Deductive Reasoning

Syllogisms

Categorical syllogisms

A *deductive argument* is an argument _ in which it is thought that the premises provide a *guarantee* of the truth of the conclusion.

In a deductive argument, the premises are intended to provide support for the conclusion that is so strong that, if the premises are true, it would be *impossible* for the

An argument is a connected series of statements or propositions, some of which are intended to provide support, justification or evidence for the truth of another statement or proposition.

Arguments consist of one or more *premises* and a *conclusion*. The premises are those statements that are taken to provide the support or evidence; the conclusion is that which the premises allegedly support.

For example, the following is an argument:

The death penalty should be adopted only if it deters murder. However, it could only do this if murderers understood the consequences of their actions before acting, and since this is not so, we must reject adopting the death penalty.

The conclusion of this argument is the final statement: “we must reject adopting the death penalty.” The other statements are the premises; they are offered as reasons or justification for this claim. The premises of an argument are sometimes also called the “data,” the “grounds” or the “backup” given for accepting the conclusion.

http://www.iep.utm.edu/ded-ind/

Aristotle

In ancient Greece, the philosopher Aristotle challenged his students with logic problems call syllogisms. A syllogism has three parts, and must be worded in a particular way.

All dogs are barking animals.

All poodles are dogs.

Therefore, all poodles are barking animals.

- The first line gives you one piece of information—all dogs are barking animals.
- The second line gives you another piece of information—all poodles are dogs.
- Each of the first two statements in a syllogism is called a premise.
- The information is put together to get the conclusion.
- The conclusion is the third statement in a syllogism.
- If the conclusion is supported by the information in the premises, it is valid.

Valid or Invalid?

All poodles are dogs.

All poodles are barking animals.

Therefore, all dogs are barking animals.

First premise

Second premise

But when you put the information from the two premises together, you don't have enough information to conclude anything about all dogs.

Invalid

The three statements in this type of logic problem are called an argument. It has a conclusion that must be supported by two premises.

There are three different categories, or sets, in a syllogism. In the syllogism about dogs, the three sets are dogs, barking animals, and poodles.

It is a rule that each statement in a syllogism must contain two of the three sets.

It also is a rule that each set must be used only twice.

Sets in Syllogisms

What are the sets in this syllogism?

All flowers are pretty:_____and_____

All daffodils are flowers:_____and_____

Therefore, all daffodils are pretty:_____&____

Is this a valid syllogism?

Sets in Syllogisms

What are the sets in this syllogism?

All flowers are pretty: flowers and pretty

All daffodils are flowers: daffodils and flowers

Therefore, all daffodils are pretty: daffodils and pretty

Is this a valid syllogism? Valid

Another Syllogism

All flowers are pretty.

All daffodils are pretty.

Therefore, all daffodils are flowers.

Is it valid?

Another Syllogism

All flowers are pretty.

All daffodils are pretty.

Therefore, all daffodils are flowers.

Is it valid? No

The two premises give no
Information about all daffodil
Being flowers or flowers being
Daffodils.

Valid or Invalid?

All dogs have three legs.
All ducks are dogs.
Therefore, all ducks have three legs.

All dragons are green.
All green things are ugly.
There all dragons are ugly.

Valid or Invalid?

All dogs have three legs.
All ducks are dogs.
Therefore, all ducks have three legs.
Valid

All dragons are green.
All green things are ugly.
There all dragons are ugly.
Valid

A syllogism is a type of formal logical argument. Syllogisms come in three sentences, each with a subject and predicate:

Major Premise: Subject, predicate
Minor Premise: Subject, predicate
Conclusion: Subject, predicate

The major premise is the first premise in a syllogism and contains both major term and the middle term. The major term is the predicate term of the conclusion and the middle term is the term that occurs in both premises, but not in the conclusion.

The minor premise is the second premise in a syllogism and contains both the minor term and the middle term. The minor term is the subject term of the conclusion.

Major premise: All men are mortal.

Minor premise: Socrates is a man.

Conclusion: Socrates is mortal.

Each of the three distinct terms represents a category, in this example, "men," "mortal," and "Socrates." "Mortal" is the major term; "Socrates", the minor term. The premises also have one term in common with each other, which is known as the *middle term* in this example, "man."

Major premise: All mortals die.

Minor premise: All men are mortals.

Conclusion: All men die.

Here, the major term is "die", the minor term is "men," and the middle term is "mortals". Both of the premises are universal.

All animals are mortal.
All men are animals.
All men are mortal.

No reptiles have fur.
All snakes are reptiles.
No snakes have fur.

No homework is fun.
Some reading is homework.
Some reading is not fun

The formal fallacy of illicit minor is committed in categorical syllogisms when the minor term appears in the conclusion, but not in the minor premise.

All cats are animals.
All cats are pets.
Therefore, all animals are pets.

All cats are mammals
This animal is a cat
Therefore, this cat is a mammal.

All humans are mortal, the major premise, *I am a human*, the minor premise, *therefore, I am mortal*

Major premise: All asteroids are made of rock.
Minor premise: Ceres is an asteroid.
Conclusion: Ceres is made of rock.

Major premise: No cat enjoys the company of snakes.
Minor premise: Fluffy enjoys the company of snakes.
Conclusion: Fluffy is not a cat.

Major premise: I will not eat anything that smells like feet.
Minor premise: Some kinds of cheese smell like feet.
Conclusion: There are some kinds of cheese I will

Add the Conclusion

All children are TV watchers.

No TV watchers are pigs.

Therefore,

All carrots are vegetables.

All vegetables are nutritious.

Therefore,

Add the Conclusion

All children are TV watchers.

No TV watchers are pigs.

Therefore, No children are pigs or No pigs are children.

All carrots are vegetables.

All vegetables are nutritious.

Therefore, All carrots are nutritious.

More. . .

No human beings are fish.

All trout are fish.

Therefore,

Some good students are female.

All good students are hard workers.

Therefore,

More. . .

No human beings are fish.

All trout are fish.

Therefore, No human beings are trout or no trout are human beings.

Some good students are female.

All good students are hard workers.

Therefore Some females are hard workers or some hard workers are females.

All fragile things are breakable things.
Some glasses are fragile things.
Therefore

All mammals are warm-blooded animals.
All whales are mammals.
Therefore

All books are things with pages.
Some books are mysteries.
Therefore

All flowers are pretty objects.
All pansies are flowers.
Therefore

No animals are plants.
All sheep are animals.
Therefore

Possible Answers

therefore glasses are breakable
whales are warm blooded
mysteries have pages
pansies are pretty objects
sheep are not plants

Complete syllogism handout and
Write two original syllogisms.

Deductive Reasoning

- Deductive reasoning is one of the two basic forms of valid reasoning.
- While inductive reasoning argues from the particular to the general, deductive reasoning argues from the general to a specific instance.
- The basic idea is that if something is true of a class of things in general, this truth applies to all legitimate members of that class.
- The key, then, is to be able to properly identify members of the class.
- Miscategorizing will result in invalid conclusions.

- Deductive reasoning works from the more general to the more specific.
- Sometimes this is informally called a "top-down" approach.
- We might begin with thinking up a *theory* about our topic of interest.
- We then narrow that down into more specific *hypotheses* that we can test.
- We narrow down even further when we collect *observations* to address the hypotheses.
- This ultimately leads us to be able to test the hypotheses with specific data -- a *confirmation* (or not) of our original theories.

Gravity makes things fall. The apple that hit my head was due to gravity.

There is a law against smoking. Stop it now.

1. Mrs. Shore is Mary Jane's mother. Mrs. Desmond is Mrs. Shore's mother. How is Mrs. Desmond related to Mary Jane?

2. Levi is Sarah's brother. Naomi is Levi's sister. How is Naomi related to Sarah?

3. Mary and James each work. One is a bricklayer. One is a skycap. The man is not a bricklayer. Who does what?

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She is Mary Jane's grandmother

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She is Sarah's sister

3. Mary and James each work. One is a bricklayer. One is a skycap. The man is not a bricklayer. Who does what?

Mary is a bricklayer

42. Three boys are hiking together. They come to a river. There are crocodiles in the river. There is a boat with oars tied at the shore. The boat will hold only 80 kilograms at a time. Each boy weighs 40 kilograms.

How can the boys use the boat to get all three of them safely across the river?

43. Four people were seated equally spaced around a table. Their names were A, B, C, and D. A and D were seated opposite each other. C was at A's right. Draw a picture showing how they were seated.

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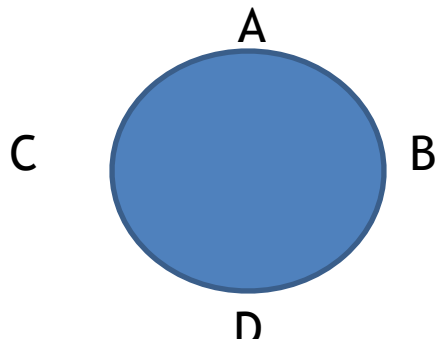
How can the boys use the boat to get all three of them safely across the river?

Two of the boys row over, leaving the third one behind. On the other side, one boy gets
Out of the boat, and the other one rows back. He picks up the boy who was left behind.
They row over to the other side.

43. Four people were seated equally around a table. Their names were A, B, C, and D. A and D were seated opposite each other. C was at A's right. Draw a picture showing how they were seated.



64. Two people share a ride to work each morning. Their first names are Sue and Terry. Their last names are Rawls and Peters. Sue is almost never ready on time. Terry drives a blue car. Rawls likes to watch TV. Peters is almost always ready on time. What is each person's full name?

65. Samatha is doing her homework. Five years ago, she was nine years old. How old is Samantha now?

66. Three years ago, Jefferson was a year older than his brother. Jefferson's brother is now 6 years old. How old is Jefferson now?

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Sue Rawls and Terry Peters

65. Samatha is doing her homework. Five years ago, she was nine years old. How old is Samantha now?

14 years old

66. Three years ago, Jefferson was a year older than his brother. Jefferson's brother is now 6 years old. How old is Jefferson now?

7 years old

Two fathers and two sons have a total of $30 between them. Each man has $10. Explain.

A total of $30 and each man having $10 suggests a total of three individuals. Father/son status isn't as certain, as one man may be both at once. A son/grandson, father/son and father/grandfather solves the apparent dilemma quite nicely.

Matrix Logic

To do matrix logic problems, start by gathering information from clues. These clues can be tricky. One clue may give you only a little information by itself, but may give more information when you fit it together with another clue.

Candy, Candy, Candy

1. Tina hates chocolate bars.
2. Kathy eats taffy.
3. Jake hates lollipops.

Candy, Candy, Candy

To record the information in this problem, record on a chart called a matrix. Write down the children's names in the boxes on the side, and the three kinds of candy in the boxes on the top.

	Choc. Bars	Taffy	Lollipops
Tina	***X***		
Kathy			
Jake			

Candy, Candy, Candy

Write Yes where Kathy and taffy meet. The mark X in the other two boxes next to Kathy's name. Finally, mark X where Tina and taffy meet and where Jake and taffy meet.

	Choc. Bars	Taffy	Lollipops
Tina	*X*		
Kathy	*X*	*Yes*	*X*
Jake		*X*	

Candy, Candy, Candy

Mark X in the box where Jake and lollipops meet. Now you can see that there's only one space left next to Tina's name—lollipops. Mark that Yes. And there's only one space left next to Jake's name– chocolate bars. Mark that box Yes.

	Choc. Bars	Taffy	Lollipops
Tina	*X*	*X*	*Yes*
Kathy	*X*	*Yes*	*X*
Jake	*Yes*	*X*	*X*

Candy, Candy, Candy

The matrix logic problem is solved.

	Choc. Bars	Taffy	Lollipops
Tina	*X*	*X*	*Yes*
Kathy	*X*	*yes*	*X*
Jake	*Yes*	*X*	*X*

Flowers

Karen, Derek, Fay, Tanya, and Scott each have a special favorite flower. No two of them have the same favorite. Which person matches which flower?

1. Karen's favorite is not the tulip.
2. Derek hates tulips and roses.
3. Someone really likes daisies.
4. Fay likes violets.
5. Tanya is allergic to carnations.
6. Scott likes the flower to which Tanya is allergic

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6. Scott likes the flower to which Tanya is allergic.

	Roses	carnations	violets	tulips	daisies
Karen	*Yes*	*X*	*X*	*x*	*X*
Derek	*X*	*X*	*X*	*X*	*Yes*
Fay	*X*	*x*	*Yes*	*X*	*X*
Tina	*X*	*X*	*X*	*Yes*	*X*

FAVORITE NUMBERS

★★

One fifth-grade teacher asked her students their favorite numbers. Each person in the front row named a different number. Each number was a counting number less than 10. Use the information given below to find out each person's favorite number. Complete the chart. Mark an X in a square when it cannot be the answer. Mark an O to show the favorite number.

1. Bonnie, Victor, and Ruth all chose even numbers.
2. Simon and Dan chose odd numbers.
3. Bonnie's number was less than 4.
4. Victor's number was greater than 6.
5. Ruth's number was three times Bonnie's number.
6. Dan's number was half of Ruth's number.
7. Simon's number was the sum of Bonnie's and Dan's numbers.

Student	1	2	3	4	5	6	7	8	9
Simon									
Bonnie									
Victor									
Dan									
Ruth									

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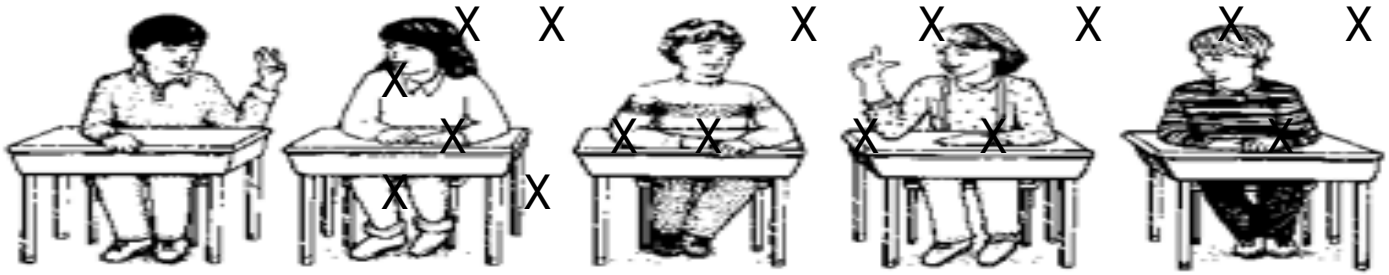
Student	1	2	3	4	5	6	7	8	9
Simon	X	X	X	X	O	X	X	X	
Bonnie	X X		X	X	X	X	X		
Victor	X	X							
Dan									
Ruth	X X	X X	X	X	X	X	X	X	



DEDUCTIVE LOGIC

★★★

Five girls were walking to the park. They were all wearing blouses of different colors. Akiko, Betty, Clara, Dana, and Eve wore blouses that were red, green, blue, white, and yellow (but not necessarily in that order). Use the information given to determine what color blouse each girl wore. Complete the chart. Mark an X in a space when it cannot be the answer. Mark an O to show who wore which blouse.

1. Clara doesn't own a green blouse.
2. Dana hates the colors green and yellow.
3. Betty's blouse was either red or blue.
4. Akiko's blouse was neither green nor white.
5. Clara walked between the girl with the yellow blouse and the girl with the blue blouse.
6. Dana's blouse was red.

	Red	Green	Blue	White	Yellow
Akiko					
Betty					
Clara					
Dana					
Eve					

2. THE ARTISTS

Mark, Meg, Melissa, and Marcie are all artists. One child uses only felt pens, one child uses only black pencils, one child uses only water colors, and one child uses only crayons. Find out what each child uses.

1. Melissa loves to use bright colors but doesn't enjoy felt pens.
2. Marcie and Melissa never have paint on their hands, but their friend does.
3. Mark takes excellent care of his brushes.
4. Meg thinks black pencils are boring.

Create an original Matrix Logic problem.

1. Use the names Pat, James, and Lori
2. Use the foods pizza, fish and hotdogs.


That’s All!