6SENG001W Reasoning about Programs

Tutorial 4: Logic

Exercises 4.2, 4.3 & 4.7 Solutions

Exercise 4.2

Complete the truth table for the following proposition:

$((P \land Q) \lor \neg R) \Rightarrow P$

P	Q	R	$P \land Q$	$\neg R$	$(P \land Q)$ $\lor (\neg R)$	$((P \land Q) \lor (\neg R))$ $\Rightarrow P$
$true$	$true$	$true$	$true$	$false$	$true$	$true$
$true$	$true$	$false$	$true$	$true$	$true$	$true$
$true$	$false$	$true$	$false$	$false$	$false$	$true$
$true$	$false$	$false$	$false$	$true$	$true$	$true$
$false$	$true$	$true$	$false$	$false$	$false$	$true$
$false$	$true$	$false$	$false$	$true$	$true$	$false$
$false$	$false$	$true$	$false$	$false$	$false$	$true$
$false$	$false$	$false$	$false$	$true$	$true$	$false$

Exercise 4.3

Completing the truth table for:

$$(P \land Q) \Rightarrow R$$

P	Q	R	$P \land Q$	$(P \land Q) \Rightarrow R$
$true$	$true$	$true$	$true$	$true$
$true$	$true$	$false$	$true$	$false$
$true$	$false$	$true$	$false$	$true$
$true$	$false$	$false$	$false$	$true$
$false$	$true$	$true$	$false$	$true$
$false$	$true$	$false$	$false$	$true$
$false$	$false$	$true$	$false$	$true$
$false$	$false$	$false$	$false$	$true$

Exercise 4.7

Consider the `PaperRound` machine again, it uses a state variable `houseset`; it might be altered by adding the following constraints:

- (houseset /= {}) => (3 : houseset)
  Literal translation:

    If houseset is not empty then house No. 3 is in it.

  or in plain English, i.e. more naturally:

    If papers are delivered to at least one house then one of them is house No. 3.

- not (houseset = {})
  Literal translation:
    houseset is not empty.

  or in plain English, i.e. more naturally:
    At least one house has papers are delivered.

Exercise 4.7

- ► (card(houseset) >= 40) or (139 /: houseset)
  Literal translation:

  > *The number of house numbers in* houseset *is at least 40 or house No. 139 is not in* houseset*.*

  or in plain English, i.e. more naturally:

  > *At least 40 houses have papers delivered or house No. 139 doesn't have a paper delivered.*

- ► !(hh).(hh : houseset => hh < 163)
  Literal translation:

  > *For all house numbers in* houseset *then the house No. is less than 163.*

  or in plain English, i.e. more naturally:

  > *Only house numbers up to 162 can have a paper delivered.*

  or

  > *No house numbered 163 or above can have a paper delivered.*