(iii) $\sim[\exists\, x\, \forall\, y\, f(x,y)] \equiv \forall x\ \exists y \sim f(x,y)$.

Solution. Exercise.

1.9. Logical Reasoning

Definition 1.9.1. (Arguments)
An **argument** is a series of statements starting from hypothesis(premises) and ending with the conclusion.

From the definition, an argument might be valid or invalid.

Definition 1.19.2. (Valid Arguments)
An argument is said to be **valid** if the hypothesis implies the conclusion; that is, if s is a statement implies from the statements $s_1, s_2, \ldots, s_n$, then write as
$$s_1, s_2, \ldots, s_n \mapsto s.$$

Example 1.9.3.
(i) Let s_1: Some mathematicians are engineering

      s_2 : Ali is mathematician

      s : Ali is engineering

Solution.
The argument $s_1, s_2 \mapsto s$ is not valid, since not all mathematicians are engineering.

(ii) Let s_1: There is no lazy student

      s_2 : Ali is artist

      s_3 : All artist are lazy

Find a conclusion s for the above premises making the argument $s_1, s_2, s_3 \mapsto s$ is valid.

Solution.
Ali is

Remark 1.9.4.
(i) An argument
$$s_1, s_2, \ldots, s_n \mapsto s$$
is valid if and only if
$$(s_1 \wedge s_2 \wedge \ldots \wedge s_n) \to s$$
is tautology; that is,
$$(s_1 \wedge s_2 \wedge \ldots \wedge s_n) \implies s.$$
Also, any valid argument called **the proof**.