Intro to Proofs Day 4 Outline (This class meets for 1 hour and 50 minutes.)

**Need extra practice 2.1/2.2 worksheet, 2.3 sets worksheet, cards, LaTeX reproduce document**

PART 1: More practice with logical equivalencies (40 minutes)

**Synthesis Presentation**[0-5 minutes]

* Section 2.2 Exercise 9(d) by truth table!

**Practice with logical equivalencies** [5-15 minutes]

* Go through video example of not(P->Q) is logically equivalent to P and not Q
* They work through synthesis activity but now on worksheet

**Logical Equivalencies Summary** [15-25 minutes]

* Our main goal here is to learn how to prove things.
  + These things often come as conditional statements (Section 1.1)
  + A direct proof of a conditional statement assumes P and shows Q must be true. (We know from the truth table this proves the statement) (Section 1.2)
  + We can also do “proof by contrapositive” (see the logical equivalency). Here we would do a direct proof of “not conclusion” implies “not hypothesis”. (LOGICAL EQUIVALENCE ABOUT CONDITIONAL STATEMENTS PART (3))
  + We will also learn “proof by contradiction” which means you negate the statement (suppose the statement is false) and show that this is impossible (LOGICAL EQUIVALENCES FOR NEGATION ARE IMPORTANT) [video showed how to negate P-> Q] Example: If ab is even then a is even. Negation: ab is even and a is odd. Example: If ab is even then a is even or b is even. Negation: ab is even and a is odd and b is odd
  + Sometimes you want to rewrite a statement (LOGICAL EQUIVALENCIES FOR P-> (QV R) or (PVQ)->R. [Statements to consider: If I win the lottery then I will invest the money or I will move to Thailand. If I go on a diet or I work out then I will lose weight.] (Be careful with “do these things make sense logically?” since we don’t always use things in English the way we do in math.)

**Equivalent statements** [25-40 minutes]

* Work on tasks in the following order:
  + Rewriting statements using logical equivalencies (activity 2 on new worksheet)
  + Negating statements on page 4 of old worksheet
  + Negating statements on page 2 of new worksheet

PART 2: Sets! (40 minutes)

Why? Because we will want to prove things about sets!

**Preview Activity for Monday discussion** [40-45 minutes]

* Slide 5: Roster notation for set of natural numbers less than or equal to 10: {1,2,3,4,…, 10} or {1,2,3,4,5,6,7,8,9,10}. Follow up question: How would you write the set of integers less than or equal to 10?
* Slide 6: Three more elements of {…,-8,-6,-4,-2,0}
* Slide 7: Progress Check 2.9. Go through #1, using \in and \notin. What’s a subset of A? For #2: Can you relate A and D? What about D and F?

**Worksheet 2.3 page 1** [45-55 minutes]

* Note that the whole set and the empty set are always subsets. Notation for the empty set.
* Emphasize that in set B, {4,9} is an element, NOT a subset. Think of it as one of the objects in the set. This is tricky, but will be relevant when we do power sets.

**Preview Activity for Wednesday discussion** [55-60 minutes]

* {m in M | Harrison Ford was an actor in m}
* {x in Z | x^2 -4 < 0} ={-1,0,1} vs. {x in R | x^2-4<0} = (infinite set)
* Write {1,2,3,4,…,10} in set builder notations: {x \in Z : 1<= x <= 10}
* Write {...,-9,-4,1,6,11,16,…} in set builder notation: {n \in Z : n=5k+1 for some k \in Z} vs. {5k+1 : k \in Z}
* Write {2,4,8,16,32, 64,…} in set builder notation: {n\in N: n=2^k for some k in N} vs. {2^k : k\in N}
* Comments on their preview activity:
  + {x | 3x} does not mean anything, you need a universal set
  + {x in Z: 3x} this has a universal set now which is good, but two thins:
    - don’t want Z, that includes negatives!
    - x such that 3x still doesn’t mean anything – you want all the x’s that are equal to a multiple of 3, need a different variable.
  + {a in N: a =3b for some b in N} is correct! OR {3k : k \in N}

**Worksheet 2.3 page 2** [60-75 minutes]

* Focus on #2 and #3

PART 3: LaTeX (30 minutes)

* Download the LaTeX template from Blackboard
* See notes on what to tell them, then give them the reproduce document.

**Synthesis Activity: (no class Monday so this is a longer preview activity)**

* Section 1.2: 3(a) on page 27. You should typeset a proof of this fact that meets our writing guidelines.
* Section 2.2 #10 on page 50-51
* Section 2.3 #2 on page 61
* Section 2.3 #6 on page 62

**Preview Activity:**

* None!