

## 1.2 Applications of Propositional Logic

- **Introduction**

- 1 Statements in mathematics and sciences often are vague. To make such statements better precise, they can be translate into the language of **logic**.
- 2 Logic is used to specify software and hardware and furthermore, propositional logic and its rules can be used to design computer circuit, to construct computer programs, to verify the correctness of programs, to build expert systems, and to ...
- 3 Translating English sentences into logical expressions removes the ambiguity and enables us to determine their truth values.

## Example

Change the following English sentence into a logical expression:

(1) “You cannot ride the roller coaster if you are under 4 feet tall unless you are older than 16 years old.”

**Answer:**  $p$ : You can ride the roller coaster.  $q$ : You are under 4 feet tall.  $r$ : You are older than 16 years old. Then the sentence may be translated to a logical expression:  $(q \wedge \sim r) \rightarrow \sim p$ .

(2) “You can graduate only if you have completed the requirements of your major and minor and you do not owe money to ASU and you do not have an overdue library book.”

**Answer:**  $g$ : You can graduate.  $h$ : You have completed the requirement of your major and minor.  $r$ : You owe money to ASU.  $s$ : You have an overdue library book.  $(h \wedge \sim r \wedge \sim s) \rightarrow g$ .

- Propositional logic is applicable in the design of computer hardware and electrical engineering.
- A logic(digital) circuit receives input signals each a bit and produces output signals each a bit. Signals are denoted by propositional variables. Complicated digital circuits are constructed from three basic gates which are inverter (**Not gate**), **Or gate**, and **AND gate**. (see the picture in pp.21).
- We use combinations of those basic gates to think about more complicated ones.