CS/SE 2XC3 Lab 2 Report

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January 28, 2022

This report includes the main observations that we found in this week's lab, along with the analysis of our results.

1 Timing Data

In this section, we analyze the test results of three functions and give our best judgement of how each of these functions is growing in n.

1.1 $f(n)$

For the data set of $f(n)$, the trend line appears to be linear. From the chart below we can see that the R^2 is 0.9992 for the linear equation. It is already a very good result.

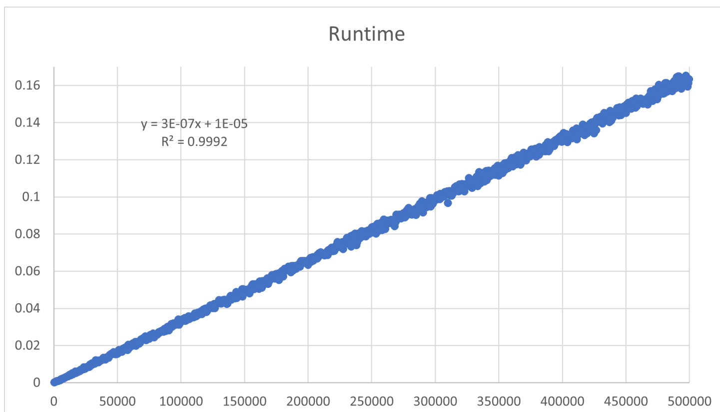

Figure 1: linear fitting for $f(n)$

Therefore, we can conclude that $f(n) = O(n)$.

1.2 $g(n)$

When we graph the data set for $g(n)$, the trend line appears to be polynomial. From the chart below we can see that the R^2 is 0.9883 for the quadratic equation.

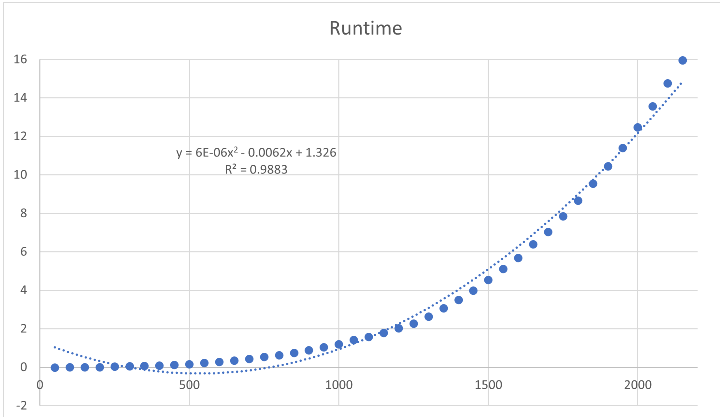

Figure 2: polynomial fitting for $g(n)$

We will try to improve the R^2 by finding the value of k in $T(n) = cn^k$. We do so by taking the logarithm of both sides of this equation: $\log T = \log c + k \log n$ and plotting $\log T$ against $\log n$.

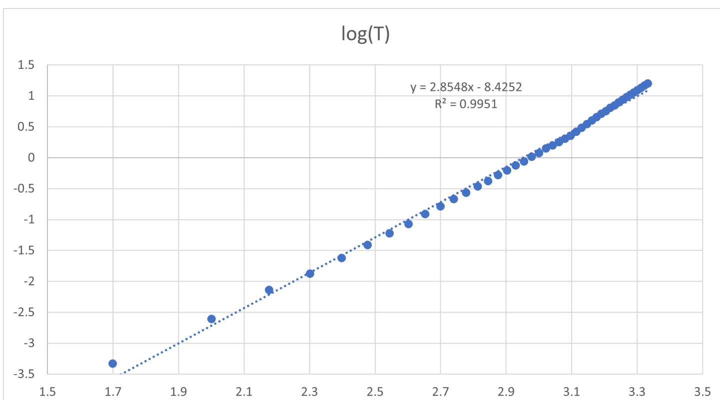

Figure 3: polynomial fitting for $\log T$

When we choose a linear trend line for this relation, we see that k, the slope, is 2.8548, which is closer to 3. When we recalculate the polynomial trend line for the original data with $k = 3$, we see that this is a better fit.

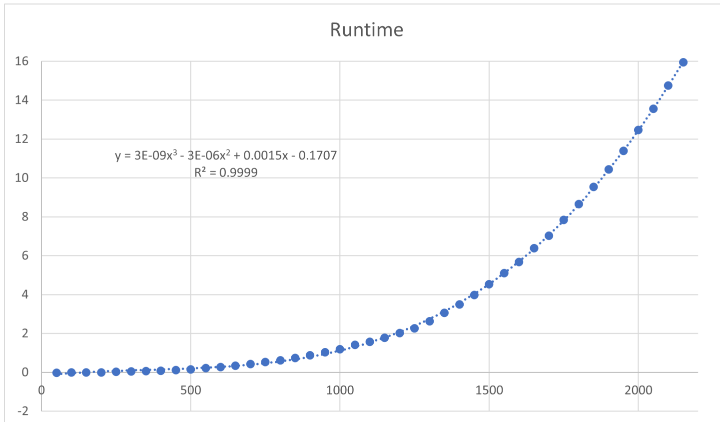

Figure 4: linear fitting for $g(n)$

Here, the R^2 is 0.9999, which is a very good result. Therefore we can conclude that $g(n) = O(n^3)$.

1.3 $h(n)$

When we graph the data set for $h(n)$, the trend line appears to be linear. From the chart below we can see that the R^2 is 0.9976 for the linear equation. This is already pretty good, but we might be able to improve it.

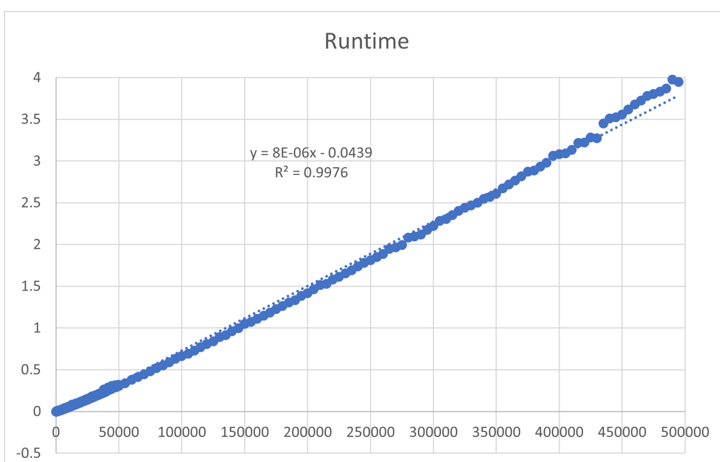

Figure 5: linear fitting for $h(n)$

First, we will check the value of k in $T(n) = cn^k$. We do so by taking the logarithm of both sides of this equation: $\log T = \log c + k \log n$ and plotting $\log T$ against $\log n$.

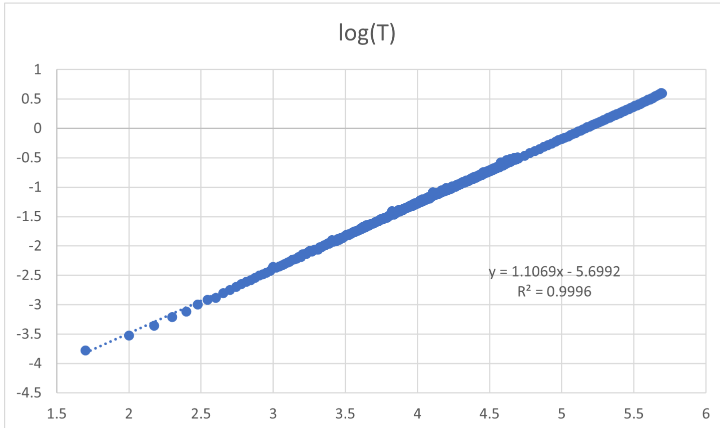

Figure 6: linear fitting for $\log T$

When we choose a linear trend line for this relation, we see that k, the slope, is 1.1069. Since k represents the exponent on n in the original data set, this makes the time complexity almost linear. However, $O(n \log n)$ may be a better fit than $O(n)$. We can check which is better by plotting $\frac{T(n)}{n}$ against n. If $T(n) = cn$, then the resulting graph $\frac{T(n)}{n} = c$, will be linear. If $T(n) = cn \log n$, then the resulting graph $\frac{T(n)}{n} = c \log n$, will be logarithmic.

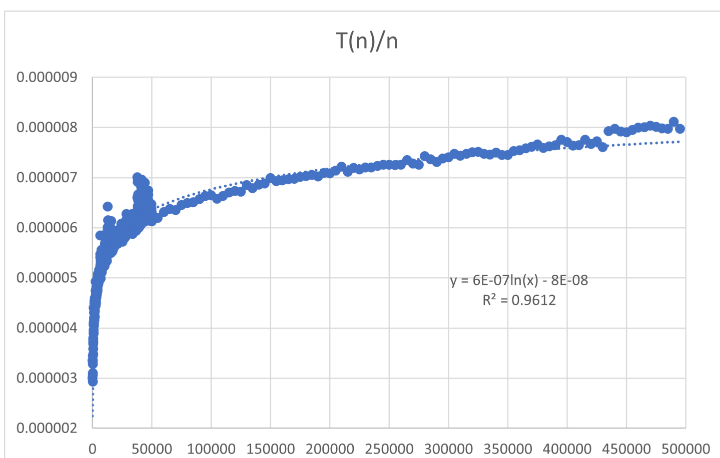

Figure 7: logarithmic fitting for $h(n)$

The resulting graph appears to be logarithmic. The R^2 is 0.9612 for the logarithmic trend line. Therefore we can conclude that $h(n) = O(n \log n)$.

2 Python Lists

2.1 Copy

2.2 Lookups

2.3 Append