Problem Sheet #4

Problem 4.1: *injective, surjective, bijective functions*   (1+1+1 = 3 points)

Are the following functions injective, surjective, or bijective? Expain why or why not.

a) $f : \mathbb{R} \to \mathbb{R}$ with $f(x) = x^3$

b) $g : \mathbb{N} \to \mathbb{N}$ with $f(x) = 2x + 1$

c) $h : \mathbb{R} \to \mathbb{R}$ with $f(x) = sin(x)$

Problem 4.2: *properties of function compositions*   (1+1+1 = 3 points)

Let $f : X \to Y$ and $g : Y \to Z$ be two functions. Show that the following propositions are true.

a) If f and g are injective, then $g \circ f$ is injective.

b) If f and g are surjective, then $g \circ f$ is surjective.

c) If f and g are bijective, then $g \circ f$ is bijective.

Problem 4.3: *sets and relations in a cinema*   (1+1+1 = 3 points)

A cinema is showing movies in multiple movie theaters. Customers order tickets for movies they like to watch at the cashier. The tickets are later shown to a ticket taker standing at the entrance of a movie theater. The ticket takers check the validity of tickets and that customers enter the correct movie theaters. Thirsty customers can walk over to the bar to order some drinks. The cashier, the ticket takers, and the people serving drinks at the bar are all employed by the cinema.

a) Identify at least five sets (entities) that play a role in the described scenario. Introduce suitable notation.

b) Identify at least five relations between the sets (entities) that you have identified. Define the relations using suitable mathematical notation.

c) Identify at least five endorelations including at least one equivalence relation, one partial order relation, and one strict partial order relation. Define the relations using suitable mathematical notation. Try to cover different sets (entities).

Problem 4.4: *characters and types (haskell)*   (1 point)

a) Write a Haskell expression to print the character code of the character =.

b) Write a Haskell expression to print the character with the code point 128119 (decimal). What does the character represent?

c) What is the type signature of the function `zipWith`? Explain what it means.

d) What is the type signature of the function `isPrefixOf` defined in `Data.List`? Explain what it means.