

## Logic: Division and Classification

### Kinds of Division

- *Logical* division divides a class into its subclasses
  - E.g., mammals into monotremes, marsupials & placentals
  - Division is useful for
- determination of exact relationships among related things
- formulation of definitions
- Other kinds of division
  - *Physical* division divides a whole into its parts
    - E.g., a complex machine into its simple mechanical parts
  - *Metaphysical* division divides an entity into its qualities, e.g.,
    - a species into its genus & difference
      - man into animality & rationality
    - a substance into its attributes

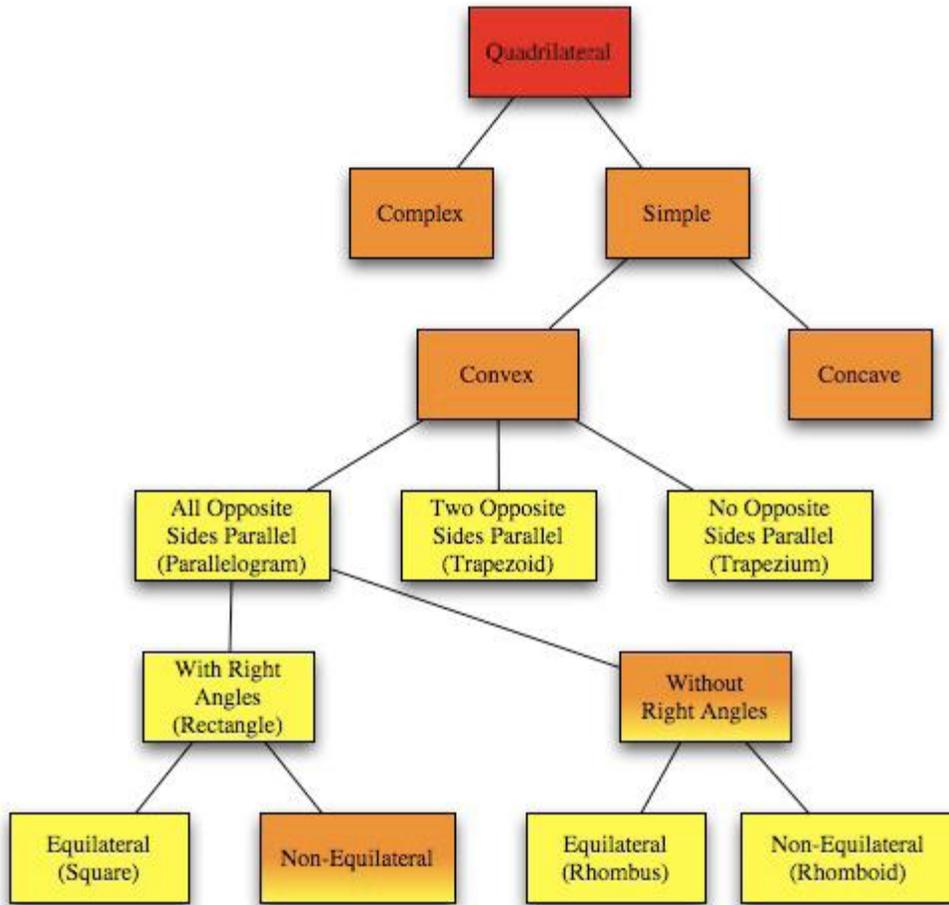
– sugar into color, texture, solubility, taste, &c.

- a quality into its dimensions
  - sound into pitch, timbre, volume

### How to Divide

- Logical Division
  - begins with a *summum genus*
  - proceeds through intermediate genera
  - ends at the *infimae species*
  - NB: It does not continue to individuals
- The results of division should meet these criteria:
  1. The subclasses of each class should be coextensive with the original class.
  2. The subclasses of each class should be mutually exclusive.
  3. The subclasses of each class should be jointly exhaustive.
  4. Each stage of a division should be based on a single principle.

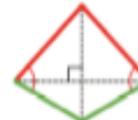
## EXAMPLE OF DIVISION



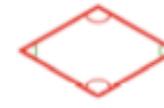
*Trapezium*  
(Amer. Eng.)



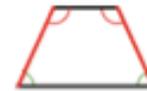
*Trapezoid* (Amer. Eng.)  
*Trapezium* (Brit. Eng.)



*Kite*



*Rhombus*



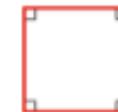
*Isosceles trapezoid* (Am.)  
*Isosceles trapezium* (Br.)



*Parallelogram*



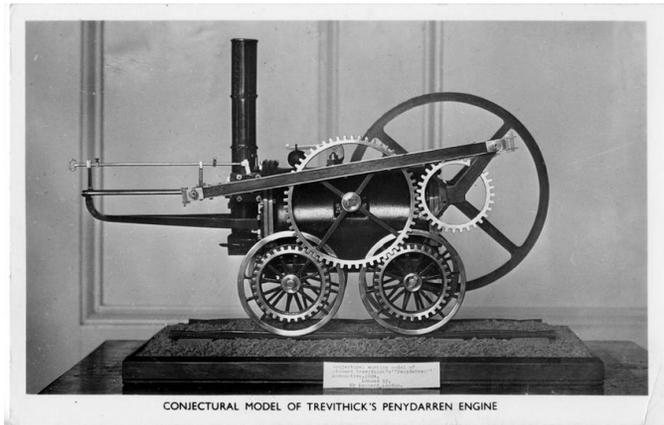
*Rectangle*



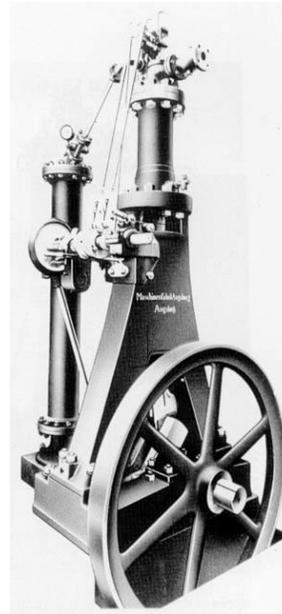
*Square*

## Kinds of Classification

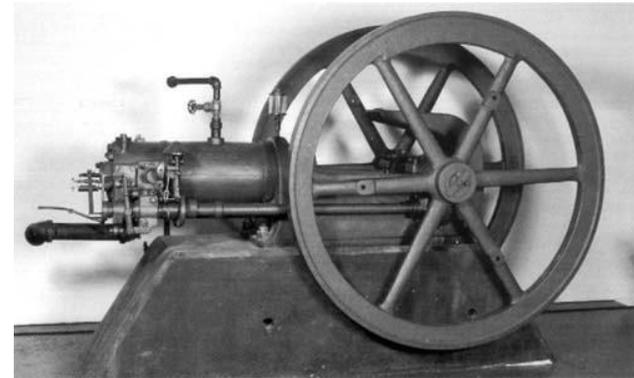
- Classification is the technique of inquiry in which similar individuals and classes are grouped into larger classes.
  - E.g., how are steam, diesel, & gasoline engines related to one another?



The Penydarren Lomotive,  
the first train  
(R. Trevithick, 1804)



First Commercial  
Diesel Engine  
(I. Lauster, 1898)

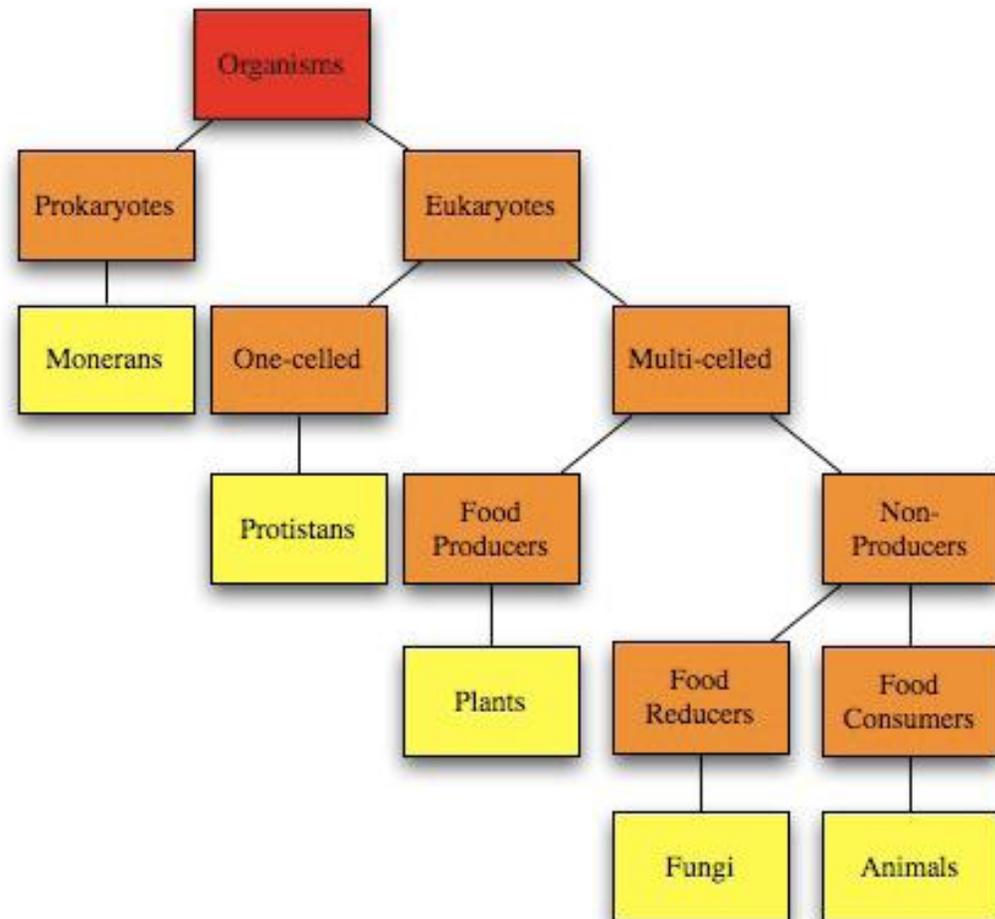
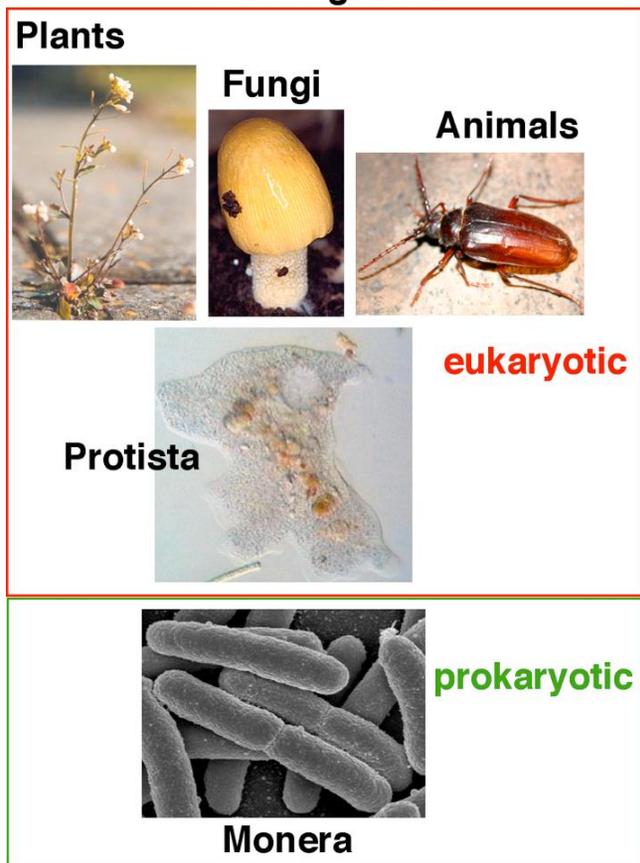


Early Gasoline  
Engine  
(N. Otto, 1895)

## Natural Classification

- Natural classification is a scheme that provides theoretical understanding of its subject matter
  - E.g., classification of living things into monerans, protistans, plants, fungi & animals
- The concept “monerans” is now obsolescent because it does not provide sufficient theoretical clarity

### Five kingdoms



## Artificial Classification

- Artificial classification is a scheme established merely to serve some particular human purpose
  - E.g., classification of plants as crops, ornamentals, and weed



Where does the sunflower go?

- “a noxious *weed*”—Iowa Dept. of Agriculture
- “one of the few *crop* species that originated in North America”—Purdue University researchers
- “... grown for *ornamental* purposes”—Kansas State University

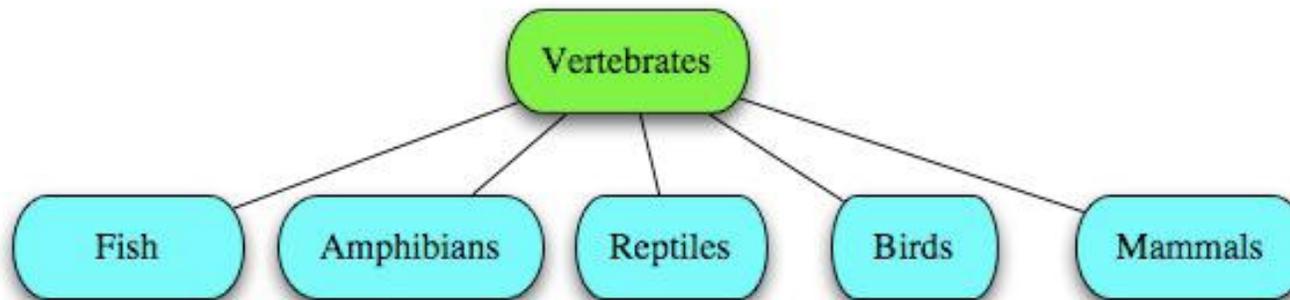


### Two Overly Ambitious Ideals

- Pure division
  - begins with the *summum genus* and
  - divides on the basis of a priori considerations
- i.e., it is based on logical possibility, not experience
- Dichotomous division
  - divides on the basis of the presence or absence of a particular feature
- (NB: Classification can also be dichotomous.)
- Striving for these ideals
  - works well with mathematical objects, &c.

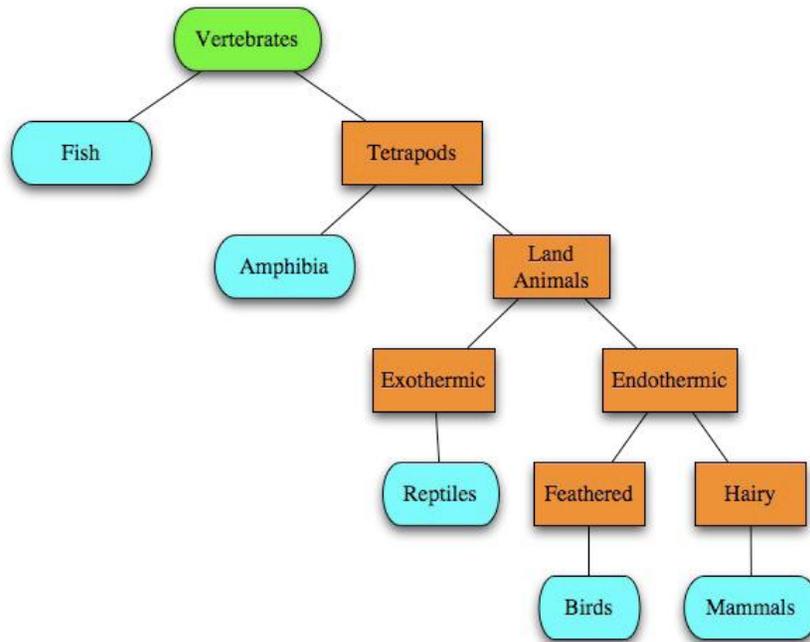
- does not work well with natural objects (e.g., kinds of animals)
- guarantees a division that meets criteria (2) – (3)
- sometimes provides more insight than alternative divisions.
- But “dichotomous division is often difficult and often impracticable”—Aristotle, *Parts of Animals* I.2-3
- Sometimes, classification (a bottom-up approach) is more practical.

### A Non-Dichotomous Division



- This shows only that there are five kinds of vertebrate.
- It does not show anything about the relations among those kinds.

## A Dichotomous Division



- How is this division better than the previous one?
- How could this division be improved?
  - Fish vs. tetrapods?
  - Land animals vs. amphibia?

## Classification & Division Compared

- The result of a classification will look like the result of a division.
- Classification begins with a individuals or small classes and works towards a *summum genus*.
  - i.e., it works in the direction opposite to that of division
- Classification begins with a set of apparently related things found in the world (i.e., it is based on experience) and builds from there.
  - Hence, it is well-suited to natural objects.
  - But it will work with any kind of object.