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# Formale Grundlagen der Informatik I -Assignment 1

Hand out: 20.02.2020 - Due to: 05.03.2020

Please upload your solutions to the Olat system.

#### 1.1 Sets and Subsets

a) (1 Min) Write in your own words how to read the following sets:

i. 
$$\{n \in \mathbb{Z} \mid n \notin \mathbb{N}\}\$$

ii. 
$$\{x \in \mathbb{R}^- \mid x > -10\}$$

b) (3 Min) Answer the following questions with a short explanation:

i. Is 
$$\emptyset \in \{\}$$
?

- ii. How many elements does the set  $\{1, 1, 1, 2, 2\}$  contain?
- iii. How many elements does the set  $\{1, 2, \{1, 2\}, \{\{1, 2\}, \{1, 2\}\}, \{2, 1\}\}\$  contain?

iv. Is 
$$\{2\} \in \{\{1\}, \{2\}\}$$
?

v. Is 
$$0 \in \{\{0\}, \{1\}\}$$
?

vi. Is 
$$\{2\} \in \{\{1,2\}\}$$
?

### 1.2 Relations and Functions

- a) (1 Min) What is the difference between a function and a relation?
- **b)** (5 Min) Let  $A = \{2, 4\}$  and  $B = \{1, 3, 5\}$ . Define the nonempty and pairwise different relations  $U, V, W \subseteq A \times B$ . Is your solution unique?
  - $x \cdot y \ge 7 \rightarrow (x, y) \in U$ .
  - $(x,y) \in V \to x > y$ .
  - $x > y \rightarrow (x, y) \in W$ .
  - i. For wich of the above tasks would the empty set be a valid solution if the additional constraints (pairwise difference and nonemptiness) weren't given?
  - ii. Determine if the relations U, V and W are functions and reason in a few words.
- c) (2 Min) Which attributes (left/right-total, left/right-unique) do the following relations  $A, B, C, D \subseteq \mathbb{N} \times \mathbb{N}$  have?
  - $A = \{(n,1) \mid n \in \mathbb{N}\}$
  - $B = \{(1,n) \mid n \in \mathbb{N}\}$

• 
$$C = \{(n,m) \mid n,m \in \mathbb{N}\}$$

• 
$$D = \{(n,n) \mid n \in \mathbb{N}\}$$

## 1.3 Logical Equivalence

a) (4 Min) Write down the truth table for the following logical statement:

$$(a \land \neg b) \lor (\neg a \land b) \leftrightarrow \neg (a \land b) \lor (a \land b)$$

b) (2 Min) Please determine (in a plausible way) if the following statements are tautologies or contradictions.

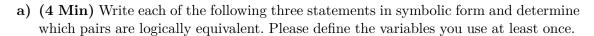
i. 
$$((p \land \neg q \land \neg r) \lor (p \land \neg q \land r)) \leftrightarrow \neg (p \lor q)$$

ii. 
$$(p \lor q) \lor \neg (p \land q)$$

<b>c</b> )	(1 Min)	With a f	few wor	ds of	explana	tion,	$\det \operatorname{ermin}_{\epsilon}$	if the	following	statements	are
	mutually excluding.										

- Susan speaks German and English. Oliver only speaks English.
- It is not the case that Oliver and Susan both speak German and English.

#### 1.4 Conditional Statements



- i. If it walks like a duck and it talks like a duck, then it is a duck.
- ii. Either it does not walk like a duck or it does not talk like a duck, or it is a duck.
- iii. If it does not walk like a duck and it does not talk like a duck, then it is not a duck.
- iv. If it walks like a duck and doesn't talk like a duck, it is a duck, but if it doesn't walk like a duck and talks like a duck it's not a duck.