

Blatt 8

Automaten und formale Sprachen Praktikum

Teammitglieder: Luis Staudt
Dominik Meurer

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1.1 Multiplikation

Basisfall: $\text{mult}(1, n) = n$

Rekursionsfall: $\text{mult}(m + 1, n) = \text{mult}(m, n) + n$

1.2 Differenz

Basisfall: $\text{diff}(m, 0) = m$

Rekursionsfall: $\text{diff}(m, n + 1) = \text{diff}(m, n) - 1$

1.3 Absolute Differenz

Rekursionsfall: $\text{absdiff}(m, n) = \text{diff}(m, n) + \text{diff}(n, m)$

1.4 Ist ungerade

Basisfall: $\text{isOdd}(0) = 0$

Rekursionsfall: $\text{isOdd}(n + 1) = 1 - \text{isOdd}(n)$

1.5 minimum

1.5.1 Verwendet $\text{sign}()$

$$\text{sign}(n) = \begin{cases} 1 & n > 0 \\ 0 & n = 0 \end{cases}$$

Basisfall: $\text{sign}(0) = 0$

Rekursionsfall: $\text{sign}(n + 1) = (\text{sign}(n) - 1) + 1$

1.5.2 Lösung

Rekursionsfall: $\text{min}(m, n) = \text{sign}(\text{diff}(m, n)) * n + \text{sign}(\text{diff}(n, m)) * m$

2

```
1 public class Ackermann {  
2     public static int ack(int x, int y){  
3         if (x == 0) {  
4             return y + 1;  
5         } else if (y == 0) {  
6             return ack(x - 1, 1);  
7         } else {  
8             return ack(x - 1, ack(x, y - 1));  
9         }  
10    }  
11  
12    public static void main(String[] args){  
13        System.out.println(ack(3,2));  
14        System.out.println(ack(3,3));  
15        System.out.println(ack(4,1));  
16    }  
17 }
```

3

3.1 $f(m, n) = (9 \ominus m^2) \times (n^2 \ominus 4)$

m n	0	1	2	3	4	..
0	$9 * 0 = 0$	$9 * 0 = 0$	$9 * 0 = 0$	$9 * 2 = 2$	$9 * 4 = 36$..
1	$8 * 0 = 0$	$8 * 0 = 0$	$8 * 0 = 0$	$8 * 2 = 18$	$8 * 4 = 32$..
2	$5 * 0 = 0$	$5 * 0 = 0$	$5 * 0 = 0$	$5 * 2 = 10$	$5 * 4 = 20$..
3	$0 * 0 = 0$	$0 * 0 = 0$	$0 * 0 = 0$	$0 * 2 = 0$	$0 * 4 = 0$..
..

$f(m, n)$ is null für $\{0 \leq n \leq 2\}$

daher:

$$\mu f(n) = \begin{cases} 0 & \text{für } 0 \leq n \leq 2 \\ 3 & \text{sonst} \end{cases}$$

3.2 $f(k, m, n) = (m \ominus k) + (n \ominus k)$

$f(k, m, n) = 0$, wenn:

1. $k \geq m$

2. $k \geq n$

somit ist $f(k, m, n) = 0$, wenn $k \geq \max(m, n)$

daher:

$$\mu f(m, n) = \max(m, n)$$

3.3 $f(m, n) = \text{absdiff}(m, n)$

m n	0	1	2	3	4	5	6
0	0	1	2	3	4	5	6
1	1	0	1	2	3	4	5
2	2	1	0	1	2	3	4
3	3	2	1	0	1	2	3
4	4	3	2	1	0	1	2
5	5	4	3	2	1	0	1
6	6	5	4	3	2	1	0

$$f(m, n) = 0, \text{ wenn } n = m$$

daher:

$$\mu f(n) = n$$

4

4.1 $\mu f(n) = 3 \times n$

$f(n, m) = \text{absdiff}(n \times 3, m)$

m n	0	1	2	3	4	5	6
0	0	3	6	9	12	15	18
1	1	2	5	8	11	14	17
2	2	1	4	7	10	13	16
3	3	0	3	6	9	12	15
4	4	1	2	5	8	11	14
5	5	2	1	4	7	10	13
6	6	3	0	3	6	9	12

4.2 $\mu f(n) = \{0 \text{ für } 0 \leq n \leq 3 \text{ sonst } \perp\}$

$f(m, n) = (n^2 \ominus 6)$

m n	0	1	2	3	4	..
0	0	0	0	3	6	..
1	0	0	0	3	6	..
2	0	0	0	3	6	..
3	0	0	0	3	6	..
..