University of Waterloo
CS240 Spring 2023
Tutorial 00

1 Mathematics

Write a proof showing that $\log(n!) \in O(n \log n)$.

$$\begin{aligned}
\log(n!) &= \log(n \times (n-1) \times \cdots \times 2 \times 1) && \text{(for } n \geq 1\text{)} \\
&= \log\left(\prod_{i=1}^{n} i\right) \\
&= \sum_{i=1}^{n} \log i \\
&= \log(n) + \log(n-1) + \cdots + \log(2) + \log(1) \\
&\leq \log(n) + \log(n) + \cdots + \log(n) + \log(n) \\
&= n \log(n)
\end{aligned}$$

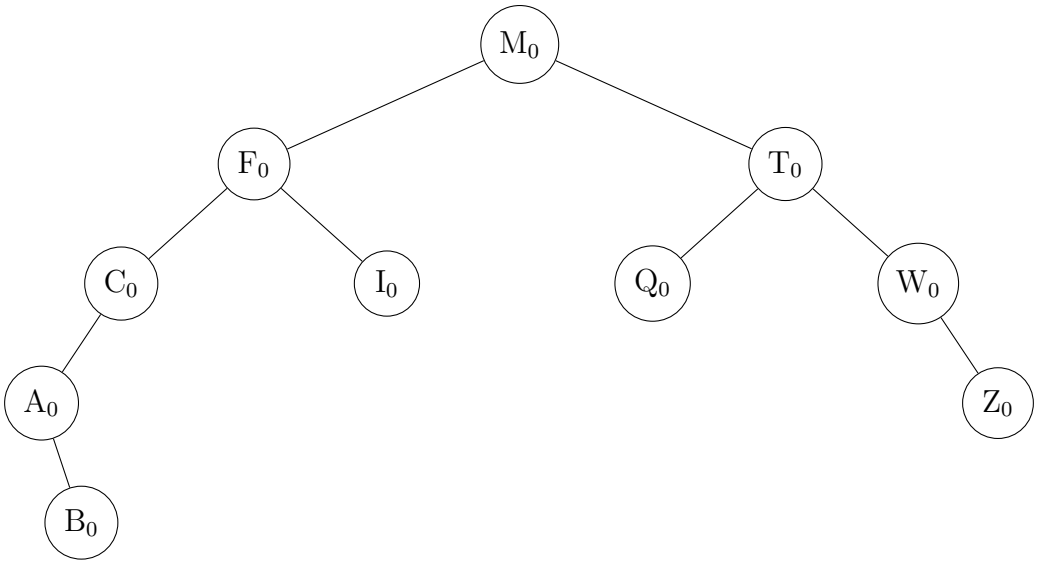
Therefore, for $c = 1$ and $n_0 = 1$,

$$0 \leq \log(n!) \leq cn \log(n)$$

for all $n \geq n_0$.

2 Trees

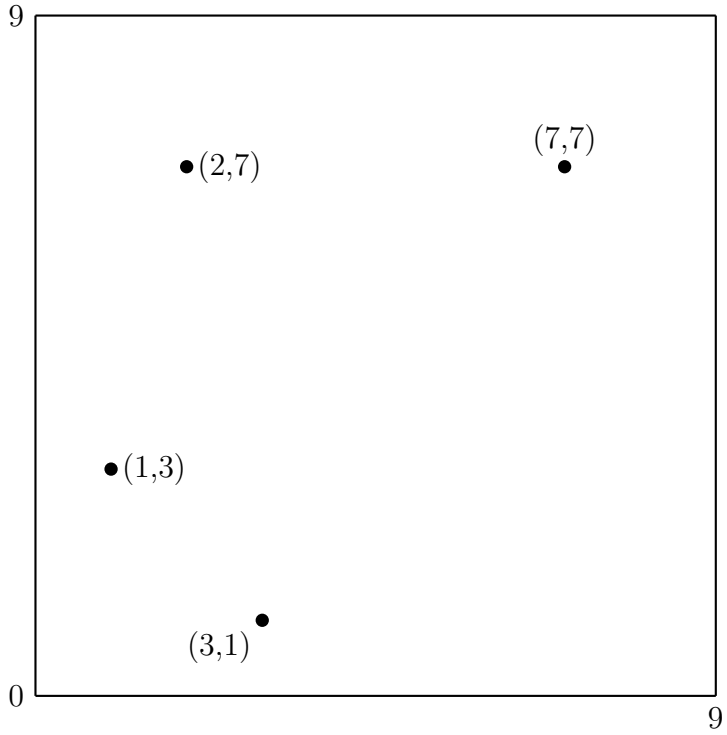
We will add the letters Z, A, and B to the BST below.



Hint: For nodes with only one child, you may wish to use "child[missing]" for the non-existent child.

3 Plots

Plot the following points below. Only show the resulting plot.
Points: (2,7), (1,3), (3,1), (7,7)



4 Latex Resources

LaTeX Editors

a) TeX Live: `https://www.tug.org/texlive/`

b) TeXstudio: `https://www.texstudio.org/`

c) Overleaf: `https://www.overleaf.com/`

d) pdflatex: on the student environment

Miscellaneous Resources

- `http://detexify.kirelabs.org/classify.html`
- `https://oeis.org/wiki/List_of_LaTeX_mathematical_symbols`
- `https://en.wikibooks.org/wiki/LaTeX`
- `https://tex.stackexchange.com/`