

Algebraic Topology (Fall 2025): Homework 1

- You **must email your submission** as a **PDF file** to kbala@wsu.edu. You are welcome to write answers by hand, and scan or take photos of the writings. Put all the images on a PDF file, though.
 - Your file name should identify you in the following manner. If you are Eric Cartman, you should name your submission EricCartman_Hw1.pdf. **Please avoid white spaces in the file name :-).**
 - The total points (given in parentheses) add up to 80.
 - **This homework is due by 8 PM on Thursday, Aug 28.**
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1. (20) Meet with me briefly—in person or on Zoom. You can do so during the scheduled Check-In hours, or set up another time with me. You are *not* required to ask me questions about this homework, but you are welcome to.
 2. (15) Show that the closed unit interval $[0, 1]$ and the closed upper unit semicircle are homeomorphic by explicitly defining the homeomorphism from the former to the latter.
 3. (25) Prove the reverse direction of the equivalence of the two definitions of a topological space given in terms of neighborhoods (termed **Definition I** or **Def I** in Lecture 1) and the definition given in Lecture 2 in terms of open sets (termed **Def II**). In other words, starting with **Def II**, check that all the axioms given as part of **Def I** hold.
 4. (20) Let $\{\mathbf{a}_0, \dots, \mathbf{a}_n\}$ be geometrically independent (GI), and let P be the n -plane spanned by these vectors. If $\mathbf{w} \notin P$, then show that $\{\mathbf{w}, \mathbf{a}_0, \dots, \mathbf{a}_n\}$ is also GI.