

Assignment 1

Solve the following four exercises. Total: 15 points. Solutions must be submitted by 22.3.2026. Use the link on e-ucilnica to turn in your work. The submission must be in pdf format.

Exercise 1

a) Find the tight asymptotic bound of the algorithm given below. (1 point)

Algorithm 1

```
1: function FUN(int  $n$ , int  $m$ )
2:   while  $n > 1$  do
3:      $m++$ ;
4:     for (int  $i = m$ ;  $i > 1$ ;  $i = i/3$ ) do
5:       UpdateData( $n, i$ ) // $\theta(n)$ 
6:     end for
7:      $m--$ 
8:     for (int  $i = 3m$ ;  $i > m$ ;  $i = i/2$ ) do
9:       UpdateDataFast( $2n, 2m - i$ ) // $\theta(\log n)$ 
10:    end for
11:     $n--$ 
12:  end while
13:  return 0
14: end function
```

b) Find the tight asymptotic bound of the following function $f(a,s,e)$ in relation to e -s. Hint: a - array, s - start, e - end. (2 points)

```
int f(int[] a, int s, int e) {
    if (s == e)
        return 7;
    int p1 = 0;
    int j = e - s;

    for(int i = j; i > 1; i-- )
        p1 += a[s + i] * a[e - i]

    int p2 = f(a, s, s + floor(j / 5));
    int p3 = f(a, s + floor(j / 5) + 1, e);
    return (p1+p2+p3);
}
```

c) Find the tight asymptotic bound of the following program in relation to variable N. (1 point)

```

Move(N, source, dest, via){
  if(N == 0) then{
    MakeMove(N, source, dest) //O(1)
  }else{
    Move(N-1, source, via, dest);
    MakeMove(N, source, dest) //O(1)
    Move(N-1, via, dest, source);
  }
}

```

Exercise 2

Solve the following two recurrences using the Masters method.

a) (2 points)

$$T(n) = 5 \cdot T\left(\frac{n}{9}\right) + \sqrt[3]{n} \quad (1)$$

b) (2 points)

$$T(n) = 5 \cdot T\left(\frac{n}{6}\right) + \log(n) \quad (2)$$

Exercise 3

Solve the following two recurrences using the Akra-Bazi method.

a) (2 points)

$$T(n) = 2T\left(\frac{n}{4}\right) + 4T\left(\frac{n}{8}\right) + \theta(n \log n) \quad (3)$$

b) (2 points)

$$T(n) = T\left(\frac{n}{9}\right) + T\left(\frac{n}{4}\right) + T\left(\frac{n}{36}\right) + \sqrt{n^3} \quad (4)$$

Exercise 4

a) (1 point) Estimate the upper asymptotic bound of the given recurrence using the recursion-tree method.

$$T(n) = 8T\left(\left\lfloor \frac{n}{2} \right\rfloor\right) + 27T\left(\left\lfloor \frac{n}{3} \right\rfloor\right) + n^3 \quad (5)$$

b) Prove the result you found in a) using the substitution method. (1 point)

c) Find the tight asymptotic bound of the given recurrence. (With any method) (1 point)