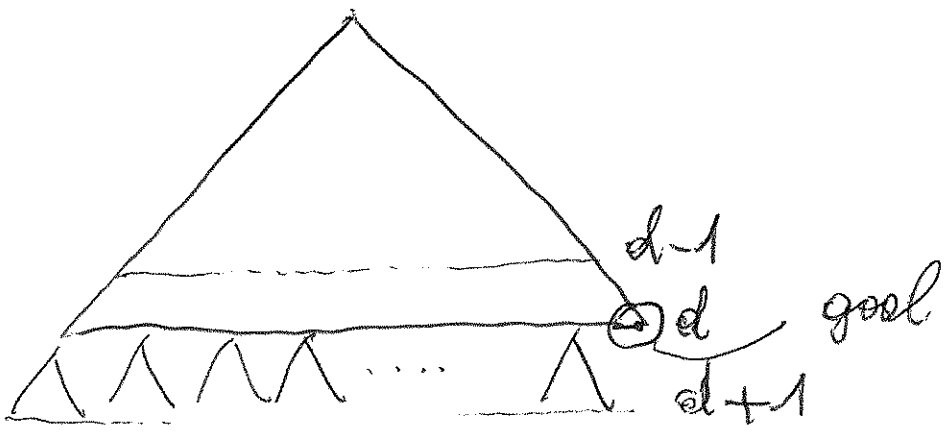
Breadth First Search

1) solution test at generation time

worst case

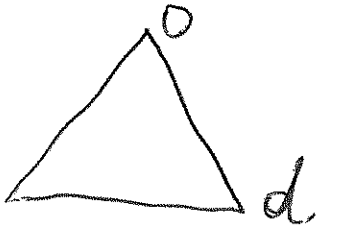
2) solution test at expansion time:



(almost) full further level d+1

Breadth First Search

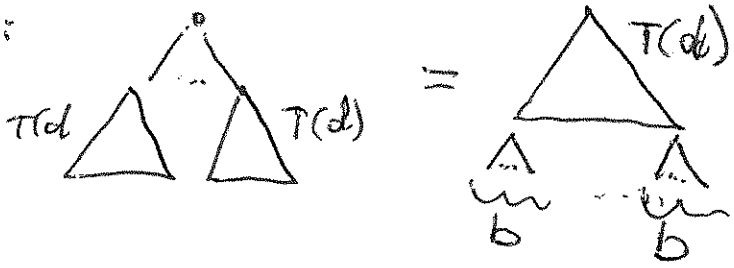
Worst case: full tree T



branching b

- Number of nodes $T(d) = \sum_{i=0}^{d} b^i$
- Closed form: $T(d) = \frac{b^{d+1} - 1}{b - 1}$

Why? $T(d+1)$:



$$1 + b \cdot T(d) = T(d+1) + b^{d+1}$$

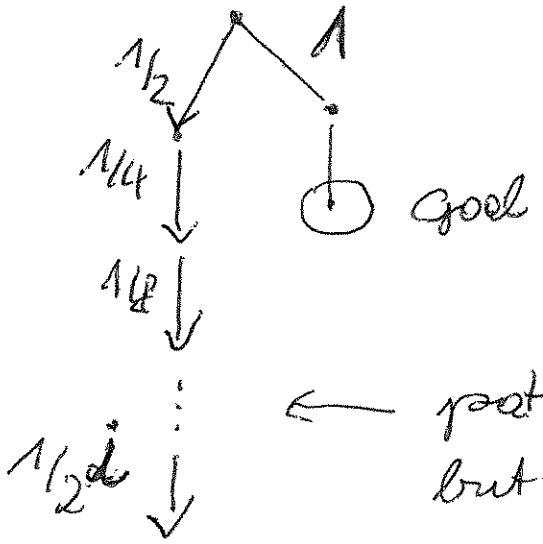
$$\Rightarrow T(d+1) = \frac{b^{d+1} - 1}{b - 1}$$

$$BFS(d) = T(d) \leq \frac{b^{d+1}}{b-1} = \frac{b}{b-1} \cdot b^d$$

Uniform Cost Search

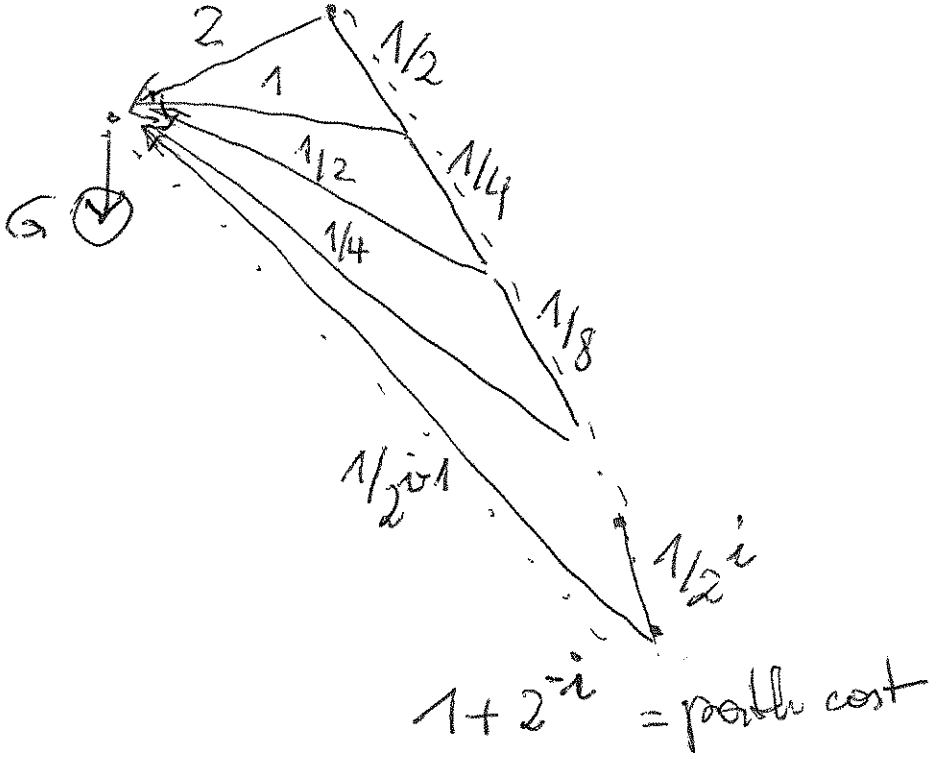
No lower cost bound.

a)



← path cost converges to 1, but is always smaller

b) goal always reachable:



Iterative Deepening Search

$$IDS(d) = \sum_{i=0}^{d} BFS(i)$$

$$= \sum_{i=0}^{d} T(i)$$

$$= \sum_{i=0}^{d} \frac{b^{i+1}-1}{b-1}$$

$$\leq \sum_{i=0}^{d} \frac{b^{i+1}}{b-1}$$

$$= \frac{b}{b-1} \cdot \underbrace{\sum_{i=0}^{d} b^{i}}_{T(d)}$$

$$= \frac{b}{b-1} \cdot \frac{b^{d+1}-1}{b-1}$$

$$\leq \frac{b}{b-1} \cdot \frac{b}{b-1} \cdot b^{d}$$

$$= \left(\frac{b}{b-1}\right)^{2} \cdot b^{d}$$

Compared to BFS, "extra cost" of $\frac{b}{b-1}$ factor