1. Provide 3 examples of **each** type of multiplicity of binary E-R relationships (many-many, many-one, and one-one), i.e., 9 examples in total (3/type.) Draw the E/R diagram and explain the assumptions. NOTE: you should NOT include the examples already covered in lectures or those from the textbook. And if a piece of information can be modeled as an attribute of an entity set, then don't model it as a separate entity set (e.g., VIN as a property of vehicles, SSN as a property of people). (18 pts)

Many-To-Many: More than one instance from one entity is connected to more than one instance in the other entity.
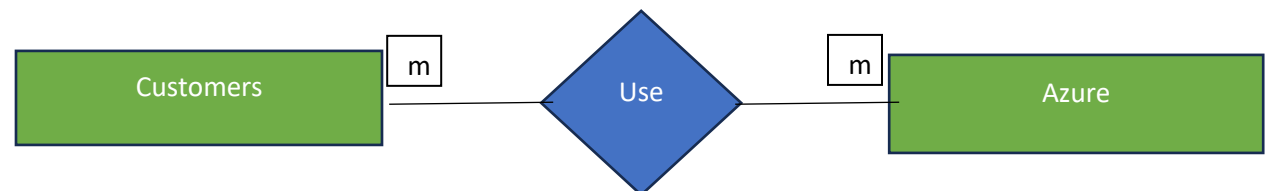
e.g., 1: A musician can play multiple instruments, and multiple musicians can play an instrument.

| Musician | —m— | Plays | —m— | Instrument |
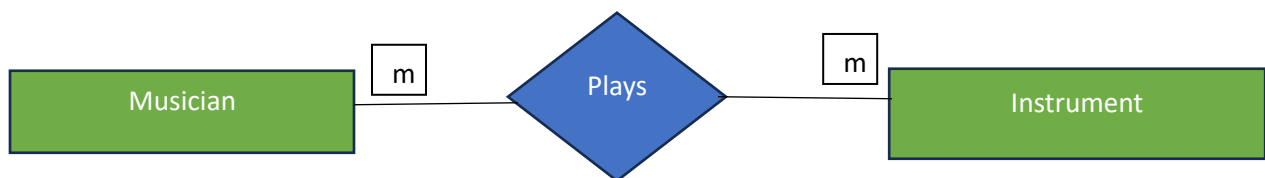
e.g., 2: A traveler can travel to multiple destinations, and multiple travelers can visit a destination.

| Traveler | —m— | Visits | —m— | Destination |

e.g., 3: Many customers use Azure, and Azure can have many customers

| Customers | —m— | Use | —m— | Azure |

Many-to-one: When there is more than one instance associated with one instance of another entity, it is called a many-to-one relationship

e.g., 1: Many people elect one president for the country. People cannot elect more than one President for the country. There cannot be more than one president, exactly one.

| People | —m— | Elect | —1→ | President |
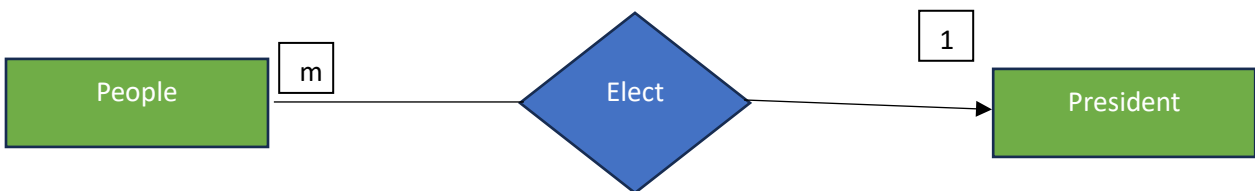
e.g., 2: Microsoft provides many Azure Cloud Computing Services, but Microsoft is the only company that provides these services.

| Azure Cloud Computing Services | —m— | Provided | —1→ | Microsoft |
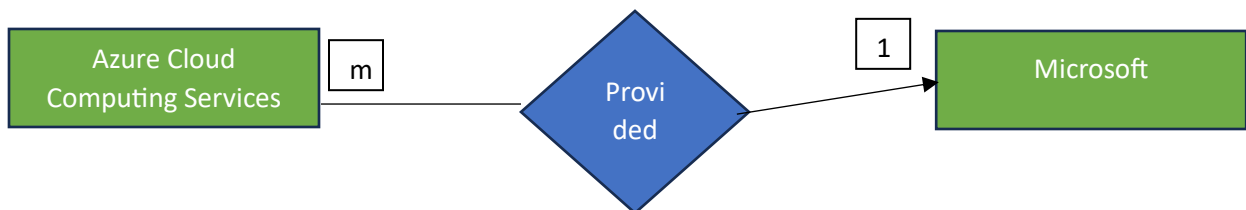
e.g., 3: There are many courses in a university but at least one professor needs to teach one or more courses, but one professor cannot teach many courses.

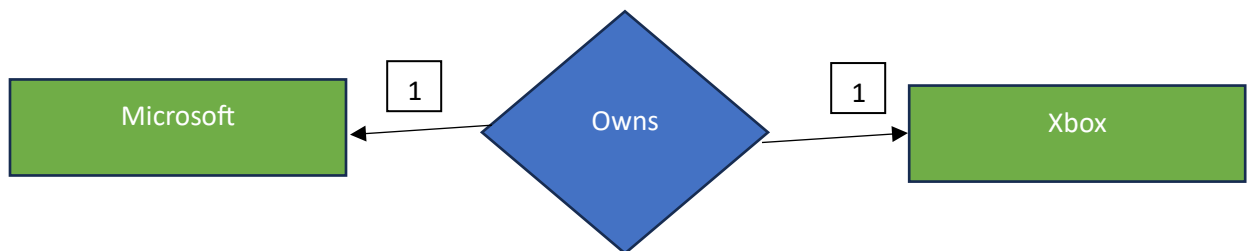| Courses | —m— | Taught By | —1→ | Professor |
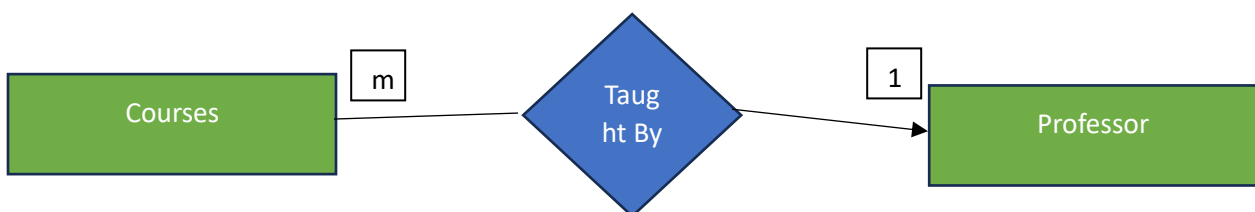
One-To-One: When one instance in the table is explicitly related to only one example in the other table and the other way around.

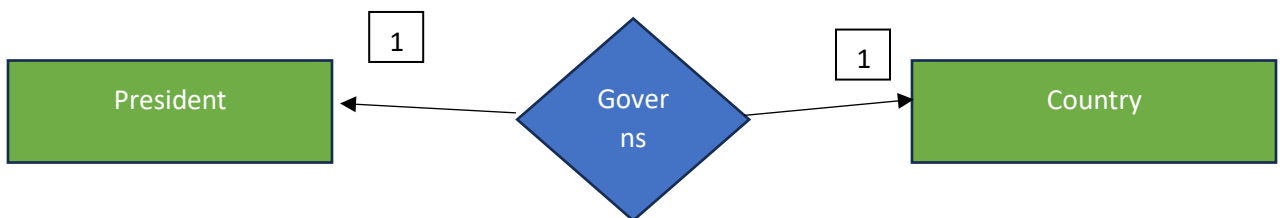e.g., 1: A CEO leads one company, and one company has only one CEO.

| CEO | 1 ← Leads → 1 | Company |
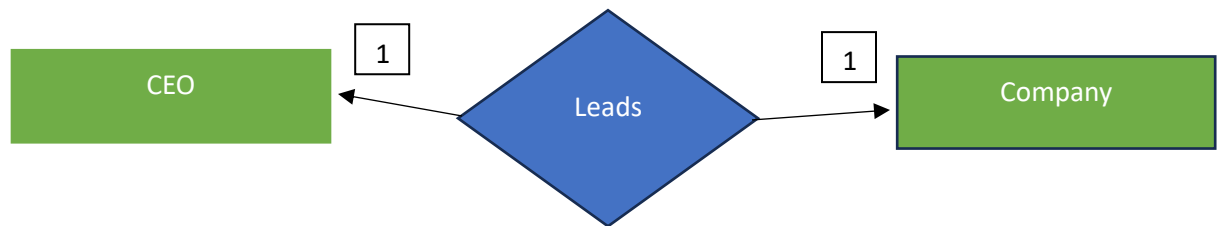
e.g., 2: Microsoft owns Xbox, and no other company owns Xbox

| Microsoft | 1 ← Owns → 1 | Xbox |

e.g., 3: A country is governed by only one president, and only one president governs one country.

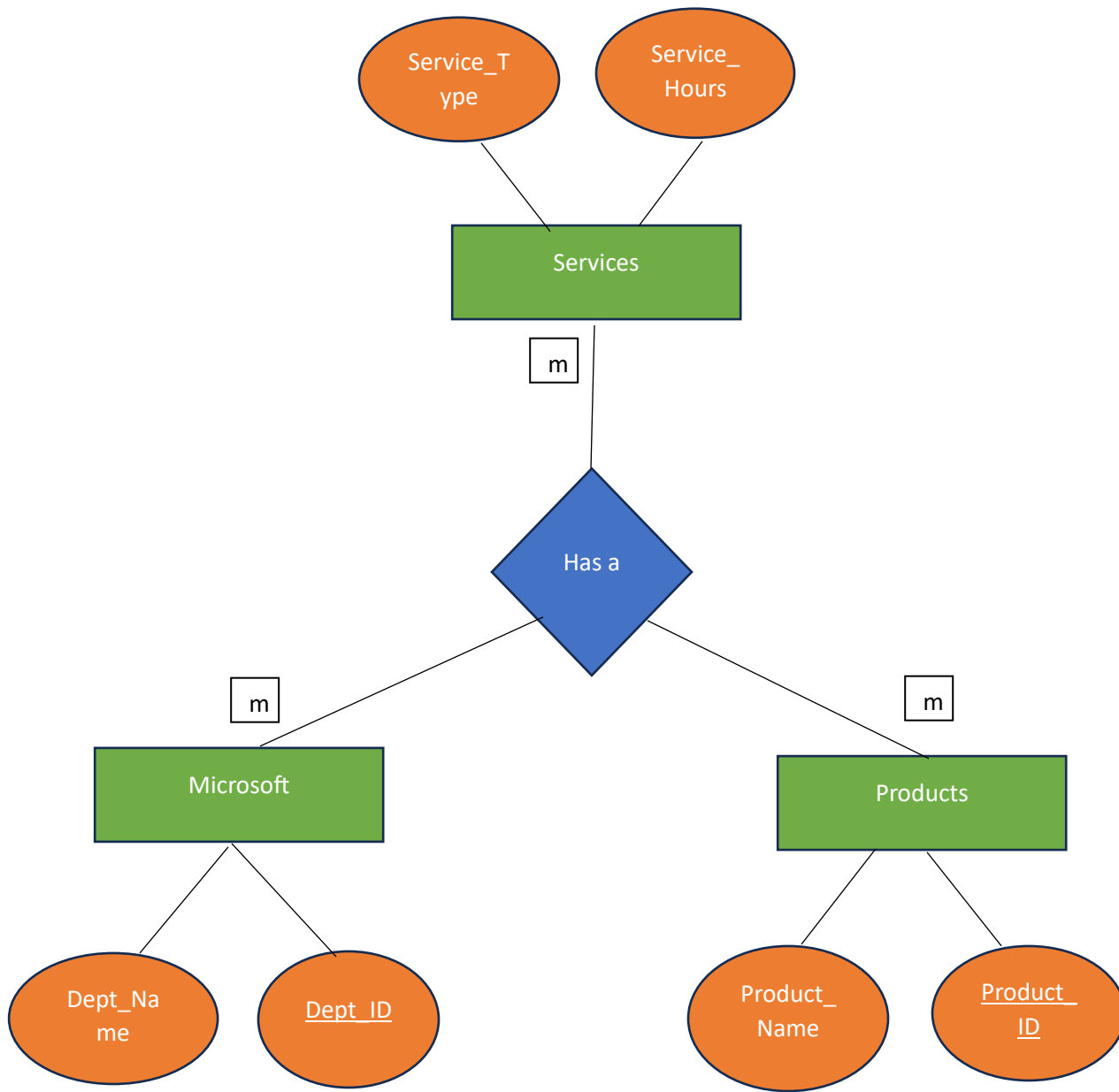| President | 1 ← Governs → 1 | Country |

2. Provide 2 examples of multiway E-R relationships. Draw the E/R diagram and explain the assumptions. NOTE: you should NOT include those examples already covered in lectures or those from the textbook. (8 pts)

e.g. 1:

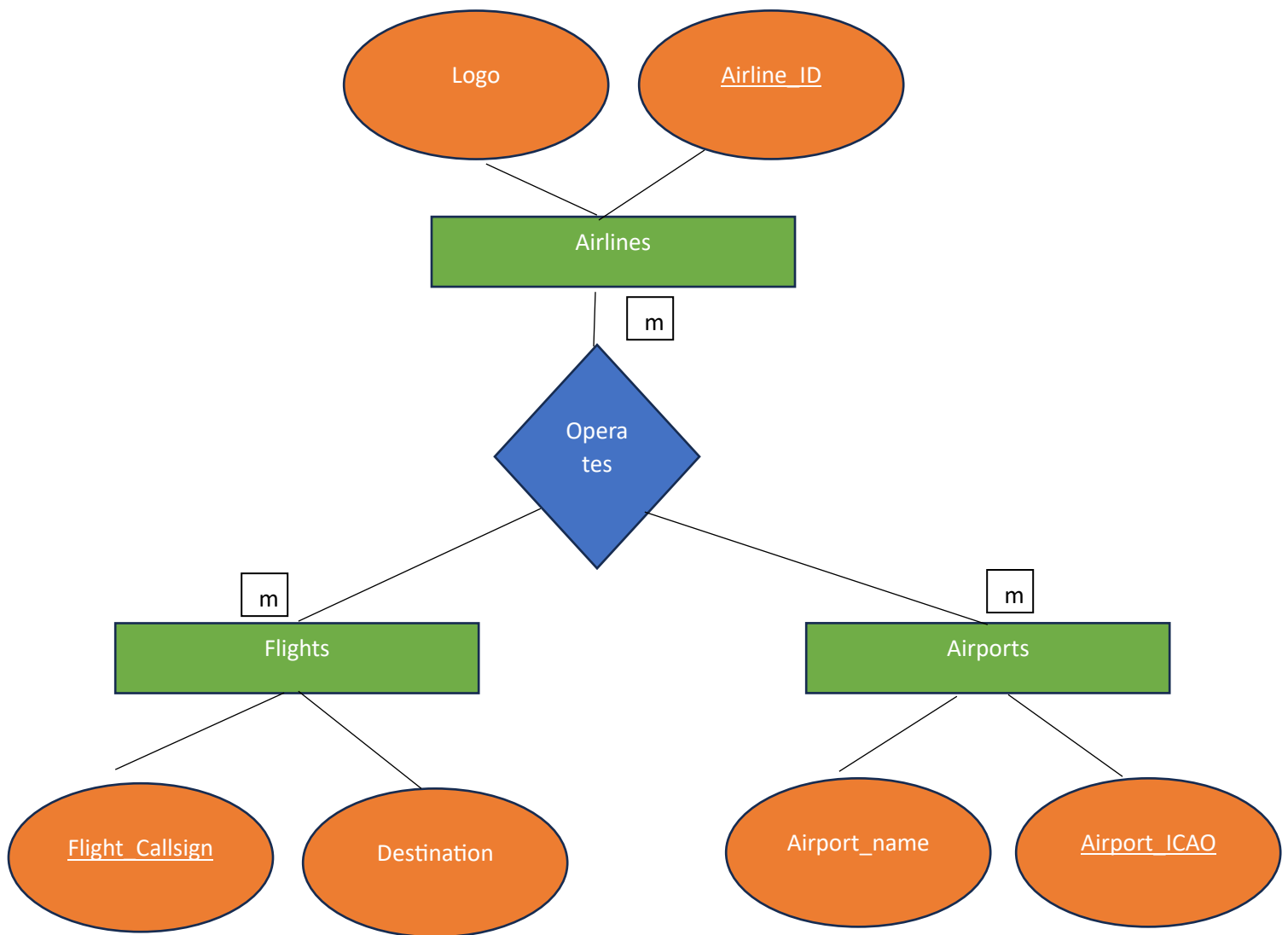Entities: Microsoft, Products, and Services

Microsoft produces multiple products, products have multiple services, and the services are supported by Microsoft.

e.g., 2:

Entities: Airlines, Flights, and Airports

An Airline operates multiple flights; each flight departs from and arrives at airports, and airports host flights from different airlines.

3. Provide one example of ISA E-R relationships. Draw the E/R diagram and explain the assumptions. NOTE: you should NOT include those examples already discussed in lectures or those from the textbook. (3 pts)
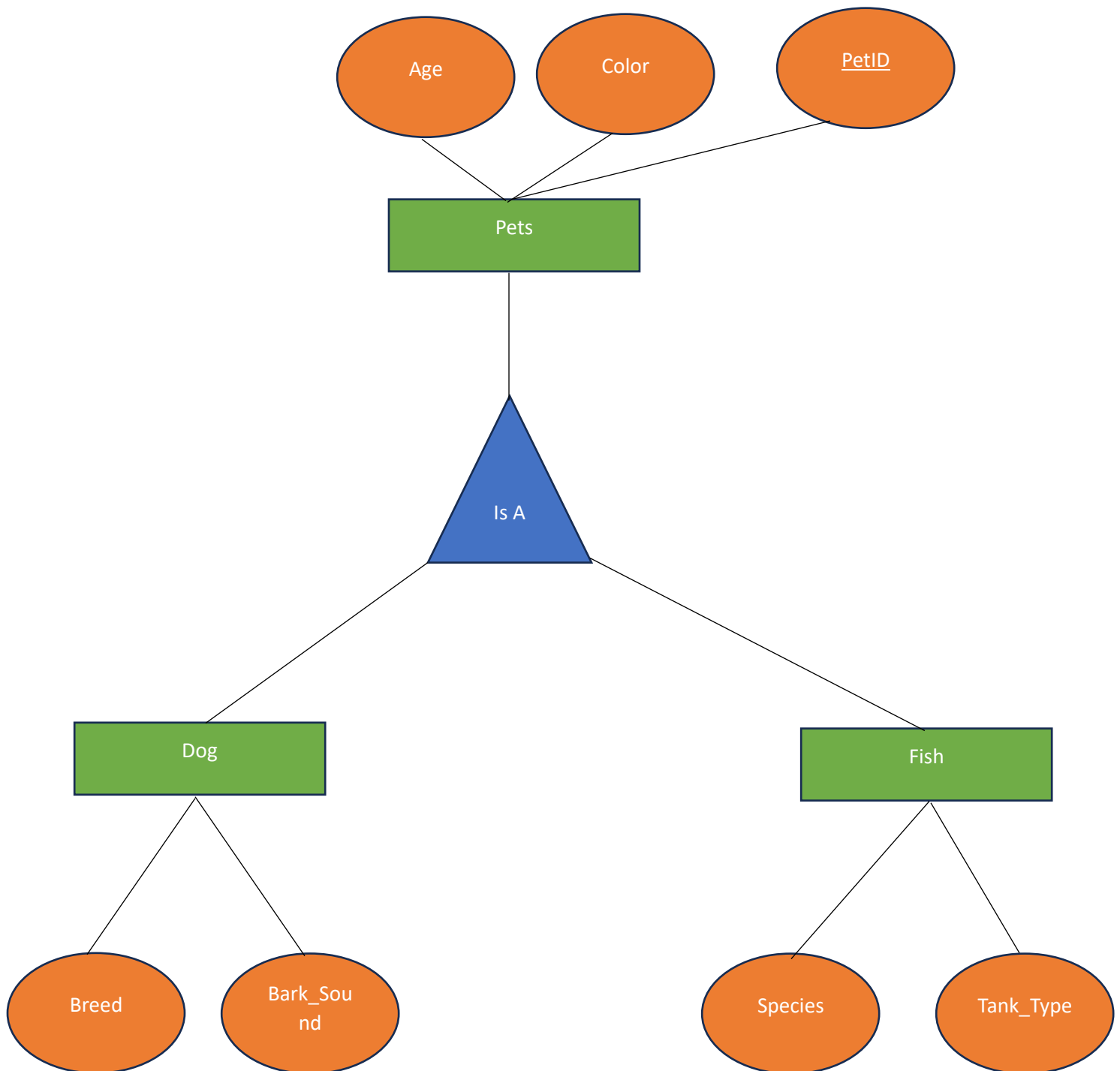
We are assuming that all dogs and fishes are pets, and dogs and fish inherit the attributes of a pet's age and color but also have their attributes. A dog's breed can vary, and each has a unique barking sound. Fish have different species and may require specific tank types based on their species.