

**HAWASSA
UNIVERSITY,
SCHOOL OF LAW**

Introduction to Logic

1. What is Logic?

- Logic from Greek Word '**Logos**'
- '**Logos**' **Reason**, so **Logic** is **reason**.
- Reasoning is a **transition in thought**, where some beliefs (or thoughts) provide the ground or reason for coming to another (J.E. Adler)
- Consider an Example from Jim's belief

What is Logic?, Cont'd...

- From **his beliefs** that
- **(1)** Either Bill **receives an A or a B** on the final.
And
- **(2)** Bill **does not receive an A**. Jim infers that
- **(3)** Bill **receives a B**.
- Assuming that Jim bases his inference on the deductive relation of (1) and (2), to (3), **believing that (1) and (2) are true**, the truth of his conclusion, i.e (3) is warranted.

What is Logic?, Cont'd...

- **Logic** may be defined as the science that evaluates arguments (Hurley)
- logic is a ***discipline of philosophy*** which is basically concerned with the **formulation of principles** which correct our reasoning processes (Teaching Material)

Logic as a “Science”

- Aims at developing ***a system*** of **methods and principles** used as ***criteria*** for evaluating the arguments
- Sets systematic rules that help **evaluate** arguments

Evaluate Arguments

- Daily encountered with arguments from different sources
- Some people **think well, and argue well**; some do not
- distinguish **good arguments from bad**
- **Source** of difference
- How to ***improve*** it?
- What **went wrong** with a certain argument?

Evaluate Arguments, Cont'd...

- Evaluate the ***following group of statements***
- All crimes are violations of the law.
Theft is a crime.
Therefore, theft is a violation of the law
- Some crimes are misdemeanors.
Murder is a crime.
Therefore, murder is a misdemeanor
- What, do you think, is **basic difference** between these two groups of statements? ***Are they arguments?***

Argument?

- An **argument** is a *group of statements*, one or more of which (the premises) are ***claimed to provide support*** for, or ***reasons to believe***, one of the others (the conclusion)
- Statements that **claim to provide support** (premises)
- A statement **that is supported** (Conclusion)

Argument, Cont'd...

- The **premises** are the statements that set forth the reasons or evidence
- the **conclusion** is the statement that the evidence is claimed to support or imply

Argument Cont'd...

- A **statement** is a
 - sentence that is ***either true or false***
 - **declarative sentence** or with that component
- Example:
 - Sun rises in the west.
 - Capital City of Ethiopia is Addis Ababa
- What is the ***truth value*** of these statements?
- List some ***sentences that cannot be a statement***, and explain why they cannot be statement

Argument, Cont'd...

- Sentences that cannot be statements include;
Questions, proposals,
suggestions, commands, an
exclamations

Eg.

- ✓ Let's go to the park today (a proposal)
- ✓ What is your name? (a Question)
- ✓ Oh my God! (an exclamation)
- ✓ Don't use your cell phone in the class room
(Command)

Argument, Cont'd...

- ***All crimes are violations of the law.
Theft is a crime.
Therefore, theft is a violation of the law.***
- Are these sentences statement?
- Can they be grouped to form an argument?
- If so, which statements are premises, and which one is a conclusion?
- How **good** is this argument, if it is?

Argument, Cont'd...

- ***Some crimes are misdemeanors.
Murder is a crime.
Therefore, murder is a
misdemeanor.***
- What about this group of sentences?
- If this group is an argument, how good/bad is it?
- Why?

Argument, Cont'd...

- Identifying Premises/Conclusion
- Two ***techniques of distinguishing premises from conclusion***
 1. Indicator words
 2. Inference
- Indicator words,
 - Premises indicators or
 - conclusion indicators

Argument, Cont'd...

□ **Conclusion indicators**

□ Therefore
accordingly
conclude
entails that
thus
we may infer
whence
it follows that
as a result

wherefore
we may

hence
consequently
it must be that
so
implies that

Argument, Cont'd...

- Corporate raiders leave their target corporation with a heavy debt burden and no increase in productive capacity.
Consequently, corporate raiders are bad for the business community.
- **Rule:** A statement that **comes after** the conclusion indicator is a conclusion

Argument, Cont'd...

□ **premise indicators**

since

because

in that

from

as

seeing that

that

inasmuch as

as indicated by

for

may be inferred

given that

for the reason

owing to

Argument, Cont'd...

- Expectant mothers should never use recreational drugs, **since** the use of these drugs can jeopardize the development of the fetus.
- **Rule 1:** A statement/statements that follow premises indicator is/are premises
- **Rule 2:** Single premises indicator may be used to indicate more than one premises

Argument, Cont'd...

- The development of high-temperature superconducting materials is technologically justified, **for** such materials will allow electricity to be transmitted without loss over great distances, and they will pave the way for trains that levitate magnetically.
- **Caution:** Passages that contain arguments sometimes contain statements that are ***neither premises nor conclusion***

Argument, Cont'd...

- If a statement simply makes a passing comment, it should not be taken as a part of an argument.
- Example:
Socialized medicine is not recommended because it would result in a reduction in the overall quality of medical care available to the average citizen. In addition, it might very well bankrupt the federal treasury. This is the whole case against socialized medicine in a nutshell

Argument, Cont'd...

- **Use of Inference:** When an argument contains ***no indicators***
- **Use Inference:** by asking ***three questions***
 1. What single statement is claimed (implicitly) to follow from the others?
 2. What is the arguer trying to prove?
 3. What is the main point in the passage?
- Answer to this questions indicate a conclusion

Argument, Cont'd...

- **Use an Inference** to identify the conclusion of the following passage
- The space program deserves increased expenditures in the years ahead. Not only does the national defense depend upon it, but the program will more than pay for itself in terms of technological spinoffs. Furthermore, at current funding levels the program cannot fulfill its anticipated potential

Inference and Proposition

- An **inference**, in the technical sense of the term, is ***the reasoning process expressed*** by an argument.
- “Inference” is loosely used interchangeably with “argument.”
- Analogously, a **proposition**, in the technical sense, is the ***meaning or information content*** of a statement.
- Look at the following statements

Inference and Proposition, Cont'd...

- John believes that the proposition that the nearest ice cream store is on Broadway and 110th St is true.
- **John believes that the nearest ice cream store is on Broadway and 110th St.**
- For the purposes of this course, however, **“proposition”** and **“statement”** are used interchangeably.

Argument, Cont'd...

- **Premises** - Claimed Evidences
- **Conclusion** = What is claimed to follow from the evidences
- **Logic is a science that evaluates arguments.**

1.2 A Brief History of the Development of Logic

- The **father of logic** is the ancient Greek philosopher Aristotle (384–322 B.C.)
- First devised systematic criteria for analyzing and evaluating arguments.
- Aristotle cataloged a number of **informal fallacies**
- His logic is called **syllogistic logic**
- Evaluate the argument depending on **how the terms are arranged** in the argument

History, Cont'd...

- Greek philosopher, **Chrysippus** (279–206 B.C.)
- the founders of the **Stoic school**
- developed a logic in which the **fundamental elements were *whole propositions***
- treated every proposition as either true or false
- developed rules for determining the ***truth or falsity of compound propositions***

History, Cont'd...

- the Middle Ages was **Peter Abelard** (1079–1142)
- ***reconstructed and refined*** the logic of Aristotle and Chrysippus
- distinguished arguments that are **valid because of their form** from those that are **valid because of their content**

History, Cont'd...

- the Oxford philosopher **William of Occham** (ca. 1285–1349)
 - Devoted much of his attention to **modal logic**, a kind of logic that involves such notions as ***possibility, necessity, belief, and doubt***
 - conducted an exhaustive study of **forms of valid and invalid syllogisms**
 - contributed to the development of the higher-level language used to discuss linguistic entities such as words, terms, propositions, and so on

History, Cont'd...

- Gottfried Wilhelm **Leibniz** (1646–1716)
 - develop a **symbolic language** or “calculus” that could be used to settle all forms of disputes
 - Accordingly, called a ***father of symbolic logic***

History, Cont'd...

- Augustus **DeMorgan** (1806–1871), George **Boole** (1815–1864), William Stanley **Jevons** (1835–1882), and John **Venn** (1834–1923)
- Contributed to extremely rapid period of development that has continued to this day
- Contributed to development of **symbolic logic**
- some of whom are popularly known today by the logical theorems and techniques that **bear their names**

History, Cont'd...

- British philosopher John Stuart **Mill** (1806–1873)
- Initiated a revival in **inductive logic**
- Toward the end of the nineteenth century, the foundations of modern ***mathematical logic*** were laid by Gottlob **Frege** (1848–1925)

1.3 Fundamental Laws of Logic

- **The Law of Non-contradiction- P is not non- P**
- This law is the first law of thought, which advocates the fundamental notion that ***nothing can both be and not be at the same time and in the same respect.***
- The Law of Non-Contradiction - **that no contradiction can be true** - has been a seemingly unassailable dogma since the work of Aristotle

Fundamental Laws of Logic, Cont'd...

- Example, a blackboard may be white and not white at different times; however, it can never be otherwise at **the same time and in same situation**
- The proposition “***The sun rises in the east***” and “***The sun doesn't rise in the east***” cannot both be ‘true’ at the same time and in the same situation

Fundamental Laws of Logic, Cont'd...

- **The Law of excluded Middle: Either P or non-P**
- This law is the second law of thought, which propounds the principle that ***something either is or is not.***
- The law of excluded middle is the logical principle in accordance with which **every proposition is either true or false.**

Fundamental Laws of Logic, Cont'd...

- It is not possible, as an alternative to the law of excluded middle, to assert that ***some proposition is neither true nor false***
- This law states that either something is X or it is not X, white or not white, black or not black, etc...
- The proposition “**The sun rises in the east**” cannot be ***neither true nor false***.
- It is **either true or false**. There is no ***middle (truth) value***

Fundamental Laws of Logic, Cont'd...

- **The Law of identity: P is P**
- This law is the last law of thought, which states the notion that ***something is what it is***
- it says that the statement P is ***the same thing as itself*** and ***different from everything else***. (P is not non-P)

Fundamental Laws of Logic, Cont'd...

- Applied to all reality, the law of identity says that everything is itself and not something else
- **The sun is the sun. The sun is not non-sun.**
- (NB: Non-P is a logical expression used to indicate ***everything in the universe other than the P itself***).

Non-P

1.4 Recognizing Arguments

- Not all passages contain arguments.
- Because logic deals with arguments, it is important to be able to ***distinguish passages that contain arguments from those that do not***
- In general, a passage contains an argument if it **purports to prove something**
- When do we say a passage purports to prove something?

Recognizing Arguments, Cont'd...

- Two **conditions** must be fulfilled for a passage to purport to prove something:
 - (1) At least one of the statements must ***claim to present evidence or reasons (the premises)***
 - (2) There must be a claim that the alleged evidence or reasons ***supports or implies something***—that is, a claim that something follows from the alleged evidence (**the conclusion**)

Recognizing Arguments, Cont'd...

- It is not necessary that the **premises present actual evidence** or true reasons
- nor that the **premises actually support** the conclusion
- Expected is the premises must at least *claim* to present evidence or reasons
- That is, argument should contain at least the two claims; **Factual and Inferential Claim**

Recognizing Arguments, Cont'd...

- a **factual claim** is about the genuinity of evidences presented by premises in support of a conclusion
- an **inferential claim** is the claim that the passage expresses a certain kind of **reasoning process**
 - —that something supports or implies something or
 - that something **follows** from something.
 - An inferential claim can be either ***explicit or implicit***.
- Whether a **passage contains an argument** is determined by **evaluating its inferential claim**

Recognizing Arguments, Cont'd...

- **Three ways** to recognize arguments from non-arguments.
- By using **indicator words**
- By evaluating **inferential link**, if any (implicit inferential claim)
- By understanding **typical non-arguments** (passages lacking inferences)

Recognizing Arguments, Cont'd...

- By using **indicator words** (explicit inferential claim)
- A passage may contain a premise or a conclusion indicator, or both
- Example

The human eye can see a source of light that is as faint as an ordinary candle from a distance of 27 kilometers, through a non-absorbing atmosphere. **Thus**, a powerful searchlight directed from a new moon should be visible on earth with the naked eye

Recognizing Arguments, Cont'd...

- **NB:** The mere occurrence of an indicator word by no means guarantees the presence of an argument.
- Example:
Since Edison invented the phonograph, there have been many technological developments.
- **Since** Edison invented the phonograph, he deserves credit for a major technological development.
- In the first passage the word “since” is used in a *temporal* sense, in the second as a reason

Recognizing Arguments, Cont'd...

- By evaluating **inferential link**, if any (implicit inferential claim)
- Where the passage contains no indicator, check for **implicit inferential claim** that shows an **inferential relationship** between the statements in a passage.
- Example: *Freedom of press is one of the most important of our constitutionally guaranteed freedoms. Without it, other freedoms would be immediately threatened. Furthermore, it provides the fulcrum for the development of new freedoms.*

Recognizing Arguments, Cont'd...

- Example 2:
- The price reduction [seen with the electronic calculator] is the result of a technological revolution. The calculator of the 1960s used integrated electronic circuits that contained about a dozen transistors or similar components on a single chip. Today, mass-produced chips, only a few millimeters square, contain several thousand such components

Recognizing Arguments, Cont'd...

- NB: it is ***not always easy to detect the occurrence of an inferential relationship*** between the statements in a passage, so the reader may,
 - **review a passage several times** before making a decision.
 - **mentally insert the word “therefore”** before the various statements to see whether it makes sense to interpret one of them as a conclusion

Recognizing Arguments, Cont'd...

- By understanding **typical non-arguments**
- These Passages,
 - lack a claim that **anything is being proved**.
 - lack a claim that any potential **premise supports a conclusion** or that any potential **conclusion is supported** by premises
 - Include warnings, pieces of advice, statements of belief or opinion, loosely associated statements, reports, etc...

Recognizing Arguments, Cont'd...

- 1. A **warning** is a form of expression that is **intended** to put someone on guard against a dangerous or detrimental situation.
- Examples: **Watch out that you don't slip on the ice**
- 2. A **piece of advice** is a form of expression that ***makes a recommendation about some future decision*** or course of conduct

Recognizing Arguments, Cont'd...

- Examples:

You should ***keep a few things in mind*** before buying a used car. Test drive the car at varying speeds and conditions, examine the oil in the crankcase, ask to see service records, and, if possible, have the engine and power train checked by a mechanic.

- *I advice you to ***improve your behavior*** before you graduate*

Recognizing Arguments, Cont'd...

- 3. A **statement of belief** or **opinion** is an expression about what ***someone happens to believe or think*** at a certain time.
- Examples:
- *In my opinion, abortion is a crime against humanity*
- I think a nation such as ours, with its high moral traditions and commitments, ***has a further responsibility to know how we became drawn into this conflict***, and to learn the lessons it has to teach us for the future.

Recognizing Arguments, Cont'd...

- 4. **Loosely associated statements** may be about the ***same general subject***, but they ***lack a claim that one of them is proved*** by the others.

- **Example 1:**

Anything that a doctor does which requires cutting or injecting is a 'Procedure'. Anything that a doctor does which requires thinking or counseling is a "cognitive services".

Procedures pay much better than cognitive services.

Recognizing Arguments, Cont'd...

□ **Example 2:**

Not to honor men of worth will keep the people from contention; not to value goods that are hard to come by will keep them from theft; not to display what is desirable will keep them from being unsettled of mind

Recognizing Arguments, Cont'd...

- 5. A **report** consists of a group of ***statements that convey information*** about some topic or event.
- **Example:**
*“The Islamic forces in Somalia led by ‘Alshebab’ groups declared war to liberate Somalia from Ethiopian forces”
Aljezira, 2008*

Recognizing Arguments, Cont'd...

□ **Example 2:**

- Even though more of the world is immunized than ever before, many old diseases have proven quite resilient in the face of changing population and environmental conditions, especially in the developing world. New diseases, such as AIDS, have taken their toll in both the North and the South

Recognizing Arguments, Cont'd...

- **NB:** Though reports are not arguments, **they can report arguments**

Example:

“The Air Force faces a serious shortage of experienced pilots in the years ahead, **because** repeated overseas tours and the allure of high paying jobs with commercial airlines are winning out over lucrative bonuses to stay in the service,” says a ***prominent Air Force official***.

Recognizing Arguments, Cont'd...

- **6. Expository Passages** is a kind of discourse that ***begins with a topic sentence*** followed by one or more ***sentences that develop the topic*** sentence.
- If the **objective** is **not to prove** the topic sentence but only **to expand** it or elaborate it
- If the **purpose** of the **subsequent sentences** in the passage is ***not only to flesh out the topic*** sentence but **also to prove** it, then the passage is an argument

Recognizing Arguments, Cont'd...

- **Example 1:**

- *The speed of reading depends entirely upon the reader. He may read as slowly or as rapidly as he can or wishes to read. If he does not understand something, he may stop and read it, or go in search of elucidation before continuing*

Recognizing Arguments, Cont'd...

- **Example 2:**
- There are three familiar states of matter: solid, liquid, and gas. Solid objects ordinarily maintain their shape and volume regardless of their location. A liquid occupies a definite volume, but assumes the shape of the occupied portion of its container. A gas maintains neither shape nor volume. It expands to fill completely whatever container it is in.

Recognizing Arguments, Cont'd...

- **7. Illustrations** consist of a statement about a certain subject combined with a reference to one or more specific instances ***intended to exemplify*** that statement.
- **NB:** Illustrations are often confused with arguments because many of them contain **indicator words** such as “thus”
- **Example 1:**

Recognizing Arguments, Cont'd...

- Chemical elements, as well as compounds, can be represented by molecular formulas. **Thus**, oxygen is represented by “O₂,” water by “H₂O,” and sodium chloride by “NaCl.”
- **Example 2:**
- *Mammals are vertebrate animals that nourish their young with milk. For example, cats, horses, goats, monkeys, and humans are mammals*

Recognizing Arguments, Cont'd...

- **Caution:** as with expository passages, many illustrations can be taken as arguments. Such arguments are often called **arguments from example**
- **Water is an excellent solvent.** It can dissolve a wide range of materials that will not dissolve in other liquids. **For example**, salts do not dissolve in most common solvents, such as gasoline, kerosene, turpentine and cleaning fluids. But many salts dissolve readily in water. So do a variety of nonionic organic substances, such as sugars and alcohols of low molecular weight.

Recognizing Arguments, Cont'd...

- In deciding whether an illustration should be interpreted as an argument one must determine whether the passage **merely shows how something is done** or what something means, or ***whether it also purports to prove something***
- In borderline cases it helps to note whether the ***claim being illustrated is one that practically everyone accepts*** or agrees with

Recognizing Arguments, Cont'd...

□ 8. Explanations

- An **explanation** is a group of statements that ***purports to shed light*** on some event or phenomenon that is ***usually accepted as a matter of fact***

□ Example 1:

The *Challenger* spacecraft exploded after liftoff because an O-ring failed in one of the booster rockets

Recognizing Arguments, Cont'd...

□ **Example 2:**

The sky appears blue from the earth's surface because light rays from the sun are scattered by particles in the atmosphere

□ **Example 3:**

Cows can digest grass, while humans cannot, because their digestive systems contain enzymes not found in humans

Recognizing Arguments, Cont'd...

- Every explanation is composed of two distinct components: the ***explanandum and explanans***.
- The **explanandum** is the statement that describes the event or phenomenon to be explained, and
- the **explanans** is the statement or group of statements that purports to do the explaining
- **Caution: *Explanations are sometimes mistaken for arguments*** because they often contain the indicator word “because.”

Recognizing Arguments, Cont'd...

- **Explanation V. Argument**
- Difference in purpose: One is to ***shed light*** while the other intends to ***prove***
- Explanans intends to show ***why*** something is the case, while premises in argument aims at proving ***that*** something is the case
- Identify the statement that is either the ***explanandum or the conclusion*** and determine what it describes (**accepted matter of fact or a fact that require proof**)

Recognizing Arguments, Cont'd...

- **NB:** as with expository passages and illustrations, there are some passages that can be interpreted as ***both explanations and arguments***
- **Example:**
- Women become intoxicated by drinking a smaller amount of alcohol than men because men metabolize part of the alcohol before it reaches the bloodstream whereas women do not
- The purpose of this passage could be ***to prove the first statement*** to those **people who do not accept it** as fact, and ***to shed light*** on that fact to those who do accept it

Recognizing Arguments, Cont'd...

- **Conditional Statements**
- A **conditional statement** is an “if . . . then . . .” statement
- **Example:** If air is removed from a solid closed container, then the container will weigh less than it did.
- Every conditional statement is made up of two component statements.

Recognizing Arguments, Cont'd...

- The component statement immediately following the “if” is called the **antecedent**, and the one following the “then” is called the **consequent**.
- The above conditional statement asserts **a causal connection** between the air being removed and the container weighing less
- **NB:** not all conditional statements express causal connections

Recognizing Arguments, Cont'd...

- **Conditional Statements and Argument**
- 1. Conditional statements are not arguments, because in it,
 - there is ***no claim*** that either the antecedent or the consequent presents evidence
 - there is **no assertion** that either the antecedent or the consequent is **true**
 - there is only the assertion that ***if the antecedent is true, then so is the consequent***

Recognizing Arguments, Cont'd...

- 2. A conditional statement as a whole ***may present evidence*** because it asserts a relationship between statements
- As such, a conditional statement may serve as either the ***premise or the conclusion*** (or both) of an argument
- **Example 1:**

Recognizing Arguments, Cont'd...

- If cigarette companies publish warning labels, then smokers assume the risk of smoking.
Cigarette companies do publish warning labels.
Therefore, smokers assume the risk of smoking
- **Example 2:**
- If banks make bad loans, then they will be threatened with collapse.
If banks are threatened with collapse, then the taxpayer will come to the rescue.
Therefore, if banks make bad loans, then the taxpayer will come to the rescue

Recognizing Arguments, Cont'd...

- 3. The **inferential content** of some conditional statement may be re-expressed to form an argument

- **Example 1:**

- **A conditional statement**

If both Saturn and Uranus have rings, then Saturn has rings.

- **Re-Expressed**

Both Saturn and Uranus have rings.
Therefore, Saturn has rings.

Recognizing Arguments, Cont'd...

□ **Example 2:**

A conditional statement

If iron is less dense than mercury, then it will float in mercury.

Re-expressed Argument

Iron is less dense than mercury.
Therefore, iron will float in mercury.

Recognizing Arguments, Cont'd...

□ **A conditional statement V. Argument, Summary**

1. A single conditional statement is not an argument
2. A conditional statement may serve as either the premise or the conclusion (or both) of an argument
3. The inferential content of a conditional statement may be reexpressed to form an argument

Recognizing Arguments, Cont'd...

- Conditional statements express the relationship between ***necessary and sufficient conditions***
- ***A sufficient Condition***
- ***A*** is said to be ***a sufficient condition for B*** whenever the occurrence of ***A*** is ***all that is needed for the occurrence of B***
- *Depriving air is a sufficient cause for death.*
- *If someone is deprived of breathing, then he dies.*

Recognizing Arguments, Cont'd...

- **Necessary Condition**
- *B* is said to be a necessary condition for *A* whenever ***A cannot occur without the occurrence of B***
- **Example:**
- *Breathing air is a necessary condition for life.*
- *If someone is alive, then he has an access to the breathing air.*
- If *X* is not an animal, then *X* is not a dog.

Necessary or Sufficient? From Hurley

- Being a tiger is _____ a condition for being an animal.
- Being an animal is a _____ condition for being a tiger.
- Drinking water is a _____ condition for quenching one's thirst.
- Burning leaves is a _____ condition for producing smoke.
- Paying attention is a _____ condition for understanding a lecture.