



**Universität  
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## Introduction to Artificial Intelligence Exercise Sheet 6

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## Exercise 6.1

a) We first brought  $\varphi$  into CNF in order to make a decision about the propositional formula in Task 6.1 a). Please consider the justification down below.

b)

$$\varphi = \neg(A \rightarrow (B \wedge \neg C)) \wedge ((A \wedge C) \vee \neg B)$$

$$\varphi \equiv \neg(\neg A \vee (B \wedge \neg C)) \wedge ((A \wedge C) \vee \neg B) \quad \text{Implication elimination}$$

$$\varphi \equiv A \wedge \neg(B \wedge \neg C) \wedge ((A \wedge C) \vee \neg B) \quad \text{DeMorgan Law, Double Negation elimination}$$

$$\varphi \equiv A \wedge \neg(B \wedge \neg C) \wedge (A \vee \neg B) \wedge (C \vee \neg B) \quad \text{Distribution Law}$$

$$\varphi \equiv A \wedge (\neg B \vee C) \wedge (A \vee \neg B) \wedge (C \vee \neg B) \quad \text{DeMorgan Law}$$

$$\varphi \equiv A \wedge (A \vee \neg B) \wedge (C \vee \neg B) \quad \text{remove duplicate sentence}$$

Justification for a):

Set A to true and C to true then  $\varphi$  is satisfiable, hence it is not unsatisfiable.

Set A to false then  $\varphi$  is not valid.

Because the sentence  $\varphi$  is satisfiable and not valid it is falsifiable.

## Exercise 6.2

a)

$$\varphi \models \psi$$

$$\psi = C \wedge \neg D, \neg \psi \equiv \neg C \vee D$$

Test if  $\varphi \rightarrow \psi$  is a tautology,

equivalently: test if  $\psi \cup \{\neg \psi\}$  is unsatisfiable  $\equiv \Delta$ , where  $\Delta$  is in CNF.

Consider the Resolution steps down below:

b) We used 9 steps. A truth table for the same sentence would have  $2^6$  rows as the number of variables (A, B, C, D, E, F) is equal to 6. Therefore we need less steps for the Resolution in comparison to building the truth table.

## Exercise 6.3

a)

## Exercise 6.4

- a)
- b)
- c)