COMP 251 Assignment 1
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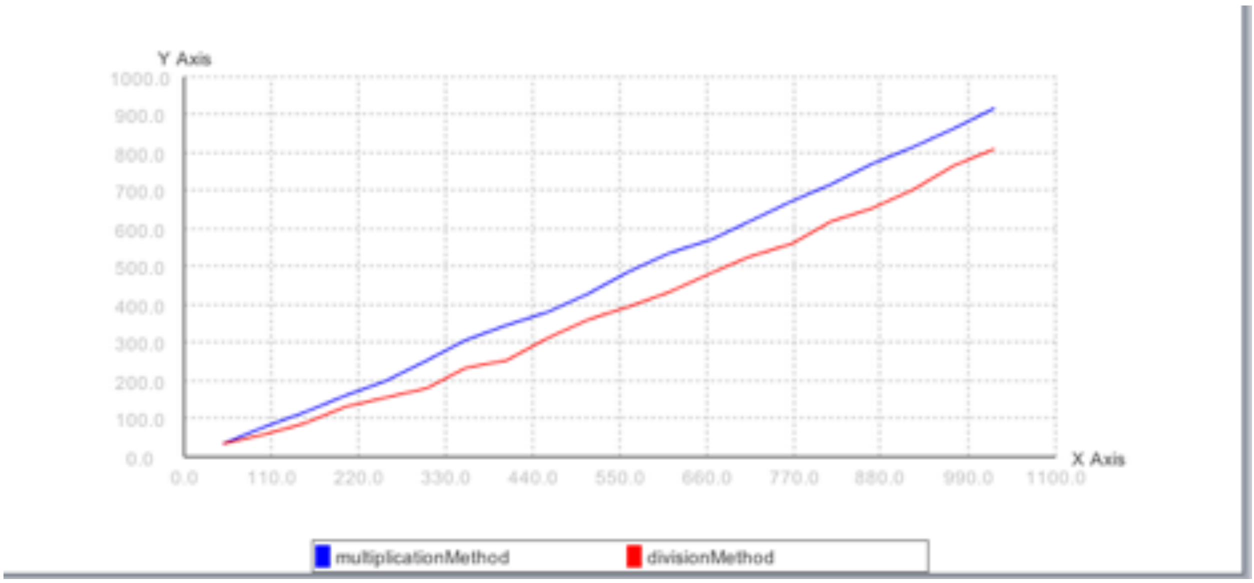
1)



This graph illustrates division method and multiplication method, the number of collisions as a function of the number of inputs. As indicated in the graph, the division method seems to work better than the multiplication method as there are consistently fewer collisions.

When experimenting with different r and w values. I noticed that the higher w is, the collisions between multiplication method and division method become more identical. With a smaller r value, there are less collisions. The value of r is the bound and w is the random number generated.

For both methods, the load factors remain the same, m/n.

2)

[6 4 3 5 1 2]

-> remove 6 and heapify rest -> [5 4 3 2 1l6] -> remove 5 -> [4 3 2 1l5 6]

-> remove 4 -> [3 2 1l4 5 6] -> remove 3 -> [2 1l3 4 5 6] -> remove 2 -> [1l2 3 4 5 6]

Result: [1 2 3 4 5 6]

3)

We should first calculate the number of misses after n objects, which is (m-1/m)^n. If we calculate the number of misses in the object from 1 to n-1, we get a geometric series of

1 + r + r^2 + r^3 + … + r^(n-1), where r = m-1/m. We get the sum to be (1-r^n)/(1-r), when expanded, we get:

O((n - m) * (1 - (m - 1)/m)^n))

4)

```
RotateRight(B, x)
    if B is empty     //handle if B is empty
        then return null
    if x is a leaf     //handle if x is a leaf
        then return x
    xl <- x.left     // get the left node of x
    //handle leaf exception
    x.left <- xl.right        //make the left node of x become the right node of xl
    xl.right <- x     //make right node of xl become x
    // find heights
    x.height <- max(height(x.left), height(x.right)) + 1
    xl.height <- max(height(xl.left), height(xl.right)) + 1
    return xl
```

5)

$t(n) = \sum t(i - 1)\, t(n - i)$

The base case is $t(0) = 1$ and $t(1) = 1$

$t(2) = t(0)t(1) + t(1)t(0) = 2$

$t(3) = t(0)t(2) + t(1)t(1) + t(2)t(0) = 2 + 1 + 2 = 5$

This pattern will be true for any n.

= (2n)!/((n+1)!n!)