REDUCTIONS

Learning Goals

- Reduce one problem to another
- Define Polynomial Time Reduction
- Describe why reductions are important

Warm-Up to [NP2]
(Reductions are a tool used in NP-Hard Proofs)

Announcements

- PS6 due dates slightly pushed back
- Ethics assignment info posted ← PS6

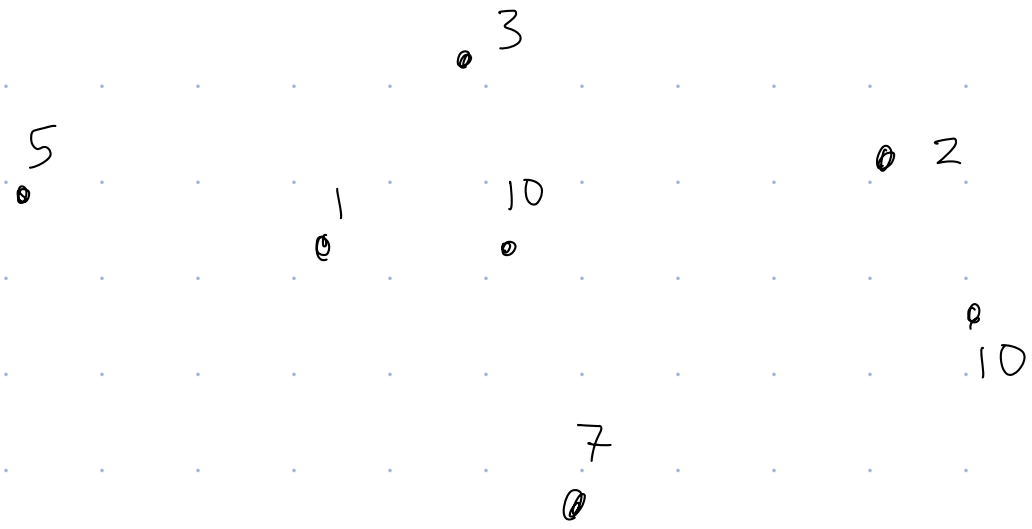
- Initial Off Meet + Greet
- All Intro first, cycle back
- Study group

← Feedback

Cell Tower Scheduling

latitude, longitude ↑

Input: Array P s.t. P[i] is location of i^{th} cell tower
Array D s.t. D[i] is # of data packets to send from i^{th} tower



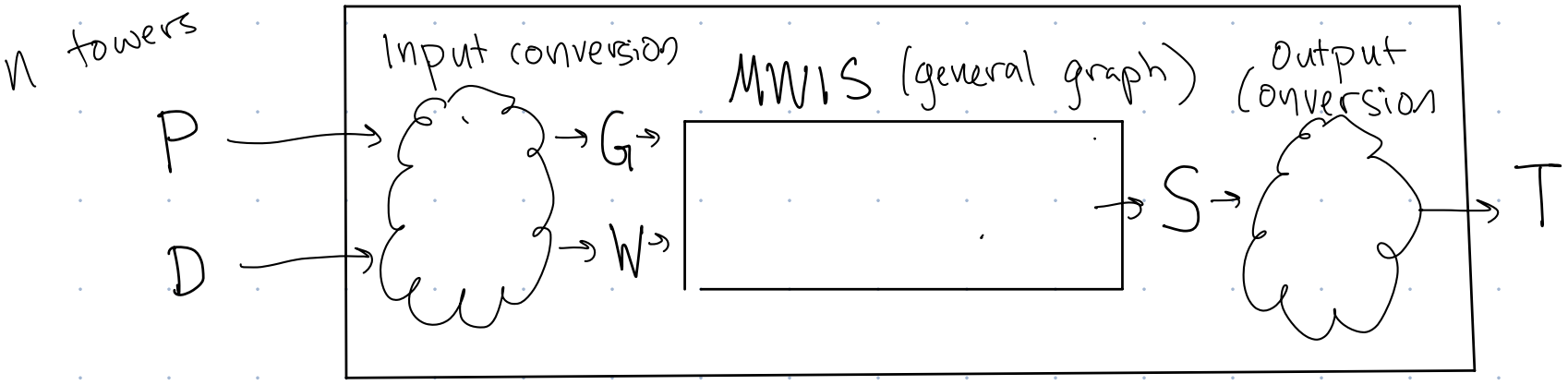
Output: Set of towers T to broadcast in the next time step.

- If 2 towers within 2 miles of each other broadcast at the same time → interference. Bad!
- Maximizes $A(T) = \sum_{i \in T} D[i]$

(Maximizes # of packets in queues of transmitting towers)

Reduction

Cell Tower Problem



1. What should input/output conversion functions be?

I.C. (P, D)

O.C. (S)

Return T

- Return $(G=(V,E), w)$

2. Ethical Matrix (Stakeholders, Well-Being, Autonomy, Justice)
3. Runtime of conversions in terms of n?

Ethical Matrix (O'Neil + Gunn)

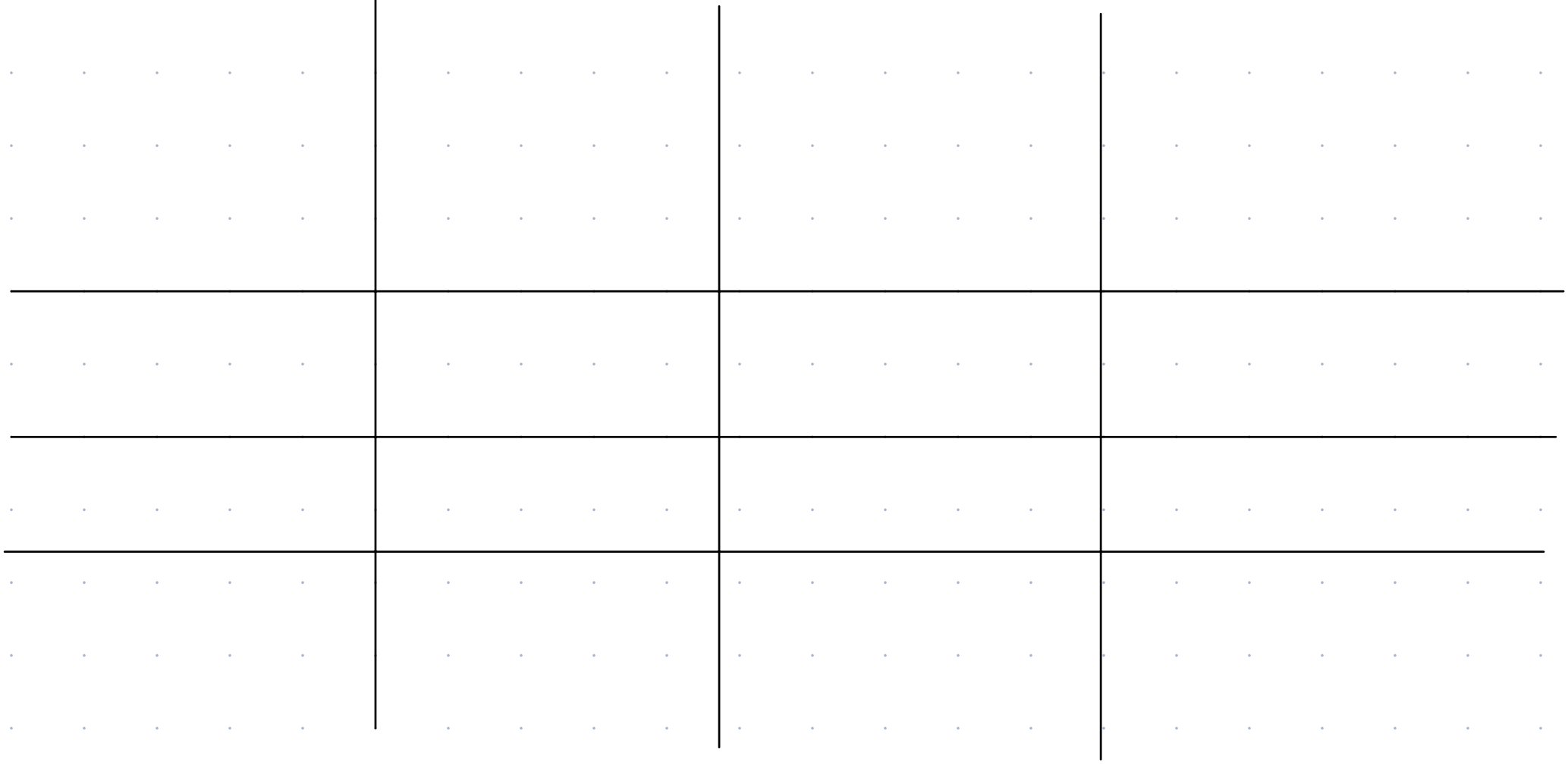
Cell Tower

Harm? Benefit? ↑

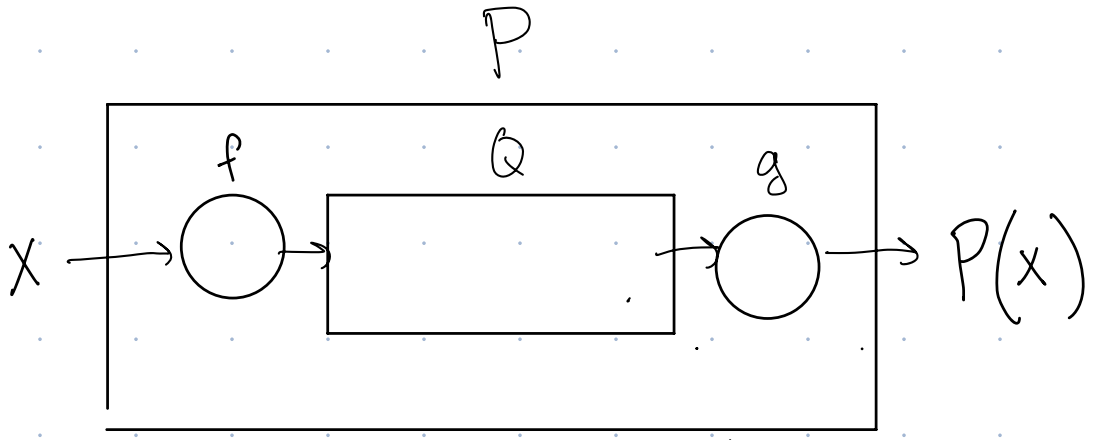
Choice to use? Are users informed enough to understand meaningfully take responsibility for use? ↑

Alg prioritizes certain groups? Unfair treatment of different groups? Access to Tech/Alg?

Stakeholders	Well-Being	Autonomy	Justice

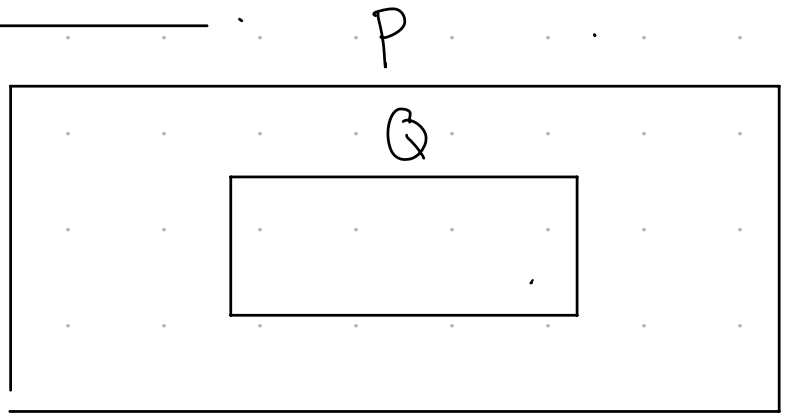


Polynomial-Time Reduction



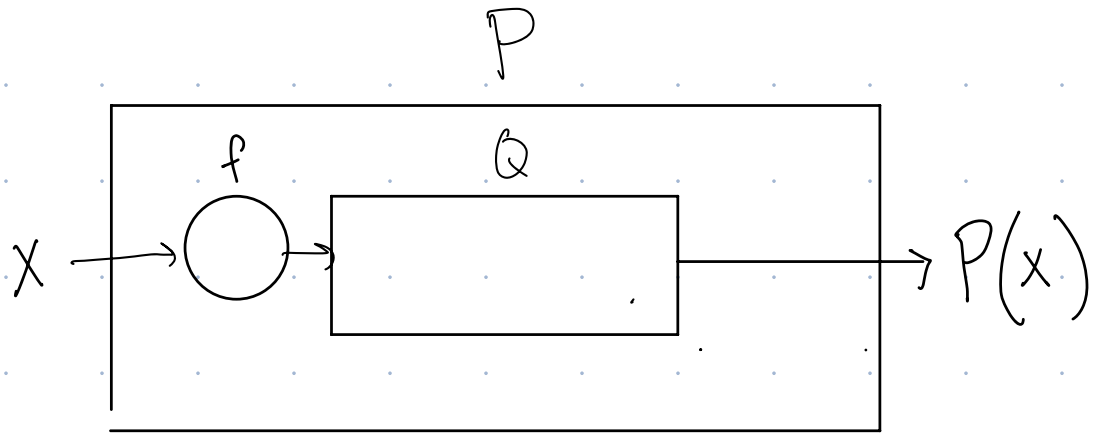
def: If can create box that correctly solves P, and the runtime of f is $O(poly(n))$, then "P is polynomial time reducible to Q, denoted $P \leq_p Q$

"P reduces to Q"

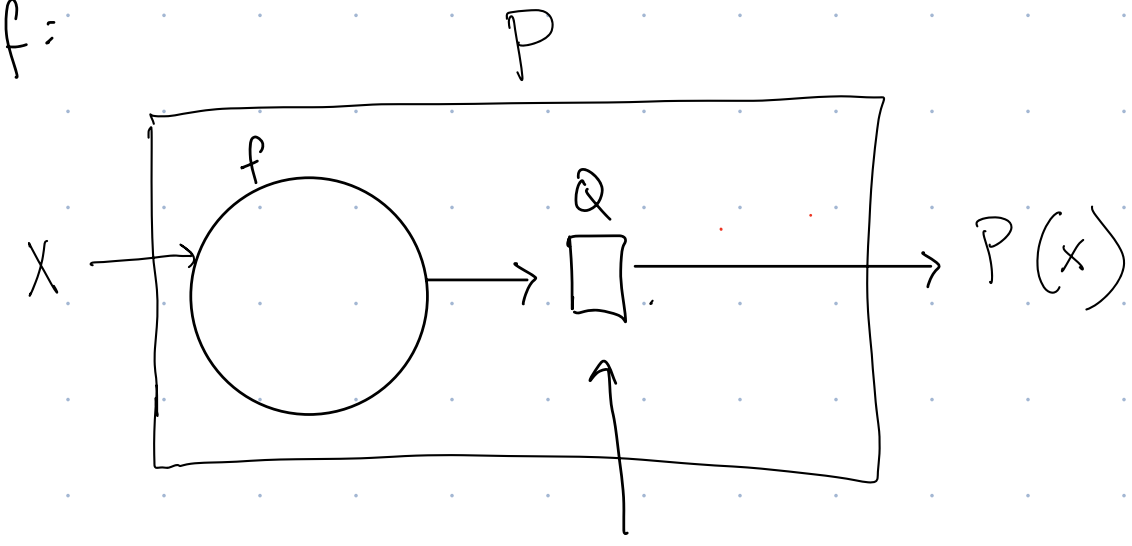


Why Polytime Reduction?

Want



What If:



Why think about reductions?

- Practical: If have an alg for Q, can use it for P
- Conceptual: Gives us a way to compare the difficulty of problems, resources needed to solve problems