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Formale Grundlagen der Informatik I - Assignment 2

Hand out: 05.03.2020 - Due to: 19.03.2020

Please upload your solutions to the Olat system.

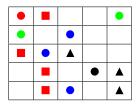
2.1 Circuits

a) (6 Min) Given the following truth table, derive and draw the corresponding circuit for the output s.

a	b	c	s
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

2.2 The Logic of Quantified Statements

a) (3 Min) Consider the following grid and colored figures:



The domain of variables (V) is the set of all figures on the grid. Function names can be figure forms (eg. Triangle(x) means x is a triangle), figure positions, colors or other attributes.

For example, IsLeftOf(x, y) returns true if x is on the left field of y.

IsNextTo(x, y) returns true if x is a neighbour of y (horizontally or vertically, but not diagonally).

Decide if the following statements are true or false for the grid given above. Please give a short reason for your decision.

i. $\exists x \in V : \text{Hexagon}(x)$

ii. $\exists x \in V : \text{Red}(x) \land \text{Square}(x)$

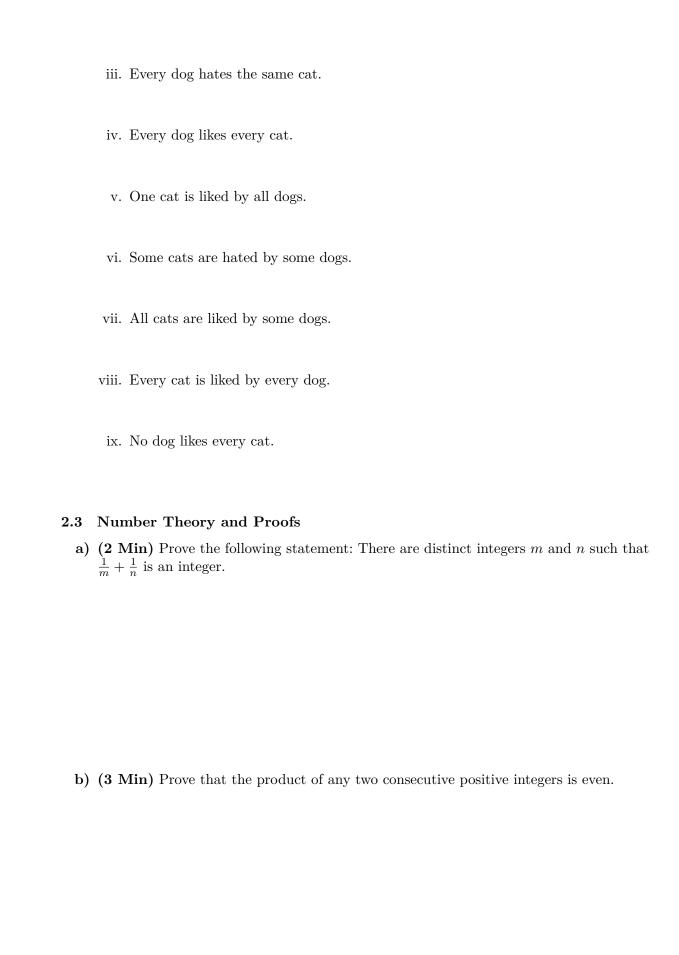
iii. $\forall x \in V : \neg \text{Yellow}(x) \land \text{Square}(x)$

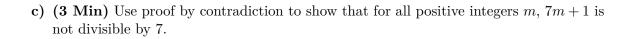
iv. $\forall x \in V : \neg Green(x) \vee Circle(x)$

v. $\exists x, y \in V : \text{Square}(x) \land \text{Triangle}(y) \land \text{IsLeftOf}(x, y)$

vi. $\forall x, y \in V : \neg \text{Square}(x) \land \neg \text{Circle}(y) \land \text{IsNextTo}(x, y)$

- b) (3 Min) Which of the following is contradicting "For all cats there exists a dog, who hates this cat."? More than one answer may be correct.
 - i. Every cat hates every dog.
 - ii. Every dog likes the same cat.





- d) (7 Min) Given are $a, b, c \in \mathbb{Z}$. Prove or disprove the following statements:
 - i. If $b \mod a = 0$ and $c \mod a = 0$, then $(b+c) \mod a = 0$.
 - ii. If $c \mod a = 0$ and $c \mod b = 0$, then $c \mod (a \cdot b) = 0$.
 - iii. If $n \in \mathbb{N}$ is even, then n^3 is even too.
 - iv. If $n \in \mathbb{N}$ is odd, then are $a, b \in \mathbb{N}$ so that $n = a^2 b^2$.
 - v. If p is a prime number and $n \in \mathbb{N}$ is smaller than p, then $\binom{p}{n} \mod p = 0$.
 - vi. If $n \in \mathbb{N}$, then $\binom{2n}{n}$ is even.