5s: Reductions

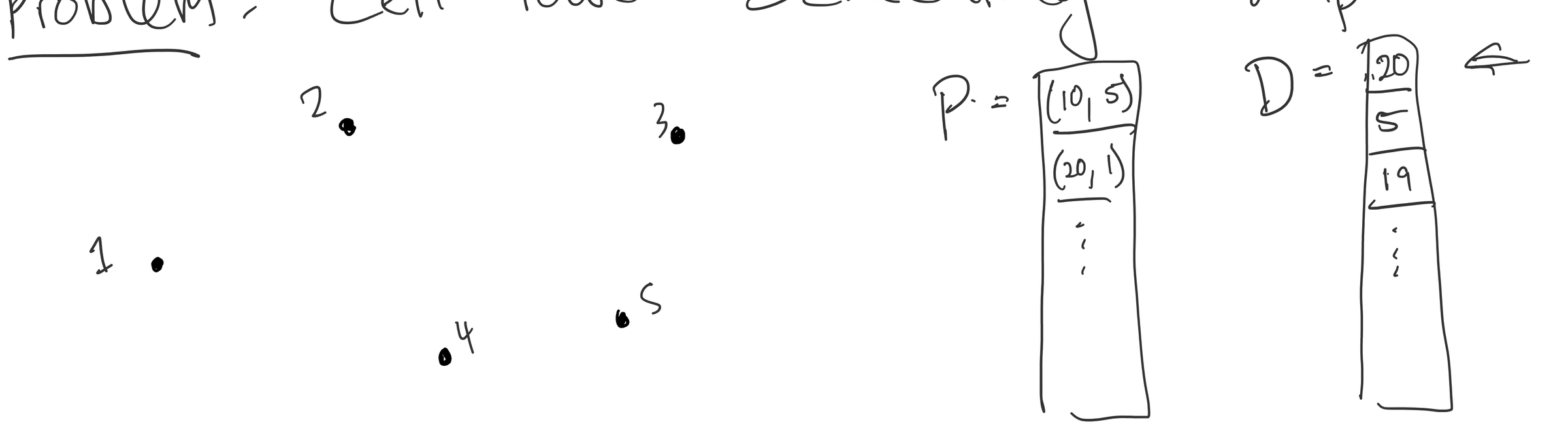
Friday, March 19, 2021 10:35 AM

Goals:
- Design a reduction
- Describe importance of reductions

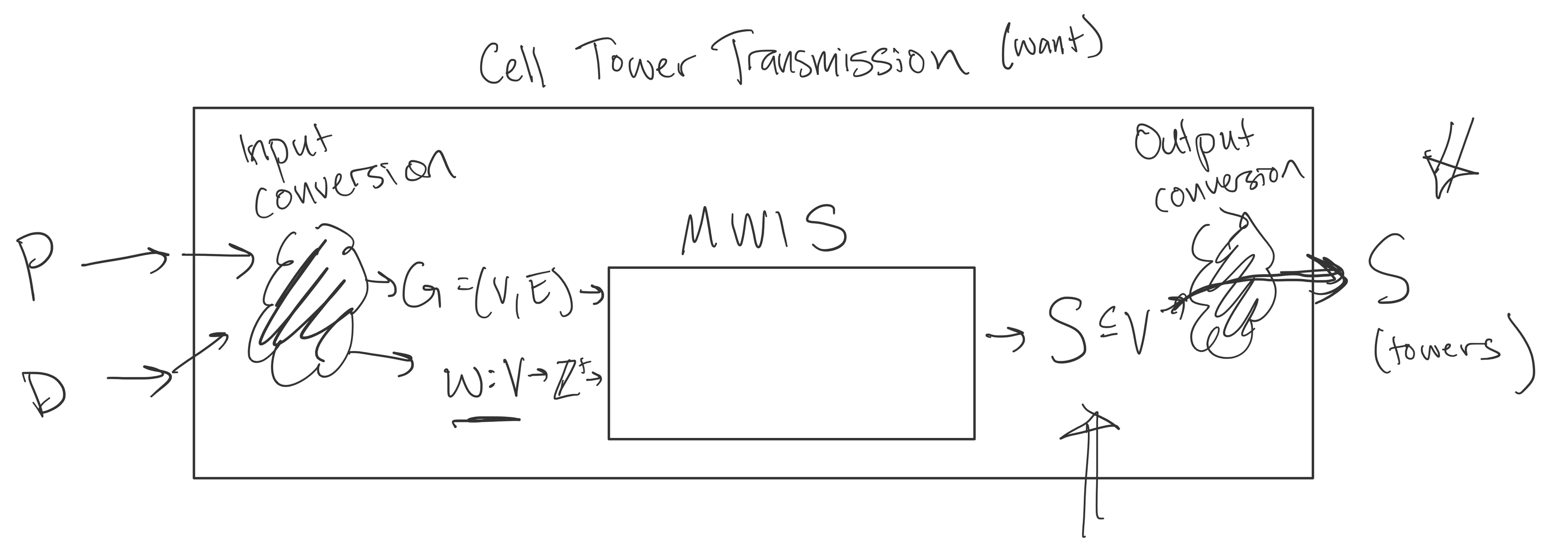
Reminders/Questions:

Probability/Quicksort Review: https://www.cs.middlebury.edu/~skimmel/Courses/302S22/
- Last day with these groups!
- Prog. Ass. No assumption of unique x,y
- Why "DP"
- Why work backwards?

Problem: Cell Tower Scheduling



Output: Set of towers to broadcast in the next time step. If two towers w/in 2 miles of each other broadcast → inteference.



- Feedback loop to increase prioritization of current prioritized group.
- Behavior could help the company determine how to improve network

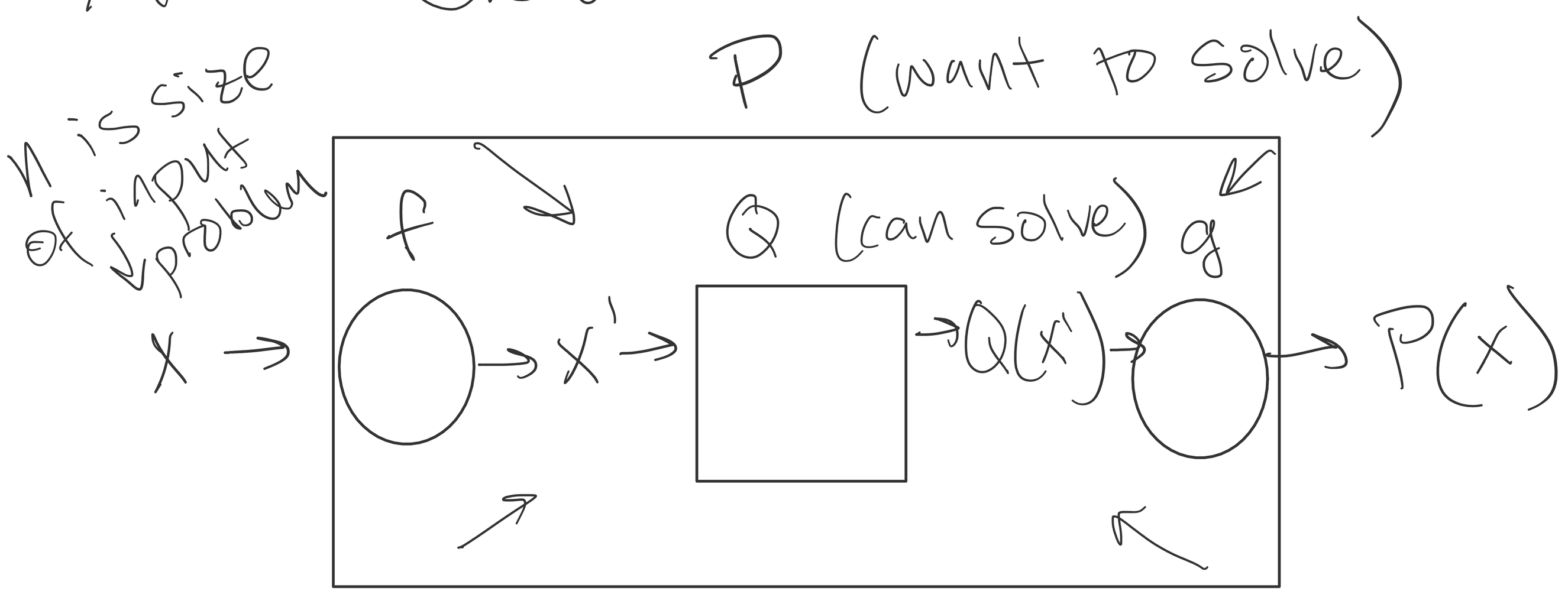
1. Ethical concerns? Towers with more packets get priority
   → Prioritize heavy users (wealthy users), prioritize urban / younger vs older non-rural
   Geographic inequalities (placing towers fairly) → could allow companies to prioritize users ⇕ throttle
   - No differentiation of high priority (911) packets
2. Describe conversion strategies:
   P, D ⇒? V, E, w
   S (vertices) ⇒? S (towers)
   - Each tower is a vertex
   - Weight is # data packets
   - Edges b/t two towers/vertices if dist is less than 2 miles
3. What is runtime of each conversion strategy? (In terms of n, number of towers.) (Brute force OK)
   For i ∈ P ← O(n)
   For j ≠ i ∈ P ← O(n)
   Check distance and if less than 2 add edge } O(1)
   } O(n²)

1.

2.

3.

More General Reduction



Runtime: Runtime f + Runtime Q + Runtime g

Usually want: $f, g \le Q$

If Runtime (f, g) is O(poly(n))
↓
$O(n), O(n^2), O(n^3), \ldots O(n^d)$ (d constant)

we write:

"P is polynomial time reducible to Q"

$P \le_p Q$ ~ Q is harder than P
Q gives us the power to solve P

Why think about reductions?

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