Phil2100 Lecture Notes

Hurley, Chapter 1

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Contents

1 What is Logic?

Example: Show that Socrates is mortal

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

Example: No one has freewill

1. Everything that happens in the universe is governed by scientific laws
2. Scientific laws require that everything that happens is necessary and could not have been otherwise
3. a person acts freely only if they could have done otherwise
4. So, no one acts freely

Definition 1.1. **Logic**: the study of inference or reasoning. Informal logic studies reasoning in ordinary language. Formal logic is the study of reasoning in a formal (symbolic) language.

Arguments in Ordinary Language Here is another. Former Secretary of Defense, Donald Rumsfeld, was once asked during a press hearing to comment on the view that there was no tie between officials in Baghdad and Al Qaeda. He had this to say in response.

> Reports that say that something hasn't happened are always interesting to me, because as we know, there are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns - the ones we don't know we don't know.[1]

Mathematical Proofs

1	$p \to \Box p$	Anselm: perfection cannot exist contingently
2	$\neg\Box\neg p$	Anselm: perfection is not impossible
3	$\Box p \to p$	Modal axiom
4	$\Box p \wedge \neg\Box p$	Principle of Excluded Middle
5	$\neg\Box p \to \Box\neg\Box p$	Becker's postulate instance
6	$\Box p \wedge \Box\neg\Box p$	4, 5 substitution
7	$\Box\neg\Box p \to \Box\neg p$	1 modal modus tollens
8	$\Box p \wedge \Box\neg p$	6, 7 substitution
9	$\Box p$	8, 2 disjunctive syllogism
10	p	9, 3 modus ponens

[1] Source: BBC News "Rum remark wins Rumsfeld an award" - http://news.bbc.co.uk/2/hi/3254852.stm

Visual Arguments Even though arguments are usually implicit. They do not have to be written or spoken. An argument is being made here - the advertisers are trying to convince the viewer of something, and they are offering something in

Figure 1: An Advertisement for the US Military.

2 Why Study Logic?

1. Going to Grad School / Law School? reasoning portions of entrance tests (GRE, LSAT) are logic tests
2. Going into Philosophy? Logic is a requirement for just about any work in Analytic Philosophy, with the exception of ethics and political philosophy
3. Continuing with Computer Science, Linguists, Mathematics? Good foundation for proofs. (Also See PHIL3030 - Symbolic Logic)
4. For All: studying logic helps improves your reasoning abilities

3 How to Study Logic?

1. Attend all the lectures
2. Pay attention to the nuances of definitions
3. Memorize definitions!
4. Do all the assigned homework exercises; more if necessary
5. Seek help right away if you are not clear on the material
6. Bring problem questions from the exercises in class
7. Do not fall behind.
8. You can omit historical notes in the readings. They are, however, recommended for philosophy majors and the curious.

4 The Structure of an Argument (Ch 1.1)

Definition 4.1. **Argument**: a group of statements (the premise) which are claimed to provide support for, or reasons to believe, another statement (the conclusion).

Definition 4.2. **Inference** (narrow): the reasoning process expressed by an argument

1. All men are mortal ← Premise
2. Socrates is a man ← Premise

   ---

3. So, Socrates is mortal ← Conclusion

Definition 1: Properties of Arguments

Thesis 4.3. The premises support the conclusion.

Thesis 4.4. The premises are reasons for the conclusion

Thesis 4.5. The premises and conclusion are statements that are true or false

Thesis 4.6. The premises and the conclusion can be usually identified by Indicator Words

An Argument in Ordinary Discourse

Premise Indicators	Conclusion Indicators
since	therefore
because	so
for	entails
given that	hence
for the reason that	consequently
owing to	it follows that
due to	as a result

Terminological Warning: In this course, 'sentence', 'statement' and 'proposition' will be used interchangeably even though in the literature they each have a different technical meaning.

I.I.6: "The fact that there was never a land bridge between Australia and mainland Asia is evidenced by the fact that the animal species in the two areas are very different. Asian placental mammals and Australian marsupial mammals have not been in contact in the last several million years."

I.I.17: An ant releases a chemical when it dies, and its fellows then carry it away to the compost heap. Apparently the communication is highly effective; a healthy ant painted with the death chemical will be dragged to the funeral heap again and again.

http://www.youtube.com/watch?v=v3Afr-zI8Ys

5 Deduction and Induction (Ch 1.3)

Definition 2: Two Kinds of Arguments

Definition 5.1. **Deductive Argument**: an argument where it is impossible that the conclusion be false given that the premises are true.

Definition 5.2. **Inductive Argument**: an argument where it is improbable for the conclusion to be false given that the premises are true.

Note that each definition can be reworded: (Deductive) an argument where necessarily the conclusion is true given that the premises are true. (Inductive) an argument where the conclusion is probably true given that the premises are true.

5.1 Example

Deductive Argument

1. All entertainers are extroverts
2. David Letterman is an entertainer

   ———————

3. Therefore, David Letterman is an extrovert

Inductive Argument

1. The vast majority of entertainers are extroverts
2. David Letterman is an entertainer

   ———————

3. Therefore, David Letterman is an extrovert

Definition 3: Recognizing a deductive or inductive Argument

Thesis 5.3. The actual strength (necessary or probable) of the inferential ink between premises and conclusions.

Thesis 5.4. the deductive **argument forms**. If the argument does not fit into common deductive forms, it is likely to be inductive.

Arguments by Definition

1. Claudio doesn't tell the truth.
2. 'mendacious' means not telling the truth.
3. Therefore, Claudio is mendacious

Categorical Syllogism A set of three statements placing objects/persons into categories/groups.

1. All cats are mammals.
2. All mammals are animals

   ---

3. Therefore, all cats are animals

Disjunctive Syllogism Either —— or ——. statement paired with two other statements in which one alternative is eliminated and we are left with the remaining alternative.

1. Either we pay the rent or we will be evicted
2. We did not pay the rent

   ---

3. Therefore, we will be evicted

Argument from Analogy

1. Fish, animals and humans are all created by a being.
2. So, there must be someone who created the universe

Generalization

1. one orange in the crate is tasty.
2. So, all oranges in the crate are tasty.

Argument from Authority

1. Scientists say that global temperatures are rising
2. So, global temperatures are rising.

6 Validity, Truth, Soundness and Cogency (Ch 1.4)

Whatever can be said is going to fall under three categories: deductive argument, inductive argument or not an argument at all. The last category includes exclamations, questions, expressions of emotions, and other forms of speech where the speaker does not try to convince you or argue for anything at all. If a speaker is attempting to convince you, then they will either try to give a deductive or an inductive argument. There are further sub-divisions under each of these types of categories.

6.1 Deductive Argument Forms

Definition 6.1. **Valid argument** = it is impossible for the conclusion to be false given that the premises are true. **Invalid** otherwise.

Definition 6.2. **Sound argument** = true premises, valid argument. Both conditions must be met for an argument to be sound. **Unsound** otherwise.

6.2 Deductive Arguments

All the Possible Kinds of Deductive Arguments Note that deductive arguments that have true premises and a false conclusion do not exist.
Here are the possible types of deductive arguments.

Properties	Valid	Invalid
True Premises True Conclusion	Ex 1	Ex4
True Premises False Conclusion	None	Ex5
False Premises True Conclusion	Ex2	Ex6
False Premises False Conclusion	Ex3	Ex7

Example 1: True Premises, True Conclusion

1. All wines are beverages
2. Chardonnay is a wine

---

3. So, Chardonnay is a beverage. **sound**

Example 2: False Premises, True Conclusion

1. All wines are soft drinks
2. Ginger ale is a wine

---

3. So, Ginger ale is a soft drink. **unsound**

Example 3: False Premises, False Conclusion

1. All wines are whiskeys
2. Ginger ale is a wine

---

3. So, ginger ale is a whiskey. **unsound**

Example 4: True Premises, True Conclusion

1. All wines are beverages
2. Chardonnay is a beverage

---

3. So, chardonnay is a wine. **unsound**

Example 5: True Premises, False Conclusion

1. All wines are beverages
2. Ginger ale is a beverage

---

3. So, Ginger ale is a wine. **unsound**

Example 6: False Premises, True Conclusion

1. All wines are whiskeys
2. Chardonnay is a whiskey

---

3. So, Chardonnay is a wine. **unsound**

Example 7: False Premises, False Conclusion

1. All wines are whiskeys
2. Ginger ale is a whiskey

---

3. So, Ginger ale is a wine. **unsound**

Definition 4: Properties of Arguments

Thesis 6.3. Whether or not an argument is valid can't be determined simply by looking at truth values of the premises and conclusion. One has to determine whether the links between the premises and conclusion is necessary.

Thesis 6.4. The only impossible combination in a valid argument is: true premises and a false conclusion.

Thesis 6.5. a set of sentences is either an argument or its is not (e.g. a set of questions). If it is an argument then it must purport to be a **deductive** argument or an **inductive** argument. If the argument purports to be deductive then it could be **valid** or **invalid**. If a valid argument has true premises then it is sound. If an argument purports to be inductive then it could be **strong** or **weak**. If it is strong and the premises are true then the argument is **cogent.**

6.3 Inductive Arguments

Definition 6.6. **Strong Inductive Argument** = improbable that the conclusion is false given that the premises are true. Weak otherwise.

Definition 6.7. **Weak Inductive Argument** = conclusion does not follow probably given that the premises are true

Definition 6.8. **Cogent Argument** = strong argument with all true premises. Not cogent otherwise.

6.4 Inductive Argument Forms

1. **Prediction**
   Since the Gators basketball team won this year, they will win next year.
2. **Argument from Analogy**
3. **Generalization**
   a pinch of salt dissolves in water, so all salt dissolves in water.
4. **Argument from Authority**
   Scientists say that global warming is a man-made phenomenon. Therefore, it is a man-made phenomenon.
5. **Causal Inference**
   A billiard ball is struck at a 45 degree angle. So, once struck it will travel at the same angle.

Properties	Strong	Weak
True Premises Probably True Conclusion	Ex 1	Ex4
True Premises Probably False Conclusion	None	Ex5
False Premises Probably True Conclusion	Ex2	Ex6
False Premises Probably False Conclusion	Ex3	Ex7

Example 1 (Strong): True Premise, Probably true conclusion

1. All previous US Presidents were older than 40

   ---

2. Therefore, probably the next US president will be older than 40. **cogent**

Example 2 (Strong): False Premise, Probably True Conclusion

1. All previous U.S. presidents were TV debaters

   ---

2. Therefore, probably the next US president will be a TV debates, **uncogent**

Example 3 (Strong): False Premises, Probably True Conclusion

1. All previous US presidents died in office

   ---

2. So, probably the next US president will dies in office. **uncogent**

Example 4 (Weak): True Premises, Probably True Conclusion

1. A few US presidents were lawyers

   ---

2. So, probably the next US president will be older than 40. **uncogent**

Example 5 (Weak): True Premises, Probably False Conclusion

1. A few US presidents were unmarried

   ---

2. Therefore, probably the next US president will be unmarried. **uncogent**

Example 6 (Weak): False Premise, Probably True Conclusion

1. A few US presents were dentists

   ---

2. Therefore, probably the next US president will be a TV debater. **uncogent**

Example 7 (Weak): False Premise, Probably False Conclusion

1. A few US presents were dentists

   ---

2. Therefore, probably the next US president will be a dentist. **uncogent**

Definition 5: Properties of Inductive Arguments

Thesis 6.9. Notice that there is only one type of sound, cogent argument: true premises, true conclusion.

Thesis 6.10. Strong arguments have a probability of 51% or greater.

Conclusion Indicators
improbable/probable
implausible
likely
reasonably

7 Argument Forms: Proving Invalidity (Ch. 1.5)

Here is a quick summary of the categories discussed thus far.

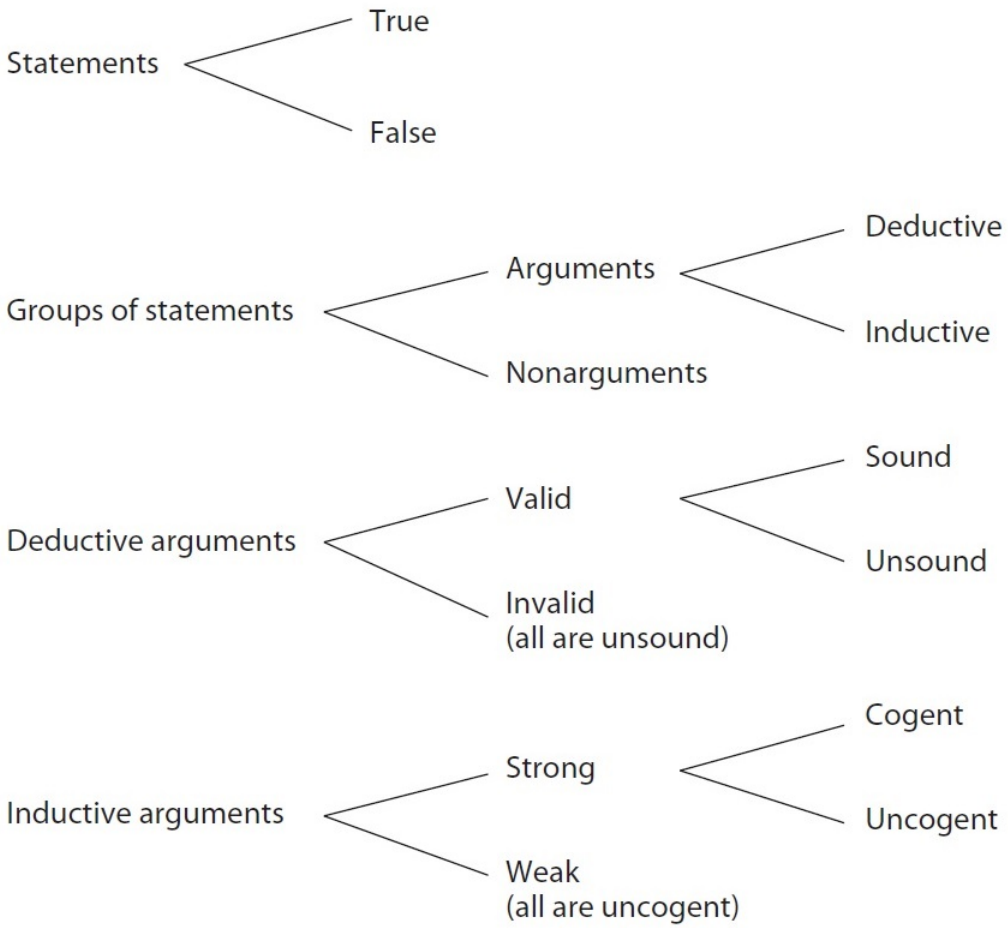

Figure 2: Arguments Categorized

Proving Invalidity
It is often not easy to tell, on first glance, whether an argument is invalid. We can use diagrams as aids (as we have been doing in class), but a more precise method exists, namely **the counter-example method**. The method dictates that we follow a number of steps to determine that a given argument is invalid.

Step 1 : Identify premises and the conclusion of the argument.
Step 2 : Identify the logical form of the argument i.e. symbolize argument
Step 3 : Attempt to find a substitution instance that yields an invalid argument
Step 4 : If a substitution instance is found, then the original argument is invalid; If substitution instance is not found, then no conclusion can be drawn.

Counter-Example Method - Example 1
Suppose someone says the following: "All daises are plants, since all daises are flowers and all flowers are plants."

Step 1: Identify premises and the conclusion

1. All daisies are flowers.
2. All flowers are plants.
3. Therefore, all daisies are plants

Step 2: Identify the logical form i.e. symbolize argument

1. All D are F
2. All F are P
   ———-
3. All D are P

Note: we are symbolizing terms (words/phrases) and leaving logical words intact
Step 3: Find a substitution instance that yields an invalid argument (False conclusion, True premises)

1. All D are F
2. All F are P
   ———-
3. All D are P

For instance, if we choose **D** — "dogs'; **P** — "puddles", this makes the conclusion: All dogs are puddles; this statement for us "in this world" is false, because, of course, some dogs are not puddles. So, we have a false conclusion, but now, we need to choose a meaning for the term **F** so that the premises turn out true. But, there is no way to do that. Try it out: let's say **F** means "animals", so the first premise is true — All dogs are animals — but now the second premise says "All animals are puddles", is false. We could try a different "F" or "D" or "P", but they won't work, now matter how many instances we accumulate.

Step 4: What does this show about the argument we started with? In this case, since we did not find an invalid substitution instance, nothing is shown. In particular, we cannot conclude, via this method, that the original argument is valid.

Counter-Example Method: Example 2
Suppose someone says the following: "Since all dogs are fast, and cats are fast, it follows that all turtles are fast."

Step 1: Identify premises and the conclusion

1. All dogs are fast
2. All cats are fast

   ———————

3. So, All turtles are fast

Step 2: Identify the logical form i.e. symbolize argument

1. All D are F
2. All C are F

   ———————

3. So, All T are F

Step 3: Find a substitution instance that yields an invalid argument (False conclusion, True premises)
Example: **F** — fake, **T** — teeth, **D** — dentures, **C** — toupees. Again, the idea is to start from the conclusion of the symbolized argument, and pick F and T so that the conclusion is false. In this case, 'F' = fake and 'T' = teeth, so the conclusion, "All teeth are fake" is false because for us, in this world, most teeth are not fake. We can then choose D and C so that both premises turn out to be true. If we choose 'D' = dentures, and 'C' = toupees, we get the following argument with true premises and a false conclusion.

1. All dentures are fake
2. All toupees are fake.

   ———————

3. So, All teeth are fake

Step 4: Since we found a substitution instance of the symbolized argument that is invalid i.e. that has true premises and a false conclusion, we can definitely conclude that the argument we started with is **invalid**.

Note on what the method yields: The counter-example method cannot be used to show that an argument is valid. We simply do not conclude anything, if we cannot find an invalid substitution instance. If we do find a substitution instance, then we can be sure the original argument is invalid.

Note on Step 3: It is easier if you begin by substituting terms in the conclusion by choosing two terms that make it false, and then proceed to try to find appropriate terms that make all premises true.

Note on Symbolization: the following logical patterns will aid symbolization step:

1. All . . . are . . . (dots typically stand for terms ('dogs') or phrases ("US Presidents"))
2. Some . . . are . . . (typically stand for terms ('dogs') or phrases ("US Presidents"))
3. Some . . . are not . . . (dots typically stand for terms ('dogs') or phrase ("US Presidents"))
4. Not . . . (dots typically, but not always, stand for a sentence)
5. If . . . then . . . (dots typically stand for a sentence)
6. Either . . . or . . . (dots typically, but not always, stand for a sentence)
7. . . . and . . . (dots typically, but not always, stand for a sentence)

Determine using the counter-example method whether the following arguments are invalid.

Example 1

> If Alexander the Great died from typhoid fever, then he became infected in India. Alexander the Great did not die from typhoid fever. Therefore, he was not infected in India.

Step 1: Identify the premises and conclusion

1. if Alexander the Great died from typhoid fever then he became infected in India.
2. Alexander the Great did not die from typhoid fever

---

3. So, he was not infected in India.

Step 2: Identify logical form i.e. symbolize argument ** The sentence "Alexander the Great **did not** die from typhoid fever" is translated as "It is not the case that Alexander the Great died from typhoid fever" or NOT A, where A — Alexander the Great died from typhoid fever.

1. if A then B
2. Not A

---

3. So, Not B

Step 3: Find substitution instance that yields invalid argument (False conclusion, True premises)
B — Abe Lincoln was shot; so the conclusion now reads "it is not the case that Abe Lincoln was shot", which for us in this world is false, because Abe Lincoln was shot. Now we need a reading of "A" that makes both premises true. So, Let's say 'A' – "George Belic shot Abe Lincoln". That clearly makes premise 2 true; George Belic did not shot Abe Lincoln is true. And, premise 1 also turns out to be true: if George Belic shot Abe Lincoln then Abe Lincoln was shot. So, with our choice of "A" and "B" we have found a substitution instance that has true premises and a false conclusion.

1. if A then B
2. Not A

---

3. So, Not B

Step 4: Since we found a substitution instance for the symbolized argument, we can conclude that the original argument about Alexander the Great is **invalid**.

Example 2

> All diabetes victims are either insulin takers or glucose eliminators. Accordingly, some diabetes victims are glucose eliminators, since some diabetes victims are insulin takers. (Ex. 1.5.II.9)

1. All D are I or G
2. Some D are Is

   ———————
3. So, Some D are Gs

Note that "Some" as used in logic means "at least one" - there is no upper bound just a lower bound i.e. there can't be none and there has to be one or more.

Example 3 No patrons of fast-food restaurants are health-food addicts. Consequently, no patrons of fast-food restaurants are connoisseurs of fine desserts, since no connoisseurs of fine desserts are health-food addicts.

Step 2:

1. No P are H
2. No C are H

   ————-
3. No P are C

Step 3:

1. No dogs are fish. (T)
2. No mammals are fi sh. (T)

   ————-
3. No dogs are mammals. (F)