

Logic in computer Science

Logical Fallacies

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Philosophical logic

- It is the investigation, critical analysis and intellectual reflection on issues arising in logic and is the branch of studying questions about reference, predication, identity, truth, quantification, existence, entailment, modality, and necessity.

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Logical Fallacies

Logical fallacies are flaws in reasoning that lead to faulty, illogical statements. They are unreasonable argumentative tactics named for what has gone wrong during the reasoning process.



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Two Types of Fallacies

- **Formal Fallacy**, also called deductive fallacy, logical fallacy, non sequitur (Latin for “it does not follow”).
 - Sequitur: the conclusion of an inference
 - This is a pattern of reasoning rendered invalid by a flaw in its logical structure.
 - Example:
 - Premise: My car is some car.
 - Premise: Some cars are red.
 - Conclusion: My car is red.
- **Informal Fallacy**, the error cannot be expressed in a formal logic.

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Formal Fallacies

Five types of Formal Fallacies:

- Affirming the consequent.
- Denying the antecedent.
- Affirming a disjunct.
- Denying a conjunct.
- Undistributed middle.

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Formal Fallacies

- **Affirming the consequent.** Any argument with the invalid structure of: If A then B. B is true, therefore A is true.
 - **Example.** If I get a B on the test, then I will get the degree. I got the degree, so it follows that I must have received a B. In fact, I got an A.

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Formal Fallacies

- **Affirming the consequent.**
- **Denying the antecedent.** Any argument with the invalid structure of: If A then B. A is false, therefore B is false.
 - **Example.** If it's a dog then it's a mammal. It's not a dog, so it must not be a mammal. In fact, it's a cat.

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Formal Fallacies

- **Affirming the consequent.**
- **Denying the antecedent.**
- **Affirming a disjunct.** Any argument with the invalid structure of: A or B are true. A is true, therefore, B is false.
 - **Example.** I am working or I am at home. I am working, so I must not be at home. In fact, I am working at home.

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Formal Fallacies

- **Affirming the consequent.**
- **Denying the antecedent.**
- **Affirming a disjunct.**
- **Denying a conjunct.** Any argument with the invalid structure of: It is not the case that both A and B. A is false, therefore B is true.
 - **Example.** I cannot be both at work and at home. I am not at work, so I must be at home. In fact, I am at a park.

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Formal Fallacies

- **Affirming the consequent.**
- **Denying the antecedent.**
- **Affirming a disjunct.**
- **Denying a conjunct.**
- **Undistributed middle.** Any argument with the invalid structure of: Every A has B. C has B, so C is A.
 - **Example.** Every bird has a beak. That creature has a beak, so that creature must be a bird. In fact, the creature is a dinosaur.

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Informal Fallacies

There are more informal fallacies than formal ones and they are divided into four groups:

- fallacies of improper premises;
- fallacies of faulty generalizations;
- fallacies of questionable cause; and
- relevance fallacies.

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Group 1: Improper Premises

Three types of logical fallacies in this group:

- **Begging the question.**
- **Circular reasoning.**
- **Fallacy of many questions.**

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Group 1: Improper Premises

- **Begging the question.** Providing what is essentially the conclusion of the argument as a premise.
 - **Example:** Everyone wants the new iPhone because it is the hottest new gadget on the market!

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Group 1: Improper Premises

- **Begging the question.**
- **Circular reasoning.** The reasoner begins with what he or she is trying to end up with.
 - **Example:** You must obey the law, because it's illegal to break the law.

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Group 1: Improper Premises

- **Begging the question.**
- **Circular reasoning.**
- **Fallacy of many questions.** Someone asks a question that presupposes something that has not been proven or accepted by all the people involved.
 - **Example:** "Who is the King of France?"

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Group 2: Faulty Generalizations

Five types of logical fallacies in this group:

- **Accident.**
- **Cherry picking.**
- **Weak Analogy.**
- **Hasty generalization.**
- **Misleading vividness.**

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Group 2: Faulty Generalizations

- **Accident.** An exception to a generalization is ignored.
 - **Example:** Cutting people with knives is a crime. Surgeons cut people with knives. Therefore, surgeons are criminals.

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Group 2: Faulty Generalizations

- **Accident.**
- **Cherry picking.** Only select favor evidence in order to persuade the audience to accept a position, and evidence that would go against the position is withheld
 - **Example:** My political candidate gives 10% of his income to the needy, and volunteers one day a week at a homeless shelter. Therefore, he is honest and morally straight.

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Group 2: Faulty Generalizations

- **Accident.**
- **Cherry picking.**
- **Weak Analogy.** The analogy is poorly suited.
 - **Example:** To say humans are immortal is like saying a car can run forever.

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Group 2: Faulty Generalizations

- **Accident.**
- **Cherry picking.**
- **Weak Analogy.**
- **Hasty generalization.** Basing a broad conclusion on a small sample or the making of a determination without all of the information required to do so.
 - **Example:** You send a message to back home that everyone in this new country is rude, because the first person you meet in the airport is rude.

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Group 2: Faulty Generalizations

- **Accident.**
- **Cherry picking.**
- **Weak Analogy.**
- **Hasty generalization.**
- **Misleading vividness.** Describing an occurrence in vivid detail, even if it is an exceptional occurrence.
 - **Example:** We have had four days of temperatures that were 100 degrees or more! Global warming is getting dramatically worse!

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Group 3: Questionable Cause

Five types of logical fallacies in this group:

- **Faulty cause/effect.**
- **Complex cause.**
- **Furtive fallacy.**
- **Gambler's fallacy.**
- **Slippery slope.**

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Group 3: Questionable Cause

- **Faulty cause/effect.** A false cause/effect fallacy occurs when one cites to sequential events as evidence that the first caused the second.
 - **Example:** Every day, I eat cereal for breakfast. One time, I had a muffin instead, and there was a major earthquake in my city. I've eaten cereal ever since.

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Group 3: Questionable Cause

- **Faulty cause/effect.**
- **Complex cause.** It is assumed that there is a single, simple cause of an outcome when in reality it may have been caused by a number of causes.
 - **Example:** President Trump has been in office for a month and gas prices have been skyrocketing.

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Group 3: Questionable Cause

- **Faulty cause/effect.**
- **Complex cause.**
- **Furtive fallacy.** Outcomes are asserted to have been caused by the hidden misconduct or wrongdoing of decision makers.
 - “Furtive” means secretive, hidden, conspiratorial, sly, and sneaky.
 - Conspiracy theory is a typical example of furtive fallacy.

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Group 3: Questionable Cause

- **Faulty cause/effect.**
- **Complex cause.**
- **Furtive fallacy.**
- **Gambler's fallacy.** The incorrect belief that separate, independent events can affect the likelihood of another random event.
 - If a fair coin lands on heads 10 times in a row, the belief that it is “due to land on tails” is incorrect.
 - Parents might believe incorrectly that the next birth is a son, after having three girls.

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Group 3: Questionable Cause

- **Faulty cause/effect.**
- **Complex cause.**
- **Furtive fallacy.**
- **Gambler's fallacy.**
- **Slippery slope.** One insists that one evidence will lead to a chain reaction resulting in an undesirable end or ends.
 - **Example:** Today late for ten minutes, tomorrow late for an hour, and then someday you will simply cease to show up.

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Group 4: Fallacies of Relevance

Nine types of logical fallacies in this group:

- **Appeal to ignorance.**
- **Appeal to common sense.**
- **Argument from repetition.**
- **Argument from silence.**
- **Appeal to motive.**
- **Appeal to authority.**
- **Appeal to emotion.**
- **Straw man.**
- **Two wrongs make a right.**

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Group 4: Fallacies of Relevance

- **Appeal to ignorance.** Assuming that a claim is true because it has not been or cannot be proven false, or vice versa.
 - **Example:** You can't prove that there isn't a mirror universe of our own, so there must be one out there somewhere!

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Group 4: Fallacies of Relevance

- **Appeal to ignorance.**
- **Appeal to common sense.** Asserting that your conclusion or facts are just "common sense" when, in fact, they are not.
 - **Example:** "I cannot imagine how this could be true; therefore, it must be false."

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Group 4: Fallacies of Relevance

- **Appeal to ignorance.**
- **Appeal to common sense.**
- **Argument from repetition.** Repeating an argument until nobody cares to discuss it any more.
 - **Example.** Stupid people are so annoying. They prove their stupidity by saying stupid things.

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Group 4: Fallacies of Relevance

- **Appeal to ignorance.**
- **Appeal to common sense.**
- **Argument from repetition.**
- **Argument from silence.** Assuming that a claim is true based on the absence of textual or spoken evidence from an authoritative source.
 - **Example.** Jay: “Dude, where are my car keys?”
Silent Bob says nothing. Jay: “I KNEW you took them!”

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Group 4: Fallacies of Relevance

- **Appeal to ignorance.**
- **Appeal to common sense.**
- **Argument from repetition.**
- **Argument from silence.**
- **Appeal to motive.** Attacking the arguer instead of the argument, dismissing an idea by questioning the motives of its proposer. The word *motive* can be replaced by character, race, gender, position status, etc.

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Group 4: Fallacies of Relevance

- **Appeal to motive.** Attacking the arguer instead of the argument, dismissing an idea by questioning the motives of its proposer. The word *motive* can be replaced by character, race, gender, status, position, etc.
 - This type of fallacies is called “**Ad hominem**”.
 - **Example:** “This is why a woman shouldn’t do a man’s job!”

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Group 4: Fallacies of Relevance

- **Appeal to motive.**
- **Appeal to emotion.** An argument is made due to the manipulation of emotions, rather than the use of valid reasoning. The emotion can be fear, flattery, pity, ridicule, etc.
 - **Example.** “There must be objective rights and wrongs in the universe. If not, how can you possibly say that torturing babies for fun could ever be right?”

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Group 4: Fallacies of Relevance

- **Appeal to motive.**
- **Appeal to emotion.**
- **Appeal to authority.** An assertion is deemed true because of the position or authority of the person asserting it. “Authority” can be replaced by nature, novelty, tradition, wealth, etc.
 - **Example.** “Einstein said ‘God does not play dice with the universe,’ therefore God must exist.”

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Group 4: Fallacies of Relevance

- **Appeal to motive.**
- **Appeal to emotion.**
- **Appeal to authority.**
- **Straw man.** An argument based on misrepresentation of an opponent's position, especially to attack a weaker version of it rather than the argument actually presented.
 - **Example.** Parent: "No dessert until you finish your chicken and vegetables!" Child: "You only love me when I eat."

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Straw Man

- The arguer makes his own position appear stronger by misrepresenting his opponent's position.



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Group 4: Fallacies of Relevance

- **Appeal to motive.**
- **Appeal to emotion.**
- **Appeal to authority.**
- **Straw man.**
- **Two wrongs make a right.** It occurs when it is assumed that if one wrong is committed, another wrong will rectify it.
 - **Example.** Jimmy stole Tommy's lunch in the past. Therefore, it is acceptable for Tommy to steal Jimmy's lunch today.

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False Dilemma (“Either/or”) Fallacy

- The suggestion that only two alternatives exist when in fact there are more.
 - **Example.** Either learn how to program a computer, or you won't be able to get a decent job after college.

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The Middle Ground Fallacy

- The suggestion that a compromise between two extreme conflicting points is always true..
 - **Example.** Mary thinks the best way to improve sales is to redesign the entire company website, but John is firmly against making any changes to the website. Therefore, the best approach is to redesign some portions of the website.

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Which Fallacy?

- The arguer uses the fact that a proposition has not been disproved as evidence that the proposition is true, or if it has not been proven, that it is false.
 - *People have been trying for centuries to provide conclusive evidence that astrology doesn't work. But they haven't. Therefore, we must conclude that the claims of astrology are true.*
 - *You haven't disproved that Mossad wasn't involved in 9/11, which suggests they almost surely were.*
 - *Since you cannot prove that ghosts do not exist, they probably exist.*

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Which Fallacy?



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Which Fallacy?



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More Practice Questions

Consider the following exchange:

Debbie: I think capital punishment is a necessary component of our justice system and should remain legal.

Dylan: So you are saying that murder should be legal and it is okay for us to go around killing people just because we think they deserve it? That isn't right.

Of what fallacy is Dylan guilty? Please state explicitly the premises and the conclusion in Dylan's reasoning.