

**University of Waterloo**  
**CS240, Spring 2020**  
**Tutorial 0**

## 1 Mathematics

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

We have that:

$$|\log(n!)| = \left| \log \left( \prod_{i=1}^n i \right) \right| \tag{1}$$

$$= \left| \sum_{i=1}^n \log i \right| \tag{2}$$

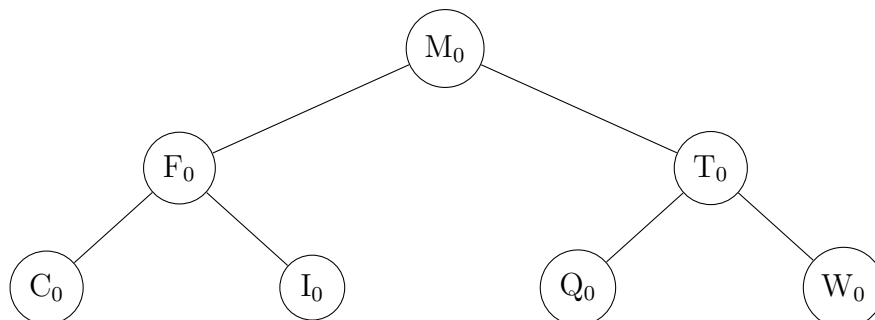
$$\leq \left| \sum_{i=1}^n \log n \right| \quad (\forall n \geq 1) \tag{3}$$

$$= |n \log n| \tag{4}$$

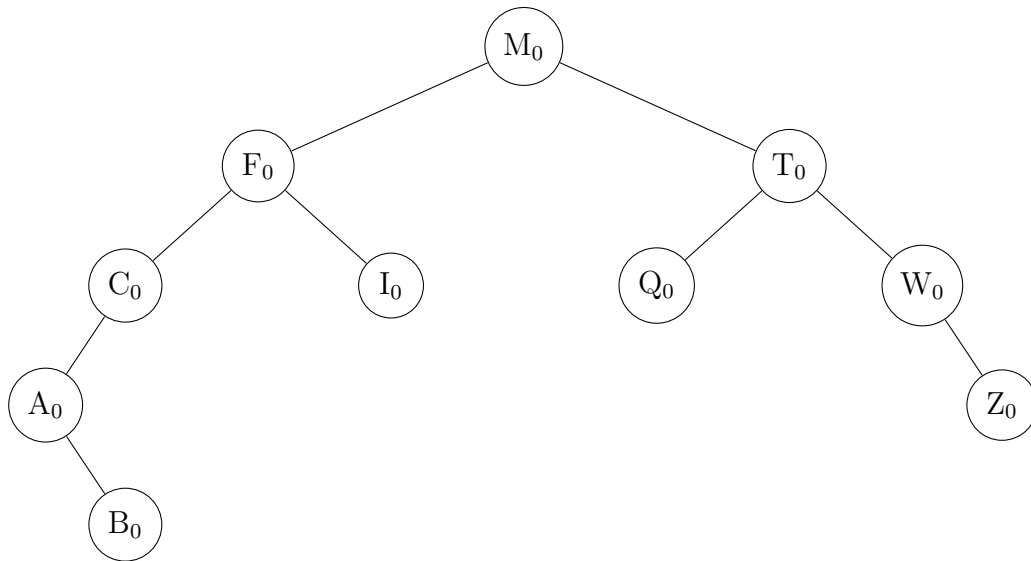
Hence picking  $c = 1$  and  $n_0 = 1$  gives the desired result.

## 2 Trees

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



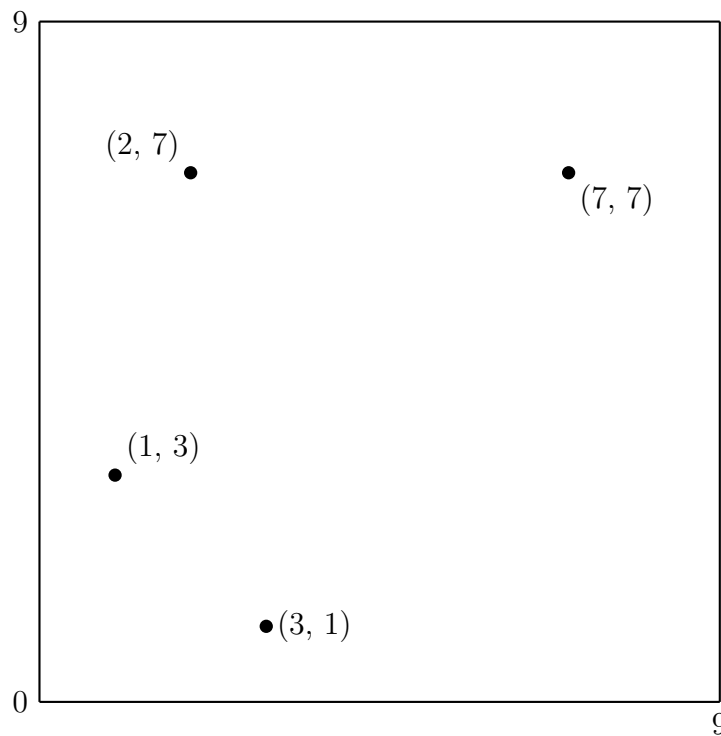
*Hint: For nodes with only one child, you may wish to use “child[missing]” for the non-existent child.*



### 3 Plots

Plot the following points below. Only show the resulting plot.

Points:  $(2,7)$ ,  $(1,3)$ ,  $(3,1)$ ,  $(7,7)$



## 4 Latex Resources

### $\text{\LaTeX}$ Editors

- MiKTeX: <https://miktex.org/>
- TeXstudio: <https://www.texstudio.org/>
- Overleaf: <https://www.overleaf.com/>
- pdflatex: on the student environment

### Miscellaneous Resources

- <http://detexify.kirelabs.org/classify.html>
- [https://oeis.org/wiki/List\\_of\\_LaTeX\\_mathematical\\_symbols](https://oeis.org/wiki/List_of_LaTeX_mathematical_symbols)
- <https://en.wikibooks.org/wiki/LaTeX>
- <https://tex.stackexchange.com/>