Lecture 8:
          1. Inductive Vs. Deductive Logic
          2. Assessing Arguments: Good vs. Bad:
              a. Deductive:
                    i. Valid / Invalid
                    ii. Sound / Unsound
              b. Inductive:
                    i. Strong / Weak
          3. Logical Fallacies

    1. Inductive Vs. Deductive Logic
There are two basic kinds of reasoning: inductive and deductive.

Induction moves from the specific to the general, while deduction goes from the general to the specific:

General Conclusion   General Rule / Principle

Specific Observations / Cases   Specific Case

Arguments, based on experience or observation, are best expressed *inductively*, while arguments based on laws, rules, or other widely accepted principles are best expressed *deductively*.

Example:

Inductive: I've noticed previously that every time I throw a ball up, it comes back down, so I guess this next time when I throw it up, it will come back down, too.

Deductive: That's Newton's Law of Gravity: Everything that goes up must come down. And so, if you throw the ball up, it will come down.

Inductive reasoning in this example is based on observation, while *deductive reasoning* draws specific conclusions by applying the law of gravity. *Deductive* argument in this case is clearly from the general (the law of gravity) to the specific instance of the ball coming down. *Inductive* argument, on the other hand, proceeds from many observed specific instances to the general conclusion, predicting that a similar event is likely to result in a similar outcome in the future.

As you can see, the difference between inductive and deductive reasoning is mostly in the way the arguments are expressed. Any inductive argument can also be expressed deductively, and any deductive argument can also be expressed inductively.

It is important to recognize whether the form of an argument is inductive or deductive, because each requires different sorts of support. Inductive argument, above, is supported by observations, while the deductive argument is supported by the reference to the law of gravity.

Another example:

Inductive reasoning:

> The Sun rose in the East today
> The Sun rose in the East yesterday
> The Sun rose in the East every single day for the few years I have observed it.
> Therefore, the Sun will rise in the East tomorrow morning.

Deductive reasoning:

> The Sun always rises in the East.
> The sun rose in the East today.
> Therefore, it will also rise in the East tomorrow morning.

A **deductive** argument is an argument whose premises are supposed to *guarantee* the conclusion.

An **inductive** argument is an argument whose premises are supposed to *support*, but *not to guarantee*, the conclusion.

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2. Assessing Arguments

In general, we assess arguments as either **GOOD** or **BAD**.

We assess **deductive** arguments as *sound* or *unsound*, but also as either *valid* or *invalid*.
We assess **inductive** arguments as either *strong* or *weak*.

There are two ways in which an argument can be a bad argument and fail to take us closer to the truth:

- The argument may have one or more false premises or
- The premises, whether true or not, do not provide proper support for the conclusion

In case of a deductive argument, **proper support is a *guarantee***. So there are two things we need to know when assessing a deductive argument:

1. **Would the premises *guarantee* the conclusion if they *were* true?** And
2. ***Are* the premises true?**

Because we can answer either 'yes' or 'no' to both questions, there are **4 possibilities**:

- The premise(s) are true, and they guarantee the conclusion'
- The premise(s) aren't all true, but, if they were, they would guarantee the conclusion.
- The premise(s) are true, but they don't guarantee the conclusion.
- The premise(s) aren't all true and, even if they were, they would not guarantee the conclusion.

Here are some examples of deductive arguments, one example for each possibility:

Argument 1:   All students in our class did well in the exam.
                     Peter is a student in our class.
                     Therefore, Peter did well in the exam.

The premises of this argument are true, and they *guarantee* the conclusion (there is no way the conclusion can be wrong if both of these premises are true).

Argument 2:   All sheep have two biological parents.
                     Dolly is a sheep.
                     Therefore, Dolly has two biological parents.

The premises of this argument aren't all true, but, if they were, they *would* guarantee the conclusion.

Argument 3:   If the TV is unplugged, it doesn't work.
                     The TV is not working.
                     Therefore, it's unplugged.

The premises of this argument are true, but they do not guarantee the conclusion. We can think of many other counterexamples that would explain why the TV may be *buggerap*! ☺

Argument 4:   Reading is the only way to pass an exam.
                     Peter read a lot in the past two weeks.
                     Therefore, Peter has passed the exam.

The premises in this argument aren't all true, and, even if they were, they wouldn't *guarantee* the conclusion.
Argument 1 is a good deductive argument – it is called a SOUND argument. The remaining three arguments are all **bad** deductive arguments for one reason or another – so they are all **UNSOUND** arguments.

> If the premises of an argument *would* guarantee the conclusion, **if they *were* true**, or
> *do* guarantee the conclusion, **because they *are* true**, then the argument is
>
> # valid.

You can see that argument 2 is valid, even though it is unsound. So argument 2 does have something going for it.

> If the premises of an argument *are* **true**, but *do not guarantee* the conclusion, or
> *Wouldn't guarantee* the conclusion **even if they *were* true**,
>
> then the argument is **invalid**.

You can see that arguments 3 & 4 are invalid, as well as unsound. Argument 3 has something going for it – at least all its premises are true, but since it is invalid (the conclusion does not follow from

the premises), it is lumped together with the other kind of unsound argument (4), which has nothing going for it at all.

So a really bad argument may have both these flaws, i.e. the premise(s) are false, and would not provide proper support for the conclusion, <u>even *if*</u> they *were* <u>true</u>.

Inductive* arguments** <u>do not</u> *guarantee* the truth of the conclusion, provided the premises are true. Inductive arguments claim that the conclusion is *likely* to be true, if the premises are true. Inductive arguments are assessed, based on the degree of this ***likelihood. They can be ***strong*** or ***weak***:

Argument 1:   I was alive last year.
            I am alive this year.
            So, I shall be alive next year.

The strength of this argument will depend on so many factors, among them the age of its author: if the author is 99 years old, the strength of this argument may be severely weakened ☺.

Argument 2:   Ann loves chocolate.
            Ann loves chocolate better than she loves any other food.
            So chocolate will be the best present for Ann's Birthday tomorrow.

Argument 3:   Peter's car is 20 years old.
            Peter's car usually takes one hour to get started.
            So, it is likely to take one hour to get started tomorrow.

We can see how the strength of these inductive arguments varies, depending on the degree of probability of their conclusions.

Bad arguments are common – they are used to persuade people, who are not *thinking*. Because they are so common, these types of bad argument have been given names. Any argument, in which the premises do not provide proper support for the conclusion, is called a ***fallacy***.

<u>MASTER LIST OF LOGICAL FALLACIES</u>

1. **Ad hominem** or ATTACKING THE PERSON. Attacking the arguer rather than his/her argument. Example: John's objections to capital punishment carry no weight since he is a convicted felon. Note: Saying something negative about someone is not automatically ad hominem. If a person (politician for example) is the issue, then it is not a fallacy to criticize him/her.

2. **Ad ignorantium** or APPEAL TO IGNORANCE. Arguing on the basis of what is not known and cannot be proven. (Sometimes called the "burden of proof" fallacy). If you can't prove that something is true then it must be false (and vice versa). Example: You can't prove there isn't a Loch Ness Monster, so there must be one.

3. **Ad verecundiam** or APPEAL TO AUTHORITY. This fallacy tries to convince the listener by appealing to the reputation of a famous or respected person. Oftentimes it is an authority in one field who is speaking out of his or her field of expertise. Example: Sports stars selling cars or hamburgers. Or, the actor on a TV commercial that says, "I'm not a doctor, but I play one on TV."

4. **AFFIRMING THE CONSEQUENT**. An invalid form of the conditional argument. In this case, the second premise affirms the consequent of the first premise and the conclusion affirms the antecedent. Example: If he wants to get that job, then he must know Spanish. He knows Spanish, so the job is his.

5. **AMPHIBOLY**. A fallacy of syntactical ambiguity where the position of words in a sentence or the juxtaposition of two sentences conveys a mistaken idea. This fallacy is like equivocation except that the ambiguity does not result from a shift in meaning of a single word or phrase, but is created by word placement.. Example: Jim said he saw Jenny walk her dog through the window. Ow! She should be reported for animal abuse.

6. **APPEAL TO EMOTION**. In this fallacy, the arguer uses emotional appeals rather than logical reasons to persuade the listener. The fallacy can appeal to various emotions including pride, pity, fear, hate, vanity, or sympathy. Generally, the issue is oversimplified to the advantage of the arguer. Example: In 1972, there was a widely-printed advertisement printed by the Foulke Fur Co., which was in reaction to the frequent protests against the killing of Alaskan seals for the making of fancy furs. According to the advertisement, clubbing the seals was one of the great conservation stories of our history, a mere exercise in wildlife management, because "biologists believe a healthier colony is a controlled colony."

7. **ARGUMENT FROM ANALOGY** or FALSE ANALOGY. An unsound form of inductive argument in which an argument relies heavily on a weak analogy to prove its point. Example: This must be a great car, for, like the finest watches in the world, it was made in Switzerland.

8. **BEGGING THE QUESTION**. An argument in which the conclusion is implied or already assumed in the premises. Also said to be a circular argument. Example: Of course the Bible is the word of God. Why? Because God says so in the Bible.

9. **SLIPPERY SLOPE**. A line of reasoning that argues against taking a step because it assumes that if you take the first step, you will inevitably follow through to the last. This fallacy uses the valid form of hypothetical syllogism, but uses guesswork for the premises. Example: We can't allow students any voice in decision making on campus; if we do, it won't be long before they are in total control.

10. **COMMON BELIEF** (Sometimes called the "bandwagon" fallacy or 'appeal to popularity"). This fallacy is committed when we assert a statement to be true on the evidence that many other people allegedly believe it. Being widely believed is not proof or evidence of the truth. Example: Of course Nixon was guilty in Watergate. Everybody knows that.

11. **PAST BELIEF**. A form of the COMMON BELIEF fallacy. The same error in reasoning is committed except the claim is for belief or support in the past. Example: We all know women should obey their husbands. After all, marriage vows contained those words for centuries.

12. **CONTRARY TO FACT HYPOTHESIS**. This fallacy is committed when we state with an unreasonable degree of certainty the results of an event that might have occurred but did not. Example: If President Bush had not gone into the Persian Gulf with military force when he did, Saddam Hussein would control the world's oil from Saudi Arabia today.

13. **DENYING THE ANTECEDENT**. An invalid form of the conditional argument. In this one, the second premise denies the antecedent of the first premise, and the conclusion denies the consequent. Often mistaken for modus tollens. Example: If she qualifies for a promotion, she must speak English. She doesn't qualify for the promotion, so she must not know how to speak English.

14. **DIVISION**. This fallacy is committed when we conclude that any part of a particular whole must have a characteristic because the whole has that characteristic. Example: I am sure that Karen plays the piano well, since her family is so musical.

15. **COMPOSITION**. This fallacy is committed when we conclude that a whole must have a characteristic because some part of it has that characteristic. Example: The Dawson clan must be rolling in money, since Fred Dawson makes a lot from his practice.

16. **FALSE DILEMMA** (often called the either/or fallacy or false dichotomy). This fallacy assumes that we must choose one of two alternatives instead of allowing for other possibilities; a false form of disjunctive syllogism. Example: "America, love it or leave it." (The implication is, since you don't love it the only option is to leave it).

17. **EQUIVOCATION**. This fallacy is a product of semantic ambiguity. The arguer uses the ambiguous nature of a word or phrase to shift the meaning in such a way as to make the reason offered appear more convincing. Example: We realize that workers are idle during the period of lay-offs. But the government should never subsidize idleness, which has often been condemned as a vice. Therefore, payments to laid off workers are wrong.

18. **HASTY GENERALIZATION**. A generalization accepted on the support of a sample that is too small or biased to warrant it. Example: All men are rats! Just look at the louse that I married.

19. **POST HOC, ERGO PROPTER HOC.** ("After this, therefore caused by this.") A form of the false cause fallacy in which it is inferred that because one event followed another it is necessarily caused by that event. Example: Mary joined our class and the next week we all did poorly on the quiz. It must be her fault.

20. **INCONSISTENCY**. A discourse is inconsistent or self-contradicting if it contains, explicitly or implicitly, two assertions that are logically incompatible with each other. Inconsistency can also occur between words and actions. Example: A woman who represents herself as a feminist, yet doesn't believe women should run for Congress.

21. **NON SEQUITUR**. ("It does not follow.") In this fallacy the premises have no direct relationship to the conclusion. This fallacy appears in political speeches and advertising with great frequency. Example: A waterfall in the background and a beautiful girl in the foreground have nothing to do with an automobile's performance.

22. **QUESTIONABLE CAUSE**. (In Latin: non causa pro causa, "not the cause of that"). This form of the false cause fallacy occurs when the cause for an occurrence is identified on insufficient evidence. Example: I can't find the checkbook; I am sure that my husband hid it so I couldn't go shopping today.

23. **RED HERRING**. This fallacy introduces an irrelevant issue into a discussion as a diversionary tactic. It takes people off the issue at hand; it is beside the point. Example: Many people say that engineers need more practice in writing, but I would like to remind them how difficult it is to master all the math and drawing skills that an engineer requires.

24. **SLANTING**. A form of misrepresentation in which a true statement is made, but made in such a way as to suggest that something is not true or to give a false description through the manipulation of connotation. Example: I can't believe how much money is being poured into the space program (suggesting that 'poured' means heedless and unnecessary spending)

25. **STRAW MAN**. This fallacy occurs when we misrepresent an opponent's position to make it easier to attack, usually by distorting his or her views to ridiculous extremes. This can also take the form of attacking only the weak premises in an opposing argument while ignoring the strong ones. Example: Those who favor gun-control legislation just want to take all guns away from responsible citizens and put them into the hands of the criminals.

26. **TWO WRONGS MAKE A RIGHT**. This fallacy is committed when we try to justify an apparently wrong action by charges of a similar wrong. The underlying assumption is that if they do it, then we can do it too and are somehow justified. Example: Supporters of apartheid are often guilty of this error in reasoning. They point to U.S. practices of slavery to justify their system.

Assignments

We remember that *validity* is a property of the argument's **form**. It doesn't matter what the premises and the conclusion actually say. It just matters whether the argument has the right form. So, in particular, a valid argument *need not* have true premises, nor need it have a true conclusion. The following is a valid argument:

> All cats are reptiles.
> Bugs Bunny is a cat.
> So Bugs Bunny is a reptile.

Neither of the premises of this argument is true. Nor is the conclusion. But the premises are of such a form that *if they were both true*, then the conclusion would also have to be true. In other words,

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> ***An argument is valid if there is no way for the conclusion not to be true while the premises are true.***

Thus, in order to evaluate an argument as either valid or invalid, we must think of a possible situation in which an argument's premises are true and its conclusion is not true. This is called a **counterexample** to the argument. We may define validity more briefly simply by saying that a valid argument is one without a counterexample.

When we speak of possible situations, the term 'possible' is to be understood in a very wide sense. To be possible, a situation need not be something we can bring about; it doesn't even have to obey the laws of physics. It just has to be something we can *coherently conceive* – that is, it has to be thinkable and describable without self-contradiction.

So, to tell whether an argument is valid, we try to imagine a possible situation in which its premises are true and the conclusion is untrue. If we succeed (that is, if we can describe a counterexample), the argument is invalid.

We appeal to counterexamples almost unconsciously in everyday life. Consider this mundane argument:

> They said on the radio that it's going to be a beautiful day today.
> So, it *is* going to be beautiful today.

One natural (even though a bit cynical) reply is, 'they could be wrong.' This reply demonstrates the invalidity of the argument by describing a counterexample – that is, a possible situation in which the conclusion ('It's going to be a beautiful day today') is untrue, even though the premise ('They said so on the radio') is true: namely, the situation in which the forecasters are simply wrong.

A counterexample need not be an actual situation, though it might; it is enough that the situation be conceptually possible. So it need not be *true* that the forecasters are wrong; to see the invalidity of the argument, we need only realize that this is *possible*.

To give a counterexample, then, is merely to tell a kind of story. The story needn't be true, but it must be conceptually coherent (thinkable and describable).

Exercise A: Classify the following arguments as valid or invalid. For those that are invalid, describe a counterexample. Take each argument as it stands; don't alter the problem by, for example, adding premises.

Example:
> Sandy is not a man.
> So Sandy is a woman.
> _____
> Invalid:
> Counterexample: Sandy is neither a man nor a woman, but a hamster.

Argument 1:   All charged particles have mass.
              Neutrons are particles that have mass.
              So neutrons are charged particles.

Argument 2:   If there is a power failure, the computer will not work.
              The computer is not working.
              So there is a power failure.

Argument 3:   Sally does not believe that Peter stole the cake.
              So Sally believes that Peter did not steal the cake.

Argument 4:   We need to raise some money for our club.
              Having a bake sale would raise money.
              So we should have a bake sale.

Argument 5:   All mathematical truths are knowable.
              All mathematical truths are eternal.
              So all that is knowable is eternal.

Argument 6:   Some fools are greedy.
              Some fools are lecherous.
              So there are some fools that are both lecherous and greedy.

Argument 7:   No one has ever lived for 200 years.
              So no one ever will.

Argument 8:   DNA contains the code of life.
              Life is sacred.
              So it is wrong to manipulate DNA.

Argument 9:   If there is a hedgehog in my gas tank, then my car will not start.
              My car will not start.
              So there must be a hedgehog in my gas tank.

Argument 10: If I publicly insult my mother-in-law, then my wife will be angry at me.
              I will not insult my mother-in-law.
              Hence, my wife will not be angry at me.

Argument 11: Either Rabaul is in PNG, or it is in Australia.
Rabaul is in PNG.
So, Rabaul is not in Australia.

Argument 12: Your high idle is caused either by a problem with the transmission, or by too little oil, or both.
You have too little oil in the car.
Therefore, your transmission is fine.

Argument 13: If the moon is made of green cheese, then cows jump over it.
The moon is made of green cheese.
Therefore, cows jump over the moon.

Argument 14: Either Mr. X or Ms Y is the culprit.
Ms Y is not the culprit.
Therefore, Mr. X is the culprit.

Argument 15: All engineers enjoy dancing.
All engineers are men.
Therefore, all men enjoy dancing.

Argument 16: Only crows are black.
John is black.
Therefore, John is a crow.

Argument 17: All crows are black.
John is black.
So, John is a crow.

Argument 18: Anyone who lives in Rabaul, also lives in PNG.
Peter lives in PNG.
Therefore, Peter lives in Rabaul.

Argument 19: Anyone who lives in Port Moresby, also lives in PNG.
Peter does not live in Port Moresby.
Therefore, Peter does not live in PNG.

Argument 20: Anyone who lives in the city of Mt. Hagen, also lives in the Highlands.
Saina does not live in the city of Mt. Hagen.
Therefore, Saina does not live in the Highlands.

Exercise B   Read the following argument and determine the type of fallacy it commits:

Money:
It can buy you a house, but not a Home.

It can buy you a bed, but not Sleep.
It can buy you a clock, but not Time.
It can buy you a book, but not Knowledge.
It can buy a position, but not Respect.
It can buy you medicine, but not Health.
It can buy you blood, but not Life.
It can buy you sex, but not Love.

So, you see, money isn't everything! And it often causes pain and suffering.
I am telling you this because I am your Friend, and as your Friend, I want to take away your pain and suffering…
So, send me all your money, and I will suffer for you – CASH ONLY, PLEASE!!! ☺

Exercise C   What are the 'dishonest' tactics described in the following joke??? ☺

Persuasive Strategies

I argue very well. Ask any of my remaining friends. I can win an argument on any topic, against any opponent. People know this, and steer clear of me at parties. Often, as a sign of their great respect, they don't even invite me. You too can win arguments. Simply follow these rules:

1. Drink Liquor

Suppose you are at a party and some hotshot intellectual is expounding on the economy of Peru, a subject you know nothing about. If you are drinking some health-fanatic drink, like grapefruit juice, you'll hang back, afraid to display your ignorance, while the hotshot enthrals your date. But if you drink several large martinis, you'll discover you have STRONG VIEWS about the Peruvian economy. You'll be a WEALTH of information. You'll argue forcefully, offering searing insights and possibly upsetting furniture. People will be impressed!

3. Make Things Up

Suppose, in the Peruvian economy argument, you are trying to prove that Peruvians are underpaid, a position you base solely on the fact that YOU are underpaid, and you are damned if you are going to let a bunch of Peruvians be better off. DON'T say: "I think Peruvians are underpaid." Say: "The average Peruvian's salary in 2000 dollars adjusted for the revised tax base is $1,452.81 per annum, which is $836.07 before the mean gross poverty level."

NOTE: Always make up exact figures.

If an opponent asks where you got your information, make THAT up, too. Say: "This information comes from Dr. Hovel T. Moon's study for the Buford Commission, published May 9, 2001. Didn't you read it?" Say this in the same tone of voice you would use to say, "You left your soiled underwear in my bathroom."

4. Use meaningless, but weighty-sounding words and phrases

Memorize this list:

> Let me put it this way
> In terms of
> Vis-à-vis
> Per se
> As it were
> Qua
> So to speak

You should also memorize some Latin abbreviations, such as "Q.E.D.," "e.g.," and "i.e." These are all short for "I speak Latin, and you do not."

Here's how to use these words and phrases. Suppose you want to say: "Peruvians would like to order appetizers more often, but they don't have enough money."
You never win arguments talking like that. But you WILL win if you say: "Let me put it this way. In terms of appetizers vis-à-vis Peruvians qua Peruvians, they would like to order them more often, so to speak, but they do not have enough money per se, as it were. Q.E.D."

Only a fool would challenge that statement.

5. Use Snappy and Irrelevant Comebacks
You need an arsenal of all-purpose irrelevant phrases to fire back at your opponents when they make valid points. The best are:

> You're begging the question.
> You're being defensive.
> Don't compare apples and oranges.
> What are your parameters?

This last one is especially valuable. Nobody, other than mathematicians, has the vaguest idea what 'parameters' means. Here's how to use your comebacks:

> You say, "As Abraham Lincoln said in 1873,…"
> Your opponent says, "Abraham Lincoln died in 1865."
> You say, "You're begging the question."

Or:

> You say, "Liberians, like most Asians…"
> Your opponent says, "Liberia is in Africa."
> You say, "You're being defensive."

So – that's it! You *now* know how to out-argue anybody!!! ☺

Appendix I

Two Main Categories of Logic

INDUCTION:	DEDUCTION:
Inductive reasoning is required when you cannot ascertain the absolute certainty of the conclusion based on the given evidence, but you can establish probability.	Deductive reasoning can be used when the premises (reasons, facts, evidence, etc.) prove WITH ABSOLUTE CERTAINTY that the conclusion is true, assuming that the premises are true.
Inductive ~ Terms & Concepts: Strength Probability Reasoning from diverse facts Generalization Arguments Hypothesis Arguments Analogical Arguments	**Deductive ~ Terms & Concepts** Validity Truth of premises Soundness Certainty Reasoning from known facts (or ASSUMED known facts) Conditional Arguments Syllogisms