Administrative

1. Review the information on the course webpage

    http://www.math.lsa.umich.edu/~jchw/2021Math592.html

    under **Course Information**. Please pay particular attention to the homework policy, and to the midterm and final exam dates. Contact Jenny (jchw@umich.edu) if you have any questions.

2. Complete the Math 592 Entrance survey by 5pm on Friday 22 January.

3. If you might need an accommodation in the class based on the impact of a disability, please get in touch with Jenny at jchw@umich.edu. You may be asked to obtain a VISA form through the Office of Services for Students with Disabilities (SSD).

4. Please contact Jenny as soon as possible if you anticipate a conflict with the midterm or final exam.

Assignment questions

Submit these questions through Gradescope by 5pm on Friday. You can find Gradescope submission instructions on the course webpage.

1. **(Functions review.)** Let $f : X \to Y$ be a function of sets X and Y. Recall that, for $A \subseteq X$, the *image* of A under f is the subset of Y

$$f(A) = \{f(a) \in Y \mid a \in A\} \subseteq Y.$$

    For $C \subseteq Y$, the *preimage* of C under f is the subset of X

$$f^{-1}(C) = \{c \in X \mid f(c) \in C\} \subseteq X.$$

    Let $A, B \subseteq X$ and $C, D \subseteq Y$. For each of the following, determine whether you can replace the symbol $\square$ with $\subseteq, \supseteq, =$, or none of the above. No justification necessary.

    (a) $f(A \cap B) \quad \square \quad f(A) \cap f(B)$ (b) $f(A \cup B) \quad \square \quad f(A) \cup f(B)$

    (c) For $A \subseteq B$, $\quad f(B \setminus A) \quad \square \quad f(B) \setminus f(A)$

    (d) $f^{-1}(C \cup D) \quad \square \quad f^{-1}(C) \cup f^{-1}(D)$ (e) $f^{-1}(C \cap D) \quad \square \quad f^{-1}(C) \cap f^{-1}(D)$

    (f) For $C \subseteq D$, $\quad f^{-1}(D \setminus C) \quad \square \quad f^{-1}(D) \setminus f^{-1}(C)$

    (g) $A \quad \square \quad f^{-1}(f(A)))$ (h) $C \quad \square \quad f(f^{-1}(C)))$

2. **(Cartesian product review.)** For sets X and Y, let $A, B \subseteq X$ and $C, D \subseteq Y$. Consider the Cartesian product $X \times Y$. For each of the following subsets, determine whether you can replace the symbol $\square$ with $\subseteq, \supseteq, =$, or none of the above. No justification necessary.

    (a) $(A \times C) \cup (B \times D) \quad \square \quad (A \cup B) \times (C \cup D)$

    (b) $(A \times C) \cap (B \times D) \quad \square \quad (A \cap B) \times (C \cap D)$

    (c) $(X \setminus A) \times (Y \setminus C) \quad \square \quad (X \times Y) \setminus (A \times C)$