Mathematics for Computing,
TUTORIAL 3 TASKS

Aim: to learn more on Booleans by practicing the truth table construction.

Pre-tutorial work (independent study):

1. **Revise:** Lecture 2 and work during Tutorial 2
2. **Reading:** pages 163 – 169 (Section 15.3) from Croft, T and Davison R **(2010)** *Foundation maths,* 5th ed. Harlow: Prentice Hall.
3. **Tasks:** Exercise 15.3 from the above textbook

Tutorial Tasks 3:

1. For the following formal expressions establish if they have a good logical grammar or indicate a problem in their logical structure otherwise.

		If NO what is a problem?
p	YES/NO	
$\Rightarrow p$	YES/NO	
$\neg\Rightarrow p$	YES/NO	
$p\ q$	YES/NO	
$p \wedge q$	YES/NO	
$p \neg q$	YES/NO	
$p \wedge \neg q$	YES/NO	
$(\neg p \vee q$	YES/NO	
$(\neg p \vee) q$	YES/NO	
$\neg(\neg p \wedge \neg q)$	YES/NO	
$(p \Rightarrow q) \wedge (q \Rightarrow p)$	YES/NO	
$(p \Rightarrow (q \wedge r)) \Rightarrow ((p \Rightarrow q) \wedge (p \Rightarrow r))$	YES/NO	

2. Build truth tables for the formulae below. You should follow the algorithm described in the lecture.
   a. $\neg (p \Rightarrow p)$
   b. $\neg (p \vee \neg p)$
   c. $(p \wedge q) \Rightarrow p$
   d. $\neg (q \vee \neg q)$
   e. $p \Rightarrow (p \vee q)$
   f. $(s \wedge t) \Rightarrow s$
   g. $u \Rightarrow (u \vee w)$

Look at the structure of the given formulae and their truth tables – can you see some patterns here? Can you identify those expressions that have similar logical structures, compare their truth tables.

3. Build truth tables for the formulae below following the algorithm described in the lecture.

   a. $\neg p \vee \neg q$
   b. $\neg (p \wedge q)$
   c. $\neg p \wedge \neg q$
   d. $\neg (p \vee q)$

Compare the resulting columns for these expressions and identify the cases where the same input values written on the left of the truth table give the same resulting value.

4. CHALLENGE.

   a) Build a truth table for the following expression following the algorithm:

      i. $\neg((s \wedge t) \Rightarrow (s \vee r))$

   Can you find input values for which the resulting value is true?

   b.) Consider the following two expressions:

      ii. $\neg\neg((s \wedge t) \Rightarrow (s \vee r))$

      iii. $\neg\neg\neg((s \wedge t) \Rightarrow (s \vee r))$

Can you obtain the truth tables for ii. and iii. only looking at the case i.?