This assignment is due at the beginning of the first section on the due date. Unless all problems carry equal weight, the point value of each problem is shown in [ ] . To receive full credit, all your answers should be carefully justified. Each solution must be written independently by yourself — no collaboration is allowed.

For this homework only, there will be no penalty for not using \LaTeX . You may choose to legibly hand-write and scan the solutions or use another text editor if you wish. However, we strongly advise you to learn \LaTeX for this homework as it will be required for all other homeworks.

Note that Question 3 is intended more as a brainteaser to get you into the problem solving mindset of CIS 160, and does not directly relate to material in lecture. Such questions generally only appear in the first few homeworks — after that, homework questions will relate more closely with the material seen in lecture and recitations.

1. [12 pts] Let $p$, $q$, and $r$ be the following propositions.

   $p$: It is windy in the park.

   $q$: The squirrels are very fat.

   $r$: The birds are sleeping.

Express the following propositions using $p$, $q$, $r$ and logical operators.

Including a line or two of explanation for your solution may be helpful in guiding your thought process, but don’t worry too much about providing justification. For this problem specifically, we’ll only be grading your final answer.

(a) The squirrels are very fat and it is windy in the park.

(b) If it is not windy in the park or the squirrels are very fat, then the birds are not sleeping.

(c) It is necessary for the squirrels to be very fat for it to be windy in the park. It is also necessary for the squirrels to be very fat for the birds to not be sleeping.

(d) The birds are sleeping if and only if it is windy in the park.

(e) The birds are not sleeping and it is windy in the park.

(f) It being windy in the park is sufficient for the squirrels to be very fat and the birds to not be sleeping.
2. [10 pts] Decide if the following proposition forms are tautologies using a truth table. Make sure your truth table shows all intermediate logical expressions — for example, in showing the truth table for \((p \lor \neg q) \land p\), your table should contain separate columns for \(p\), \(q\), \(\neg q\), \(p \lor \neg q\), as well as the final expression. You should also clearly state your final answer to the question.

(a) \[\[(p \lor q) \lor (p \land \neg q)\] \land (p \implies \neg q)\]

(b) \[\[(\neg p \land q) \implies (p \lor \neg q)\] \implies (p \lor \neg p)\]

3. [8 pts] Kara, Ayyah, and Meri want to go to the beach one last time before they have to start studying hard. They find their bucket of sunglasses, which contains 3 red pairs and 2 blue pairs, and each pick a pair to put on without looking into the bucket. With sunglasses on, each person can see the sunglasses the other two are wearing, but they can’t see their own. As they are exemplary CIS 160 TAs with infallible deductive abilities, they want to logically deduce the color of their sunglasses instead of simply taking them off and checking. After some thought, Kara concludes out loud, “I don’t know the color of my sunglasses.” Hearing this, Ayyah thinks momentarily and also announces, “I don’t know the color of my sunglasses.” At this point, does Meri know the color of her sunglasses? Please justify your answer.