

Introduction to Informal Logical Fallacies

Course Outline

Day 1

- Housekeeping
- Introduction to Logic
 - Values and Functions
 - Abduction, Induction, Deduction
 - Validity
 - Soundness
- Language to Logic

Day 2

- Fallacies

Day 3

- Fallacies

Scope

Informal Logic

Set of techniques used to evaluate arguments made in everyday language.

Formal Logic

Set of formulae used to assign truth values to symbolic equations.

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Informal Logic

Set of techniques used to evaluate arguments made in everyday language.

Formal Logic

Set of formulae used to assign truth values to symbolic equations.

Truth Values

A	$\sim A$
True	False
False	True

Logical Functions

A truth table defines all possible combinations of truth values for Assertions A, B.

A	B	A Or B	A And B	If A Then B
True	True	True	True	True
True	False	True	False	False
False	True	True	False	True
False	False	False	False	True

Logical Functions

Assertions A,B have four possible combinations of truth values. Given n arguments, there are 2^n possible truth value combinations.

A	B	A Or B	A And B	If A Then B
True	True	True	True	True
True	False	True	False	False
False	True	True	False	True
False	False	False	False	True

Logical Functions

Function columns show the value of the function given the truth values of its arguments.

A	B	A Or B	A And B	If A Then B
True	True	True	True	True
True	False	True	False	False
False	True	True	False	True
False	False	False	False	True

Logical Functions

“Or” is false only when both arguments are false.

A	B	A Or B	A And B	If A Then B
True	True	True	True	True
True	False	True	False	False
False	True	True	False	True
False	False	False	False	True

Logical Functions

“And” is true only when both arguments are true.

A	B	A Or B	A And B	If A Then B
True	True	True	True	True
True	False	True	False	False
False	True	True	False	True
False	False	False	False	True

Logical Functions

Implication is false **only** when the premise is true and the conclusion is false.

A	B	A Or B	A And B	If A Then B
True	True	True	True	True
True	False	True	False	False
False	True	True	False	True
False	False	False	False	True

Logical Functions

“False implies anything.”

A	B	A Or B	A And B	If A Then B
True	True	True	True	True
True	False	True	False	False
False	True	True	False	True
False	False	False	False	True

Truth Values

Excluded Middle



A	$\sim A$	A OR $\sim A$	A AND $\sim A$
True	False	True	False
False	True	True	False



Non-Contradiction

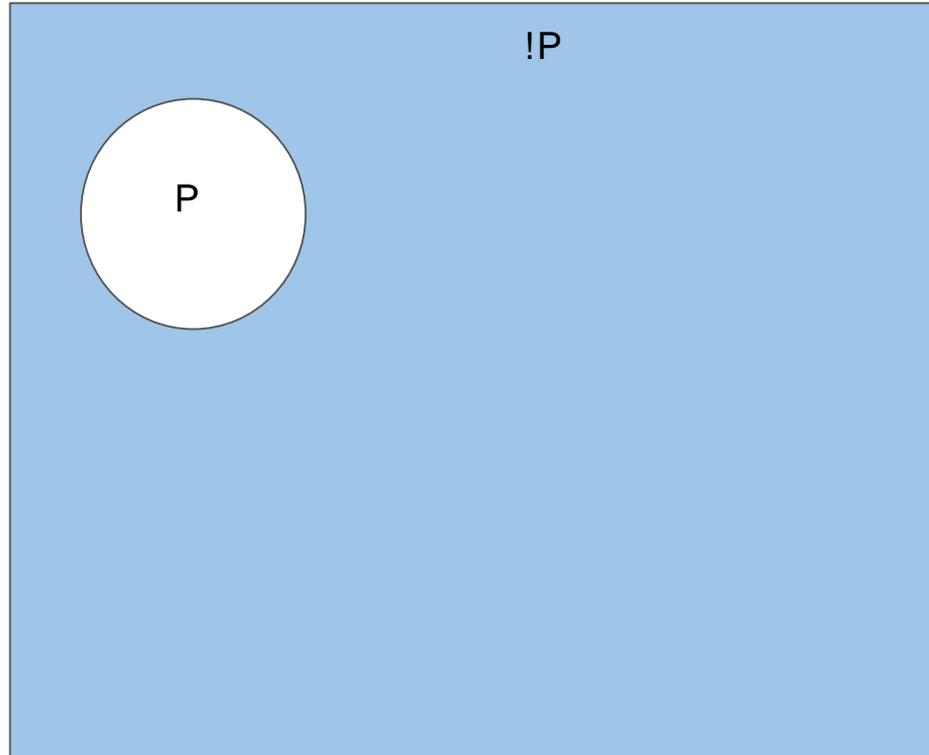
A Short-List of Formal Logic Symbols

Logic Function	Verbiage	Symbolic Representations
Not	Not P	$\neg P$ $\sim P$ $\neg P$
Or	P or Q	$P \vee Q$ $P+Q$
And	P and Q	$P \wedge Q$ PQ $P \cdot Q$
Implication	If P then Q	$P \supset Q$ $P \rightarrow Q$
Conclusion	Therefore	\therefore \therefore

Logic Functions Venn Diagrams

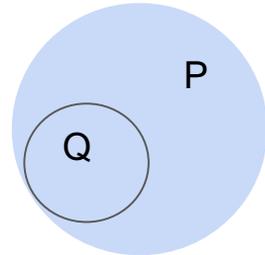
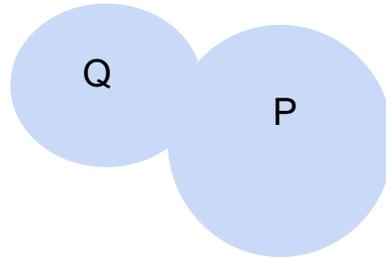
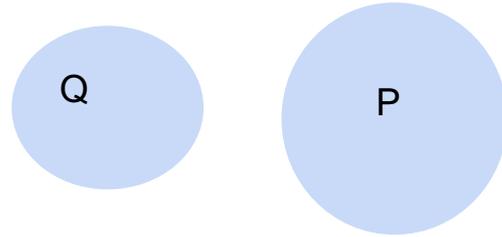
P

!P



Logic Functions Venn Diagrams

$P \vee Q$



Colloquial “Or” (AKA Exclusive Or)

P or Q

(P and !Q) or (Q and !P)

Are you going to the store this morning or this afternoon?

Colloquial “Or” (AKA Exclusive Or)

P or Q

(P and !Q) or (Q and !P)

Are you going to the store this morning or this afternoon?

Do not answer, “Yes.”

Colloquial “Or”

P or Q

(P and !Q) or (Q and !P)

Are you going to the store this morning or this afternoon?

I'm going this morning.

I'm going this afternoon.

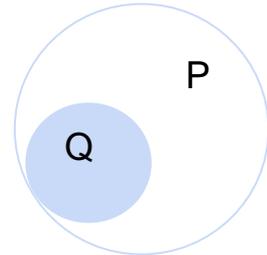
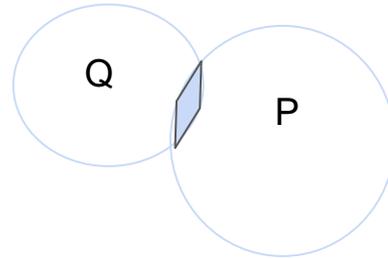
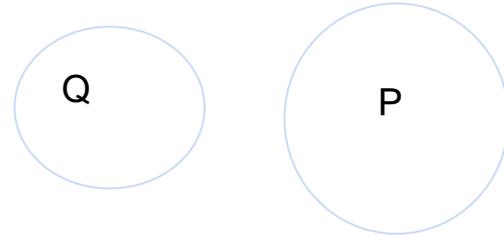
I'm not going today.

I'm going this morning and this afternoon.

Logic Functions Venn Diagrams

P And Q

$P \wedge Q$



Abductive, Inductive, and Deductive Reasoning

Abductive

Start with a concrete instance.

Draw a conclusion based on the best explanation.

My lettuce plants nearly always die in January after a cold night.

I conclude frosts in January kill my plants.

Abductive, Inductive, and Deductive Reasoning

Abductive

Be on the lookout for conclusions that are not the best explanation.



**MY HEAD HURTS.
I THINK MY HORNS
ARE COMING IN.**

Abductive, Inductive, and Deductive Reasoning

Inductive

Start with an hypothesis.

Find supporting evidence.

Find contradictory evidence.

Generalize.

Frost kills lettuce plants in January.

True in 1970 - 2002, and 2004 - 2019.

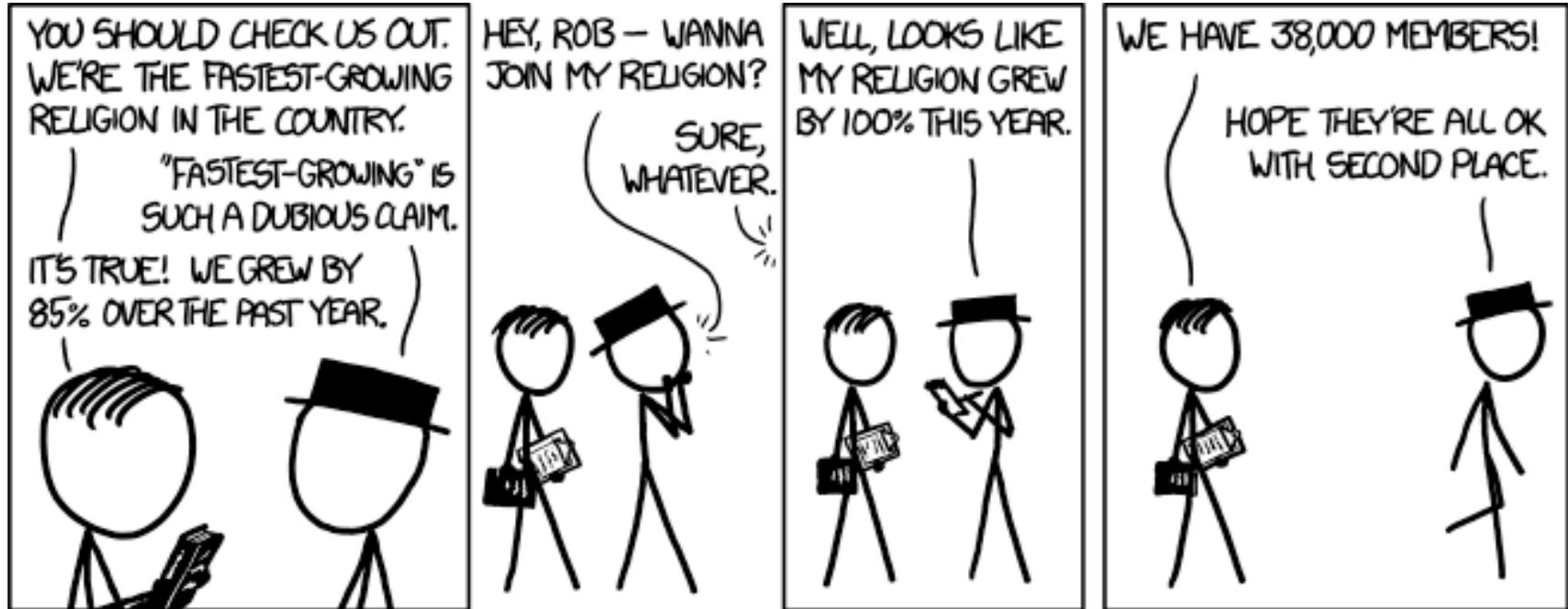
False in 2003.

For practical purposes, assume lettuce will not survive through January.

Abductive, Inductive, and Deductive Reasoning

Inductive

Be on the lookout for false claims of evidence or insufficient evidence.



Abductive, Inductive, and Deductive Reasoning

Deductive

Start with what you know.

Draw a conclusion.

Frost usually kills lettuce in January.

Lettuce takes 60 days to produce a crop.

Therefore, for reliable results, plant lettuce no later than October.

What is a Fallacy?

A fallacy is a defect in an argument where the conclusion is not supported by the propositions.

What is a Fallacy?

A fallacy is **a defect in an argument** where the conclusion is not supported by the propositions.

The Argument

Premise 1

Premise 2

...

Premise n

\therefore Conclusion

The Syllogism

Major Premise	Relate two argument components.
Minor Premise	Assert the value of a component from the major premise.
Conclusion	Derive some information about the second component.

Modus Ponens

If A then B

A

Therefore B

All humans are mortal.

Socrates is a human,

Therefore Socrates is mortal.

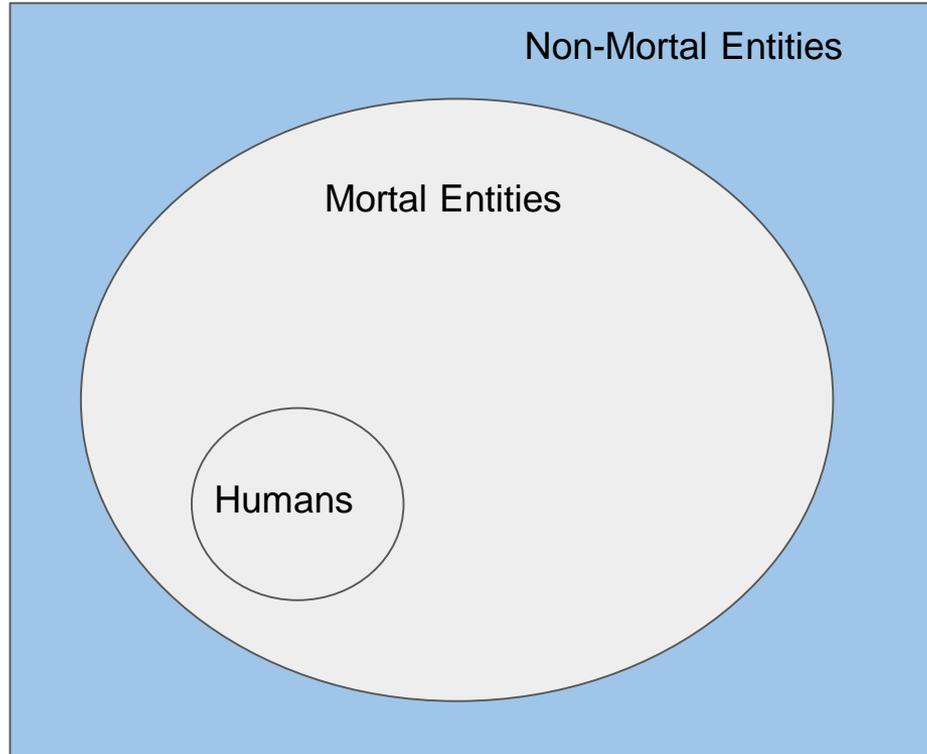
Syllogism Venn Diagrams

Modus Ponens

All humans are mortal.

Socrates is a human.

Therefore Socrates is mortal.



Modus Ponens Examples

If we've had at least 1 cm of rain in the past week, I don't need to water my garden.

We've had 1.3 cm of rain in the past week,

Therefore I don't need to water my garden.

Anyone who lies under oath in order to become a judge is not qualified to have the job.

Vicki lied under oath during her job interview,

Therefore Vicki is not qualified to be a judge.

Modus Tollens

If A then B

Not B

Therefore Not A

All humans are mortal.

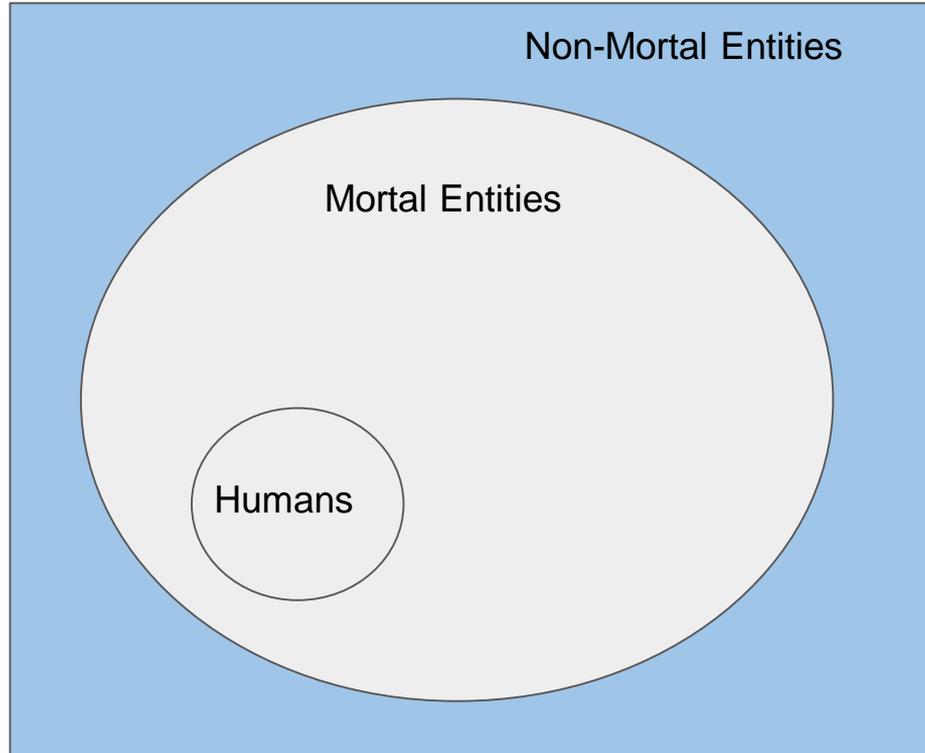
Socrates is not mortal,

Therefore Socrates is not a human.

Syllogism Venn Diagrams

Modus Tollens

All humans are mortal.
Socrates is not mortal.
Therefore Socrates is not
human.



Modus Tollens Common Mistake

If A then B

Not A

Therefore Not B

All humans are mortal.

Socrates is not human,

Therefore Socrates is not Mortal.

Modus Tollens Common Mistake

If A then B

Not A

Therefore

All humans are mortal

Socrates is not human

Therefore Socrates is not Mortal.

Socrates might be a cat, or an elephant, or a fish, or a mushroom, or a...

“False implies anything.”

Modus Tollens Examples

If we've had at least 1 cm of rain in the past week, I don't need to water my garden.

I need to water my garden,

Therefore we've had less than 1 cm of rain in the past week. ✓

Anyone who lies under oath in order to become a judge is not qualified to have the job.

Vicki is qualified to be a judge,

Therefore Vicki did not lie under oath. ✓

Modus Tollens Examples

If we've had at least 1 cm of rain in the past week, I don't need to water my garden.

I need to water my garden,

Therefore we've had less than 1 cm of rain in the past week. ✓

A : We've had at least 1 cm of rain in the past week.

B: I need to water my garden.

Anyone who lies under oath in order to become a judge is not qualified to have the job.

Vicki is qualified to be a judge,

Therefore Vicki did not lie under oath. ✓

A: A judicial candidate lies under oath under oath.

B: A judicial candidate is not qualified to be a judge.

Modus Tollens Examples

If we've had at least 1 cm of rain in the past week, I don't need to water my garden.

I need to water my garden,

Therefore we've had less than 1 cm of rain in the past week.

If we've had at least 1 cm of rain in the past week, I don't need to water my garden.

We haven't had 1 cm of rain in the past week,

Therefore I need to water my garden.

Anyone who lies under oath in order to become a judge is not qualified to have the job.

Vicki is qualified to be a judge,

Therefore Vicki did not lie under oath.

Anyone who lies under oath in order to become a judge is not qualified to have the job.

Vicki did not lie under oath,

Therefore Vicki is qualified to be a judge.

Modus Tollens Examples

If we've had at least 1 cm of rain in the past week, I don't need to water my garden.

I need to water my garden,

Therefore we've had less than 1 cm of rain in the past week.

If we've had at least 1 cm of rain in the past week, I don't need to water my garden.

We haven't had 1 cm of rain in the past week,

Therefore I need to water my garden.



Anyone who lies under oath in order to become a judge is not qualified to have the job.

Vicki is qualified to be a judge,

Therefore Vicki did not lie under oath.

Anyone who lies under oath in order to become a judge is not qualified to have the job.

Vicki did not lie under oath.

Therefore Vicki is qualified to be a judge.



Disjunctive Syllogism

Either A or B

Not A

Therefore B

Either Socrates is mortal or Socrates is not a man

Socrates is not mortal

Therefore Socrates is not a man

Syllogism Venn Diagrams

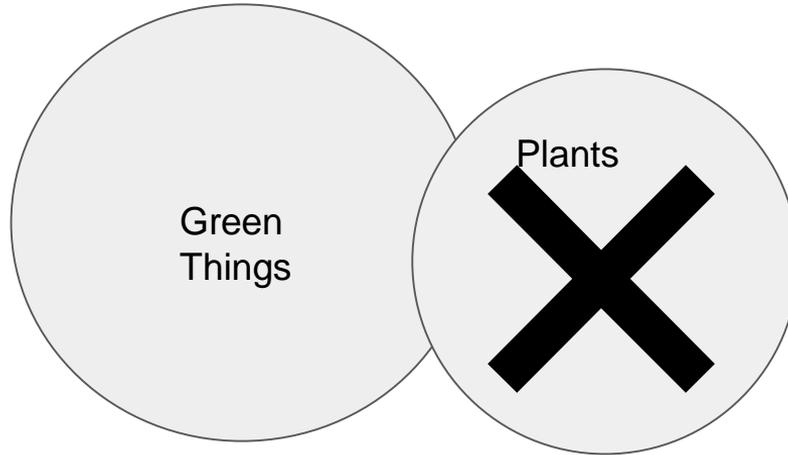
Disjunctive Syllogism

Socrates is either a plant or
is green.*

Socrates is not a plant.

Therefore Socrates is
green.

*Logical, not linguistic “or.”



Hypothetical Syllogism

If A then B

If B then C

Therefore if A then C

All humans are animals.

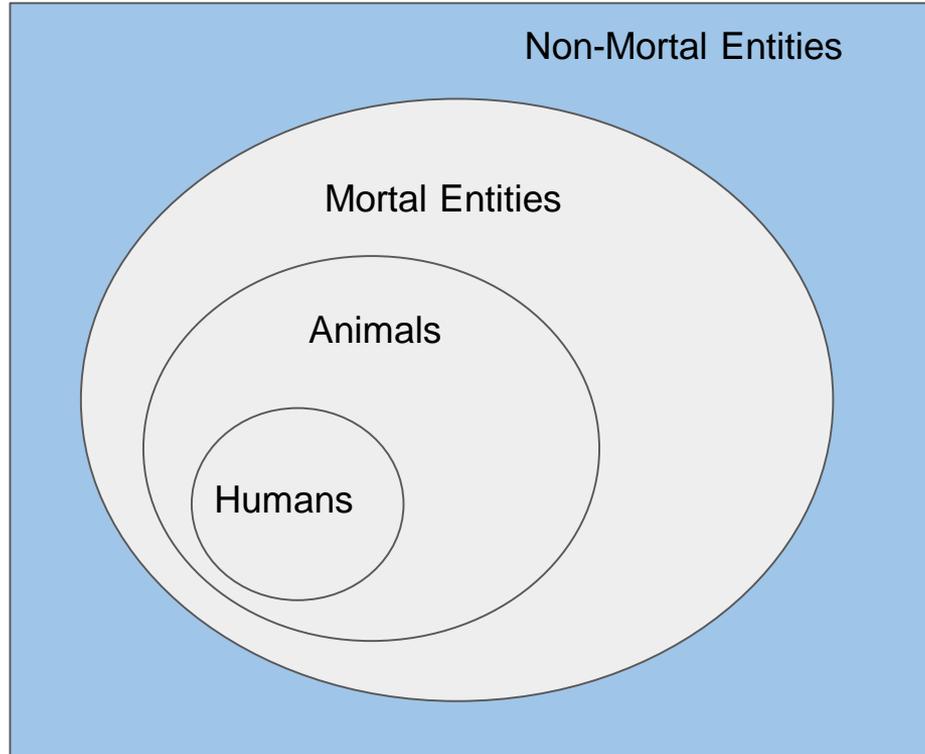
All animals are mortal,

Therefore all humans are mortal.

Syllogism Venn Diagrams

Hypothetical Syllogism

All humans are animals.
All animals are mortal
Therefore all humans are mortal.



“All Soldiers are brave;
Some Englishmen are brave.
∴ Some Englishmen are soldiers”

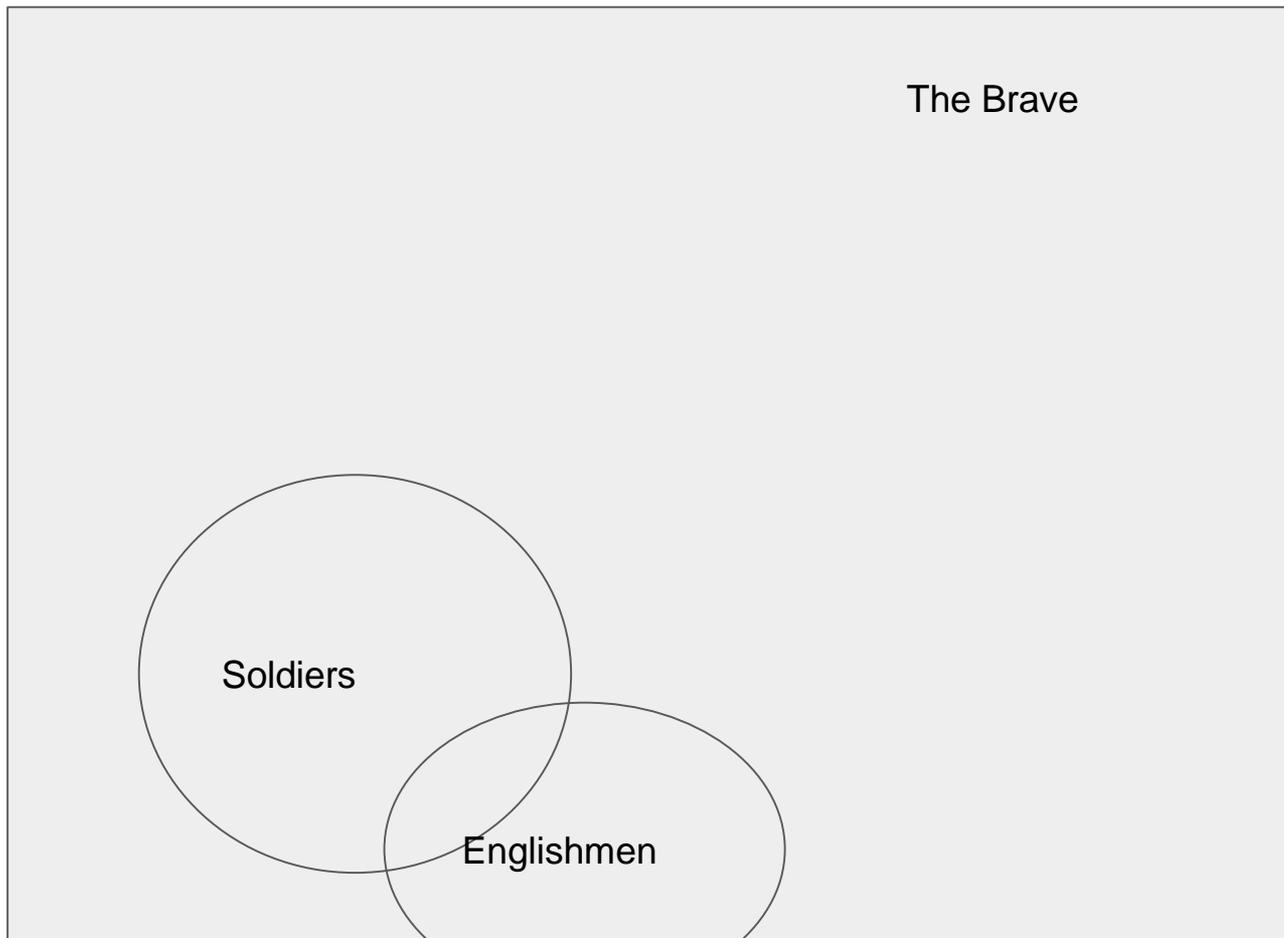
-Lewis Carroll, *The Game of Logic*

“All Soldiers are brave;
Some Englishmen are brave.
∴ Some Englishmen are soldiers”

“[The above] **looks** uncommonly like a Syllogism, and might easily take in a less experienced Logician. But **you** are not to be caught by such a trick!”

-Lewis Carroll, *The Game of Logic*

The not Brave



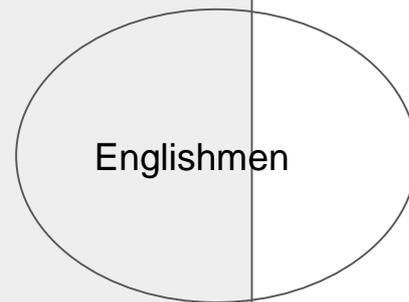
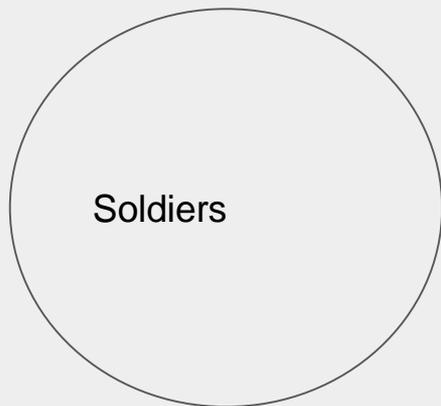
The Brave

Soldiers

Englishmen

The not Brave

The Brave



Soldiers

Englishmen

Not a Syllogism

If A then C

If B then C

Therefore if either A or B then C

If someone is a soldier or a brave Englishman, then that someone is brave,

Validity

An argument is valid if there is no way for the premises to be true and the conclusion false.

An argument is **invalid** if the premise(s) can be true and the conclusion false.

Invalid Arguments

If A then B

Not A

Therefore not B

All men are mortal

Socrates is not a man

Therefore Socrates is not mortal

Invalid Arguments

If A then B

B

Therefore A

All men are mortal

Socrates is mortal

Therefore Socrates is a man

Invalid Arguments

Freddy is a skin-head

Freddy is a Republican

Joe is a Republican

Therefore Joe is a skin-head

Freddy vilifies police officers

Freddy is a Democrat

Joe is a Democrat

Therefore Joe vilifies police officers

Valid Arguments

All unicorns have white fur.

Lorenzo is a Unicorn,

Therefore Lorenzo has white fur.

It doesn't matter if there are no unicorns. The argument is valid because there is no way for the premises to be true and the conclusion false.

Valid Arguments

All Republicans are skin-heads.

Joe is a Republican,

Therefore Joe is a skin-head.

All Democrats hate police officers.

Joe is a Democrat,

Therefore Joe hates police officers.

Soundness

An argument is sound if it is valid and the premises are true.

Unsound Arguments

All men are fish.

Socrates is a man.

Therefore Socrates is a fish.

Unsound Arguments

All men are fish.

Socrates is a man.

Therefore Socrates is a fish.

Valid

Unsound Arguments

All men are fish. **X**

Socrates is a man.

Therefore Socrates is a fish.

Valid

Unsound

Unsound Arguments

All unicorns have white fur.

Lorenzo is a Unicorn, **X**

Therefore Lorenzo has white fur.

Unsound Arguments

All Republicans are skin-heads. **X**

Joe is a Republican,

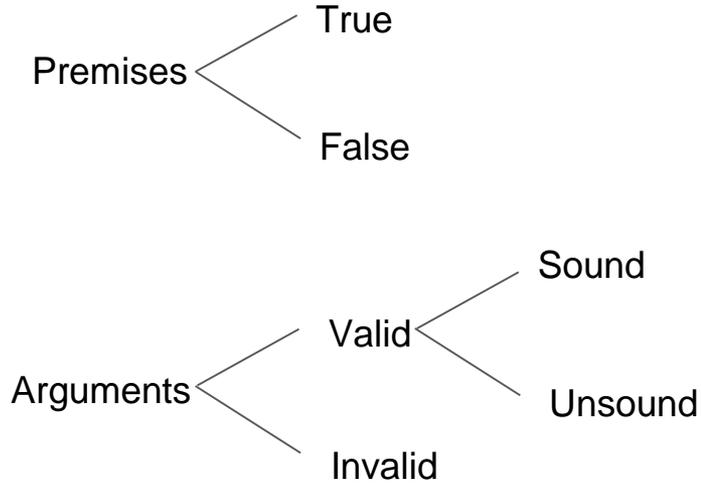
Therefore Joe is a skin-head.

All Democrats hate police officers. **X**

Joe is a Democrat,

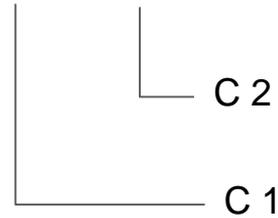
Therefore Joe hates police officers.

Terminology



Major Premise : defines a relationship between two distinct argument components.

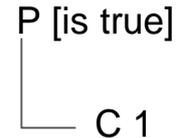
If P then Q



Relationship:

If...then
(Implication)

Minor Premise: provides information about one of the components from the major premise.



Some Important Logicians

Aristotle (385 BCE - 322 BCE)

Cantor (1845 - 1918)

Schröder (1841 - 1902)

Peano (1858 - 1932)

Whitehead (1861 - 1947)

Russell (1872 - 1970)

Stanford Encyclopedia of Philosophy. (April 2007 rev July 2016.) The Early Development of Set Theory. Retrieved in November 2019 from

<https://plato.stanford.edu/entries/settheory-early/#Emer>

Natural Language to Logical Argument

1. Determine whether an argument exists.
2. Decide what the argument is.
3. Fill in the missing statements.
4. Remove biased language.
5. Decide if the argument is valid - identify fallacies.
6. Decide if the argument is sound - assign truth values to the statements.
7. Then draw your conclusion.

Natural Language Example

“Choosy mothers choose Jiff.”

All good mothers are careful about what they feed their children.

Careful mothers feed their children the best peanut butter.

The best peanut butter is Jiff,

HS: Therefore all good mothers feed their children Jiff.

MP: If you are a good mother, then you must feed your children Jiff.

MT: If you don't feed your children Jiff, then you aren't a good mother.

Recognizing Arguments

85% of Democrats support a single-payer health-care system.

Over half of Republicans oppose a single-payer health-care system.

Recognizing Arguments

85% of Democrats support a single-payer health-care system.

Most Republicans oppose a single-payer health-care system.

These assertions may be true or false, but are not arguments.

Recognizing Arguments

Libtards want death panels.

Repuglicans think only the rich deserve health-care.

Recognizing Arguments

Libtards want death panels.

Repuglicans think only the rich deserve health-care.

These are arguments because the author wants you to conclude that “the other guy” is not looking out for your best interest.

Fill in the Missing Statements

Libtards want death panels.

Conclusion: Democrats will eliminate your health-care choices.

Premises:

- Democrats are mentally deficient.
- The Democratic party's health-care plan will necessitate panels that decide who will and will not receive treatment.
- Today's health-care system does not include panels that decide who and who will not receive treatment.
- Therefore, Democrats want to eliminate your health-care choices.

Fill in the Missing Statements

Repuglicans think only the rich deserve health-care.

Conclusion: Republicans will take away your health care.

Premises:

- Republicans are amoral hypocrites.
- The Republican party's health-care plan will take away health-care from anyone who isn't rich.
- You aren't rich.
- Therefore Republicans will take away your health-care.

Remove Biased Language

Libtards want death panels.

Conclusion: Democrats want to eliminate your health-care choices.

Premises:

- ~~— Democrats are mentally deficient.~~
- The Democratic party's health-care plan will necessitate committees to ~~decide who will and will not receive treatment~~ define treatment standards.
- Today's health-care system ~~does not include committees to decide who and who will not receive treatment~~ lets you and your doctor define treatment standards.
- Therefore, ~~Democrats want to eliminate your health-care choices~~ the Democratic party's health-care plan will take treatment decisions out of your hands and put them into the hands of a third-party committee.

Remove Biased Language

Repuglicans think only rich people should have health-care.

Conclusion: Republicans will take away your health-care..

Premises:

- ~~— Republicans are amoral hypocrites.~~
- The Republican party's health-care plan ~~will take away health-care from anyone who isn't rich.~~ requires individuals or employers to pay for health-care coverage. (Exceptions: Medicare, Medicaide, prisons)
- ~~— You aren't rich.~~ Most people, probably including you, will no longer be covered or won't be able to afford health-care under the Republican plan.
- Therefore Republicans will take away your health-care.

Establish Validity

The Democratic party's health-care plan will necessitate committees to define treatment standards.

Today's health-care system lets you and your doctor define treatment standards.

Therefore, the Democratic party's health-care plan will take treatment decisions out of your hands and put them into the hands of a third-party committee.

Is it valid?

Establish Validity

The Democratic party's health-care plan will necessitate committees to define treatment standards.

Today's health-care system lets you and your doctor define treatment standards.

Therefore, the Democratic party's health-care plan will take treatment decisions out of your hands and put them into the hands of a third-party committee.

Valid!

Establish Validity

The Republican party's health-care plan requires individuals or employers to pay for health-care coverage. (Exceptions: Medicare, Medicaid, prisons)

Most people, including you, won't be able to afford health-care under the Republican plan.

Therefore Republicans will take away your health-care.

Valid?

Establish Validity

The Republican party's health-care plan requires individuals or employers to pay for health-care coverage. (Exceptions: Medicare, Medicaid, prisons)

Most people, including you, won't be able to afford health-care under the Republican plan.

Therefore Republicans will take away your health-care.

Valid!

Establish Soundness

The Democratic party's health-care plan will necessitate committees to define treatment standards. ✓

Today's health-care system lets you and your doctor define treatment standards. ✗

Therefore, the Democratic party's health-care plan will take treatment decisions out of your hands and put them into the hands of a third-party committee.

Unsound!

The conclusion **may be true**, but is not supported by the argument.

Establish Soundness

The Republican party's health-care plan requires individuals or employers to pay for health-care coverage. (Exceptions: Medicare, Medicaid, prisons) ✓

Most people, including you, won't be able to afford health-care under the Republican plan. ✗

Therefore Republicans will take away your health-care.

Unsound!

The conclusion **may be true**, but is not supported by the argument.

Homework Examples

The Brexit slogan.

“We want our country back.”

The ‘Checkers’ speech.

<https://watergate.info/1952/09/23/nixon-checkers-speech.html>

List of Fallacies We Will Try to Discuss in Detail

- Ad Hominem
- Genetic Fallacy
- Appeal to Authority
- False Dilemma
- Unwarranted Generalization
- Fallacy of Composition
- Fallacy of Division
- Strawman
- Circular Argument
- Post Hoc
- Deflection
- Equivocation
- Weak Analogy
- Appeal to Ignorance
- Ad Populum
- Appeal to Pity