CS2002 Tutorial Week 3

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1. This may be revision (from CS1003 or non-University courses).

    (i) Convert the integers 73 and -493 (base ten) into 12-bit two's complement binary. Also give the octal and hexadecimal representations of those resulting bit sequences.

    (ii) What are the smallest (i.e. most negative) and largest integers that can be represented in 12 bits two's complement?

2. In two's complement, perform the subtraction below, showing your working.

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    00011100 - 00001001
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3. Why do we even have the previous questions? Aren't computers already very good at computing numbers, and you can Google these kind of questions to get the answers, surely?

4. Consider $(A \vee B) \to ((A \to B) \to B)$.

    (a) Construct the truth table.

    (b) How does the truth table show that this is a tautology?

5. Now consider $(A \wedge B) \to ((A \to B) \to B)$.

    (a) Construct the truth table.

    (b) Is this a tautology? Is this satisfiable? Explain your answer.

6. Now consider the formula:
$$(A \vee B) \to ((C \to \neg A) \to \neg C)$$

    Is it a tautology? Satisfiable? Unsatisfiable?

7. Use the laws of Boolean algebra to prove that the following formula is a tautology

    $\neg(\neg(A \wedge B) \vee C) \vee (\neg A \vee (\neg B \vee C))$

    You should describe each step and give the laws used but you need not give every detailed step that would be required e.g. to move subformulas around via commutativity and associativity.

8. Somebody has been looking through old family photos printed on paper. Photos are either round or square in shape - but not both. They can be either colour or monochrome (black and white) - but not both. They can be a picture of a person or not, and they can have a date on them or not.

   The following statements are true about one particular photo.

   (i) If it is square, then it is monochrome.

   (ii) If it is round, then it is dated and is colour.

   (iii) If it is dated or monochrome, then it is a picture of a person.

   (iv) If it is a picture of a person, then it is a picture of Jane.

   (a) Making an appropriate choice of propositional variables, formulate these statements in propositional calculus.

   (b) Is it possible that the particular photo is *not* a picture of Jane? Use any of the logical methods from the module to justify your answer.