1. This exam is closed book. It must be entirely your individual work. You may not consult any texts, notes, internet, or any other humans or robots.

2. You have 3 hours to take the exam.

3. You have 3 hours 30 minutes from the time you pick up your exam from the box on my office door to the time you should slide it under my door. You should sign in the time that you pick up and drop off the exam on the sheet on my door.

4. You may use extra scratch paper, but if you turn in additional paper please make sure it is clear what is scratch work and what is your solution.

5. Exams are available starting Wednesday, March 14 at 11:05, and the latest you should turn an exam in is Friday, March 16 at 6pm.

6. I will post times when I will be in my office to answer questions on the Announcements section of the website. I suggest taking the exam at a time that overlaps with my availability, in case you have questions.

Honor Code Statement and Signature:

_________________________________________________________

_________________________________________________________

_________________________________________________________

Time started: ________________    Time finished: ________________
We will use the following definitions (image taken from Discrete Mathematics, an Open Introduction by Levin):

0.2. M

only if" (Sam is a man if and only if Chris is a woman), and “not” (Sam is not a man). The first four are called binary connectives (because they connect two statements) while “not” is an example of a unary connective (since it applies to a single statement).

Which connective we use to modify statement(s) will determine the truth value of the molecular statement (that is, whether the statement is true or false), based on the truth values of the statements being modified. It is important to realize that we do not need to know what the parts actually say, only whether those parts are true or false. So to analyze logical connectives, it is enough to consider propositional variables (sometimes called sentential variables), usually capital letters in the middle of the alphabet: P, Q, R, S, ...

These are variables that can take on one of two values: T or F. We also have symbols for the logical connectives: ∧, ∨, →, ↔, ¬.

Logical Connectives

• P ∧ Q means P and Q, called a conjunction.
• P ∨ Q means P or Q, called a disjunction.
• P → Q means if P then Q, called an implication or conditional.
• P ↔ Q means P if and only if Q, called a biconditional.
• ¬P means not P, called a negation.

The truth value of a statement is determined by the truth value(s) of its part(s), depending on the connectives:

Truth Conditions for Connectives

• P ∧ Q is true when both P and Q are true.
• P ∨ Q is true when P or Q or both are true.
• P → Q is true when P is false or Q is true or both.
• P ↔ Q is true when P and Q are both true, or both false.
• ¬P is true when P is false.

Set Theory Notation

{} We use these brackets to enclose the elements of a set. So {1, 2, 3} is the set containing 1, 2, and 3.
{x : x > 2} is the set of all x such that x is greater than 2.
2 ∈ {1, 2, 3} asserts that 2 is an element of the set {1, 2, 3}.
4 ∉ {1, 2, 3} because 4 is not an element of the set {1, 2, 3}.
A ⊆ B asserts that A is a subset of B: every element of A is also an element of B.
A ⊂ B asserts that A is a proper subset of B: every element of A is also an element of B, but A ≠ B.
A ∩ B is the intersection of A and B: the set containing all elements which are elements of both A and B.
A ∪ B is the union of A and B: the set containing all elements which are elements of A or B or both.
A × B is the Cartesian product of A and B: the set of all ordered pairs (a, b) with a ∈ A and b ∈ B.
A \ B is A set-minus B: the set containing all elements of A which are not elements of B.
The complement of A is the set of everything which is not an element of A.
The cardinality (or size) of A is the number of elements in A.