# MAT237 Lecture Notes

A Compact Version of Notes by Tyler Holden

Tianyu Du

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## Contents



# 1 The Topology of $\mathbb{R}^n$

**Definition 1.1.** A **set** is any collection of distinct objects.

**Definition 1.2.** Let $S$ be a set and $A$ and $B \subseteq S$, the binary operator **union** is defined as

$$A \cup B = \{x \in S : x \in A \vee x \in B\}$$

**Definition 1.3.** Let $S$ be a set and $A$ and $B \subseteq S$, the binary operator **intersection** is defined as

$$A \cap B = \{x \in S : x \in A \wedge x \in B\}$$

**Definition 1.4.** Let S be a set and $A \subseteq S$, then the **complement** of $A$ with respect to $S$ is defined as

$$A^c = \{x \in S : x \notin A\}$$

**Definition 1.5.** The **Cartesian Product** of two sets $A$ and $B$ is the collection of ordered pairs, one from $A$ and one from $B$, denoted as

$$A \times B = \{(a, b) : a \in A \wedge b \in B\}$$

**Definition 1.6.** Let $f : A \to B$ be a function, then

1. If $U \subseteq A$ then we define the **image** of $U$ as

$$f(U) = \{y \in B : \exists x \in U s.t.\ f(x) = y\} = \{f(x) : x \in U\}$$

2. If $V \subseteq B$ then we define the **pre-image** of $V$ as

$$f^{-1}(V) = \{x \in A : f(x) \in V\}$$

**Definition 1.7.** Let $f : A \to B$ be a function, we say that

1. $f$ is **injective** if and only if

$$f(x) = f(y) \implies x = y,\ \forall x, y \in A$$

2. $f$ is **surjective** if and only if

$$\forall y \in B, \exists x \in A\ s.t.\ f(x) = y.$$

3. $f$ is **bijective** if and only if it is both injective and surjective.

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