All The World’s NP-Complete, And All of Us Merely P...

Every problem in this assignment (except the optional challenge problem) involves transforming some problem $X$ into another problem $Y$ such that

- Any instance of problem $X$ satisfying some property $Q$ corresponds to an instance of problem $Y$ satisfying some (hopefully related!) property $Q'$, and
- Any instance of problem $X$ not satisfying property $Q$ corresponds to an instance of problem $Y$ not satisfying property $Q'$. This is often proven by contrapositive by assuming that the instance of problem $Y$ does satisfy $Q'$ and showing that the instance of problem $X$ from which it was derived must have satisfied property $Q$.
- The instance of problem $Y$ constructed from an instance of problem $X$ is not too big.

Be sure to establish each of these facts in your solutions!

Note: In proving NP-completeness for a problem $Y$, time spent selecting the most appropriate NP-complete problem $X$ to reduce from is time well spent!

**Question 1.** Chapter 8, Problem 5: Hitting Set.

**Question 2.** Chapter 8, Problem 6: Monotone Satisfiability with Few True Variables.

**Question 3.** Chapter 8, Problem 14: Interval Scheduling.

**Question 4.** Chapter 8, Problem 17: Zero-Weight Cycles.

**Question 5.** Chapter 8, Problem 32: Perfect Assembly.

**Optional Challenge**

**Question 6.** Chapter 8, Problem 23: Bad Proofs and Pigeons.