

Reasoning, Critical Thinking, and Basic Logic Primer

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- **What is an argument, and why care?**
 - Not all reasoning is equal
 - Not “entitled to our opinion” unless we can support it!
 - Why does good reasoning matter?
 - Good reasoning will make us more effective thinkers, and so more effective people with happier lives.
 - Think of successful people- they are generally good reasoners.
 - Logic has two purposes: (1) to discover truth and (2) to persuade others.

- **Clarifying an Argument**
 - Identify if it is an Argument- Is it trying to give reasons or support for a claim?
 - **Argument = premises** (reasons/evidence) + **conclusion** (claim, opinion, etc. to be supported)
 - Arguments are composed of *Statements*- What are statements?
 - A statement is a declarative sentence that is either true or false.
 - Not commands, proposals, questions (except “rhetorical questions”)
 - Nature of true and false
 - Objective truth- Not truth relative to a subjective
 - The True/False Principle: Every statement is either true or false, but never both at the same time. Either corresponds to the way the world/reality is or it doesn't .
 - Conditional statements- what makes a hypothetical true or false?
 - In classical logic, we treat conditionals as something called a “material conditional”
 - Consider “If you help me move, I’ll buy you pizza.”
 - The only way this is false is if you DO help me move, but I do NOT buy you pizza. Conditionals are always true, unless the antecedent (the “if” part) is true, but the consequent (the “then” part) is false.
 - Identify the Conclusion- every argument has one conclusion
 - The conclusion does not have to be last. It can show up anywhere in the argument.
 - Look for keywords to help determine structure:
 - Conclusion indicators (in conclusion, therefore, so, since, hence, etc.)
 - Premise indicators (because, since, after all, assuming that, etc.)
 - Ask yourself what is the overall claim that is trying to be established, and then ask what reasons are being provided.
 - Identify the Premise(s)- reasons or evidence given to support the conclusion
 - Some premises support sub-conclusions that are then used as premises.
 - Add Suppressed/Implicit/Hidden Premises/Conclusion if needed
 - Example: The bumper sticker: “Abortion stops a beating heart” is intended as an argument with both a hidden premise (“Anything that stops a beating heart is morally wrong”) and a hidden conclusion (“Abortion is morally wrong”).
 - Follow the Principle of Charity- be fair and charitable in reconstruction and evaluation!

- **Evaluating an Argument**

- “Every argument makes two claims: (1) That reasons and evidence actually exists and (2) that the alleged evidence or reasons support something (or that something follows from it). The first is a factual claim, the second an inferential claim.”- Patrick Hurley
- Imagine that we are evaluating a proposed building. It has two important aspects: (1) is the architectural design or structure good, with the proper supporting relationships and connections, and (2) are the materials that the design interconnects good solid materials of the right kind? Similarly, in logic, we separate the form of an argument from the content.
- A good argument should have both a good form and good content. So we need to evaluate each independently.

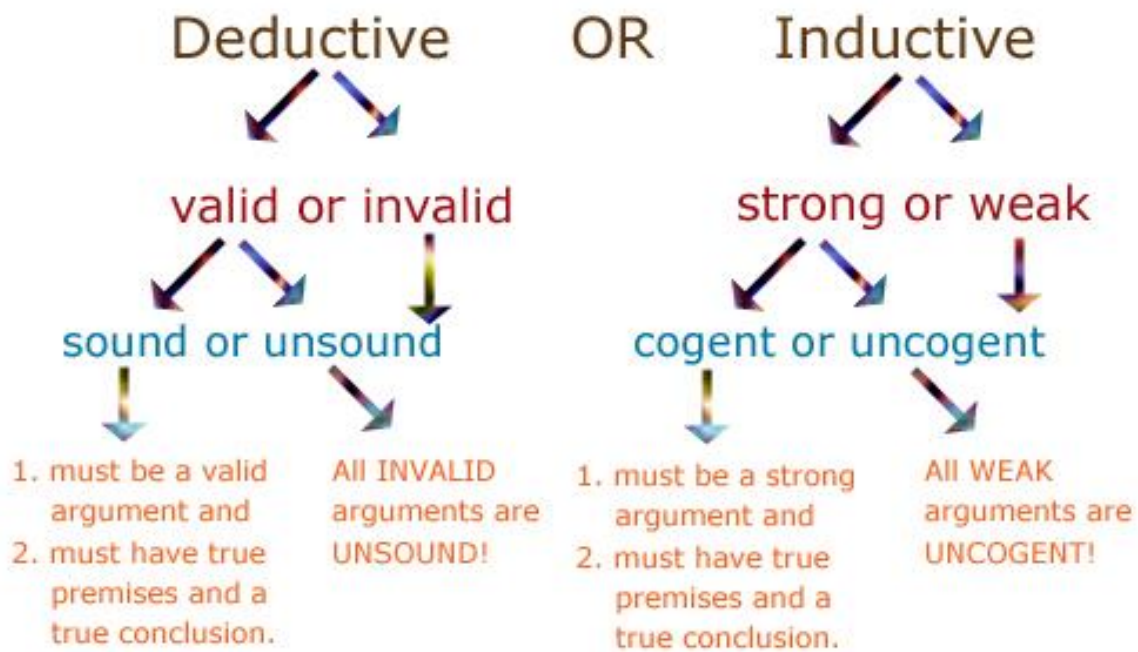
- **Evaluating the form**

- First, FORGET whether premises are actually true or not. Focus on the form/structure of the reasoning used. Try *assuming* or pretending that the premises are true.
- **Deductive or Inductive?** Arguments are either deductive or inductive. Deductive arguments *attempt* to provide 100% proof that a conclusion is true. Inductive arguments *attempt* to show that a conclusion is probably true.
 - **Deductive Arguments** are *intended* to be valid, show a necessary connection.
 - Deductive arguments are either valid or invalid. (There are no “degrees”.)
 - Definitions of '**valid**':
 - it is impossible for all the premises in the argument to be true while the conclusion is false.
 - Alternatively: Assuming the premises are true, this would *guarantee* that the conclusion is also true.
 - Consider: (1) All squares are circles (2) All circles are triangles what conclusion follows from this? (3) All squares are triangles. How did your brain know that when every statement is necessarily false? Focus on that thinking procedure- this is the essence of validity!
 - Definition of '**invalid**': it is possible for all the premises in the argument to be true while the conclusion is false.
 - **Valid** arguments are:
 - truth preserving
 - Not falsity preserving
 - perfectly strong arguments. If the premises are all true then the conclusion is 100% probable.
 - Do not say anything about whether the premises are factually correct/true or not!
 - Testing for Validity
 - Focus on form and ignore truth!
 - An invalid argument with true premises and a true conclusion is one where you just got lucky. The structure allowed the conclusion to be false, even with true premises. We want more than blind luck!
 - Is there anything new in conclusion that's not in premises? This is *usually* a good sign that the argument is invalid.

- Famous forms- does the argument form match a common valid form like Modus Ponens, Modus Tollens, Disjunctive Syllogism, Hypothetical Syllogism, etc.
 - Counter-example method- show the argument form does not preserve truth by constructing a similar argument with the same structure that has obviously true premises and an obviously false conclusion.
 - Symbolize the argument and test using a formal logical technique like the Truth-Table method or the Proof method. (These require more advanced logic training.)
- Remember, the conclusion of an invalid argument could still be true; we only know that this particular argument fails to establish the conclusion!
- **Inductive arguments** are not intended to be valid, instead they deal with *probability*. The premises are meant to increase the likelihood that the conclusion is true. There is always some risk involved in an inductive argument.
 - Instead of being valid, a good inductive argument is '**Strong** ', which means that: Assuming the premises are true, then the conclusion is *probably* true.
 - A **weak** argument is one that is not strong. So, even the truth of the premises would not show the conclusion to be probably true.
 - Be careful working with probabilities and generalizations!
- **Evaluating the Content**
- We've said that good deductive arguments are valid. Is validity enough? Consider: "All toasters do not exist. The God you believe in is a toaster, therefore your God does not exist." This should not convince anyone!
- What we want is **soundness** (which is the "Holy Grail" in logic and philosophy). If we take a valid argument and add that the evidence *does* exist (the reasons offered are factually correct), then we have a sound argument.
 - Evaluate the truth of the premises to determine soundness or cogency.
 - Are the premises known to be true or reasonable to accept without further argumentation? We should accept premises that are:
 - Obviously true
 - Adequately supported by sub-arguments
 - Adequately supported by (good) science
 - Plausibly true- in which case we should accept the premises conditionally.
 - Some premises are of unknown truth-value. In these cases, we should demand further evidence before accepting them.
- **For Deductive arguments:**
 - '**sound**': both i) all of the premises in the argument are true (factually correct), and ii) the argument is valid
 - '**unsound**': either i) at least one of the premises in the argument is false, or ii) the argument is invalid (or both (i) and (ii))

- **For Inductive arguments:**
 - **'Cogent'**: both i) all of the premises in the argument are true, and ii) the argument is strong
 - **'uncogent'**: either i) at least one of the premises in the argument is false, or ii) the argument is weak (or both (i) and (ii))
- Notice that if we do not like the conclusion of an argument, we must either find a flaw with its reasoning or show that a premise may be false. Otherwise, we should accept the argument's conclusion—whether we like it or not!
- Here is a helpful diagram from the internet:

Deductive & Inductive decision tree



- **Common Mistakes**
 - Language problems
 - Different senses of words, ambiguity, equivocation problems, etc.
 - For example: “Only man is rational. No woman is a man. Therefore, no woman is rational”. This argument appears to have a valid form, but that is only if we fail to notice that the word ‘man’ means two very different things, and is best understood as two different words that happen to be spelled the same. This reveals that the argument is actually invalid.

- Formal fallacies: these are mistakes/errors in the form or argument structure that often appear similar to valid forms, and so can trick people into thinking they are good arguments.
 - Examples: Affirming the consequent, denying the antecedent, undistributed middle, etc.
- Informal fallacies: these are mistakes/errors that are not problems with the technical form or structure of the argument. They may involve problems with the content or language, or prey on our psychology in some way. They can be hard to detect and very persuasive if we don't notice the error. Informal fallacies are dangerous because they seem better than they are.
 - Examples:
 - unacceptable premises (circular reasoning/begging the question, false dilemma, complex question, etc.),
 - irrelevant premises (appeal to unreliable authority, *ad hominem*, appeal to popularity, appeal to emotion, appeal to fear, straw man, red herring, etc.),
 - insufficient premises (hasty generalization, false cause, faulty analogy, slippery slope, etc.)
- Common psychological fallacies and errors
 - Rationalizations, confirmation bias, anecdotal evidence, framing effect, wishful thinking, etc
 - Memory errors (forgetting or misremembering, availability heuristic, etc.)
 - Mistakes when working with probabilities and statistics (gambler's fallacy, base rate fallacy, statistical sample errors, etc.)
- Why mistakes happen
 - There are lots of social pressures that may influence our beliefs, even without us knowing!
 - There may be evolutionary reasons. Certain parts of our brains' processes may have made sense in our species in the past, and so have been evolutionarily advantageous. But things have changed considerably in how we survive and interact with the world...
 - Finally, thinking carefully, critically, and effectively is HARD. We may try and fail, or just make mistakes because we are being lazy.