IF

Conditionals and Arguments

Concepts

- Conditional
- Antecedent and Consequent
- Necessary and sufficient conditions: how to identify
- Biconditional
- Contrapositive
- Corresponding conditional
- Argument
- Premises and Conclusions: how to identify

- Deductive and Inductive arguments: how they differ
- Validity
- Soundness
- Logical form
  - Logical and non-logical expressions
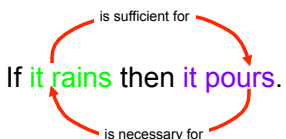 - Substitution instance: how to identify
  - Method of counterexample

Conditionals

- A conditional is an if-then sentence:
  "If .... , (then) ....

- In a conditional the clause that follows the "if" is the *antecedent*; the other clause is the *consequent*.

- Example: If it rains then it pours.

  antececent   consequent

Necessary & Sufficient Conditions

- The state of affairs described in the antecedent is asserted to be a *sufficient* condition on the state of affairs described in the consequent.

- The state of affairs described in the consequent is asserted to be a *necessary* condition on the state of affairs described in the antecedent

  is sufficient for

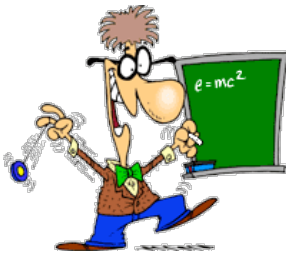 If it rains then it pours.

  is necessary for

Necessary & Sufficient Conditions

- "Necessary" and "sufficient" mean exactly what you think they mean!

- "Necessary" means "required"
  - Being 21 is a **necessary** condition for drinking legally in California.

- "Sufficient" means "enough"
  - A blood alcohol level of exactly 0.08 is a **sufficient** condition on being legally drunk in California.

Let's try some examples!

Necessary or sufficient?

1. Being a tiger is a _____ for being an animal.
2. Being an animal is a _____ condition for being a tiger
3. Drinking water is a _____ condition for quenching one's thirst.
4. Having a racket is a _____ for playing tennis.
5. Pulling the cork is a _____ for drinking an expensive bottle of wine.

I said *expensive* wine.

Not the kind that comes with screw caps.

Necessary or sufficient?

1. Stepping on a cat's tail is a _____ condition for making the cat yowl.
2. Burning leaves is a _____ condition for producing smoke.
3. Paying attention is a _____ condition for understanding a lecture.
4. Taking a swim in the North Sea is a _____ for cooling off.
5. Opening a door is a _____ for crossing the threshold.

Antecedent is sufficient for consequent

(1) If someone is a mother then they're female

- If you know that someone is a mother that is *enough* to show that the person is female therefore being a mother is a **sufficient** condition on being female.

- Being a mother is **not** a **necessary** condition on being female since you can be female without being a mother.

Consequent is necessary for antecedent

(1) If someone is a mother then they're female

- Being female *is* **necessary** for being a mother: if someone is not female they can't possibly be a mother.

- Thus (1) says that being a mother is a **sufficient** condition on being female and being female is a **necessary** condition on being a mother.

Antecedent sufficient
Consequent necessary

In general, for any conditional whatsoever, the antecedent is a sufficient condition on the consequent and the consequent is a necessary condition on the antecedent.

Sometimes it's not obvious

(2) If you study then you pass

(3) If you didn't pass then you couldn't have studied

- Passing is necessary for studying? Huh???

- Yes! Forget about tense.

- (2) and (3) are logically equivalent: (3) is the **contrapositive** of (2)

If P then Q <--> contrapositive: If not-Q then not-P

Something can be both

- There is a difference between necessary and sufficient conditions

- Example: in (1), being a mother is sufficient, but not necessary, for being female while being female is necessary but not sufficient for being a mother.

- **BUT**: some times one thing is **both** necessary and sufficient for something else.

Biconditionals

- (4) For any integers x and y, xy is odd if and only if both x and y are odd

- (4) says that the oddness of xy is both necessary and sufficient for the oddness of both x and y.

- Statements of necessary and sufficient conditions like (4) are two way conditionals: each of the conditions is necessary and sufficient for the other.

- The standard strategy to prove such **biconditionals** is to prove that the first condition is sufficient for the second and then that the second is sufficient for the first.

Both antecedent and consequent are false but the conditional is true!

- (5) If Ralph Nader is elected then I'll eat my hat.

- (6) Ralph Nader will be elected, therefore I will eat my hat.

- Someone who asserts (5) is convinced that neither the antecedent nor the consequent is true--he is betting *against* Ralph Nader!

- (6) is not a conditional but an argument..

- **The difference between conditionals and arguments is the BIG IF:**

- **In an argument both the premises and the conclusion are *asserted*— put forth as true.**

- **In a conditional *neither* the antecedent nor the consequent is asserted.**

ARGUMENTS

Argument

- A group of statements, one or more of which (the *premises*) are claimed to provide evidential reasons to believe one of the others (the *conclusion*)

- Factual claim: premises are *asserted*, i.e. put forth as true.

- Inferential claim: premises provide *evidential reasons* to believe the conclusion.

Example of an argument

1. All men are mortal.

2. Socrates is a man.

3. [therefore] Socrates is mortal.

1 and 2 are premises;

3 is the conclusion.

Not everything is an argument

- **"A string of statements asserting or clarifying…views does not an argument make"**

- **Not an argument:** "I hate Bush. Every time I see his face I want to step on it." (assertion)

- **Not an argument:** "I can't stand Hillary. She's such a Woman of the '80s--you can imagine her in a power-suit with shoulder-pads out to *there* and a scarf tied in a bow as a pretend necktie." (clarification)

- **Not an argument:** "I don't like Obama or McCain either."(statement in the interest of being Fair and Balanced)

Symptoms of an argument

- Premise indicators
  - Since
  - Because
  - …
- Conclusion indicators
  - Therefore
  - So
  - It follows that
  - …

An argument is as an argument does!

- An argument makes an inferential claim

- "The easiest way to identify an argument is to find the conclusion."

- Ask: "What claim is the writer or speaker trying to get me to accept?"

Example of an argument

Poverty offers numerous benefits to the nonpoor. Antipoverty programs provide jobs for middle-class professionals in social work, penology, and public health. Such workers' future advancement is tied to the continued growth of bureaucracies dependent on the existence of poverty. (J. John Palen, *Social Problems*)

Conclusion

Poverty offers numerous benefits to the nonpoor. Antipoverty programs provide jobs for middle-class professionals in social work, penology, and public health. Such workers' future advancement is tied to the continued growth of bureaucracies dependent on the existence of poverty. (J. John Palen, *Social Problems*)

Conclusion: what the arguer wants to prove

- The conclusion is typically less obvious, more controversial than premises

- Premises are what we assume the hearer *already* believes

YOU WANT PROOF? I'LL GIVE YOU PROOF!

More arguments…

Since the good, according to Plato, is that which furthers a person's real interests, it follows that in any given case when the good is known, men will seek it.

More arguments…

Premise indicator →
Since the good, according to Plato, is that which furthers a person's real interests

Conclusion indicator →
it follows that in any given case when the good is known, men will seek it.

Look for indicator words. This argument includes both a premise indicator and a conclusion indicator. But be careful because these are just clues!

More arguments…

To every existing thing God wills some good. Hence, since to love any thing is nothing else than to will good to that thing, it is manifest that God loves everything that exists.

------Thomas Aquinas

More arguments…

To every existing thing God wills some good.

Conclusion indicator →
Hence, since to love any thing is nothing else than to will good to that thing, it is manifest that God loves everything that exists.

Premise indicator

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Look for indicator words. This argument includes both a premise indicator and a conclusion indicator. But be careful because these are just clues!

More arguments…

To every existing thing God wills some good. Hence, ~~since~~ to love any thing is nothing else than to will good to that thing it is manifest that God loves everything that exists.

------Thomas Aquinas

"Hence" really attaches to "it is manifest…" so this is the conclusion.

More arguments…

Neither a borrower nor a lender be
For loan oft loses both itself and friend
And borrowing dulls the edge of husbandry

------William Shakespeare

Sometimes it helps to paraphrase. Don't think of the conclusion as a piece of text, but as the proposition that the arguer wants to prove— which you can state in your own words.

More arguments…

Don't borrow or lend stuff, because if you lend stuff to a friend, lots of times you don't get it back and that breaks up the friendship. And borrowing makes you a careless manager.

------Shakespeare made easy

This is the conclusion. On quizzes/tests when I ask you to identify the conclusions of arguments, paraphrase is ok.

More arguments…

Since private property helps people define themselves, since it frees people from mundane cares of daily subsistence, and since it is finite, no individual should accumulate so much property that others are prevented from accumulating the necessities of life.

Don't get hung up on premise and conclusion indicators or other textual clues. Remember what an argument is supposed to do, viz. to convince the hearer of something he doesn't already believe.

More arguments…

Since private property helps people define themselves, since it frees people from mundane cares of daily subsistence, and since it is finite, no individual should accumulate so much property that others are prevented from accumulating the necessities of life.

So the conclusion is typically less obvious and more controversial than the premises. The conclusion of this argument is clearly controversial!

Deductive and Inductive Arguments

- Difference in inferential claim

- Deductive: premises are supposed to force (necessitate, guarantee) the conclusion

- Inductive: premises are just supposed to make conclusion probable

- NOTE: deductiveness and inductiveness are a matter of what is *supposed* to happen--not all arguments do what they're supposed to do!

Example: Inductive Generalization

Premise: 32% of all Nielson households watch The Simpsons.

Conclusion: 32% (+/- 2%) of all American households watch The Simpsons

- This is a good inductive argument because the sample is large and fair

- The premise can't force the conclusion because there's more information in the conclusion!

Inductive Generalization

Sample: Nielson Households

Target: All Households
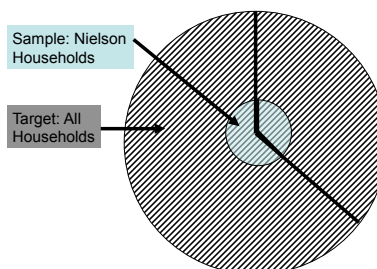
Other kinds of inductive arguments

- **Analogical induction** ("Argument from analogy")
  - X and Y both have property 1.
  - X has property 2.
  - Therefore, Y probably has property 2 also.
- **Abduction** ("Argument to the best explanation")
  - P
  - E is the best explanation for P
  - Therefore E

Argument from analogy

- Example
  - My Nissan Sentra is very reliable--209,000+ miles on the clock and it hasn't given me a lick of trouble!
  - Therefore your Nissan Sentra will probably do good for you.
- The Argument from Analogy for Other Minds is probably the most famous analogy argument in philosophy.

X and Y both have Property #1

We look pretty much the same, behave pretty much the same and both of us have brains.

X has property #2

Cogito, ergo sum

I think!

Y has property #2

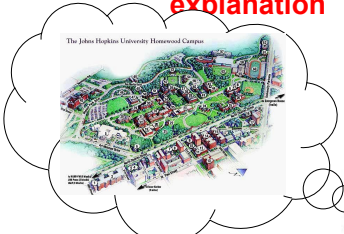Therefore, (probably) he thinks too!

Abduction: inference to the best explanation

My experience is coherent, predictable (but sometimes surprising) and sometimes comes to me against my will

Abduction: inference to the best explanation

The best explanation for this is that there's an external world causing my experiences.

Abduction: Inference to the Best Explanation

Therefore, there the external world probably exits!

Inductive Arguments

- There's supposed to be information in the conclusion that's not in the premises

- So even in a good inductive argument the premises don't *necessitate* the conclusion

- I.e. it is *logically possible* for the premises to be true and the conclusion false

- Even though that's improbable

Deductive Arguments

- Premises are supposed to *necessitate* ("force," "guarantee") the conclusion

- A deductive argument is **valid** if this really happens: the premises *really do* necessitate the conclusion

- Validity is "internal" to the argument: it concerns the connection between premises and conclusion *whether they're true or not.*
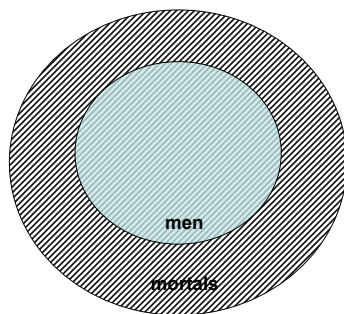
Validity

- The premises necessitate (force, guarantee) the conclusion
- It is not logically possible for the premises to be true and the conclusion false ("There is no possible world at which the premises are true and the conclusion is false")
- It is *truth-preserving*: IF the premises are true then the conclusion must be true
- There is no information in the conclusion that's not in the premises ("The conclusion is 'contained' in the premises")
- It is not possible to represent the premises without representing the conclusion
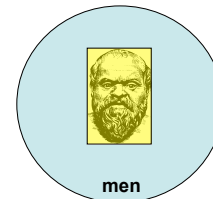
A valid argument

1. All men are mortal.
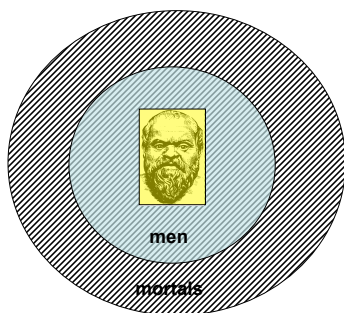2. Socrates is a man.
3. [therefore] Socrates is mortal.

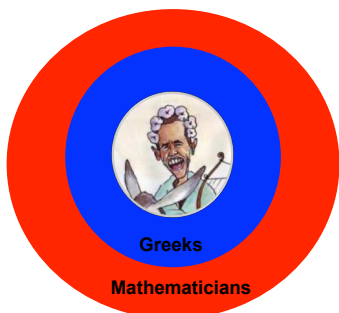## All men are mortal

Socrates is a man

Socrates is mortal

Stupid arguments can be valid!

1. All Greeks are mathematicians
2. Obama is a Greek
3. [Therefore] Obama is a mathematician

$a^2 + b^2 = c^2$

Same form as Socrates Argument!

Greeks

Mathematicians

Soundness

- Validity + all true premises

- So sound arguments have true conclusions too

- The Obama argument is *valid* but not *sound*!

Conditionals can be parts of arguments

(7) If you study then you'll pass. If you pass then you'll graduate. Therefore if you study you'll graduate.

(8) If a number is even then it's divisible by 2 without a remainder. 4 is divisible by 2 without a remainder. Therefore, 4 is even.

Conditionals, Arguments & Inferences

- Like arguments, conditionals may express inferences.
- *A conditional by itself is not an argument*.
- Difference: when you put forth an argument you commit yourself to the truth of all its parts--even if "only for the sake of the argument."
- When you assert a conditional, you do not commit yourself to the truth of either its antecedent or its consequent.
- The whole conditional can be true even if both its antecedent and consequent are false.

Corresponding Conditional

- For any given argument, the conditional that is formed by taking the conjunction (the "and-ing") of its premises as the antecedent and the conclusion of the argument as its consequent is the corresponding conditional to that argument.
- The corresponding conditional to an argument is the conditional that expresses the same inference as the argument.

Corresponding Conditional

Argument	Conditional
1. All men are mortal	If all men are mortal
2. Socrates is a man	and Socrates is a man
3. Therefore, Socrates is mortal	then Socrates is mortal

Not an argument!

Validity and Necessary Truth

- The Socrates argument is **valid**

- Its corresponding conditional is **necessarily true**

- In general, an argument is valid if and only if its corresponding conditional is necessarily true.

Validity is a matter of form

1. All men are mortal
2. Socrates is a man
3. Socrates is mortal

1. All Greeks are mathematicians
2. Obama is a Greek
3. Obama is a mathematician

Both arguments are **substitution instances** of this form ⟶

1. All S are P
2. *X* is an S
3. *X* is a P

Validity and Truth Value

- **Valid**

  – True premises/ true conclusion (sound)

  – False premises/ false conclusion

  – False premises/ true conclusion

- **Invalid**

  – True premises/true conclusion

  – False premises/ false conclusion

  – False premises/true conclusion

  – **True premises/ false conclusion**

Ruled out for valid arguments by definition

Logical form

- Logical expressions: all, no, some, are, not, and, or, if-then, if and only if . . .

- Non-logical expressions: "content" words, e.g. men, mortal, mathematician, Greek, Socrates, Obama . . .

- We can't give a firm list of logical expressions apart from a system of formal logic that studies the their behavior so for now we'll leave it intuitive.

Same logical form

- Same logical expressions
- Same pattern of same non-logical expressions

So, what's the logical form of *this*?

Same logical form

All dogs are mammals

All mammals are vertebrates

All dogs are vertebrates

All ants are insects

All insects are arthropods

All ants are arthropods

Different logical form

All dogs are mammals

All mammals are vertebrates

All dogs are vertebrates

All cats are vertebrates

All mammals are vertebrates

All cats are mammals
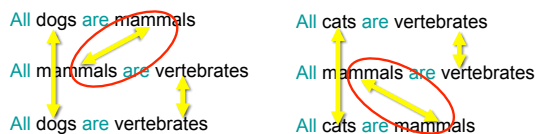
Validity is a matter of form

- If two arguments are of the same form then they're either both valid or both invalid

- Is this true?

- No. But we will *define* "validity" as "formal validity" to *make* it true.

Valid but not formally valid

George is a bachelor
_____

Therefore, George is not married

Why not formally valid?

George is a bachelor	Ducati is a dog
George is not married	Ducati is not warm-blooded

The argument at left is valid but its validity doesn't come from its form. *We resolve to ignore such arguments!*

We *stipulate* that from now on "valid" means "formally valid"!

Given our definition of validity…

- Arguments of the same form are the same as regards validity/invalidity
  - So, if one argument of a given form is invalid, so are all other arguments of the same form
- If an argument has all true premises and a false conclusion then it *must* be invalid

The Method of Counterexample

- To test an argument for validity, we try to find another argument of the same form that has all true premises and a false conclusion.
- If we can find such an argument then, given our definition of validity, the original argument is shown to be invalid
- If we can't, it shows nothing!

Counterexample

Argument C is a counterexample to Argument A iff

1. A and C are substitution instances of the same logical form, and

2. C has all true premises and a false conclusion

If an argument has a counterexample then it is invalid!

Example

1. **All dogs are vertebrates**	1. **All x > 2 are x > 1**
2. **All mammals are vertebrates**	2. **All x > 10 are x > 1**
3. **All dogs are mammals**	3. **All x > 2 are x > 10**

These arguments are of the same form so must be the same as regards validity/invalidity. The argument at the right must be invalid because it has all true premises and a false conclusion so the argument at the left must be invalid also. The argument at the right is a "counterexample" to the argument at the left.

So, what do I have to know about this stuff for the quiz?

- Arguments and conditionals (see handout)

- How to recognize the conclusions of arguments (multiple choice)

- Determining when 2 arguments are of the same form, when one is a counterexample to another, and what that shows about (in)validity.