CS 135 Spring 2018: Problem Set 1.

Start each problem on a separate page. Submit your solutions on Canvas as ONE **pdf** file.
Late submissions will not be graded; submit your solutions well ahead of the deadline! The problem set is due Sunday, January 28 before 11:59pm.

Problem 1. (10 points) Use the laws of propositional logic and the rules of inference for the following. Be sure to show every step of your proof.

a. Prove that the propositions $\neg(p \vee (\neg p \wedge q))$ and $\neg p \wedge \neg q$ are equivalent.
b. Either prove that the following argument is valid, or else give a counterexample.

Premise 1: If Superman were able and willing to prevent evil, he would do so.
Premise 2: If Superman were unable to prevent evil, he would be impotent.
Premise 3: If Superman were unwilling to prevent evil, he would be malevolent.
Premise 4: Superman does not prevent evil.
Premise 5: If Superman exists, he is neither malevolent nor impotent.
Conclusion: Therefore, Superman does not exist.

Problem 2. (10 points)
It recently came to light that a certain cabal within the CS 135 CAs is plotting to make the problem sets ridiculously hard and demanding that the answers be written in ancient Egyptian hieroglyphics. This cabal will not be stopped unless you determine who is in the cabal and who is not.
Here are the facts: There are nine CAs: Ed, Cassidy, David, Jared, Jo, Katie, Ryan, Sam and Yifan. A membership roster has been found and appears below, but has been deviously encrypted in logic notation. The predicate $incabal$ indicates membership in the cabal; $incabal(x)$ is True if and only if x is in the cabal.
Translate each statement below into English and deduce who is in the cabal, explaining every step in the process.

1. $\exists x \exists y \exists z\ (x \neq y\ \wedge x \neq z\ \wedge y \neq z\ \wedge incabal(x) \wedge incabal(y) \wedge incabal(z))$
2. $\neg(incabal(Ed) \wedge incabal(Yifan))$
3. $(incabal(Sam) \vee incabal(Cassidy))\ \Rightarrow\ \forall x\ incabal(x)$
4. $incabal(Ed) \Rightarrow incabal(Yifan)$
5. $incabal(Ryan) \Rightarrow incabal(Sam)$
6. $\big(incabal(Jared)\ \vee\ incabal(Jo)\big) \Rightarrow \neg incabal(Katie)$
7. $(incabal(Jared) \vee incabal(Yifan)) \Rightarrow \neg incabal(David)$