**Definition**

An Undirected Graph is a set of vertices \( V \) and a set of edges \( E \) where each edge is an unordered pair of distinct vertices \( a \) and \( b \).

\[ a - b \text{ (edge } ab \text{)} = \{a, b\} \]

**Degree** of a vertex \( v \) is the number of edges it connects to.

\[ \text{deg}(a) = 2 \quad \text{deg}(b) = 4 \]

**Isomorphic Graphs**

Graphs \( G_1 \) and \( G_2 \) are isomorphic if there exists a bijection \( f: V_1 \rightarrow V_2 \) such that for all \( u, v \) in \( V_1 \)

\[ u \rightarrow v \text{ is in } E_1 \quad \text{iff} \quad f(u) \rightarrow f(v) \text{ is in } E_2 \]

There is a one-to-one correspondence between the nodes of \( G_1 \) and \( G_2 \) that preserves all edge connections.
Are these Isomorphic?

Find a Mapping

Function
f(Dog) = beef
f(Cat) = tuna
f(Cow) = hay
f(Pig) = corn

Finding the Mapping

- Not easy, can try all possible mappings
  - Roughly $n!$ possibilities

- Can test for Invariants
  - Same number of nodes, edges
  - Same degree distributions
  - Preserves cycles, longest path, etc

Class Problems

1 & 2