Regular Expression

Introduction

We need to extract rquired information from given data.

Searching the required data can be effectively carried out using REGULAR EXPRESSION.

Definition:

> Regular expression is a string that contains special symbol and characters to find and extract the information needed by user from given data

Regular Expression helps to **search** information, **match, find and split** information as per requirement

It is simply called as ***regex***

It is available in many languages like Java, Perl, AWK, Python

Python provides **module re** for regular expression. It needs to be imported for using methods to perform operations

How to write Regular Expression?

Regular Expression is a string containing characters and special symbols

It can be represented

> **1. As a raw string**: Use 'r' before normal string

> **2. Using backslashes**: Use backslash before any escape sequence

Whenever a normal string is written including escape sequences then it has formatting information.

```
st = "This is normal \nString"
print(st)
```

The above code interpretes \n as new line character and gives output as

```
This is normal
String
```

Therefore in order to represent regular expression using symbols '' we need to treat the strings as a raw string.

Otherwise formatting information can be skipped using double backslashes.

Example:

```
reg = r'm\w\w'             # Treat the string as a raw string
reg1 = 'm\\w\\w'           # Normal string using double back slashes
```

How to interpret Regular Expression

Let us take an example to understand the meaning of regular expression

```
reg = r'm\w\w'
```

The preceding 'r' represents that it is a raw string.

> The first character in the string is 'm'. It tells that **first character must be 'm' only**.

> The second character '\w' represents any one character **in A to Z, a to z and 0 to 9.**

> The third character is also '\w'. So it is expected to be **alphanumeric**

Hence, above Regular Expression is representing string with length three and it is starting with character 'm'. Next two charcters could be alphanumeric.

Note: '\w' is called as sequence characters

Sequence Characters in Regular Expression

Character	Description
\d	Represents any digit 0 to 9
\D	Represents any non-digit
\s	Represents white space E.g. \t \n \r \f \v
\S	Represents non – white space character
\w	Represents any alphanumeric (A to Z, a to z, 0 to 9)
\W	Represents non – alphanumeric
\b	Represents space around the word
\A	Matches only at the start of the string
\Z	Matches only at the end of the string

Note:

> Each of these sequence characters represents a single character matched in the string

> If we want to repeat sequence characters then Quantifiers will be used

Quantifiers in Regular Expression

Character	Description
+	1 or more repetition of the preceding group
*	0 or more repetition of the preceding group
?	0 or 1 repetition of the preceding group
{m}	Exactly m occurrences
{m, n}	From m to n occurrences. m defaults to 0. n to infinity

Example:

\w indicates any one alphanumeric character

[\w]* represents 0 or more occurrences of alphanumeric characters

[\w]+ represents 1 or more occurrences of alphanumeric characters

[\w]{5} represents alphanumeic character will be repeated 5 times

[\w]{4,} represents strings with minimum lenght 4 and all characters are alphanumeric. Maximum lengh can be anything above 4.

[\w]{4,7} represents strings with minimum lenght 4 and maximum length will be 7. all characters are alphanumeric.

Steps to use regular expression

> 1. Import module 're'
>
> 2. Create a regular expression for required data
>
> 3. Compile expression using compile( ) method
>
> 4. Perform required operation (match, search, findall, split, sub) on given data using compiled object and store result as object.
>
> 5. Apply group( ) method on the result object to get desired output

Compiled object can be used to perform operations on different set of data

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Example 1: To search pattern with length three in which first character is 'm' followed by any two alphanumerals

```
import re              # Step 1

st = r"m\w\w"          # Step 2

prog = re.compile(st)  # Step 3

# Step 2 and 3 can be combined as
# prog = re.compile(r"m\w\w")

data = "cat mat bat rat"                        # given data

result = prog.search(data)                      # Step 4

print("search result on data1:", end ="")
print(result.group())                           # Step 5

# prog contains compiled object for given regular expression.
# It can be applied on different set of data as well

data2 = "Operating System format"

print("search result on data2:", end ="")
result2 = prog.search(data2)
print(result2.group())
```

```
     search result on data1:mat
     search result on data2:mat
```

Single Step Compilation of Regular Expression

The general syntax can be written as:

```
<obj> = re.<method>('expression','string')
```

Here

obj: To store the result of operation

method: Any suitable method from module 're'

expression: Regular Expression to match the pattern

string: The data on which the operation will be performed

The search operation in Example 1 can be written as

```
result = re.search(r'm\w\w', st)
```

The above code is equivalent to

```
prog = re.compile(r'm\w\w')
result = prog.search(st)
```

Operations performed using Regular Expression

Operation	Method	Description
Matching strings	match ()	• Searches in the beginning of the string • If the matching string is found, it returns an object that contains the resultant string • If the matching string is not found then it returns none • group () method is used to access the string from returned object
Searching for strings	search ()	• Searches the string from beginning till the end • It returns first occurrence of the matching string otherwise returns none • group () method is used to access the string from returned object
Finding all strings	findall ()	• Searches the string from beginning till the end • Returns all occurrences of the matching string in the form of list object • If the matching string is not found then it returns empty list • All strings from the list can be retrieved using for loop
Splitting string into pieces	split ()	• Splits the string according to the regular expression • Resultant pieces are returned as a list • If there are no string pieces then it returns empty list • All string pieces can be retrieved from list using for loop
Replacing string	replace ()	• Substitutes (or replaces) new strings in the place of existing strings • After substitution, the main string is returned by this method

Program 1: Program to create a regular expression to search for string starting with m and total 3 characters using search( ) method

```
import re

st = 'man sun mop run'
result = re.search('m\w\w',st)     # search method returns only the first occurrence of th

if result:                  # If object is not null
  print(result.group())
```

```
     man
```

Program 2: Program to create a regular expression to search for string starting with m and total 3 characters using findall( ) method

```
import re

st = 'man sun mop run'
result = re.findall('m\w\w',st)     # findall method returns all the occurrence of the pat

print(result)
```

```
     ['man', 'mop']
```

Program 3: Program to create a regular expression to search for string starting with m and total 3 characters using match( ) method

```
import re

# Pattern is at the start of data
st = 'man sun mop run'
result = re.match('m\w\w',st)

print(result.group())

# Pattern is present in between
st2 = 'sun man mop run'
result = re.match('m\w\w',st2)

print(result)
```

```
     man
     None
```

Program 4: Program to create a regular expression to split a string into pieces where one or

```
import re

st = 'This; is the; "Core" Python\'s book'
result = re.split(r'\W+', st)
print(result)
```

```
['This', 'is', 'the', 'Core', 'Python', 's', 'book']
```

Program 5: Program to create a regular expression to replace a string with a new string

```
import re
st = 'Calcutta is the capital of West Bengal'
res = re.sub(r'Calcutta', 'Kolkata', st)
print(res)
```

```
Kolkata is the capital of West Bengal
```

Program 6: Program to create a regular expression to retrieve all words starting with a in the given string

Regular expression can be:

r'a[\w]*' - Here first character is a followed by any number of alphanumerals

But above expression will identify substrings(part of the word) as well.

In order to get entire word then regular expression must be

r'\ba[\w]*\b - First \b and last \b tells that before and after the pattern there must be blank space

```
import re

st = 'an apple a day keeps the doctor away'
result = re.findall(r'a[\w]*', st)                # Regular Expression that finds all subs

print('Result for all substrings:')
for word in result:
  print(word)


result2 = re.findall(r'\ba[\w]*\b', st)                # Regular Expression that finds all

print('Result for all words:')
for word in result2:
  print(word)
```

```
Result for all substrings:
an
apple
```

```
a
ay
away
Result for all words:
an
apple
a
away
```

Program 7: Program to create a regular expression to retrieve all words starting with a numeric digit

Regular expression can be:

r'\d[\w]* - The first character is digit followed by any number of alphanumerals

```
import re

st = 'The meeting will be conducted on 1st and 21st of every month'
result = re.findall(r'\d[\w]*', st)                # Regular Expression that finds all sub

print('Result for all substrings:')
for word in result:
  print(word)
```

```
Result for all substrings:
1st
21st
```

Program 8: Program to create a regular expression to retrieve all words having 5 characters length

Regular expression can be:

r'\b\w{5}\b - There are five alphanumerals which are preceded and succeeded by blank spaces

```
import re

st = 'One Two Three Four Five Six Seven 8 9 10'
result = re.findall(r'\b\w{5}\b', st)                # Regular Expression that finds all s

print('Result:',result)
```

```
Result: ['Three', 'Seven']
```

Program 9: Program to create a regular expression to retrieve all words having 5 characters length using search ( ) method

```
import re
```

```
st = 'One Two Three Four Five Six Seven 8 9 10'
result = re.search(r'\b\w{5}\b', st)          # search method returns only the first occ

# To retrieve the word from result object, use group ()
print(result.group())

     Three
```

Program 9: Program to create a regular expression to retrieve all words having different range of length

Following regular expressions are used

r'\b[\w]{4,}\b' - It finds all the words with minimum length 4

r'\b[\w]{3,5}\b' - It finds all the words with minimum length 3 and maximum length 5

```
import re

st = 'One Two Three Four Five Six Seven 8 9 10'

result = re.findall(r'\b\w{4,}\b', st)            # words with minimum length 4
print('Words with minimum length four:',result)

result2 = re.findall(r'\b\w{3,5}\b', st)            # words with minimum length 3 and max
print('Words with minimum length three and max lenght five :',result2)

     Words with minimum length four: ['Three', 'Four', 'Five', 'Seven']
     Words with minimum length three and max lenght five : ['One', 'Two', 'Three', 'Four',
```

Program 10: Program to create a regular expression to retrieve only single digit from string

```
import re

st = 'One Two Three Four Five Six Seven 8 9 10'
result = re.findall(r'\b\d\b', st)

print(result)

     ['8', '9']
```

Program 11: Program to create a regular expression to retrieve the last word of a string starting with T

```
import re

st = 'One Two Three'
result = re.findall(r'T[\w]*\Z', st)
```

```
print(result)

     ['Three']
```

Program 12: Program to create a regular expression to retrieve the phone number of a person and name of the person separately

Regular Expression can be used as:

r'[\d]+': One or more occurrences of digit

r'[\D]+: One or more occurrences of non Digit

```
import re

st = 'Abhijit: 9820123122'

res = re.search(r'\d+', st)
print("Phone Number of Person:",res.group())

res1 = re.search(r'\D+', st)
print("Name of Person:",res1.group())

     Phone Number of Person: 9820123122
     Name of Person: Abhijit:
```

Program 13: Program to create a regular expression to find all the words starting with an or ak.

Regular Expression can be used as:

r'a[nk][\w]*' : Here first character is a. Then any character from [nk] can be selected. It is followd by any number of alphanumeric characters

```
import re

st = 'anil akhil anant arun arati arundhati abhijit ankur'
result = re.findall(r'a[nk][\w]*', st)

print(result)

     ['anil', 'akhil', 'anant', 'ankur']
```

Program 14: Program to create a regular expression to retrieve date of birth from a string

Regular Expression can be used as:

r'[\d]{2}-\d{2}-\d{4}' : Here first two digits are followed by'-'. Then next two digits are followed by '-'. At the last four digits will be checked

```
import re
```

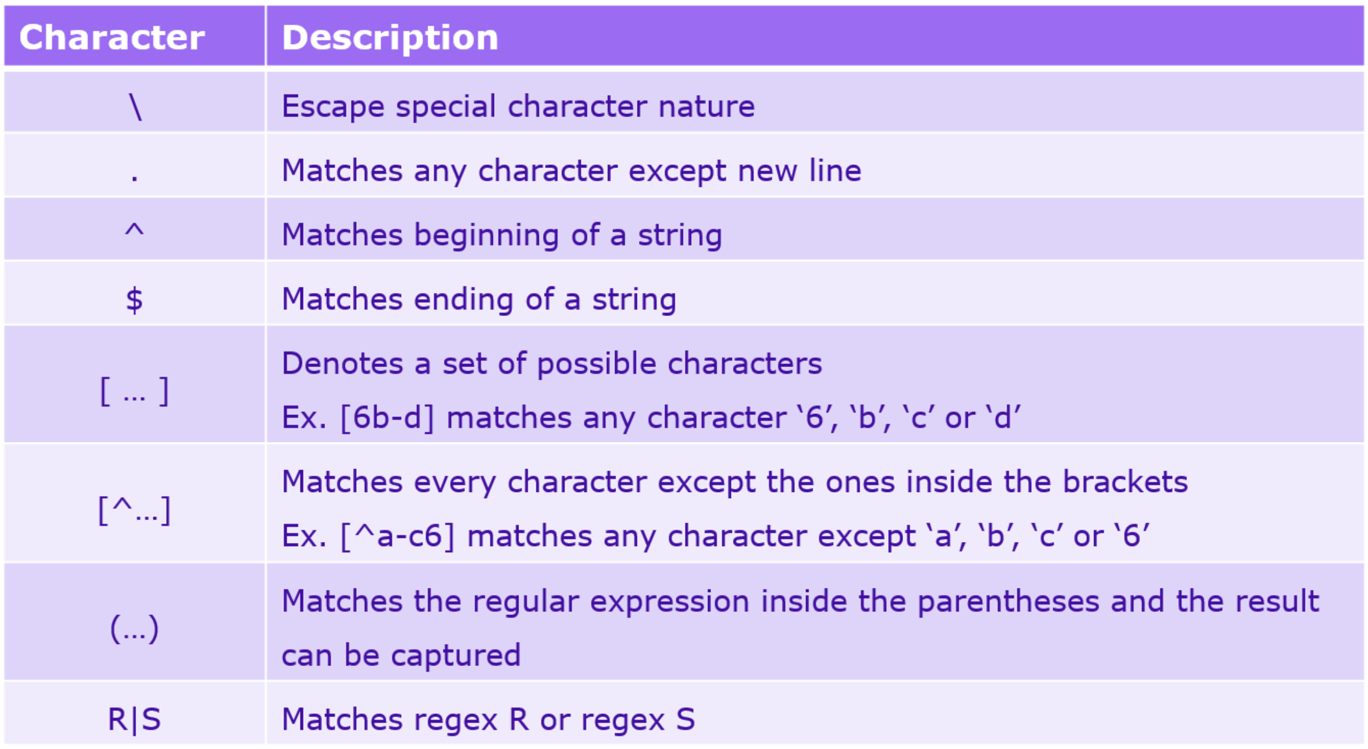
```
st = 'Vijay: 1-1-2001, Rohit: 22-10-1990, Sita: 15-09-2000  '

result = re.findall(r'[\d]{2}-\d{2}-\d{4}', st)
print("Expression 1:",result)

result2 = re.findall(r'[\d]{1,2}-\d{1,2}-\d{4}', st)
print('Expression 2:',result2)
```

```
     Expression 1: ['22-10-1990', '15-09-2000']
     Expression 2: ['1-1-2001', '22-10-1990', '15-09-2000']
```

First Date is not retrieved in result as it is not following the format.

All the dates are retrieved for second regular expression

Special Characters in Regular Expression



Character	Description
\	Escape special character nature
.	Matches any character except new line
^	Matches beginning of a string
$	Matches ending of a string
[...]	Denotes a set of possible characters Ex. [6b-d] matches any character '6', 'b', 'c' or 'd'
[^...]	Matches every character except the ones inside the brackets Ex. [^a-c6] matches any character except 'a', 'b', 'c' or '6'
(...)	Matches the regular expression inside the parentheses and the result can be captured
R|S	Matches regex R or regex S

Program 15: Program to create regular expression to search whether string is starting with 'He' or not

```
import re

st = "Hello World"

res = re.search(r'^He',st)
if res:
  print("String starts with He")
else:
  print("String does not start with He")
```

```
    String starts with He
```

Program 16: Program to create regular expression to search whether string is ending with 'World' or not

```
import re

st = "Hello World"

res = re.search(r'world$',st)         # Here w is in lowercase

print("Case sensitive output:")
if res:
  print("String ends with 'World'")
else:
  print("String does not end with 'World'")


res2 = re.search(r'world$',st, re.IGNORECASE)         # Here case of letter is ignored

print("Case is ignored output:")
if res2:
  print("String ends with 'World'")
else:
  print("String does not end with 'World'")
```

```
    Case sensitive output:
    String does not end with 'World'
    Case is ignored output:
    String ends with 'World'
```

Program 17: Program to create regular expression to retrieve marks and names from a given string

```
# Displaying Marks and Names
import re

st = 'Rahul got 75 marks Vijay got 55 marks, whereas Subhash got 98 marks.'

# Extract marks with 2 digits.
marks = re.findall(r'\d{2}', st)
print(marks)

# Extract names starting with a capital letter
# and remaining alphabetic character
names = re.findall(r'[A-Z][a-z]*', st)
print(names)
```

```
    ['75', '55', '98']
    ['Rahul', 'Vijay', 'Subhash']
```

Program 18: Program to create regular expression to retrieve the timings either 'am' or 'pm'

```
import re
st = 'The meeting may be at 8 am or 9 am or 4 pm or 5 pm'

res = re.findall(r'\d\sam|\d\spm',st)
print(res)
```

```
    ['8 am', '9 am', '4 pm', '5 pm']
```

Using Regular Expression on Files

Regular Expression can be applied on Files. Files consists of multiple strings. The searching, matching operations can be performed on these strings.

There are three steps:

1. Open the file to read its content

```
f = open('<filename>','r')
```

2. Read line by line from file object f and apply regular expression on it

```
for line in f:
   res = re.findall(regexpression, line)
```

3. Check the size of resultant object. If it is greater than zero then display the content.

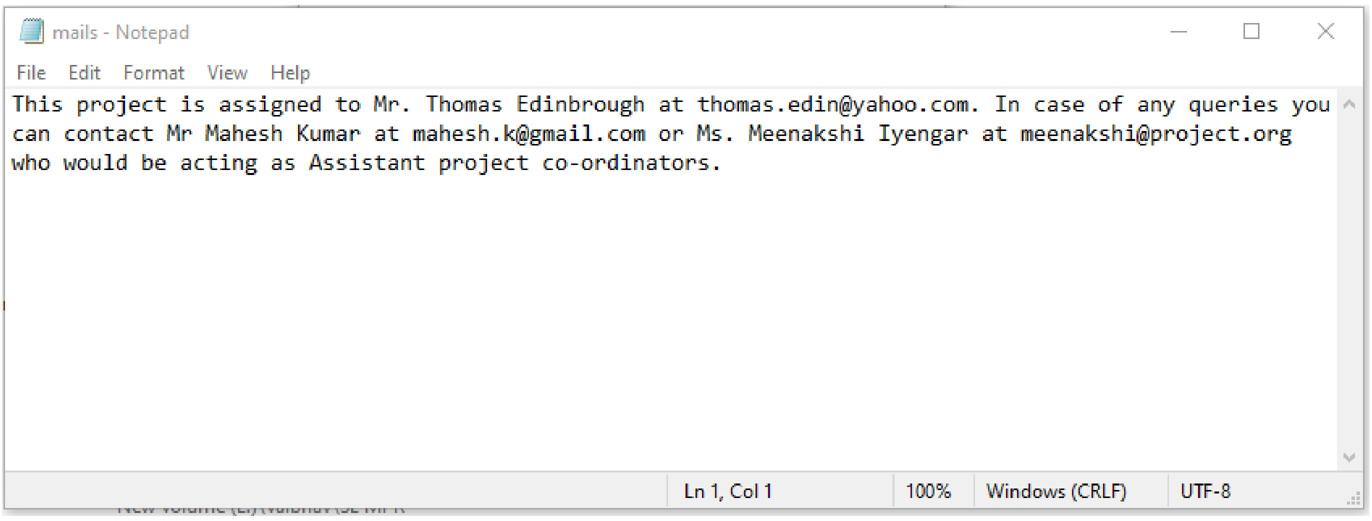
```
if len(res) > 0 :
   print(res)
```

4. Close the file

```
f.close()
```

Program 19: Program to create regular expression that reads email-ids from text file

The contents of file is shown below



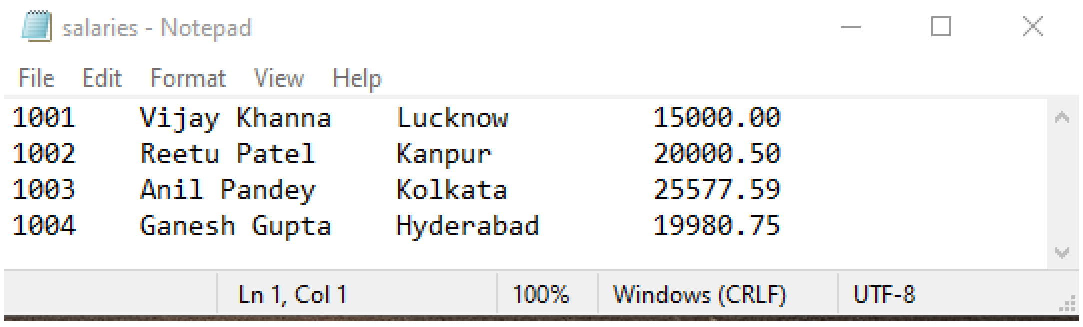
```
This project is assigned to Mr. Thomas Edinbrough at thomas.edin@yahoo.com. In case of any queries you
can contact Mr Mahesh Kumar at mahesh.k@gmail.com or Ms. Meenakshi Iyengar at meenakshi@project.org
who would be acting as Assistant project co-ordinators.
```

```python
import re

# Open the file for reading
f = open('mails.txt','r')

# Repeat for each line of the file
for line in f:
  res = re.findall(r'\S+@\S+', line)

# Display if there are some elements in result
if len(res) > 0:
  print(res)

# Close the file
f.close()
```

```
['thomas.edin@yahoo.com.', 'mahesh.k@gmail.com', 'meenakshi@project.org']
```

Program 20: Program to retrieve data from file using Regular Expression and then write data into file

The content of file is shown as below



```
1001    Vijay Khanna    Lucknow     15000.00
1002    Reetu Patel     Kanpur      20000.50
1003    Anil Pandey     Kolkata     25577.59
1004    Ganesh Gupta    Hyderabad   19980.75
```

```python
import re

# Open the files
```

```
f1 = open('salaries.txt','r')
f2 = open('newfile.txt','w')

# Repeat for each line in f1
for line in f1:
  res1 = re.search(r'\d{4}',line)           # Extract id from file
  res2 = re.search(r'\d{4,}.\d{2}', line)   # Extract salary from file
  print(res1.group(),res2.group())          # Display the extracted content
  f2.write(res1.group()+"\t")               # Write id into file
  f2.write(res2.group()+"\n")               # Write salary into f2

# Close the file
f1.close()
f2.close()

# To read the content of new file
f = open('newfile.txt','r')

print('\nThe content of new file')
for line in f:
  print(line,end='')
```

```
1001 15000.00
1002 20000.50
1003 25577.59
1004 19980.75

The content of new file
1001    15000.00
1002    20000.50
1003    25577.59
1004    19980.75
```

Retrieving Information from HTML File

We need to open the html file using urlopen() method of urllib.request module in Python

Assume that file is available in F:\py\breakfast.html

Code can be written as

```
import urllib.request
f = urllib.request.urlopen(r'file:///f|py/breakfast.html')
```

Observe raw string.

> The first word 'file:///' indicates file URL scheme that is used to refer to files in the local computer system.

> The next word 'f|py' indicates the driver name 'f' and sub directory 'py'.

> In this folder we have file breakfast.html

We can read the data using read() method as:

```
text = f.read()
```

But the data in the HTML files would be stored in the form of byte strings.

Hence this string is decoded in normal string as

```
st = text.decode()
```

The string st is used to retrieve the required information using regular expression.

```
r'<td>\w+</td>\s<td>(\w+)</td>\s<td>(\d\d.\d\d)</td>'
```

There are three special characters which are embedded in the tags.

So the information which is in between the tags is searched.

> \w+ indicates that we are searching for a word (item numbers).

> The next \w+ is written inside the parentheses. The parentheses tells that the result of the RE inside the parentheses will be obtained. (\w+) stores item names into variables

> (\d\d.\d\d) stores the words item prices in another variable.

If we use findall() method to retrieve the information, it returns the list which contains these two variables as a tuple in every row

```
import os
import re
import urllib.request

# Open the html file using urlopen() method
print(os.getcwd())
f = urllib.request.urlopen(r'file:///content/breakfast.html')

# Read data from the file object into text string
text = f.read()

# Convert the byte string into normal string
st = text.decode()

# Apply regular expression on the string
result = re.findall(r'<td>\w+</td>\s<td>(\w+)</td>\s<td>(\d\d.\d\d)</td>', st)

# Display result
print(result)

# Display the items of the result
for items, price in result:
  print('Item:%-15s Price:%-10s'%(items,price))

# close the file
f.close()
```

```
/content
[('Roti', '50.05'), ('Chapati', '55.75'), ('Dosa', '48.08'), ('Idly', '25.02'), ('Vac
Item:Roti            Price:50.05
Item:Chapati         Price:55.75
Item:Dosa            Price:48.08
Item:Idly            Price:25.02
Item:Vada            Price:38.90
Item:Coffee          Price:20.00
Item:Tea             Price:15.00
```

✓ 0s completed at 15:16