

HANDOUT #1 – ELEMENTS OF LOGIC – PROPOSITIONS, ARGUMENTS, VALIDITY

We begin our discussion of Symbolic Logic with a number of definitions.

Propositions

A **proposition** is a sentence (or something that is expressed by a sentence) that is capable of being true or false. These include sentences like the following:

John is tall.
There are 10, 234 trees in State College.
Socrates is Mortal.

Many types of things do not express propositions. For example:

Questions: Is John tall?
Exclamations: Woah!
Commands: Close the door.
Performative Utterances: ‘I do’ uttered on your wedding day.

It is important to note that in order for a sentence to express something that is capable of being evaluated as true or false, you do not need to know *whether* it is true or false. Someone might utter ‘There are 10, 234 trees in State College’, which is true or false, but might not know whether it is true or false.

Classroom Exercise: Proposition or Not a Proposition?

1. Be a yardstick of quality.
2. Don’t make friends with drug dealers.
3. How may I help you?
4. I know that God exists.
5. God does not exist.

Arguments & Arguing

An **argument** is a series of propositions in which a certain proposition (the conclusion) is represented as following from another set of propositions (the premises or assumptions). Here is an example:

1	All women are mortal.	Premise
2	Liz is a woman.	Premise
3	Therefore, Liz is mortal.	Conclusion

In the above example, we have a series of three propositions, (1) and (2) support (3). That is, the premises (1) and (2) support the conclusion (3).

Arguing and *arguments* differ in many important ways. When we are *arguing*, we usually are doing it with our friends, family, or strangers. Sometimes we may yell, roll our eyes in disbelief, or snicker in disgust. None of these features are a part of the definition of an argument,

which is highly circumscribed to how the content expressed by a set of propositions is used to support another proposition.

There are two ways to identify arguments

1. Identify certain key terms called “argument indicators” like ‘therefore,’ ‘in conclusion,’ ‘since,’ ‘it follows that’ that indicate the presence of an argument.
2. Determine whether one proposition (the conclusion) is claimed to logically follow from another set of propositions (the premises or an assumption)

1	Casper is friendly	Premise
2	If Casper is friendly, then at least one ghost is friendly.	Premise
3	Therefore, at least one ghost is friendly.	Conclusion (argument indicator ‘therefore’)

Classroom Exercise: Create Your Own Argument!

In a small group, create your own argument. Make sure you label the premises, the conclusion, and any terms that be considered argument indicators.

Deductive Validity

An argument is **deductively valid** if and only if it is logically impossible for the premises to be true *and* the conclusion false. Alternatively put, an argument that is **deductively valid** is one where it is necessarily the case that if the premises are true, then the conclusion is true. So, a valid argument that has all true premises *must* have a true conclusion.

A major confusion involved in understanding the concept of deductive validity is that people sometimes think that in order for an argument to be deductively valid, the premises and the conclusion must, in fact, be true. This is not the case for when we consider whether an argument is deductively valid, we don’t consider the actual truth or falsity of the premises but rather consider whether it is *logically impossible* for all of the premises to be true and the conclusion false. What this means then is that an argument can be deductively valid where the argument has:

- (i) *true* premises and a *true* conclusion
- (ii) *false* premises and a *true* conclusion.
- (iii) *false* premises and a *false* conclusion,

What cannot be the case is an argument that has *true* premises and a *false* conclusion. In fact, that scenario cannot even be possible.

To see this more clearly, consider that the propositions in an argument (the premises and the conclusion) *can be* true or false. Let’s represent some of these combinations as follows:

Premise	True	True	False	True	True	False
Premise	True	False	False	True	False	False
Conclusion	True	True	True	False	False	True
	1	2	3	4	5	6

An argument is deductively valid if and only if column (4) is *logically impossible*. That is, that (4) cannot occur.

To illustrate, consider the following argument:

- | | | |
|---|--|------------|
| 1 | Either Jennifer Lopez or Mario Lopez is the president of the United State of America (USA) | Premise |
| 2 | Mario Lopez is not the president of USA. | Premise |
| 3 | Therefore, Jennifer Lopez is the president of USA. | Conclusion |

Notice that premise (1) is false. It is not the case that either Jennifer Lopez or Mario Lopez is the president of the USA. Nevertheless, if the premises (1) and (2) were true, would the conclusion also be true? The answer is a resounding *Yes!* It is impossible for (1) and (2) to be true while (3) is false. That is, it is necessarily the case that if (1) and (2) are true, then (3) is true. Thus, the argument is *deductively valid*.

The reason that logicians are so interested in deductively valid arguments is that they are *truth-preserving!* That is, if the premises of a deductively valid argument are true, that fact guarantees that the conclusion is true. *This is amazing!* If you know that a set of propositions are true, provided you only put forward deductively valid arguments, you won't end up reasoning to something false.

Testing for Deductive Validity

We can propose a step-by-step procedure for testing arguments to see if they are deductively valid.

THE NEGATIVE TEST FOR VALIDITY	
1.	Is it possible for all of the premises to be true?
2.	If the answer to (1) is yes , then is it logically possible for all of the premises to be true and the conclusion false? If the answer to (1) is no , then the argument is valid.
3.	If the answer to (2) is yes , then the argument is not valid. If the answer to (2) is no , then the argument is valid.

Consider the argument considered earlier:

- | | | |
|---|--|------------|
| 1 | Either Jennifer Lopez or Mario Lopez is the president of the United State of America (USA) | Premise |
| 2 | Mario Lopez is not the president of USA. | Premise |
| 3 | Therefore, Jennifer Lopez is the president of USA. | Conclusion |

	QUESTION	ANSWER / RESULT
1.	Is it possible for all of the premises to be true?	Yes!
2.	If the answer to (1) is yes , then is it <i>necessary</i> that if the premises were true, the conclusion would also be true?	No!
3.	If the answer to (2) is yes , then the argument is not valid.	Valid

Let's consider another example

- | | | |
|---|---|------------|
| 1 | Some basketball players are millionaires. | Premise |
| 2 | Some millionaires have fancy cars. | Premise |
| 3 | Therefore, some basketball players have fancy cars. | Conclusion |

	QUESTION	ANSWER / RESULT
1.	Is it possible for all of the premises to be true?	Yes!
2.	If the answer to (1) is yes , then is it logically possible for all of the premises to be true and the conclusion false?	Yes!
3.	If the answer to (2) is yes , then the argument is not valid.	Not Valid!

It is logically possible for all of the premises to be true and the conclusion false because it is possible that basketball players do not have fancy cars, i.e., they may buy large homes and fancy jewelry but own modest cars.

Soundness

Finally, an argument is **sound** if and only if all of the premises are (in fact) true and it is deductively valid. In short, soundness = valid + all true premises. We won't be concerned with soundness in this course, but is important to know that *soundness* is a stronger notion than validity since an argument can be valid without being sound.

Classroom Exercises: Valid or Invalid?

1. All pigs fly. Babe is a pig. Therefore, Babe flies.
2. Some people are nice. Some people are mean. Therefore, some people are both nice and mean.
3. John eats brains if and only if John is a zombie. John is not a zombie. Therefore, John does not eat brains.
4. John is happy. Therefore, John is happy or hungry.
5. God exists or he doesn't. Well, I see no good reason for thinking God exists. Therefore, God doesn't exist.

Further Questions to Consider:

1. What does it mean to say that an argument is sound?
2. What does it mean for an argument to be deductively invalid?
3. What does it mean for a proposition to be a contradiction?
4. What does it mean to say that an argument is sound?
5. What does it mean to say that an argument is unsound (not sound)?
6. Is it possible for an argument to be valid, have true premises, and have a false conclusion?
7. Is it possible for an argument to be valid yet have false premises?
8. Is it possible for an argument to be valid, have one true premise and one false premise?
9. What types of sentences do not express propositions?