Appendix B: Visualizing Structures of Thought with Venn Diagrams

The relationships between classes (categories) of things can be usefully visualized using Venn diagrams. The Basic Relations below show how the relationships between two categories can be represented. What is important about these drawings is how their boundaries exclude, include or overlap one another. Although the use of circles is traditional, it is not necessary. Ovals or rectangles may be sometimes be used. Also, the relative size of the figures has no meaning. A big circle does not necessarily have more items in it than a small one.

THE BASIC RELATIONS

1. 	2. 	3. 
No A is B.	**All A is B**	**(Only) Some A is B.**
e.g., felines, cars.	e.g., transoms, cars.	e.g., felines, Asian

Imagine the circles as boundaries containing all items of the class it names. So in figure 1 we see that if we arbitrarily let A = the class of all felines and B = the class of all cars, nothing in A can also be in B, and vice versa. (We could have as easily let A = the class of all cars and B = the class of all felines. It would not matter for this relationship.) This is because their boundaries do not overlap. Nothing that is a feline is also a car and vice-versa.

In figure 2, it is not arbitrary which class circles A and B symbolize. We only get a diagram of a true relationship if we assign B = all cars and A = all TransAms. Then because every example of a TransAm is also a car, the boundary of A is contained entirely within the boundary of B. However, because not every car is a TransAm, the boundary of B contains space not within the boundary of A.

In figure 3 we see an overlap between A and B. It is arbitrary in this case which figure we use to indicate the class of all felines and the class of all things Asian. Let's let A= class of all felines and B = class of all things Asian. Clearly there are some felines that are not Asian, there are Asian felines and there are Asian things that are not feline. The diagram illustrates this nicely.

Exercise Group A: identifying classes

For each of the diagrams below, three applicable classes are given. Identify which is class A, B, and C. Some choices may be arbitrary. (Note that simple descriptions such as "aquatic" or "dangerous" are short expressions for "things that are aquatic" or "things that are dangerous.")

Diagram	Applicable Classes	Identifications
I. 	cars cattle books	A= B= C=
II. 	cars books TransAms	A= B= C=
III. 	mammals aquatic Hondas	A= B= C=
IV. 	Ford cars cars vehicles	A= B= C=

Exercise Group B: representing relationships

To test your understanding of the way Venn diagrams represent relationships, find the set of categories best represented by the diagram from the three choices offered.

Diagram	Match Set A	Match Set B	Match Set C
I. 	appliances perfumes trees	automobiles stock cars encyclopedias	beers beverages coffee
II. 	animals spiders ducks	schooling education whipped cream	flags textbooks schizophrenia

III. 	animals terrestrial whales	animals aquatic bears	animals terrestrial bears
IV. 	animals dangerous aquatic	plants quadruped ferns	roses plants animals

Exercise Group C: judging the truth of diagrammed statements.

Test your understanding of the way Venn diagrams represent the relationships among classes of objects. Mark the sentences as true or false using **the diagram and the identifications given for A, B and C.** The sentence may be factually false when judged against outside information.

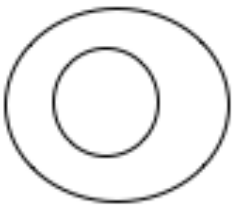
Diagrams	Identifications	Sentences to be Judged
I. 	A=pianos B=spinets C=Yamahas	1. All pianos are spinets. 2. Some Yamahas are pianos. 3.All spinets are Yamahas.
II. 	A=radios B=SONY C=functioning	1. All radios are SONYs. 2. No radios are functioning. 3.Some functioning radios are SONYs..
III. 	A=widgets B=gadgets C=brizzles	1. All gadgets are brizzles. 2. All widgets are brizzles. 3. No brizzles are widgets.
IV. 	A=meat B=hamburgers C=edible	1. Meat is never edible. 2. All meat is edible. 3.No hamburgers are edible.

The Relationship Between Venns and Syllogistic Arguments

Now that you are familiar with Venn diagrams, the relationships that constitute valid, sound syllogistic arguments are easily represented by such diagrams. In the charts below, each Venn diagram is given interpretations that enable them to illustrate argument forms.

Modus Ponens: Asserting the Antecedent

The first argument form is called *modus ponens* and is illustrated in the chart below.

Venn Diagram	Premisses and Conclusion	Alternative Form
 2a.	**A** implies **B**, and **x** is in **A**; therefore **x** is in **B.** e.g. *Every dog is a mammal*, and *Fido is a dog*, therefore *Fido is a mammal*.	Let A = p. Let B = q, Restate the argument as p implies q p therefore q.

Tell what is wrong with this:

(C) *Some animals are cold-blooded and Fido is an animal, so Fido is cold-blooded.*

Can you illustrate the fallacy using Venn diagrams? This brings up an important point. A logical fallacy is made **when a possible option (a conceivable situation) is dismissed out-of-hand.** What possible option has been dismissed by ***(C)***?

Modus Tollens: Negating the Consequent

The only other argument form we need consider is called *modus tollens*. The chart below illustrates it.

Venn Diagram	Premisses and Conclusion	Alternative Form
 2b.	**A** implies B**,** and **x** is not in **B**, So, **x** is not in **A**. *e.g.* Dogs are animals, and New York is not an animal, so New York is not a dog.	Let A = p Let B = q, then p implies q not q therefore not-p.

With just these two forms, *modus ponens* and *modus tollens*, we can reconstruct the arguments behind a good deal of informal reasoning. Of course, there are subtleties we cannot deal with here, such as probabilistic reasoning, modal logics, implicatures, problems with inconsistency and expressivity, etc. The interested reader is counseled to further study.