Handout (Week 1)

Natural Language Arguments

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Big-picture theme of the course: propositional logic is a theory of how we should reason (in certain situations).

Goals of this handout: explain what arguments are, what valid and sound arguments are, and give lots of examples.

1   Natural Language Arguments

1.1   Definitions

An *argument* is a sequence of two or more propositions.

- A *proposition* is, roughly, a sentence which can be either true or false. If a sentence can be either true or false, then I will say that the sentence is 'truth-evaluable': its truth value, that is, can be evaluated.

The *conclusion* of an argument is the last proposition in it.

A *premise* of an argument is a proposition which is not the conclusion.

1.2   Examples of Arguments and Non-Arguments

Here are some examples of arguments.

Argument
1. It is raining.
2. If it is raining, then there are clouds in the sky.
3. There are clouds in the sky.

Line 3 is the conclusion. Lines 1 and 2 are premises.

Argument

1. Either the final is on Thursday or the final is on Friday.
2. The final is not on Thursday.
3. The final is on Friday.

Argument

1. Pines grow in Washington.
2. Maples grow in New Jersey.
3. Cacti grow in Arizona.
4. Pines grow in Washington, maples grow in New Jersey, and cacti grow in Arizona.

Note that an argument can have any finite number of lines. In this course, I will focus on three-line arguments, because they are particularly simple and easy to discuss. But arguments can have four lines—like the above argument—or five lines, or more.

Here are some examples of non-arguments.

Non-Argument

1. Go to the store.
2. If it is raining, then there are clouds in the sky.
3. There are clouds in the sky.

This is not an argument because line 1 is not a proposition. To see why line 1 is not a proposition, just note that it cannot be either true or false. It is a command, and commands are not truth-evaluable.

Non-Argument

1. If it is raining, then there are clouds in the sky.
2. Should we go to the store?
3. There are clouds in the sky.

This is not an argument because line 2 is not a proposition. Line 2 is a question, and questions are not the sorts of things that can be either true or false.

Non-Argument

1. It is raining
2. If it is raining, then go to the store.
3. Go to the store.

This is not an argument. Neither line 2 nor line 3 are propositions.

Here are some more examples of arguments. They feel like non-arguments. But they are arguments nonetheless.

Argument
1. Green apples are sour.
2. Violets are blue.
3. It is hot in August.

Argument
1. If it rains, then I will get wet.
2. Oranges grow in Florida.
3. I will get wet.

Despite appearances, these are indeed arguments. For they are sequences of two or more propositions. They are just *bad* arguments; that is why they sound so odd. They are, in fact, arguments; they are just shitty ones. In the next section, I will discuss what makes some arguments good and other arguments bad.

2   Validity and Soundness

There are several ways in which an argument can be good. In this course, we will focus on two.
- *Valid* arguments: these arguments are good because they have a very nice form. The premises and the conclusion all 'fit' together. Later on, I will define this special kind of 'fit' more precisely.
- *Sound* arguments: these arguments are good because (i) they are valid, and (ii) they also have true premises. So these arguments have a nice form, but in addition, their premises are true.

2.1   Definitions

A *valid* argument is an argument with the following property: if the argument's premises are all true, then the argument's conclusion must also be true.
- In other words, in a valid argument, the truth of the premises <u>guarantees</u> the truth of the conclusion.
- This is what I meant earlier, when I wrote that in a valid argument, the premises and the conclusion all 'fit' together. They 'fit' together in the sense that the premises' truth guarantees the conclusion's truth.

An *invalid* argument is an argument which is not valid. So an argument is invalid just in case that argument's premises could all be true, and yet the conclusion could nonetheless, still, be false.

A *sound* argument is a valid argument with true premises.
- In other words, in order for an argument to be sound, it must be (i) valid, and (ii) have premises which are true.

An *unsound* argument is an argument which is not sound. So an argument is unsound just in case either (i) that argument is invalid, or (ii) at least one premise in that argument is false.

These are merely rough, first-pass, intuitive definitions. Later in this course, we will study definitions that are more precise. In fact, that is one of the main reasons why propositional logic is worth studying. Propositional logic has the resources to give an extremely precise definition of validity. And the formalism of propositional logic was designed, in large part, for that very purpose.

2.2   Examples

Here are some examples of valid, invalid, sound, and unsound arguments.

> Argument (valid, sound)
>   1. Either the final is on Thursday or the final is on Friday.
>   2. The final is not on Thursday.
>   3. The final is on Friday.

This argument should 'feel good' to you. For intuitively, it does seem to be the case that if both premises are true, then the conclusion must be true. So this argument is, intuitively, valid. In addition, both premises are true (check the syllabus for the date of the final). So this argument is sound.

> Argument (valid, might be sound)
>   1. It is raining.
>   2. If it is raining, then there are clouds in the sky.
>   3. There are clouds in the sky.

This argument should 'feel good' to you. For intuitively, it does seem to be the case that if both premises are true, then the conclusion must be true. So this argument is, intuitively, valid. The second premise expresses a simple fact about how weather works: so it is true. The first premise may or may not be true: it depends, of course, on whether it is actually

raining. So this argument may or may not be sound.

Argument (not valid, so not sound)
1. Either the final is on Thursday or the final is on Friday.
2. The final is on Thursday.
3. The final is on Friday.

Here is why the argument above is not valid: there is a way for the premises to be true without the conclusion also being true. To see how, suppose that the final is on Thursday and not on Friday. That certainly seems possible. And if that is the case, then obviously, line 2 is true. Line 1 is true as well: if the final is indeed on Thursday, then obviously, it is true that either the final is on Thursday or the final is on Friday. But line 3 is false: the final is not on Friday. So both of the premises are true, and yet the conclusion is not. And so the truth of the premises does <u>not</u> guarantee the truth of the conclusion.

Argument (valid, sound)
1. Pines grow in Washington.
2. Maples grow in New Jersey.
3. Pines grow in Washington and maples grow in New Jersey.

Argument (not valid, so not sound)
1. If it rains, then the ground will get wet.
2. Oranges grow in Florida.
3. The ground will get wet.

Here is why the above argument is not valid: the premises could both be true without the conclusion also being true. In particular, suppose that it does not rain, and the ground remains dry. Then line 1 is true: for <u>if</u> it rained, then the ground would get wet. And line 2 is true as well: oranges do, indeed, grow in Florida. But the ground is not wet; so the conclusion is false.

Non-Argument (not an argument, so not valid, and so not sound)
1. Go to the store.
2. If it is raining, then there are clouds in the sky.
3. There are clouds in the sky.

This is not an argument. So by the definitions given above, this is not a valid argument, and this is not a sound argument.

Argument (valid, but not sound)
1. If Earth has two moons, then Earth has the same number of moons as Mars.
2. Earth has two moons.
3. Earth has the same number of moons as Mars.

This argument is valid. If both premises are true, then clearly, the conclusion must be true. But in fact, both premises are <u>not</u> true. Line 2 is false: Earth has one moon, not two. So this argument is not sound.

2.3   Colloquial Examples

The above examples of arguments probably seem pretty artificial. Usually, when we give arguments in everyday life, we do not number the premises and the conclusion. We sort of 'smoosh' it all together, into a single paragraph.

Here are some examples of arguments like that. I will call these 'colloquial' arguments: they are expressed colloquially, in a kind of unpretentious, uncomplicated, familiar, everyday sort of way.

- Look outside: it's pouring down there. You better take an umbrella. Why? Well, if you don't, you'll get drenched. And of course, you don't want that.
- Millions of people are starving. You're not: you've got more than enough to survive. So you should give as much money as possible to charity.

At the end of this course, we will learn how to transform 'colloquial' arguments like these into arguments which—like the majority of the arguments on this handout—have numbered premises.

In the meantime, I will continue to focus on arguments in which the premises and the conclusion are all numbered; call these 'numbered-premise' arguments. I focus on numbered-premise arguments because they are extremely clear: in a numbered-premise argument, it is obvious which propositions are premises and which proposition is the conclusion. That is less obvious in colloquial arguments: it often takes work to extract the premises and the conclusion from arguments written in a more colloquial form. So in order to be simple and clear, this course will primarily focus on arguments which have been written in numbered-premise format.