$$\mathcal{O}(g) = \{ f \mid \exists c \in \mathbb{R}^+ \, \exists n_0 \in \mathbb{N} : \forall n \geq n_0 : f(n) \leq c\, g(n) \}$$

$$\Omega(g) = \{ f \mid \exists c \in \mathbb{R}^+ \, \exists n_0 \in \mathbb{N} : \forall n \geq n_0 : f(n) \geq c\, g(n) \}$$

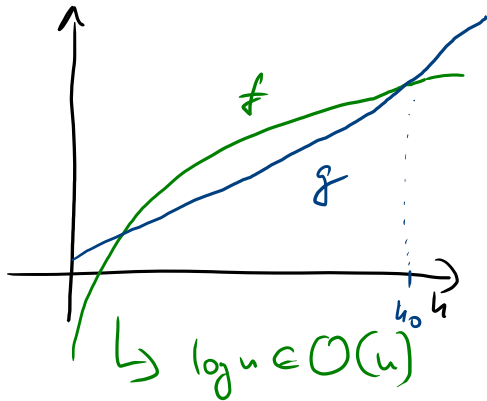
$$\Theta(g) = \mathcal{O}(g) \cap \Omega(g)$$

$f_1(n) = n^2 + 1$ $\quad \mathcal{O}(n^2)$

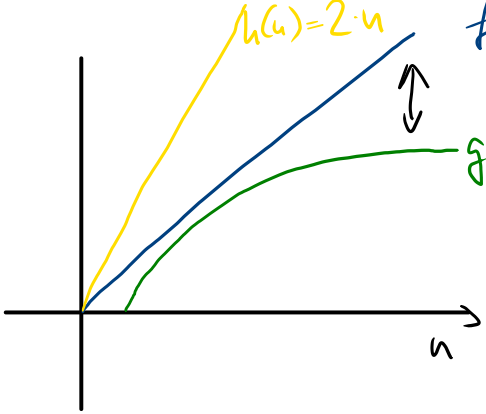
$f_2(n) = n^2 - 10n + 3$ $\quad \mathcal{O}(n^2)$

$f_3(n) = 5n^2$ $\quad \mathcal{O}(n^2)$

$f_4(n) = 1000n^2 - 20$ $\quad \mathcal{O}(n^2)$



$\log n \in \mathcal{O}(n)$



$$\lim_{n\to\infty} \frac{\log n}{n} \overset{L'H}{=} \lim_{n\to\infty} \frac{1/n}{1} =$$

$$= \lim_{n\to\infty} 1/n = 0$$

$3n^5 - 16n + 2$

- $O(n^2)$ ✗
- $O(n)$ ✗
- $O(n^{13})$ ✓
- $\Omega(n^5)$ ✓
- $\Theta(n^5)$ ✓
- $\Theta(n)$ ✗

$n^2 + \log n$ (5)

$(3/2)^n$ (7)

n (3)

$\log(n!)$ (4)

$7n^5 - n^3 + n$ (6)

2^n (8)

$n \cdot \log n$ (4)

n^n (10)

$O(n \log n)$

$n = 2^{\log_2 n}$ (3)

n^2 (5)

$\log n$ (2)

$n!$ (9)

6 (1)

$\log(n!) \leq \log n^n = n \cdot \log n$

$1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdots n$ (n)

$n \cdot n \cdot n \cdot n \cdots n$ (n)

$$\log_a x = \frac{\log_b x}{\log_b a} \rightarrow \underbrace{\log_b a}_{\text{constante}} \log_a x = \log_b x$$

$$\lim_{n\to\infty} \frac{(3/2)^n}{2^n} \qquad \lim_{n\to\infty} \left(\frac{3/2}{2/1}\right)^n = \lim_{n\to\infty} (3/4)^n = 0$$

$3/4 < 1$

A: $f(n) = 100n$ $\in O(n)$

B: $g(n) = n^2$ $\in O(n^2)$

2^n operací za sekundu ... velikost n

OLD: 1 den $\rightarrow$ $n = 36$

NEW: 1 den $\rightarrow$ $n = ?$

1000× rychlejší

$$\frac{1}{1000} = \frac{2^{36}}{2^x}$$

$$2^x = 1000 \cdot 2^{36}$$

$$x = \log_2(1000) + 36$$

$$\doteq 10$$

$2^{10} = 1024$

$x \doteq 46$

VSTUP: A[N] : INT

```
1: S=0
2: FOR I=0 TO N-1 :
3:     S += A[I]
4: RETURN S
```

$O(1)$
$+ O(n)$
$+ n \cdot O(1)$
$+ O(1)$
$= O(n)$

$A[2] \rightarrow$ 3. prvek

adda $A + |D| \cdot 2$

konstantní

INDEXACE

U POLI

KONSTANTNÍ

A(N)

```
FOR I=0 TO 9999:
    IF I<N:
        PRINT(A[I])
```

O(1)

```
FOR I=0 TO N-1:
    FOR J=0 TO N-1:
        PRINT(A[I]*A[J])
```

$O(N^2)$

FOR I=0 TO N-2: n

FOR J=I TO I+1: 2

PRINT(A[I]·A[J])

J=I

J=I+1

$O(n)$

$n-1$
$n-10$
$\frac{n}{2}$
$\in O(n)$

VSUP : $y, z \in \mathbb{N}$

```
x = 0
WHILE z > 0:
    IF z EST PAIR:
        x = x + y
    y = 2 * y
    z = ⌊z/2⌋
RETURN x
```

$\mathcal{O}(\log_2 z)$

$z = 2^k$

$\rightarrow \frac{2^k}{2} = 2^{k-1}$

$\rightarrow \frac{2^{k-1}}{2} = 2^{k-2}$

$\vdots$

$2^0 = 1$

k

$\log_2 2^k = k$

$\binom{n}{2}$ $\frac{n(n-1)}{2} \in O(n^2)$

$\frac{1}{2}n^2 - \frac{1}{2}n$

$A[N]$

$[1, 3, 5, 8, 9]$ → SERAZIONE

↑ MIN

HEJLO N ZNAKŮ
POUZE CVICE

10^N