**Raval’s method a Simplified approach to Propositional Logic Arguments**

Propositional logic, also known as sentential logic and statement logic, is the branch of logic that studies ways of joining and/or modifying entire propositions, statements or sentences to form more complicated propositions, statements or sentences, as well as the logical relationships and properties that are derived from these methods of combining or altering statements.

Of the many and varied [argument forms](http://en.wikipedia.org/wiki/Argument_form) that can possibly be constructed; only very few are **valid argument forms**. In order to evaluate these forms, [statements](http://en.wikipedia.org/wiki/Statement_%28logic%29) are put into [logical form](http://en.wikipedia.org/wiki/Logical_form). Logical form replaces any sentences or ideas with letters to remove any bias from content and allow one to evaluate the argument without any bias due to its subject matter.

**Basic Argument Forms**

|  |  |  |
| --- | --- | --- |
| **Name** | **Sequent** | **Description** |
| [Modus Ponens](http://en.wikipedia.org/wiki/Modus_Ponens) | ((p \to q) \land p) \vdash q | If *p* then *q*; *p*; therefore *q* |
| [Modus Tollens](http://en.wikipedia.org/wiki/Modus_Tollens) | ((p \to q) \land \neg q) \vdash \neg p | If *p* then *q*; not *q*; therefore not *p* |
| [Hypothetical Syllogism](http://en.wikipedia.org/wiki/Hypothetical_Syllogism) | ((p \to q) \land (q \to r)) \vdash (p \to r) | If *p* then *q*; if *q* then *r*; therefore, if *p* then *r* |
| [Disjunctive Syllogism](http://en.wikipedia.org/wiki/Disjunctive_syllogism) | ((p \lor q) \land \neg p) \vdash q | Either *p* or *q*, or both; not *p*; therefore, *q* |
| [Constructive Dilemma](http://en.wikipedia.org/wiki/Constructive_dilemma) | ((p \to q) \land (r \to s) \land (p \lor r)) \vdash (q \lor s) | If *p* then *q*; and if *r* then *s*; but *p* or *r*; therefore *q* or *s* |
| [Destructive Dilemma](http://en.wikipedia.org/wiki/Destructive_dilemma) | ((p \to q) \land (r \to s) \land(\neg q \lor \neg s)) \vdash (\neg p \lor \neg r) | If *p* then *q*; and if *r* then *s*; but not *q* or not *s*; therefore not *p* or not *r* |
| Bidirectional Dilemma | ((p \to q) \land (r \to s) \land(p \lor \neg s)) \vdash (q \lor \neg r) | If *p* then *q*; and if *r* then *s*; but *p* or not *s*; therefore *q* or not *r* |

Conclusions from the Arguments containing ‘If –then’ conditions can be deduced very easily without any significant memorization by applying Raval’s method.

Method: In Raval’s method If P then Q is written as P (2$) – Q (1$) and viewed numerically, in currency form i.e. P is viewed as 2$ and Q is viewed as 1$ and implications from this notations are valid conclusions.

If one has 2$ then he definitely have 1$.

If one do not have 2$, he may not have 1$.

If one is having 1$, he may not have 2$.

If one do not have 1$, he definitely doesn’t have 2$.

## Valid propositional forms

### Modus ponens

Modus ponens says that if one thing is true, then another will be. It then states that the first is true. The conclusion is that the second thing is true. It is shown below in logical form.

If A, then B

A

Therefore, B

Explanation by Raval’s method

If A (2$), then B (1$)

A (2$)

Therefore, B (1$)

An example of an argument that fits the form *modus ponens*:

If today is Tuesday, then John will go to work.

Today is Tuesday.

Therefore, John will go to work.

Explanation by Raval’s method

If today is Tuesday (2$), then John will go to work (1$).

Today is Tuesday (2$).

Therefore, John will go to work (1$).

### Modus tollens

Another form of argument is known as [modus tollens](http://en.wikipedia.org/wiki/Modus_tollens). In this form, you start with the same first premise as with modus ponens. However, the second part of the premise is denied, leading to the conclusion that the first part of the premise should be denied as well. It is shown below in logical form.

If A, then B

Not B

Therefore, not A.

Explanation by Raval’s method

If A (2$), then B (1$)

Not B (no 1$)

Therefore, not A (no 2$).

Consider an example:

If the watch-dog detects an intruder, the watch-dog will bark.

The watch-dog did not bark.

Therefore, no intruder was detected by the watch-dog.

Explanation by Raval’s method

If the watch-dog detects an intruder (2$), the watch-dog will bark (1$).

The watch-dog did not bark (no 1$).

Therefore, no intruder was detected by the watch-dog (no 2$).

Another example:

If I am the axe murderer, then I can use an axe.

I cannot use an axe.

Therefore, I am not the axe murderer.

Explanation by Raval’s method

If I am the axe murderer (2$), then I can use an axe (1$).

I cannot use an axe (no 1$).

Therefore, I am not the axe murderer (no 2$).

*Modus tollens* is closely related to [*modus ponens*](http://en.wikipedia.org/wiki/Modus_ponens). There are two similar, but [invalid, forms of argument](http://en.wikipedia.org/wiki/Fallacy): [affirming the consequent](http://en.wikipedia.org/wiki/Affirming_the_consequent) and [denying the antecedent](http://en.wikipedia.org/wiki/Denying_the_antecedent).

**Affirming the consequent**, sometimes called **converse error**, **fallacy of the converse** or **confusion of necessity and sufficiency**, is a [formal fallacy](http://en.wikipedia.org/wiki/Formal_fallacy) of inferring the [converse](http://en.wikipedia.org/wiki/Converse_%28logic%29) from the original statement. The corresponding argument has the general [form](http://en.wikipedia.org/wiki/Argument_form):

If P, then Q.

Q.

Therefore, P.

Explanation by Raval’s method

If P(2$), then Q(1$).

Q(1$).

Therefore, P(2$). x

An argument of this form is [invalid](http://en.wikipedia.org/wiki/Validity), i.e., the conclusion can be false even when statements 1 and 2 are true.

To put it differently, if *P* implies *Q*, the **only** inference that can be made is *non-Q* implies *non-P*. (*Non-P* and *non-Q* designate the opposite propositions to *P* and *Q*.) This is known as logical [contraposition](http://en.wikipedia.org/wiki/Contraposition).

## Examples

If [Bill Gates](http://en.wikipedia.org/wiki/Bill_Gates) owns [Fort Knox](http://en.wikipedia.org/wiki/United_States_Bullion_Depository) , then he is [rich](http://en.wikipedia.org/wiki/Wealth).

Bill Gates is rich.

Therefore, Bill Gates owns Fort Knox. x

Explanation by Raval’s method

If [Bill Gates](http://en.wikipedia.org/wiki/Bill_Gates) owns [Fort Knox](http://en.wikipedia.org/wiki/United_States_Bullion_Depository) (2$), then he is [rich](http://en.wikipedia.org/wiki/Wealth) (1$).

Bill Gates is rich (1$).

Therefore, Bill Gates owns Fort Knox (2$). x

Owning Fort Knox is not the *only* way to be rich. Any number of other ways exists to be rich.

However, one can affirm with certainty that "if Bill Gates is not rich" (*non-Q*) then "Bill Gates does not own Fort Knox" (*non-P*). This is the [contrapositive](http://en.wikipedia.org/wiki/Contrapositive) of the first statement, and it must be true if the original statement is true.

Arguments of the same form can sometimes seem superficially convincing, as in the following example:

If I have the [flu](http://en.wikipedia.org/wiki/Flu), then I have a [sore throat](http://en.wikipedia.org/wiki/Sore_throat).

I have a sore throat.

Therefore, I have the flu.

Explanation by Raval’s method

If I have the [flu](http://en.wikipedia.org/wiki/Flu) (2$), then I have a [sore throat](http://en.wikipedia.org/wiki/Sore_throat) (1$).

I have a sore throat (1$).

Therefore, I have the flu (2$). x

But having the flu is not the *only* cause of a sore throat since many illnesses cause sore throat, such as the [common cold](http://en.wikipedia.org/wiki/Common_cold) or [strep throat](http://en.wikipedia.org/wiki/Strep_throat).

**Denying the antecedent**, sometimes also called **inverse error** or **fallacy of the inverse**, is a [formal fallacy](http://en.wikipedia.org/wiki/Formal_fallacy) of inferring the [inverse](http://en.wikipedia.org/wiki/Inverse_%28logic%29) from the original statement. It is committed by reasoning in the [form](http://en.wikipedia.org/wiki/Argument_form):

If P, then Q.

Not P.

Therefore, not Q.

Explanation by Raval’s method

If P (2$), then Q (1$).

Not P (no 2$).

Therefore, not Q (no 1$). x

[Arguments](http://en.wikipedia.org/wiki/Argument) of this form are [invalid](http://en.wikipedia.org/wiki/Validity).

## Examples

If [Rene Descartes](http://en.wikipedia.org/wiki/Rene_Descartes) was thinking, then Rene Descartes existed at the time.

It happened once that Rene Descartes was not thinking.

Therefore, Rene Descartes did not exist at the time.

Explanation by Raval’s method

If [Rene Descartes](http://en.wikipedia.org/wiki/Rene_Descartes) was thinking (2$), then Rene Descartes existed at the time (1$).

It happened once that Rene Descartes was not thinking (no 2$).

Therefore, Rene Descartes did not exist at the time (no 1$). x

The conclusion is invalid because there are other reasons why the man could not be thinking at the time (he may be sleeping at the time or be unconscious).

Another example:

If [Queen Elizabeth](http://en.wikipedia.org/wiki/Elizabeth_II_of_the_United_Kingdom) is an American citizen, then she is a human being.

Queen Elizabeth is not an American citizen.

Therefore, Queen Elizabeth is not a human being.

Explanation by Raval’s method

If [Queen Elizabeth](http://en.wikipedia.org/wiki/Elizabeth_II_of_the_United_Kingdom) is an American citizen (2$), then she is a human being(1$).

Queen Elizabeth is not an American citizen (no 2$).

Therefore, Queen Elizabeth is not a human being (no 1$). X

Another example:

If I am [President of the United States](http://en.wikipedia.org/wiki/President_of_the_United_States), then I can veto Congress.

I am not President.

Therefore, I cannot veto Congress.

Explanation by Raval’s method

If I am [President of the United States](http://en.wikipedia.org/wiki/President_of_the_United_States) (2$), then I can veto Congress(1$).

I am not President (no 2$).

Therefore, I cannot veto Congress (no 1$). x

### Hypothetical syllogism

In [classical logic](http://en.wikipedia.org/wiki/Classical_logic), **hypothetical syllogism** is a [valid](http://en.wikipedia.org/wiki/Validity) [argument form](http://en.wikipedia.org/wiki/Logical_form) which is a [syllogism](http://en.wikipedia.org/wiki/Syllogism) having a [conditional statement](http://en.wikipedia.org/wiki/Material_conditional) for one or both of its [premises](http://en.wikipedia.org/wiki/Premise)

[Hypothetical syllogism](http://en.wikipedia.org/wiki/Hypothetical_syllogism) states that if one thing happens, another will as well. If that second thing happens, a third will follow it. Therefore, if the first thing happens, it is inevitable that the third will too. It is shown below in logical form.

If A, then B

If B, then C

Therefore, if A, then C

Explanation by Raval’s method

If A (2$), then B (1$)

If B (1$), then C (0.5$)

Therefore, if A (2$), then C (0.5$)

## Examples

If I do not wake up, then I cannot go to work.

If I cannot go to work, then I will not get paid.

Therefore, if I do not wake up, then I will not get paid.

Explanation by Raval’s method

If I do not wake up (2$), then I cannot go to work (1$).

If I cannot go to work (1$), then I will not get paid (0.5$).

Therefore, if I do not wake up (2$), then I will not get paid (0.5$).

This is a shortened example of what is known as a [slippery slope](http://en.wikipedia.org/wiki/Slippery_slope). A slippery slope is the idea that if one single event happens, it will inevitably cause a whole list of other things to happen with no way to stop them.

### Disjunctive syllogism

[Disjunctive syllogism](http://en.wikipedia.org/wiki/Disjunctive_syllogism): In Disjunctive Syllogism, the first premise establishes two options. The second takes one away, so the conclusion states that the remaining one must be true. It is shown below in logical form.

A or B

Not A

Therefore, B

When used A and B are replaced with real life examples it looks like below.

Either you will see Joe in class today or he will oversleep

You did not see Joe in class today

Therefore, Joe overslept

Disjunctive syllogism takes two options and narrows it down to one.

### Constructive dilemma

Another valid form of argument is known as [constructive dilemma](http://en.wikipedia.org/wiki/Constructive_dilemma) or sometimes just "dilemma". It does not leave the user with one statement alone at the end of the argument; instead it gives an option of two different statements. The first premise gives an option of two different statements. Then it states that if the first one happens, there will be a particular outcome and if the second happens, there will be a separate outcome. The conclusion is that either the first outcome or the second outcome will happen.

If A then C

If B then D

A or B

Therefore C or D

Explanation by Raval’s method

If A (2$) then C (1$)

If B (2#) then D (1#)

A (2$) or B (2#)

Therefore C (1$) or D (1#)

## Natural language example

If I win a million dollars, I will donate it to an orphanage.

If my friend wins a million dollars, he will donate it to a wildlife fund.

I win a million dollars or my friend wins a million dollars.

Therefore, either an orphanage will get a million dollars, or a wildlife fund will get a million dollars.

Explanation by Raval’s method

If I win a million dollars (2$), I will donate it to an orphanage (1$).

If my friend wins a million dollars (2#), he will donate it to a wildlife fund (1#).

I win a million dollars (2$) or my friend wins a million dollars (2#).

Therefore, either an orphanage will get a million dollars (1$), or a wildlife fund will get a million dollars (1#).

[Destructive dilemma](http://en.wikipedia.org/wiki/Destructive_dilemma)

There is a slightly different version of dilemma that uses negation rather than affirming something known as [destructive dilemma](http://en.wikipedia.org/wiki/Destructive_dilemma). When put in argument form it looks like below.

If A then C

If B then D

Not C or not D

Therefore not A or not B

If A (2$) then C (1$)

If B (2#) then D (1#)

Not C (no 1$) or not D (no 1#)

Therefore not A (no2$) or not B (no 2#)

## Natural language example

If it rains, we will stay inside.

If it is sunny, we will go for a walk.

Either we will not stay inside, or we will not go for a walk, or both.

Therefore, either it will not rain, or it will not be sunny, or both.

Explanation by Raval’s method

If it rains (2$), we will stay inside (1$).

If it is sunny (2$), we will go for a walk (1$).

Either we will not stay inside (no 1$), or we will not go for a walk (1$), or both.

Therefore, either it will not rain (no 2$), or it will not be sunny (no 2$), or both.

## Bidirectional Dilemma

If A then C

If Bthen D

A or not D

Therefore C or not B

Explanation by Raval’s method

If A (2$) then C (1$)

If B (2#)then D (1#)

A (2$) or not D (no 1#)

Therefore C (1$) or not B (no 2#)

When content is inserted in place of the letters, it looks like below.

If he takes the stairs, he will be tired when he gets to his room

If he takes the elevator, he will miss the start of the football game on TV

Bill will either take the stairs or he will not miss the start of the football game on TV

Therefore, Bill will either be tired when he gets to his room or he will not take the elevator

Explanation by Raval’s method

If he takes the stairs (2$), he will be tired when he gets to his room (1$)

If he takes the elevator (2#), he will miss the start of the football game on TV (1#)

Bill will either take the stairs (2$) or he will not miss the start of the football game on TV (no 1#)

Therefore, Bill will either be tired when he gets to his room (1$) or he will not take the elevator (no 2#)

*End*