Sec 3.5 Analyzing Arguments with Euler Diagrams

— Recall —

- Two types of reasoning: **inductive** and **deductive**.
- Inductive reasoning observed patterns to solve problems.
- Deductive reasoning involves drawing specific conclusions from given general premises.

Parts of an Arguments

A **logical argument** is composed of:

1. **premises** (assumptions, laws, rules, widely held ideas, or observations) and

2. **conclusion**

Valid and Invalid Arguments

- An argument is **valid** if the fact that **all the premises are true** forces the **conclusion to be true**.
- An argument that is not valid is said to be **invalid** or a **fallacy**.
- Deductive reasoning can be used to determine whether logical arguments are **valid** or **invalid**.
- **Note**: **valid** and **`true`** are not the same — an argument can be valid even though the conclusion is false, as we shall see later.

Euler diagrams

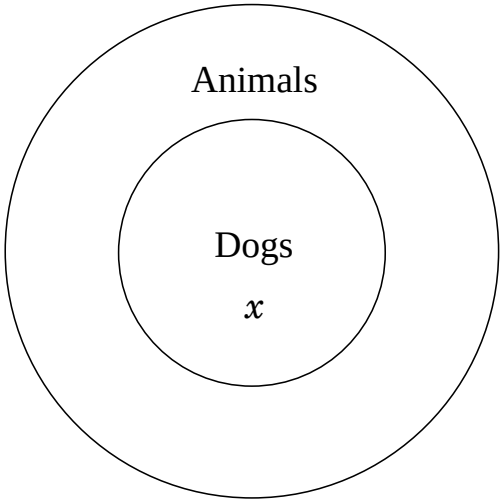
- One method for verifying the validity of an argument is the visual technique based on **Euler diagrams**
- This technique is similar to Venn diagrams, in that circles are used to denote sets, with
  - **overlap** indicating shared elements
  - **disjoint** circles indicating no shared elements
  - a circle **contained within** another circle indicating a subset
- An **x** may be used to indicate a single element
- This is like a game — if possible, we want to show the argument is **invalid** ! As long as the circles and x's do not contradict the premises, we can position them to win the game.

Example 1. Is the following argument valid?

All dogs are animals.
Fred is a dog.

Fred is an animal.

Draw regions to represent the premise. (Let *x* represent **Fred**)



Since:

- the set of all animals contains the set of all dogs, and
- that set contains **Fred**
- **Fred** is also inside the regions for animals.

Therefore, if both premises are true, the conclusion that **Fred** is an animal must be true also.

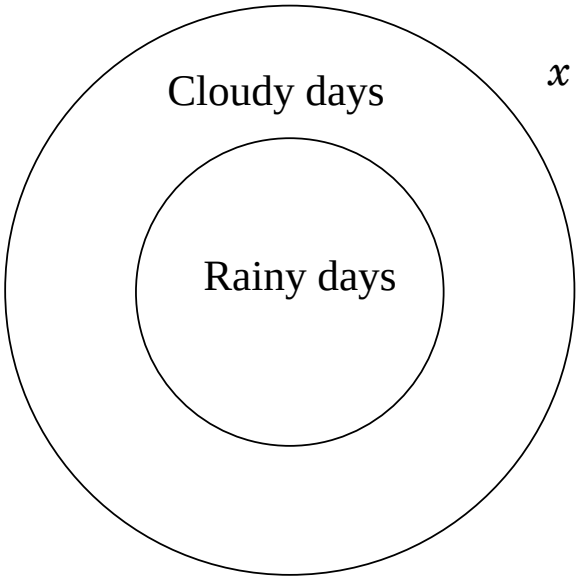
The argument is valid as checked by the Euler diagram.

Example 2. Is the following argument valid?

All rainy days are cloudy.
Today is not cloudy.

Today is not rainy.

Draw regions to represent the premise. (Let *x* represent **today**)



Placing the *x* for **today** outside the **cloudy days** region forces it to also be outside the **rainy days** region.

Thus, if both premises are true, the conclusion that **today** is not rainy is also true.

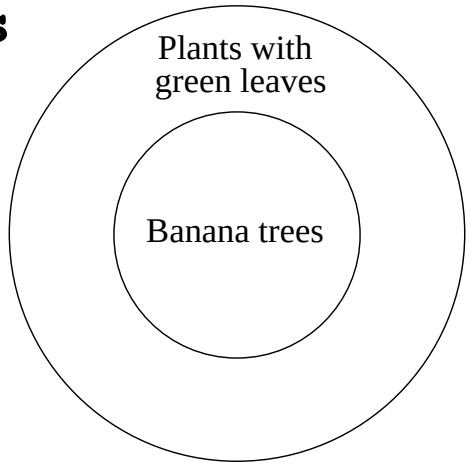
The argument is valid.

Example 3. Is the following argument valid?

All banana trees have green leaves
That plant has green leaves.

That plant is a banana tree.

Draw regions to represent the premise. (Let *x* represent **that plant**)

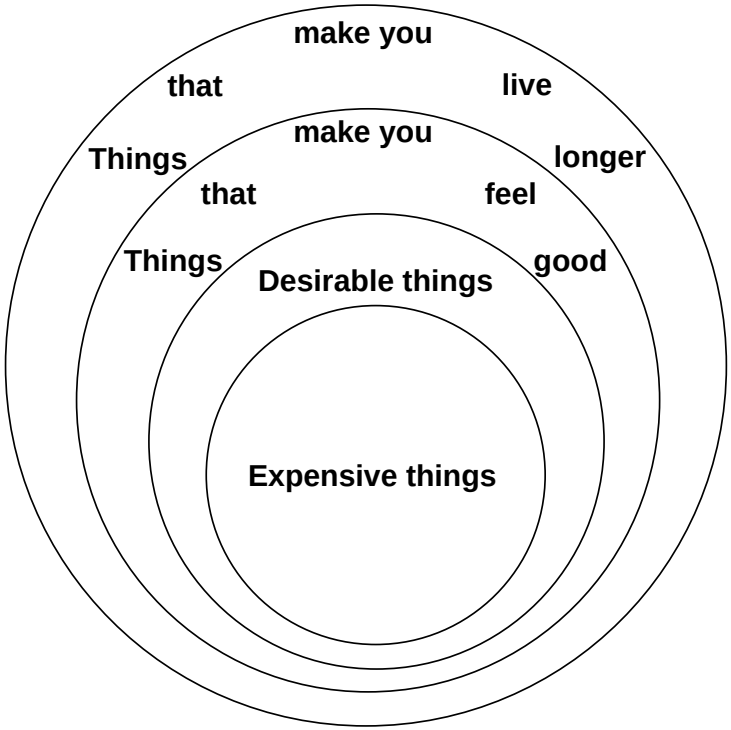


Where does the x go?

Rule: Place the *x* to make the argument **invalid** if possible.

Example 4. Is the following argument valid?

```
All expensive things are desirable.
All desirable things make you feel good.
All things that make you feel good make you live longer.
-----------------------------------------------------------
All expensive things make you live longer.
```



Example of a **valid** argument which need **not** have a true conclusion.

Example 5. Is the following argument valid?

```
Some students go to the beach
                for Spring Break.
I am a student.
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I go to the beach for
                    Spring Break.
```

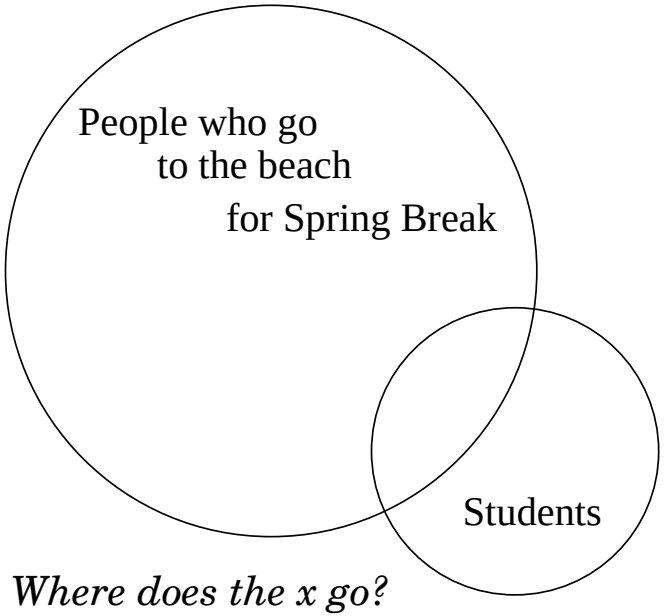

Where does the x go?

Can we place the *x* to make the argument **invalid**?

Valid or Invalid Arguments?

1. **All boxers wear trunks.**
   Steve Tomlin is a boxer.

   Steve Tomlin wears trunks.

2. **All residents of NYC love Coney Island hot dogs.**
   Ann Stypuloski loves Coney Island hot dogs.

   Ann Stypuloski is a resident of NYC.

3. **All politicians lie, cheat, and steal.**
   That man lies, cheats, and steals.

   That man is a politician.

4. **All contractors use cell phones.**
   Laura Boyle does not use a cell phone.

   Laura Boyle is not a contractor.

5. **Some trucks have sound systems.**
   Some trucks have gun racks.

   Some trucks with sound systems have gun racks.

Each of these arguments has a **true** conclusion—determine if the argument is **valid** or **invalid**.

1. **All cars have tires.**
   All tires are rubber.

   All cars have rubber.

2. **All chickens have beaks.**
   All birds have beaks.

   All chickens are birds.

3. **Veracruz is south of Tampico.**
   Tampico is south of Monterrey.

   Veracruz is south of Monterrey.

4. **All chickens have beaks.**
   All hens are chickens.

   All hens have beaks.

5. **No whole numbers are negative.**
   -4 is negative.

   -4 is not a whole number.

Given the premises:

1. **All people who drive contribute to air pollution.**
2. **All people who contribute to air pollution make life a little worse.**
3. **Some people who live in a suburb make life a little worse.**

Which of the following conclusions are valid?

a) Some people who live in a suburb drive.

b) Some people who contribute to air pollution live in a suburb.

c) Suburban residents never drive.

d) All people who drive make life a little worse.