1.2 — Forms and Validity

Deductive Logic is the study of methods for determining whether or not an argument is *valid*. In this section we identify some famous *valid argument forms*.

Argument Forms

Consider the following two arguments:

> 1. If Pepé is a Chihuahua, then Pepé is a dog.
> 2. Pepé is a Chihuahua.
>
> So, 3. Pepé is a dog.

> 1. If Clinton is a US president, then Clinton is a US citizen
> 2. Clinton is a US president.
>
> So, 3. Clinton is a US citizen.

Both argument are valid — *if* the premises are true, the conclusion *must* be true as well. Again: it is *not possible* both for the premises to be true and the conclusion false.

And both share the same pattern or *argument form*:

> An *argument form* is a pattern of reasoning.

The form in this case is known as *modus ponens*.

> ***Modus Ponens***
> 1. If A, then B
> 2. A
>
> So, 3. B

The letters A and B are *variables* that stand for statements. The grammatical pattern in statement 1 is known as a *conditional*. The arguments above are *substitution instances* of modus ponens.

> A *substitutions instance* of an argument form is an argument that results from uniformly replacing the variables in that form with statements (or terms).

Modus ponens is what is known as a *valid* argument form:

> A *valid argument form* is one in which every substitution instance is valid.

It is enough, therefore, to determine the validity of an argument, if it can be identified as an instance of a valid argument form. Such arguments are known as *formally valid*:

> A *formally valid argument* is an argument that is valid in virtue of its form (that is, in virtue of being an instance of a valid argument form).

While most valid arguments are formally valid, the converse isn't true — although most examples of valid arguments that are not formally valid:

1. All logicians are fastidious.
So, 2. No squares are circles.

The validity of this argument is simply due to the fact that it is not possible for its conclusion to be false. For given that, it is not possible both for the conclusion to be false the premises to be true, i.e., it is valid. But the *form* of this argument is simply:

      1. A
  So, 2. B

And there are clearly invalid instances of this argument, e.g.,

     1. All logicians are fastidious.
So, 2. All logicians love porridge.

Understanding Conditional Statements

Consider the following:

(a)   If it is raining, then the ground is wet.

(b)   If Lincoln was born in 1709, then he was born before the Civil War.

Important Characteristics of Conditionals

1. The statement in the "if"-clause is called the *antecedent* of the conditional; the statement in the "then"-clause is called its *consequent*.

- The antecedent of (a) is "it is raining", *not* "if it is raining".

- The consequent of (a) is "the ground is wet", *not* "then the ground is wet".

2. Conditionals are hypothetical in nature

They say, in effect, that *if* the antecedent is true, the consequent is true.

3. There are many ways to express conditionals in ordinary English. (More on this later in the semester.)

Some Famous Valid Argument Forms

> 1. If it is raining, then the ground is wet.
> 2. The ground is not wet.
>
> So, 3. It is not raining.

> 1. If there is fire in the room, then there is air in the room.
> 2. There is no air in the room.
>
> So, 3. There is no fire in the room.

These arguments are clearly valid. Their form is *modus tollens*:

> ### *Modus Tollens*
> 1. If A, then B.
> 2. Not B.
>
> So, 3. Not A.

The difference between modus ponens and modus tollens is the presence of the *negations* "Not B" and "Not A". The *negation* of a statement S is its denial, the claim that S is false.

Three general points

1. The order of the premises does not matter to the validity of an argument.

So the numbering of the premises in an argument or argument form is only to provide us with labels for referring to them. It does not mean that, e.g., the conditional in an instance of modus tollens must come first.

2. The conditionals in a valid argument can be rather long and complex.

The only thing that matters is form!

3. Putting an argument into explicit form helps to focus attention on key issues.

Consider the argument from the text:

1. If the physical universe has existed for an infinite period, then all the energy in the universe is spread out evenly (as opposed to being concentrated in such bodies as planets and stars).
2. It is not true that all the energy in the universe is spread out evenly (as opposed to being concentrated in such bodies as planets and stars).

So, 3. It is not true that the physical universe has existed for an infinite period.

The truth of premise 2 is not in doubt, nor is the argument's validity, since it is an instance of modus tollens. The only controversial element of the argument, premise 1. Putting the argument in this form enables us to focus on that element alone. (If the universe oscillates between a "Big Bang" and a "Big Crunch" then it could be infinite without the energy in the universe ever being spread out evenly.)

The next form is *hypothetical syllogism*:

1. If tuition continues to increase, then only the wealthy will be able to afford a college education.
2. If only the wealthy will be able to afford a college education, then class divisions will strenthen.

So, 3. If tuition continues to increase, then class divisions will strenthen.

Hypothetical Syllogism

1. If A, then B.
2. If B, then C.

So, 3. If A, then C.

So far our argument forms have only involved conditional and negations. Our final forms involve *disjunctions*, indicated by "or".

1. Either Picasso painted *Woman with a Guitar* or Braque painted it.
2. Picasso did not paint *Woman with a Guitar*.
So, 3. Braque painted *Woman with a Guitar*.

1. Either experimentation on live animals should be banned or experimentation on humans should be permitted.
2. Experimentation on humans should not be permitted.
So, 3. Experimentation on live animals should be banned.

These arguments are instances of *disjunctive syllogism*:

Disjunctive Syllogism (two versions)

1. Either A or B.	1. Either A or B.
2. Not A.	2. Not B.
So, 3. B.	So, 3. A.

Statements "A" and "B" in a disjunction "A or B" are known as its *disjuncts*.

Inclusive vs Exclusive Disjunction

Note that we will understand "or" in its *inclusive* sense; that is, we will count it as true if *at least one* of its premises is true. Consider an ad for a job:

The successful applicant will have either 5 years of programming experience or a BS in computer science.

Clearly, someone meeting *both* conditions would be considered a legitimate applicant.

When "or" is meant to exclude one disjunct, it is being used in its *exclusive* sense.

The inclusive sense is sometimes emphasized by adding "or both" to a disjunction. Similarly, the exclusive sense is sometimes forced by adding "but not both":

1. Either Jones will get the job or Smith will (but not both).
2. Jones will get the job.

So, 3. Smith will not get the job.

Be sure to distinguish this argument from:

1. Either Jones will get the job or Smith will.
2. Jones will get the job.

So, 3. Smith will not get the job.

That argument, without the "not both" qualification, is clearly invalid. (Why?)

Finally, consider the following:

1. Either God cannot prevent suffering or God does not want to prevent any of it.
2. If God cannot prevent suffering, then God is weak.
3. If God does not want to prevent suffering, then God is not good

So, 4. Either God is weak or God is not good.

This notorious "atheological" argument — known as the *Problem of Evil* — is an instance of the form *constructive dilemma*:

Constructive Dilemma

1. Either A or B.
2. If A, then C.
3. If B, then D.

So, 4. Either C or D.

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The "Famous Forms" Method

An argument is valid if it is an instance of a valid argument form. This suggests a very simple method for determining that some arguments are valid.

The Famous Forms Method	
Step 1:	Identify the component statements in the argument (ignoring stylistic variation), uniformly labeling each with its own capital letter.
Step 2:	Rewrite the argument using capital letters instead of English statements.
Step 3:	Check to see whether the pattern of reasoning is one of our famous argument forms. If it is, conclude the argument is valid.

Important Limitations of the Famous Forms Method

1. Many valid arguments are not instances of our five famous forms.

Hence, the method is incomplete; the fact that this method does not show that an argument is valid does *not* mean that it is *not* valid. For all the method tells us, an argument whose form is not among our five forms could be valid or invalid.

This entails our second limitation:

2. The method does nothing to help us determine that an invalid argument *is* invalid.