Exercise 1: *Asymptotic complexity of the functions*

- $6n^3 + 10n^2 + 5n + 2 \to \mathrm{O}(n^3)$.
- $3\log_2(n) + 4 \to \mathrm{O}(\log_2(n))$.
- $2^n + 6n^2 + 7n \to \mathrm{O}(2^n)$.
- $4k + 2 \to \mathrm{O}(1)$.
- $4\log(n) + n \to \mathrm{O}(n)$.
- $2\log_{10}(k) + kn^2 \to n^2$

Exercise 2: *Compare the functions near infinity*

$$\left(\frac{1}{3}\right)^n < 17 < \log(n) < \frac{n}{\log(n)} <$$

$$\sqrt{n} < n < \left(\frac{3}{2}\right)^n < 2^n$$

Exercise 3: *Find number of operations and complexity*

- *A:* $1 + 2n \to \mathrm{O}(n)$.
- *B:* $1 + 2(2n + n) \to \mathrm{O}(n)$.
- *C:* $2\frac{n(n+1)}{2}n \to \mathrm{O}(n^3)$.

Exercise 4: *Find number of operations and complexity*

- f_1*:* $1 + 2\frac{n(n+1)}{2} \to \mathrm{O}(n^2)$.
- f_2*:* $2 + 4\log_2(n) \to \mathrm{O}(\log_2(n))$.
- f_3*:* $2 + 4\log_2(n) \to \mathrm{O}(\log_2(n))$.
- f_4*:* $2 + 2n\log_2(n) + 2\log_2(n) \to \mathrm{O}(n\log_2(n))$.

Exercise 5:

1.

```
input: n > 0
output: n!

S := 1
for i = 2 to n do
  S = S*i
end
return S
```

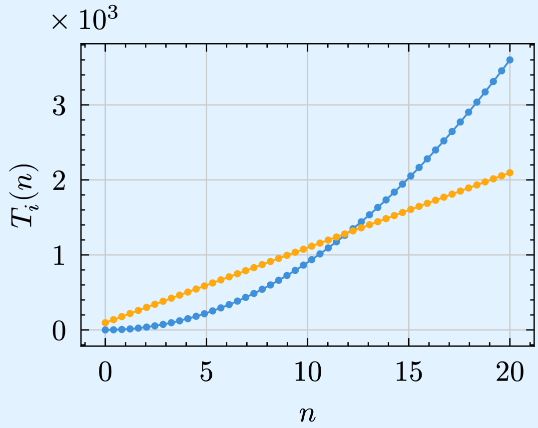
2. *The complexity is* $1 + 2(n-1) = O(n)$.

Exercise 6:

1. 1. $T_1(n) = 9n^2 = O(n^2)$.
   2. $T_2(n) = 100n + 96 = O(n)$.
2. 1. *For* T_1*:* $(n_0, c) = (1, 9)$ *clearly.*
   2. *For* T_2*:* $(n_0, c) = (1, 200)$ *since* $200n = 100n + 100n > 100n + 100 > 100n + 96$.
3.

$T_i \setminus n$	1	3	5	10	14
T_1	9	81	225	900	1764
T_2	196	396	596	1096	1496

4.



5. *for* $n < 12$*:* T_1 *is better, otherwise* T_2 *is better.*
6. *calling the algorithms with complexity* T_1 *and* T_2 *we get an algorithm of complexity* $T_1 + T_2 + c$ *where* c *is a constant, and its complexity would be* $\mathrm{O}(n^2)$.

Exercise 7:

1.

```
input:
  - n: size
  - A: matrix of size n
  - B: matrix of size n
output:
  - C: matrix product of A*B

C = [][]
for i = 0 to n-1
  for j = 0 to n-1
    for k = 0 to n-1
      C[i][j] += A[i][k] * B[k][j]
    end
  end
end
return C
```

2. $T(n) = 3 * (n-1)^3 \to \mathrm{O}(n)$.