Deductive arguments & Deductive fallacies

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Deductive arguments

• An **argument** aims at proving (or disproving) a certain conclusion (C) on the basis of premises (P1..Pn) and recognized rules of inference (deductive, inductive, abductive)

• —> Deductive rules of inference

• A **deductive argument** aims at proving (or disproving) a certain conclusion (C) on the basis of premises (P1..Pn) and **deductive rules of inference**
Deductive arguments

• **Valid arguments**
  • If premises are true, then the conclusion is necessarily true

• **Sound arguments**
  • Valid arguments with true and justified premises

• **Good arguments**
  • Valid and sound arguments, whose premises are psychologically persuasive and pragmatically interesting
Deductive arguments

- **Valid arguments**
  - If bananas are blue, then donkeys fly; bananas are blue; therefore, donkeys fly [NB: an argument may be valid even if one or more of its premises is false]

- **Sound arguments**
  - If bananas are yellow, then they are not blue; bananas are yellow; therefore, banana are not blue

- **Good arguments**
  - If bananas are yellow, then they reflect light on a frequency of 520 hz; bananas are yellow; therefore, they reflect light on a frequency of 520 hz
Deductive arguments

• **Validity vs truth**

• A deductive argument is *valid* when it succeeds in linking, with logical necessity, the conclusion to its premises.

  • Therefore, validity can never apply to any single proposition by itself, because the needed relation cannot possibly be found within any one proposition.

• **Structure, syntax**

• **Truth and falsehood**, on the other hand, are attributes of individual propositions (premises and conclusion of the argument).

  • Therefore, truth and falsehood can never apply to the whole argument.

• **Content, semantics**
Deductive arguments

• If a deductive argument is valid, no additional premises can make it “more” valid, that is, can possibly add to the strength of that argument;

• Deductive arguments cannot become better or worse: they either succeed (valid) or they do not succeed (invalid) in exhibiting a compelling relation between premises and conclusion.

• (This is not true of inductive arguments).
Deductive arguments

• **Main characteristic of DA**

• Even if many deductive arguments go from general statements to particular ones, this is not always true (and it is not the right way to characterize deductive arguments);

• Deductive arguments are characterized by the fact that the conclusion necessarily follows from the premises.
Deductive arguments

• **Disjunction (disjunctive syllogism)**

  • A or B; not A. Therefore, B

    • The killer must be either the brother or the butler; the brother has an alibi; Therefore, the killer must be the butler

• **N.B.** A and B must be the only two viable alternatives (either A or B).
Deductive arguments

• **Modus ponens**

• If A then B; A. Therefore, B

  • If you have the license, then you are at least 18yo; You do have the license. Therefore, you are at least 18yo.
Deductive arguments

• **Modus tollens**

• If A then B; nonB. Therefore, nonA
  
  • If you have the license, then you are at least 18yo; You are not 18yo yet. Therefore, you do not have the license.
Remind!

• **Necessary vs sufficient conditions**
  
  • “If you have the license, then you must be over 18”

• Necessary condition

• Sufficient condition
Remind!

- **Necessary vs sufficient conditions**

  - “If you have the license, then you must be over 18”

  - **Necessary condition**
    - Being over 18 (it is necessary for having the license)

  - **Sufficient condition**
    - Having the license (it is sufficient for being over 18)
Deductive arguments

• (Pure) hypothetical syllogism

• If A then B; if B then C. Therefore, if A then C

• If a creature has a mind, then it has a brain; if a creature has a brain, then it is a physical creature. Therefore, if a creature has a mind, then it is a physical creature.
Deductive arguments

- **Categorical syllogisms**

- A deductive argument with two premises and a conclusion

- Premises and conclusions are categorical statements

  - (A) All X are Y; (I) Some X are Y; (E) No X are Y; (O) Some X are not Y

- It contain three terms: the **major** term (P, it occurs in the first premise and is the predicate of the conclusion), the **minor** term (S, it occurs in the second premise and is the subject of the conclusion); the **middle** term (M, it occurs in both premises, not in the conclusion)
Deductive arguments

- **Categorical syllogisms**
  - Mood: it is determined by the types of propositions (A, E, I, O)
    - AAA, EAE, AII,…
  - Figure: it is determined by the position of the middle term
    - 1st: M–P, S–M, therefore S–P.
    - 2nd: P–M, S–M, therefore S–P.
    - 3rd: M–P, M–S, therefore S–P.
    - 4th: P–M, M–S, therefore S–P.
Deductive arguments

• **Syllogisms**

  • (AAA-1) All M are P; All S are M; Therefore, all S are P
    
    • All mammals are mortals; All humans are mammals; Therefore, all humans are mortals.

  • (All-1) All M are P; Some S are M; Therefore, some S are P
    
    • All humans are mortals; Socrate is a human; Therefore, Socrate is mortal.

  • (EAE-2) No P are M; All S are M; Therefore no S are P
    
    • No cocker spaniel is a cat; All persian longhair are cats; Therefore, no persian longhair is a cocker spaniel

  • ....
Deductive fallacies

• Validity is a matter of form, not content; it has nothing to do with the truth of any of the statements in the argument.

• An argument is valid iff, when the evidence is true, the claim must be true. The necessity of this relationship allows us to say that the claim follows from the evidence.

• An argument is invalid if it fails to follow the rules for a particular pattern of inference.

• Deductive fallacies seem deductive arguments (they have a similar structure), but the conclusion DOES NOT necessarily follows from the premises.
Deductive fallacies

- **Affirming the disjunct**
  - A or B; A (B). Therefore, not B (A)
    - The killer must be either the brother or the butler; the brother has confessed; Therefore, the killer cannot be the butler
  - **N.B.** This is when the “or” is not explicitly defined as being exclusive (e.g., heads or tails)
Deductive fallacies

- **Affirming the consequent**

  - If A then B; B. Therefore, A

  - If taxes were lowered, I will have more money to spend; I have more money to spend; Therefore, taxes have been lowered.

- **N.B.** This fallacy has the same structure of abductive reasoning or the inference to the best explanation (which are kinds of inductive arguments), as well as the confirmation bias.
Deductive fallacies

• **Denying the antecedent**

• If A then B; not A. Therefore, not B

  • If I were you, I would go to the party; I am not you. Therefore, I won’t go to the party.
Deductive fallacies

• **Invalid syllogisms (syllogistic fallacies)**

• Some P is M; Some M is S; Therefore, some S is P

  • Some cats are tigers. Some tigers are yellow-striped. Therefore, some yellow-striped are cats.

  • Analogy: Some women are Americans. Some Americans are men. Therefore, some men are women.
Fallacies vs heuristics

- Fallacies are somehow similar to **cognitive biases and heuristics**, that is, mental shortcuts (Daniel Kahneman and Amos Tversky), as they both deal with errors in reasoning.

- However, **fallacies require an argument** whereas cognitive biases and heuristics refer to our default pattern of thinking.

- Cognitive biases are largely unconscious processes that bypass reason; however, the exercise of consciously evaluating an argument can counteract the bias.
Deductive fallacies vs heuristics

• **Example 1 (selection task):**

• Each card has a letter on one side, and a number on the other.

• Which card(s) must be turned over to test the idea that

  • if a card shows a vowel on one face, then its opposite face shows an even number?
Deductive fallacies vs heuristics

- **Example 1**

  - In Italy, the legal drinking age is 18

  - Which card(s) must be turned over to test the rule that

    - “If you are drinking alcohol, then you must be over 18”
Deductive fallacies vs heuristics

- Example 1:
  - Which card(s) must be turned over to test the idea that
    - if a card shows a vowel on one face, then its opposite face shows an even number?

- **Confirmation bias**: the tendency to search for information that confirms one's preexisting hypothesis.

- **Affirming the consequent**: If A then B; B. Then, A
Deductive fallacies vs heuristics

- **Example 1:**
  - Which card(s) must be turned over to test the idea that
    - if a card shows a vowel on one face, then its opposite face shows an even number?
  - However, we have to search for information that could disconfirm one's preexisting hypothesis.

- **Modus tollens:** If A then B; not B. Then, not A
Deductive fallacies vs heuristics

• **Example 2***

• Which card(s) must be turned over to test the rule that

• “If you are drinking alcohol, then you must be over 18”

• **No confirmation bias**: when we are presented with a rule, we already have the tendency to search for information that could disconfirm the rule, and thus the confirmation bias is weaker.

![Diagram with cards labeled 15, 25, BEER, COKE](image-url)
Deductive fallacies vs heuristics

• **Example 2:**

  • **Bandwagon effect:** the tendency to believe things because many other people believe them (cognitive bias, heuristic)

  • **Appeal to popularity/majority:** using the popularity of a premise or proposition as evidence for its truthfulness.

    • The appeal to popularity is a fallacy because it applies to an argument.
Recap

- **Deductive arguments**
  - Disjunctive syllogism
  - Modus ponens
  - Modus tollens
  - (Pure) hypothetical syllogism
  - Categorical syllogism

- **Deductive fallacies**
  - Affirming the disjunct
  - Affirming the consequent
  - Denying the antecedent
  - Invalid syllogisms (syllogistic fallacies)
Example

• If a man could not have done otherwise than he in fact did, then he is not responsible for his action. But if determinism is true, it is true of every action that the agent could not have done otherwise. Therefore, if determinism is true, no one is ever responsible for what he does.

• —Winston Nesbit and Stewart Candlish, “Determinism and the Ability to Do Otherwise,” Mind, July 1978
Example

• **If** a man could not have done otherwise than he in fact did, **then** he is not responsible for his action.

• But **if** determinism is true, **(then)** it is true of every action that the agent could not have done otherwise.

• **Therefore**, **if** determinism is true, **(then)** no one is ever responsible for what he does.
Example

• If a man could not have done otherwise than he in fact did, then he is not responsible for his action.

• But if determinism is true, (then) it is true of every action that the agent could not have done otherwise.

• Therefore, if determinism is true, (then) no one is ever responsible for what he does.
Example

• If a man could not have done otherwise than he in fact did, then he is not responsible for his action.

• But if determinism is true, (then) it is true of every action that the agent could not have done otherwise.

• Therefore, if determinism is true, (then) no one is ever responsible for what he does.
Example

- But **if** determinism is true, *(then)* it is true of every action that the agent could not have done otherwise.

- **If** it is true of every action that the agent could not have done otherwise, **then** no one is ever responsible for what he does.

- **Therefore**, **if** determinism is true, *(then)* no one is ever responsible for what he does.

- Pure hypothetical syllogism, valid.
• 1.

• If each man had a definite set of rules of conduct by which he regulated his life he would be no better than a machine. But there are no such rules, so men cannot be machines.
2. If the second native told the truth, then the first native denied being a politician. If the third native told the truth, then the first native denied being a politician. Therefore if the second native told the truth, then the third native told the truth.
3. If the one-eyed prisoner does not know the color of the hat on his own head, then the blind prisoner cannot have on a red hat. The one-eyed prisoner does not know the color of the hat on his own head. Therefore the blind prisoner cannot have on a red hat.
• 4.

• I have already said that he must have gone to King’s Pyland or to Capleton. He is not at King’s Pyland, therefore he is at Capleton. —Arthur Conan Doyle, The Adventure of Silver Blaze
• 5.

• It is clear that we mean something, and something different in each case, by such words [as substance, cause, change, etc.]. If we did not we could not use them consistently, and it is obvious that on the whole we do consistently apply and withhold such names.
—C. D. Broad, Scientific Thought, 1923
6. Total pacifism might be a good principle if everyone were to follow it. But not everyone does, so it isn’t. — Gilbert Harman, The Nature Of Morality, 1977
Exercises
Mankind, he said, judging by their neglect of him, have never, as I think, at all understood the power of Love. For if they had understood him they would surely have built noble temples and altars, and offered solemn sacrifices in his honor; but this is not done. —Plato, Symposium

If then, it is agreed that things are either the result of coincidence or for an end, and that these cannot be the result of coincidence or spontaneity, it follows that they must be for an end. —Aristotle, Physics

There is no case known (neither is it, indeed, possible) in which a thing is found to be the efficient cause of itself; for in such a case it would be prior to itself, which is impossible. —Thomas Aquinas, Summa Theologiae, I, question 2, article 3

Either wealth is an evil or wealth is a good; but wealth is not an evil; therefore wealth is a good.
—Sextus Empiricus, Against the Logicians, second century CE

I do know that this pencil exists; but I could not know this, if Hume's principles were true; therefore, Hume's principles, one or both of them, are false.

If number were an idea, then arithmetic would be psychology. But arithmetic is no more psychology than, say, astronomy is. Astronomy is concerned, not with ideas of the planets, but with the planets themselves, and by the same token the objects of arithmetic are not ideas either.
—Gottlob Frege, The Foundations of Arithmetic, 1893

... If a mental state is to be identical with a physical state, the two must share all properties in common. But there is one property, spatial localizability, that is not so shared; that is, physical states and events are located in space, whereas mental events and states are not. Hence, mental events and states are different from physical ones.

When we regard a man as morally responsible for an act, we regard him as a legitimate object of moral praise or blame in respect of it. But it seems plain that a man cannot be a legitimate object of moral praise or blame for an act unless in willing the act he is in some important sense a “free” agent. Evidently free will in some sense, therefore, is a precondition of moral responsibility.
—C. Arthur Campbell, In Defence of Free Will, 1938