CS2134 Spring 2016
Homework 1 Written Solutions

1.a. O(n)
  b. O(n^2)
  c. O(n^3)
  d. O(n^2)
  e. O(n^3)
  f. O(n)
  g. O(n^2 * log n)
  h. O(n^2)
  i. O(n^3)

2.a. O(1)
  b. O(n)
  c. O(n^2)
  d. O(n^2)
  e. O(n^3)
  f. O(n)
  g. O(n^2)
  h. O(n^3)
  i. O(log n)
  j. O(n * log n)
  k. O(log n)

3.
  • n^3
  • n^2
  • n(logn)^2
  • n^1.5
  • nlogn
  • n, n/2 (Same rate)
  • sqrt(n)

4.a. 0.2 seconds
  b. 0.8 seconds
  c. 12.8 seconds

5. O(n^2)

6. Show 3n^2 + 2nlog(n) + 6n + 19 = O(n^2).
   As n -> infinity, 3n^2 + 2nlog(n) + 6n + 19 < c*(n^2), where c > 3.
   For your answer, you should pick a specific c.

7. Actual Output Times (times will vary):

n	mSS1 (cubic)	mss2 (quad)	mss4 (linear)
128	0.000965	0.000033	0.000001
256	0.007425	0.000118	0.000002
512	0.053746	0.000458	0.000004
1024	0.421135	0.001992	0.000007
2048	3.354881	0.007371	0.000015
4096	27.861598	0.029916	0.000028

8. Calculated Times (based on n = 128 from above):

```
n    | mSS1 (cubic) | mss2 (quad) | mss4 (linear)
---- | ------------ | ----------- | -------------
128  | 0.000965     | 0.000033    | 0.000001
256  | 0.007720     | 0.000132    | 0.000002
512  | 0.061760     | 0.000528    | 0.000004
1024 | 0.494080     | 0.002112    | 0.000008
2048 | 3.952640     | 0.008448    | 0.000016
4096 | 31.62112     | 0.033792    | 0.000032
```

9. Calculating the time for 2^18:

   For these calculations, we will use the times calculated from n = 4096.
   n_o = 4096 = 2^12
   n_f = 2^18
   r = n_f / n_o = 2^6

   mSS1 (cubic):
   31.62112 * (2^6)^3 = 31.62112 * 2^18 = 8,289,286.881

   mSS2 (quadratic):
   0.033792 * (2^6)^2 = 0.033792 * 2^12 = 138.412

   mSS4 (linear):
   0.000032 * (2^6)^1 = 0.000032 * 2^6 = 0.002048

10. Expansion in weeks, days, hours, minutes, seconds:

    Conversion Table:
    ----
        60 minutes = 1 hour
         24 hours = 1 day
           7 days = 1 week

        60 seconds = 1 minute
      3,600 seconds = 1 hour
     86,400 seconds = 1 day
    604,800 seconds = 1 week

    mSS1 (cubic):
    13 weeks 4 days 22 hours 34 minutes 46.881 seconds

    mSS2 (quadratic):
    2 minutes 18.412 seconds

    mSS4 (linear):
    0.002048 seconds

11. Actual Output Times:

```
n    |        a |        b |        c | d
---- | -------- | -------- | -------- | ----------
128  | 0.000000 | 0.000086 | 0.000045 | 0.009283
256  | 0.000001 | 0.000119 | 0.000060 | 0.029788
512  | 0.000002 | 0.000443 | 0.000223 | 0.229734
1024 | 0.000004 | 0.001763 | 0.000994 | 1.847280
2048 | 0.000016 | 0.007179 | 0.003629 | 14.730072
4096 | 0.000032 | 0.029244 | 0.014154 | 117.264173
```