Critical Thinking Lecture 2:
Conditionals and Deduction

2.1 Propositions

Last time we learned that an argument consist of premises and a conclusion, and that premises can be linked or convergent. This week we will look at a very important form of argument in which the premises are linked; namely, deduction. We will begin by investigating conditional claims, which play a crucial role in many deductive arguments. But before we do that, we need some basic information about philosophical terminology and conventions for representing claims and arguments.

Indicative sentences (sentences that say that such and such was/is/will be the case) express **propositions**. The proposition expressed by an indicative sentence is what that sentence says. Two different sentences can express the same proposition, e.g. "Snow is white" and "Schnee ist weiss", "Europe is North of Africa" and "Africa is South of Europe". Propositions can be true or false. (NB There are lots of legitimate uses of language that cannot be true or false, e.g. questions, commands, expressions of attitude, greetings.) Propositions can also be simple/basic or complex. Complex propositions are made out of combinations of simple propositions. In philosophy, it is common to use 'p' and 'q' to stand for possible propositions that could be slotted into arguments, just as in algebra 'x' and 'y' stand for possible numbers that could be slotted into equations. When someone makes a claim, they assert an indicative sentence. They claim that p.

Some propositions ascribe properties to objects or events. e.g. "This lecture is interesting" ascribes the property of being interesting to this lecture. Philosophical convention is to use 'F', 'G', 'H'... to stand for properties and 'a', 'b', 'c'... to stand for objects or events. Hence, the claim that an object possesses a property can be represented as 'a is F' or 'Fa'. Often, objects that have property F are referred to as Fs.

cf. Those who have the property of being able to surf and doing so regularly are called 'surfers'.

2.2 Conditional Statements

Many deductive arguments involve what we call "conditional statements" or "conditionals". These are statements of the form "**If p then q**", or any statements which have an equivalent meaning. e.g. "If you are a father then you are a parent". To assess conditional deductive arguments, we first must understand conditional statements. NB At this stage, we are not asking whether these statements are true or false. We are asking what such statements mean, or, what is said when someone makes such a statement.

Often it is hard to tell the difference between conditional statements and causal statements or causal explanations. Sometimes people express causal explanations by saying things of the form "if p then q".

e.g. Why is Tina drunk? Because if Tina drinks too much champagne, then Tina gets drunk.

Probably what the speaker means in this situation is that Trev's drinking to much beer makes Trev drunk, or causes him to be drunk. However, conditional claims do not have the same meaning as causal claims. In the context of this unit of study, conditional statements should not be read as causal explanations. Rather, they are statements about what can be inferred from what. **"If p then q" doesn't mean "p makes q happen". Instead, it means "If p is true, then q is true".** (Perhaps, more generally, it means "If we can say p then we can say q".)

This is complicated by the fact that sometimes when someone makes a specific conditional claim that has the form "If p then q", there actually is a causal connection between p and q. Sometimes the fact that p causes q what explains the truth of the conditional claim "If p then q". In many other cases though, it is true that "If p then q", but p does not cause q. In order to understand this, we need to consider several examples:

If it rained then the dam levels are higher.

(p = it rained, and q = the dam levels are higher.)

This claim means "If it is true that it rained then it is true that the dam levels are higher." In this specific example, it is true that the event refered to in p happens before the state of affairs referred to in q, and causes that state of affairs. But the claim "If it rained then the dam levels are higher" is not a causal claim. It does not mean "p causes q". Rather, it is a conditional claim, i.e. If it is the case that it rains, then it is the case that the dam levels are higher. From the fact that it rained we can infer that the dam levels are higher.

If I am a father then I am a parent.

This means that "If it is true that I am a father then it is true that I am a parent." In this case, p does not happen either before or after q, and there is not a causal relationship between p and q. Being a father does not cause you to be a parent. Rather, being a father is one way of being a parent.

If you are bigger than Arnie then you are bigger than me.

In this case, p does not happen either before or after q, and there is not a causal relationship between p and q.

If the dam levels are higher then it rained.

(p = it rained, and q = the dam levels are higher.)

This means "If it is true that the dam levels are higher then it is true that it rained." In this case, the event referred to in p happens after q and is caused by q. According to the statement "If the dam levels are higher then it rained", from the fact that the dam levels are higher we can infer that it rained. (NB The meaning of this statement is not the same as the meaning of the statement "If it rained then the dam levels are higher.")

In the context of informal logic, if you are unsure whether a statement of the form "If p then q" should be interpreted as either a conditional claim or a causal claim, interpret it as a conditional claim. When we talk about causal claims we will explicitly label them as causal claims.

2.3 Sufficient and Necessary Conditions

A conditional statement contains two parts that slot into the "If ... then ..." formula. Each of these parts is called a 'condition'. They are the sufficient condition and the necessary condition. (For people who have studied logic in more depth, in this unit we are treating conditionals as truth-functional material conditionals. This is a simplification, but a useful simplification at this level.)

Sufficient condition. For the standard form of conditional "If p then q", the sufficient condition is p (i.e. the proposition that comes after the "if" and before the "then"). This conditional statement tells us that the truth of p is sufficient for the truth of q. Hence, the conditional statement can be rewritten as "p is sufficient for q", i.e. "The truth of p is enough for the truth of q". (Sometimes the sufficient condition is called the "antecedent condition" or the "antecedent".)

e.g. **If you are a father then you are a parent.**
The sufficient condition in this claim is "you are a father". The fact that you are a father is enough to make it true that you are a parent. Being a father is sufficient for being a parent. This conditional claim is true.

If you are a police officer then you are allowed to break the law.
The sufficient condition in this claim is "you are a police officer". According to this claim, the fact that you are a police officer is enough to make it true that you are allowed to break the law. Being a police officer is sufficient for being allowed to break the law. NB This conditional claim is FALSE.

If the asteroid hits Earth tomorrow, everyone will die tomorrow.
The sufficient condition in this claim is "the asteroid hits Earth tomorrow". According to this claim, the fact that the asteroid hits the Earth tomorrow is enough to make it true that everyone will die tomorrow. The asteroid hitting the Earth is sufficient for everyone dying tomorrow.

Necessary condition. For the standard form of conditional "If p then q", the necessary condition is q (i.e. the proposition that comes after the "then"). The conditional statement tells us that the truth of q is necessary for the truth of p. Hence, the conditional statement can be rewritten as "q is necessary for p", i.e. The truth of q is required by the truth of p". (Sometimes the necessary condition is called the "consequent".)

e.g. If you are a father then you are a parent.
The necessary condition in this claim is "you are a parent". According to this claim, the fact that you are a parent is required by the fact that you are a father. Being a parent is necessary for being a father. This conditional claim is true.

If you are a police officer then you are allowed to break the law.
The necessary condition in this claim is "you are allowed to break the law" (or "you being allowed to break the law"). According to this claim, the fact that you are allowed to break the law is required by your being a police officer. Being allowed to break the law is necessary for being a police officer. This conditional claim is FALSE.

If the asteroid hits Earth tomorrow, everyone will die tomorrow.
The necessary condition in this claim is "everyone will die tomorrow". According to this claim, the fact that everyone dies tomorrow is required by the fact that the asteroid hits the Earth tomorrow. Everyone dying tomorrow is necessary for the asteroid hitting the Earth tomorrow.

Note that, when it comes to identifying the sufficient and the necessary conditions, there is nothing special about the letters 'p' and 'q'. What matters is the position of the proposition in the conditional claim. Hence, in the conditional claim "If q then p", the sufficient condition is q and the necessary condition is p.

Note also that variables like 'p' and 'q' are fixed within each example/question, but can differ from example to example. This is just like 'x' and 'y' in algebra. The algebraic equation (e.g. x = 2y +3) sets limits on the possible values for x and y *in that question*, and the values of x and y do not carry over into a new question.

2.4 Equivalent Forms of Conditionals

Lots of claims of various forms turn out to be equivalent in meaning to the basic form of the conditional claim "**If p then q**". (NB Here we are fixing on the value of p and q in the claim "if p then q") e.g.

*** p is sufficient for q**

"If I am a father then I am a parent" means the same as "Being a father is sufficient for being a parent". NB Not causal.

"If it is more expensive than Paddington then it is more expensive than Marrickville" means the same as "Being more expensive than Paddington is sufficient for being more expensive than Marrickville".

*** q is necessary for p**

"If I am a father then I am a parent" means "Being a parent is necessary for being a father". Think of this as "It must be the case that you are a parent if you are a father".

"If it is more expensive than Paddington then it is more expensive than Marrickville" means the same as "Being more expensive than Marrickville is necessary for being more expensive than Paddington".

*** q if p**

For instance, "If I am a father, then I am a parent" has exactly the same meaning as "I am a parent if I am a father".

"If it is more expensive than Paddington then it is more expensive than Marrickville" means the same as "It is more expensive than Marrickville if it is more expensive than Paddington".

*** p only if q**

"If I am a father then I am a parent" means "I am a father only if I am a parent". Note that it does not mean "I am a parent only if I am a father".
"If it is more expensive than Paddington then it is more expensive than Marrickville" means the same as "It is more expensive than Paddington only if it is more expensive than Marrickville".

*** Only if q, then p**

"If I am a father then I am a parent" means "Only if I am a parent, then I am a father"
"If it is more expensive than Paddington then it is more expensive than Marrickville" means the same as "Only if it is more expensive than Marrickville is it more expensive than Paddington".

We can see for the past three examples, that **the clause after an "if" is the sufficient condition, whereas the clause after an "only if" is the necessary condition**.

All we are doing here is trying to spell out systematically the way in which some very basic and very common words and phrases work. Notice how tricky it can be to think clearly about what we ordinarily take for granted.

2.5 "All", "Every" and "Only" Generalisations

Recall that 'a' and 'b' stand for objects or events and 'F' and 'G' stand for properties. Another common form of conditional statement is "**If a is F then a is G**". This is equivalent in form to "If p then q", where p = "a is F" and q = "a is G". This terminology allows us to translate some conditional claims into equivalent generalisations. This works for conditional claims involving types of thing, e.g. fathers, people, planets, but not for conditional statements involving particular objects rather than types.

*** All Fs are Gs (also "Every F is a G")**

"If I am a father then I am a parent" means "All fathers are parents". Again, it does not mean "All parents are fathers".
"If it is more expensive than Paddington then it is more expensive than Marrickville" means the same as "All suburbs more expensive than Paddington are more expensive than Marrickville".

* **No Fs are non-Gs**

"If I am a father then I am a parent" means "No fathers are non-parents".
"If it is more expensive than Paddington then it is more expensive than Marrickville" means the same as "No suburbs more expensive than Paddington are not more expensive than Marrickville".

* **Only Gs are Fs**

"If I am a father then I am a parent" means "Only parents are fathers".
"If it is more expensive than Paddington then it is more expensive than Marrickville" means the same as "Only suburbs more expensive than Marrickville are more expensive than Paddington".

* **The only Fs are Gs**

"If I am a father then I am a parent" means "The only fathers are parents".
"If it is more expensive than Paddington then it is more expensive than Marrickville" means the same as "The only suburbs that are more expensive than Paddington are more expensive than Marrickville".

There are many complications with conditional claims and generalisations that we will briefly mention here, and then ignore. Sometimes when people make claims of the form "All Fs are Gs", they mean all actual Fs now are Gs, but not that all possible Fs were, are and will be Gs.

e.g. All Members of the Board are bald.

In ordinary language, this would not be taken to imply that all possible Members of the Board are bald, or that all past and future members were and will be bald. Other claims which are superficially of the same form have a much stronger meaning.

cf. All numbers greater than 7 are greater than 2.

All electrons have a negative charge.

All coloured objects are extended (i.e. take up space).

All dogs have hair.

All presidents of the USA are born in the USA.

These five claims are true, but there are differing kinds of necessity in each of these cases (stronger to weaker, with the last necessity being merely legal necessity).

When people use the conditional form "If p then q", and when they speak of necessary and sufficient conditions, they usually mean the stronger form of claim, i.e. not just all actual Fs now are Gs, but all possible Fs are Gs.

1.5 Translations between Conditional Claims

Since all of these statements have the same meaning, we can translate a conditional statement from one form to another. This can be quite tricky, but it is a very useful skill when it comes to assessing conditional deductive arguments.

If someone can smell food cooking then she is near a kitchen.

This is equivalent to:

All people who can smell food cooking are near a kitchen.

Only people who are near a kitchen can smell food cooking.

Everyone who can smell food cooking is near a kitchen.

People can smell food cooking only if they are near a kitchen.

No people who can smell food cooking are not near a kitchen.

Being near a kitchen is necessary for smelling food cooking.

Smelling food cooking is sufficient for being near a kitchen.

If you eat no carbs then you lose weight.

This is equivalent to:

All people who eat no carbs lose weight.

Only people who lose weight eat no carbs.

Everybody who eats no carbs loses weight.

People eat carbs only if they lose weight.

No people who eat no carbs do not lose weight.

Losing weight is necessary for eating no carbs.

Eating no carbs is sufficient for losing weight.

Some common mistakes that lead to mistranslation of conditional claims:

As we have seen, there is a temptation to read a conditional claim “If p then q” as a causal claims, and to think about the actual causal relationship between p and q. This mistake can lead us to mistranslate conditional claims: when q is actually the cause of p, we might automatically assume that q must be the sufficient condition and that p must be the necessary condition.

e.g. **I am easy to see only if I am wearing a red jumper.**

Many people are tempted to translate this as:

"If I am wearing a red jumper then I am easy to see". This seems plausible, because wearing a red jumper usually causes one to be easy to see. But it is a mistake to think here about the actual relationship between wearing a red jumper and being easily seen. Instead we must look carefully at what is said in the original claim. The original claim is actually equivalent to the following claims:

If I am easy to see then I am wearing a red jumper.

I am wearing a red jumper if I am easy to see.

Only if I am wearing a red jumper am I easy to see.

None of these claims mean "If I am wearing a red jumper then I am easy to see". In the original claim "**I am easy to see only if I am wearing a red jumper**" the sufficient condition is “I am easy to see”, and the necessary condition is “I am wearing a red jumper”. According to this claim, me wearing a red jumper is required if I am highly visible, but it is not sufficient for to be highly visible. (This conditional claim is false.)

Remember, conditional claims are not claims about what causes what or what contributes to what. They are claims about what can be inferred from what.

NB "If p then q" does not mean "If q then p".

When translating conditional claims it is a mistake to think too much about what is true and interesting about the relationship between p and q, rather than what the claimant has actually said about the relationship between p and q. **When dealing with conditional claims it is very important to notice carefully what the claimant said, and not confuse this with what you think the claimant ought to have said.** Many conditional claims are false, and people have a strong temptation to mistranslate them so that they come out true, or as true and maximally informative.

e.g. Suppose that Trev says "**Only kelpies are dogs**".

Trev's claims translates to:

If it is a dog then it is a kelpie.

Only if it is a kelpie is it a dog.

All dogs are kelpies.

Trev's claim is false, but there is a strong temptation to mistranslate Trev's claim so that it comes out true, i.e. "If it is a kelpie then it is a dog", which is equivalent to "All kelpies are dogs", "Only dogs are kelpies". If we are trying to assess what Trev said, we should not mistranslate his claim so that it comes out to be true. Rather, we should say to Trev, "What you actually said was false. Perhaps what you meant to say was that only dogs are kelpies".

1.6 Counterexamples to Conditional Claims and Generalisations

We can test the truth of a conditional claim by searching for a **counterexample** to the claim. A counterexample to a conditional statement is an actual or possible object, event or state of affairs which shows that the conditional statement is false. i.e. a thing or event that meets the sufficient condition but not the necessary condition, or a state of affairs in which the sufficient condition is true but the necessary condition is false.

e.g. **Only if you are a student are you in this lecture.**

This is equivalent to

If you are in this lecture, you are a student.

Everyone in this lecture is a student.

The only people in this lecture are students.

You are in this lecture only if you are a student.

No person in this lecture is a non-student.

Counterexample: A person who is in this lecture and is not a student, e.g. the lecturer.

e.g. **If you can drive on it directly from the Sydney CBD to the North Shore, it is a bridge.**

Counterexample: The Harbour Tunnel.

As we have seen, some generalisations of the form "All Fs are Gs" are intended to cover only actual Fs. If such a claim is true, there will be no **actual** counterexample to that claim (although it may be possible to describe what a counterexample would be).

e.g. If it is an ant, it is smaller than an elephant.

There is no actual counterexample to this claim, as there are no actual ants as big as or bigger than elephants. This shows that the claim is true about all of the ants now in existence. But it is very easy to say what a counterexample would be - it would be an ant that is as big as or bigger than an elephant. In one sense of "possible", such an creature is not possible, but such a creature is "logically possible", i.e. the idea of such a creature is not self-contradictory. As philosophers like to say, this claim is false in the actual world, but true in some possible worlds.

Sometimes, there are no **possible** counterexamples to a conditional claim or generalisation.

e.g. If it is a triangle (in Euclidean space), then its angle sum is 180 degrees.

If you are a bachelor then you are unmarried.

If it is water then it is H_2O.

There are no actual and no possible counterexamples to these claims. Hence, these claims are true, and are true in all possible worlds.

Last week we saw that, in some contexts, most people perform poorly when asked to find out whether conditional claims are false. e.g. "**If a card has a D on one side it has a 3 on the other**" is a conditional claim. What would be a counterexample to that claim? Every counterexample to a condition claim is a thing or state of affairs which makes the sufficient condition true and the necessary condition false. In this case, that would be a card with a D on one side but something other than a 3 on the other side. Thus, you would need to check cards that might have a D on one side and something other than a D on the other side. e.g. You would have to check a card with 7 on one side, but not a card with 3 on one side.

We have seen that a conditional claim "If p then q" is false in cases in which p is true but q is false. **When are conditional claims true?** Surprisingly, there is heated philosophical debate over this issue. Some philosophers say that conditional claims are true when both p and q are true, and whenever p is false. Other philosophers point out that many conditional claims in which p is false strike us as being false claims. E.g. "If you touch that wire you will be electrocuted" seems to be true in some cases in which the sufficient condition is false, i.e. in cases in which you do not touch the wire, but that same conditional claim also seems to be false in some cases in which the sufficient condition is false.

For the purposes of this introductory level unit, we will ignore these complications (although you can go on to study this in more detail in other philosophy units). When you are asked to assess the truth of a conditional claim, we will stick with cases in which either there is a counterexample (so the conditional is false), or the conditional claim is obviously true.

1.7 Practice Questions on Conditionals

For each of the following conditional statements:

Translate the statement into the standard "If... then..." form.

Identify the sufficient condition and the necessary condition.

If possible, give a counterexample to the statement. If it is not possible to give a counterexample, explain why.

a) Mark goes to the movies only if Star Wars is showing.

If Mark goes to the movies then Star Wars is showing.

Suff con: Mark going to the movies

Nec con: Star Wars showing

Counterexample: Mark going to the movies when Star Wars is not on.

b) Being coloured is necessary for being red.

If it is red, then it is coloured. (Or "If something is red then it is coloured")

Suff con: Being red (or "It being red", etc)

Nec con: Being coloured

Counterexample: A counterexample would be something that is red but is not coloured, and there could be no such things, so there are no actual nor possible counterexamples.

c) All children are annoying.

If it is a child then it is annoying.

Suff con: Being a child

Nec con: Being annoying

Counterexample: A child who is not annoying

d) Mum is going if Dad is going.

If Dad is going then Mum is going.

Suff con: Dad going

Nec con: Mum going

Counterexample: A case in which Dad is going but Mum is not going (or "A case in which Dad goes but Mum stays")

e) The only genuinely funny animals are monkeys.

If it is a genuinely funny animal then it is a monkey.
Suff con: Being a genuinely funny animal
Nec con: Being a monkey
Counterexample: A genuinely funny animal that is not a monkey, e.g. a genuinely funny dog, etc.

f) Being a mammal is sufficient for being a dog.

If it is a mammal then it is a dog
Suff con: Being a mammal
Nec con: Being a dog
Counterexample: A mammal that is not a dog, e.g. a cat, pig etc.

1.8 Deduction

Now that we are familiar with conditional claims, we will begin to explore **deduction**. Deduction is a special form of argument. As we shall see, in lots of arguments the truth of the premises make it likely that the conclusion is true, but it is possible nonetheless that the premises could be true and yet the conclusion false.

e.g.
The price of gold has risen steadily over the past year.
Market analysts predict that it will rise further in the next six months.
Therefore, the price of gold will rise in the next six months.

Even if these premises are true, it is possible that the conclusion is false. The truth of the premises does not guarantee the truth of the conclusion. This might seem to be a real weakness in this argument. Sometimes in life, as well as in philosophy, we want to know something, and we want to know for sure.

Deduction is a form of argument that seems, at first glance, to provide the kind of certainty we often think we need. **Deductive arguments are those arguments in which the truth of the premises is *intended* to *guarantee* the truth of the conclusion (and, perhaps, which possess a form that is similar to those arguments in which the truth of the premises does guarantee the truth of the conclusion).** The person who puts forward a deductive argument thinks that once you accept the premises, you must accept the conclusion. NB the "must" here does not mean that you always will. Rather, it means that you rationally should. If you accept the premises, the argument rationally demands that you accept the conclusion.

The best possible kind of deductive argument, then, is one that really does guarantee the truth of the conclusion. How does it do this? It must possess two features in order to be a faultless deductive argument:

1) It must have only true premises.

2) The truth of those premises must guarantee the truth of the conclusion.

We can see these two demands, more generally as...

1) It must have good (i.e. true) content in its premises.

2) It must have good (i.e. truth-preserving) form.

This will guarantee that it has good content in its conclusion, i.e. It will guarantee that its conclusion is true. A deductive argument that possesses both of these features is known as a **sound** argument.

1.9 Validity & Invalidity

In order to gain a proper understanding of soundness, we must think about demand 2) in more depth. What is it for a deductive argument to have good form? It is for that argument to be **valid**. As we have seen, this means that the truth of the premises must guarantee the truth of the conclusion. If a deductive argument is valid, then it is impossible for the premises to be true and the conclusion false. Necessarily, if the premises are true, the conclusion is true also.

e.g. **All men are mortal.**
Socrates is a man.
Therefore, Socrates is mortal.

If I drink Fanta I have the strength of 10 men.
I'm drinking Fanta.
Therefore, I have the strength of 10 men.

If an argument is valid, then you ought either to accept the conclusion *or* reject at least one of the premises (because if the premises were true and the argument valid, the conclusion would have to be true). With the first example above, I think we should accept the conclusion. With the second example above, it is clear that we ought to reject the first premise and the conclusion.

Note that it does not matter for validity whether the premises actually *are* true or not. Both of the above examples are valid. Valid arguments can have false premises and false conclusions. To say an argument is valid is just to say it has a good *form* for a deductive argument. To say that an argument is valid is not to say anything about the truth or falsity of its conclusion. An argument is valid when it must be the case that ***if*** the premises are true, the conclusion would also be true.

Note also that only arguments or inferences can be valid or invalid. Premises and conclusions by themselves cannot be valid or invalid, but instead can be true or false.

If a deductive argument is not valid, then it is **invalid.** A deductive argument is invalid if, assuming the premises are true, the conclusion might not be true. That is, it is possible for the premises to be true and the conclusion false.

e.g. **Everyone who drinks beer is an adult.**
Luke is an adult.
Therefore, Luke drinks beer.

The above argument is invalid, even though its conclusion is true. It is invalid because the truth of the premises does not guarantee the truth of the conclusion. It is possible that it be true that everyone who drinks beer is an adult, and that I am an adult, and yet that I do not drink beer. (Note that the conditional premise was NOT "Everyone who is an adult drinks beer".)

It does not matter for invalidity whether or not the premises actually are true, just that it is possible that *if they were true*, the conclusion could be false. Invalid arguments can have true premises and true conclusions.

e.g. **Cats are mammals**
Cats are carnivores
Lots of people own cats as pets

All of these statements are true, but the argument is invalid, because the truth of the premises does not demand that the conclusion is also true. The premises could have been true even if cats were actually herbivores. To say an argument is invalid is just to say it has a bad *form* for a deductive argument, not to say that the content of its premises or its conclusion is bad.

Another example of an invalid argument:
Australia is in the Southern hemisphere.
Australia is a continent.
Australia is not prone to earthquakes.

Here, again, the conclusion doesn't follow from the premises. Those premises could be true in circumstances in which the conclusion was false.

Why do we care about validity and invalidity, if the conclusion of a valid argument could be false, and the conclusion of an invalid argument could be true? Because validity is a crucial part of soundness. Sometimes we are unsure about the truth of the conclusion of an argument, but we know that its premises are true. If we see that an argument has only true premises and that it is valid, then we can discover that its conclusion must be true. Hence, in some cases, the ability to detect validity can be useful in finding out that the conclusion is true.

NB Sometimes philosophers use the label "deductive argument" to refer to "deductively valid argument", and hence say that invalid arguments cannot be deductive arguments. In this course, though, we are defining deductive arguments as those in which the truth of the premises is *intended* to guarantee the truth of the conclusion, but might fail to do so (in which case the argument is an invalid deductive argument).

1.10 Valid Conditional Arguments

Hopefully you have noticed that some of the examples of deductive arguments we have considered include conditional claims.

Conditional arguments are a kind of deductive argument. They contain as premises a conditional statement and the affirmation or denial of one of its conditions. So, their premises include a **conditional premise** and a **non-conditional premise**.

e.g.
Conditional Premise: If my pet is a cat then my pet is mammal.
Non-Conditional Premise: My pet is a cat.
Therefore, my pet is a mammal.

This argument has the form:

If p then q.

p

Therefore q

Note that the first (conditional) premise is a conditional statement, and the second (non-conditional) premise is the affirmation of the sufficient condition, i.e. it is the claim that it is the case that p.

Conditional arguments come in four standard forms: **affirming the sufficient condition, denying the sufficient condition, affirming the necessary condition and denying the necessary condition**. To affirm a condition is to say that it is true. To deny a condition is to say that it is false. The names that we give to these four forms of conditional argument refer to what happens in the non-conditional premise of the argument, not to what happens in the conclusion. e.g. An argument "affirms the sufficient" if *one of the premises* affirms the sufficient condition (NOT if the conclusion affirms the sufficient condition). The conclusion of a conditional argument is the affirmation or denial of the remaining condition.

Two forms of conditional argument are valid (i.e. it must be the case that if their premises are true then their conclusions are true), and two forms are invalid. Affirming the sufficient and denying the necessary are the two valid conditional argument forms.

Affirming the sufficient condition. The valid conditional argument form where the non-conditional premise affirms the sufficient condition of the conditional statement. (This argument has the Latin name "**Modus Ponens**". It is also called "affirming the antecedent".)

e.g.

If p then q

p

Therefore q

If there is a baboon in your tent, you ought not go into your tent.

There is a baboon in your tent.

Therefore, you ought not go into your tent.

Of course, if an argument with false conditional statements and/or a false non-conditional premise affirms the sufficient, then it is valid too.

e.g.

If I play Roger Federer in tennis tomorrow, I will beat him.

I am playing Roger Federer in tennis tomorrow.

Therefore, I will beat him.

The above argument is valid because it must be the case that, if the premises were true, the conclusion would also be true. You can also tell that it is valid by the fact that it is a conditional argument which affirms the sufficient condition, and this is a valid form of conditional argument.

Denying the necessary condition. The valid conditional argument form where the non-conditional premise denies (i.e. is the negation of) the necessary condition of the conditional statement. (This argument has the Latin name "**Modus Tollens**". It is also called "denying the consequent".)

e.g.

If p then q

Not q

Therefore not p

If you are from New York then you are from the USA.

You are not from the USA.

Therefore, you are not from New York.

If Debbie is older than you then Debbie is older than your little sister.
Debbie is not older than your little sister
Therefore Debbie is not older than you.

Again, if an argument with false conditional premise and/or a false non-conditional premise denies the necessary, then it is valid. To say that it is valid is not to say that there is nothing wrong with it. It is just to say that if the premises were true, the conclusion would also be true.

This form of argument can be used with absolutely bizarre conditional premises, and it is still valid. This feature of modus tollens has carried over into some odd expressions, e.g. If he actually owns that car, then I'm a monkey's uncle. If you are the best painter in Australia, then I am the Queen of Sheba. Think about the form of the argument that s suggested by such expressions:

If you are the best painter in Australia, then I am the Queen of Sheba.
I am not the Queen of Sheba.
Therefore, you are not the best painter in Australia.

Since I am not the Queen of Sheba, you are not the best painter in Australia.

NB To help you remember the valid forms of conditional argument, note that their abbreviations, "aff suff" and "den nec" both repeat a letter in their first and second words. In "aff suff" there are two fs in the first and two fs in the second words, and in "den nec" the n is to be found in both the first and second words.

The argument form "Denying the necessary" gives us a neat way to change the order of conditions in a conditional claim while preserving its meaning. We've already seen that "If p then q" does not mean the same thing as "If q then p". But look what happens when we start with the conditional "If p then q" and then deny the necessary. We get: "If not q then not p".

"If p then q" has the same meaning as "If not q then not p".