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LESSON PLAN



INSTYTUT
RÓZDZIĘNSKIEGO



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01 LOGIC



1.1

MATERIAL IMPLICATION AND LOGICAL INFERENCE

What is logic? Use the Wason selection task (four card problem) as an introductory example. Compare it to the same problem stated with drinks and ages. Describe connection between invalid argumentation and logic and polarisation as a lack of proper communication. Examples of statements in first-order logic. Show examples on Venn diagrams:

- "Robert is a human"
- "Ana is a doctor"
- "Alice is a human and Alice is a doctor"
- "Mimi is not a doctor"
- "Luka is a human and Luka is not a doctor"
- "Ivan is a doctor or a fish"
- "Jake is a not a human and Jake is a doctor or a fish." (In this case Jake can be both a fish and a human simultaneously. This is not relevant to the logical content of the statement and may well be true in some fictional world.)
- "Jake is a doctor and Jake is not a human or a fish." (ORDER OF OPERATIONS MATTERS)

On the examples above explain logical operators and their order (NOT, AND, OR). Explain how these operators logically connect sentences. Show what these operators can look like in natural language and some of the hidden subtleties of logical statement in natural language ("if then", "only if", "or" vs. "either or", implied order of operations, vacuous truths, etc.).

Can someone be a doctor, but not a human? Or both a fish and a human? Formally yes, this is not a problem in logic. After all, we may as well be talking about a fiction novel. To talk about the real world we must add well-accepted assumptions such as "If someone is a doctor then they are a human" or "A fish cannot be a doctor" because it is true in the real world.

Describe what is material implication.

Examples of material implication:

- "If Robert is a human then Robert is a doctor"
- "If Robert eats chocolate then Robert will be happy"
- "If it is raining outside then the grass is wet."
- "If the grass is wet then it is raining outside." (Is it? Put in a real-world context.)

Logical statements have a truth value. They are either true or false. They cannot be in between. Try to find the truth value of the above four statement in relation to the real world as an example. Describe the basic modus poens argument and the modus tollens contraposition and connect it to the introductory example with cards. Show how vacuous truths are counter-intuitive.



EXERCISE 1:

True statements
(axioms):

- John is the son of Marco.
- Emily is Eva's mother.
- Eva is John's sister,
- John is Lea's brother.
- Fred is Emily's brother..

Are the following logical statements true or false assuming the axioms above are true?

- Lea is the daughter of Emily.
- Eva and Lea are siblings.
- Fred and Eva are siblings.
- Fred is John's uncle.
- Marco is Fred's uncle.
- Emily is not the mother of Lea or John is Fred's nephew.
- John is Emily's son and Eva is Marco's son and Marco is not Fred's brother.

1.2 QUANTIFIERS

Explain the universal and existential quantifier. Show examples of quantifiers:

- Every Polish gnome is short.
- There exists a Polish gnome who wears a green hat.
- All penguins live on Antarctica.
- There is at least one penguin who lives in Germany.

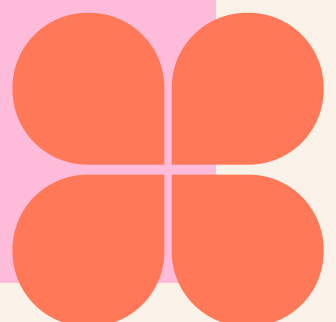
1.3 NEGATIONS

What is a negation? The difference between a contradictory statement and a negative statement. Describe on the below examples how to negate sentences and the rules for negating AND/OR (De Morgan's laws, OR and AND are opposites). Explain the rules for negating quantifiers (universal and existential are opposites). Explain the rules for negating implications and it's importance for constructing counter-arguments. Explain how the negation of the statement always has the opposite truth value to the original.

EXERCISE 2:

Marco likes ice cream.

- Poland is in Europe.
- All sheep are cute.
- There exists a drink that Mia likes.
- If Boris says he will do something, he will do it for sure.
- Luka is taller than Marco and Fred.
- If a number is even, then it is divisible by two. (CAREFUL HERE)
- Every Polish gnome that is tall wears a red hat.
- I like Katowice or I dislike Warsaw.
- Every participant in this project is not sad and likes cheese.
- X is true.
- X and Y is true.
- X or Y is true.
- If X then Y is true.



02 & 03 ARGUMENTATION AND ENTHYMEMES

What is an argument?

Argument in basic terms consists of premises, the conclusion and logical steps that show the conclusion logically follows from the premises. Show the three examples below:

p1. All Polish gnomes can run.
p2. Pete is a Polish gnome.

c. Pete can run.

p1. Many Polish gnomes can fly.
p2. Ella is a Polish gnome.

c. Ella can fly.

I shouldn't eat peanuts because I am allergic to peanuts and people should not eat food they are allergic to.

What makes an argument valid? Why is first of the above valid and the second is not? Deconstruct the third natural-language argument into its premises and its conclusion and talk about if it follows or not. It does not follow because there is a missing premise "I am a person". After all, the subject could be a fictional talking cat or otherwise not a person. Talk about enthymemes, hidden premises and how we naturally assume some common knowledge premises. Talk about how we should always find all the premises and verify if the conclusion actually logically follows.

NEXT EXAMPLE:

All fish can breathe under water. Therefore sharks can breathe underwater.

Is this a valid argument? Why or why not? There is a common-sense premise missing: sharks are fish. This kind of information can commonly be omitted when talking to people and we have to reconstruct the missing information to be able to know what is the underlying argument so we can analyze it and possibly attack it.

NEXT EXAMPLE:



Animals in a zoo are more free than in nature because there are no predators to kill them.

Is this a valid argument? What are the premises and what premises are implied? What can we learn about the person who is making this argument and how can we attack them? In this case there are two hidden premises. The first one is "There exist predators in nature", which is a common-knowledge hidden premise, but is still worth mentioning in the context of constructing a valid argument. The second is "If there are no predators to kill an animal, then they are more free than if there were predators to kill them". With these two premises being true, and the explicitly stated ones as well, the argument logically follows. However, we may raise questions of the validity of the second hidden premise. It shows a non-standard definition of the word "freedom" and is therefore subject to an attack. The correct way to counter this argument is to question this premise, why is it true? Does it reflect well on the standard definition of the word "free"? Instead, many people do not attack this hidden premise and may continue talking without mentioning it, which is bad because in the natural flow of the conversation it will lead to us talking as if we have accepted this hidden premise and may lead to us losing the argument.



04 FALLACIES

Show examples and demonstrate common logical fallacies: irrelevance/strawman fallacy, middle ground fallacy, black or white fallacy, slippery slope fallacy, appeal to nature, begging the question and others: <https://yourlogicalfallacyis.com/>



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