Analyzing Arguments

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Inductive vs. Deductive Argument

Premise: A statement that is assumed to be true and from which a conclusion can be drawn.

Argument 1 (Inductive)

Premise:		Birds fly up into the air, but eventually come back down.
Premise:		People who jump into the air come back down.
Premise:		Balls thrown into the air come back down.
Conclusion:		What goes up must come down.

Argument 2 (Deductive)

Premise:		All politicians are married.
Premise:		Senator Harris is a politician.
Conclusion:		Senator Harris is married.

Definitions:

An inductive argument makes a case for a general conclusion from more specific premises.

A deductive argument makes a case for a specific conclusion from more general premises.

Types of Arguments

I. Inductive Reasoning

specific premises ⇒ general conclusion

II. Deductive Reasoning

general premises ⇒ specific conclusion

Inductive Argument

Even though all the premises are true, and even though they strengthen the conclusion, they **don't prove** the conclusion regardless of how strong the inductive argument may seem.

Inductive argument is evaluated in terms of its strength, which is completely subjective (i.e. a same argument may seem strong to one person, weak to another), and it is not necessarily related to the truth of its conclusion (i.e. a weak argument may yield a true conclusion, and a strong argument a false conclusion).

the nature of induction: inducing the universal from the particular.

Example: Inductive Argument

Premise: Sparrows are birds that fly.

Premise: Eagles are birds that fly.

Premise: Hawks are birds that fly.

Premise: Larks are birds that fly.

Conclusion: All birds fly.

Example 1

Premise:		Hired big stars.
Premise:		Planned great advertising campaign.
Premise:		It's a sequel to her last hit.
Conclusion:		The film will be a hit.

Example 2

Premise:		On average, the San Andreas Fault suffers a major earthquake once every 100 years.
Conclusion:		San Andreas Fault will be hit by another major earthquake during the next 100 years.

Example 3

Premise:		All observed crows are black.
Conclusion:		All crows are black.

Example 4

Premise:		Many speeding tickets are given to teenagers.
Conclusion:		All teenagers drive fast.

Out of these four examples, which ones have strong arguments?

Notes on Inductive Arguments

1. An inductive argument **cannot prove its conclusion true**.
2. An inductive argument can be evaluated only in terms of its **strength**.
3. The **strength** of an inductive argument is a measure of how well the premises support the conclusion. Clearly, this is subjective (a personal judgment).

Example

Premise: (-6) (-4) = 24
Premise: (-2) (-1) = 2
Premise: (-27) (-3) = 81

Conclusion: Whenever we multiply two negative members, the result is a positive number.

Truth of the Premises:
Strength of the argument:
Truth of the Conclusion:

Deductive Arguments

A **deductive argument** makes a case *for* a specific conclusion *from* more general premises.
In other words, general premises are used to form a specific conclusion.
(The specific conclusion is deduced.)

Evaluating a deductive argument requires answering two key questions:

1) Does the conclusion follow necessarily from the premises?
2) Are the premises true?

A deductive argument is **valid** if the answer to the first question is "yes," it is **sound** if, in addition, the answer to the second question is also "yes." We can be sure that the conclusion is true only if the argument is sound, i.e. if the answer to both questions is yes.

Notes on Deductive Arguments

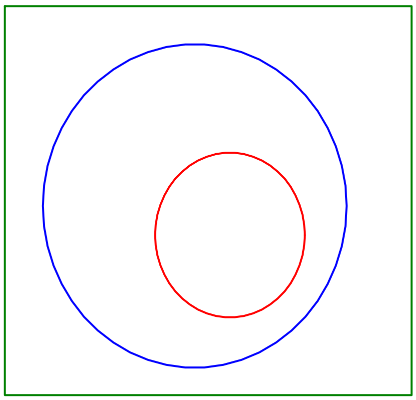
- A Deductive Argument can be evaluated in terms of its **Validity** and **Soundness**.
- A Deductive Argument is **Valid** if its conclusion follows necessarily from its premises. **Validity** is concerned only with the logical structure of the argument. It has nothing to do with the truth of the premises or the conclusion.
- A Deductive Argument is **Sound** if
  a) it is **valid** ***and*** **b) its premises are all true**.
- A **Sound Deductive Argument** provides definitive proof that its conclusion is true. (However, this often involves personal judgment.)

Tests of Validity

Premise:		All politicians are married.
Premise:		Senator Harris is a politician.
Conclusion:		Senator Harris is married.

A Venn diagram test of validity

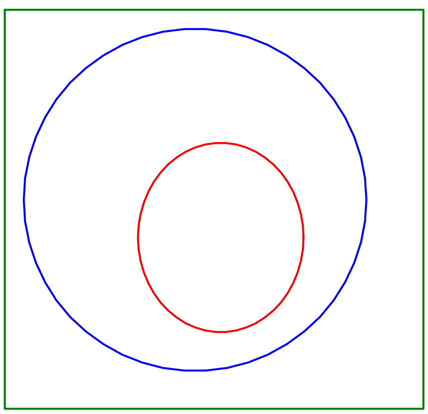
M	Set of all married people.
P	set of all politicians



Example 5 (Invalid Argument)

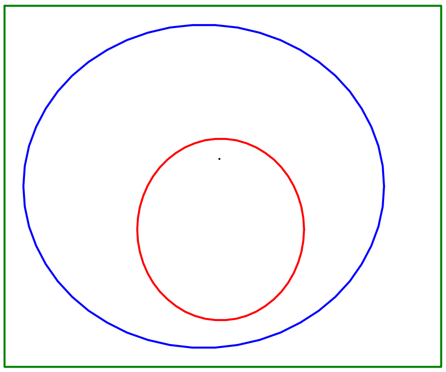
Premise:		All fish live in the water.
Premise:		Whales are not fish.
Conclusion:		Whales do not live in the water.

Let ***S*** be the set of all living creatures that live in water, and let ***P*** be the set of all fish.



Example 6 (Invalid but true conclusion)

Premise:		All 20th century U.S. presidents were men.
Premise:		John Kennedy was a man.
Conclusion:		John Kennedy was a 20th century U.S. president.

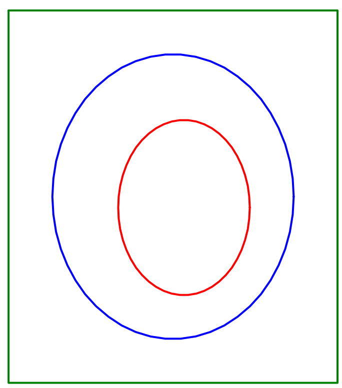


Conditional Deductive Arguments

A **Conditional Deductive Argument** has a **conditional statement for its first premise**.

There are four basic conditional arguments:

1. **Affirming the Hypothesis.**
2. **Affirming the Conclusion**.
3. **Denying the Hypothesis**.
4. **Denying the Conclusion**.



Example 7

Premise:		If a person lives in Chicago, then this person likes windy days.
Premise:		Carlos lives in Chicago.
Conclusion:		Carlos likes windy days.

Conditional statement: if p then q.

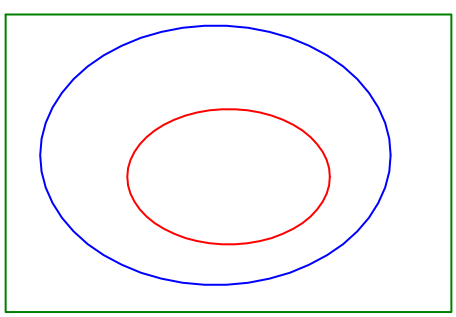
Four Basic Conditional Arguments

Example 8 (Affirming the Hypothesis)

p is true. q is true. Then it's valid.

p = a person lives in Chicago.
q = the person likes windy days.

Valid or Invalid?



Example:

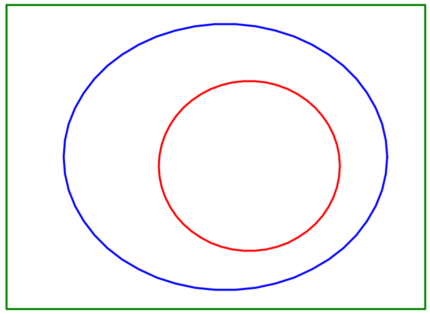
Premise: If one gets a college degree, then one can get a good job.
Premise: Marilyn has a college degree.
Conclusion: Marilyn can get a good job.

Structure: If p, then q.

p is true

q is true

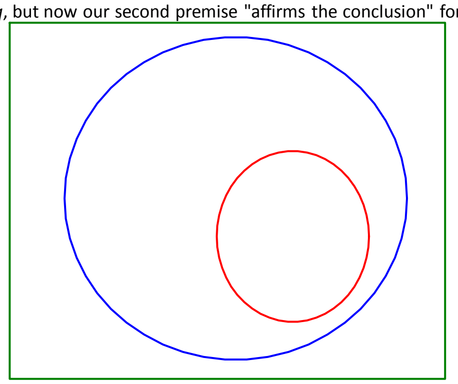
Validity: Valid



Example 9 (Affirming the Conclusion)

Premise:		If an employee is regularly late, then the employee will be fired.
Premise:		Sharon was fired.
Conclusion:		Sharon was regularly late.

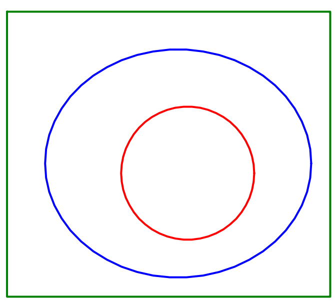
Again we start with a premise *if p then q*, but now our second premise "affirms the conclusion" for a person named Sharon.



Valid or Invalid?

Example:

Premise: If one gets a college degree, then one can get a good job.
Premise: Marilyn gets a good job.
Conclusion: Marilyn has a college degree.



Structure: If p, then q.

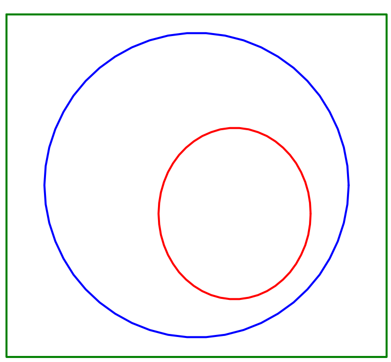
q is true

p is true

Validity:
Invalid – Converse Fallacy

Example 10 (Denying the Hypothesis)

Premise:		If you liked the book, then you'll love the movie.
Premise:		You did not like the book.
Conclusion:		You will not love the movie.



Valid or Invalid?

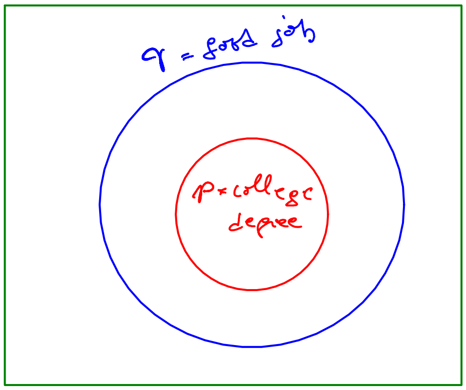
Example:

Premise: If one gets a college degree, then one can get a good job.
Premise: Marilyn does not have a college degree.
Conclusion: Marilyn cannot get a good job.

Structure: If *p*, then *q*.

p is not true

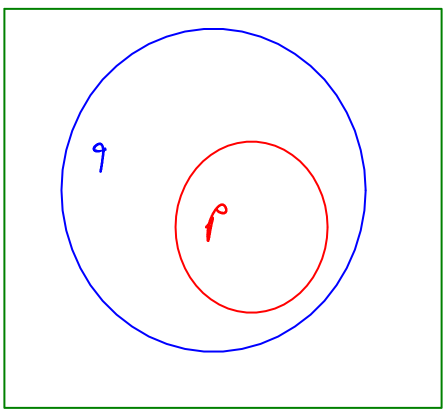
q is not true



Invalid – **Inverse Fallacy**

Example 11 (Denying the Conclusion)

Premise:		A narcotic is habit-forming.
Premise:		Heroin is not habit-forming.
Conclusion:		Heroin is not a narcotic.



Valid or Invalid?

Sound?

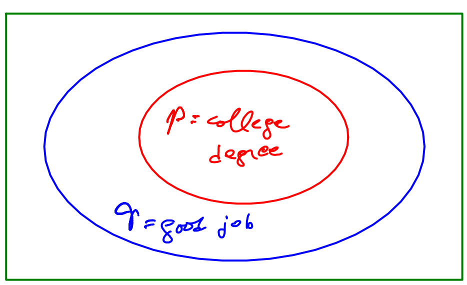
Example:

Premise: If one gets a college degree, then one can get a good job.
Premise: Marilyn does not have a good job.
Conclusion: Marilyn does not have a college degree.

Structure: If *p*, then *q*.

q is not true

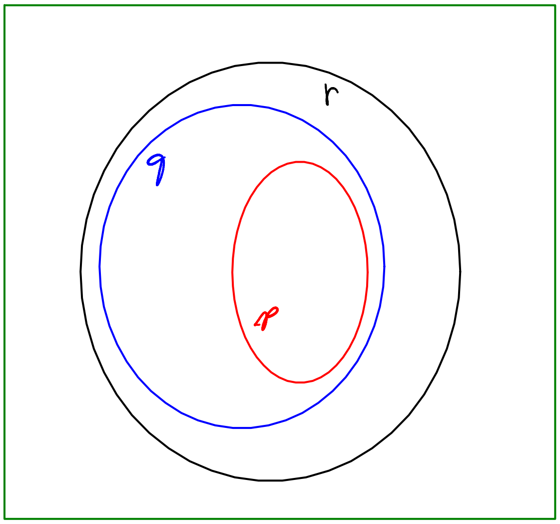
p is not true



Valid

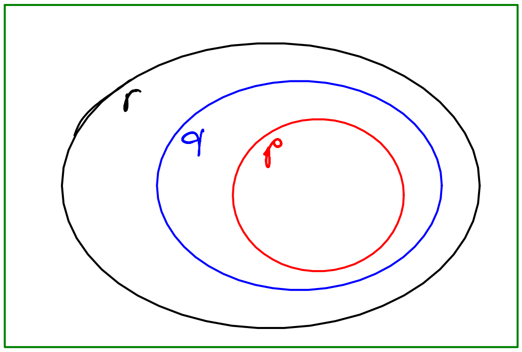
Deductive Arguments with a Chain of Conditionals

Premise:		If p, then q.
Premise:		if q, then r.
Conclusion:		If p, then r.

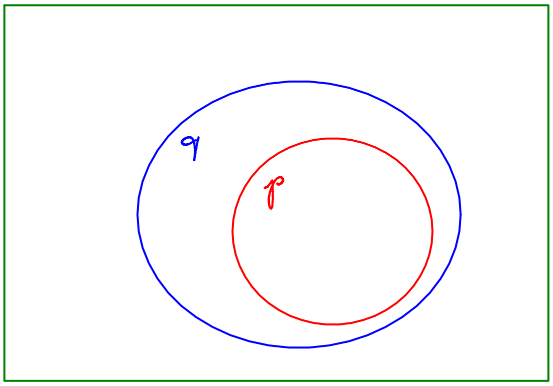


Examples:

If I go to the game, then I'll eat a hotdog.
If I eat a hotdog, then I'll get sick.
So, if I go to the game, I'll get sick.



We agreed that if you shop, I make dinner.
We also agreed that if you take out the trash, I make dinner.
Therefore, if you shop, you should take out the trash.



Deductive Arguments With A
Chain Of Conditionals

1. **Structure:** If p, then q.
If q, then r.
If p, then r.

Validity: Valid

2. **Structure:** If p, then q.
If r, then q.
If p, then r.

Validity: Invalid

Mathematics relies heavily on proofs. A mathematical proof is a deductive argument that demonstrates the truth of a certain claim or theorem. A theorem is proven if it is supported by a valid and sound proof. Although mathematical proofs use Deduction, theorems are often discovered by Induction.

Inductive Counterexample

Consider the following algebraic expression: $n^2 - n + 11$

It appears that $n^2 - n + 11$ will always equal a prime number when $n \geq 0$.

Or does it?

How about $n = 11$?

$11^2 - 11 + 11 = 121$
(a non-prime counterexample)

n	$n^2 - n + 11$
0	$0^2 - 0 + 11 = 11$ (prime)
1	$1^2 - 1 + 11 = 11$ (prime)
2	$2^2 - 2 + 11 = 13$ (prime)
3	$3^2 - 3 + 11 = 17$ (prime)
4	$4^2 - 4 + 11 = 23$ (prime)
5	$5^2 - 5 + 11 = 31$ (prime)

[redacted]