# CS 1200 FS19 HW 04

Due Monday 10/22/18 at 11:59 PM

Please submit two files to Canvas (one is a PDF file and the other is the code .py file) :

1. A PDF file that contains all the answers to the individual questions, all pictures, all code, and all code output. This should all be well-organized. Points will be deducted for sloppy or disorganized work.
2. All the Python codes (.py file) (You may put all codes in one .py file).

If you need a program that helps you put PDF files together into a single PDF file, try http://www.pdfsam.org/. The program there is open source and available for free.

**Note: Partial credit will be given on every problem.**

1. (15 pts) Using truth tables, prove the following arguments are valid.

a.
$P \rightarrow \sim Q$
$\sim R \mid Q$
$R$
---
$\sim P$

b.
$P \rightarrow Q$
$Q \rightarrow R$
---
$P \rightarrow R$

2. (10 pts) Use Python programs to verify the results in Problem 1.

3. (10 pts) Derive the associated sets for the arguments in Problem 1 (by negating the conclusion). Determine if the associated sets are satisfiable.

4. (15 pts) Use the **truth tree method** to decide if the following arguments are valid.

a.
$P \rightarrow Q$
$\sim Q$
---
$\sim P$

b. $P \rightarrow \sim Q$
$Q \mid R$
$P$
---
$R$

5. (20 pts) Translate the following argument into symbolic form and use the truth tree method to decide if the argument is valid. If it is not valid find all truth assignments that will make the hypotheses true, but the conclusion false. The parentheses below are put in to remove ambiguity. Be sure to check your work.

   - If today is Monday and I have a test in Computer Science, then my History professor is not sick or I don't have a test in History.
   - If I do not have a test in Computer Science or my History professor is sick, then today is not Monday and I do not have a test in History.
   - (If today is not Monday then I have test in Computer Science) or (if my History professor is not sick then I have a test in History).

   Conclusion: If (today is Monday or my History professor is sick) then (I have a test in Computer Science and I don't have a test in History).

   Note: use the Boolean variable C, H, M and S to represent the truth values of "I have a test in CS", "I have a test in History", "Today is Monday", and " My History professor is sick" respectively.

6. (15 pts) Write Python functions to solve the following problem:

   - Clark, Daw and Fuller make their living as carpenter, painter and plumber, though not necessarily respectively.
   - The painter recently tried to get the carpenter to do some work for him, but was told that the carpenter was out doing some remodeling for the plumber.
   - The plumber makes more money than the painter.
   - Daw makes more money than Clark.
   - Fuller has never heard of Daw.

   What position does each man fill? Submit a listing and a run of your program. (Note: For your reference, see the Bank Employee example in Lecture 20 or see Section 9.3 in textbook)

7. (15 pts) Let the predicate PRED be defined as follows:

```
def  PRED(A,B):
     return (A==-B) or (A > B)
```

where A and B range over $-100, \ldots, 100$. Indicate whether each of the following predicates is true or false, and give a brief justification for each answer.

| Predicate | Ture or False? | Why? |
|---|---|---|
| $\forall$A $\forall$B PRED(A,B) | | |
| $\forall$A $\exists$B PRED(A,B) | | |
| $\exists$A $\forall$B PRED(A,B) | | |
| $\exists$A $\exists$B PRED(A,B) | | |