**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 options w/ best f-value.

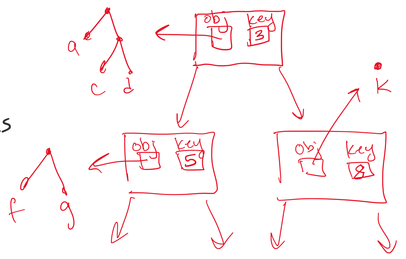
## Huffman's Algorithm

Initialize min heap

O(nlogn) — For each $i \in \Sigma$
- Create a tree with 1 node, label "i"
- Assign tree weight $p_i$ ← f-values
- Insert tree into heap

(n) While (more than 1 tree)

n steps
- O(logn) · Remove min elt (twice)
- O(1) · Merge 2 trees with smallest weight
- O(1) · Set weight of merged tree to be sum of weights of the merged trees ← f-values updated
- O(logn) · 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(nlogn)

~~MinHeap~~ → van Emde Boas tree → O(nlog(logn))

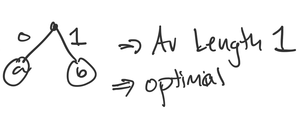
What is runtime of Huffman's Alg?
What is the societal impact of Huffman's Algorithm?
What connections are there between algorithms + climate change?

## Programming!

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

Proof:
- Prefix-free ⟹ Because of merging approach ✓
- Minimum Av. Length ⟹ induction on $|\Sigma| = n$. (Regular)

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




Inductive step: Let $k \geq 2$. Assume Huffman produces a code with smallest possible av. length for any input with $|\Sigma| = k$.

Consider an input with $|\Sigma| = k+1$.