# CS 70 Discussion 1A

September 4, 2024

# Direct Proof

**Goal**: Prove $A \implies B$

**Approach**: Do the following in order:

1. Assume $A$ is true
2. Do some mathematical/logical steps...
3. State that therefore, $B$ is true

# Contraposition Proof

**Goal**: Prove $A \implies B$

**Approach**: Do the following:

1. State that you will prove $\neg B \implies \neg A$ instead (this is logically equivalent to proving $A \implies B$)
2. Assume $\neg B$ is true
3. Do some mathematical/logical steps...
4. State that therefore, $\neg A$ is true

# Contradiction Proof

**Goal**: Prove $A \implies B$

**Approach**: Do the following:

1. Assume that $A$ is true and $B$ is false
2. Do some mathematical/logical manipulations...
3. Find out some statement $C$ is true
4. Do some mathematical/logical manipulations...
5. Find out that $C$ is now false
6. State that you can't have $C \wedge \neg C$, so we have a contradiction, and this means that $A \implies B$

*Note: Often, proofs that can be proven via contradiction can also be proven with contraposition, and vice versa*

# Cases Proof

**Goal**: Prove $A \implies B$

**Approach**: Do the following:

1. Split the scenarios where $A$ is true into several cases (we will call these cases/propositions $C_1, C_2, \ldots, C_n$). For each case $C_i$:
   - 1.1 Assume that $A$ and $C_i$ are true and do a direct, contraposition, or contradiction proof for why $(A \wedge C_i) \implies B$
2. Since every case $C_i$ results in $(A \wedge C_i) \implies B$, we know that $A \implies B$.