CS 4050 Algorithms and Algorithm Analysis

Project 2

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Let

$$T(n) = \Sigma_{k=1}^{n} \log_2 k$$

And

$$g(n) = \Sigma_{k=1}^{n} 2 \ln k$$

Therefore

$$\int_{1}^{n} \log_2 x \, dx \leq T(n)$$

$$\frac{n(\ln(n) - 1)}{\ln 2} \leq T(n)$$

And

$$\int_{1}^{n} 2 \ln x \, dx = g(n)$$

$$2(n \ln(n) - n + 1) = g(n)$$

As

$$2(n \ln(n) - n + 1 \geq \frac{n(\ln(n) - 1)}{\ln 2}$$

Then

$$T(n) \leq g(n)$$

As

$$g(n) \in \theta(n \log(n))$$

Thus

$$T(n) \in \theta(n \log(n))$$