Critical Thinking & Logical Fallacies

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Reasoning What is a logical argument?

A logical argument consists of one or more premises and one conclusion.

There are two fundamental ways of logical reasoning: Inductive & deductive.

Reasoning Inductive reasoning

Inductive reasoning

specific observations ⇒ broader generalizations and theories (bottom up)

In inductive reasoning, we begin with specific observations and measures, begin to detect patterns and regularities, formulate some tentative hypotheses that we can explore, and finally end up developing some general conclusions or theories.



Reasoning Examples

Inductive reasoning:

Fact₁ In 1999, John joined the Army and became a soldier after basic training.

*Fact*₂ My Father is a soldier now and he completed his basic training in 1985

*Fact*₃ Mary, my girl friend, became a soldier in 2009 after she passed basic training. Generalization All soldiers must complete basic training

Factn

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Reasoning Deductive reasoning

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Deductive reasoning
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general ⇒ specific (top-down)
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We might begin with **thinking up a theory** about our topic of interest. We then narrow that down into **more specific hypotheses** that we can test. We narrow down even further when we collect observations to address the hypotheses. This ultimately leads us to be able **to test the hypotheses with specific data**—a confirmation (or not) of our original theories.



Reasoning Deductive reasoning



Deductive reasoning:

Premise:	Every event has a cause.
Premise:	The universe has a beginning.
Premise:	All beginnings involve an event.
Inference:	This implies that the beginning of the universe involved an event.
Inference:	Therefore the beginning of the universe had a cause.
Conclusion:	The universe had a cause.

The proposition in line 4 is inferred from lines 2 and 3. Line 1 is then used, with the proposition derived in line 4, to infer a new proposition in line 5. The result of the inference in line 5 is then re-stated (in slightly simplified form) as the conclusion.

Deductive reasoning:

Premise: All politicians I know talk very convincingly.

Premise: Tom always talks convincingly about whatever he has to say.

Inference: We can infer that Tom always talks convincingly like all politicians, he therefore can definitely be a politician.

Conclusion: Therefore, Tom can definitely be a politician.

Deductive reasoning:

Premise:	human = eat + sleep + work + play	
Premise:	pig = eat + sleep	
Inference:	human = pig + work + play	
Inference:	human - play = pig + work	
Conclusion:	a human without play = a working pig!	

Premise:人=吃飯+睡覺+上班+玩Premise:豬=吃飯+睡覺Inference:人=豬+上班+玩Inference:人-玩=豬+上班Conclusion:不懂玩的人=會上班的豬!

Deductive reasoning:

Premise:	man = eating + sleeping + making money	
Premise:	pig = eating + sleeping	
Inference:	man = pig + making money	
Inference:	pig = man – making money	
Conclusion:	A man without making money is a pig!	

Premise:男人=吃飯+睡覺+掙錢Premise:豬=吃飯+睡覺Inference:男人=豬+掙錢Inference:豬=男人-掙錢Conclusion:男人不掙錢等於豬!

logics What logic isn't

- 1. Logical reasoning is not an absolute law which governs the universe.
- 2. Logic reasoning is not a set of rules which govern human behavior.

logics What logic isn't

- 1. Logical reasoning is not an absolute law which governs the universe.
- 2. Logic reasoning is not a set of rules which govern human behavior.
 - For example:
 - John wishes to speak to whomever is in charge.
 - The person in charge is Steve.
 - Therefore John wishes to speak to Steve.

Unfortunately, John may have a conflicting goal of avoiding Steve, meaning that the reasoned answer may be inapplicable to real life.

Bill: "I believe that abortion is morally wrong."

- Dave: "Of course you would say that, you're a priest."
- Bill: "What about the arguments I gave to support my position?"
- Dave: "Those don't count. Like I said, you're a priest, so you have to say that abortion is wrong. Further, you are just a lackey to the Pope, so I can't believe what you say."

Fallacies Ad Hominem (at a person)

"Ad Hominem" means "against the man" or "against the person."

Rejecting a claim on the basis of irrelevant fact about the person presenting the claim or argument.

First, an attack against the character of person making the claim

Second, this attack is taken to be evidence against the claim or argument

- 1. Person A makes claim X.
- 2. Person B makes an attack on person A.
- 3. Therefore A's claim is false.

Peter: "Based on the arguments I have presented, it is evident that it is morally wrong to use animals for food or clothing."

Bill: "But you are wearing a leather jacket and you have a roast beef sandwich in your hand! How can you say that using animals for food and clothing is wrong!"

Fallacies Ad Hominem Tu Quoque (you too)

Also known as "You Too Fallacy"

This fallacy is committed when it is concluded that a person's claim is false because it is inconsistent with something else a person has said or is using. This type of "argument" has the following form:

- 1. Person A makes claim X.
- 2. Person B asserts that A's actions or past claims are inconsistent with the truth of claim X.
- 3. Therefore X is false.

- It is claimed by some people that severe illness is caused by depression and anger. After all, people who are severely ill are very often depressed and angry. Thus, it follows that the cause of severe illness actually is the depression and anger. So, a good and cheerful attitude is the key to staying healthy.
- 2. Bill sets out several plates with bread on them. After a couple days, he notices that the bread has mold growing all over it. Bill concludes that the mold was produced by the bread going bad. When Bill tells his mother about his experiment, she tells him that the mold was the cause of the bread going bad and that he better clean up the mess if he wants to get his allowance this week.

Fallacies Confusing Cause and Effect

also known as Questionable Cause

This fallacy is committed when a person assumes that one event must cause another just because the events occur together.

Confusing Cause and Effect is a fallacy that has the following general form:

- 1. A and B regularly occur together.
- 2. Therefore A is the cause of B.

- When sales of hot chocolate go up, street crime drops. We can take a serious consideration that some components of hot chocolate might be able to prevent crime.
- 2. According to the following table, we can conclude that the students did not do well on their test because they have too much anxiety. Or too much anxiety caused them to perform poorly on their test.

Student ID	Degree of anxiety	scores
Jack	6	30
Tony	2	87
Sean	5	40
Daniel	1	95
Earnest	2	85
Frank	6	32
Gail	4	50
Henry	3	45

Fallacies Confusing correlation and causation

This fallacy is committed when a person takes the correlation between two variables as one variable causes the other.

Confusing correlation and causation is a fallacy that has the following general form:

- 1. A is (highly) correlated with B.
- 2. Therefore, A causes B or B causes A.

- Can a person quit smoking? Of course—as long as he has sufficient willpower and really wants to quit."
- 2. You should exercise because it's good for you.
- 3. Free trade will be good for this country. The reason is patently clear. Isn't it obvious that unrestricted commercial relations will bestow on all sections of this nation the benefits brought by an unimpeded flow of goods between countries?
- 4. "You can't give me a C. I'm an A student!"

Fallacies Circular reasoning

Circular reasoning is an attempt to support a statement by simply repeating the statement in different or stronger terms. In this fallacy, the reason given is nothing more than a restatement of the conclusion that poses as the reason for the conclusion.

Circular reasoning is a fallacy that has the following general form:

- 1. There is result A.
- 2. Reason B is actually a paraphrase of result A.
- 3. Therefore, result A is caused by reason B.

- Jane gets a rather large wart on her finger. Based on a story her father told her, she cuts a potato in half, rubs it on the wart and then buries it under the light of a full moon. Over the next month her wart shrinks and eventually vanishes. Jane writes her father to tell him how right he was about the cure.
- The picture on Jim's old TV set goes out of focus. Jim goes over and strikes the TV soundly on the side and the picture goes back into focus. Jim tells his friend that hitting the TV fixed it.

Fallacies Post Hoc (after the fact)

Also Known as: False Cause, Questionable Cause

After this, therefore because of this. A causes or caused B because A occurs before B and there is not sufficient evidence to actually warrant such a claim.

A Post Hoc is a fallacy with the following form:

 A occurs before B.
Therefore A is the cause of B.

- Minds, like rivers, can be broad. The broader the river, the shallower it is. Therefore, the broader the mind, the shallower it is.
- The solar system reminds me of an atom, with planets orbiting the sun like electrons orbiting the nucleus. We know that electrons can jump from orbit to orbit; so we must look to ancient records for sightings of planets jumping from orbit to orbit also.
- 3. We have pure food and drug laws; why can't we have laws to keep movie-makers from giving us filth?

Fallacies Bad/false analogy

This fallacy is committed when a person claims that two situations are highly similar, when they aren't.

False analogy is a fallacy that has the following general form:

- 1. Situation X: A is to B.
- 2. Situation Y; C is to D.

As C is to D, so A is to B.

- Sam is riding her bike in her home town in Maine, minding her own business. A station wagon comes up behind her and the driver starts beeping his horn and then tries to force her off the road. As he goes by, the driver yells "get on the sidewalk where you belong!" Sam sees that the car has Ohio plates and concludes that all Ohio drivers are jerks.
- Smith, who is from England, decides to attend graduate school at Ohio State University. He has never been to the US before. The day after he arrives, he is walking back from an orientation session and sees two white (albino) squirrels chasing each other around a tree. In his next letter home, he tells his family that American squirrels are white.

Fallacies Hasty Generalization

Also Known as: Fallacy of Insufficient Statistics, Fallacy of Insufficient Sample, Leaping to A Conclusion, Hasty Induction.

This fallacy is committed when a person draws a conclusion about a population based on a sample that is not large enough.

It has the following form:

 Sample S, which is only one or two cases, or too small, is taken from population P.

 Conclusion C is drawn about Population P based on S.

Bill is assigned by his editor to determine what most Americans think about a new law that will place a federal tax on all computers purchased. The revenues from the tax will be used to enforce new online decency laws. Bill, being technically inclined, decides to use an email poll. In his poll, 95% of those surveyed opposed the tax. Bill was quite surprised when 65% of all Americans voted for the taxes.

Fallacies Biased sample

This fallacy is committed when a person draws a conclusion about a population based on a sample that is biased or prejudiced in some manner. It has the following form:

- Sample S, which is biased, is taken from population P.
- Conclusion C is drawn about Population P based on S.

Fallacies How can we find reliable sampling?

- 1. Random Sample: This is a sample that is taken in such a way that nothing but chance determines which members of the population are selected for the sample.
- 2. Stratified Sample: This is a sample that is taken by using the following steps:
 - 1) The relevant strata (population subgroups) are identified,
 - 2) The number of members in each stratum is determined and
 - 3) A random sample is taken from each stratum in exact proportion to its size. This method is obviously most useful when dealing with stratified populations. For example, a person's income often influences how she votes, so when conducting a presidential poll it would be a good idea to take a stratified sample using economic classes as the basis for determining the strata.

- 1. A patriot pontificates: "In times of crisis, every American supports his President."
- There are 23,000,000 citizens in Taiwan supporting the independence of Taiwan. What I have just said represent the inner voice of the 23,000,000 people on this island.

Fallacies Overgeneralization

This fallacy is committed when a person tries to exaggerate the number of subjects and make the claim sound/look reliable or trustworthy. This kind person often skip steps in showing reliable/valid evidence to support the claim.

Overgeneralization is a fallacy that has the following general form:

- A person or a small number of people think A is B.
- 2. Therefore, all think A is B.

"Oh, no! Look who just moved into the neighborhood—that scary looking biker guy! Now the whole neighborhood will go to ruin. What kinds of friends might he have over there? What will this do to my property value?"

Fallacies Stereotyping

This fallacy is committed when a person tries to exaggerate the number of subjects and make the claim sound/look reliable or trustworthy. This kind person often skip steps in showing reliable/valid evidence to support the claim.

Overgeneralization is a fallacy that has the following general form:

- A person or a small group of persons in a group/community have a certain feature.
- 2. Therefore, the whole group/community has the same feature.

 Look, you are going to have to make up your mind. Either you decide that you can afford this stereo, or you decide you are going to do without music for a while.

Compare it with this:

- A: Bill is dead or he is alive.
- B: Bill is not dead.
- A: Therefore, Bill is alive.
- 2. I'm not a doctor, but your runny nose and cough tell me that you either have a cold or have the flu.
- 3. President George W. Bush: "You're either with us or against us."

Fallacies False Dilemma

Also known as Black & White Thinking; False Either/or

An either/or fallacy occurs when a speaker suggests that there are only two choices possible, when three or more really exist.

A False Dilemma is a fallacy in which a person uses the following pattern of "reasoning":

- Either claim X is true or claim Y is true (when X and Y could both be false).
- 2. Claim Y is false.
- 3. Therefore claim X is true.

Or

- 1. There are only two choices: either A or B.
- 2. Therefore, you have to choose either of them.

In fact, there are more choices other than these two choices.

- "You know, I've begun to think that there is some merit in the Republican's tax cut plan. I suggest that you come up with something like it, because if we Democrats are going to survive as a party, we have got to show that we are as tough-minded as the Republicans, since that is what the public wants."
- 2. "I think there is great merit in making the requirements stricter for the graduate students. I recommend that you support it, too. After all, we are in a budget crisis and we do not want our salaries affected."

Fallacies Red Herring (diverting attention from a question)

Also Known as: Smoke Screen

A Red Herring is a fallacy in which an irrelevant topic is presented in order to divert attention from the original issue. The basic idea is to "win" an argument by leading attention away from the argument and to another topic.

This sort of "reasoning" has the following form:

- 1. Topic A is under discussion.
- Topic B is introduced under the guise of being relevant to topic A (when topic B is actually not relevant to topic A).
- 3. Topic A is abandoned.

- Bill: "I believe that abortion is morally acceptable. A woman should have a right to her own body."
- Jane: "I disagree completely. Dr. Johan Skarn says that abortion is always morally wrong, regardless of the situation. He has to be right because he is a respected expert in his field."
- Bill: "I've never heard of Dr. Skarn. Who is he?"
- Jane: "He's the guy that won the Nobel Prize in physics for his work on cold fusion."
- Bill: "I see. Does he have any expertise in morality or ethics?"
- Jane: "I don't know. But he's a world famous expert, so I believe him."

Fallacies Appeal to Authority

Also known as Fallacious Appeal to Authority, Misuse of Authority, Irrelevant Authority, Questionable Authority, Inappropriate Authority, Ad Verecundiam

- Person A is (claimed to be) an authority on subject S.
- 2. Person A makes claim C about subject S.
- 3. Therefore, C is true.

An Appeal to Authority is a fallacy with the following form:

Fallacies Appeal to Authority

- 1. The person has sufficient expertise in the subject matter in question.
- 2. The claim being made by the person is within her/his area(s) of expertise.
- 3. There is an adequate degree of agreement among the other experts in the subject in question.
- 4. The person in question is not significantly biased.
- 5. The area of expertise is a legitimate area or discipline.
- 6. The authority in question must be identified.

What distinguishes a fallacious Appeal to Authority from a good Appeal to Authority is that the argument meets the six conditions discussed above.

- 1. "Yeah, I know some people say that cheating on tests is wrong. But we all know that everyone does it, so it's okay."
- 2. "Sure, some people buy into that equality crap. However, we know that everyone pays women less then men. It's okay, too. Since everyone does it, it can't really be wrong."
- 3. "There is nothing wrong with requiring multicultural classes, even at the expense of core subjects. After all, all of the universities and colleges are pushing multiculturalism."

Fallacies Appeal to Common Practice

The Appeal to Common Practice is a fallacy with the following structure:

- 1. X is a common action.
- 2. Therefore X is correct/moral/ justified/reasonable, etc.

More formally,

- It is common practice to treat people of type Y in manner X and to treat people of type Z in a different manner.
- 2. There is no relevant difference between people of type Y and type Z.
- 3. Therefore people of type Z should be treated in manner X, too.

Most people do X; therefore X is morally correct.

- 1. "God must exist! If God did not exist, then all basis for morality would be lost and the world would be a horrible place!"
- 2. "It can never happen to me. If I believed it could, I could never sleep soundly at night."
- 3. "I don't think that there will be a nuclear war. If I believed that, I wouldn't be able to get up in the morning. I mean, how depressing."
- 4. "I think we should stop building nuclear plants. If we don't stop doing that, the possible explosion will blow everything away and we will be gone. Therefore I strongly support that we should ban nuclear plants."

Fallacies Appeal to Consequences of a Belief

This line of "reasoning" is fallacious because the consequences of a belief have no bearing on whether the belief is true or false. For example, if someone were to say "If sixteenheaded purple unicorns don't exist, then I would be miserable, so they must exist" it would be clear that this would not be a good line of reasoning.

The Appeal to the Consequences of a Belief is a fallacy that comes in the following patterns:

- X is true because if people did not accept X as being true then there would be negative consequences.
- 2. X is false because if people did not accept X as being false, then there would be negative consequences.
- 3. X is true because accepting that X is true has positive consequences.
- 4. X is false because accepting that X is false has positive consequences.
- 5. I wish that X were true, therefore X is true. This is known as Wishful Thinking.
- I wish that X were false, therefore X is false. This is known as Wishful Thinking.

- The new Power Tangerine computer gives you the power you need. If you buy one, people will envy your power. They will look up to you and wish they were just like you. You will know the true joy of power. Tangerine Power.
- The new UltraSkinny diet will make you feel great. No longer be troubled by your weight. Enjoy the admiring stares of the opposite sex. Revel in your new freedom from fat. You will know true happiness if you try our diet!
- 3. Bill goes to hear a politician speak. The politician tells the crowd about the evils of the government and the need to throw out the people who are currently in office. After hearing the speech, Bill is full of hatred for the current politicians. Because of this, he feels good about getting rid of the old politicians and accepts that it is the right thing to do because of how he feels.

Fallacies Appeal to Emotion

This fallacy is committed when someone manipulates peoples' emotions in order to get them to accept a claim as being true. More formally, this sort of "reasoning" involves the substitution of various means of producing strong emotions in place of evidence for a claim.

An Appeal to Emotion is a fallacy with the following structure:

- 1. Favorable emotions are associated with X.
- 2. Therefore, X is true.
- Or (Appeal to Popularity; Ad Populum)
- 1. Most people approve of X.
- 2. So, I should approve of X, too.
- 3. Since I approve of X, X must be true.

Or (Appeal to Emotion)

- 1. I approve of X.
- 2. Therefore, X is true.

- A tiger eats more food than a human being. Therefore, tigers, as a group, eat more food than do all the humans on the earth.
- 2. Sodium and Chloride are both dangerous to humans. Therefore any combination of sodium and chloride will be dangerous to humans.

Fallacies Composition

The fallacy of Composition is committed when a conclusion is drawn about a whole based on the features of its constituents when, in fact, no justification provided for the inference. The "reasoning" would look something like this:

- 1. Individual F things have characteristics A, B, C, etc.
- Therefore, the (whole) class of F things has characteristics A, B, C, etc.
- Or
- 1. The parts of the whole X have characteristics A, B, C, etc.
- 2. Therefore the whole X must have characteristics A, B, C.

The End Any questions



Thank you.