task45_Zhukov_vlad

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0.0.1 See src.py, test.py files for algorithm code

```
In [14]: import src
         import test
         import matplotlib.pyplot as plt
```

1 Let's test algorithm

See test.py

```
In [15]: import unittest
         suite = unittest.TestLoader().loadTestsFromTestCase(test.Tests)
         unittest.TextTestRunner(verbosity=2).run(suite)
```

```
test_strings_overlap (test.Tests) ... ok

----------------------------------------------------------------------
Ran 1 test in 0.002s

OK


Out[15]: <unittest.runner.TextTestResult run=1 errors=0 failures=0>
```

1.1 Example of usage

```
In [16]: strings = ['cde', 'abc', 'eab', 'fgh', 'ghf', 'hed']
         algo = src.superstring4(strings)
         print('superstring4: ' + str(algo.solve()))
         print ('greedy:       ' + \
                str(src.greedy_min_max_contain_string(strings)))
         print ('answer:       ' + \
                str(src.min_max_contain_string(set(strings))))
                                 #input must be set of strings
```

```
superstring4: cdeabcfghfhed
greedy:       fghfhedcdeabc
answer:       ghfghedcdeabc
```

```
In [17]: from itertools import combinations
         from itertools import combinations_with_replacement
         from itertools import permutations
         from itertools import product

         def short_string_test(n_words, words):
             for c in combinations(words, n_words):
                 l1 = len(src.greedy_min_max_contain_string(c))
                 l2 = len(src.min_max_contain_string(set(c)))
                 res.append((1.0 *l1) / l2)
             return res
```

2 Let's "make sure" that aproximation ratio is equal 2 for short strings(a.r.>=2)

It takes some time to find right answers

```
In [18]: letters = 'abcd'
         tmp = [map(''.join, product(letters, repeat=length))\
                 for length in range(1, 4)]
         words = [x for n in tmp for x in n]
         res = []
         sst = short_string_test(3, words)
         print(max(sst))
```

```
1.4
```

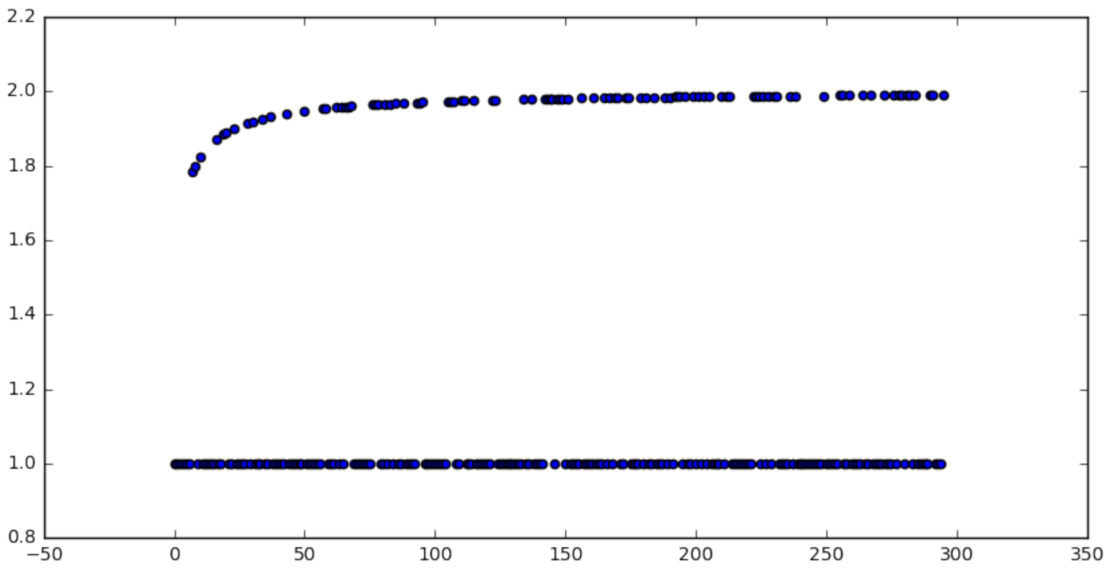
For sentences with two words, where words consist of $1, 2, 3$ letters aproximation ratio is ~<= 1.5

Let's implement test described in: http://www.mimuw.edu.pl/~mucha/teaching/aa2008/ss.pdf (2.2 The greedy algorithm)

```
In [19]: def generate_worst_test(k):
             return ['a' + 'b' * k, 'b' * k + 'c', 'b' * (k + 1)]
         test = generate_worst_test(4)
         res = list()
         for c in [generate_worst_test(i) for i in range(4, 300)]:
             l1 = src.greedy_min_max_contain_string(c)
             l2 = src.min_max_contain_string(set(c))
             res.append(((1.0 *len(l1)) / len(l2)))
         print (max(res))
```

```
1.990066225165563
```

```
In [20]: plt.figure(figsize=(10, 5))
         plt.scatter(range(len(res)), res)
         plt.show()
```



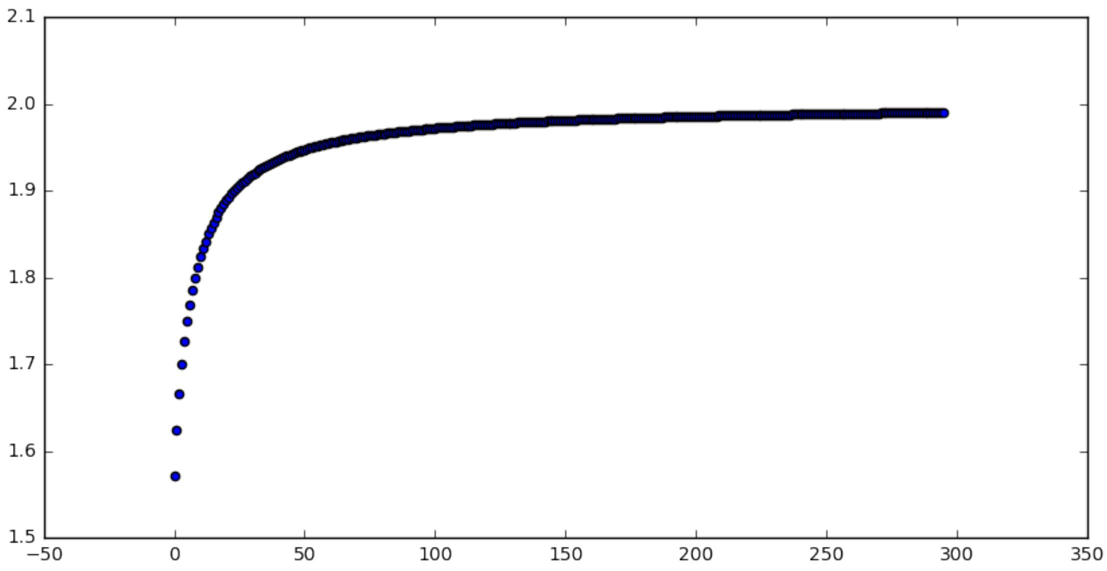
So we can see on $\{ab^k, b^k c, b^{k+1}\}$ tests algorithm's aproximation ratio converges to 2. We have a little bit better algorighm than in article(in article assumes that strings can not contain each other) that merges strings in one, if one contains another

3 Testing graph algorithm

```
In [21]: test = generate_worst_test(4)
         res = list()
         for c in [generate_worst_test(i) for i in range(4, 300)]:
             algo = src.superstring4(c)
             l1 = algo.solve()
             l2 = src.min_max_contain_string(set(c))
             res.append(((1.0 *len(l1)) / len(l2)))
         print (max(res))
```

```
1.990066225165563
```

```
In [22]: plt.figure(figsize=(10, 5))
         plt.scatter(range(len(res)), res)
         plt.show()
```



Small strings tests

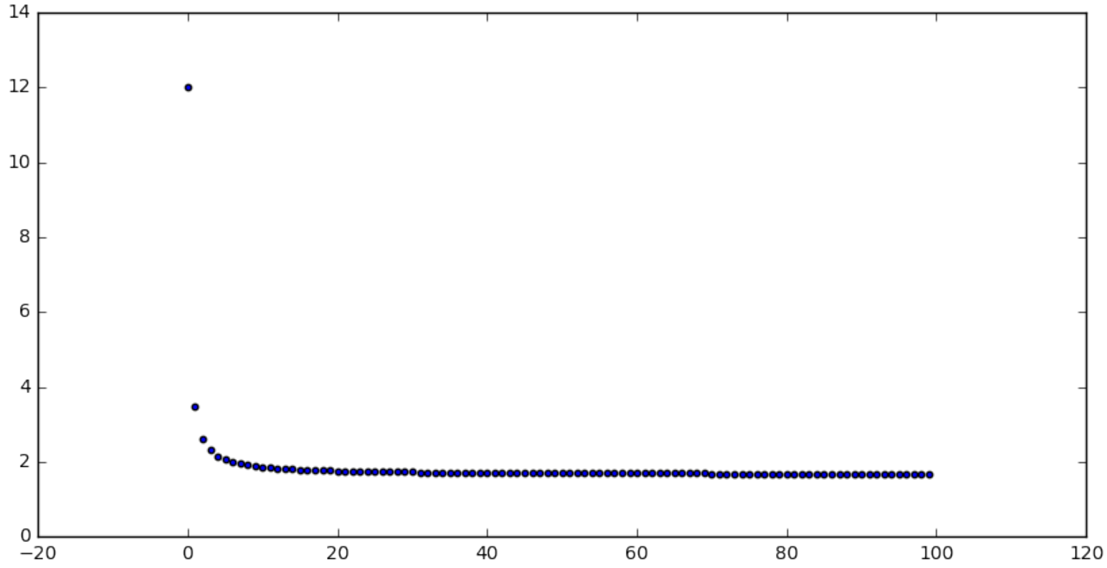
```
In [23]: letters = 'abcd'
         tmp = [map(''.join, product(letters, repeat=length))\
                 for length in range(1, 4)]
         words = [x for n in tmp for x in n]
         res = []
         for c in combinations(words, 3):
                 algo = src.superstring4(c)
                 l1 = len(algo.solve())
                 l2 = len(src.min_max_contain_string(set(c)))
                 res.append((1.0 *l1) / l2)
         print(max(res))
```

```
1.6666666666666667
```

Worse than greedy

```
In [45]: res = []
         a = ""
         b = ""
         c = ""
         d = ""
         e = ""
         f = ""
         for k in range(100):
             tst = []
             a = a + "a"
             b = b + "b"
             c = c + "c"
             d = d + "d"
             e = e + "e"
             f = f + "f"
             x = "x"
             tst.append(a + x + b)
             tst.append(b + x + c)
             tst.append(c + x + d)
             tst.append(d + x + e)
             tst.append(e + x + f)
             tst.append(b[:-1] + x + a + x)
             tst.append(c[:-1] + x + b + x)
             tst.append(d[:-1] + x + c + x)
             tst.append(e[:-1] + x + d + x)
             tst.append(f[:-1] + x + e + x)
             algo = src.superstring4(tst)
         #     print(tst)
         #     algo = src.superstring4(tst)
             l1 = len(algo.solve())
         #     print (algo.solve())
             l2 = 9 * k + 1
         #     l2 = len(src.min_max_contain_string(set(tst)))
             res.append((1.0 * l1) / l2)
```

```
In [46]: plt.figure(figsize=(10, 5))
         plt.scatter(range(len(res)), res, s=10)
         # plt.ylim((0, 5))
         plt.show()
```



3.0.1 DOT GRAPH

```
In [26]: strings2 = ['abc', 'bcd', 'daa', 'bcc']
         for i_id, i in enumerate(strings2):
             print ("v" + str(i_id) +" [shape=box, label=\"" + i + "\"]")
         for i_id, i in enumerate(strings2):
             for j_id, j in enumerate(strings2):
                 print ("v" + str(i_id) + "->" + "v" + str(j_id) + " [label=\""+ st
```

```
v0 [shape=box, label="abc"]
v1 [shape=box, label="bcd"]
v2 [shape=box, label="daa"]
v3 [shape=box, label="bcc"]
v0->v0 [label="3"]
v0->v1 [label="2"]
v0->v2 [label="0"]
v0->v3 [label="2"]
v1->v0 [label="0"]
v1->v1 [label="3"]
v1->v2 [label="1"]
v1->v3 [label="0"]
v2->v0 [label="1"]
v2->v1 [label="0"]
v2->v2 [label="3"]
v2->v3 [label="0"]
v3->v0 [label="0"]
v3->v1 [label="0"]
v3->v2 [label="0"]
v3->v3 [label="3"]
```