Goals

- Climate teach-in.
- Improved Huffman's Algorithm (data structures strikes back)
- Proof of Correctness

New office hours today 3-4!
Reflection 3 due today!

Greedy Alg

Each round

- Assigns $f$-value to each option ←
- Picks option w/ best $f$-value.

Huffman's Algorithm

Initialize min heap

1. For each $i \in Z$
   - Create a tree with 1 node, label $i$.
   - Assign tree weight $p_i$.
   - Insert tree into heap

While (more than 1 tree)

1. Remove min elt (twice)

2. Merge 2 trees with smallest weight

3. Set weight of merged tree to be sum of weights of the merged trees ← $f$-values updated

Reinsert merged tree into heap.

Priority Queue (Min Heap)

- Find Min Elt: $O(1)$
- Remove Min Elt: $O(\log(n))$
- Insert New Elt: $O(\log(n))$
- Initialize: $O(n \log n)$

$\text{MinHeap} \rightarrow \text{van Emde Boas tree} \rightarrow O(n \log \log n)$

What is runtime of Huffman’s Alg?

What is the societal impact of Huffman’s Algorithm?

What connections are there between algorithms & climate change?

Programming!

Correctness: Huffman's Alg Always Produces a Prefix-free code with smallest possible average length

Proof:

- Prefix-free $\implies$ Because of merging approach
- Minimum $A_1$ Length $\implies$ Induction on $|A_1|=n$

Base case: If $n=2$, two letters $a,b$

Inductive step: Let $k>2$. Assume Huffman produces a code with smallest possible avg length for any input with $|A_1|=k$.

Consider an input with $|A_1|=k+1$. 