James Rogers
605.621 Algorithms

Project 3

605.621 - Algorithms Project 3

Introduction

```
Usage:
$ javac Project3.java && java Project3 x y ../input/in.txt
Example:
$ javac Project3.java && java Project3 1100 1100 ../input/in.txt
```

* x is the first of the known signals (ie 101)

* y is the second of the known signals (ie 001)

* in.txt is the superposition of the two signals.

Algorithm:

For it to be a valid interweaving of the two signals, a character must exist in s that is the beginning character of either x or y.
Either x or y may lead, so iterating through the string twice checking first if x leads and then if y leads will cover all cases. This will add one more iteration of n elements to the complexity.

Starting with x first:

1. Find the beginning of x if it exists. If it does not exist, exit.
2. Increment to the next character in x.
3. Check if the next character in s is either the current index value of x or

the current index value of y. If not, exit.

4. If every value of s is checked, return that it is a valid interweaving.

Else go to step 3.

Starting with y first:

1. Find the beginning of y if it exists. If it does not exist, exit.

2. Increment to the next character in y.

3. Check if the next character in s is either the current index value of x or the current index value of y. If not, exit. Increment the string that matched.

4. If every value of s is checked, return that it is a valid interweaving.

Else go to step 3.

Psuedo Code

```
boolean untangle(x,y,s) {
      x_index = 0
      y_index = 0
 first_time = true
 s_index = 0

 //check if x leads
      for char in s:
  s_index++
  // Step 1
  if first_time == true:
   if x[x_index] == char:
    first_time = false
    // Step 2
```

```
      x_index++
    continue
  // Step 3
  if char == x[x_index % len(x)]:
    x_index++
    continue
  if char == y[y_index % len(y)]
    y_index++
    continue
  return false

// Step 4
if s_index == len(s):
  return true

x_index = 0
          y_index = 0
first_time = true
s_index = 0

//check if y leads
          for char in s:
  s_index++
  // Step 1
  if first_time == true:
    if y[y_index] == char:
      first_time = false
      // Step 2
```

~~~
    y_index++
   continue
  // Step 3
  if char == y[y_index % len(y)]
   y_index++
   continue
  if char == x[x_index % len(x)]:
   x_index++
   continue

  return false

 // Step 4
 if s_index == len(s):
  return true
}
```
~~~

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Analysis:

Theoretical

The algorithm will iterate through s once for x leading and once for y leading.

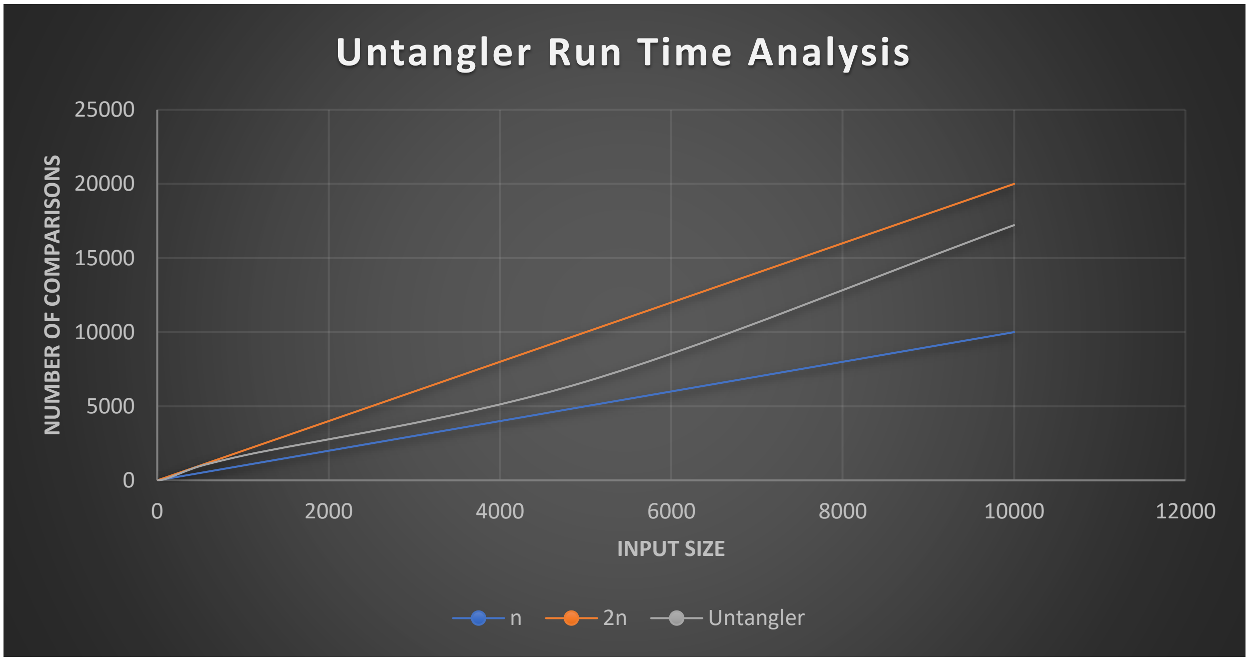
The complexity of this algorithm is therefore O(2n) where n is the size of s.

Run Time

I gathered the following data running the untangler on strings of varying length:

	Number of comparisons					
Input Size	10	100	500	1000	5000	10000
n	10	100	500	1000	5000	10000
2n	20	200	1000	2000	10000	20000
Untangler	13	103	964	1668	6660	17220

As a graph:



The untangler always runs between n and 2n, as described in my algorithm. The theoretical analysis is supported by the run time data.