# CS 330 : Discrete Computational Structures

**Spring Semester, 2019**
ASSIGNMENT #1
**Due Date:** Monday, January 28

**Suggested Reading:** Rosen Sections 1.1 - 1.3; LLM Sections 1.1, 3.1 - 3.4

These are the problems that you need to hand in for grading. Always explain your answers and show your reasoning.

1. **[6 Pts]** Let $p$, $q$ and $r$ be the propositions "you have the flu", "you miss the final", and "you pass the course" respectively. Express (a) $p \vee \neg q$, (b) $(\neg p \wedge \neg q) \rightarrow r$ and (c) $(p \wedge \neg r) \vee (q \wedge r)$ as English sentences.

2. **[6 Pts]** Translate the following English sentences into logic. First, define your basic propositions and use logical operations to connect them.
   (a) Being sunny is sufficient for us to play tennis.
   (b) To play tennis, it is necessary that it be sunny and not windy.
   (c) It is sunny only if we play tennis, unless it is windy.

3. **[10 Pts]** Use logical reasoning or truth tables to solve the following puzzle:
   *Five friends can't agree on whether they want Chinese or Italian food for dinner. It is not true that both David and Ellen want Italian. Ben and Ellen want the same cuisine. Ben and Cathy don't want the same cuisine. If Cindy wants Italian, then so does Ann. If David wants Chinese, then so do Ann and Ellen.* Who wants what cuisine?

4. **[4 Pts]** Determine whether $(\neg q \wedge (\neg p \vee q)) \rightarrow \neg p$ is a tautology. Prove your answer using a truth table.

5. **[4 Pts]** Construct the truth table for $(p \wedge q) \rightarrow (q \vee r))$.

6. **[10 Pts]** Prove that $(p \rightarrow r) \vee (q \rightarrow r)$ and $(p \wedge q) \rightarrow r$ are logically equivalent, (a) by truth tables, and (b) by deduction using a series of logical equivalences studied in class.

7. **[10 Pts]** Assume that $p \,\mathrm{NAND}\, q$ is logically equivalent to $\neg(p \wedge q)$. Then, (a) prove that {NAND} is functionally complete, i.e., any propositional formula is equivalent to one whose only connective is NAND. Now, (b) prove that any propositional formula is equivalent to one whose only connectives are XOR and AND, along with the constant TRUE. Prove these using a series of logical equivalences.

For more practice, you are encouraged to work on the problems given at the end of Rosen, Sections 1.1 - 1.2.