



**MARMARA UNIVERSITY FACULTY OF  
ENGINEERING**

**CSE2246-PROJECT 1 REPORT**

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# STEP1

- (a) Deciding on / generating long HTML files.
- (b) Deciding on patterns.

## (a) Deciding on / generating long HTML files:

We found a long article about “World War 2” on Wikipedia and used the HTML code from this article. We used the HTML code from this article because we wanted it to be more than 1MB, because algorithms need enough data to effectively evaluate their performance. We did not choose a larger file because it would make performance tests difficult.

We wrote java code containing random bit strings as Type 2. We set the DEFAULT\_LENGTH length in this code to 1110000. We used this length to pass the 1Mb size.

```
import java.io.FileWriter;
import java.io.IOException;
import java.util.Random;

4
5 public class Main {
    private static final int DEFAULT_LENGTH = 1110000;
    private static final int LINE_BREAK_INTERVAL = 200;

    public static void main(String[] args) {
        generateRandomBitStringHTMLFile("random_bits.html", DEFAULT_LENGTH);
    }

    public static void generateRandomBitStringHTMLFile(String fileName, int length) {
        try {
            FileWriter fileWriter = new FileWriter(fileName);
            fileWriter.write("<!DOCTYPE html>\n");
            fileWriter.write("<html>\n");
            fileWriter.write("<head>\n");
            fileWriter.write("<title>Random Bit String</title>\n");
            fileWriter.write("</head>\n");
            fileWriter.write("<body>\n");

            Random random = new Random();
            for (int i = 0; i < length; i++) {
                int bit = random.nextInt(2);
                fileWriter.write(bit + "");
                if ((i + 1) % LINE_BREAK_INTERVAL == 0) {
                    fileWriter.write("<br/>\n");
                }
            }

            fileWriter.write("\n</body>\n");
            fileWriter.write("</html>");
            fileWriter.close();

            System.out.println("Random bit string HTML file created: " + fileName);
        } catch (IOException e) {
            e.printStackTrace();
        }
    }
}
```

## (b)Deciding on patterns.

We have identified the patterns we will use in the project. These patterns represent the text fragments that will be searched for in the HTML file. For HTML files with English text, we chose meaningful words as patterns.

These words are "October", "Kuomintang", "and".

For HTML files containing random bit strings, we selected random 4bit, 8bit and 16-bit random patterns of different lengths. These patterns are the following:

"1010", "11111100", "1110101101100011".

Factors such as the first characters of the patterns, the repetition of the patterns and the length of the patterns significantly affect the running time of the algorithm. Therefore, we chose patterns of different lengths to better evaluate the performance and effects of the algorithm.

We have two HTML file:

### **1)English Text HTML file**

URL:

[https://en.wikipedia.org/wiki/World\\_War\\_II](https://en.wikipedia.org/wiki/World_War_II)

Size: 1,07 MB

### **2) Random Bit Strings HTML file**

Size: 1,08 MB

### **Purpose:**

The purpose of this report is to explain the selection of the patterns "October", "Kuomintang" and "and" in the context of the Horspool, Brute-Force, and Boyer-Moore searching algorithms. The impact of these patterns on the runtime of the code will be analyzed and discussed in detail.

### **1. Introduction:**

In this study, we implemented three different searching algorithms: Horspool, Brute-Force, and Boyer-Moore. These algorithms were applied to search for the patterns "October", "Kuomintang" and "and" in a given English text. The choice of these specific patterns was based on their relevance and diversity in common text data. The objective was to observe how these algorithms perform when searching for different patterns with varying occurrences.

## **2. Algorithm Descriptions:**

### **2.1 Horspool Algorithm:**

The Horspool algorithm is a simplified version of the Boyer-Moore algorithm, which utilizes a bad character heuristic. It preprocesses the pattern and skips unnecessary comparisons based on the mismatched characters. This algorithm has a linear time complexity in the best case and a worst-case complexity of  $O(nm)$ , where  $n$  is the text length and  $m$  is the pattern length.

### **2.2 Brute-Force Algorithm:**

The Brute-Force algorithm is a straightforward searching method that checks each character of the pattern against each character in the text. It has a time complexity of  $O(nm)$ , making it the least efficient among the three algorithms.

### **2.3 Boyer-Moore Algorithm:**

The Boyer-Moore algorithm utilizes both bad character and good suffix heuristics to skip comparisons. It preprocesses the pattern and skips a variable number of characters based on the mismatched character and previously matched characters. This algorithm has a best-case time complexity of  $O(n/m)$  and a worst-case complexity of  $O(nm)$ .

## **3. Experimental Analysis:**

The code implemented with the three algorithms was executed on a sample English text. The patterns "October", "Kuomintang" and "and" were chosen to represent different scenarios:

- "October": A common English word with moderate occurrence.
- "Kuomintang": The reason for choosing the word "Kuomintang" is that this word is a proper noun and is not very common in the text. In this case, the running speed of the algorithm is affected. At the same time, the fact that this word ends with the letter "g" is one of the reasons for choosing this word. Because the number of words ending with the letter "g" is less.
- "and": A short and frequently occurring word.

The impact of these patterns on the runtime of the code was observed and analyzed. The runtime was measured for each algorithm separately, and the results were compared.

#### **4. Results and Discussion:**

The runtime of the algorithms varied depending on the chosen patterns. The following observations were made:

##### **4.1 Horspool Algorithm:**

The Horspool algorithm showed consistent performance across all three patterns. Since it does not consider the arrangement of characters in the pattern, the runtime was primarily dependent on the length of the pattern. Therefore, the patterns "October", "Kuomintang" and "and" did not significantly affect the runtime of the Horspool algorithm.

##### **4.2 Brute-Force Algorithm:**

It performs a character-by-character comparison, the length and occurrence of the pattern directly influenced the runtime. As a result, the longer pattern "Kuomintang" took more time to search compared to "October" and "and."

##### **4.3 Boyer-Moore Algorithm:**

The Boyer-Moore algorithm demonstrated efficient runtime characteristics due to its heuristic-based approach. The patterns "October" and "and" had relatively lower impact on the runtime because they appeared frequently and had shorter lengths. However, the pattern "Kuomintang" showed a noticeable effect due to its length and lower occurrence.

#### **5. Conclusion:**

In conclusion, the choice of patterns in the Horspool, Brute-Force, and Boyer-Moore searching algorithms affected their runtime differently.

A search algorithm usually runs faster when searching for a less frequent word in a text. This is because a less frequent word has fewer instances in the text, so the algorithm has to perform fewer operations.

To find a word in a text, a search algorithm usually scans the text and checks each word. If the searched word is found less frequently in the text, the algorithm will operate on fewer words and give faster results. Fewer steps to find a less frequent word reduces the running time of the algorithm.

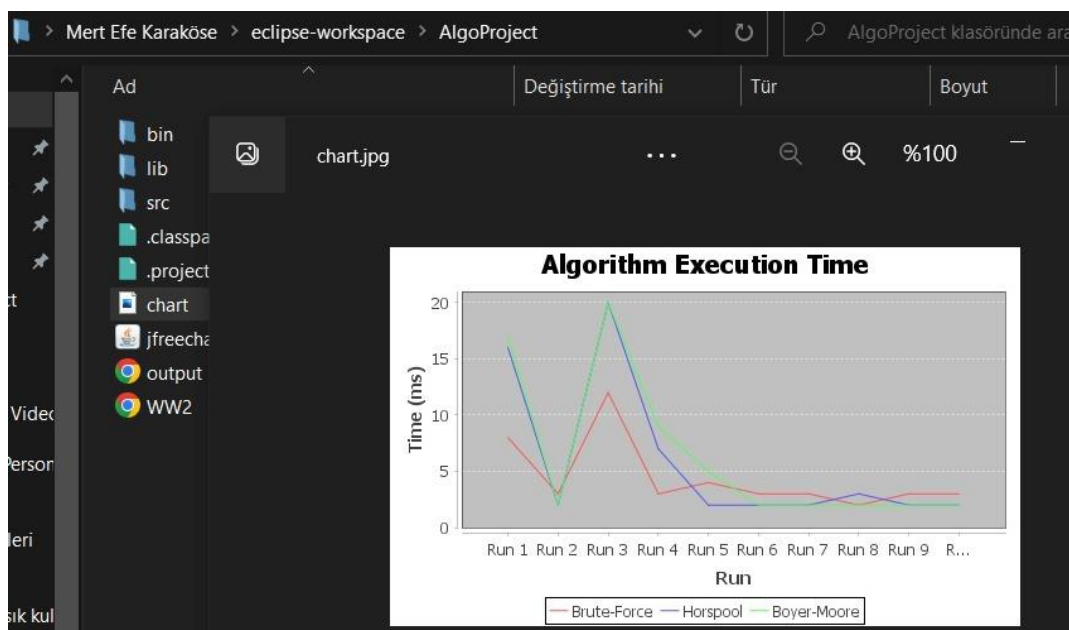
However, other factors such as the choice of search algorithm and the size of the text are also important. Some algorithms work by checking all words in the text, while others can search more efficiently. The size of the text can also affect the algorithm's running time. For example, it may take longer to find a less common word in a very large text, because the algorithm will scan the entire text and spend more time finding the word it is looking for.

As a result, a search algorithm usually works faster when searching for a less frequent word in a text. However, other factors such as the choice of algorithm and the size of the text should also be taken into account.

The reason we chose the word “October” is because we want to search for a word starting with a capital letter.

## 6. Graphs:

The graphs we use to compare our algorithms. We created it using the JFreeChart library in java. When we run the code, the graph of the comparison of the three algorithms is automatically added to the file part of the project as png.



# STEP2 and STEP3

When we run the code, it gives the user the option to select one of three different HTML files.

The patterns "October", "Kuomintang" and "and".

## 1)October:

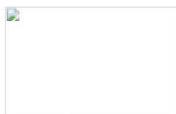
```
Enter the pattern: October
Run #1
Highlighted pattern occurrences (Brute-Force): 30
Highlighted pattern occurrences (Horspool): 30
Highlighted pattern occurrences (Boyer-Moore): 30
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 15 ms
Horspool: 9 ms
Boyer-Moore: 10 ms
-----
Run #2
Highlighted pattern occurrences (Brute-Force): 30
Highlighted pattern occurrences (Horspool): 30
Highlighted pattern occurrences (Boyer-Moore): 30
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 2 ms
Horspool: 6 ms
Boyer-Moore: 2 ms
-----
Run #3
Highlighted pattern occurrences (Brute-Force): 30
Highlighted pattern occurrences (Horspool): 30
Highlighted pattern occurrences (Boyer-Moore): 30
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 26 ms
Horspool: 7 ms
Boyer-Moore: 8 ms
-----
Run #4
Highlighted pattern occurrences (Brute-Force): 30
Highlighted pattern occurrences (Horspool): 30
Highlighted pattern occurrences (Boyer-Moore): 30
Number of character comparisons: 1118106
Execution time (ms):
```

```
Select an HTML file option:
1. English Text
2. Bit String
3. Given Example In The Hw PDF
Enter the option number: 1
Enter the pattern: October
Run #1
Highlighted pattern occurrences (Brute-Force): 30
Highlighted pattern occurrences (Horspool): 30
Highlighted pattern occurrences (Boyer-Moore): 30
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 14 ms
Horspool: 7 ms
Boyer-Moore: 10 ms
-----
```

[Army during the defence of Poland](#), September 1939

On 8 September, German troops reached the suburbs of [Warsaw](#). The Polish [counter-offensive](#) to the west halted the German advance for several days, but it was outflanked and encircled by the *Wehrmacht*. Remnants of the Polish army broke through to [besieged Warsaw](#). On 17 September 1939, two days after signing a [cease-fire with Japan](#), the [Soviet Union invaded Poland](#)<sup>[72]</sup> under the pretext that the Polish state had ostensibly ceased to exist.<sup>[73]</sup> On 27 September, the Warsaw garrison surrendered to the Germans, and [the last large operational unit of the Polish Army surrendered on 6 October](#). Despite the military defeat, Poland never surrendered; instead, it formed the [Polish government-in-exile](#) and a [clandestine state apparatus remained](#) in occupied Poland.<sup>[74]</sup> A significant part of Polish military personnel [evacuated to Romania](#) and Latvia; many of them later [fought against the Axis](#) in other theatres of the war.<sup>[75]</sup>

Germany [annexed the western](#) and [occupied the central part of Poland](#), and the Soviet Union [annexed its eastern part](#); small shares of Polish territory were transferred to [Lithuania](#) and [Slovakia](#). On 6 October, Hitler made a public peace overture to the United Kingdom and France but said that the future of Poland was to be determined exclusively by Germany and the Soviet Union. The proposal was rejected,<sup>[63]</sup> and Hitler ordered an immediate offensive against France,<sup>[76]</sup> which was postponed until the spring of 1940 due to bad weather.<sup>[77][78][79]</sup>



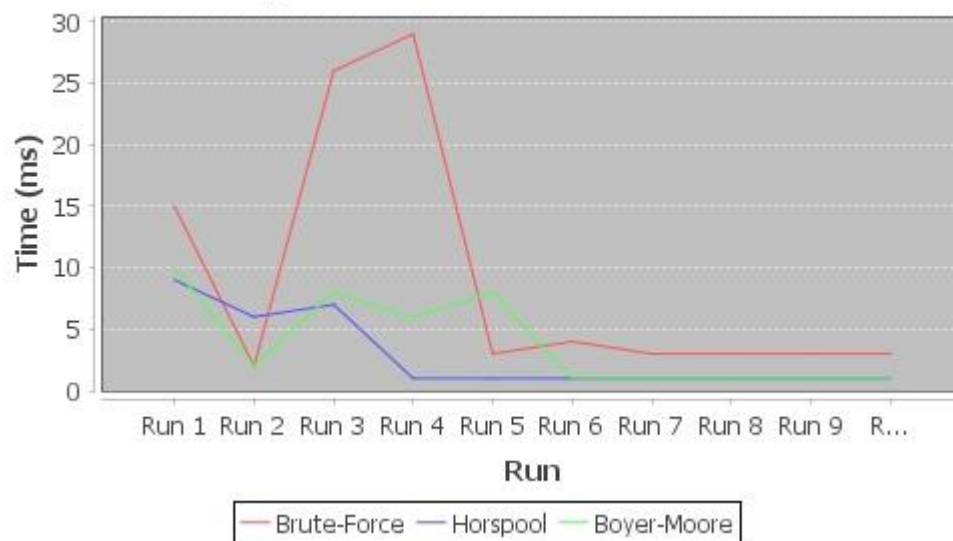
Finnish machine gun nest aimed at Soviet [Red Army](#) positions during the [Winter War](#), February 1940

After the outbreak of war in Poland, Stalin threatened [Estonia](#), [Latvia](#), and [Lithuania](#) with military invasion, forcing the three [Baltic countries](#) to sign [pacts](#) that stipulated the creation of Soviet military bases in these countries. In [October 1939](#), significant Soviet military contingents were moved there.<sup>[80][81][82]</sup> [Finland](#) refused to sign a similar pact and rejected ceding part of its territory to the Soviet Union. [The Soviet Union invaded Finland](#) in November 1939<sup>[83]</sup> and was subsequently expelled from the [League of Nations](#) for this crime of aggression.<sup>[84]</sup> Despite overwhelming numerical superiority, Soviet military success during the [Winter War](#) was modest,<sup>[85]</sup> and the Finno-Soviet war ended in March 1940 with [some Finnish concessions of territory](#).<sup>[86]</sup>

In June 1940, the Soviet Union [occupied](#) the entire territories of Estonia, Latvia and Lithuania,<sup>[81]</sup> and the Romanian regions of [Bessarabia](#), [Northern Bukovina](#), and the [Herzegovina region](#). In August 1940, Hitler imposed the [Second Vienna Award](#) on Romania which led to the transfer of [Northern Transylvania](#) to Hungary.<sup>[87]</sup> In September 1940, Bulgaria demanded [Southern Dobruja](#) from Romania with German and Italian support, leading to the [Treaty of Craiova](#).<sup>[88]</sup> The loss of one-third of Romania's 1939 territory caused a coup against King Carol II, turning Romania into a fascist dictatorship under Marshal [Ion Antonescu](#) with a course set firmly towards the Axis in the hopes of a German guarantee.<sup>[89]</sup> Meanwhile, German-Soviet political rapprochement and economic co-operation<sup>[90][91]</sup> gradually stalled,<sup>[92][93]</sup> and both states began preparations for war.<sup>[94]</sup>



## Algorithm Execution Time



## 2) Kuomintang

```
Enter the pattern: Kuomintang
Run #1
Highlighted pattern occurrences (Brute-Force): 5
Highlighted pattern occurrences (Horspool): 5
Highlighted pattern occurrences (Boyer-Moore): 5
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 15 ms
Horspool: 7 ms
Boyer-Moore: 9 ms
-----
Run #2
Highlighted pattern occurrences (Brute-Force): 5
Highlighted pattern occurrences (Horspool): 5
Highlighted pattern occurrences (Boyer-Moore): 5
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 4 ms
Horspool: 9 ms
Boyer-Moore: 10 ms
-----
Run #3
Highlighted pattern occurrences (Brute-Force): 5
Highlighted pattern occurrences (Horspool): 5
Highlighted pattern occurrences (Boyer-Moore): 5
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 8 ms
Horspool: 9 ms
Boyer-Moore: 5 ms
-----
Run #4
Highlighted pattern occurrences (Brute-Force): 5
Highlighted pattern occurrences (Horspool): 5
Highlighted pattern occurrences (Boyer-Moore): 5
Number of character comparisons: 1118106
Execution time (ms):
```



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### European treaties

The United Kingdom, France and Italy formed the [Stresa Front](#) in April 1935 in order to contain Germany, a key step towards [military globalisation](#); however, that June, the United Kingdom made an [independent naval agreement](#) with Germany, easing prior restrictions. The Soviet Union, concerned by Germany's [goals of capturing vast areas of Eastern Europe](#), drafted a treaty of mutual assistance with France. Before taking effect, though, the [Franco-Soviet pact](#) was required to go through the bureaucracy of the League of Nations, which rendered it essentially toothless.<sup>[23]</sup> The United States, concerned with events in Europe and Asia, passed the [Neutrality Act](#) in August of the same year.<sup>[24]</sup>

Hitler defied the Versailles and [Locarno Treaties](#) by [remilitarising the Rhineland](#) in March 1936, encountering little opposition due to the policy of [appeasement](#).<sup>[25]</sup> In October 1936, Germany and Italy formed the [Rome–Berlin Axis](#). A month later, Germany and Japan signed the [Anti-Comintern Pact](#), which Italy joined the following year.<sup>[26]</sup>

### Asia


The [Kuomintang](#) (KMT) party in China launched a [unification campaign](#) against [regional warlords](#) and nominally unified China in the mid-1920s, but was soon embroiled in a [civil war](#) against its former [Chinese Communist Party](#) allies<sup>[27]</sup> and [new regional warlords](#). In 1931, an [increasingly militaristic Empire of Japan](#), which had long sought influence in China<sup>[28]</sup> as the first step of what its government saw as the country's [right to rule Asia](#), staged the [Mukden Incident](#) as a pretext to [invade Manchuria](#) and establish the [puppet state](#) of [Manchukuo](#).<sup>[29]</sup>

China appealed to the [League of Nations](#) to stop the Japanese invasion of Manchuria. Japan withdrew from the League of Nations after being [condemned](#) for its incursion into Manchuria. The two nations then fought several battles, in [Shanghai](#), [Rehe](#) and [Hebei](#), until the [Tanggu Truce](#) was signed in 1933. Thereafter, Chinese volunteer forces continued the resistance to Japanese aggression in [Manchuria](#), and [Chahar and Suiyuan](#).<sup>[30]</sup> After the 1936 [Xi'an Incident](#), the [Kuomintang](#) and communist forces agreed on a ceasefire to present a [united front](#) to oppose Japan.<sup>[31]</sup>

### Pre-war events

#### Italian invasion of Ethiopia (1935)

Main article: [Second Italo-Ethiopian War](#)



[Benito Mussolini](#) inspecting troops during the [Italo-Ethiopian](#)

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## Algorithm Execution Time



**3) and**

```
Enter the pattern: and
Run #1
Highlighted pattern occurrences (Brute-Force): 1726
Highlighted pattern occurrences (Horspool): 1726
Highlighted pattern occurrences (Boyer-Moore): 1726
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 8 ms
Horspool: 16 ms
Boyer-Moore: 18 ms
-----
Run #2
Highlighted pattern occurrences (Brute-Force): 1726
Highlighted pattern occurrences (Horspool): 1726
Highlighted pattern occurrences (Boyer-Moore): 1726
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 5 ms
Horspool: 2 ms
Boyer-Moore: 2 ms
-----
Run #3
Highlighted pattern occurrences (Brute-Force): 1726
Highlighted pattern occurrences (Horspool): 1726
Highlighted pattern occurrences (Boyer-Moore): 1726
Number of character comparisons: 1118106
Execution time (ms):
Brute-Force: 12 ms
Horspool: 19 ms
Boyer-Moore: 15 ms
-----
Run #4
Highlighted pattern occurrences (Brute-Force): 1726
Highlighted pattern occurrences (Horspool): 1726
Highlighted pattern occurrences (Boyer-Moore): 1726
Number of character comparisons: 1118106
Execution time (ms):
```

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## Coups

[Yugoslavia](#) · [Iraq](#) · [Italy](#) · [Romania](#) · [Bulgaria](#) · [Hungary](#)

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### World War II

Navigation

[Campaigns](#) · [Countries](#) · [Equipment](#)  
[Timeline](#) · [Outline](#) · [Lists](#) · [Historiography](#)  
[Portal](#) · [Category](#) · [Bibliography](#)

X'ITE

**World War II** or the **Second World War**, often abbreviated as **WWII** or **WW2**, was a **global conflict** that lasted from 1939 to 1945. The **vast majority of the world's countries**, including all of the **great powers**, fought as part of two opposing **military alliances**: the **Allies** and the **Axis**. Many participants threw their economic, industrial, and scientific capabilities behind this **total war**, blurring the distinction between civilian and military resources. **Aircraft played a major role**, enabling the **strategic bombing** of population centres and the delivery of the **only two nuclear weapons** ever used in war. World War II was by far the **deadliest conflict** in history, resulting in an estimated **70 to 85 million fatalities**, mostly among civilians. Tens of millions died due to **genocides** (including the **Holocaust**), **starvation**, **massacres**, and **disease**. In the wake of the Axis defeat, **Germany and Japan were occupied**, and **war crimes tribunals** were conducted **against German and Japanese leaders**.

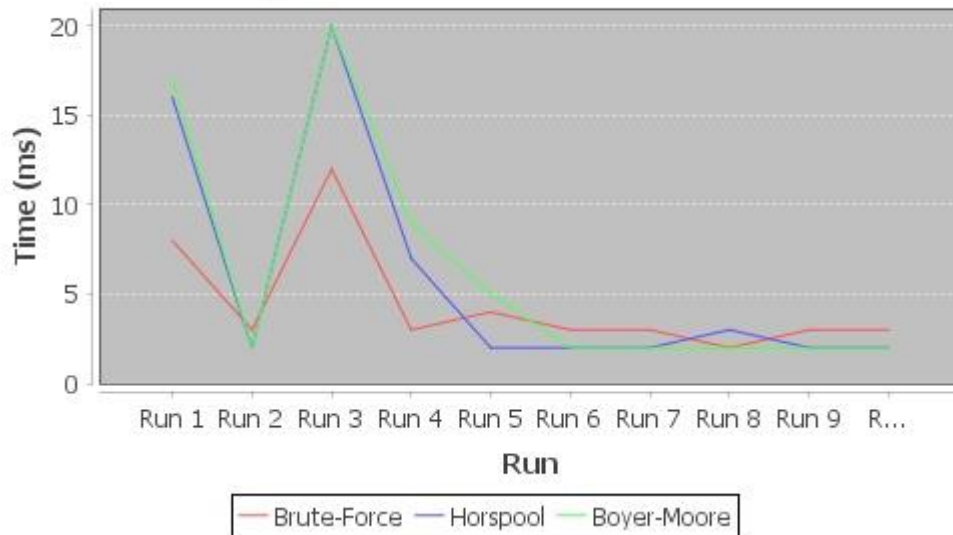
The **causes of World War II** are debated, but contributing factors included the **Second Italo-Ethiopian War**, **Spanish Civil War**, **Second Sino-Japanese War**, **Soviet–Japanese border conflicts**, the rise of **fascism in Europe**, and European tensions in the **aftermath of World War I**. World War II is generally considered to have begun on 1 September 1939, when **Nazi Germany**, under **Adolf Hitler**, invaded **Poland**. The **United Kingdom** and **France** subsequently declared war on Germany on 3 September. Under the **Molotov–Ribbentrop Pact** of August 1939, Germany and the **Soviet Union** had partitioned **Poland** and marked out their "**spheres of influence**" across **Finland**, **Estonia**, **Latvia**, **Lithuania** and **Romania**. From late 1939 to early 1941, in a series of **campaigns** and **treaties**, Germany conquered or controlled much of **continental Europe**, in a military alliance with **Italy**, **Japan** and other countries called the **Axis**. Following the onset of campaigns in **North Africa** and **East Africa**, and the **fall of France** in mid-1940, the war continued primarily between the European Axis powers and the **British Empire**, with war in the **Balkans**, the aerial **Battle of Britain**, the **Blitz** of the United Kingdom, and the **Battle of the Atlantic**. On 22 June 1941, Germany led the European Axis powers in **an invasion of the Soviet Union**, opening the **Eastern Front**, the largest **land theatre of war** in history.

Japan, which aimed to **dominate Asia and the Pacific**, was at war with the **Republic of China** by 1937. In December 1941, Japan attacked American and British territories with near-simultaneous **offensives against Southeast Asia and the Central Pacific**, including an **attack on the U.S. fleet at Pearl Harbor** which resulted in the United States and United Kingdom declaring war against Japan. The **European Axis powers declared war on the United States** in solidarity. Japan soon captured much of the western Pacific, but its advances were halted in 1942 after losing the critical **Battle of Midway**; later, Germany and Italy were **defeated in North Africa** and at **Stalingrad** in the Soviet Union. Key setbacks in 1943—including a series of German defeats on the Eastern Front, the **Allied invasions of Sicily and the Italian mainland**, and Allied offensives in the Pacific—cost the Axis powers their initiative and forced them into strategic retreat on all fronts. In 1944, the Western Allies **invaded German-occupied France**, while the Soviet Union **regained its territorial losses** and pushed Germany and its allies back. During 1944 and 1945, Japan suffered reversals in mainland Asia, while the Allies crippled the **Japanese Navy** and captured key western Pacific islands. The war in Europe concluded with the liberation of **German-occupied territories** and the **invasion of Germany by the Western Allies** and the Soviet Union, culminating in the **Fall of Berlin** to Soviet troops, **Hitler's suicide**, and the German **unconditional surrender on 8 May 1945**. Following the refusal of Japan to surrender on the terms of the **Potsdam Declaration** (issued 26 July 1945), the United States **dropped the first atomic bomb** on the Japanese cities of **Hiroshima** on 6 August and **Nagasaki** on 9 August. Faced with an imminent **invasion of the Japanese archipelago**, the possibility of additional atomic bombings, and the Soviet Union's declared entry into the war against Japan on the eve of **invading Manchuria**, Japan announced on 10 August its intention to surrender, signing a **surrender document** on 2 September 1945.

World War II changed the political alignment and social structure of the globe and set the foundation for the international order of the world's nations for the rest of the 20th century and into the present day. The **United Nations** was established to foster international co-operation and prevent future conflicts.<sup>[]</sup> with the victorious great powers—China, France, the Soviet Union, the United Kingdom, and the United States—becoming the **permanent members of its Security Council**. The Soviet Union and the United States emerged as rival **superpowers**, setting the stage for the nearly half-century-long **Cold War**. In the wake of European devastation, the influence of its great powers waned, triggering the **decolonisation of Africa and Asia**. Most countries whose industries had been damaged moved towards **economic recovery and expansion**. Political and economic integration, especially in Europe, began as an effort to forestall future hostilities, end pre-war enmities, and forge a sense of common identity.

## Start and end dates

## Algorithm Execution Time



For HTML files containing random bit strings, we selected random 4bit, 8bit and 16-bit random patterns of different lengths. These patterns are the following:

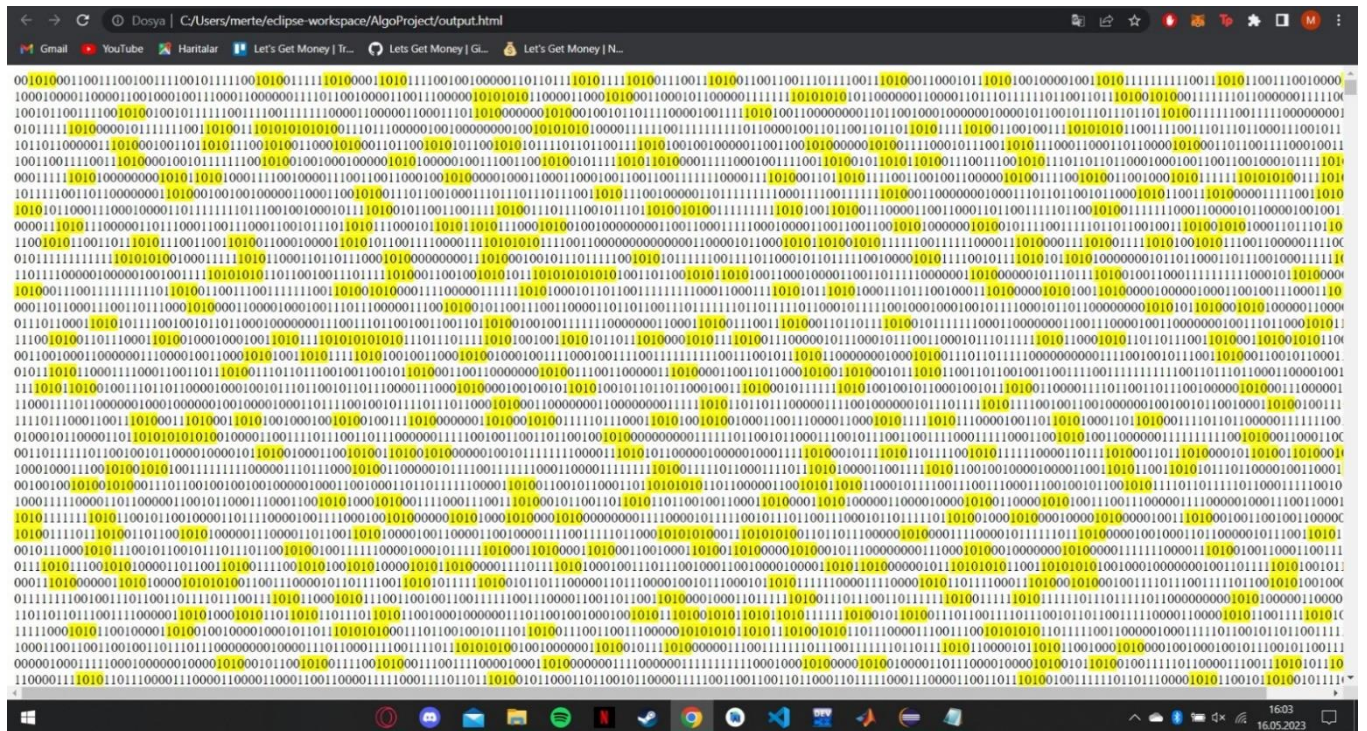
"1010", "11111100", "1110101101100011".

We chose short, medium and long patterns to better compare the lengths of the patterns we tried in our random binary bit string text.

### 1) "1010"

```
Enter the pattern: 1010
Run #1
Highlighted pattern occurrences (Brute-Force): 68294
Highlighted pattern occurrences (Horspool): 68204
Highlighted pattern occurrences (Boyer-Moore): 68294
Number of character comparisons: 1137836
Execution time (ms):
Brute-Force: 14 ms
Horspool: 16 ms
Boyer-Moore: 15 ms
-----
Run #2
Highlighted pattern occurrences (Brute-Force): 68294
Highlighted pattern occurrences (Horspool): 68204
Highlighted pattern occurrences (Boyer-Moore): 68294
Number of character comparisons: 1137836
Execution time (ms):
Brute-Force: 9 ms
Horspool: 10 ms
Boyer-Moore: 11 ms
-----
Run #3
Highlighted pattern occurrences (Brute-Force): 68294
Highlighted pattern occurrences (Horspool): 68204
Highlighted pattern occurrences (Boyer-Moore): 68294
Number of character comparisons: 1137836
Execution time (ms):
Brute-Force: 11 ms
Horspool: 13 ms
Boyer-Moore: 8 ms
-----
Run #4
Highlighted pattern occurrences (Brute-Force): 68294
Highlighted pattern occurrences (Horspool): 68204
Highlighted pattern occurrences (Boyer-Moore): 68294
Number of character comparisons: 1137836
Execution time (ms):
```





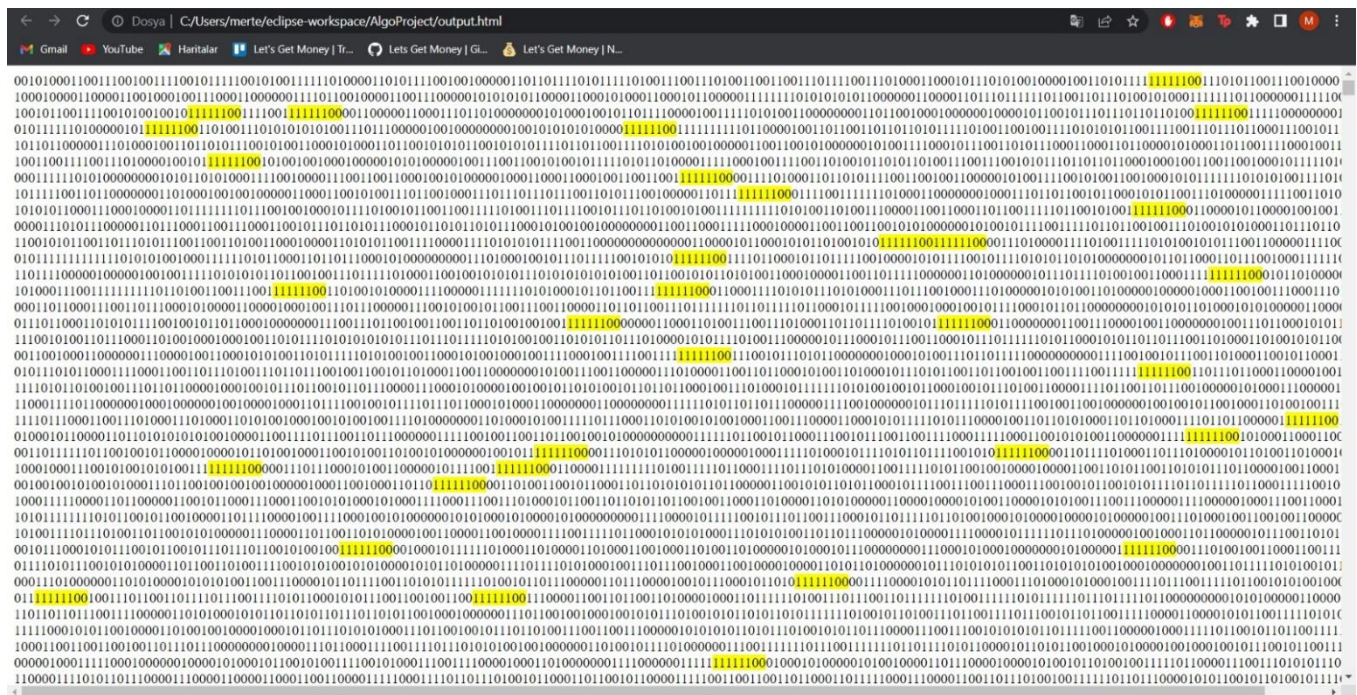
## Algorithm Execution Time



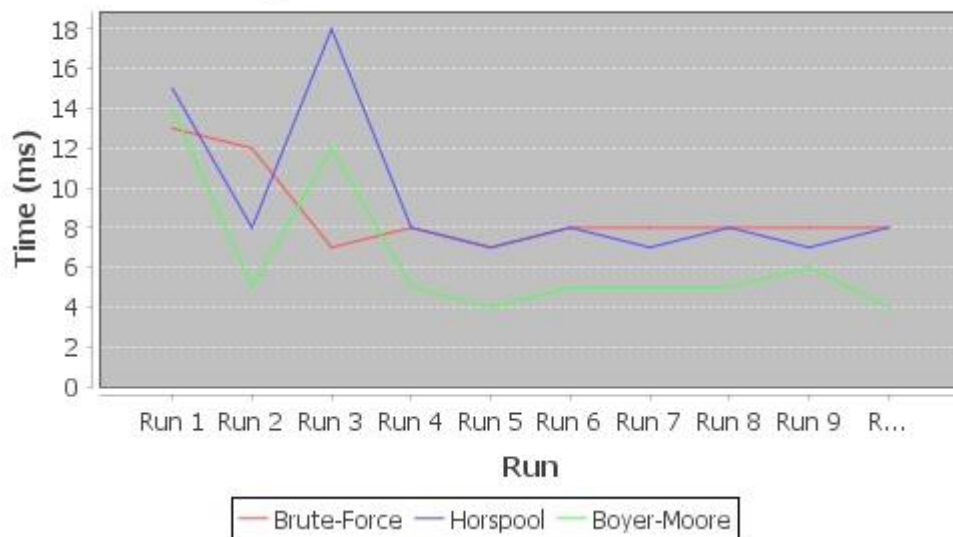


## 2) "11111100"

```
Enter the pattern: 11111100
Run #1
Highlighted pattern occurrences (Brute-Force): 4225
Highlighted pattern occurrences (Horspool): 1665
Highlighted pattern occurrences (Boyer-Moore): 4225
Number of character comparisons: 1137836
Execution time (ms):
Brute-Force: 13 ms
Horspool: 15 ms
Boyer-Moore: 14 ms
-----
Run #2
Highlighted pattern occurrences (Brute-Force): 4225
Highlighted pattern occurrences (Horspool): 1665
Highlighted pattern occurrences (Boyer-Moore): 4225
Number of character comparisons: 1137836
Execution time (ms):
Brute-Force: 12 ms
Horspool: 8 ms
Boyer-Moore: 5 ms
-----
Run #3
Highlighted pattern occurrences (Brute-Force): 4225
Highlighted pattern occurrences (Horspool): 1665
Highlighted pattern occurrences (Boyer-Moore): 4225
Number of character comparisons: 1137836
Execution time (ms):
Brute-Force: 7 ms
Horspool: 18 ms
Boyer-Moore: 12 ms
-----
Run #4
Highlighted pattern occurrences (Brute-Force): 4225
Highlighted pattern occurrences (Horspool): 1665
Highlighted pattern occurrences (Boyer-Moore): 4225
Number of character comparisons: 1137836
Execution time (ms):
```



## Algorithm Execution Time



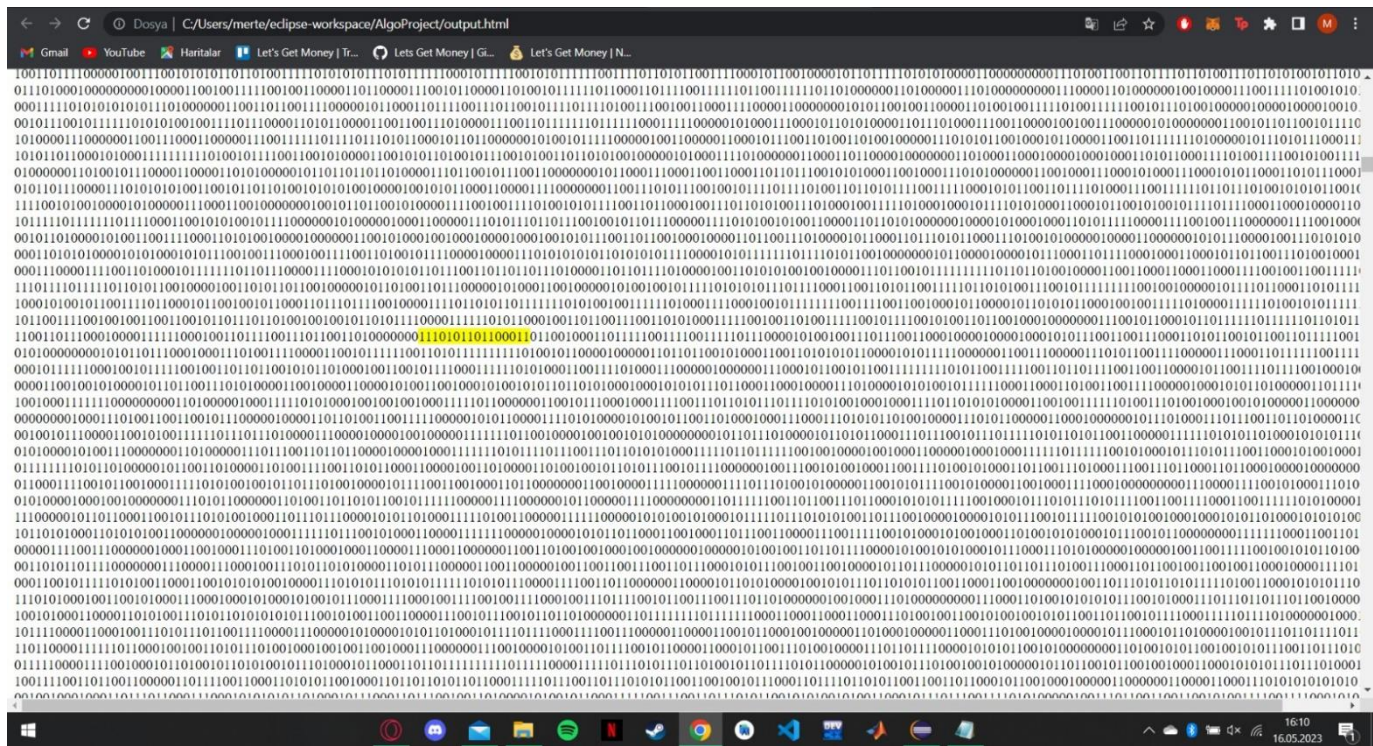
### 3) "1110101101100011"

```

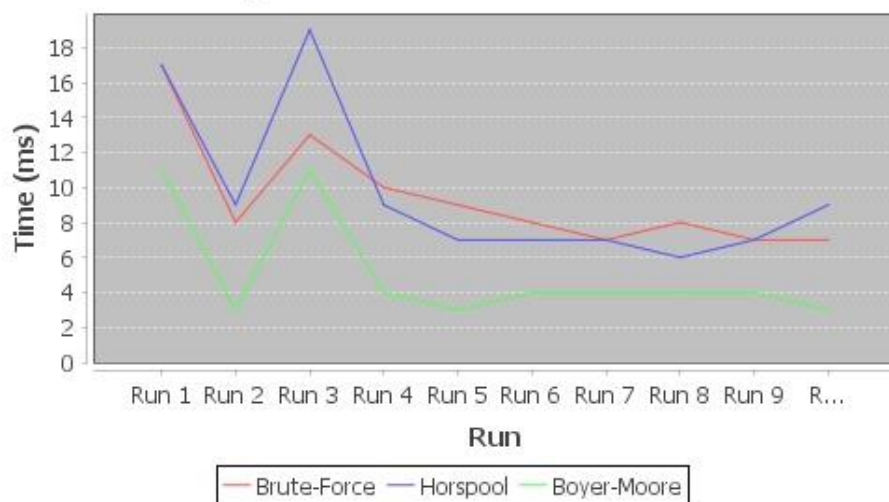
Enter the pattern: 1110101101100011
Run #1
Highlighted pattern occurrences (Brute-Force): 17
Highlighted pattern occurrences (Horspool): 17
Highlighted pattern occurrences (Boyer-Moore): 17
Number of character comparisons: 1137836
Execution time (ms):
Brute-Force: 17 ms
Horspool: 17 ms
Boyer-Moore: 11 ms
-----
Run #2
Highlighted pattern occurrences (Brute-Force): 17
Highlighted pattern occurrences (Horspool): 17
Highlighted pattern occurrences (Boyer-Moore): 17
Number of character comparisons: 1137836
Execution time (ms):
Brute-Force: 8 ms
Horspool: 9 ms
Boyer-Moore: 3 ms
-----
Run #3
Highlighted pattern occurrences (Brute-Force): 17
Highlighted pattern occurrences (Horspool): 17
Highlighted pattern occurrences (Boyer-Moore): 17
Number of character comparisons: 1137836
Execution time (ms):
Brute-Force: 13 ms
Horspool: 19 ms
Boyer-Moore: 11 ms
-----
Run #4
Highlighted pattern occurrences (Brute-Force): 17
Highlighted pattern occurrences (Horspool): 17
Highlighted pattern occurrences (Boyer-Moore): 17
Number of character comparisons: 1137836
Execution time (ms):

```

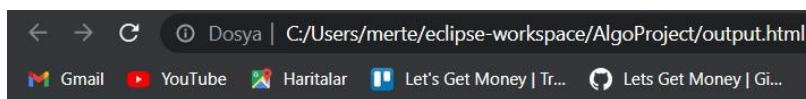




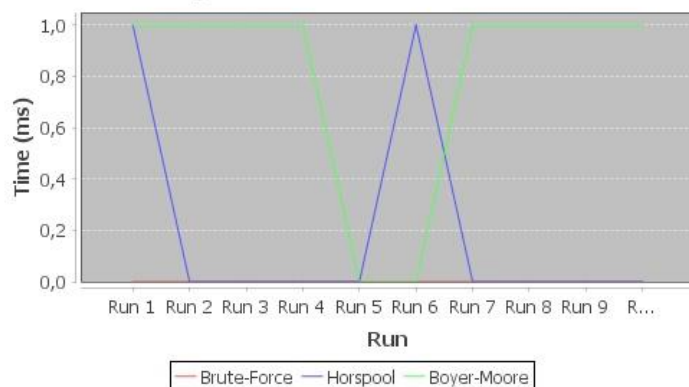
## Algorithm Execution Time



Given Example In The Homework PDF



## Algorithm Execution Time



## Comparison:

We entered 3 different pattern values for each algorithm. We found that the algorithms have different running times according to the length of these entered values. We found that the Brute force algorithm was the fastest and the horspool algorithm was slower in the short bit string pattern. But as the number of runs increased, the running times of all algorithms reached the optimum point. In the long input bit string pattern, we found that the fastest algorithm was the Boyer-Moore algorithm. In the same way, we found that the running times of the algorithms were close to each other when we ran more than one run. The reason for the decrease in running times when we run the algorithms consecutively is that the pattern entered in the first run is found and detected beforehand.

## Distribution of tasks:

Everyone was involved in every part of the assignment. The whole assignment was done by the whole group.

Name and ID	Works
Abdullah Enes Dizer – 150119880	Code implementation, three algorithms comparison and writing report
Mert Efe Karaköse – 150119805	Code implementation, three algorithms comparison and writing report
Yağmur Koçoğlu – 150119715	Code implementation, three algorithms comparison and writing report