Sentential Logic
A logic that takes as its unit of analysis simple sentences that turn out to be true or else depending on how the world is like, i.e., most declarative simple sentences.

The Notion of Argument
An argument is a sequence of sentences which has a set of premises and a conclusion.
A set of premises can be a null set.
SO
An argument is a sequence of 1 or more sentences, 0 or more of which are called premises and the last one is called a conclusion.

Validity:
An argument is valid if and only if it is necessary that if all its premises are true, its conclusion is true.
An argument is valid if and only if it is impossible for all the premises to be true while the conclusion is false.
True premises and a valid argument guarantee a true conclusion.

The Notion of Validity
An argument is valid if and only if there is no possible world that all premises are true and the conclusion is false.
An argument is invalid if and only if there is some possible world in which all premises are true and the conclusion is false.

Two plus two equals four and dogs have four legs.
---
Dogs have four legs.

Two plus two equals four and dogs have four legs.
---
Two plus two equals four.
All humans are creatures.
All creatures are mortal.
All humans are mortal.

Some people speak English.
Some people speak German.
Some people speak both English and German.

Today is Tuesday or Today is Wednesday.
Today is not Tuesday.
Today is Wednesday.

All humans are mortal.
Socrates is a human.
Socrates is mortal.

As you can see in the definition of validity and the procedure, the validity of an argument does not necessarily depend on whether the premises and conclusion are actually true or false.
What the validity of an argument depends on is whether there is any possible world in which its premises are true and its conclusion is false.

The Procedure to Decide Whether a Given Argument is Valid or Invalid:
1. Given an argument, think of all the possible worlds in which all its premises are true.
2. Think of whether the conclusion is true or false in those possible worlds.
3. If it is true in ALL of them, the argument is valid. If not, the argument is invalid.  (One possible world in which the conclusion is false is enough to show the argument is invalid.)

Either the Eiffel tower is in France or it is in Germany.
The Eiffel tower is not in Germany.
The Eiffel tower is in France.

Either the Eiffel tower is in England or it is in Germany.
The Eiffel tower is not in Germany.
The Eiffel tower is in England.

If it is raining, the ground is wet.
The ground is wet.
It is raining.

If whales are fish, they live in water.
Whales live in water.
Whales are fish.
If whales live in water, they are fish.
Whales live in water.
Whales are fish.

If the Eiffel tower is not in England, it is in France.
The Eiffel tower is in France.
The Eiffel tower is not in England.

Every instructor is an automaton.
Helga is an instructor.
Helga is an automaton.

Possible Argument Patterns
true premises + valid argument = true conclusion
true premises + invalid argument = true conclusion
false premises + valid argument = true conclusion
false premises + invalid argument = true conclusion

Possible Argument Patterns (cont)
true premises + valid argument = false conclusion
true premises + invalid argument = false conclusion
false premises + valid argument = false conclusion
false premises + invalid argument = false conclusion

Valid or invalid arguments?

<table>
<thead>
<tr>
<th>premises</th>
<th>conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>all true</td>
<td>true</td>
</tr>
<tr>
<td>not all true</td>
<td>false</td>
</tr>
</tbody>
</table>
Validity of an argument having no premise:

An argument (having a null set as its premise) is **valid** if and only if there is no possible world in which its conclusion is false.

An argument (having a null set as its premise) is **invalid** if and only if there is some possible world in which the conclusion is false.

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Soundness =

validity + true premises

A **sound argument always has a true conclusion**.

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**Sound or unsound arguments?**

<table>
<thead>
<tr>
<th></th>
<th>conclusion</th>
<th>false</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
</tr>
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<td>not all true</td>
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<td></td>
</tr>
</tbody>
</table>

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The Concept of Entailment (a.k.a. Implication)

A set of premises of an argument entails (or implies) the conclusion of the argument if and only if the argument is valid.