CSE 4201

Ethical Issues and Professional Practice in Computing

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Critical Reasoning and Logical Arguments

- Critical reasoning tools, especially *argument analysis*, can help us to resolve many of the disputes in cyberethics.
- A logical argument, or *argument*, is a form of reasoning comprising various *claims*, or *statements*.

Logical Arguments

An *argument* can be defined as a:

form of reasoning that attempts to establish the truth of one claim (called a *conclusion*) based on the assumed truth of the evidence in other claims (called *premises*) provided to support the conclusion.

Arguments (Continued)

- As a “form of reasoning,” or reasoning form/ structure, an argument has two important characteristics or features worth noting; it:

i. includes *at least two **claims*** (but can include an indefinite number of claims),

ii. aims at establishing a ***conclusion*** (i.e., the truth of one claim) based on evidence provided by one or more other claims, called *premises*.

The Structure of an Argument

- Premise 1
- . optional
- . optional
- Premise N optional
- Conclusion

Note that this particular form/structure (i.e., where the premises are listed before the conclusion) is called the *standard form*.

Argument Structure (Continued): Converting an Argument to Standard Form

- **Premise 1**. When I recently visited the Computer Science Department at the University of Hiroshima I noticed that graduate students and professors there were field testing a new computer chip, whose code name is Chip X.
- **Premise 2**. I have a copy of the design specifications for Chip X, which shows that it will be several times faster than any chip currently available in the US.
- **Premise 3**. Lee Smith, a mutual colleague of ours who was recently an exchange student in the computer science program at the University of Hiroshima and who participated in the field testing of Chip X, will corroborate my account.
- **Conclusion**. Chip X is currently being developed in Japan.

Argument *Structure* vs. Argument *Strength*

- Not all arguments are strong – i.e., not all arguments succeed in establishing their conclusions.
- Any form of reasoning will qualify as an argument *if* it satisfies the three conditions we specified above.
- Analyze the following argument and ask yourself whether it is a strong argument – i.e., does it establish its conclusion?

Argument Structure vs. Argument Strength (Continued)

- **Premise 1**. An author's freedom to write a book on how to build a bomb is one that is protected by the First Amendment.
- **Premise 2**. Authoring a book is similar to constructing a Web Site.
- **Conclusion**. Constructing a Web site on how to build a bomb ought to be protected by the First Amendment.

Argument Structure vs. Argument Strength (Continued)

- Analyze the following argument:

- **Premise**: The Internet is in public space.
- **Conclusion**: Those who use the Internet should not expect to retain any personal privacy while online.

- Is this argument strong – i.e., does it succeed in establishing its conclusion?
- Later, we will see why this argument is very weak (in this case, “fallacious”).
- So, we can see why it is important to separate an argument’s structure from its strength.

Constructing an Argument in Ordinary Language (Prose)

Consider the following argument that is expressed in prose (or narrative) form:

> We must build a *national missile defense system* (NMD) because without such a system we are vulnerable to nuclear attacks from rogue nations that might arise in the future. Additionally, several engineers and computer scientists have testified that they can design a computer-guided missile defense system that is effective, safe and reliable. Furthermore, it is our obligation as Americans to take whatever measures we can to protect the safety of our citizens.

Converting the Preceding Argument into Standard Form

- **Premise 1.** Without the new National Missile Defense System, the U.S. is vulnerable to nuclear attacks in the future from "rogue nations.
- **Premise 2.** Computer scientists and engineers have testified that they can design a computer-guided missile defense system that is both safe and reliable.
- **Premise 3.** The U.S. must do whatever is necessary to preserve the military defense of the nation and the safety of its citizens.
- **Conclusion.** Therefore, the U.S. should build the new National Missile Defense System.

Counterexamples to Arguments

- A *counterexample* is:

  a possible case where the premises in an argument can be imagined to be true while, at the same time, the conclusion could still be false

- Note that if an argument is valid, no counterexample is possible.

Valid and Invalid Arguments The Counterexample Strategy (Continued)

- Because a counterexample to the NMD argument is possible, it is *invalid*.
- For example, one can imagine a case where all of the premises in that argument are assumed true, while the argument's conclusion could still be imagined to be false.
- However, it is also possible to revise or reconstruct the NMD argument by adding another premise.

The NMD Argument Revised

- **Premise 1.** Without the new National Missile Defense System, the U.S. is vulnerable to nuclear attacks in the future from "rogue nations.
- **Premise 2.** Computer scientists and engineers have testified before Congress that they can design a computer-guided missile defense system that is both safe and reliable.
- **Premise 3.** The U.S. must do whatever is necessary to preserve the military defense of the nation and the safety of its citizens.
- **Premise 4.** The national missile defense system is necessary to preserve the defense and safety of the U.S. and its citizens.
- **Conclusion.** Therefore, the U.S. should build the new National Missile Defense System.

The Form of a Valid Argument

- A valid argument is valid solely in virtue of its *logical form*, not its content.
- An example of a valid logical form is:

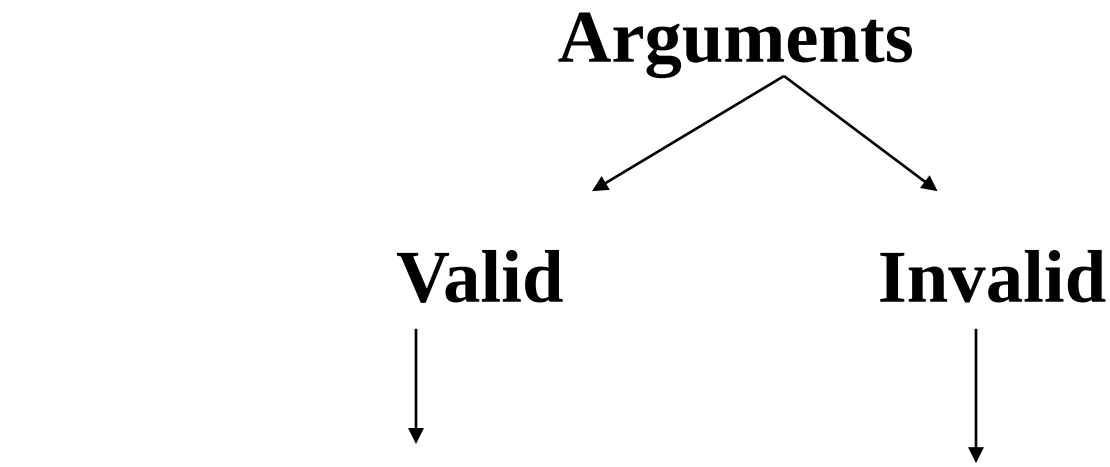
  PREMISE 1. Every A is a B.

  PREMISE 2. C is an A.

  CONCLUSION. C is a B.

- No matter what values are substituted for A, B, and C, the argument form is always valid.

Valid and Invalid Arguments



The assumed truth of the premises is sufficient to guarantee the conclusion.

Premises (even when true) do not guarantee the conclusion.

Examples: Are these valid?

1. Elizabeth owns either a Honda or a Saturn.
   Elizabeth does not own a Honda.
   Therefore, Elizabeth owns a Saturn.

2. All toasters are items made of gold.
   All items made of gold are time-travel devices.
   Therefore, all toasters are time-travel devices.

PREMISE 1. Every A is a B.

PREMISE 2. C is an A.

CONCLUSION. C is a B.

Valid Arguments that are not Sound

- An argument can be valid (in virtue of its logical *form*), but still not succeed in accomplishing its task.
- For example, one or more of the (valid) argument's premises might not be true in the actual world.
- In this case the argument would still be valid, but it would not be *sound*.

Sound and Unsound Arguments

- For an argument to be *sound*, it must satisfy two conditions – i.e., it must be:

a) valid (i.e., the *assumed* truth of the premises would guarantee the truth of the argument's conclusion);

b) the (valid) argument's premises must also be *true in the actual world*.

Arguments that are Valid and Unsound

- The following argument is valid, but unsound:

PREMISE 1. People who own iPhones computers are smarter than those who own Droids.

PREMISE 2. My roommate owns an iPhone.

PREMISE 3. I own a Droid.

CONCLUSION. My roommate is smarter than me.

Sound Arguments

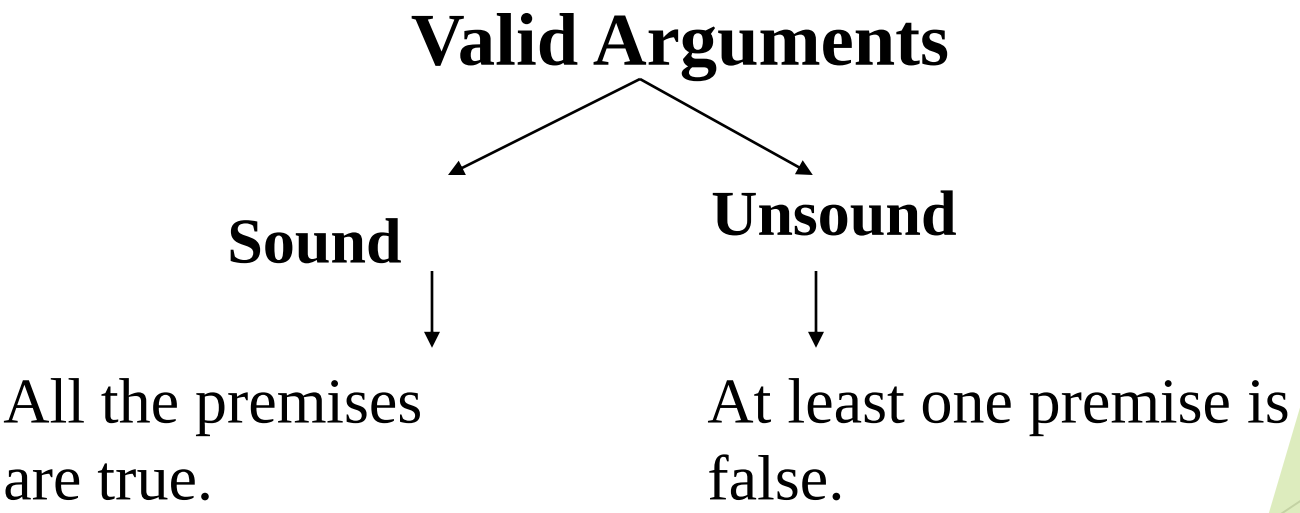
- Sound arguments are very rare; the following argument is sound:

PREMISE 1. CEOs of major computer corporations are high-school graduates.

PREMISE 2. Bill Gates was the CEO of a major computer corporation.

CONCLUSION. Bill Gates is a high-school graduate.

Sound and Unsound Arguments



Are these Arguments Sound?

1. In some states, no felons are eligible voters, that is, eligible to vote.
   In those states, some professional athletes are felons.
   Therefore, in some states, some professional athletes are not eligible voters.
2. A sound argument is one that is not only valid but begins with premises that are actually true.

Examples of Valid Forms

- All tigers are mammals.
  No mammals are creatures with scales.
  Therefore, no tigers are creatures with scales.
- All spider monkeys are elephants.
  No elephants are animals.
  Therefore, no spider monkeys are animals
- These arguments share the same form:

  All A are B;
  No B are C;
  Therefore, No A are C.

Examples of Invalid Forms

- All basketballs are round.
  The Earth is round.
  Therefore, the Earth is a basketball.
- All popes reside at the Vatican.
  John Paul II resides at the Vatican.
  Therefore, John Paul II is a pope.
- These arguments also have the same form:

  All A's are F;
  X is F;
  Therefore, X is an A.

Examples of Other Forms

- My table is circular. Therefore, it is not square shaped.
- Juan is a bachelor. Therefore, he is not married.
- These arguments, at least on the surface, have the form:

x is F;
Therefore, x is not G.

Arguments of this form are not valid as a rule. However, it seems clear in these particular cases that it is, in some strong sense, *impossible* for the premises to be true while the conclusion is false.

Logical forms that are not easy to discern

- (1) Tony is a ferocious tiger.
  (2) Clinton is a lame duck.

- Despite their apparent similarity, only (1) has the form "x is a A that is F." From it one can validly infer that Tony is a tiger. One cannot validly infer from (2) that Clinton is a duck. Indeed, one and the same sentence can be used in different ways in different contexts

Consider

- (3) The King and Queen are visiting dignitaries.

- It is not clear what the logical form of this statement is. Either there are dignitaries that the King and Queen are visiting, in which case the sentence (3) has the same logical form as "The King and Queen are playing violins," or the King and Queen are themselves the dignitaries who are visiting from somewhere else, in which case the sentence has the same logical form as "The King and Queen are sniveling cowards." Depending on which logical form the statement has, inferences may be valid or invalid

Invalid Arguments: Inductive vs. Fallacious Reasoning

- An argument is *invalid* if you can give one counterexample to the argument.
- We saw that a *counterexample* is

  a possible case where the premises can be assumed to be true while, at the same time, the conclusion could be false (Nolt).

- Invalid arguments will be either:

a) *inductive*,
b) *fallacious*.

Invalid Arguments (Continued)

- The following argument is invalid because a counter example is possible:

PREMISE 1. All CEOs of major United States computer corporations have been United States citizens.

PREMISE 2. Bill Gates is a United States citizen.

CONCLUSION. Bill Gates has been a CEO of a major computer corporation in the U.S.

Inductive Arguments

- An argument is *inductive* when:

  the conclusion would likely be true when the premises of the argument are assumed to be true.

- Even though a counterexample to an inductive argument is possible, the argument's conclusion would likely be true in the majority of cases where the premises are assumed true.

Inductive Arguments (Continued)

- The following is an example of an inductive argument:

PREMISE 1. Most CEOs of computer corporations are college graduates.

PREMISE 2. Satya Nadella is the CEO of Microsoft, a computer corporation.

CONCLUSION. Satya Nadella is a college graduate.

Fallacious Arguments

- An argument is *fallacious* when:

  the argument's conclusion would not likely follow from its premises, even when all of the premises are assumed true.

- Multiple counterexamples to a fallacious argument can be provided.

Fallacious Arguments (Continued)

- Recall an argument we considered earlier:

- **Premise**: The Internet is in public space.
- **Conclusion**: Those who use the Internet should not expect to retain any personal privacy while online.
- We noted that the argument seemed weak.
- Now we can see why this argument is not only weak, but also *fallacious*.
- Note that we can apply *numerous counterexamples* that show why the conclusion would not likely be true even when the premise is assumed true.

Fallacious Arguments (Continued)

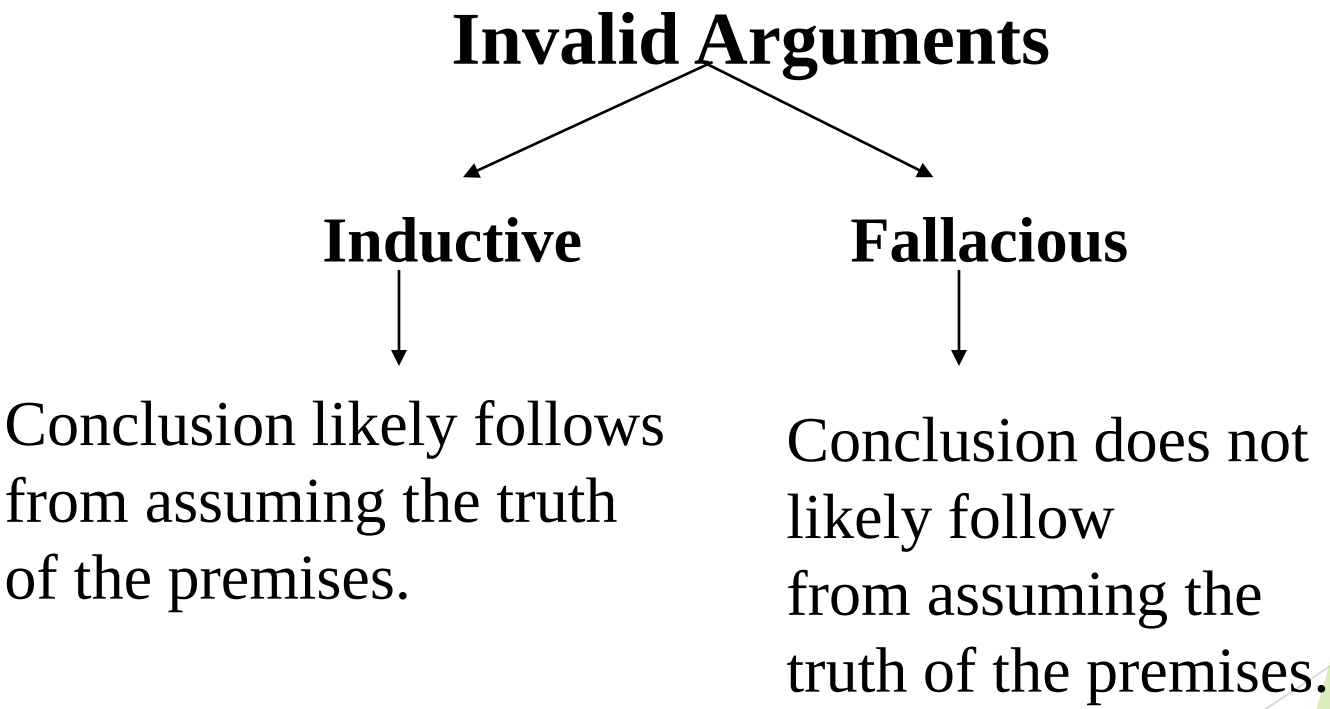
- The following reasoning form is an example of a fallacious argument:

PREMISE 1. Ten percent of people who own iPods also own iPhones.

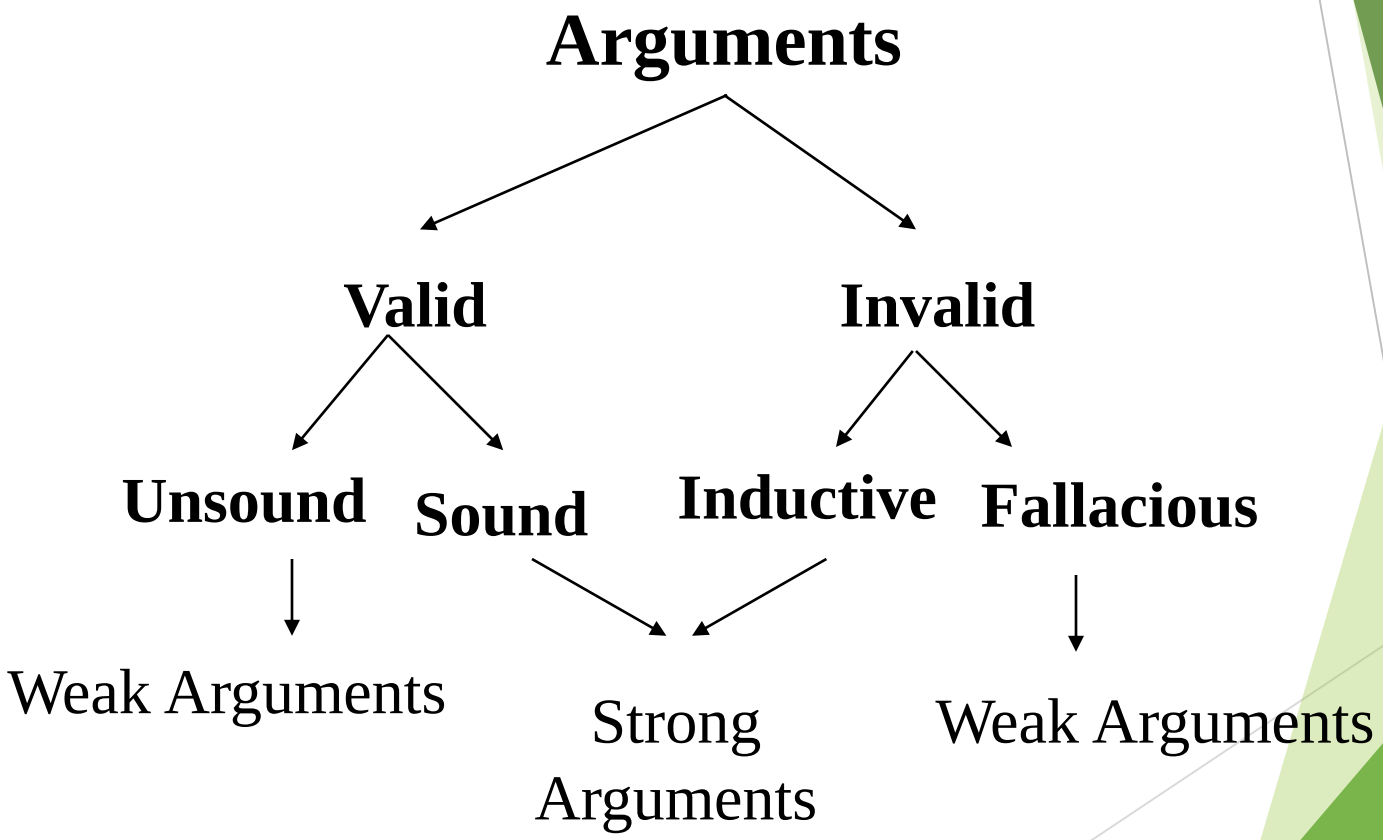
PREMISE 2. My roommate owns an iPod.

CONCLUSION. My roommate also owns an iPhone.

Inductive vs. Fallacious Arguments (Continued)



A Comprehensive Scheme for Viewing Argument Strength



Seven-Step Strategy for Evaluating Arguments I: Steps 1-4

Step 1. Convert the argument into standard form. (List the premises first, followed by the conclusion.)

Step 2. Test the argument for its reasoning strength to see whether it is valid or invalid. (Assume the premises to be true, and ask yourself whether the conclusion must also be true when those premises are assumed true. Is a counterexample to the argument possible?)

Step 3. Is the argument valid?

If yes, go to Step 4.

If no, go to Step 5.

Step 4. Is the (valid) argument also sound? That is, are the premises true in the actual world?

4a. If the argument is valid and if all of the premises are true in the actual world, then the argument is also sound. (To determine truth-values for statements, see Appendix G.)

4b. If the argument is valid, but one or more premises can be shown to be either false or not capable of being verified in the actual world, then argument is unsound.

Seven-Step Strategy For Evaluating Arguments II: Steps 5-7

Step 5. Is the (invalid) argument inductive or fallacious? (How likely will the conclusion be true when the premises are assumed true?)

5a. If the conclusion would likely be true because the premises are assumed true, the argument is inductive.

5b. If the conclusion would not likely be true even when the premises are assumed true, the argument is fallacious. (Keep in mind that a fallacious argument can be made up of Individual claims that are themselves true in the actual world.)

Step 6. Determine whether the premises in your argument are either true or false.

Step 7: Make an overall assessment of the argument. That is, describe the argument's strength of reasoning in conjunction with the truth conditions of the argument's premises. For example, is the argument inductive with all true premises? Is it inductive with some false premises? Is it fallacious with a mixture of true and false premises, and so forth? Remember that an inductive argument with premises that are all true is stronger than a valid argument with one or more false premises.)

Applying the Seven-Step Strategy

- Revisit Scenario 3-1 and apply the seven-step strategy to it.
  - **PREMISE 1**. Downloading proprietary software (without permission from the copyright holder) is identical to stealing physical property.
  - **PREMISE 2**. Stealing physical property is morally wrong.
  - **CONCLUSION**. Downloading proprietary software (without permission) is morally wrong.

Applying the Seven-Step Strategy Continued)

- Applying Step 1, we note that the argument is already in standard form (so there is no need to convert it into this form).
- At Step 2, we examine the argument's strength of reasoning and determine that the argument is *valid* because:
- Consider that if we assume the truth of both of its premises (viz., Premises 1 and 2), the conclusion cannot be false (i.e., the combination of true premises and false conclusion in this example would be a logical contradiction).

Applying the Seven-Step Strategy Continued)

- Now that we determined that the argument is valid (at Step 3), we next go to Step 4 and ask whether it is also either *sound* or *unsound*.
- Premise 2 is a true statement (and is easily verifiable as well as uncontroversial).
- But the truth or falsity of Premise 1 is less clear cut.
- Although there is a strong analogy between stealing physical property and downloading unauthorized software, there are also some disanalogies; thus, the two behaviors are not, strictly speaking, “identical.”

Applying the Seven-Step Strategy Continued)

- Because Premise 1 may be either false or indeterminate (i.e., it is not literally true, as stated), we now see that this argument is *unsound*.
- However, the argument is still valid; so we can skip Step 5, which applies only to invalid arguments.
- At Step 6, we note that both Premise 2 and the conclusion are true, while Premise 1 may be either false or indeterminate (since it is not literally true).
- So our overall evaluation of this argument, at Step 7, is: *Valid but Unsound*.
- Note that the conclusion happens to be true, even though its truth is not logically supported by the argument's premises.

A Less Formal Strategy for Identifying Fallacious arguments

- While the seven-step strategy is a useful tool for evaluating a wide range of arguments, it is worth noting that some less formal techniques are also available to us for spotting fallacious arguments that commonly occur in ordinary, everyday reasoning.
- So, fortunately, there is also an *informal*, and arguably simpler, way of identifying and cataloging many (informal) logical fallacies that frequently appear in everyday discourse.
- We need to understand what is meant by "informal logical fallacy."

Logical Fallacies in Everyday Reasoning

- What do we mean by the term *fallacy*?
- Contrary to popular belief, "fallacy" does not mean false statement.
- Instead, it means *faulty reasoning*.
- We have already seen that it is possible for an argument to contain all true statements and still be (logically) fallacious.

Informal Logical Fallacies

- As noted above, many (informal logical) fallacies appear in everyday discourse and conversation.
- Logicians and philosophers have categorized these kinds of fallacies in ways that are convenient for us to recognize.
- We will refer to these kinds of fallacious arguments as *informal logical fallacies*.

The Names of Some Common Informal Logical Fallacies

- *Ad Hominem Argument*
- *Slippery Slope Argument*
- *Fallacy of Appeal to Authority*
- *False Cause Fallacy*
- *Fallacy of Composition/Fallacy of Division*
- *Fallacy of Ambiguity /Equivocation*
- *False Dichotomy/Either-Or/All-or-Nothing Fallacy*
- *The Virtuality Fallacy*

Ad Hominem Argument

- *Ad hominem* arguments attack the person rather than the substance of the person's argument.
- Consider the kind of attack that occurred in the Edward Snowden case of whistle-blowing, which involved the leaking of sensitive documents from the National Security Agency (NSA)in 2013:

> Edward Snowden was not a whistle-blower, but rather a self-serving narcissist who was more interested in promoting himself than in exposing any wrong doing. Also, he is reported to have lied both to his employer and his girlfriend. So, how could anyone possibly believe that Snowden's leaking of the sensitive NSA documents was morally justified?

The Slippery Slope Fallacy

- The *slippery slope fallacy* has the form:

  X could possibly be abused; therefore, we should not allow X.

- For example, one might argue:

  We should not continue to allow computer manufacturers to build computer systems that include CD burners. If we allow them to do so, young users will burn copies of copyrighted music illegally. If the rate of unauthorized copying of music continues, recording artists will lose more money. If they lose more money, the entire music industry could be in jeopardy. If the music industry in America declines, the entire US economy will suffer. So, we must prohibit computer manufacturers from providing CD burners as part of the computer systems they build.

The Fallacy of Appeal to Authority

- The *Fallacy of Appeal to Popular Authority* has the form:

  X is an authority in field Y; X said Z; therefore, Z.

- The following argument commits this fallacy:

  Tim Berners-Lee believes that Comcast is a highly reliable ISP for home use. And Berners-Lee is clearly an expert on matters involving the Web and the Internet. So Comcast must be a reliable ISP.

The False Cause Fallacy

- The *false cause fallacy* reasons from the fact that event X preceded event Y to the conclusion that event X is necessarily the cause of event Y.
- Consider the following argument about an alleged link involving the release of Microsoft's Windows 10 operating system and a decline in Microsoft's stock price:

  > Shortly after the release of Windows 10 in 2015, Microsoft's stock plummeted severely. Hence, there is no doubt that this was responsible for the decline in Microsoft's loss in the stock market.

Fallacy of Composition

- The *fallacy of composition* confuses the characteristics that apply to the parts of a whole, or to the individual members of a group, with the characteristics of the whole of the group itself.
- Consider the following argument:

  > The new XYZ Desktop Computer is the best system on the market. XYZ has the fastest processor currently available on any PC; it comes with twice the amount of RAM than any of its competitors; and it comes equipped with a suite of office applications that are superior to those on any currently available system. Also, its monitor offers the best resolution and graphic display currently available on any commercial desktop computer.

The Fallacy of Division

- The *fallacy of division* mistakenly infers that the same attributes or characteristics that apply to the whole or to the group must also apply to every part of the whole or to every member of the group.
- Consider the fallacy in the following argument:

  Harvard University is the highest ranked U.S. college. Thus, Harvard must have best computer science department in the U.S.

The Fallacy of Ambiguity/Equivocation

- The *fallacy of ambiguity occurs* whenever one or more terms in an argument are used *ambiguously* or *equivocally*.
- Ambiguous terms have more than one meaning.
- Equivocal terms are used in more than one sense.
- Consider the following fallacy:

  Computers have memory. Humans have memory. Having memory enables humans to recall some of their childhood experiences. Therefore, computers can recall experiences from their childhood.

False Dichotomy/Either-Or/ All-or-Nothing Fallacy

- This fallacy typically presents us with two options that might initially seem to be mutually exclusive.
- For example, one might assert: *If you are not with us, you are against us*, thus suggesting that no neutral ground is possible in a particular situation.
- However, many claims, especially one's involving controversial political issues, appeal to a strict either/or rhetorical strategy in cases where additional options are indeed available.
- For instance, some people claim that we must choose between privacy **or** security, while not showing why it is impossible to have both.

The Virtuality Fallacy

- The *virtuality fallacy* (Moor, 2001) has the following form:

PREMISE 1. X exists in cyberspace.

PREMISE 2. Cyberspace is virtual.

CONCLUSION. X (or the effect of X) is not real.

Additional Fallacies

- You can no doubt come up with additional labels for fallacious arguments that you encounter in your analysis of cyberethics issues.
- For the names of some other (standard) logical fallacies not covered in Chapter 3, see http://yourlogicalfallacyis.com/.