

## Introduction;

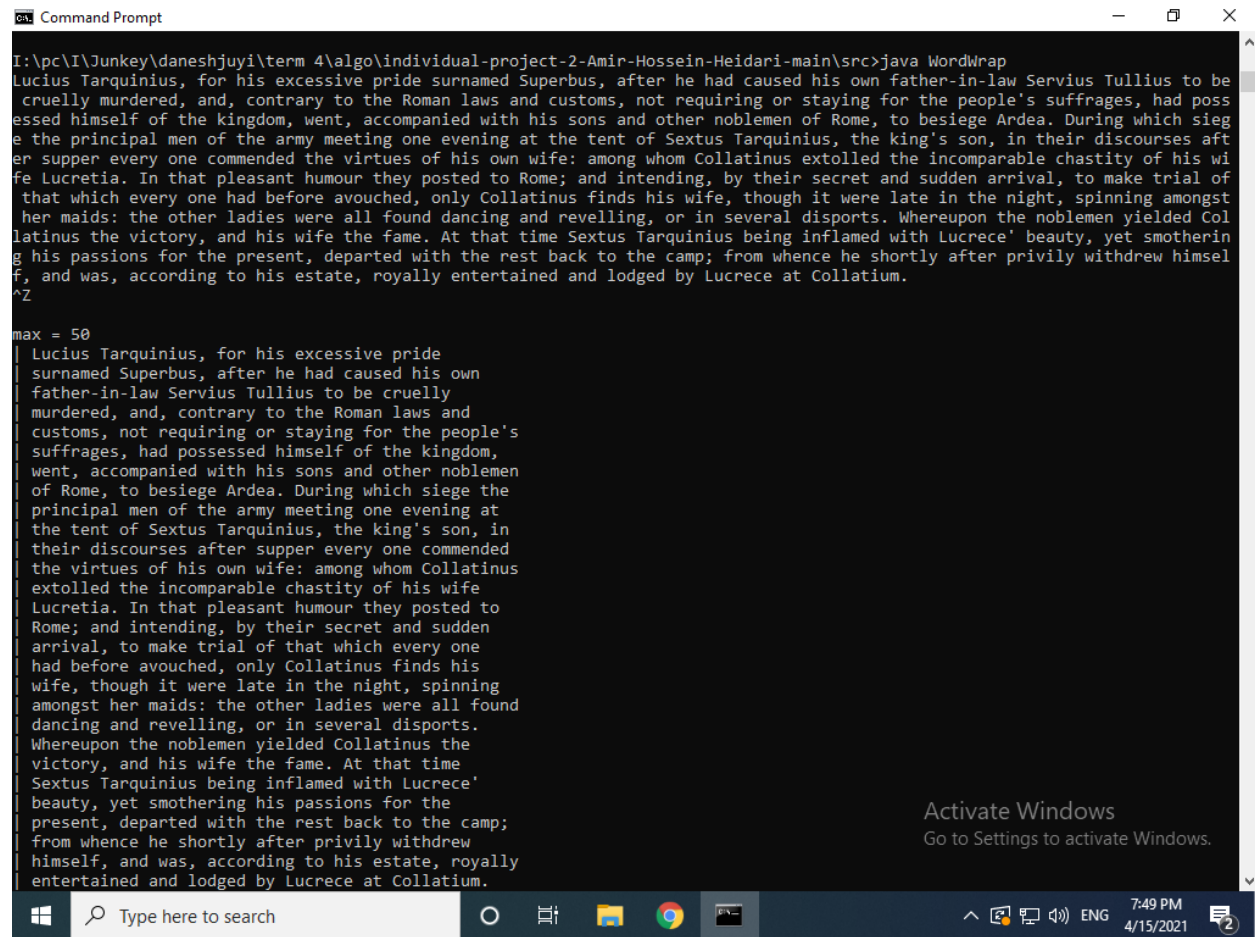
This is a project to wrap a given text in lines with length of 50 and making the spacing the minimum by Amir Hossein Heidari from K.N Toosi University using Java.

It consists of a class by the name of "WordWrap.

## Implementation;

In the beginning user ought to enter a text and by pushing ENTER and then Ctrl z and again an ENTER, the program starts the computation and printing it out.

Here is an example given on how it works on a long poet of Shakspears.



```
Command Prompt

I:\pc\I\Junkey\daneshjuyi\term 4\algo\individual-project-2-Amir-Hossein-Heidari-main\src>java WordWrap
Lucius Tarquinius, for his excessive pride surnamed Superbus, after he had caused his own father-in-law Servius Tullius to be
cruelly murdered, and, contrary to the Roman laws and customs, not requiring or staying for the people's suffrages, had poss
essed himself of the kingdom, went, accompanied with his sons and other noblemen of Rome, to besiege Ardea. During which sieg
e the principal men of the army meeting one evening at the tent of Sextus Tarquinius, the king's son, in their discourses aft
er supper every one commended the virtues of his own wife: among whom Collatinus extolled the incomparable chastity of his wi
fe Lucretia. In that pleasant humour they posted to Rome; and intending, by their secret and sudden arrival, to make trial of
that which every one had before avouched, only Collatinus finds his wife, though it were late in the night, spinning amongst
her maids: the other ladies were all found dancing and revelling, or in several disports. Whereupon the noblemen yielded Col
latinus the victory, and his wife the fame. At that time Sextus Tarquinius being inflamed with Lucrece' beauty, yet smotherin
g his passions for the present, departed with the rest back to the camp; from whence he shortly after privily withdrew himsel
f, and was, according to his estate, royally entertained and lodged by Lucrece at Collatium.
^Z

max = 50
| Lucius Tarquinius, for his excessive pride
| surnamed Superbus, after he had caused his own
| father-in-law Servius Tullius to be cruelly
| murdered, and, contrary to the Roman laws and
| customs, not requiring or staying for the people's
| suffrages, had possessed himself of the kingdom,
| went, accompanied with his sons and other noblemen
| of Rome, to besiege Ardea. During which siege the
| principal men of the army meeting one evening at
| the tent of Sextus Tarquinius, the king's son, in
| their discourses after supper every one commended
| the virtues of his own wife: among whom Collatinus
| extolled the incomparable chastity of his wife
| Lucretia. In that pleasant humour they posted to
| Rome; and intending, by their secret and sudden
| arrival, to make trial of that which every one
| had before avouched, only Collatinus finds his
| wife, though it were late in the night, spinning
| amongst her maids: the other ladies were all found
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| victory, and his wife the fame. At that time
| Sextus Tarquinius being inflamed with Lucrece'
| beauty, yet smothering his passions for the
| present, departed with the rest back to the camp;
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| himself, and was, according to his estate, royally
| entertained and lodged by Lucrece at Collatium.
```

To find the minimum of the spacing I have used dynamic programming a bottom-up approach :

$$\begin{aligned} &0 && \text{if } j=0 \\ \text{Cost}[j] = & \\ &\text{Min} ( \text{Cost}[i-1] + \text{lineCost}[i][j] ) && \text{if } j>0 \end{aligned}$$

In the above formula  $i$  refers to the count of words in the previous lines and  $j-i$  is the count of words in the current line

This is how it is implemented :

```
private static int[] wordWrap (int[] input, int M){
    int n = input.length;
    int[][] extraSpace = new int[n][n];
    int[][] lineCost = new int[n][n];
    int[] cost = new int[n+1];
    int[] track = new int[n];

    for(int i=0;i<n;i++){
        extraSpace[i][i] = M - input[i];
        for(int j=i+1;j<n;j++){
            extraSpace[i][j] = extraSpace[i][j-1] - input[j] - 1;
        }
    }

    for(int i=0;i<n;i++){
        for(int j=i;j<n;j++){
            if(extraSpace[i][j]<0)
                lineCost[i][j] = Integer.MAX_VALUE;
            else if(j==n-1)
                lineCost[i][j] = 0;
            else
                lineCost[i][j] = extraSpace[i][j]*extraSpace[i][j]*extraSpace[i][j];
        }
    }

    cost[0] = 0;
    for(int j=0;j<n;j++){
        cost[j+1] = Integer.MAX_VALUE;
        for(int i=0;i<=j;i++){
            if(cost[i]!=Integer.MAX_VALUE && lineCost[i][j]!=Integer.MAX_VALUE &&
                (cost[i] + lineCost[i][j] < cost[j+1])){
                cost[j+1] = cost[i] + lineCost[i][j];
                track[j] = i;
            }
        }
    }

    return track;
}
```

## The time complexity and the memory complexity;

The time complexity is :

$$T(n) = 3 * n(n+1)/2 = O(n^2)$$

and the memory complexity is :

$$S(n) = n*n + n*n + n+1 + n = O(n^2)$$

### **Suggested improvements;**

Changing the fixed value 50 to a final integer and get it from a user /\* which is an easy job do it. :) \*/