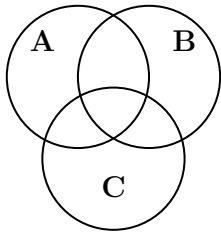


## Assignment Sheet 1

### Assignment 1 Classical Set Theory

Consider the shown sets in the following diagram over the universe  $U$  of all animals.



The set  $A$  of gray animals.

The set  $B$  of animals with fur.

The set  $C$  of big animals (animals that are longer than 80 cm in any direction).

Describe the following sets as specific as possible by means of the given sets and the operators union ( $\cup$ ), intersection ( $\cap$ ) and complement ( $^C$ ). Note that we only consider mature animals.

- the set of all animals having a gray fur
- the set of all big and gray animals
- the set containing wolfs
- the set containing all mice
- the set representing only gray mice
- the set that represents polar bears
- the set that contains earthworms

### Assignment 2 Boolean Algebra

A set of operators is called *complete* if all functions  $\{0, 1\}^n \mapsto \{0, 1\}$  can be constructed by means of the given operators.

- a) Show that  $\{\wedge, \neg\}$  containing conjunction and negation is complete.
- b) Show that  $\{\downarrow\}$  which only includes the Peirce function (NOR) is complete.
- c) Show that  $\{\mid\}$  which just contains the Sheffer function (NAND) is complete.
- d) Show that  $\{\rightarrow, \neg\}$  containing implication and negation is complete.
- e) Why are the following sets of operators not complete?
  - i)  $\{\wedge\}$
  - ii)  $\{\vee\}$
  - iii)  $\{\rightarrow\}$

*Hint: You can reorder the subtasks and can use results shown earlier.*

## **Fuzzy Systems**

Prof. Dr. Rudolf Kruse, Alexander Dockhorn

### **Assignment 3      Representation of Boolean Functions**

Represent the operators conjunction, disjunction, negation, implication and exclusive disjunction (exclusive or, XOR) only by means of the four basic arithmetic operations addition, subtraction, multiplication and division. Do not use the modulo operator.

### **Assignment 4      Representation of Boolean Functions**

Consider again the logical operators given in Assignment 3. This time, represent them only using the minimum, maximum and subtraction. Do not use the modulo operator.