

# Conditional statements and valid arguments

Phil 12: Logic and Decision Making  
Winter 2010  
UC San Diego  
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# Announcements

- Due to forces beyond my control, sections A01 (Wed 10am) and A04 (Wed 2pm) have been cancelled
- Remaining sections:
  - A02 (Wed 11am), Room TBD
  - A03 (Wed 1pm), Room TBD
- Check email or Google Group for new section rooms
- Make sure your student ID is entered into clicker
- See Google Group for info about web exercises & questions

# Review

- Statements are sentences that have a truth value—are either true or false
- Conditional statements (*IF A, THEN B*)
  - Truth conditions:  
false when antecedent = T, consequent = F
  - *IF A, THEN B = IF NOT B, THEN NOT A.*
  - What follows *only if* is the consequent
  - *Unless = If not*

# Preview

- Today we'll cover:
  - more on conditional statements
  - arguments
    - validity and soundness
    - arguments using conditional statements

# Sufficient Conditions

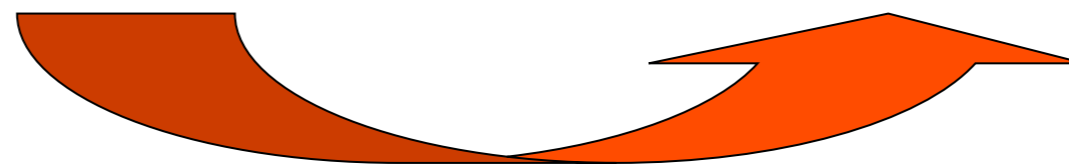
- When a conditional statement uses general terms (e.g., *dog*, *mammal*) it expresses relations between categories of things that satisfy those terms

*If something is a dog, then it is a mammal*

Presents a relation between *being a dog* and *being a mammal*

It asserts that meeting the first condition (being a dog) suffices for meeting the second condition (being a mammal)

If \_\_\_\_\_, then \_\_\_\_\_



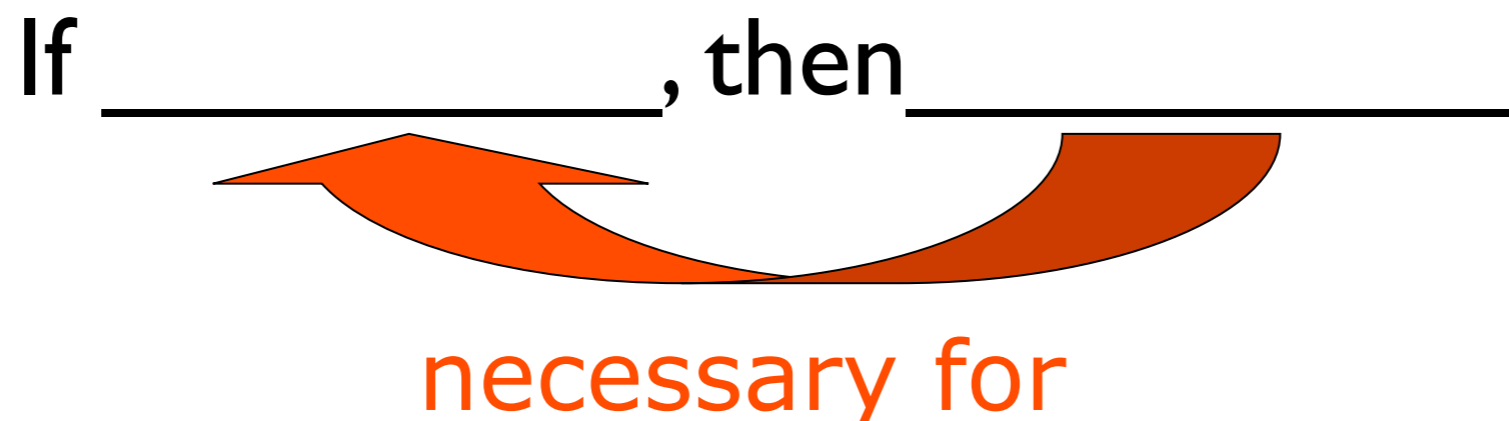
suffices for

# Necessary Conditions

- Since a true conditional statement cannot have a true antecedent and a false consequent, the consequent of a conditional expresses something that is necessary if the antecedent is true

*If something is a dog, then it is a mammal*

Asserts that meeting the second condition (**being a mammal**) is necessary for meeting the first condition (**being a dog**)



# *If vs. Only If* again

- What follows the *if* of a conditional is a *sufficient* condition
- What follows *only if* is a *necessary* condition
  - *You can vote only if you are at least 18 years old*

Being 18 is a necessary condition for voting
  - *If you are able to vote, then you are at least 18 years old*

Being able to vote is sufficient (evidence) that you are at least 18 years old

# Clicker question 1

Consider the statement:

*Unless you go to medical school, your parents won't be happy.*

*You go to medical school is:*

- A. a necessary condition for your parents' being happy
- B. a sufficient condition for your parents' being happy
- C. neither necessary nor sufficient for your parents' being happy
- D. both necessary and sufficient condition for your parents' being happy



# Clicker question 2

The statement:

*Taking the SAT is a necessary condition for being admitted to UCSD*

is false if:

- A. Someone takes the SAT and is admitted to UCSD
- B. Someone takes the SAT and is not admitted to UCSD
- C. Someone does not take the SAT and is admitted to UCSD
- D. Someone does not take the SAT and is not admitted to UCSD

# Arguments and justification

- If someone asserts something which you do not believe, you frequently ask them to justify what they say
- An argument is a set of statements, some of which are offered as support for other statements in the set
- An argument provides reasons to believe something
- An argument need not involve another person: you can construct an argument to demonstrate that something is true without showing it to anyone

# Elements of Arguments

- Premises are the statements offered in support of a conclusion, i.e., the statement you're supposed to believe
- Premises are often indicated by words such as:
  - *because, since, given that, on account of, etc.*
- Conclusions are indicated by words such as:
  - *thus, therefore, hence, this establishes that, etc.*

# Good and bad arguments

- We don't just care whether the conclusion is true
- We also want to know whether the reasons stated in the premises give us good logical grounds for thinking that the conclusion is true
- The goal is not actual persuasion (people can be persuaded for bad reasons), but establishing the truth
- Two factors relevant to the evaluation of arguments:
  1. Are the premises true?
  2. Is the connection between the premises and the conclusion such that: if the premises were true, would they establish that the conclusion is true?

# Valid arguments

- An argument is valid iff it meets the following condition: if the premises were true, the conclusion must also be true
  - A valid argument cannot have true premises and a false conclusion
- This relationship is modal: it tells us what would be the case were certain conditions to be met
  - These conditions might not be satisfied in reality
  - The definition tells you nothing about what happens when they are not satisfied
- A way to test for validity: if you can imagine a situation in which the premises are true and the conclusion false, then the argument is not valid

# Sound arguments

- An argument is sound iff:
  1. the premises are true
  2. the argument is valid
- This definition of a sound argument does not say anything about the truth of the conclusion
  - But the conclusion of a sound argument must be true
- A sound argument meets both of the desiderata of a good argument:
  - True premises
  - Valid

# Clicker question 3

True or false: A valid argument cannot have a false conclusion.

T

F

# Clicker question 4

True or false: A sound argument cannot have a false conclusion.

T

F



# Clicker question 5

True or false: An argument with a true conclusion is sound.

T

F

# Using conditionals in arguments

There are two ways to use a conditional statement in a *valid* inference:

- The first, obvious way:

Start with **If A, then B**

Affirm **A**

From this it follows that **B**

– Why?

- If B weren't true, and A is true, then **If A, then B** would be rendered false

- So the following argument form is valid:

If A, then B

A

∴ B

***Modus ponens***

# Using conditionals in arguments

There are two ways to use a conditional statement in a *valid* inference:

- The second, less obvious way:

From **If A, then B**, what happens if **B** is denied?

If **B** is false and **A** is true, then what is the truth value of **If A, then B**?

It is false. Thus **A** cannot be true when the whole conditional is true.

- So the following argument form is valid:

If A, then B

Not B

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∴ Not A

***Modus tollens***

# Uses of conditional arguments in scientific reasoning

- *Modus ponens* is most commonly invoked to make predictions from a hypothesis

If malaria is transmitted by mosquitoes and we eliminate the mosquitoes, then malaria will decline.

Malaria is transmitted by mosquitoes and we are eliminating the mosquitoes.

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∴ Malaria will decline.

- *Modus tollens* is most commonly invoked to confirm or falsify a hypothesis based on the truth or falsity of a prediction

# Invalid conditional arguments

- Not all arguments starting with conditional statements are valid
- What can you conclude (validly) from:

If A, then B  
Not A  

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?

*Denying the Antecedent*  
**INVALID**

- Remember, to be valid, it must be that *if the premises were true, the conclusion would also have to be true*
- What conclusion has to be true in this case?
  - Both **B** and **not B** are compatible with the premises
  - There is no valid argument here!