
III. Funktionale Programmierung

- 1. Prinzipien der funktionalen Programmierung
- 2. Deklarationen
- 3. Ausdrücke
- 4. Muster (Patterns)
- 5. Typen und Datenstrukturen
- 6. Funktionale Programmieretechniken: Funktionen höherer Ordnung

Funktionen höherer Ordnung: comp

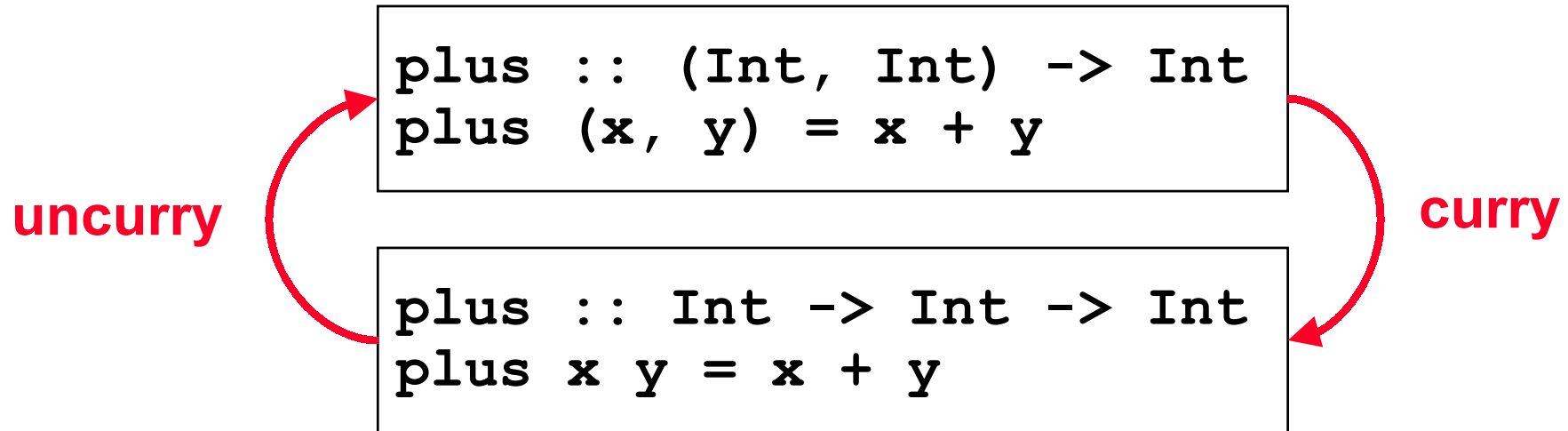
$\text{comp} :: (b \rightarrow c) \rightarrow (a \rightarrow b) \rightarrow (a \rightarrow c)$

$\text{comp } f \ g = \lambda x \rightarrow f (g \ x)$

Argument vom Typ: $(b \rightarrow c)$

Ergebnis vom Typ: $(a \rightarrow b) \rightarrow (a \rightarrow c)$

Funktionen höherer Ordnung: curry



```
curry :: ((a,b) -> c) -> a -> b -> c
curry f = g
      where g x y = f (x,y)
```

```
uncurry :: (a -> b -> c) -> (a,b) -> c
uncurry g = f
      where f (x,y) = g x y
```

Funktionen höherer Ordnung: map

```
suclist :: [Int] -> [Int]
suclist [] = []
suclist (x:xs) = suc x : suclist xs
```

```
sqrtnlist :: [Float] -> [Float]
sqrtnlist [] = []
sqrtnlist (x:xs) = sqrt x : sqrtnlist xs
```

```
suclist [x1, ..., xn] = [suc x1, ..., suc xn]
sqrtnlist [x1, ..., xn] = [sqrt x1, ..., sqrt xn]
map g [x1, ..., xn] = [g x1, ..., g xn]
```

```
f :: [a] -> [b]
f [] = []
f (x:xs) = g x : f xs
```

```
map :: (a -> b) -> [a] -> [b]
map g [] = []
map g (x:xs) = g x : map g xs
```

Funktionen höherer Ordnung: map

```
suclist :: [Int] -> [Int]
suclist = map suc
```

```
sqrtnlist :: [Float] -> [Float]
suclist = map sqrt
```

```
suclist [x1, ..., xn] = [suc x1, ..., suc xn]
sqrtnlist [x1, ..., xn] = [sqrt x1, ..., sqrt xn]
map g [x1, ..., xn] = [g x1, ..., g xn]
```

```
f :: [a] -> [b]
f [] = []
f (x:xs) = g x : f xs
```

```
map :: (a -> b) -> [a] -> [b]
map g [] = []
map g (x:xs) = g x : map g xs
```

Funktionen höherer Ordnung: filter

```
dropEven :: [ Int ] -> [ Int ]
dropEven [] = []
dropEven (x:xs) | odd x = x : dropEven xs
                | otherwise = dropEven xs
```

```
dropUpper :: [ Char ] -> [ Char ]
dropUpper [] = []
dropUpper (x:xs) | isLower x = x : dropUpper xs
                 | otherwise = dropUpper xs
```

```
f :: [ a ] -> [ a ]
f [] = []
f (x:xs) | g x = x : f xs
         | otherwise = f xs
```

```
filter :: (a -> Bool) -> [a] -> [a]
filter g [] = []
filter g (x:xs) | g x = x : filter g xs
                | otherwise = filter g xs
```

Funktionen höherer Ordnung: filter

```
dropEven :: [ Int ] -> [ Int ]  
dropEven = filter odd
```

```
dropUpper :: [ Char ] -> [ Char ]  
dropUpper = filter isLower
```

```
f :: [ a ] -> [ a ]  
f [] = []  
f (x:xs) | g x = x : f xs  
          | otherwise = f xs
```

```
filter :: (a -> Bool) -> [a] -> [a]  
filter g [] = []  
filter g (x:xs) | g x = x : filter g xs  
                | otherwise = filter g xs
```