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INTRODUCTION TO ADTs

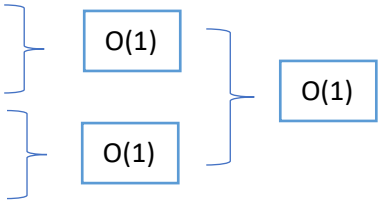
SPECIFICATION

```
spec StringHandler
      genre StringHandler
      operations
            empty: string -> bool
            first: string -> char
            iesm: string,int -> char
            middle: string -> char
            addAtBeg: string,string -> string
            addAtEnd: string,string -> string
            concatenate: string,string -> string
            reverse: string -> string
            rotate: string,int -> string
endspec
```

IMPLEMENTATION

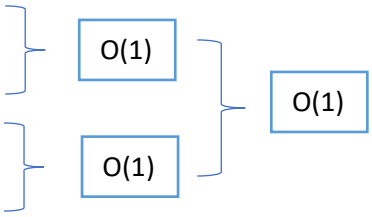
```
class StringHandler
      public bool empty(string)
      public char first(string)
      public char iesm(string,int)
      public char middle(string)
      public string addAtBeg(string,string)
      public string addAtEnd(string,string)
      public string concatenate(string,string)
      public string revese(string)
      public string rotate(string,int)
endclass
```

```
public bool StringHandler::empty(s:string)
      if (s.length()==0)
            return true
      else
            return false
endmethod
```



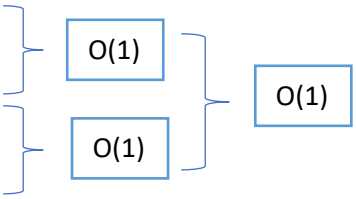
- The running time of “empty” method is O(1) because it only has operations with simple statements.

```
public char StringHandler::first(s:string)
      if (empty(s))
            return ("Error")
      else
            return s[0]
endmethod
```



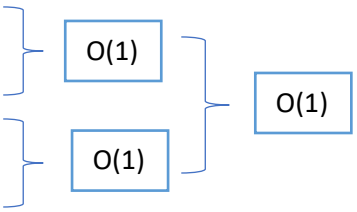
- The running time of “first” method is O(1) because it only has operations with simple statements.

```
public char StringHandler::iesm(s:string,i:int)
      if (empty(s))
            return ("Error")
      else
            return s[i]
endmethod
```



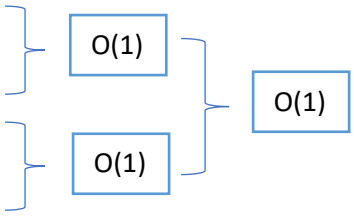
- The running time of “iesm” method is O(1) because it only has operations with simple statements.

```
public char StringHandler::middle(s:string)
      if (empty(s))
            return ("Error")
      else
            return s[s.length\2]
endmethod
```



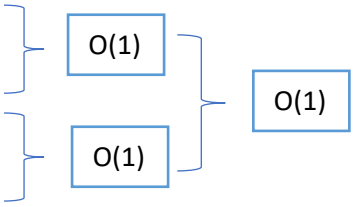
- The running time of “middle” method is O(1) because it only has operations with simple statements.

```
public string StringHandler::addAtBeg(s:string,s1:string)
      if (empty(s))
            newString=s1
      else
            newString=s1+s
endmethod
```



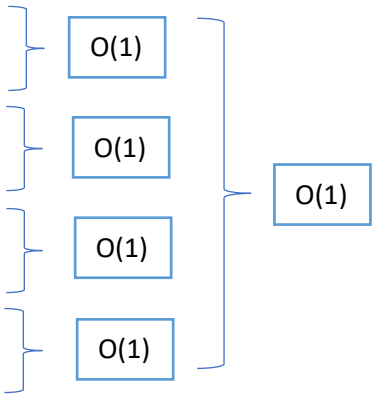
- The running time of “addAtBeg” method is O(1) because it only has operations with simple statements.

```
public string StringHandler::addAtEnd(s:string,s1:string)
      if (empty(s))
            newString=s1
      else
            newString=s+s1
endmethod
```



- The running time of “addAtEnd” method is O(1) because it only has operations with simple statements.

```
public string StringHandler::concatenate(s:string,s1:string)
      if (empty(s))
            newString=s1
      else if (empty(s1))
            newString=s
      else if (empty(s)&&empty(s1))
            printf(“%s”,”Both strings are empty”)
      else
            newString=s+s1
endmethod
```



- The running time of “concatenate” method is O(1) because it only has operations with simple statements.

```
public string StringHandler::reverse(s:string)
      if (s.length() == 1)
            return s;
      else
            s_reverse=""
            for (int i=s.length()-1;i>=0;i--)
                  s_reverse+=s[i]
            return s_reverse
endmethod
```

O(1)

O(n)

O(n+1) → O(n)

- The running time of "reverse" method is O(n) because it has a conditional statement in which the running time of the largest branch is O(n).
- This largest branch is a for loop that is being executing n times.

```
public string StringHandler::rotate(s:string,n:int,s1:string)
      sufix=""
      prefix=""
      if (s.length() == 1)
            newString=s
      else
            if (s1.compare("left")==0)
                  for (int i=0;i<n;i++)
                        sufix+=s[i]
                  for (int j=n;j<s.length();j++)
                        prefix+=s[j]
            else
                  for (int i=0;i<(s.length()-n);i++)
                        sufix+=s[i]
                  for (int j=(s.length()-n);j<s.length();j++)
                        prefix+=s[j]
            newString=prefix+sufix
endmethod
```

O(1)

O(n)

O(1)

O(1)

O(n)

O(n)

O(n+n) → O(n)

O(n)

O(n)

O(n)

O(1)

- The running time of "rotate" method is O(n) because it has an if-else statement in which the running time of the largest branch is O(n).
- This largest branch are some for loops that are being executing n times at the same time.

- Is it possible to get a better running time with alternative data structures and/or implementation/s?

  No, because almost all the method has O(1) that can’t have a better running time. Then, the two ones that has a running time of O(n) I think it can’t be converted to a better running time, due to the for loop that is obligatory for the correct behaviour function of the method.