

## Obligatory Exercise 1

### Due date: April 6, 1998 at 1500

Note: These exercises are to be turned in to Petter Edblom. Do not place them in the mail shelf of Stephen Hegner, or you will risk lateness penalties.

1. Using de Morgan's identities, convert the following formula to one which only involves the connectives  $\wedge$ ,  $\vee$ , and  $\neg$ . Ensure furthermore that all negations are applied to proposition names only, and not to larger formulas.

$$((A \rightarrow (\neg A))) \rightarrow ((A \leftrightarrow (B \rightarrow C)))$$

2. Further convert the formula of problem 1 to DNF.
3. Based upon your answer to problem 2, state whether or not the above formula is satisfiable.
4. Draw a logic diagram which realizes the formula  $\varphi_3$  shown below, using only AND and OR gates, and inverters. Your AND and OR gates may have as many input lines as necessary.

$$\varphi_3 := ((A \leftrightarrow B) \vee (C \wedge (\neg A)))$$

5. Determine whether or not each of the following formulas is
  - (i) satisfiable, and
  - (ii) a tautology.
    - (a)  $((A \rightarrow B) \wedge (B \rightarrow B))$
    - (b)  $((A \rightarrow B) \vee (B \rightarrow B))$
    - (c)  $((A \rightarrow B) \vee (B \rightarrow A))$
    - (d)  $((A \rightarrow (\neg A)) \rightarrow (B \rightarrow A))$
    - (e)  $((\neg(A \rightarrow A)) \rightarrow (A \rightarrow (\neg B)))$
    - (f)  $((\neg(A \rightarrow B)) \wedge ((\neg B) \rightarrow (\neg A)))$