Introduction to Computer Science
Jacobs University Bremen
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Course: CH08-320101
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ICS 2018 Problem Sheet #3

Problem 3.1: *distributive laws for sets* (2+2 = 4 points)

Let A, B and C be sets. Proof that the following two distributive laws hold:

a) $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

b) $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

Problem 3.2: *reflexive, symmetric, transitive* (1+1+1 = 3 points)

For each of the following relations, determine whether they are reflexive, symmetric, or transitive. Provide a reasoning.

a) $R = \{(a, b) | a, b \in \mathbb{Z} \wedge a \neq b\}$
(The numbers a and b are different.)

b) $R = \{(a, b) | a, b \in \mathbb{Z} \wedge |a - b| \leq 3\}$
(The absolute difference of the numbers a and b is less than or equal to 3.)

c) $R = \{(a, b) | a, b \in \mathbb{Z} \wedge (a \bmod 10) = (b \bmod 10)\}$
(The last digit of the decimal representation of the numbers a and b is the same.)

Problem 3.3: *circular prime numbers (haskell)* (1+2 = 3 points)

A *circular prime* is a prime number with the property that all numbers generated by cyclically permuting its (base 10) digits will be prime. For example, 1193 is a circular prime, since 1931, 9311 and 3119 all are also prime.

a) Implement a function `prime :: Integer -> Bool` that returns a `Bool` value indicating whether the `Integer` argument is a prime number or not.

```
> prime 2
True
> filter prime [2..100]
[2,3,5,7,11,13,17,19,23,29,31,37,41,43,47,53,59,61,67,71,73,79,83,89,97]
```

Explain how your function works.

b) Using the `prime` function, implement a function `circprime :: Integer -> Bool` that returns a `Bool` value indicating whether the `Integer` value is a circular prime number or not.

```
> filter circprime [2..100]
[2,3,5,7,11,13,17,31,37,71,73,79,97]
```

Explain how your function works.

Submit your Haskell code as a plain text file.

Hints:

- The Haskell `div` function returns how many times the first number can be divided by the second one and the `mod` function returns the remainder after division of the first number by the second.
- You can reuse the `rotate` and `circle` functions from the last assignment to solve this problem. To convert an Integer value into a string of (base 10) digits, you can use the `show` function. To convert a string of (base 10) digits into an Integer, you can use the `read::String->Integer` function.

```
> show 42
"42"
> (read::String->Integer) "42"
42
```