MAD 3105 Assignment 01 **NAME:**_____
Relations and Their Properties **DUE: Thursday, January 18th (11:59pm EST)**

Directions: Show ALL work for credit. There are 5 questions. Write on your own paper. Each part is worth 3 points, unless stated otherwise. **40 points total**. You may type or neatly write your solutions. Make sure you write your name on all papers that you use. **Scan this page at the front of your work**, and compile as ONE .pdf file. Check that all work was saved and scanned legibly.
Save your file as: **A01xyLASTNAME.pdf.** (where "*xy*" is your first and middle initial)

Once completed, attach your file under "Assignment 01" on Canvas. Thank you!

1) For the relation $R = \{(1,3),(1,4),(2,3),(2,4),(3,1),(3,4)\}$ on the set $A = \{1,2,3,4\}$, explain/show whether or not the relation is the following:
(For any credit, be sure to give a reason why for each). **(2 points each)**
(a) reflexive,
(b) symmetric,
(c) antisymmetric,
(d) transitive.

2) Let the sets be relations on the real numbers: $R_1 = \{(a,b) \in \mathbb{R}^2 \mid a \geq b\}$, the "greater than or equal to" relation and let $R_2 = \{(a,b) \in \mathbb{R}^2 \mid a \neq b\}$, the "unequal to" relation.
Find:
(a) $R_1 \cap R_2$ (write out the relation in the set notation, as R_1 and R_2 were written)

(b) $R_1 - R_2$ (write out the relation in the set notation, as R_1 and R_2 were written)

(c) $R_1 \oplus R_2$ (write out the relation in the set notation, as R_1 and R_2 were written)

3)(a) How many **binary** relations are there on the set $\{a,b,c\}$? **(2 points)**
(b) If $R = \{(1,1),(1,2),(2,4),(3,1),(3,0)\}$, $S = \{(1,2),(2,0),(3,1),(0,0),(4,3)\}$ find $S \circ R$, with elements listed as above.

4) R is the relation represented by the matrix $\boldsymbol{M}_R = \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$, find the matrix for:

(a) R^{-1}

(b) $\overline{R}$

(c) $R \circ R$ (i.e. R^2)

5) (a) The relation R is on $\{1,2,3\}$. Represent the relation **(4 points)**

$R = \{(1,1),(2,1),(2,2),(2,3),(3,2)\}$ with a matrix.

(b) By looking at the matrix, is the relation R reflexive? Why or why not? **(2 points)**

(c) Draw the directed graph that represents the relation R. **(3 points)**