Updated April 9, 2018.

Instructions

Pre-class assignments are intended to help you get more out of class. You are not expected to provide a complete solution, but you should give it your best attempt and try to reflect on some of the big ideas. If you are not confident in your solution, describe some *specific* points where your understanding could be improved. Write out all your work and questions and submit them in writing (not in LaTeX) at the beginning of class on the due date.

January 19

Section 1.2

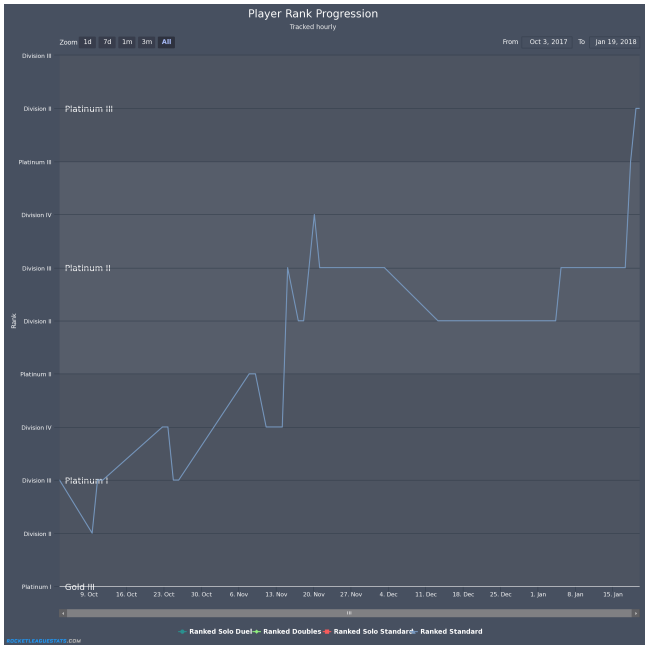
- Optional viewing: Watch a video on making rigorous definitions.
  https://www.youtube.com/watch?v=RoqoSxUoK-A
  - The important bit from this video is the definition of an even integer: An integer n is said to be **even** if there exists another integer k such that $n = 2k$.
- Watch a video on know-show tables.
  https://www.youtube.com/watch?v=H8LLINU6ebY
- Construct a know-show table for the following conditional statement:
  If m and n are even integers, then mn is an even integer.

January 22

Section 2.1

- Read the definitions of conjunction, disjunction, negation, and implication on page 33 in the text, and take a look at the truth tables for these operations on page 36.
- Watch a video on using truth tables to analyze compound statements.
  https://www.youtube.com/watch?v=d2yksDk4h6s

- Construct a truth table for the following compound statement: I played Rocket League for six consecutive hours and I did not reach Diamond rank.



January 24

Section 2.2

- Watch a video on logical equivalence.
https://www.youtube.com/watch?v=oY8Xt5GvZ1g
- Use truth tables to prove the following two logical equivalences. (These are very useful equivalences known as DeMorgan's Laws.)

$$\neg(P \vee Q) \equiv (\neg P) \wedge (\neg Q)$$
$$\neg(P \wedge Q) \equiv (\neg P) \vee (\neg Q)$$

January 26

Section 2.3

- Optional viewing: Watch a video introducing the concept of a set.
https://www.youtube.com/watch?v=01OoCH-2UWc
- Watch a video introducting set builder notation.
https://www.youtube.com/watch?v=DEhWj-52rlw
- What elements belong to the set $\{n \in \mathbb{Z} \mid n^2 < 16\}$?
- Use set builder notation to describe the set $\{1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \dots\}$.

January 29

Section 2.4

- Watch a video introduction universal and existential quantifiers.
  https://www.youtube.com/watch?v=6qTzP03waOA
- Write each of the following statements in English and explain why the statement is false.

$$(\exists x \in \mathbb{R})(x^2 < 0)$$

$$(\forall n \in \mathbb{Z})(n^2 \geq 1)$$

January 31

Section 3.1

No pre-class homework.

February 2

Section 3.1

- Watch a video about integer congruence.
  https://www.youtube.com/watch?v=_-ZMdsQyIJw
- Show that each of the following statements is true.
  - $6 \equiv 0 \pmod 3$
  - $6 \equiv 11 \pmod 5$
  - $6 \not\equiv 11 \pmod 4$

February 5

Section 3.2

- Watch a video about proof by contraposition.
  https://www.youtube.com/watch?v=hAFpc9abNFc
- Use contraposition to sketch a proof for the following proposition. (You need not write in full detail.)
  If n^3 is even, then n is even.

February 7

Section 3.2

No pre-class homework.

February 9

Section 3.3

- Watch an introduction to proof by contradiction.
  https://www.youtube.com/watch?v=YUL6HMJmTM4
- We established the following fact during the previous class. Prove it formally using contradiction.
  There are no integers m and n such that $6m + 15n = 2$. (Hint: Factor a common 3 from the right hand side.)

February 12

Section 3.3

No pre-class homework.

February 14

Section 3.4

No pre-class homework.

February 16

Section 3.5

- Watch a video on the division algorithm.
  https://www.youtube.com/watch?v=XHjSy_MT7u0
- Rewrite the expression $23 \div 4$ in the $a = bq + r$ form specified by the division algorithm.

February 19

Section 4.1

No pre-class homework.

February 21

Section 4.1

No pre-class homework.

February 23

Section 4.2

- (Optional) If you like, you can watch the introduction to induction videos I intended to assign for February 19.
  - Part 1: https://www.youtube.com/watch?v=JTj6ID4-084
  - Part 2: https://www.youtube.com/watch?v=1H0gg3fMYVA
- Watch a video on the second principle of induction (often called "strong induction"). https://www.youtube.com/watch?v=n-bJB_7QbQU
- Carefully state the strong inductive hypothesis for the following proposition. (You do not have to prove it.)

  Each natural number greater than or equal to 4 can be written as the sum of at least two natural numbers, each of which is a 2 or a 3. (For example, $7 = 2 + 2 + 3$.)

February 26

Exam 1

No pre-class homework.

February 28

Discuss Exam

No pre-class homework.

March 2

Problem Session

No pre-class homework. Begin work on your proof portfolio.

March 12

Section 4.3

- Watch an introduction to recursively-defined sequences.
  https://www.youtube.com/watch?v=txdmCgThR6o
- Write out the first five terms of the following recursively-defined sequence:
  $a_n = a_{n-1} + a_{n-2}$ for $n \geq 2$ and $a_0 = a_1 = 1$

March 14

Section 5.1

- Watch an introduction to set operations.
  https://www.youtube.com/watch?v=QiOfsWm3peE
- Define the sets $A = \{1, 2, 3\}$ and $B = \{3, 4, 5\}$ viewed as subsets of the universal set $\mathbb{N}$. Write down the contents of the sets $A \cup B$, $A \cap B$, $A - B$, and A^c.

March 16

Section 5.2

- **Bring printed drafts of portfolio proofs 1 and 2 (two copies each).**
- Watch an introduction to subset inclusion ("element-chasing") proofs.
  https://www.youtube.com/watch?v=8QmqjwFLV7k
- Let A contain all positive multiples of 6 ($A = \{6, 12, 18, \dots\}$) and let B contain all positive multiples of 3 ($B = \{3, 6, 9, \dots\}$). Sketch a proof that $A \subset B$.

March 19

Section 5.3

- Watch a discussion on various set identities.
  https://www.youtube.com/watch?v=gUMmcfyGb-U
- Sketch a proof that $(A \cap B)^c = A^c \cup B^c$ for all sets A and B.

March 21

Exam 2a

No pre-class homework. Exam 2a will feature problems 1 – 4.

March 23

Section 5.4

- **Bring printed drafts of portfolio proofs 3 and 4 (two copies each) and critiques of proofs 1 and 2.**
- Watch an introduction to Cartesian products.
  https://www.youtube.com/watch?v=knwM9OWK3oA
- Let $A = \{a, b, c\}$ and $B = \{1, 2\}$. Write out all the elements of $A \times B$.

March 26

Section 6.1

- Watch an introduction to functions.
  https://www.youtube.com/watch?v=PZFU3JC3Plo
- Refer to the "five basic ingredients" in the video. Suppose I create a function that, presented with any person the class, returns the color of their eyes. Discuss the five basic ingredients as they pertain to this function.

March 28

Section 6.3

No pre-class homework.

April 4

Section 6.4

- Watch an introduction to composition of functions.
  https://www.youtube.com/watch?v=f_t1I3WgXbM
- Define functions $f : \mathbb{N} \to \mathbb{N}$ by $f(x) = 3x + 1$ and $g : \mathbb{N} \to = \mathbb{R}$ by $g(x) = \sqrt{x}$. Evaluate each of the following or explain why it does not exist.
  - $(g \circ f)(2)$
  - $(f \circ g)(2)$

April 6

Section 6.5

- **Bring printed drafts of portfolio proofs 5 and 6 (two copies each) and critiques of proofs 3 and 4.**

April 9

Exam 2b

No pre-class homework. Exam 2b will feature questions 5 – 7 from the study guide.

April 11

Section 7.1

No pre-class homework.

April 13

Section 7.2

- **Bring printed drafts of portfolio proof 7 (two copies), critiques of proofs 5 and 6, and email final drafts of problems 1 – 4.**

April 16

Section 9.2

No pre-class homework.

April 18

Section 9.3

No pre-class homework.

April 20

Exam 3a

- **We will meet in Smith-Curtis 122.**

- **Bring printed drafts of portfolio proof 8 (two copies).**

No pre-class homework. Exam 3a will feature questions 1 – 7 from the study guide.

April 23

Exam 3b

No pre-class homework. Exam 3a will feature questions 8 – 9 from the study guide.

April 25

NWU Student Research Symposium

No class. You may write brief reflections on two mathematics presentations to earn a point of extra credit toward your post-class homework. (You may submit four or six reflections for two or three points, respectively.)

April 27

Section 8.2

- **Email final drafts of problems 5 – 8.**
- No pre-class homework.

May 3

Final Exam

The final exam starts at 8 am in our usual classroom. It will feature questions 1 – 9.