Part 2 Module 1 – Introduction to Logic

In P2M1-P2M5 we will study logic. Logic is a systematic study of reasoning, or the process of using

____________________________. We will analyze relationships between information and using established

facts and assumptions to ________________________.

Statements, quantifiers, negations

A ___________________________________ or *proposition* is a declarative sentence that has *truth value*.

To say that a sentence has truth value means that, when we hear or read the sentence, it makes sense to ask

whether the sentence is ______________________________

Here are some examples of statements:

Words like "all," "some," and "none" are called ______________________________

In logic, the word **"some" has a specific meaning. It means**

"____ ." Unlike in everyday usage, in logic, "some" does not

necessarily indicate plural.

Quantified Statements

In logic, terms like "all," "some," or "none" are called**_________________________________**

A statement based on a quantifier is called a **quantified statement** or

____

Here are some examples of quantified statements:

"All bad hair days are catastrophes."

"No slugs are speedy."

"**Some** owls are hooty."

Quantified statements state a relationship between two or more classes of

____

In the above examples, the categories mentioned were:

In this course, a sentence that sounds like an opinion will be treated as an acceptable statement. In such a

case we will pretend, for the sake of discussion, that a subjective, value-laden term like "dishonest" has been

precisely defined.

Sentences that aren't statements

Not every sentence is a statement. Here are some examples:

Questions are not statements.

It doesn't make sense to ask whether a question is true or false.

Commands are not statements.

It doesn't make sense to ask whether a command is true or false.

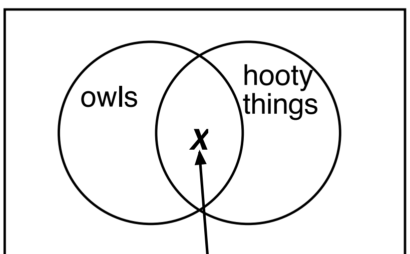
The previous sentence is a *paradox*. It is neither true nor false, so it isn't a statement.

Existential Statements, and diagramming them

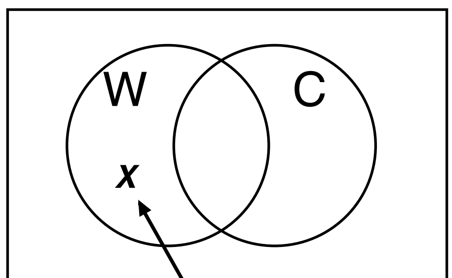
A statement of the form "Some A are B" or "Some A aren't B" asserts the

________________________________ element

In logic, the word "some" has a meaning of "___________________________________".



According to the statement "Some owls are hooty," there must be at least one element in this region of the diagram.



According to the statement "Some W are not C," there must be at least one element in this region of the diagram.

Categorical statements having those forms are called ___________________________

"Some owls are hooty"

"Some wolverines are not cuddly"

These are examples of ____ statements.

"Some owls are hooty" asserts that there exists at least one thing that____________________________.

That is, the **intersection** of the categories "owls" and "hooty things" is ________________________. We can convey that information by making a mark on a Venn diagram.

We place an "X" in a region of a Venn diagram to indicate that that region must contain at ______________________.

The existential statement “Some wolverines are not cuddly” asserts that there ____________________

element who is a wolverine (W) but__________________

Universal Statements, and diagramming them

A statement of the form **“No A are B”** is called a **negative universal.**

It asserts that there is no element in category A and category B at the same time. This means that the intersection of the two categories is _______________.

A statement of the form **“All A are B”** is called a **positive universal Statement**

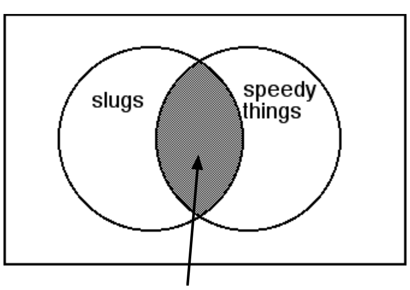
and it asserts that there is no element in category A that isn’t also in Category B.

> “All bad hair days are catastrophes”
>
> “No slugs are speedy”
>
> Are examples of a positive and a negative universal statement.

Diagramming Negative Universal Statements

In logic, we use shading to indicate that a certain region of a Venn diagram is <u>empty</u> (contains no elements).

The negative universal statement “No slugs are speedy” asserts that the region of the diagram where “Slugs” and “Speedy things” intersect must be empty.

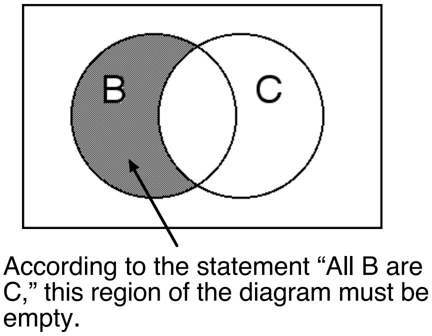


According to the statement “No slugs are speedy,” this region of the diagram must be **empty**.

Diagramming Positive Universal Statements

The positive universal statement “All bad hair days are catastrophes” asserts that it is impossible to be a ______________________________without also being ______________________________.

This means that the region of the diagram that is inside B but _____________________ must be ______________.



Interpreting Venn Diagrams in Logic

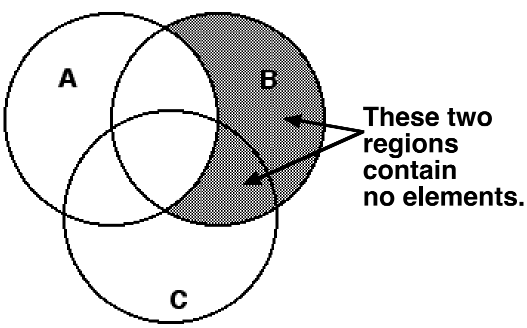
We will use Venn diagrams (typically three-circle diagrams) to convey the information in propositions about relationships between various categories.

Shading means "nothing here…"

In logic, when a region of a Venn diagram is **shaded**, this tells us that that region

___________________________. That is, **a shaded region is ___________________**

Suppose that we are presented with the marked Venn diagram shown below and on the following slides. We should be able to interpret the meaning of the marks on the diagram.



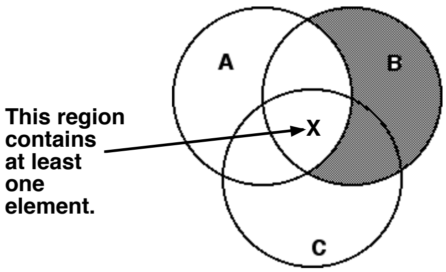
An "X" means "something is here…"

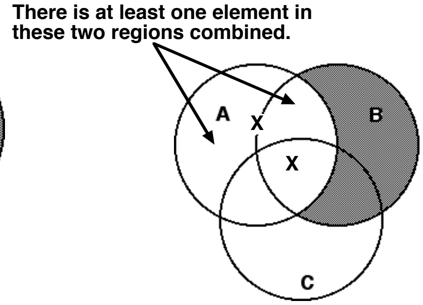
In logic, when a region of a Venn diagram contains an "X", this tells us that that region

____

In logic, when an "X", appears on the border between two regions, this tells us that there is

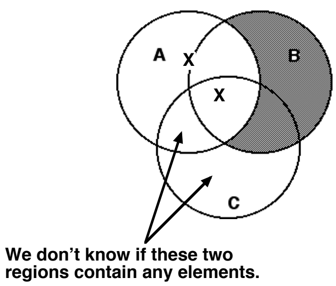
__________________ **element in the union of the two regions, but we are not certain whether the element(s) are**



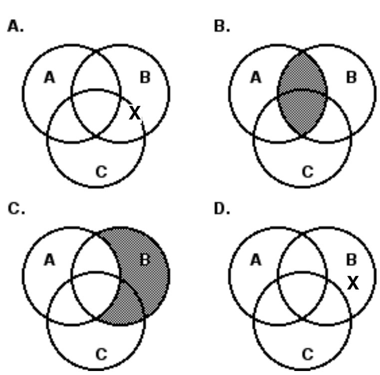


No marking means "uncertain…"

In logic, when a region of the Venn diagram contains no markings, it is ______________________________ whether or not that region ___________________________________.



Example
Use a three-circle Venn diagram to convey information about the relationships between these three categories: **A**ngry apes (A); **B**lissful baboons (B); **C**hurlish chimps (C). Select the diagram whose markings correspond to **"No blissful baboons are angry apes."** Assume that we do not know of any other relationships between categories.



Names for statements

We will tend to use lower case letters, like p, q, r, and so on, as names for statements.

p: Today is Saturday.　　　　q: Today I have math class.

r: 1 + 1 = 3

u: All lawyers are dishonest.

s: Some cats have fleas.

Let p be any statement. The **_______________________________________**, denoted

is another statement that is logically opposite to p.

This means that **~p will ____ to p**.

- In any situation that makes *p* a true statement, *~p* will be false.
- In any situation that makes *p* a false statement, *~p* will be true.

For each of the statements that were named at the beginning of this discussion, write the negation.

There is a very strong relationship between any statement p and its negation ~p:

It is impossible to conceive of a situation where ______________________ will have the same

____

Example Select the correct negation of "Some cats have fleas."

A. All cats have fleas.

B. Some cats don't have fleas.

C. No cats have fleas.

D. Some fleas have cats.

The correct negation of "Some cats have fleas" is ______________________________

Fact: if a statement has the form "Some A are B", its negation will have the form

"____" One way to verify this fact is by diagramming.

Example: Select the correct negation of "All lawyers are dishonest."

A. All lawyers are honest.

B. Some lawyers are honest.

C. No lawyers are dishonest.

D. Some lawyers are dishonest.

Fact: If a statement has the form "All A are B" then its negation will have the form

"____."

Again, one way to verify this fact is by diagramming.

Negations, alternative phrasing

We have seen that the correct negation of "All lawyers are dishonest" is

____. However, there are many other (non-preferred) ways to correctly state the negation of "All lawyers are dishonest." Each of the following statements is a correct negation of "All lawyers are dishonest."

"*It is not the case that* all lawyers are dishonest."

"*It is not true that* all lawyers are dishonest."

"All lawyers are dishonest…*NOT!*

Example Select the **negation** of "No beetles fight battles."

A. All beetles fight battles.

B. Some beetles fight battles.

C. Some beetles don't fight battles.

D. No beetles swing paddles

Example Select the **negation** of "Some poodles don't leap puddles."

A. Some poodles leap puddles.

B. No poodles leap puddles.

C. All poodles leap puddles.

D. None of the above.

Compound statements

A **compound statement** is formed by joining ________________________________, using special connecting words or structures such as "and," "or," or "if…then."

1 + 1 = 2 ***or*** *4 < 3* is an example of a compound statement.

All lawyers are dishonest ***and*** *some cats have fleas* is another example.

Logical connectives

Words or phrases such as "and," "or," or "if…then," ____________________are called **logical connectives**.

The Conjunction

Let p, q be any statements. Their **conjunction** is the compound statement having the form

"________________________." This is denoted

In order for a conjunction to be true, both terms ______________________.

The Disjunction

Let p, q be any statements. Their **disjunction** is the compound statement having the form

"____________________________." This is denoted

In order for a disjunction to be true, __________________________________ terms must be true.

A disjunction is false only in the case where ___________________________.

Symbolic statements

Suppose p represents the statement "I have a dime," and q represents the statement "I have a nickel."

The symbolic statement

$\sim p \vee q$ corresponds to

"____."

The symbolic statement

$p \wedge \sim q$ corresponds to

"____."

This last statement can also be read as

"I have a dime **but** I don't have a nickel."

Example

Let p: you are nice q: you are funny

Symbolize the compound statement "You aren't nice or you are friendly."

Symbolize "It isn't the case that you are nice or you are friendly."

Symbolize "You aren't nice and funny."

Finding Truth values of Compound Statements

Example Suppose p represents a true statement, while q, r represent false statements. Find the truth value of $(\sim r \wedge p) \wedge \sim(\sim q \vee r)$

Example Suppose p, q represent false statements, while r represents a true statement. Find the truth value of $\sim[\, q \vee (\sim p \wedge r)\,]$

Example Suppose p, q represent false statements, while r represents a true statement. Find the truth value of $\sim[\, \sim r \wedge (p \vee \sim q)\,]$

Example Suppose p represents a false statement and q represents a false statement. Find the truth value of

$\sim(\sim p \wedge q)$

Summary of the Conjunction and Disjunction

Conjuntion

A and B

$A \wedge B$

$A \wedge B$ is is true only when

Disjunction

A or B

$A \vee B$

$A \vee B$ is false only when

Truth tables

A **truth table** is a device that allows us to analyze and compare compound logic statements.

Consider, for example, the symbolic statement p ∨ ~q.

Whether this statement turns out to be true or false will depend upon whether p is true or false, whether q is true or false, and the way the "∨" and "~" operators work.

A truth table will show all the possibilities.

As an introduction to constructing and filling in truth tables, we will make a truth table for the statement p ∧ q and a truth table for the statement p ∨ q.

Example

Make a truth table for the statement p ∨ ~q

Example

Referring to the truth table shown below, answer True or False based on whether the truth table represents the correct results for the given statement. Be aware that the **values in the rightmost column may not be correct.** Insert intermediate columns as needed where you see("????"), fill in the truth table, and decide whether the rightmost column is correctly filled in as shown.

A. Yes, the rightmost column is correctly filled in.

B. No, the values in the rightmost column are not all correct.

p	q	????	q∨~(p∧q)
T	T		T
T	F		T
F	T		T
F	F		T

A tautology

The truth table column for the statement q∨~(p∧q) shows ____________________

This means that it is never possible for that statement _________________________.

The statement is always ______________________, due to its logical structure.

A statement that can _______________________ is called a **tautology.**

A **tautology** is a statement that can never be false, due to its logical structure. To decide whether a symbolic statement is a tautology, make a truth table having a column for that statement.

If the truth table column shows only ____________________________, then the statement is a tautology.

Otherwise, the statement is not a tautology.

Example

Decide whether this symbolic statement is a tautology: $(\mathbf{p \wedge {\sim}q}) \vee (\mathbf{{\sim}p \vee q})$

A. Yes, this statement is a tautology.

B. No, this statement isn't a tautology.

Negation of a compound statement

Select the correct negation of

A. I'm a lumberjack and I'm not okay.

B. I'm not a lumberjack and I'm not okay.

C. I'm not a lumberjack or I'm not okay.

D. None of these.

DeMorgan's Laws

The previous example suggests the following facts, known as **DeMorgan's Laws for Logic**:

$\sim(p \wedge q) \equiv {\sim}p \vee {\sim}q$

$\sim(p \vee q) \equiv {\sim}p \wedge {\sim}q$

To negate a conjunction or disjunction, negate both terms and switch the connective to the other.

(The three-barred equals sign means "is equivalent to" in logic.)

DeMorgan's Laws show us an economical way to state the negation of

____.

For example, instead of using the awkward sentence

"*It is not the case that* I have **both** a dime **and** a nickel"

we can use the much simpler form

"I don't have a dime **or** I don't have a nickel."

In Part 2 Module 1 we have now seen four rules for negations.

Statement	Negation
Some A are B	No A are B
All A are B	Some A aren't B
$p \wedge q$	${\sim}p \vee {\sim}q$
$p \vee q$	${\sim}p \wedge {\sim}q$

Example

Select the statement that is the negation of "Today is Monday and it isn't raining."

A. Today isn't Monday and it isn't raining.

B. Today isn't Monday or it isn't raining.

C. Today isn't Monday or it is raining.

D. Today isn't Monday and it is raining.

E. Today is Friday and it is snowing.

Example

Select the statement that is the negation of "I'm careful or I make mistakes."

A. I'm not careful and I don't make mistakes.

B. I'm not careful or I don't make mistakes.

C. I'm not careful and I make mistakes.

D. I'm not careful or I make mistakes.

E. I never make misteaks. ☺

A three-variable truth table

Suppose we need to make a truth table for a statement involving three variables (*p*, *q*, *r*), such as

$$(r \vee \sim q) \wedge (\sim p \vee q).$$

This more-complicated statement will require a more-complicated truth table skeleton.

If a statement involves three variables, then its truth table skeleton requires ***eight rows****, not four, and begins with a columns for p, q, and r, filled in as shown below.*

p	q	r	
T	T	T	
T	T	F	
T	F	T	
T	F	F	
F	T	T	
F	T	F	
F	F	T	
F	F	F	

Example

Referring to the partially-completed truth table shown below, add intermediate columns as needed, fill everything in, and then select the choice that shows the column for (r ∨ ~q) ∧ (~p ∨ q) correctly filled-in.

p	q	r	????????	(r∨~q)∧ (~p∨q)
T	T	T		
T	T	F		
T	F	T		
T	F	F		
F	T	T		
F	T	F		
F	F	T		
F	F	F		

A.

(r∨~q)∧ (~p∨q)
T
F
F
T
T
F
T
F

B.

(r∨~q)∧ (~p∨q)
T
F
F
F
T
F
T
T

C.

(r∨~q)∧ (~p∨q)
T
T
T
T
T
T
T
T

D. None of these

Example

'But wait a bit,' the Oysters cried, Before we have our chat;

For some of us are out of breath, And all of us are fat!'

"No hurry!' said the Carpenter. They thanked him much for that.

Select the statement that is the negation of "Some of us are out of breath, and all of us are fat."

A. Some of us aren't out of breath or none of us is fat.

B. Some of us aren't out of breath and none of us is fat.

C. None of us is out of breath and some of us aren't fat.

D. None of us is out of breath or some of us aren't fat.

Example

Select the statement that is the negation of the following statement (overheard in the crowd at the Little League ball park in Woodville, Florida.)

"All of my husbands are dead or in jail."

A. None of my husbands is dead or none of my husbands is in jail.

B. None of my husbands is dead and none of my husbands is in jail.

C. At least one of my husbands is not dead and is not in jail.

D. At least one of my husbands is not dead or is not in jail.

E. None of these.

Another connective

Consider the following disjunction, which may be a warning issued to a young child:

"You will behave, or you will get punished."

Can you think of another way to convey exactly the same warning without using the "or" connective or the "and" connective?

How about:

*"**If** you don't behave, **then** you will get punished."*

This is an example of a conditional statement.

A conditional statement has the form "If p, then q."

The conditional statement is the topic in Part 2 Module 2.

Part 2 Module 2 - The Conditional Statement, Exclusive Disjunction and IFF

A **conditional statement** is a statement of the form ____

denoted _______________________________

Example

Let p represent: "You drink Dr. Pepper."

Let q represent: "You are happy."

In this case ___________________ is the statement: "If you drink Dr. Pepper, then you are happy."

In the conditional statement "If you drink Dr. Pepper, then you are happy," the simple statement "You drink Dr. Pepper" is called the _____________________________

and the simple statement "You are happy" is called the ______________________________ .

Variations on the conditional statement

For a conditional statement such as "If you drink Dr. Pepper, then you are happy," there are three similar-sounding conditional statements that have special names:

Variations: the Converse

Suppose a statement has the form ____________________ such as "If you drink Dr. Pepper, then you are happy." (We will refer to this as the .)

The related statement ___________________________ is called the converse.

"If you are happy, then you drink Dr. Pepper" is the converse of "If you drink Dr. Pepper, then you are happy." We can also say that those two statements are converses of each other.

Variations: the Inverse

Suppose the direct statement has the form ____________, such as "If you drink Dr. Pepper, then you are happy."

The related statement ________________________ is called the inverse.

"If you don't drink Dr. Pepper, then you aren't happy" is the inverse of "If you drink Dr. Pepper, then you are happy." We can also say that those two statements are inverses of each other.

Variations: the Contrapositive

Suppose the direct statement has the form _____________, such as "If you drink Dr. Pepper, then you are happy." The related statement ______________________________ is called the contrapositive. "If you aren't happy, then you don't drink Dr. Pepper" is the contrapositive of "If you drink Dr. Pepper, then you are happy." We can also say that those two statements are contrapositives of each other.

Example

Select the statement that is the inverse to 'If you aren't a whale, then you don't live in the briny deep.'

A. If you don't live in the briny deep, then you aren't a whale.

B. If you are a whale, then you live in the briny deep.

C. If you live in the briny deep, then you are a whale.

D. If you are a whale, then you don't live in the briny deep.

E. None of these.

Truth table for ____________________

p	q	$p \rightarrow q$
T	T	
T	**F**	
F	T	
F	F	

The Fundamental Property of the Conditional Statement

The only situation in which a conditional statement is FALSE is when the ________________ is TRUE while the ________________________is FALSE.

Any other configuration yields _______________.

Example

Suppose p is true, q is true, and r is false. Find the truth value of

IFF operator

The "iff" operator, also called " __________________________________" is an operator connecting two statements such that the new statement formed holds true when both statements are false, or both statements are true.
. Notation for exclusive disjunction is ___________________________ and the following truth table demonstrates the truth value of compound statements formed using this operator.

p	q	
T	T	
T	F	
F	T	
F	F	

Exclusive Disjunction Operator The “exclusive disjunction” operator, also called “______________________________” is an operator connecting two statements, such that the new statement formed holds true only in the cases where ____.
In other words, the statement formed is true if and only if one is true and the other is false. Notation for exclusive disjunction is _____________________________ and the following truth table demonstrates the truth value of compound statements formed using this operator.

p	q	
T	T	
T	F	
F	T	
F	F	

Example

Suppose p is true, q is true, and r is false. Find the truth value of

$[\sim q \wedge (\sim p \oplus q)] \leftrightarrow (p \oplus q)$

Example

Create a truth table to demonstrate the truth value of the following statement:

$\sim r \leftrightarrow (p \oplus q)$

Truth tables, tautologies

Example

Decide if the following statement is a tautology:

$[\sim q \wedge (\sim p \rightarrow q)] \rightarrow p$

A. Yes, this statement is a tautology.

B. No, this statement isn't a tautology.

Truth tables and equivalencies

Example

Select the statement that is equivalent to "If you are a dog, then you wag your tail when you are happy."

A. If you wag your tail when you are happy, then you are a dog.

B. You aren't a dog, or you wag your tail when you are happy.

C. You are a dog, and you don't wag your tail when you are happy.

D. If you aren't a dog, then you don't wag your tail when you are happy.

Based on the definitions of p, q above, here are the symbolic renditions of each multiple-choice answer.

A. $q \rightarrow p$ B. $\sim p \vee q$ C. $p \wedge \sim q$ D. $\sim p \rightarrow \sim q$

A truth table will show which of these choices is equivalent to $p \rightarrow q$.

Facts

There are several generalizations that follow from the truth table in the previous exercise.

Note that the column for $p \rightarrow q$ is different from the column for $q \rightarrow p$:

1. A conditional statement is NOT equivalent to its converse.

Note that the column for $p \rightarrow q$ is different from the column for $\sim p \rightarrow \sim q$:

2. A conditional statement is NOT equivalent to its inverse.

Note that the column for $p \rightarrow q$ is the <u>same as</u> the column for $\sim p \vee q$:

3. $p \rightarrow q$ is equivalent to $\sim p \vee q$

Note that the column for $p \rightarrow q$ is exactly the <u>opposite of</u> the column for $p \wedge \sim q$:

4. The negation of $p \rightarrow q$ is $p \wedge \sim q$

An equivalency for "if p, then q"

The truth table in the previous example confirms the following fact:

$p \rightarrow q \equiv \sim p \vee q$

That is, you can change a conditional statement into an equivalent "or" statement, by

________________________ and switching the _________________________

Example

Select that statement that is logically equivalent to: "If you don't carry an umbrella, you'll get soaked."

A. You carry an umbrella and you won't get soaked.

B. You carry an umbrella or you get soaked.

C. You don't carry an umbrella and you get soaked.

D. You don't carry an umbrella or you get soaked.

E. You leave your umbrella in the classroom, so you get soaked anyway.

Negation of a conditional statement

Based on the truth table we constructed in an earlier exercise, we have already made an observation about the correct form for the negation of a conditional statement.

We can also use this equivalency:

$$p \rightarrow q \equiv \sim p \vee q$$

to find the correct **negation** of $p \rightarrow q$

The **negation** of $p \rightarrow q$ is $\mathbf{p \wedge \sim q}$.

Notice that the **negation** of an "if…then" statement doesn't have any "ifs" or "thens."

Negations: Summary

In Part 2 Modules 1 and 2 we have seen five rules for negations. Here they are.

Statement	Negation
Some A are B	No A are B.
All A are B.	Some A aren't B.
$p \wedge q$	$\sim p \vee \sim q$
$p \vee q$	$\sim p \wedge \sim q$
$p \rightarrow q$	$p \wedge \sim q$

Example

Select the statement that is the negation of "If a dog wags its tail, then it doesn't bite."

A. A dog wags its tail and it bites.

B. A dog wags its tail and it doesn't bite.

C. A dog doesn't wag its tail or it bites.

D. If a dog doesn't wag its tail, then it bites.

E. None of these.

Another equivalency

Select the statement that is the equivalent to "If I am a cloud, then I have a silver lining."

A. If I have a silver lining, then I am a cloud.

B. If I am not a cloud, then I don't have a silver lining.

C. If I don't have a silver lining, then I am not a cloud.

D. A, B, C are all equivalent to the given statement.

E. None of these is correct.

We will use a truth table to answer this question.

Equivalency

The truth table in the previous exercise establishes the following fact:

$p \rightarrow q \equiv {\sim}q \rightarrow {\sim}p$

That is, **a conditional statement is equivalent to its contrapositive, but <u>not</u> equivalent to its converse or inverse**.

We now have two rules for equivalency:

1. $p \rightarrow q \equiv {\sim}p \vee q$
2. $p \rightarrow q \equiv {\sim}q \rightarrow {\sim}p$

Summary: The conditional statement

Let **$A \rightarrow B$** be any conditional statement.

A is the antecedent. **B** is the consequent.

Fundamental Rule

The <u>only</u> situation that makes **$A \rightarrow B$** false is when A is true while B is false.

Negation

The **negation $A \rightarrow B$** of is **$A \wedge \sim B$**

Two Equivalencies

1. $A \rightarrow B \equiv \sim A \vee B$

2. $A \rightarrow B \equiv \sim B \rightarrow \sim A$

Variations

Converse: $B \rightarrow A$ Inverse: $\sim A \rightarrow \sim B$ Contrapositive: $\sim B \rightarrow \sim A$

Part 2 Module 4 - Categorical Syllogisms and Diagramming

Some lawyers are judges.

Some judges are politicians.

Therefore, some lawyers are politicians.

This is an example of a **CATEGORICAL SYLLOGISM**, which is an argument involving

_______________________, both of which (along with the conclusion) are

____

.

Categorical statements are propositions of the form __________________________,

__________________________,

_________________________________, or _________________________________.

Remember that the validity of an argument has nothing to do with whether the conclusion sounds true or reasonable according to your everyday experience. The previous argument is

__________________________________.

One way to see that the argument has an invalid structure is to replace “lawyers” with “alligators,” replace “judges” with “gray (things),” and replace “politicians” with “cats.” Then, the argument

____

Some alligators are gray.

Some gray things are cats.

Therefore, some alligators are cats.

We will introduce a formal technique to deal with categorical syllogisms.

During the middle ages, scholastic philosophers developed an extensive literature on the subject of categorical syllogisms. This included a glossary of special terms and symbols, as well as a classification system identifying and naming dozens of forms. This was hundreds of years before the birth of John Venn and the subsequent invention of Venn diagrams. Through the use of Venn diagrams, analysis of categorical syllogisms becomes a process of calculation, like simple arithmetic.

Diagramming categorical syllogisms

Here is a synopsis of the diagramming method that will be demonstrated in detail in the following exercises. It is similar to the method of diagramming Universal-Particular arguments.

1. To test the validity of a categorical syllogism, use a three circle Venn diagram.

2. Mark the diagram so that it conveys the information in the two premises. *Always start with a universal premise.* (If there is not at least one universal premise, the argument is invalid; no further work needed.)

3. If the marked diagram shows that the conclusion is **true**, then the argument is **valid**.

4. If the marked diagram shows that the conclusion is **false or uncertain**, then the argument is **invalid**.

Example

Some bulldogs are terriers.

No terriers are timid.

Therefore, some bulldogs are not timid.

A. Valid

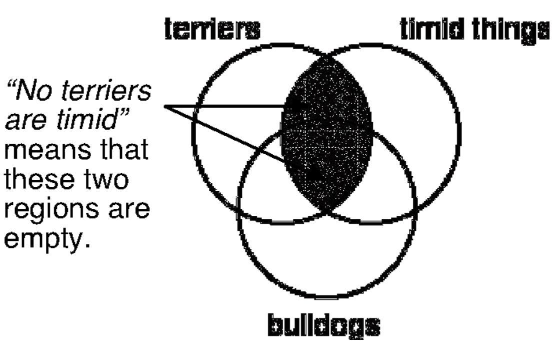
B. Invalid

1. A valid categorical syllogism must have at least one universal premise. **If both premises are existential statements** ("Some are…," "Some aren't…") **then the argument is invalid**, and we are done.

No terriers are timid.

2. Assuming that one premise is universal and one premise is existential, draw a three-circle Venn diagram and mark it to convey the information in the universal premise. This will always have effect of **shading out two regions of the diagram**, because a universal statement will always assert, either directly or indirectly, that some part of the diagram must contain **no elements**.

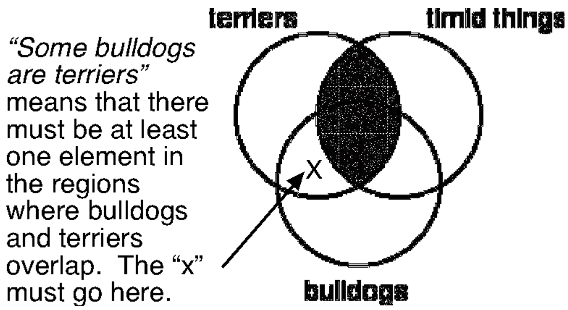
We mark our diagram according to the premise "No terriers are timid."



Some bulldogs are terriers.

3. Now mark the diagram so that it conveys the information in the other premise.

Typically, this will be an existential statement, and it will have the effect of placing an "X" somewhere on the diagram, because an existential statement always asserts that some part or the diagram must contain at least one element. Pay attention to whether the “X” sits directly in one region of the diagram, or on the border between two regions.



Therefore, some bulldogs are not timid.

4. Now that we have marked the diagram so that it conveys the information in the two premises, we check to see if the marked diagram shows that the conclusion is true. If the marked diagram shows that the conclusion is true, then the argument is valid. If the marked diagram shows that the conclusion is false or uncertain, then the argument is invalid. For this argument to be valid, the “X” should be inside “bulldogs” but outside “timid”.

5. In presenting this technique, we have assumed that one premise is a universal statement, and the other premise is an existential statement.

The technique works in the case where both premises are universal statements, too.

Example

Use diagramming to test the validity of this argument.

Some useful things are interesting.

All widgets are interesting.

Therefore, some widgets are useful.

A. Valid

B. Invalid

Step 1: Is there a universal premise?

Step 2: Mark universal premises first.

Step 3: Mark the other premise.

Step 4: Is the conclusion shown to be true?

Example

Test the validity of this argument.

All mean-looking dogs are good watchdogs.

All bulldogs are mean-looking dogs.

Therefore, all bulldogs are good watchdogs.

A. Valid B. Invalid

Part 2 Module 3 - Arguments and deductive reasoning

Logic is a formal study of the process of **reasoning**, or using common sense.

Deductive reasoning involves taking in and analyzing information, and recognizing when a collection of facts and assumptions can lead to new facts and new assumptions. Logic and reasoning form the foundation for mathematics, science, scholarly research, law, and effective communication, among other things.

An **____________________________** in logic is a simple model that illustrates either correct, logical reasoning, or incorrect, illogical attempts at reasoning.

Formally, an **argument** typically involves two or more propositions, called **____________________________** followed by another proposition, called the **___________________________________.**

In any argument, we are interested in the logical relationship between the premises and the conclusion.

Two simple arguments

Here are two examples of short arguments, such as a prosecutor might make in summarizing his/her case to the jury at the end of a trial.

Argument #1

The person who robbed the Mini-Mart drives as 1999 Corolla.

Gomer drives a 1999 Corolla.

Therefore, Gomer robbed the Mini-Mart.

Argument #2

The person who drank my coffee left these fingerprints on the cup.

Gomer is the only person in the world who has these fingerprints.

Therefore, Gomer drank my coffee.

When we read the first argument, we probably recognize that the reasoning is ___________________________ because many people drive 1999 Corollas. Notice that argument two doesn't share the defect of the first. In this argument, if we believe the two premises, we have to ______________________________________.

From a more general perspective, this argument is illogical (*invalid*) because it is <u>*possible* for us to</u> ____, even if we accept _______________________________.

Also, an argument is well-structured (*valid*) if it is ___________________________, assuming that we _______________________________________.

Valid arguments

We are always interested in the logical relationship between the premises and the conclusion of an argument.

An argument is *valid* if it is ____ or uncertain when

every premise ____.

Note that whether an argument is valid has nothing to do with whether the statements in the argument sound ______________________________ Validity is determined entirely by how the statements in the argument relate to one another, regardless of whether those statements seem reasonable to us.

Invalid arguments

An argument is *invalid* if it is ____ at the same time that every premise is ____.

An invalid argument is a model of incorrect or illogical attempts at reasoning.

Techniques for analyzing arguments

In this course we will learn several different techniques for analyzing short arguments.

These techniques are based upon the definition of a valid argument:

An argument is ***valid*** *if it*

____ *when every premise is* ____.

Diagramming Universal-Particular arguments

The simplest style of nontrivial argument is called a Universal-Particular argument.

A **Universal-Particular** argument is a ____ in which one premise is a **universal** proposition ("All are…," "None are…"), while the other premise, and the conclusion, are propositions that relate a **____** to the categories in the universal premise. The ____________________________________ will also be referred to as the **major** premise.

The _________________________________ will also be referred to as the **minor** premise.

Examples of U.P. arguments

All cats have rodent breath.

Whiskers doesn't have rodent breath.

Thus, Whiskers isn't a cat.

Gomer is not a rascal.

No rascals are reliable.

Therefore, Gomer is reliable

Diagramming a U.P. argument

One way to test the validity of a Universal-Particular argument is to use a method based upon the diagramming techniques that were introduced in Part 2 Module 1. In a nutshell, the method works like this:

1. First, mark the diagram according to the content of the universal premise.

If the universal premise is positive, we will "shade out" a crescent-shaped region. If the universal premise is negative, we will "shade out" a football-shaped region.

The shading shows that a region must have <u>no elements</u>.

2. Next, place a "X" on the diagram according to the content of the particular statement, bearing in mind the meaning of the shading already on the diagram. (The "X" represents the particular individual who is the subject of the argument.)

If it is uncertain which of two regions should receive the "X," then place the "X" on the boundary between the two regions.

3. **If the marked diagram shows that the conclusion is true, then the argument is valid.**

If the marked diagram shows that the conclusion is false or uncertain, then the argument is invalid.

Example

Use diagramming to test the validity of the following U-P argument:

All cats have rodent breath.

Whiskers doesn't have rodent breath.

Thus, Whiskers isn't a cat.

A. Valid

B. Invalid

Example

Use diagramming to test the validity of this argument.

Gomer is not a rascal.

No rascals are reliable.

Therefore, Gomer is reliable.

A. Valid

B. Invalid

Diagramming conventions

The following is a reminder of P2M1 content.

In this case, the diagramming rules are stated in terms of a two-circle Venn diagram, because a U-P argument will involve two categories, not three.

Also, this summary will involve a simplest kind of existential statement – namely, a particular statement, which proposes the existence of a single, named individual, rather than a sub-category that could conceivably encompass many individuals.

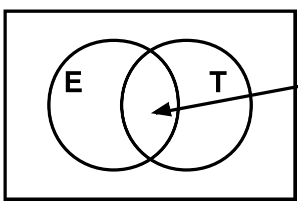
This stuff will get more complicated when we discuss **categorical syllogisms** in Part 2 Module 4.

We diagram a universal premises ("all are…", "none are..") by using shading to __________________________ the region(s) of the diagram that contradict the universal statement.

In other words, we use shading to indicate that the shaded region must contain

__________________________.

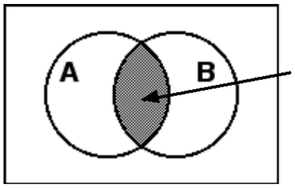
Example Consider the universal statement "No elephants are tiny" in the context of this two-circle Venn diagram. **E** represents the set of elephants, and **T** represents the set of tiny things.



According to the statement ―No elephants are tiny,“ this region must be **empty.**

Shading "No elephants are tiny." According to the statement "No elephants are tiny," the region where **E** intersects **T** must be **empty.** This is because any element that is in the intersection of **E** with **T** is both an elephant and tiny, contracting the statement that "No elephants are tiny." We shade that region of the diagram, to indicate that it _______________________________.

Diagramming a negative universal premise

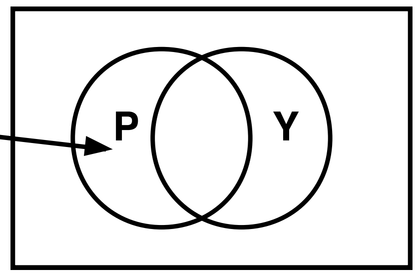


A negative universal premise, "**No A are B**", or **"No B are A"**, will always have the effect of shading the football-shaped region where A and B intersect, because the statement asserts that that region must be empty.

Diagramming "All poodles are yappy."

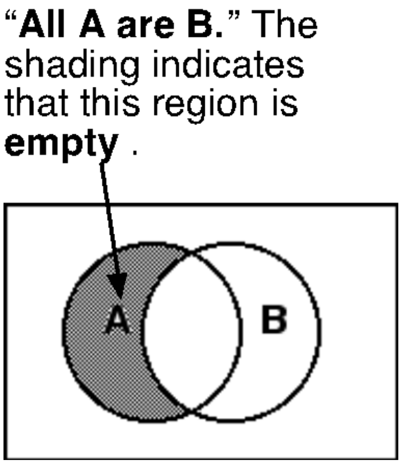
We will mark the Venn diagram to convey the information in the positive universal statement "All poodles are yappy." **P** represents the set of poodles, and **Y** represents the set of yappy things. According to the statement "All poodles are yappy," any region of the diagram that shows poodles who aren't yappy must be ___________________. So we need to _________________________________this region.

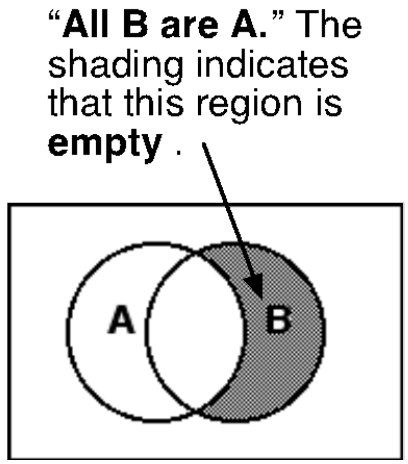
Any element in this region of the diagram is a poodle who isn't yappy. According to the statement "All poodles are yappy," this region must be **empty**.



Diagramming "All are…"

Generally, diagramming a statement of the form "all are…", such as "All A are B" or "All B are A," will have the effect of shading a crescent-shaped region.





The shading always indicates that the shaded region is **empty.**

Diagramming a *particular* statement

Recall that a **particular** statement is a statement that relates an individual to a category, such as "Gomer is a firefighter" or "Whiskers doesn't have rodent breath."

To diagram a particular statement, we use an "X" to represent the particular person who is the subject of the statement, and when place the "X" on the diagram according to the content of the statement.

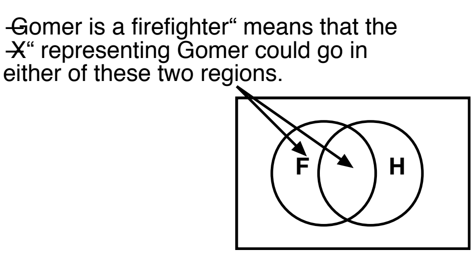
If the "X" can be placed in either of two regions, then we place the "X" on the boundary between the two regions.

Example: Diagramming a *"Gomer is a firefighter."*

Suppose that the diagram below refers to the categories "Firefighters"(**F**) and "Heroes" (**H**).

Mark the diagram to convey the information "Gomer is a firefighter."

Let "X" represent Gomer.



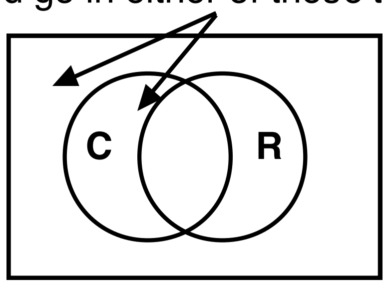
Note that there are two regions of the diagram in which the “X” can be placed to satisfy the statement “Gomer is a firefighter.” Therefore we placed the “X” ____

Example: Diagramming a *“Whiskers doesn’t have rodent breath.”*

Suppose the Venn diagram below relates to the categories “Cats” (**C)** and “things with Rodent Breath” (**R)**. Mark the diagram to convey the information in the particular statement “Whiskers doesn’t have rodent breath. We will use an “X” to represent the particular individual “Whiskers.” Note that there are two regions of the diagram in which the “X” could be placed to satisfy the the condition “Whiskers doesn’t have rodent breath.” Therefore we place the “X” ____

–Whiskers doesn‘t have rodent breath.“

Whiskers could go in either of these two regions.



P2M3 Contiued – Truth Tables to test for Valid arguments

A <u>valid</u> argument has the following property:

It is impossible for_________________________________, if we assume that every premise is ____________________

In a valid argument, "the truth of the premises _____________________________ of the conclusion."

Using a Truth Table to analyze argument validity

1. Symbolize (consistently) all of the premises and the conclusion.

2. Make a truth table having a column for each premise and for the conclusion.

3. If there is a row in the truth table where every premise column is true but the conclusion column is false (a **counterexample row**) then the argument is **invalid**. If there are no counterexample rows, then the argument is valid.

Why does this method work?

When we have filled in the truth table, we are checking to see if there is **a row where the conclusion is ______________________________________ every premise is _______________________**

If there is such a row**,** then the truth table has shown that it is ________________________________for the

conclusion to be false at the same time that ____: this is exactly the

definition of an ____

Example *Use a truth table to test the validity of the following argument.*

If I enter the poodle den, then I will carry my electric poodle prod or my can of mace.

I am carrying my electric poodle prod but not my can of mace.

Therefore, I will enter the poodle den.

A. Valid B. Invalid

Example

Test the validity of the argument.

I don't like muskrats.

If I own a badger or I don't own a wolverine, then I like muskrats.

Therefore, I own a wolverine and I don't own a badger.

A. Valid B. Invalid

p	q	r	~q	~r	q∨~r	**Premise** **~p**	**Premise** **(q∨~r) →p**	**Conclusion** **r ∧ ~q**
T	T	T	F	F	T	F	T	F
T	T	F	F	T	T	F	T	F
T	F	T	T	F	F	F	T	T
T	F	F	T	T	T	F	T	F
F	T	T	F	F	T	T	F	F
F	T	F	F	T	T	T	F	F
F	F	T	T	F	F	T	T	T
F	F	F	T	T	T	T	F	F

Example The Argue-mentor, Part 3 has more examples like this one.
Test the validity of this argument.

~p ∨ ~q

q

∴ **~p**

A. Valid

B. Invali

P2M3 Continued – Common Logical Forms

Study the following four arguments.

If today is Tuesday, then I have math class. Today is Tuesday. Therefore, I have math class.

I don't own a badger. If I don't own a badger, then I own a tortoise. Therefore, I own a tortoise.

If that animal is a wolverine, then it isn't cuddly. That animal is a wolverine. Therefore, that animal isn't cuddly.

I don't like living below ground. If I don't like living below ground, then I'm not a potato. Therefore, I'm not a potato.

Do you see that all four arguments have the same structure?

.

Each of these four arguments can be characterized as follows:

One premise is a ____; the other premise

____

of the conditional premise (*"affirms the antecedent"*); the conclusion

____

of the conditional premise (*"affirms the consequent"*).

Because all four arguments have the same structure, if one of them is valid, the other three should also be valid; if one of them is invalid, the other three should also be invalid.

If today is Tuesday, then I have math class. Today is Tuesday. Therefore, I have math class.

$$\begin{array}{l} p \to q \\ \underline{\quad p} \\ \therefore q \end{array}$$

premise		premise	conclusion	
p	q	$p \rightarrow q$	p	q
T	**T**	**T**	**T**	**T**
T	**F**	**F**	**T**	**F**
F	**T**	**T**	**F**	**T**
F	**F**	**T**	**F**	**F**

The truth table shows that the argument is VALID.

Since the other three arguments on the previous slide have the same structure as this argument, they must also be valid. We don't need to make three more truth tables.

There are several forms of short, valid arguments, and corresponding invalid forms, that occur so often that it is helpful to be able to recognize and name them.

We will encounter names such as

Four Common Logical Forms

VALID forms	**INVALID forms**
Direct Reasoning	***Fallacy of the Converse***
Contrapositive Reasoning	***Fallacy of the Inverse***

Examples of Contrapositive Reasoning

Each of these arguments is valid, because of Contrapositive Reasoning:

If I have a hammer, then I will hammer in the morning.

I don't hammer in the morning.

Therefore, I don't have a hammer.

I don't have to work.

If today is Thursday, then I have to work.

Therefore, today isn't Thursday.

I own a badger.

If don't own a wolverine, then I don't own a badger.

Therefore, I own a wolverine.

Examples of Fallacy of the Inverse

Each of these arguments is invalid, because of Fallacy of the Inverse:

If today is Wednesday, then I have math class.

Today isn't Wednesday.

Therefore, today I don't have math class.

I own a bike.

If I don't own a bike, then I have math class.

Therefore, I don't have math class.

Example

Test the validity of this argument:

I'm not out of bananas or I won't feed my monkeys.

I will feed my monkeys.

Therefore, I'm not out of bananas.

A. Valid B. Invalid

Disjunctive Syllogism

Disjunctive Syllogism is a method that turns ___________________________________ into ____________________argument, as follows.

Any argument having one of these forms is **valid:**

$\mathbf{A \vee B}$	$\mathbf{A \vee B}$
$\underline{\ \ \mathbf{\sim A}}$	$\underline{\ \ \mathbf{\sim B}}$
$\therefore\ \mathbf{B}$	$\therefore\ \mathbf{A}$

This common form is called Disjunctive Syllogism.

Examples of Disjunctive Syllogism

Each of the following arguments is valid, because it is a disjunctive syllogism. Note that this form is characterized as follows:

one premise is a ______________________________________,

the other premise ____, while the

conclusion ____________________________________

Argument 1

I own a badger or I own a wolverine.

I don’t own a badger.

Therefore, I own a wolverine.

Argument 2

I own a badger or I own a wolverine.

I don’t own a wolverine.

Therefore, I own a badger.

Disjunctive Fallacy

In order to turn an "or" premise into a valid argument, the minor premise

__________________________________ of the major ("or") premises.

If the minor premise *affirms* one of the terms of the "or" premise, then we have the structure

_______________________________________. Any argument having one of these forms is

_____________________________.

$A \vee B$	$A \vee B$
$\underline{\quad A}$	$\underline{\quad B}$
$\therefore \sim B$	$\therefore \sim A$

This common form is called Disjunctive Fallacy.

Example

Test the validity of the argument.

If I get elected, I'll reduce taxes.

If I reduce taxes, the economy will prosper.

Thus, if I get elected, the economy will prosper.

A. Valid

B. Invalid

Transitive Reasonong

This is an example of **Transitive Reasoning**, a valid form in which __________________________________ are connected, so to speak, in order to arrive at a ____.

Any argument that can be reduced to the form

$A \to B$

$\underline{B \to C}$

$\therefore A \to C$

is VALID.

We refer to this common form as **Transitive Reasoning**.

The following argument is valid, because it is an example of Transitive Reasoning.

If I eat my spinach, then I'll become muscular.

If I become muscular, then I'll become a professional wrestler.

If I become I professional wrestler, then I'll bleach my hair.

If I bleach my hair, then I'll wear sequined tights.

If I wear sequined tights, then I'll be ridiculous.

Therefore, if I eat my spinach, then I'll be ridiculous.

The previous example illustrates an important property of **Transitive Reasoning**: *This method of reasoning*

____

We easily can construct valid arguments that have as many "if...then" premises as we wish, as long as the fundamental pattern continues: namely, the

____ with the

____.

<u>Not</u> Transitive Reasoning

The following argument looks similar to Transitive Reasoning, but the relationship between terms isn't quite right.

If I get elected, I'll take lots of bribes.

If I get elected, I'll reduce taxes.

Thus, if I take lots of bribes, then I'll reduce taxes.

This is an example of a common *fallacy*, called a **False Chain.**

False Chains

Any argument that can be reduced to one of these forms is INVALID.

$\mathbf{A \to B}$	$\mathbf{A \to B}$
$\underline{\mathbf{A \to C}}$	$\underline{\mathbf{C \to B}}$
$\therefore\ \mathbf{B \to C}$	$\therefore\ \mathbf{A \to C}$

We refer to these common fallacies as **False Chains.**

Examples

Argument 1

If today is Friday, then I have math class.

If I have math class, then I write.

Therefore, if today is Friday, then I write.

Argument 2

If today is Friday, then I have math class.

If today is Friday, then I wash the dog.

Therefore, if I have math class, then I wash the dog.

Argument 3

If today is Friday, then I have math class.

If today is Wednesday, then I have math class.

Therefore, if today is Friday, then today is Wednesday

Although they sound similar, you should recognize that

____ and Arguments 2 and 3 are

____.

Example

Test the validity of this argument:

Some lawyers are judges.

Some judges are politicians.

Therefore, some lawyers are politicians.

A. Valid

B. Invalid

Part 2 Module 5 - Analyzing premises, forming conclusions

Common Forms: In Part 2 Module 3, we identified a number of common forms of valid arguments, and common fallacies. For our work in Part 2 Module 5, it will be especially helpful if we are able to recognize these common forms.

Direct Reasoning, Fallacy of the Converse

Valid	Invalid
$A \rightarrow B$	$A \rightarrow B$
$\underline{\quad A \quad}$	$\underline{\quad B \quad}$
$\therefore B$	$\therefore A$
If today is Wednesday,	If today is Wednesday,
then I have math class.	then I have math class.
Today is Wednesday.	I have math class.
Therefore,	Therefore,
I have math class.	Today is Wednesday.

Contrapositive Reasoning, Fallacy of the Inverse

Valid	Invalid
$A \rightarrow B$	$A \rightarrow B$
$\underline{\quad \sim B \quad}$	$\underline{\quad \sim A \quad}$
$\therefore \sim A$	$\therefore \sim B$
If today is Wednesday,	If today is Wednesday,
then I have math class.	then I have math class.
I don't have math class.	Today isn't Wednesday.
Therefore,	Therefore,
Today isn't Wednesday.	I don't have math class.

Transitive Reasoning, False Chains

Valid	***Invalid***	***Invalid***
A→B	**A→B**	**A→B**
B→C	**A→C**	**C→B**
∴ A→C	**∴ B→C**	**∴ A→C**

Disjinctive Syllogism (valid)

A v B	I own a cat, or I own a dog.	**A v B**	I own a cat, or I own a dog.
~A	I don't own a cat.	**~B**	I don't own a dog.
∴ B	Therefore, I own a dog.	**∴ A**	Therefore, I own a cat.

Disjunctive fallacy (invalid)

A v B	I own a cat, or I own a dog.	**A v B**	I own a cat, or I own a dog.
A	I own a cat.	**B**	I own a dog.
∴ ~B	Therefore, I don't own a dog	**∴ ~A**	Therefore, I don't own a cat.

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

I use my computer or I don't get anything done.

I get something done.

A. I use my computer.

B. I don't use my computer.

C. I use an abacus.

D. None of these is warranted.

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

If we strive, then we excel.

We didn't strive.

A. We excelled.

B. We didn't excel.

C. We didn't inhale.

D. None of these is warranted.

Guidelines

In this course, when we are trying to

____, if

we have the ____, the correct choice will always be "None of these is warranted."

This is because it is never possible to turn an illogical premise set-up into a non-trivial valid argument.

Moreover, if we have the premise ____, the correct answer will never be "None of these is warranted."

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

If my car doesn't start, then I'll be late for work.

I'm not late for work.

A. My car started.

B. I rode the bus.

C. I'm late for work.

D. None of these is warranted.

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

No kittens are fierce.

Fluffy isn't fierce.

A. Fluffy is a kitten.

B. Fluffy has fleas.

C. Fluffy isn't a kitten.

D. None of these is warranted.

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

All politicians are promise makers.

Gomer is not a politician.

A. Gomer is not a promise maker.

B. Gomer is a politician.

C. All promise makers are politicians.

D. None of these is warranted.

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

If you want a better grade, then you bring an apple for the teacher.

If you bring an apple for the teacher, then you expose the teacher to dangerous agricultural chemicals.

A. If you expose the teacher to dangerous agricultural chemicals, then you want a better grade.

B. If you don't expose the teacher to dangerous agricultural chemicals, then you don't want a better grade.

C. You want a better grade.

D. None of these is warranted.

In words, the ____ is **"If you want a better grade, then you expose the teacher to dangerous agricultural chemicals."** This is

____.

Using Transitive Reasoning

In order to see that we can use Transitive Reasoning to arrive at a valid conclusion, it may be necessary

to___________________________________statements

____.

We can never replace a statement with ___________________________________.

Example
Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

If you aren't bitey, then you aren't a wolverine.

If you are bitey, then you aren't cuddly

A. If you aren't a wolverine, then you are cuddly.

B. If you are cuddly, then you are a wolverine.

C. If your name is Dudley, then you are cuddly.

D. If you are cuddly then you aren't a wolverine.

E. None of these is warranted.

Recognizing common forms
The presence of a common logical form may not be obvious when you first read the premises of an argument.

To help recognize the occurrence of a common form, we can always:

1. Rearrange the order in which the premises are presented;
2. Replace statements with **equivalent** statements;

In particular, we can always replace a conditional statement with its **contrapositive**.

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

If I invest wisely, then I won't lose my money.

If I don't invest wisely, then I buy junk bonds.

If I read Investor's Weekly, then I won't buy junk bonds.

A. If I invest wisely, then I read Investor's Weekly.

B. If I buy junk bonds, then I don't invest wisely.

C. If I lose my money, then I don't read Investor's Weekly.

D. If I eat junk food, then I invest weakly.

E. None of these is warranted.

Using Transitive Reasoning

In order to see that we can use Transitive Reasoning, it may be necessary to rearrange the order in which the premises are listed. We want the first "if…then" premise to begin with a term that appears only one time in the premise scheme. Continue rearranging the order of the premises, and perhaps replacing premises with their contrapositives, so that the antecedent of each successive premise matches the consequent of the preceding premise. When we have used every premise in this manner, we can form a chain of reasoning to state a valid conclusion that uses every premise (a **major** valid conclusion).

If at any point it is ____ of premises, then the argument involves a ______________. In this case, the correct answer will ____.

Universal statements ("All are…" "None are…") can be written as ______________________________.

"All poodles are yappy" means "____."

"No porcupines are cuddly" means "____."

"All A are B" is equivalent to A→B.

"No A are B" is equivalent to A →~B.

Particular statements can also be written as ____

"Gomer is a judge" means "____"

"Homer isn't a lawyer" means "____."

Existential statements (“Some are…” “Some aren’t…”)

____, so don’t even try.

Example

Should we try an example?

Express “Some lawyers are judges” as a _________________________

Sorry __________________________________**cannot** be written as an

____

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

All people who get many tickets are uninsurable.

All careless drivers get many tickets.

All people who are uninsurable have bad credit ratings.

A. All careless drivers have bad credit ratings.

B. If your car is repossessed because you have bed credit, then you are a car-less driver.

C. All people are uninsurable get many tickets.

D. None of these is warranted.

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

If you aren't a good stirrer, then you aren't handy with a swizzle stick.

If you are a graduate of Billy Bob's Big Bold School of Mixology, then you are a bartender.

No good stirrers have weak wrist muscles.

If you don't have weak wrist muscles, then you have a firm handshake.

All bartenders are handy with a swizzle stick.

A. If you are a graduate of Billy Bob's Big Bold School of Mixology, then you don't have a firm handshake.

B. If you don't have a firm handshake, then you aren't a graduate of Billy Bob's Big Bold School of Mixology.

C. If you have a firm handshake, then you are a graduate of Billy Bob's Big Bold School of Mixology.

D. None of these is warranted.

Example

Select the statement that is a valid conclusion from the following premises, if a valid conclusion is warranted.

Sylvester isn't a parakeet.

Elephants never squawk.

All parakeets squawk.

No elephants are tiny.

A. Sylvester is an elephant.

B. Sylvester isn't tiny.

C. All parakeets are tiny.

D. None of these is warranted.

Further discussion

Focus on the two middle premises. Ignore the first premise and the last premise.

1. Sylvester isn't a parakeet.
2. **Elephants never squawk.**
3. **All parakeets squawk.**
4. No elephants are tiny.

This is an example of a **minor valid conclusion** (a valid conclusion that doesn’t require the use of every premise) For a problem like this, in this course, **a minor valid conclusion will never be listed among the multiple choice options**. The right answer will always be a **major valid conclusion** (a valid conclusion that requires the use of every premise),

or, if a major valid conclusion is not possible, the right answer will be “None of these…”