

Program Structures & Algorithms

Spring 2022

Assignment No. 3

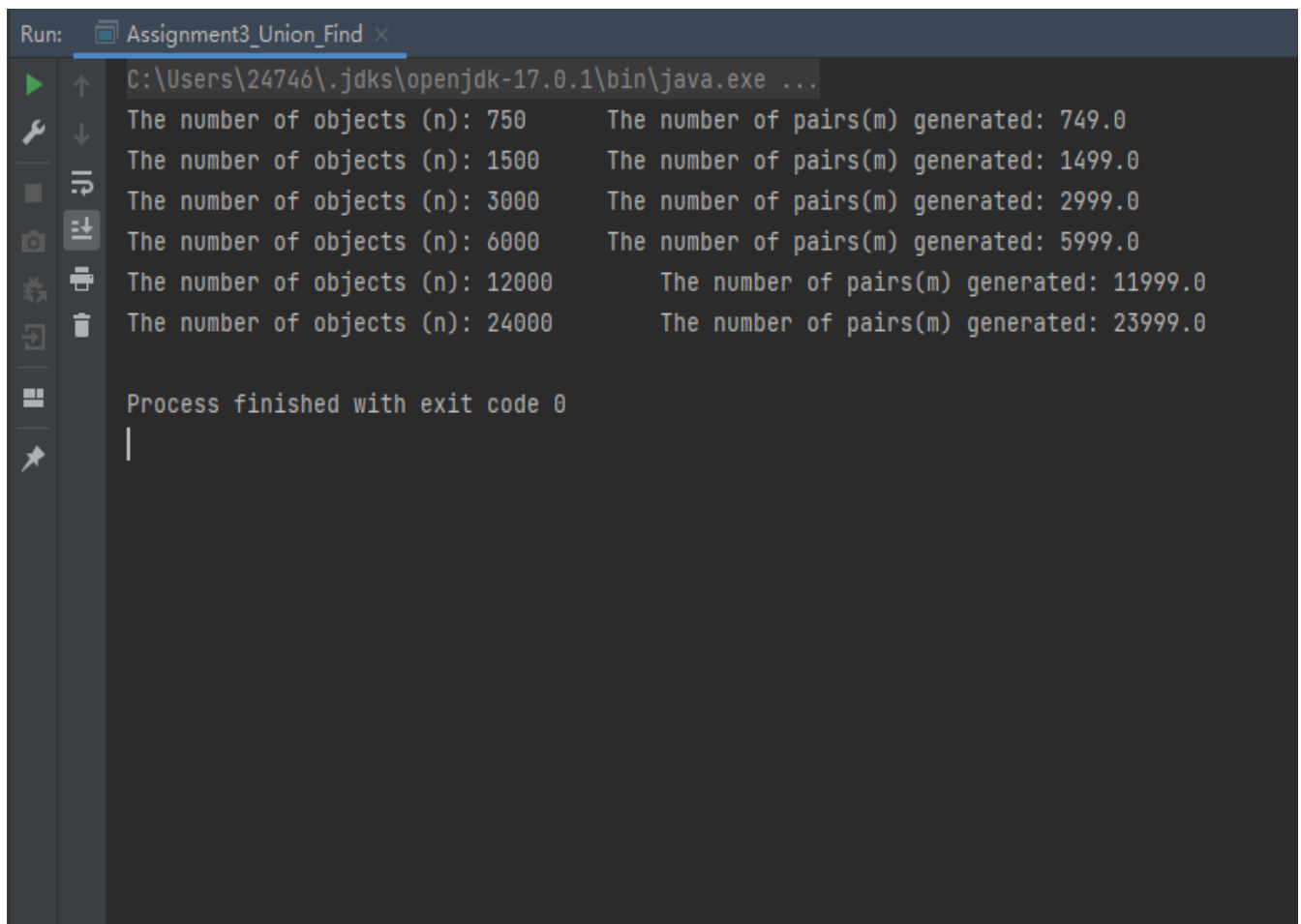
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- **Task**

When using the height-weighted Quick Union with path Compression. Determine the relationship between the number of objects (n) and the number of pairs (m) generated to accomplish this (i.e. to reduce the number of components from n to 1).

- **Output screenshot**



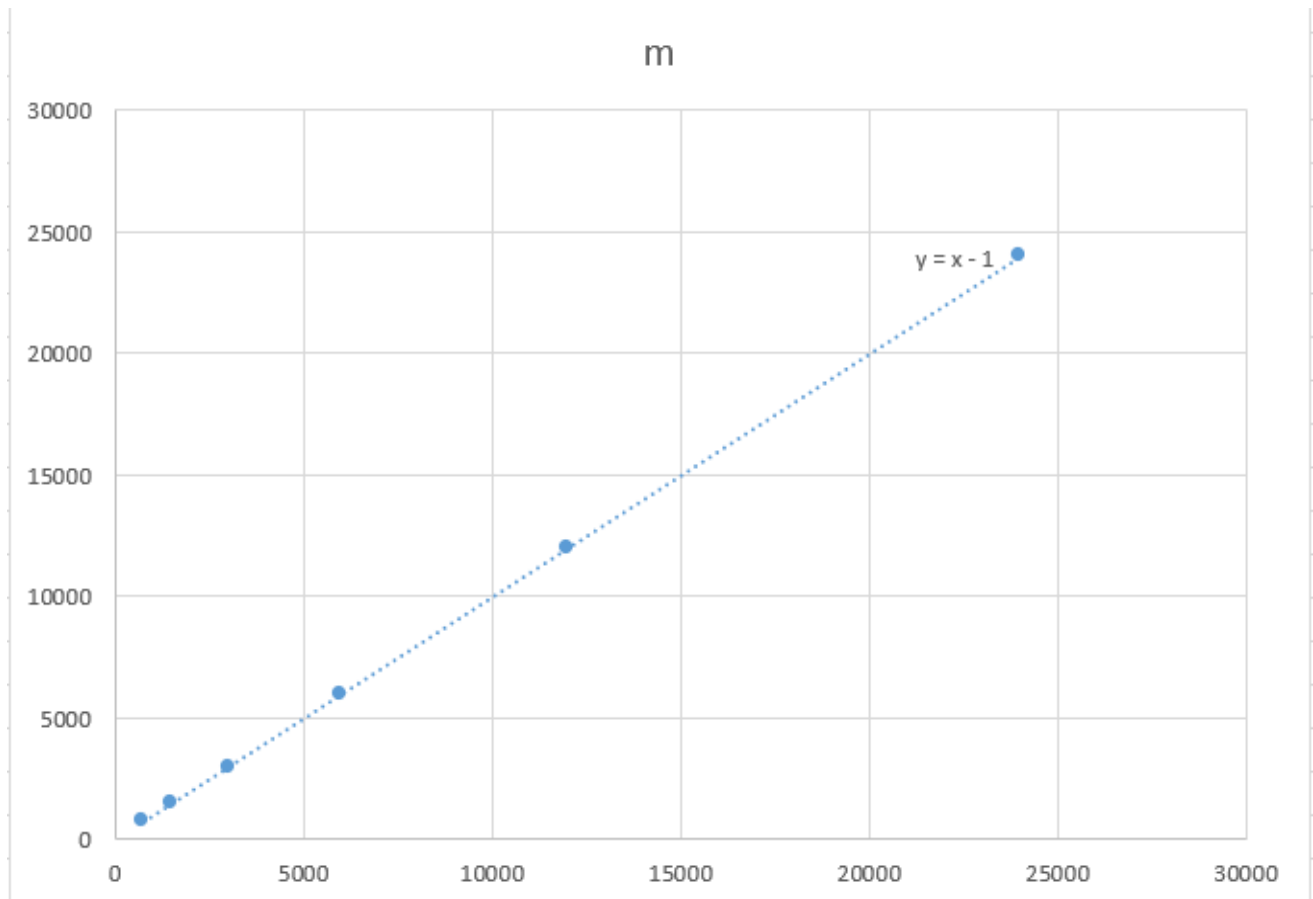
```
Run: Assignment3_Union_Find x
C:\Users\24746\.jdk\openjdk-17.0.1\bin\java.exe ...
The number of objects (n): 750      The number of pairs(m) generated: 749.0
The number of objects (n): 1500     The number of pairs(m) generated: 1499.0
The number of objects (n): 3000     The number of pairs(m) generated: 2999.0
The number of objects (n): 6000     The number of pairs(m) generated: 5999.0
The number of objects (n): 12000    The number of pairs(m) generated: 11999.0
The number of objects (n): 24000    The number of pairs(m) generated: 23999.0

Process finished with exit code 0
|
```

- **Relationship Conclusion**

- Which we can find that $m = n - 1$.
- And the reason is that at the beginning of the whole program. There are n component since we have n sites. The first time we generate a pair of integers i and j where $i \neq j$. We reduce the component to $n-1$.
- And the second time we generate a pair of integers the not connect with each other. There are two situations.
 - The first is that we connect a new site to the small component we generated in step 1.
 - Or we generate a new component that different from the component we generate in the first step.
- But in both situations, we reduce the number of component by 1.
- So, as we can see, every time we union two site together that not connected before. No matter what the situation is, we reduce the number of components by 1.
- If we want to reduce the number of components from n to 1. We need generate $n-1$ pairs to accomplish that.

- **Evidence / Graph**



- **Unit tests result**

