# Proofs problems

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August 31, 2023

# Chapter 1

# Intuitive Proofs

**Fact 1.0.1: The pigeonhole principle**

**Simple form:** If $n+1$ objects are placed into $n$ boxes, then at least one box has at least two objects in it.
**General form:** If $kn+1$ objects are placed into $n$ boxes, then at least one box has at least $k+1$ objects in it.

**Proposition**

If one chooses $n+1$ numbers from $\{1, 2, 3, \ldots, 2n\}$, it is guaranteed that two of the numbers they chose are consecutive.

*Proof.* TODO *Quick maths*

**Proposition**

If one selects any $n+1$ numbers from the set $\{1, 2, \ldots, 2n\}$, then two of the selected numbers will sum to $2n+1$.

*Proof.* TODO *Quick maths*

**Proposition**

If one chooses 31 numbers from the set $\{1, 2, 3, \ldots, 60\}$, then two of the numbers must be relatively prime.

*Proof.* TODO *Quick maths*

**Problem**

Determine whether or not the pigeonhole principle guarantees that two students at your school have the same 3-letter initals.

TODO

# Chapter 2

# Direct proofs