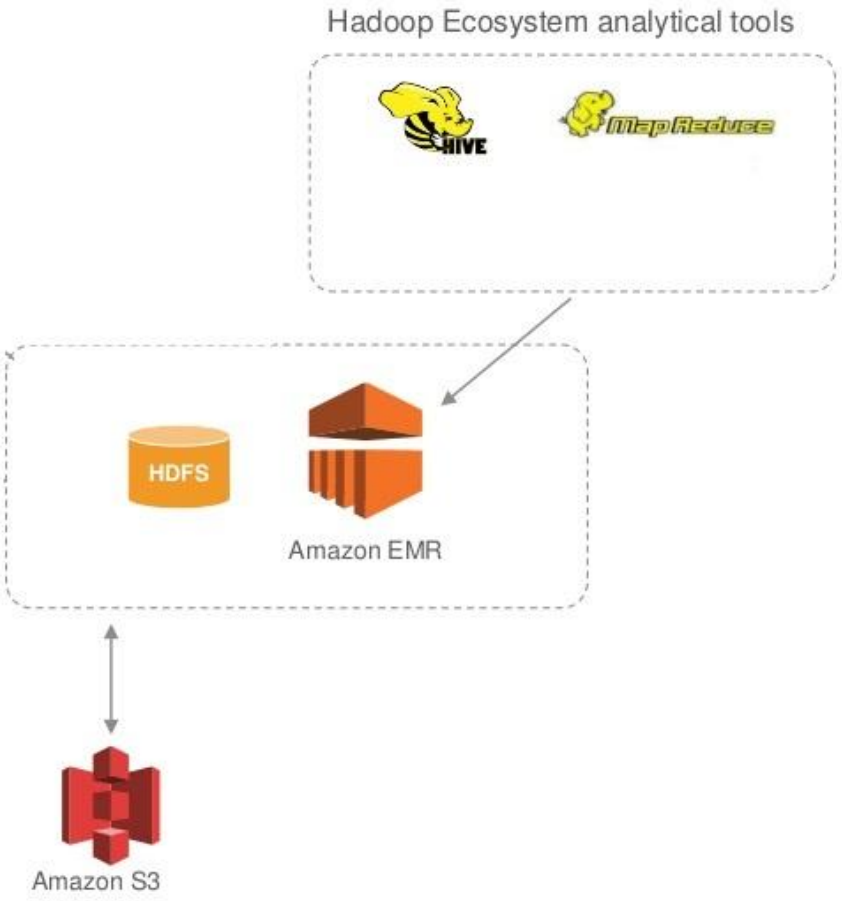
Introduction

- Input output structure



Introduction

- Hadoop & Amazon Web Service (AWS)



amazon web services

Dataset

We use:

- a collection of **3000 books** (1.1 GB,from Gutemberg's Project) and on the collection's subsets:
  - **2000** (abt 800 megabyte)
  - **1000** (abt 400 megabyte)
  - **500** (abt 80 megabyte)
  - **150** (abt 50 megabyte)
  - **100** (abt 40 megabyte)
  - **50** (abt 20 megabyte)

The size of each book is about **360 KB**

Implementation

- Sequential implementation

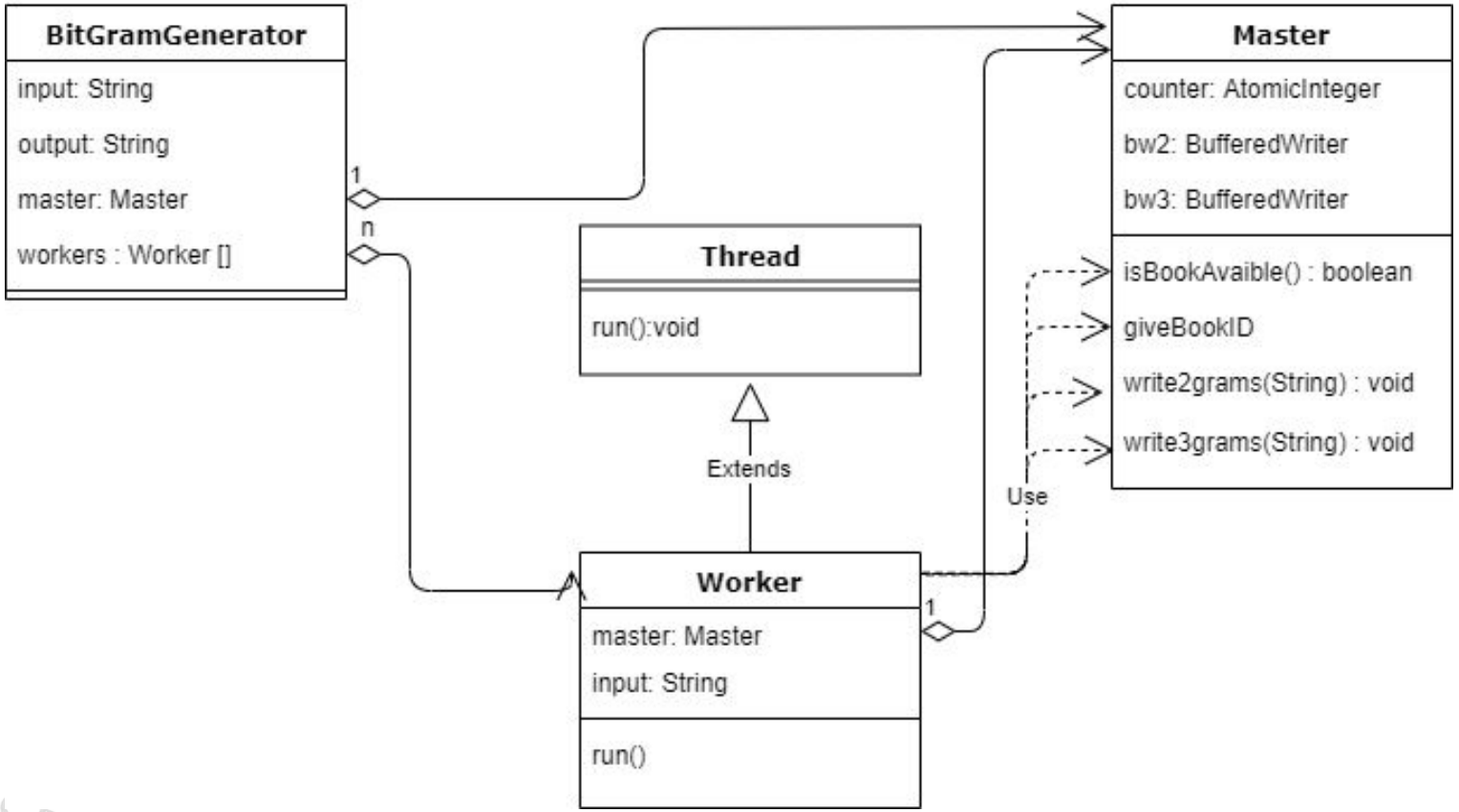
Algorithm 1

Input: dataset (folder with books) **Output:** bigram.txt and trigram.txt

```
for book in dataset
    for line in book
        tmp ← lineWithoutSpace
        for i = 0 to tmp.length
            ngrams2.append(j + 2).append(",")
            ngrams3.append(j + 3).append(",")
        end for
    end for
    write ngrams2 on ngrams2.txt
    write ngrams3 on ngrams3.txt
end for
```

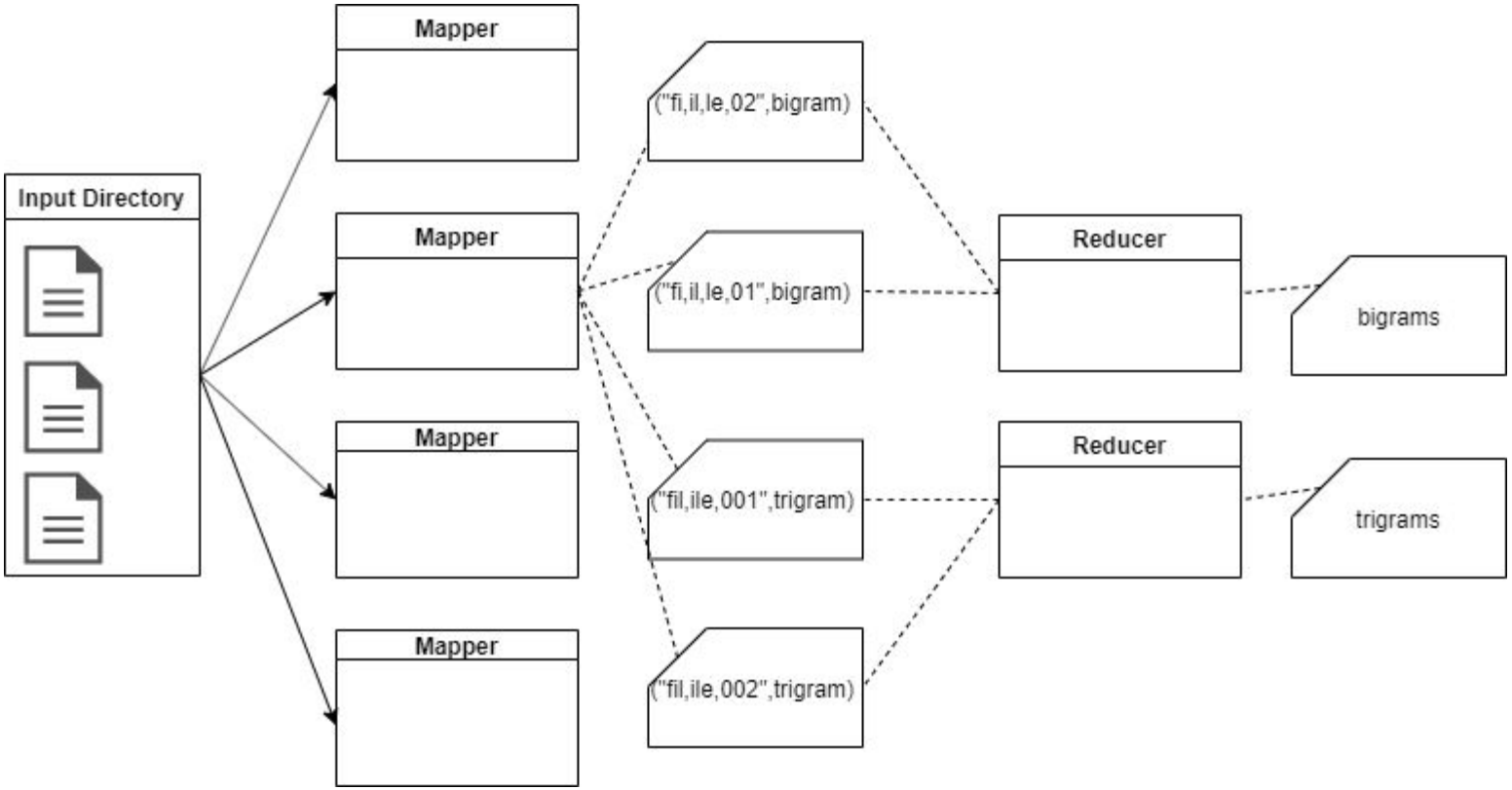
Implementation

- Parallel implementation



Implementation

- Hadoop implementation



Test platform

MSI GS65 with:

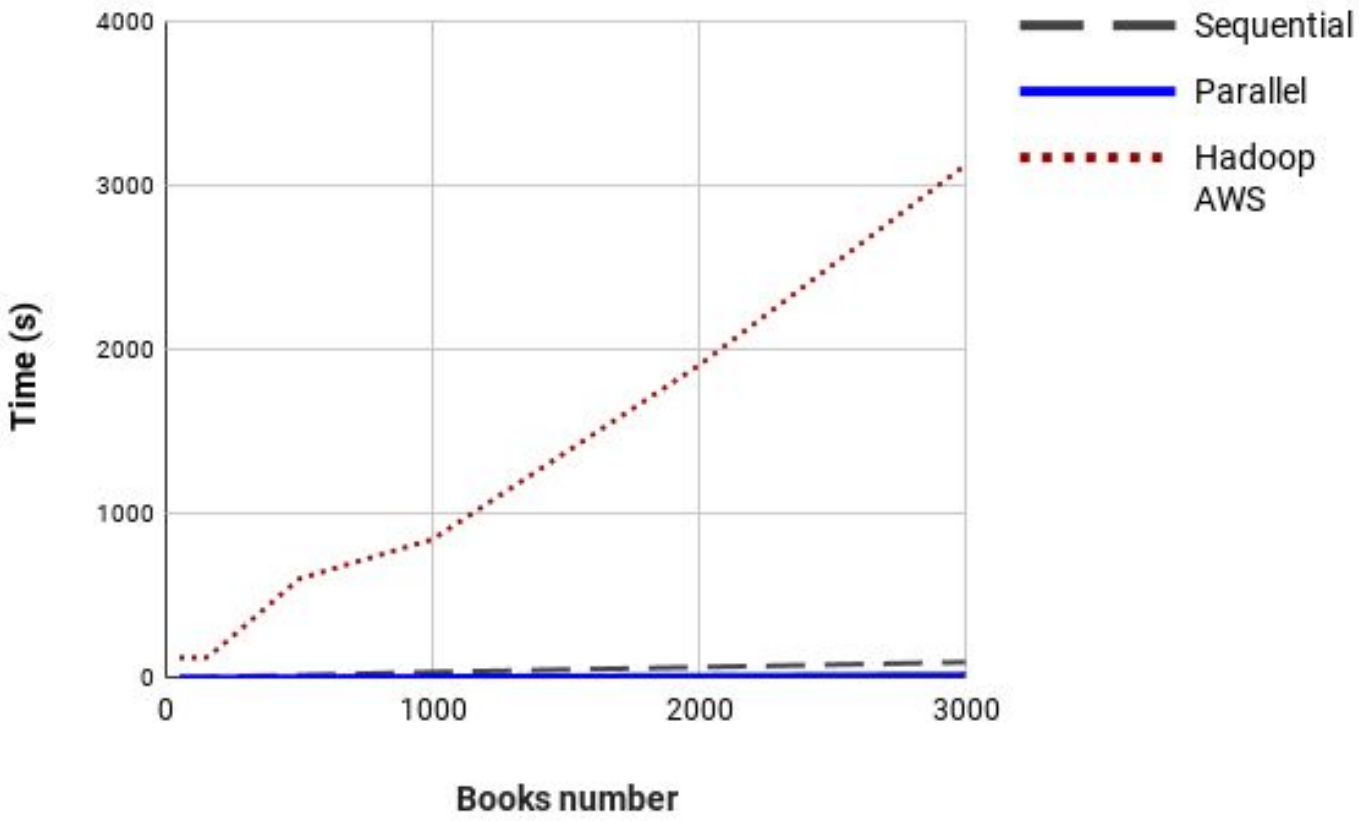
- i7-8750H 6 CORES 12 THREAD
- 16 GB 2400 MHz DDR4 RAM
- M2 SSD SAMSUNG MZVLW256HEHP

Results

- Parellel implementation setup
  - 12 threads and 1 book to process each time
- AWS
  - Emr cluster:
    - m4.xlarge 1 master 4 slaves, Amazon Hadoop version 2.8.5
  - Storage:
    - S3 bucket

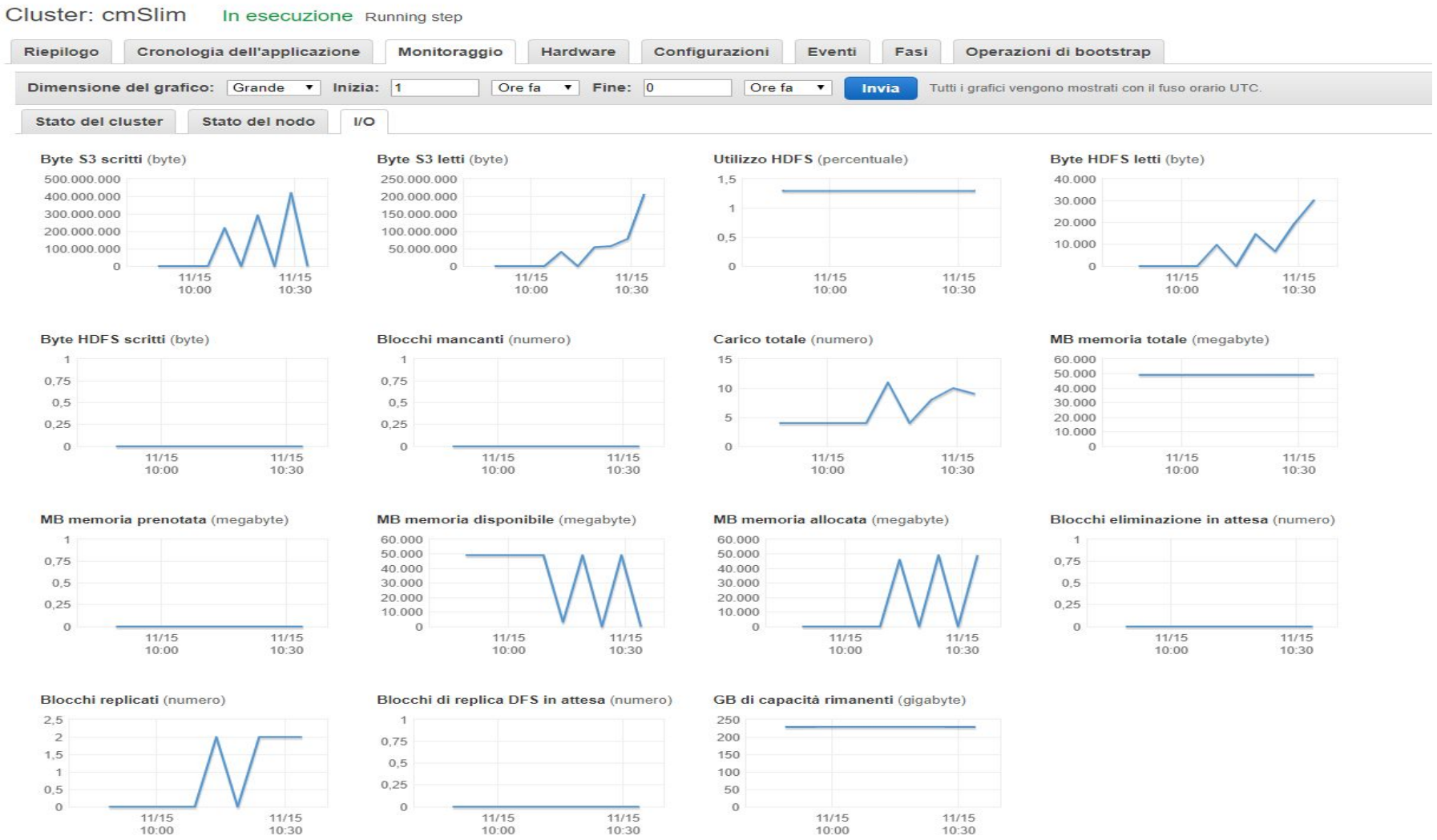
Results

- All versions compared respect to the number of books



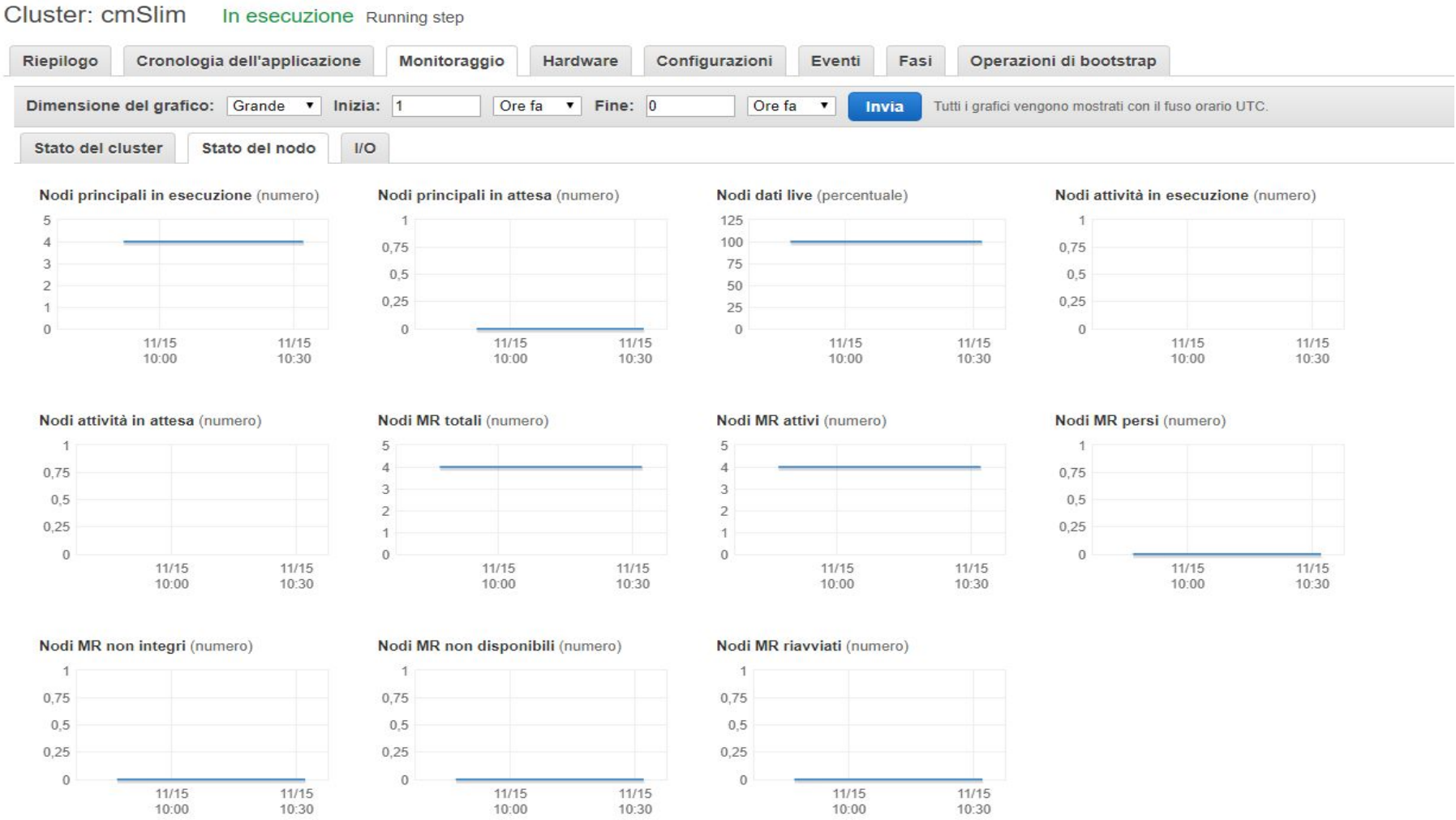
Results

- AWS


Cluster: cmSlim
In esecuzione
Running step
Riepilogo
Cronologia dell'applicazione
Monitoraggio
Hardware
Configurazioni
Eventi
Fasi
Operazioni di bootstrap
Dimensione del grafico: Grande
Inizia: 1
Ore fa
Fine: 0
Ore fa
Invia
Tutti i grafici vengono mostrati con il fuso orario UTC.
Stato del cluster
Stato del nodo
I/O
Byte S3 scritti (byte)
Byte S3 letti (byte)
Utilizzo HDFS (percentuale)
Byte HDFS letti (byte)
Byte HDFS scritti (byte)
Blocchi mancanti (numero)
Carico totale (numero)
MB memoria totale (megabyte)
MB memoria prenotata (megabyte)
MB memoria disponibile (megabyte)
MB memoria allocata (megabyte)
Blocchi eliminazione in attesa (numero)
Blocchi replicati (numero)
Blocchi di replica DFS in attesa (numero)
GB di capacità rimanenti (gigabyte)
11/15 10:00
11/15 10:30

Results

- AWS


Cluster: cmSlim
In esecuzione
Running step
Riepilogo
Cronologia dell'applicazione
Monitoraggio
Hardware
Configurazioni
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Fasi
Operazioni di bootstrap
Dimensione del grafico: Grande
Inizia: 1
Ore fa
Fine: 0
Ore fa
Invia
Tutti i grafici vengono mostrati con il fuso orario UTC.
Stato del cluster
Stato del nodo
I/O
Nodi principali in esecuzione (numero)
Nodi principali in attesa (numero)
Nodi dati live (percentuale)
Nodi attività in esecuzione (numero)
Nodi attività in attesa (numero)
Nodi MR totali (numero)
Nodi MR attivi (numero)
Nodi MR persi (numero)
Nodi MR non integri (numero)
Nodi MR non disponibili (numero)
Nodi MR riavviati (numero)
11/15 10:00
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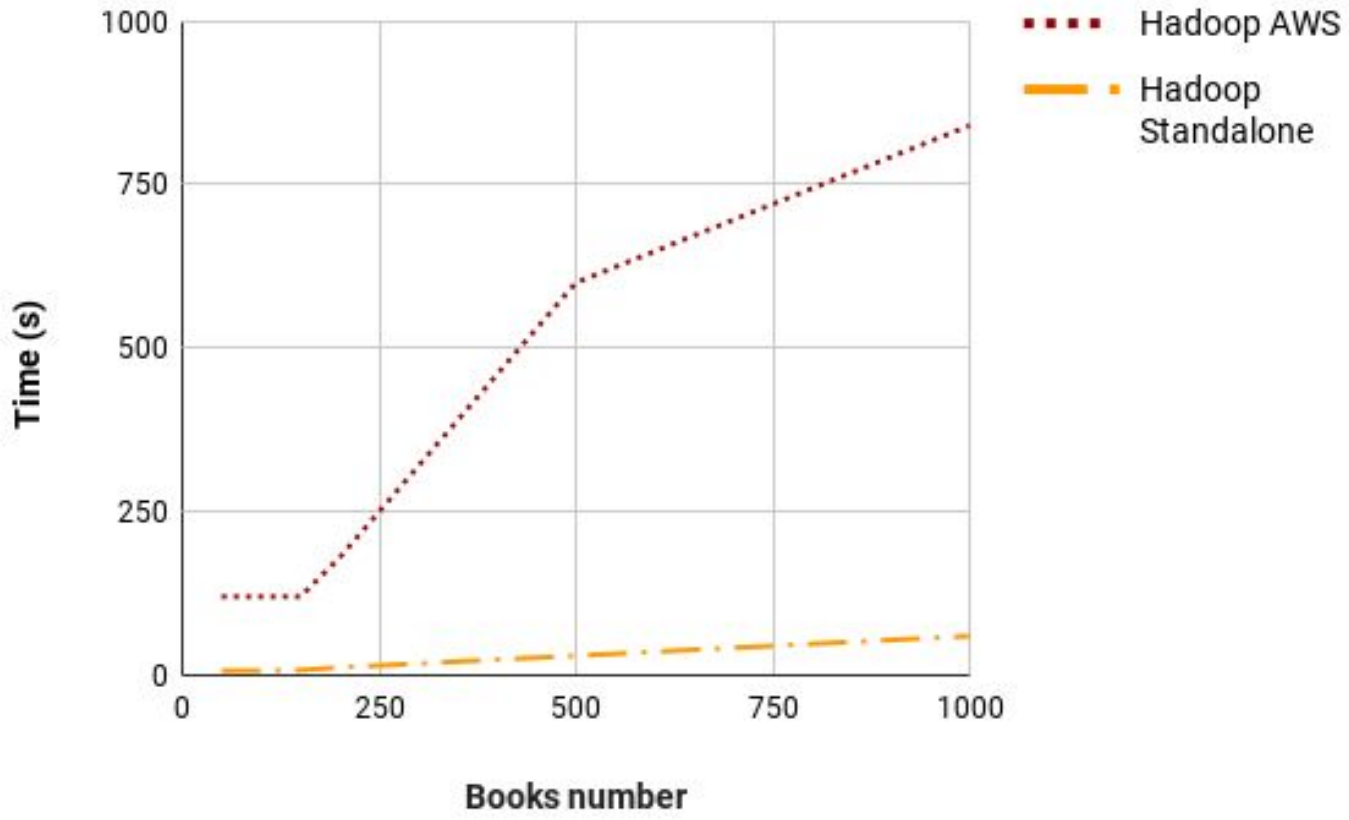
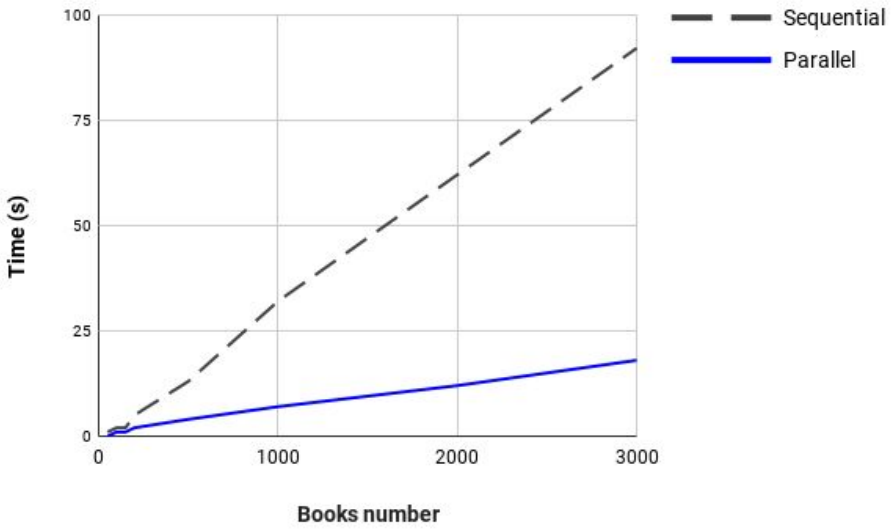
Results

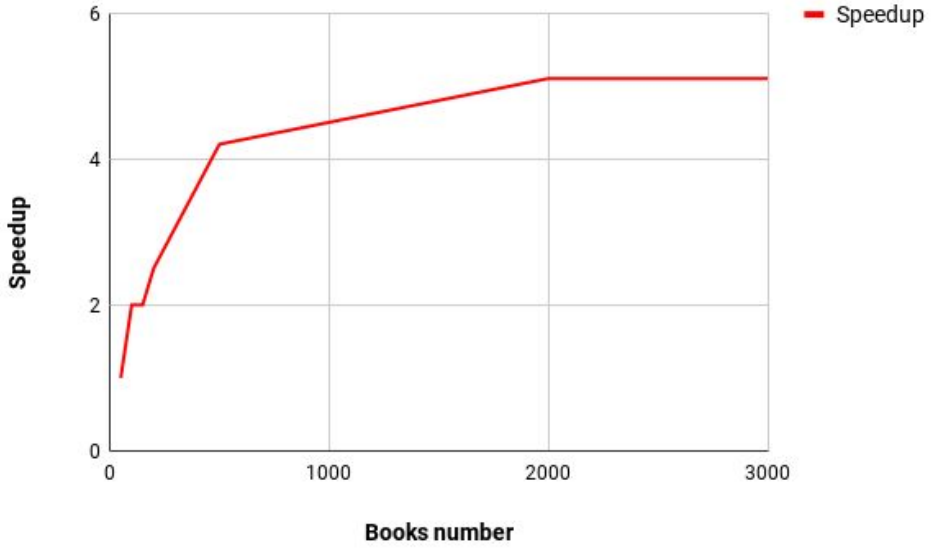
- AWS vs Standalone respect to the number of books



Results

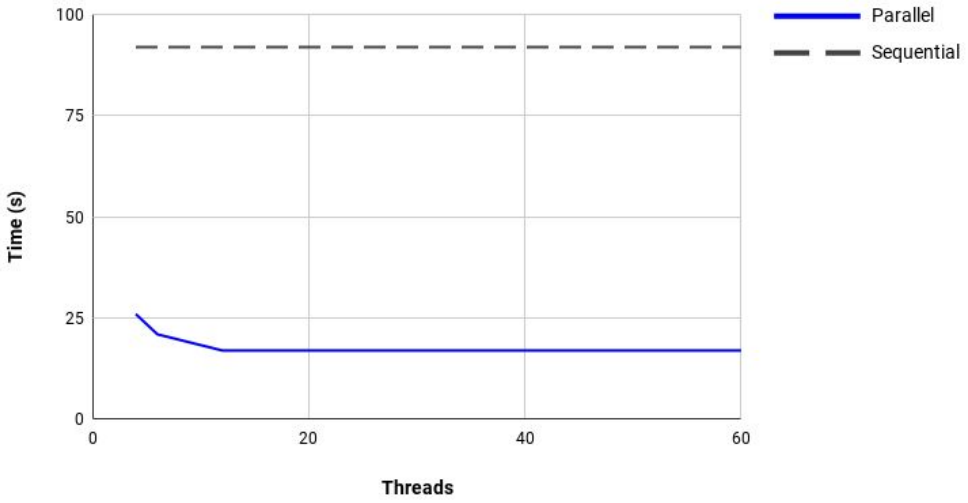
- Parallel vs sequential respect to number of books

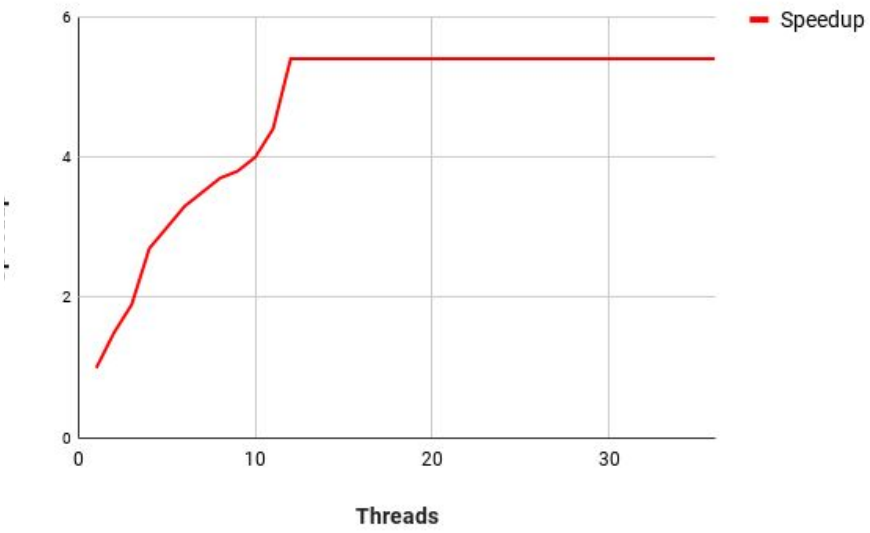




Results

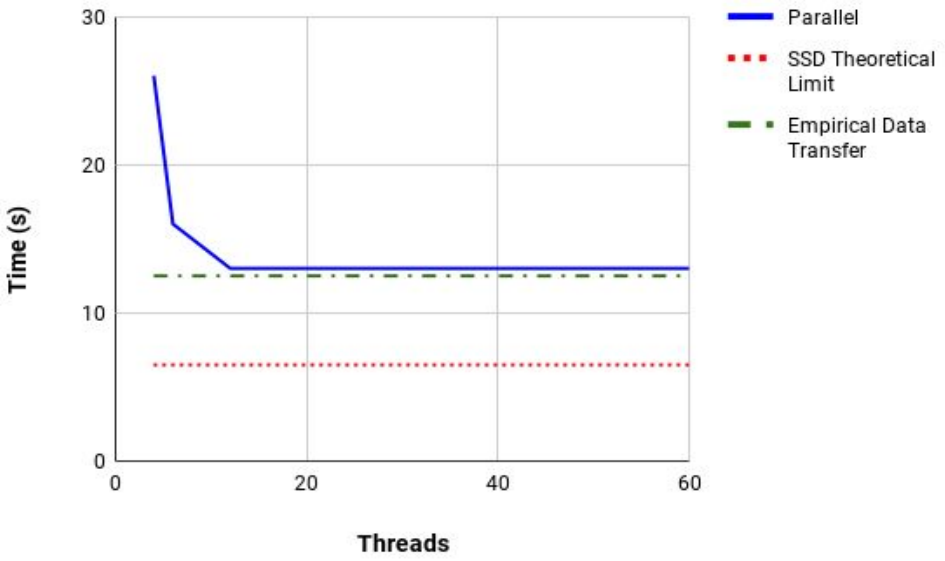
- Parallel vs sequential respect to number of threads

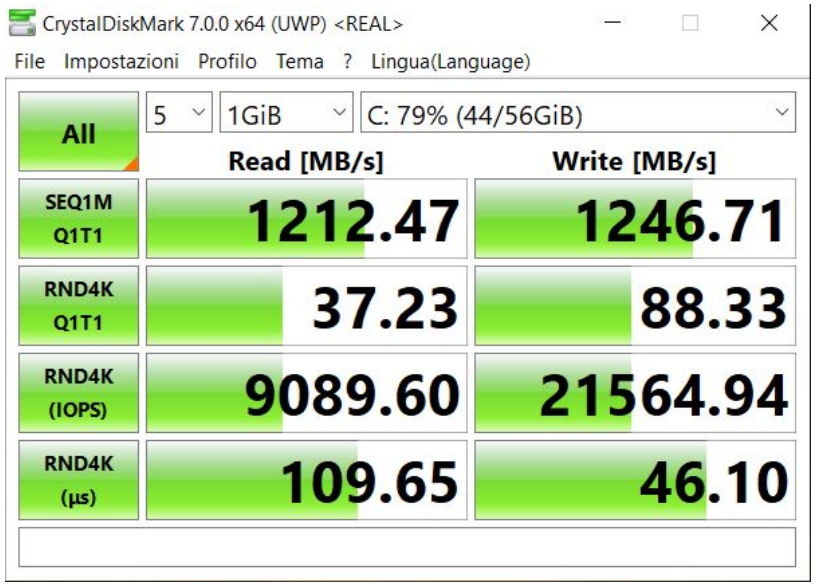




Results

- A deeper analysis





Conclusions

- Classic case of Hadoop usage:
  - perform local computations over huge amounts of input data while returning relatively small result set, which makes our case not suitable to be implemented with Hadoop
- A program for n-grams counting rather than writing them only, probably we would have been able to see the potential of this distributed technology

Conclusions

Thanks for the attention!