T.C.
DOKUZ EYLUL UNIVERSITY
ENGINEERING FACULTY
ELECTRICAL & ELECTRONICS ENGINEERING DEPARTMENT

Word Recognition and Correction Algorithm and Application

By
Atakan Ertugrul
Beyza Karaca
Enes Erten
Fatih Korkmaz
Kutlu Uzay Yenidogan

Advisor
Dr. Abdul Balikci

May 2020
IZMIR

Abstract

Nowadays, everything is searched in Google. Google receives over 63.000 searches per second averagely, it makes 5.6 billion per a year also it is increasing exponential. Each of us are making mistakes while entering anything to the search engine. Search engine must recognize the sentence and correct the mistakes to find true results. That is the reason of why this project trying to create a simple and basic recognition and matching algorithm.

This project has four part. Firstly, it creates a word database. Secondly, it gets the word's all combination. Thirdly, it searches the word in database to find the closest word. Fourthly, it displays the result.

The word database has 8 files. These are one_word, two_word, three_word, four_word, five_word, six_word, seven_word, and common_word files. The group members decided to create maximum seven word file because of the limited time. In the database, there are thousands of words. However, it can be expanded any time.

When user is entering a word to system, algorithm creates an array and assigns to all combinations. That is the most important part of the algorithm due to user could forget a letter or press more letter. If we need to get true match we have to search all combinations. At the future algorithm can be expanded.

Third part of algorithm counts how many common words have matched with array and database word. The biggest count will be the matching.

Fourth part of algorithm displays the result of matching.

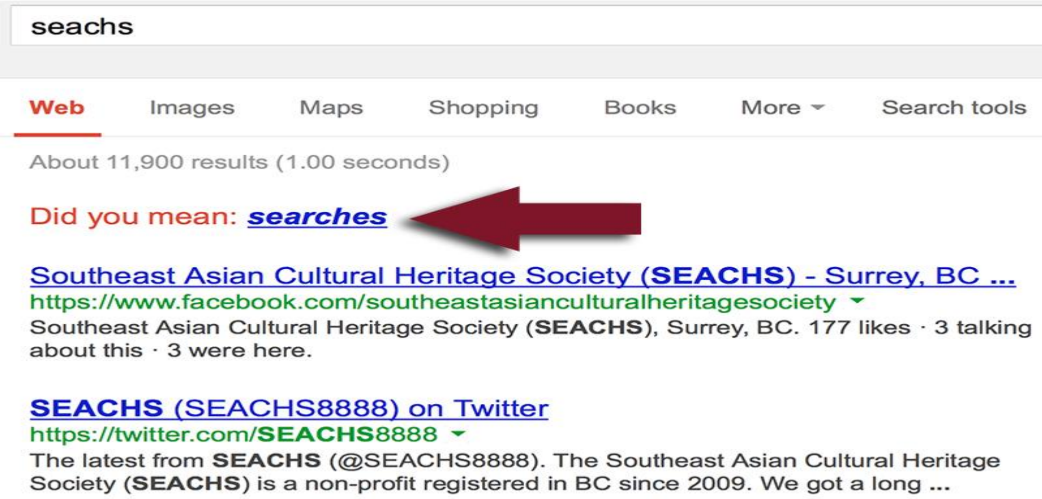
The cost of this project is 0 $ because of no need to any equipment except personal computers.

Key words: Recognition, Matching, Algorithm, Flowchart, File, Database.

TABLES OF CONTENTS

1. EXECUTIVE SUMMARY

Firstly there is a need to introduce what is search engine. According to the Cambridge Dictionary [1] definition, it is a computer program which finds information on the internet by looking for words that you typed in [2]. The most widely used search engine is absolutely GOOGLE [3] search engine. Most people make mistakes while entering words and sentences to the search engines. These mistakes can be caused wrong results and this situation affects them life very harder. However, search engines use some algorithms to fix these mistakes. For example, GOOGLE uses Did you mean [4] algorithm. Basically, this algorithm has two parts. First part is recognition the word or words. The second part is correction the word or words. If there is no word recognition and correction algorithm, everyone spends more time with trying to correct what they wrote. Also this case were caused spend more electrical energy. And also that were caused emit more CO_2 and pollute environment more than today. That algorithm is smart, simple and basic. However, it has countless benefits in the other hand.



About 11,900 results (1.00 seconds)

Did you mean: *searches*

Southeast Asian Cultural Heritage Society (**SEACHS**) - Surrey, BC ...
https://www.facebook.com/southeastasianculturalheritagesociety
Southeast Asian Cultural Heritage Society (**SEACHS**), Surrey, BC. 177 likes · 3 talking about this · 3 were here.

SEACHS (SEACHS8888) on Twitter
https://twitter.com/**SEACHS**8888
The latest from **SEACHS** (@SEACHS8888). The Southeast Asian Cultural Heritage Society (**SEACHS**) is a non-profit registered in BC since 2009. We got a long ...

Figure 1

In the big picture, recognizing and correcting algorithms become very popular and this makes human's life easier as it can be seen from the first paragraph. Also algorithms connect to Artificial Intelligence, and Machine Learning. Obviously, these technologies are changing and with no doubt, they will change the world either.

Python programming language [5] were used in this project because of five reasons. First, easy syntax. Second, useful commands. Third, flexible and useful functions. Fourth, useful and flexible data structures and functions. Fifth, the programming language is very useful to create project like this.

PyCharm [6] Compiler and Python shell were used [7] in this project because of the easy usage and free license.

2. STATEMENT OF PROBLEM

Time is an importance for people which cannot waste recklessly. The reason why technology was existed is this opinion. Humans want to save their time. Also they want to save their energy. With these desires, they invent and develop. So, trying to create something which practical and facilitate must be main goal for engineers.

In 21th century, with existence of internet and computer, people wasting their life in internet. They playing, watching, reading, surfing, writing and searching. This situation is a good opportunity to develop something useful for people which about internet.

Internet gives to people some opportunities. This opportunities include easy way to search something. When user enter what it want to learn about to search engine, a hundreds of searching results which connected to user's word was displayed on computer screen in seconds. These results depend on what user's write and it is an inevitable situation that some mistakes are occurred. Normally, user have to notices it's mistake and have to rewrite correctly what it wrote before. But another way can be possible. This way including a software. A kind of program which corrects mistakes in user's words that it entered the searching engine instead of user. With some proper codes this program can facilitate using of internet.

In conclusion, this project will be helpful to many internet users by understand them correctly and completely beside to other assistances which belong to internet.

3. OBJECTIVES

Actually, this project has 4 main part as it mentioned before. In addition, function must include the way of

1. Creating word database
2. Creating essential functions which are length, compare_count, combination, permute, readfile_word.
3. Taking a word from user and get all combinations of word
4. Compare the combinations of word with words in the database
5. Displaying result

The database was created manually by .dat files. The database was created just for the English language because of the limited time and the fact of most spoken language is English around the world. The database has 8 word files.

The first part exists from 8 file; one_letter, two_letter, three_letter, four_letter, five_letter, six_letter, five_letter, seven_letter, common_words.

1. one_letter file includes one letter words.
2. two_letter file includes two letter words.
3. three_letter file includes three letter words.
4. four_letter file includes four letter words.
5. five_letter file includes five letter words.
6. six_letter file includes six letter words.
7. seven_letter file includes seven letter words.
8. three_letter file includes common words in English.

After creating files, it reads from file and it assigns to the lists which are called same with files such as: one_letter_list, two_letter_list, three_letter_list, four_letter_list, five_letter_list, six_letter_list, five_letter_list, seven_letter_list, common_words_list. After that's, words can be used in the program.

You can reach to files in GitHub environment from these link.

https://github.com/EnesErten/Spellcheckalgorithm/blob/master/two_words.dat

https://github.com/EnesErten/Spellcheckalgorithm/blob/master/three_words.dat

https://github.com/EnesErten/Spellcheckalgorithm/blob/master/six_word.dat

https://github.com/EnesErten/Spellcheckalgorithm/blob/master/seven_word.dat

https://github.com/EnesErten/Spellcheckalgorithm/blob/master/one_word.dat

https://github.com/EnesErten/Spellcheckalgorithm/blob/master/four_word.dat https://github.com/EnesErten/Spellcheckalgorithm/blob/master/five_words.dat

https://github.com/EnesErten/Spellcheckalgorithm/blob/master/common_words.dat

This program includes 4 functions and main. These functions are described as permute, combination, length, and compare_count.

Permute function is a recursively function. It assigns result list for all permutations of string. This function's algorithm is simple. It uses swap operations to change letters and get permutations of string. For instance, "ABC" string will assigned to the ["ABC,"BCA","ACB","BAC","CAB","CBA"] result list. It can be seen clearly with flowchart.

- **Permute function flowchart**

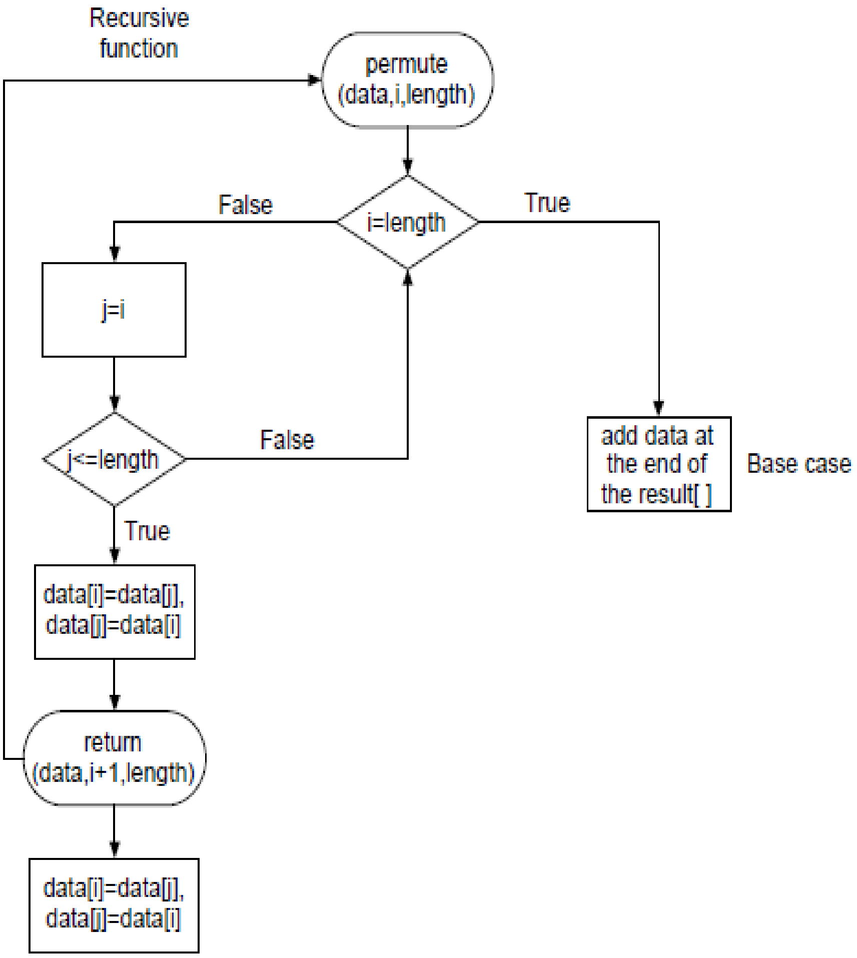


Figure 2

The second function is a combination function. This function is also a recursively function. It gets combinations of a string. For instance, if "ABC" string was sendt to function, it will returned ['', 'A', 'B', 'AB', 'C', 'AC', 'BC', 'ABC'] . If combinations and permutations were summed up, all combinations of string were came up.

- **Combination function flowchart**

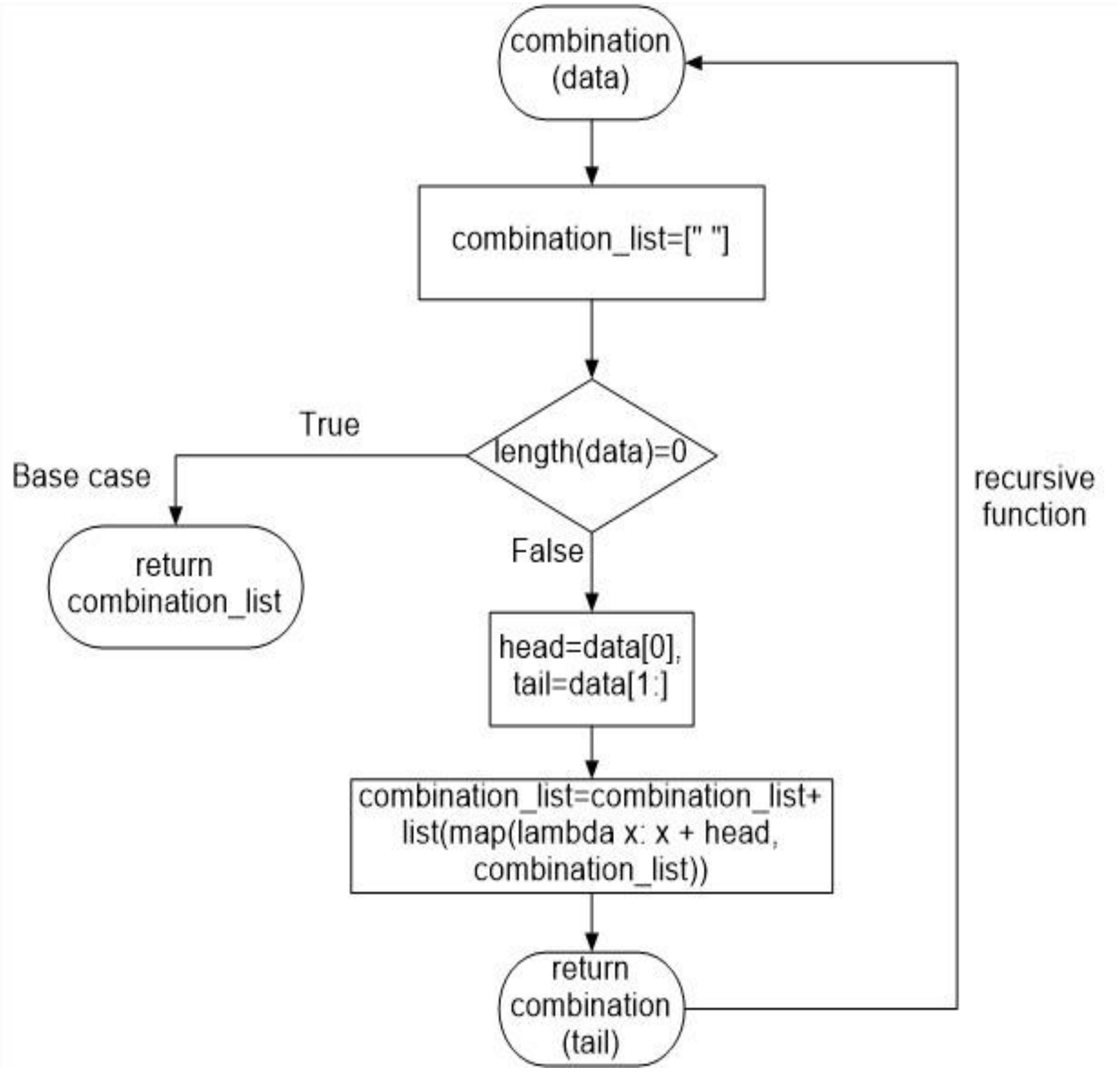

combination (data)
combination_list=[" "]
True
Base case
length(data)=0
recursive function
return combination_list
False
head=data[0], tail=data[1:]
combination_list=combination_list+ list(map(lambda x: x + head, combination_list))
return combination (tail)

Figure 3

The length functions returns the length of list, string, etc. It is worked iteratively it is counting all the elements of string, list, etc.

- **Length function flowchart**

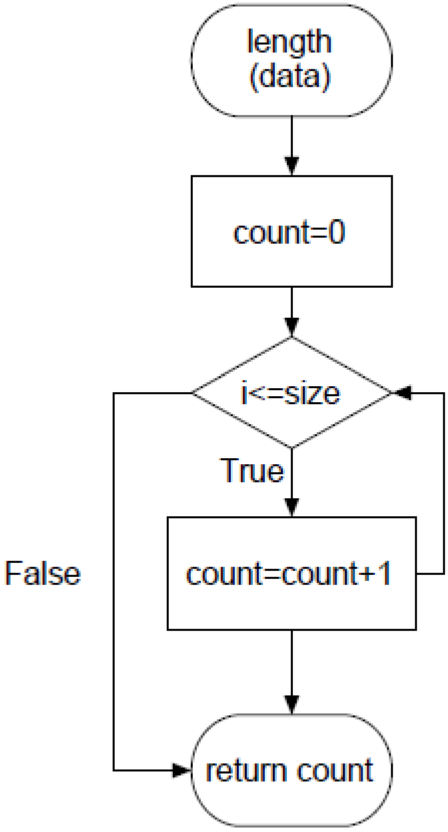


Figure 4

The compare_count function compares how many letters are same in two strings and it returns the number of the same letters.

- **Compare_count function flowchart**

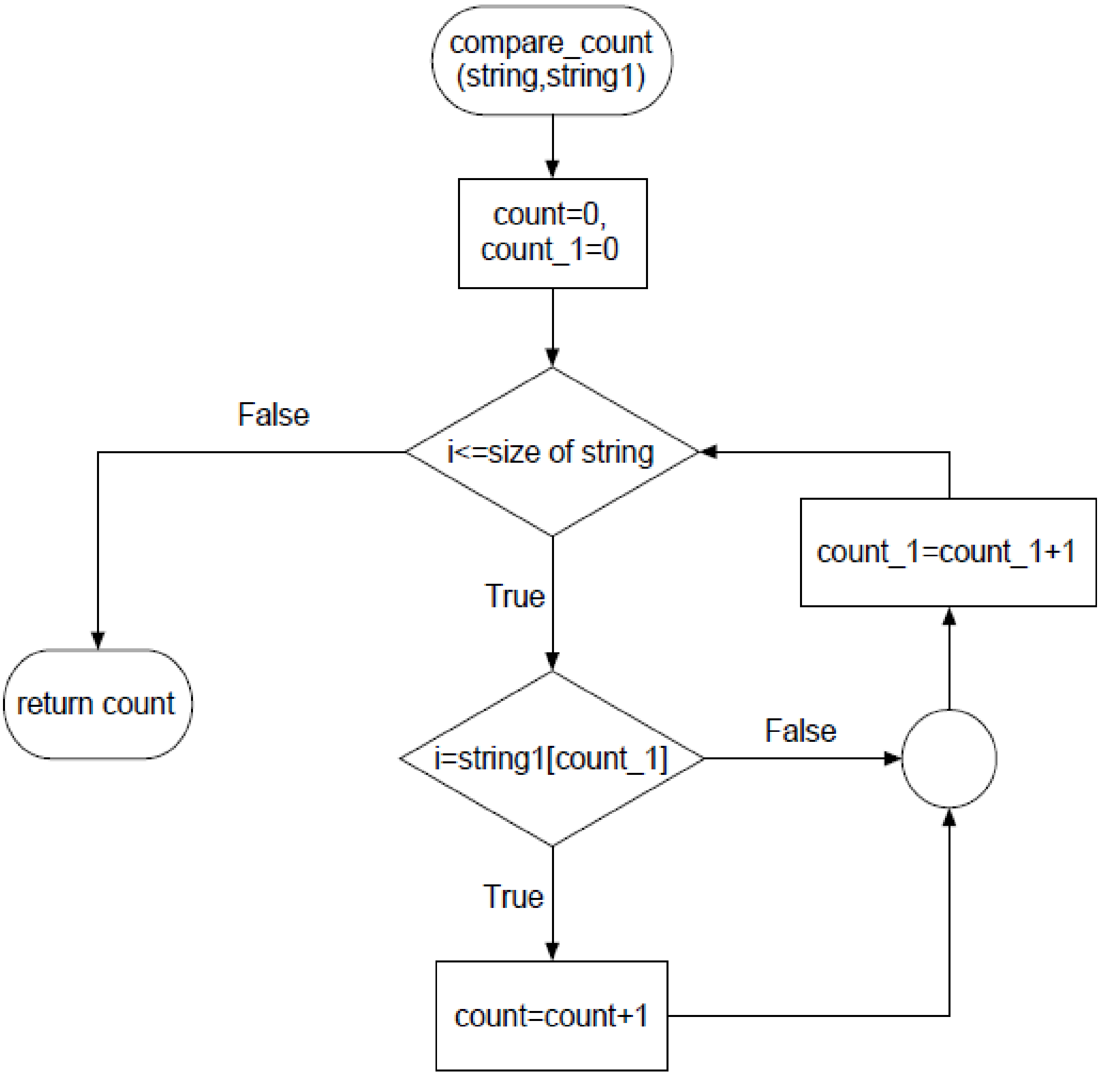


Figure 5

The main function is gets a list which include the combination and permute results. Then searches in the word database. At the end, it displays the results.

- **The flowchart of the main function**

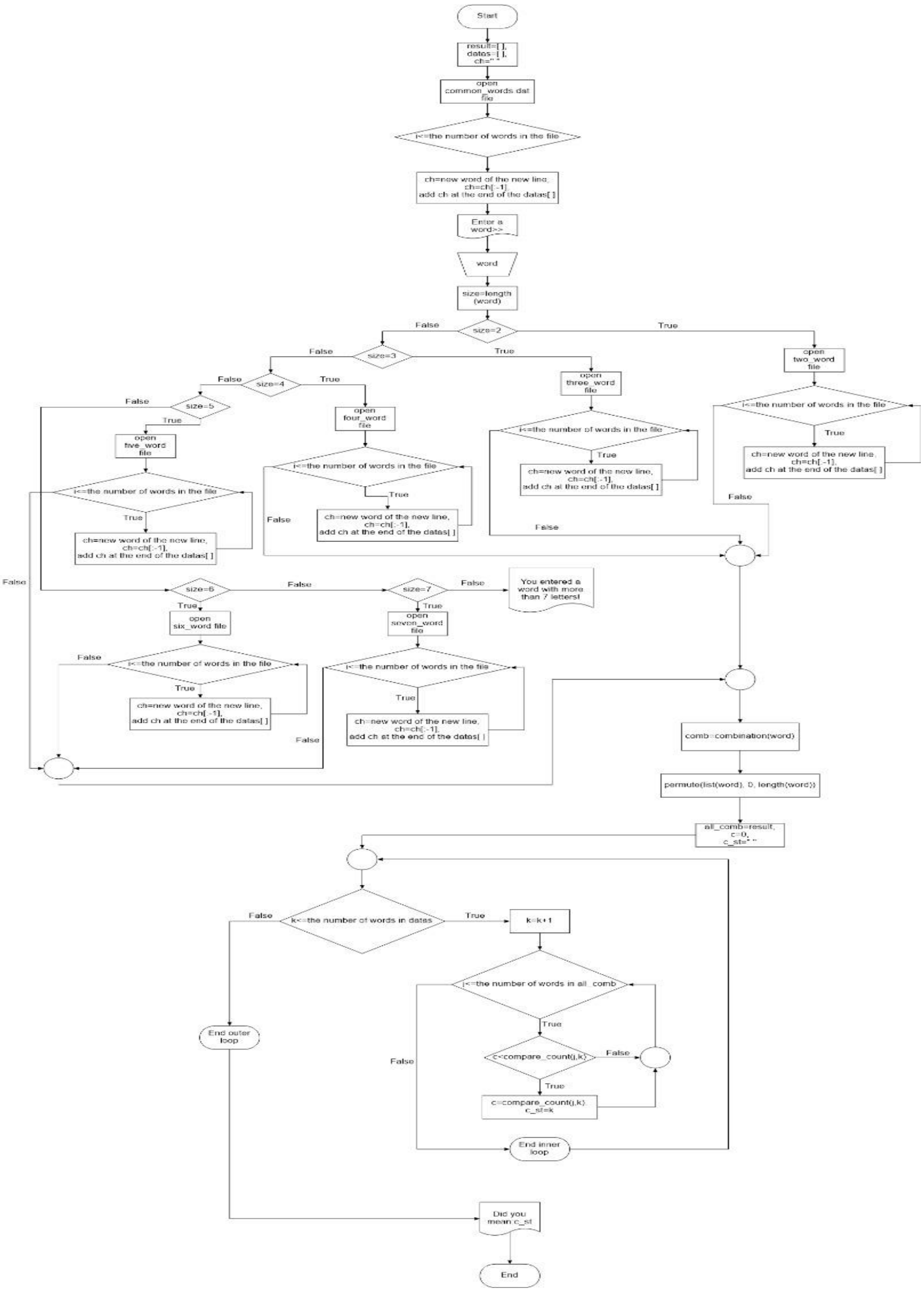


Figure 6

4. TECHNICAL APPROACH

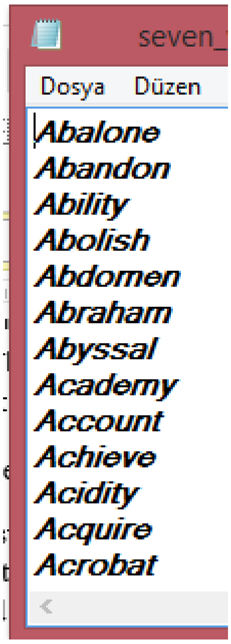
Nowadays, computers and software are becoming inseparable in lifetime. Almost all of the houses have more than one computer and have a number of software. Computers and software are making life easier.

Identifying Customer Needs

As mentioned many time in the report, a little mistake about any word can be caused loss of time and energy. This amount of loss can be enormous. This project offers an algorithmic solution and creates the program of algorithm.

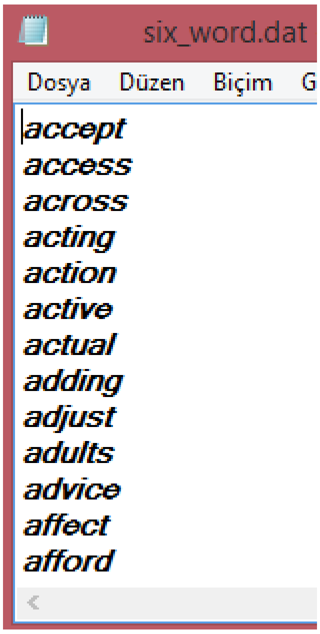
Generating Design Concepts

Firstly, this project is needing thousands of classified words. Creating these words's database is the important pillar of this structure. These words were found in the Cambridge dictionary [1] and they were used in the classified in the .dat files. The classification is the length of the words's:



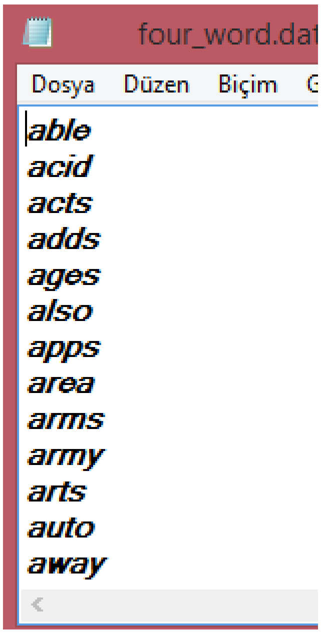
Abalone
Abandon
Ability
Abolish
Abdomen
Abraham
Abyssal
Academy
Account
Achieve
Acidity
Acquire
Acrobat

Figure 7



accept
access
across
acting
action
active
actual
adding
adjust
adults
advice
affect
afford

Figure 8



able
acid
acts
adds
ages
also
apps
area
arms
army
arts
auto
away

Figure 9

Getting all combinations of the words in real life is very easy. However, creating an algorithm about word combinations is more complicated than real life. In this project, two functions were created to get all of the combinations of a word. These are permute (figure 2) and combinations (figure 3) functions.

Permute function

```
def permute(data, i, len):
    if i == len:
# base case
        result.append(".join(data))
        # append the list

    else:
        # swap operation

        for j in range(i, len):
            # swap values
            data[i], data[j] = data[j], data[i]
            # recursively call
            permute(data, i + 1, len)
            # after recursively call
            data[i], data[j] = data[j], data[i]
```

Combination function

```
def combination(data, combination_list=[""]):
    if length(data) == 0:
        # base case
        return combination_list
        # return comblist
    head, tail = data[0], data[1:]
    # head tail head is keeping the firs element of the data
    # tail is keeping the rest of string
    combination_list = combination_list + list(map(lambda x: x + head, combination_list))
    # shuffling the words
    return combination(tail, combination_list)
    # recursively call
```

Length function is counting the letters of the word.

length function

```
    def length(data):
    # create a counter initialize to 0
    count = 0
    # for loop loops data times
    # make data to list
    for i in list(data):
        # count the elements of list(data)
        count += 1

    # return the count length of the string
    return count
```

compare_count function is comparing by letter and counting how many letter is the same place in two string.

compare_count function

```
def compare_count(string, string1):
    # import library collections
    # use Counter functions
    from collections import Counter

    return sum((Counter(string) & Counter(string1)).values())
    # return the number of common letters
```

The main function opens a file which is makes a proper decide to that. However current algorithm hasn’t finished yet. This is the reason of the code which is below is the demo version of the original code.

```
if __name__ == "__main__":
    result = []
    datas = []

    # assign ch ""
    ch = ""
    # open file common_words.dat
    with open("common_words.dat", "r") as file:
        # loops 1000 times
        for i in range(1001):
            # read one line
            ch = file.readline()
            # take len-1
            ch = ch[:-1]
            # append to the list
            datas.append(ch)

    # take string from user
    word = input("Enter a word\n>>")
    # send to the function
    comb = combination(word)
    # send to the function
    permute(list(word), 0, length(word))
    # get all combinations
    all_comb = result
```

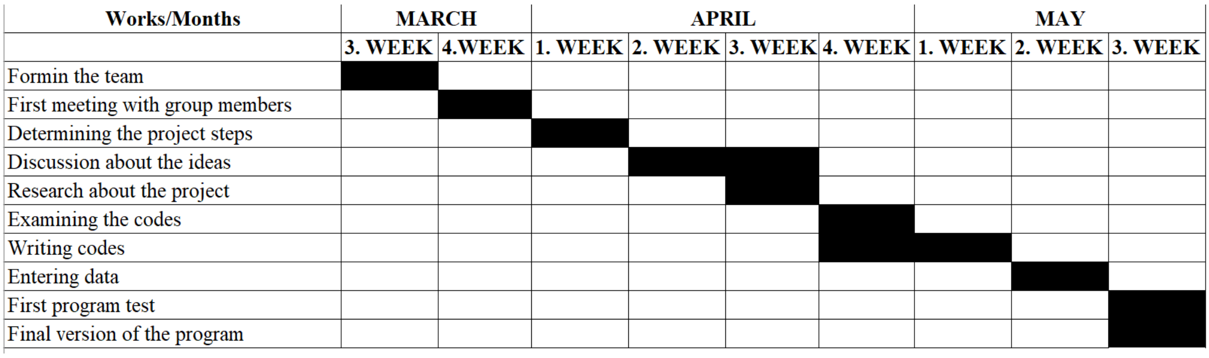
```
# assign 0 and ""
c = 0
c_st = ""

# for loop, loops datas
for k in datas:
    # for loop, loops all_comb
    for j in all_comb:
        # if statement is true
        if c < compare_count(j, k):
            # update c value
            c = compare_count(j, k)
            # update c_st
            c_st = k

# display the result
print("Did you mean : ", c_st)
```

The addition to that demo will be decide the word length and open read file of the word if word doesn’t found look different word data’s.

Selecting Design Object

As it mentioned before all the algorithm is ready. However, the main function just need an upgrade. Lengths of the words and capital letter determinations will be upgraded.

5. PROJECT MANAGEMENT



Works/Months	MARCH		APRIL				MAY		
	3. WEEK	4.WEEK	1. WEEK	2. WEEK	3. WEEK	4. WEEK	1. WEEK	2. WEEK	3. WEEK
Formin the team	■								
First meeting with group members		■							
Determining the project steps			■						
Discussion about the ideas				■	■				
Research about the project					■				
Examining the codes						■			
Writing codes						■	■		
Entering data								■	
First program test									■
Final version of the program									■

Figure 10: Gantt chart for the project. Painted areas show that the job has been done successfully.

Deliverables

This program provides convenience for anyone who wants to research any phrases at the Internet. The feature of this program is translating the typed word into the closest and most meaningful word to the user’s write and return to the user with the correct word. This condition provides great convenience for internet users.

Budget

There is no need any budget because of program was produced and used digitally. This situation is one of the most useful feature of program. The amount of money which spent on making such a convenience is zero.

Team Qualifications

In this section qualifications and duties of team members are stated.

Enes ERTEN **:** Dokuz Eylül University

Electric and Electronic Engineering

A student from first grade

- Organized the team.
- Wrote the main code.
- Wrote the functions
- Wrote the sections Abstract in the report.

Kutlu Uzay YENİDOĞAN **:** Dokuz Eylül University

Electric and Electronic Engineering

A student from first grade

- Arranged the first meeting of the group members.
- Wrote the sections Objectives in the report.
- Helped the code writing phase.
- Drawn the flowchart in report.

Beyza KARACA **:** Dokuz Eylül University

Electric and Electronic Engineering

A student from first grade

- Determined how the project would proceed.
- Wrote Statement of Problem and Technical approach sections.
- Translated some article about project.
- Improving some parts of report

Atakan Ertuğrul **:** Dokuz Eylül University

Electric and Electronic Engineering

A student from first grade

- Made the distribution of tasks in project.
- Wrote the sections Executive Summary and Conclusion in report.
- Edited the references section.
- Improve some parts of report.

Fatih Korkmaz **:** Dokuz Eylül University

Electric and Electronic Engineering

A student from first grade

- Arranged the group member’s second online meeting.
- Wrote the Statement of Problem and Project Management parts.
- Improve some parts of report.

6. CONCLUSION

There are a number of words which are written in search engine. Sometimes they are written wrong and sometimes they are written properly.

Google developed an algorithm called “Did You Mean” in case of writing a wrong word in search engine. This algorithm is a genius code and it need to develop and examination. This project is trying to describe “Did You Mean” algorithm.

Writing this algorithm’s code in C language is quite difficult so using Phyton is a more sensible way in this situation. Selecting a project about programming and algorithms will be more beneficial for freshmen students and this way is more cheap so everyone of us agreed in this project. The main goal is find a solution that prevent to loss of time and energy. This project is a kind of program that recognize word and correct them if there is a mistake.

7. REFERENCES

[1] Cambridge Dictionary, [online] [Citied May 25.05.2020] World Wide Web: https://dictionary.cambridge.org/

[2] Cambridge Dictionary, [online] [Citied May 25.05.2020] World Wide Web: https://dictionary.cambridge.org/dictionary/english-turkish/search-engine

[3] Google Search Engine, [online] https://www.google.com/

[4] Google , [online] https://www.google.com/search?sxsrf=ALeKk02HraoUYJCns1gYVpFCYpk7CKFgWA%3A1590143224109&ei=KjHXqmvBoeWaOK0u8AK&q=seaches&oq=seaches&gs_lcp=CgZwc3ktYWIQAzIECCMQJzIICAAQBxAKEB4yCAgAEAcQChAeMgQIABAKMgIIADIECAAQCjIECAAQCjIECAAQCjIECAAQCjIECAAQCjoECAAQRzoGCAAQBxAeOgUIABDLAToFCAAQkQI6BwgAEBQQhwJQmB9YvDpgokpoAHABeACAAboBiAGlBJIBAzAuM5gBAKABAaoBB2d3cy13aXo&sclient=psy-ab&ved=0ahUKEwipi4QocfpAhUHCxoKHWLaDqgQ4dUDCAw&uact=5

[5] Python programming Language**,** https://www.python.org/

[6] PyCharm Compiler, https://www.jetbrains.com/pycharm/, ver. 3.8.3, JetBrains

[7] Python Shell, https://www.python.org/downloads/, ver. 3.8.3 , Python

DECLARATION

I have contributed to the writing of this Project Proposal. I have carefully read the whole Project proposal document and declare that this report contains no other person's work which has been used without due acknowledgement in the main text of the proposal.

Name of Group Member	Signature
1) Atakan Erugrul	
2) Beyza Karaca	
3) Enes Erten	
4) Fatih Korkmaz	
5) Kutlu Uzay Yenidogan	