Running Time Survey

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Running Time Survey

- This week, let's do a running time survey as a practice(**Practice 2**).
- You will be given a simple frame to do the running time survey of different algorithms on increasing inputs.

`RunningTimeSurvey.java`

How to use?

- You should register your tasks and methods in the taskList

```
public class RunningTimeSurvey {
    //              task name              function name              run times upper
    static String[][] taskList = {
            {  "LinearTimeTest",          "linearTime",              "10000000"},
            {  "LinearTimeTest",          "linearTimeCollections",   "10000000"},
            /*
             * { "NlognTimeTest",         "NlognTime",               "1000000"},
             * { "QuadraticTimeTest",     "QuadraticTime",           "100000"},
             * { "CubicTimeTest",         "CubicTime",               "1000"},
             * { "ExponentialTimeTest",   "ExponentialTime",         "29"},
             * { "FactorialTimeTest",     "FactorialTime",           "12"}
             */
    };
```

You can change the numbers based on your computer's performance.

LinearTimeTest

Since "linearTime" is registered for "LinearTimeTest", you should define a function named linearTime, which looks like the following code:

```
public static long linearTime(int n) {
    long[] list = new long[n];
    generateList(n, list);
    long timeStart = System.currentTimeMillis();
    getMax(n, list);
    long timeEnd = System.currentTimeMillis();
    long timeCost = timeEnd - timeStart;
    return timeCost;
}
```

You can first write a function to generate data for your following algorithm.

Implements a Linear algorithm, for example, computing the maximum.

```
max ← a1
for i = 2 to n {
    if (ai > max)
        max ← ai
}
```

You can also choose other linear time algorithms.

O(n log n) TimeTest

- You should register a new task named “NlognTimeTest”.
- You should register a function named “NlognTime”, the input parameter should be int, the return type should be long.
- You should generate your test data for your algorithm.
- You should implement your algorithm in which running time is required, for example, heap sort.

```
public static long NlognTime(int n) {
    //TODO:generate you test input data here
    long timeStart = System.currentTimeMillis();
    //TODO: write a algorithm
    long timeEnd = System.currentTimeMillis();
    long timeCost = timeEnd - timeStart;
    return timeCost;
}
```

QuadraticTimeTest

- Optional:
- Closest pair of points. Given a list of n points in the plane (x1, y1), ..., (xn, yn), find the pair that is closest.
- $O(n^2)$ solution. Try all pairs of points.

```
min ← (x_1 - x_2)^2 + (y_1 - y_2)^2
for i = 1 to n {
    for j = i+1 to n {
        d ← (x_i - x_j)^2 + (y_i - y_j)^2
        if (d < min)
            min ← d
    }
}
```

CubicTimeTest

- Set disjointness. Given n sets S1, ..., Sn each of which is a subset of 1, 2, ..., n, is there some pair of these which are disjoint?
  O(n3) solution: For each pair of sets, determine if they are disjoint.

```
foreach set Si {
    foreach other set Sj {
        foreach element p of Si {
            determine whether p also belongs to Sj
        }
        if (no element of Si belongs to Sj)
            report that Si and Sj are disjoint
    }
}
```

ExponentialTimeTest

- Given n bits, enumerate all possible Number.

FactorialTimeTest

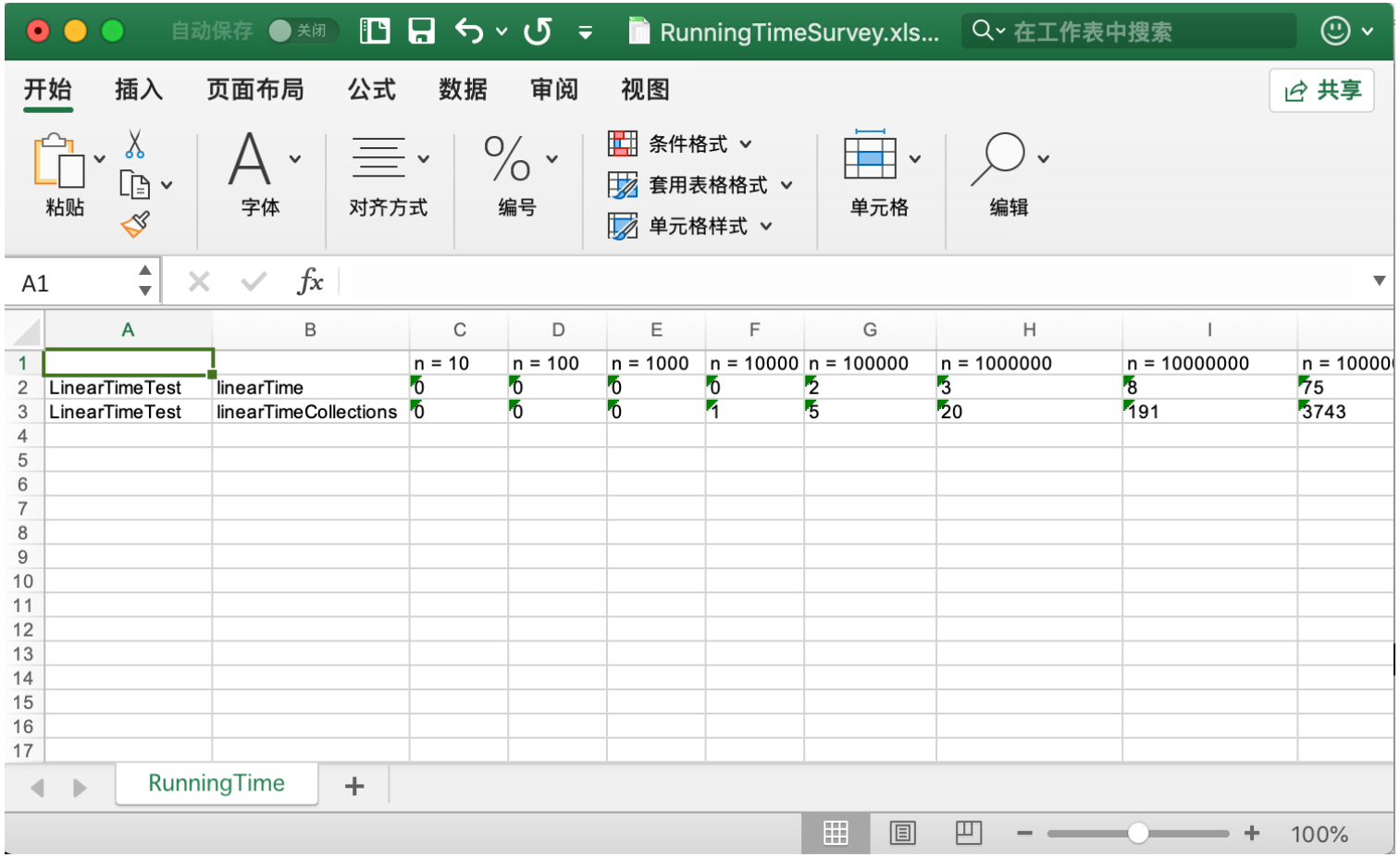
- Bruce force to compute factorial n
- Use addition instead of multiplication

Optional: KPolynomialTimeTest

- Independent set of size k. Given a graph, are there k nodes such that no two are joined by an edge?
- O(nk) solution. Enumerate all subsets of k nodes.

```
foreach subset S of k nodes {
    check whether S is an independent set
    if (S is an independent set)
        report S is an independent set
    }
}
```

Running result of the frame:



	A	B	C	D	E	F	G	H	I	
1			n = 10	n = 100	n = 1000	n = 10000	n = 100000	n = 1000000	n = 10000000	n = 10000
2	LinearTimeTest	linearTime	0	0	0	0	2	3	8	75
3	LinearTimeTest	linearTimeCollections	0	0	0	1	5	20	191	3743
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										

Result example:

		n = 10	n = 100	n = 1000	n = 10000	n = 10000(	n = 10000(	n = 10000000												
LinearTime	linearTime	0	0	0	0	15	0	0												
LinearTime	linearTime(	0	0	0	0	0	38	142												
NlognTime	NlognTime	0	0	0	8	10	111													
QuadraticT	QuadraticT	0	0	131	684	46994														
CubicTime	CubicTime	0	0	216																
		n = 10	n = 11	n = 12	n = 13	n = 14	n = 15	n = 16	n = 17	n = 18	n = 19	n = 20	n = 21	n = 22	n = 23	n = 24	n = 25	n = 26	n = 27	n = 28	n = 29
Exponentia	Exponentia	0	0	0	0	0	0	0	0	16	0	0	0	22	32	50	150	192	602	670	2385
FactorialTir	FactorialTir	113	1300	22989																	

The practice will be checked in this lab class or the next lab class(before **Mar.16**) by teachers or SAs.

This practice will contribute **1 mark** to your overall grade. Late submissions within 2 weeks after the deadline (before Mar.30)will incur a 20% penalty, meaning that you can only get 80% of the score.