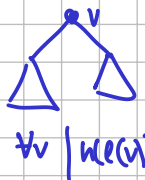


# AVL stromy

AVL strom: hloubka je  $O(\log n)$ .



$$\forall v |h(l(v)) - h(r(v))| \leq 1$$

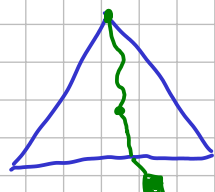
Znaménko vrcholu v:

$$\delta(v) := h(r(v)) - h(l(v))$$

$$\delta \in \{-1, 0, +1\}$$

Obecně: do vrcholu přijde **zdele** signál "podstrom se prohloubil"  
 červená = před Insertem  
 zelená = bylo - před akt. vzh.  
 červená = nové

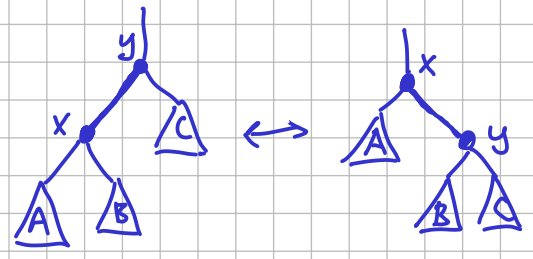
## Insert(x)



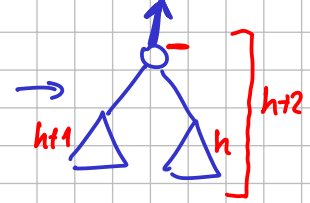
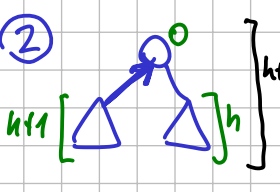
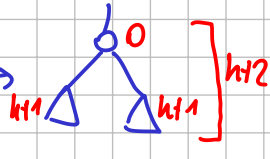
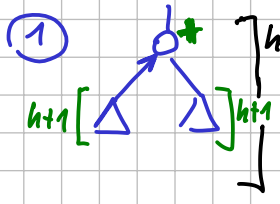
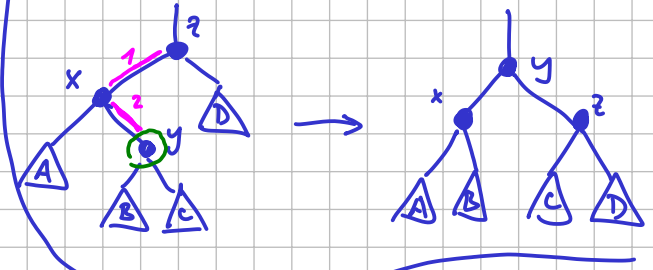
začátek Insertu:



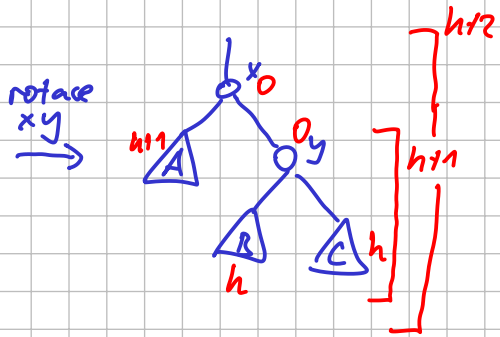
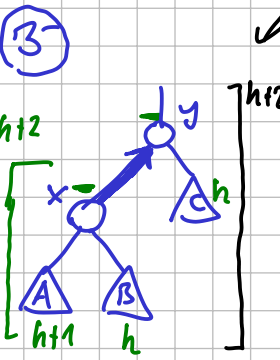
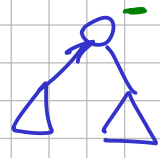
## Rotace strany



## Dvojitá rotace

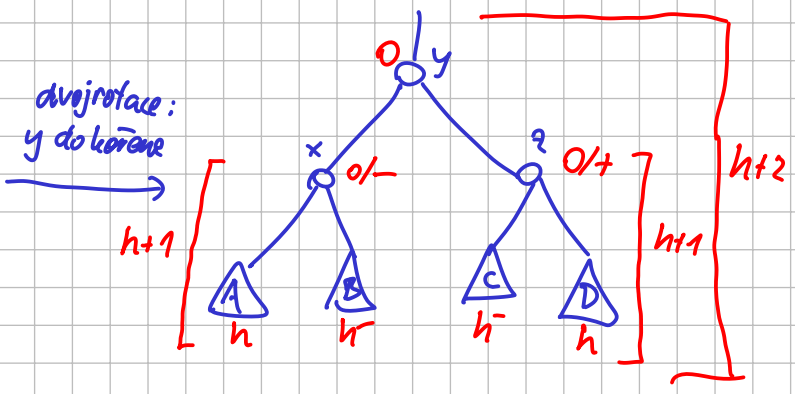
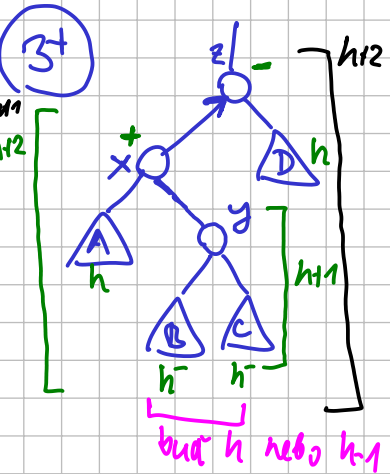


3

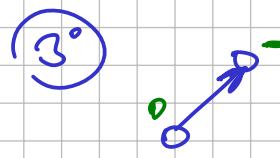


celkově:

- buď oprava znaménka a pak možná rotace.
- nebo (dvoj)rotace a sloučení



končíme



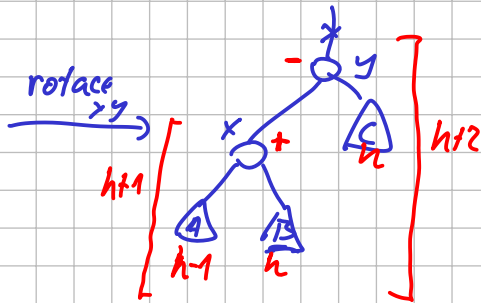
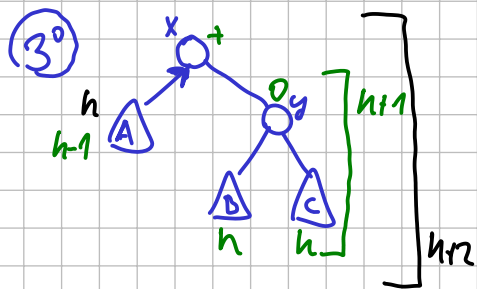
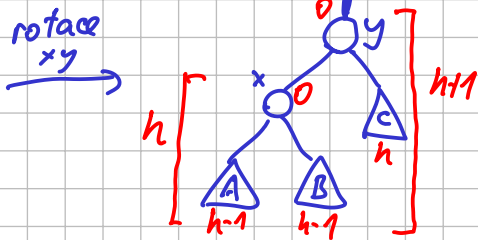
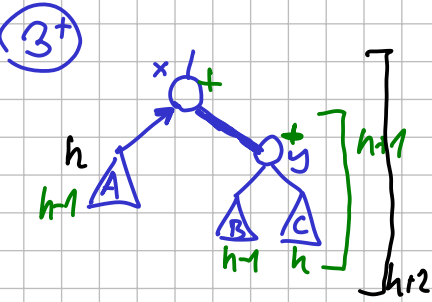
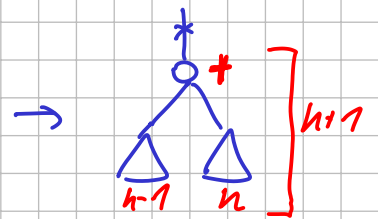
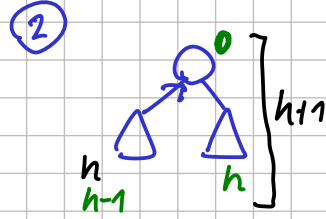
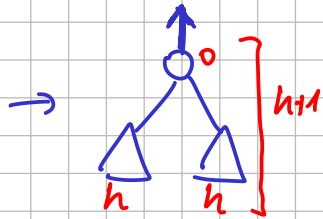
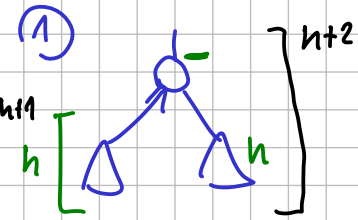
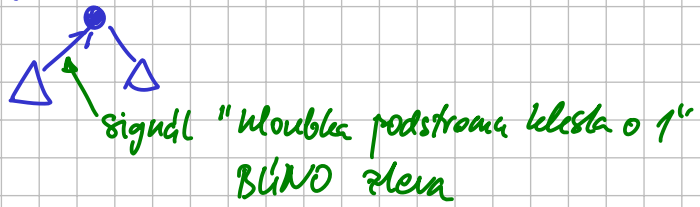
nenastane ∞ ∞

Delete převod na smířdní



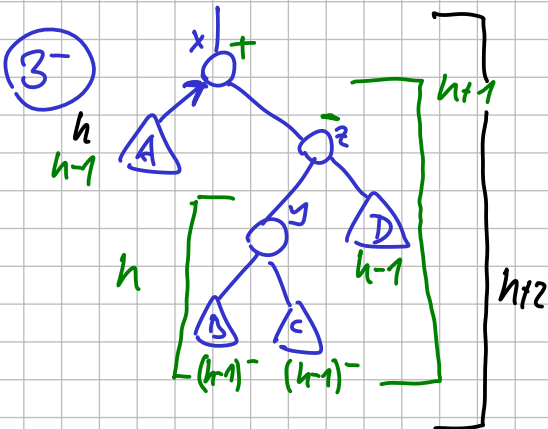
listu vcholu s 1 synem

obecně:

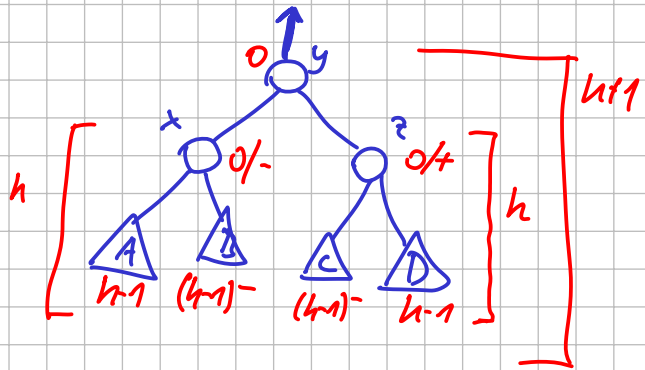


Celkově:

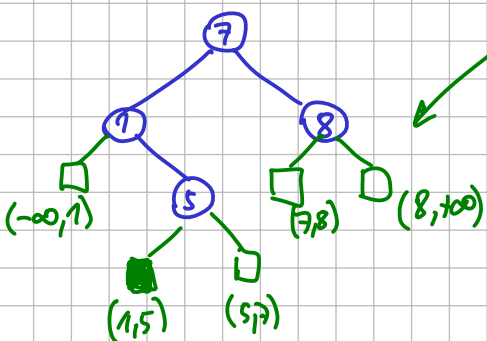
- buď změna znamének nebo (dvój) rotace
- možná poleracijsme



dvójrotace: kořen y

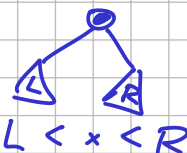


Věta: Find, Insert a Delete v AVL stromu mají časovou složitost  $O(\log n)$ .

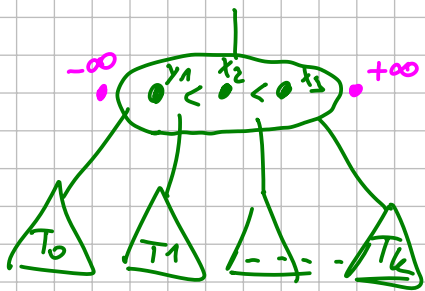


externí vchody (NULL/None v programu)

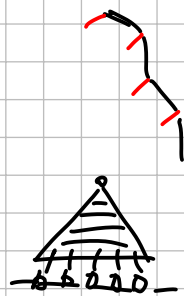
- ⇒ ext. ↔ listy
- ⇒ int. má právě 2 syny
- ⇒ ext. odpovídají intervalům mezi klíči



# Vícecestný vyhledávací strom



- zakoreněný strom
  - má int. + ext. vrcholy
  - synové vrcholy mají pořadí
  - v int. vrcholech jsou klíče (aspoň 1)
- $-\infty = x_0 < x_1 < \dots < x_k < x_{k+1} = +\infty$
- #synů = #klíčů + 1  
↳ podstromy  $T_0, \dots, T_k$
  - uspořádání:  $\forall i \forall y$  klíč v  $T_i$ :  
 $x_i < y < x_{i+1}$



parametry:  
 $a \geq 2, b \geq 2a-1$

(a,b)-strom je vícecestný VS t.č.:

- 1 všechny ext. vrcholy jsou stejně hluboko
- 2 int. vrcholy mají a až b synů (a-1 až b-1 klíčů)  
výjimka: kořen má 2 až b synů (1 až b-1 klíčů)

→ příklad: (2,3)-strom  
2?

