2.1. Write the following argument in symbolic form. Then determine whether the argument is valid or not. (Please show your working, and do *not* use a truth table!)

If Peter sees some chocolate then he will eat it.
Either Ruth or Stuart has some chocolate.
If Stuart does not have any chocolate then Tina does not have any chocolate.
Peter will not eat any chocolate or Stuart has some chocolate.
Stuart does not have any chocolate.
If Peter does not see any chocolate and Ruth has some chocolate then everyone is happy.
Therefore, everyone is happy.

Please use the following variables:

p	Peter sees some chocolate
e	Peter eats some chocolate
r	Ruth has some chocolate
s	Stuart has some chocolate
t	Tina has some chocolate
h	Everyone is happy

Note: Do not attempt to draw a truth table; you'd need 2^6 lines!

2.2. Determine whether or not the following argument is valid; explain your answer carefully. (Note that here t represents a statement, not a tautology.)

$$[(p \vee q) \wedge (q \to r) \wedge ((p \wedge s) \to t) \wedge (\sim r) \wedge (q \to s)] \;\to\; t$$

2.3. Write down the negation of each of the following statements:

(a) All fire engines are red.

(b) Some apples are ripe.

(c) A triangle with equal sides exists.

2.4. For each of the following English sentences:

- Write the statement in symbolic form.
- Write the negation of the statement in symbolic form.
- Determine which of the statement or its negation is true, and explain briefly.

(a) For any rational number x and any negative integer y there exists a real number that is greater than the product of x and y.

(b) For every real number x, there is a real number y for which $3y = x$.

2.5. Write down the negation of each of the following statements. Then determine whether the statement is true, or whether its negation is true, and explain briefly why.

(a) $\forall x \in \mathbb{R}$, $\exists y \in \mathbb{R}$ such that $xy = 1$.

(b) $\forall x \in \mathbb{Z}$ and $\forall y \in \mathbb{Z}$, $\exists z \in \mathbb{Z}$ such that $z = x - y$.

(c) $\forall\ x \in \mathbb{R}, \exists\ y \in \mathbb{R}$ such that $x^2 - xy - 2y^2 = 0$.

Here are two **puzzles** that you can think about during week 3. Feel free to ask your lecturer for more hints!

C. Show that in any group of six people, either three people all know each other, or three people all don't know each other.· We assume that whenever A knows B then B also knows A.

D. What is the smallest integer n with the following property: for every choice of n integers, there exist at least two whose sum or difference is divisible by 2015? Can you prove this?

Extra practice questions from the textbook (Solutions at the back of the book.)

Epp 5th ed.:
Section 2.3, pp. 76–79: Questions 1, 3, 6, 8, 12a, 22, 24, 25, 26, 27.
Section 3.1, pp. 119–121: Questions 2, 3ac, 4ac, 5ac, 6a, 7, 9, 11, 13, 14, 16ace, 17a, 18abe, 19, 22a, 23a, 25ace, 26b, 28bd, 30b.
Section 3.2, pp. 129–131: Questions 1, 3ac, 4ac, 5a, 6a, 9, 11, 13, 15ac, 16, 18, 20, 22, 34a, 37, 41, 43, 45, 47, 50.
Section 3.3, pp. 143–146: Questions 1ab, 2ab, 3ab, 4a, 9a, 11acd, 12ab, 13, 14, 15, 18, 21ab, 22, 29, 31, 32, 33, 34, 37, 39, 40a, 41abe, 55.

Epp 4th ed.:
Section 2.3, pp. 61–63: Questions 1, 3, 6, 8, 12a, 22, 24, 25, 26, 27.
Section 3.1, pp. 106–108: Questions 2, 3, 9, 11, 13, 14, 16ace, 17a, 18abe, 19, 21ac, 22a, 23a, 24a, 25ace, 26b, 28bd, 30b.
Section 3.2, pp. 115–117: Questions 1, 3ac, 4ac, 5a, 6a, 9, 11, 13, 15ac, 16, 18, 20, 22, 34a, 37, 41, 43, 45, 48.
Section 3.3, pp. 129–131: Questions 1ab, 2ab, 3ab, 4a, 9a, 11acd, 12ab, 13, 14, 15, 18, 21ab, 22, 29, 31, 32, 33, 34, 37, 39, 40a, 41abe, 55.

Puzzle hints:

Stuck on the puzzles from week 2? Here are some hints!

A. Drawing one common perpendicular gives you *two* points of the same colour, but not *four* points at the corners of a rectangle. What happens if you draw two perpendiculars? What happens if you draw many?

B. You can't say much about any three consecutive points in particular, since you don't know where the labels $1, \ldots, 10$ have been placed. Can you say something about the *sum* of *all ten* sets of three consecutive points?