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.

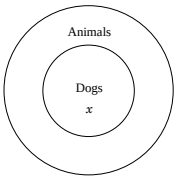
Euler diagrams

- 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.

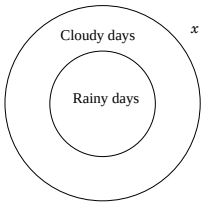
Therefore, if both premises are true, the conclusion that **`Fred`** is an animal must be true also.

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.

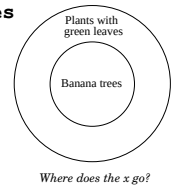
Thus, if both premises are true, the conclusion that **`today`** is not rainy is also true.

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)

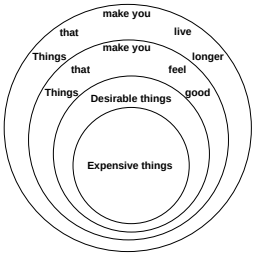


Where does the x go?

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

Example 4. Is the following argument valid?

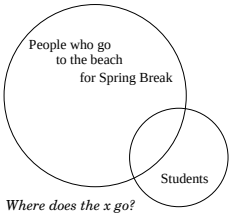
```
All expensive things are desirable.
All desirable things make you feel good.
All things that make you feel good make you live longer.
-------------------------------------------------------
All expensive things make you live longer.
```



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.
------------------------------
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.