Tutorial Revision: solutions

Solutions

1.

a) From hex to binary = `1011 1110 0101 0111 0100 0010 1000 0000`
b) To floating point = -0.2102146148681640625
c) As 2 two's complement values = -16809 and 17024

2. `0xF0 0x9D 0x92 0x86 0xE2 0x84 0x95 0xCE 0x94`

3.

a)

i. A^C
ii. $C \setminus B$ or $C \cap B^C$
iii. $A \cap B$

b)

i. 68 + 12 = 80
ii. 46 + 41 + 7 + 34 + 12 + 26 = 166
iii. 68 + 12 + 7 + 26 + 16 = 129 (the alternative brackets get to 68 + 12 + 7 = 87)

4. Firstly the expression needs to be written in propositional logic:

$(h \wedge d) \vee \neg(\neg h \wedge d) \vee \neg d$

The final simplification is $h \vee \neg d$. The statement can be rewritten as:

```
if hour >= 12 or day != Sunday
```

5.

a)

H	E	P	Lights
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

The expression is $HE + \overline{E}P$ or equivalent expression.

b) No solution provided. 1 NOT gate, 2 AND gates, and 1 OR gate are required to draw the circuit.

6.

a) $h \circ g$ and $f \circ g$ are injective.

b) $h \circ f$ is surjective.

7. No solutions provided.

8.

a) $P(7,7) = \frac{7!}{0!} = 7! = 5040$
b) $7^7 = 823543$
c) $P(6,6) = \frac{6!}{0!} = 6! = 720$
d) $P(5,5) = \frac{5!}{0!} = 5! = 120$
e) same as c)
f) There are 720 numbers that start with 1, so for the 1000th number it will be the 280th number that starts with 2. With 1 and 3 in the second position, we get to number 720+120+120 = 960, so the second position will have a 4. The next digit will be a 3, which takes us to number 984. Then we skip over 1 and 5 to put 6 in the 4th position, taking us to number 996. Now there are three options for the 5th position, with two options each for the last two positions, so we can count through in order to 1000 as 157, 175, 517 and 571.

   The 2000th number is 3652174.

9. This is derived from Project Euler question 15 (https://projecteuler.net/problem=15). Start with the smaller grid and mark out how many routes there are to a particular point. This should lead to a pattern that will looked at in lectures, and from there you should be able to take a guess at the answer. Try with another small grid size before testing with the 5 x 5 grid.

10. The three concepts are:

- reflexive: this can be seen in the loops on vertices. v_6 has no loop and therefore (v_6, v_6) is not in relation, so it is not reflexive.
- symmetric: this can be seen by the double-ended edges. (v_2, v_3) means (v_3, v_2) should be in the relation but it is not, so it is not symmetric.
- transitive: this means looking for a particular connection of three vertices. v_1, v_2 and v_6 are transitive with each other. One example that is not is (v_1, v_2) and (v_2, v_3): this implies (v_1, v_3) should be in the relation. Note that (v_2, v_3) and (v_2, v_5) does not imply that (v_3, v_5) should be in the relation.

11. No answer provided.