

Sorted Tree Dictionary

Logic Programming - Fall 12

Benjamin GUILLET



What's the matter?

- We want to build a index (dictionary) of performances of horses

- Let's build a database!

winnings(abaris, 582).

winnings(careful, 17).

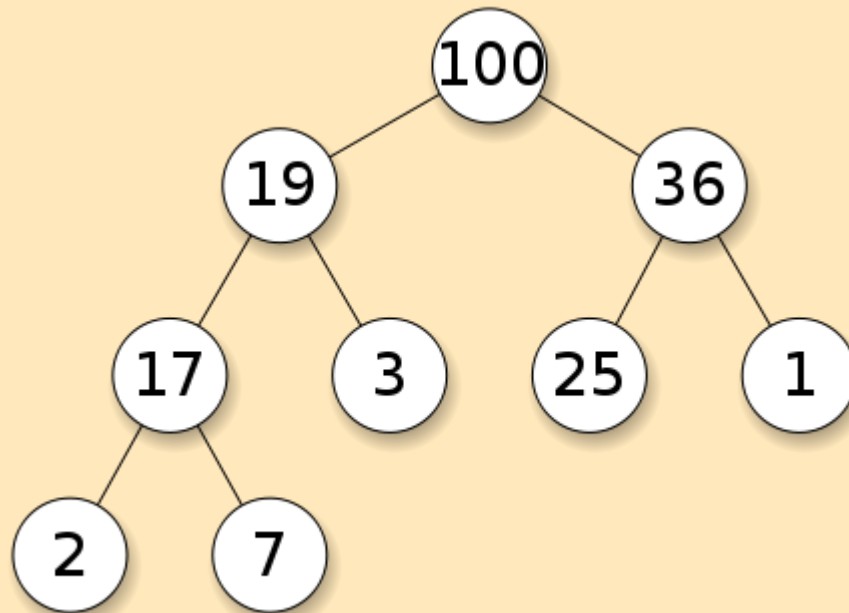
winnings(jingling_silver, 300).

winnings(maloja, 356).

- It's slow! $O(n)$

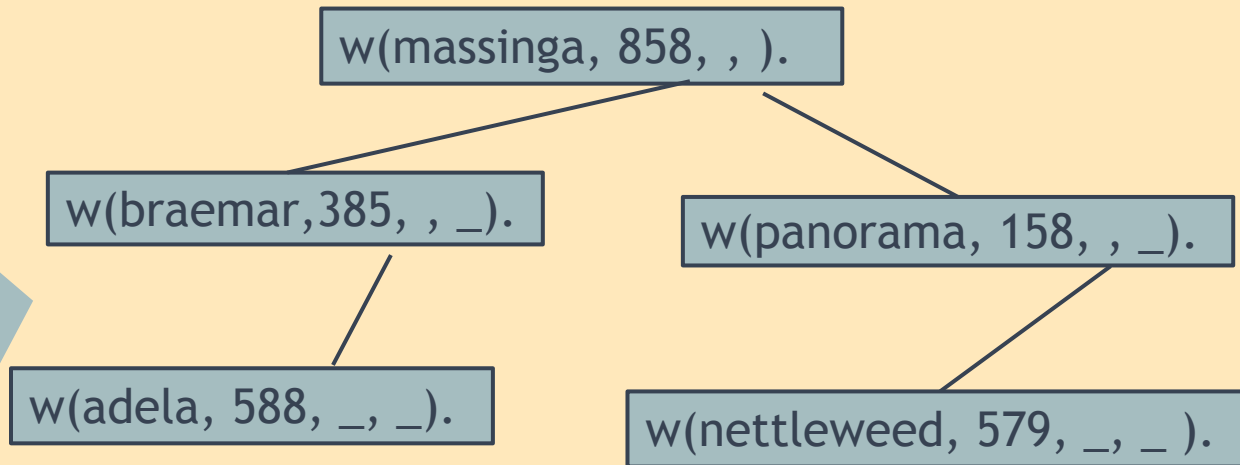
Solution

- Create a Sorted Tree Dictionary
- Basically: a Binary Search Tree (BST).



- Search: $O(\log n)$

Implementation: w(H, W, L, G).



```
w(massinga, 858,  
  w(braemar, 385,  
    w(adela, 588, _, _),  
    _),  
  w(panorama, 158,  
    w(nettlesweed, 579, _, _),  
    _)  
).
```

Implementation: lookup

```
lookup(H, w(H, G, _, _), G1) :- !, G1=G.
```

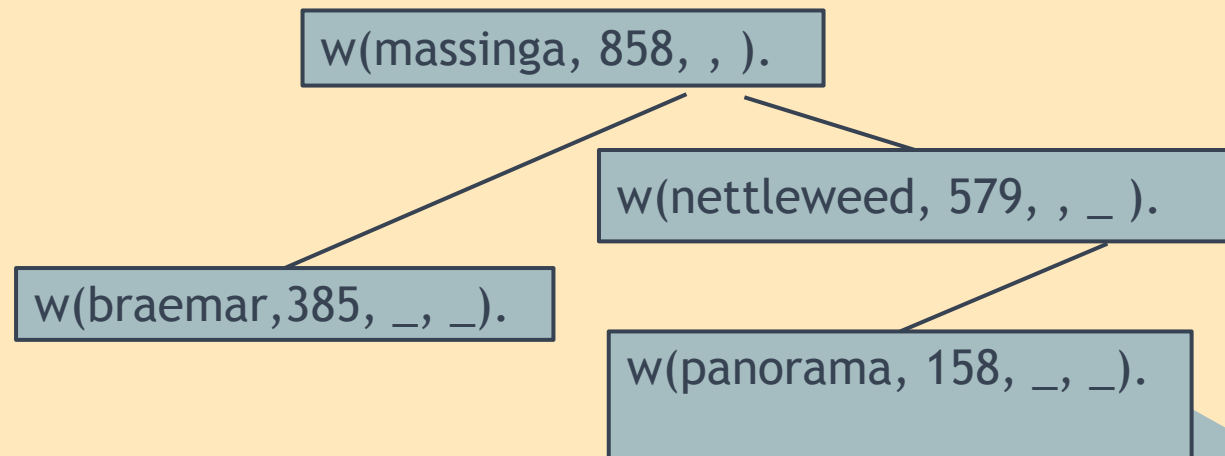
```
lookup(H, w(H1, _, Before, _), G) :-  
    H @< H1,  
    lookup(H, Before, G).
```

```
lookup(H, w(H1, _, _, After), G) :-  
    H @> H1,  
    lookup(H, After, G).
```

Experiment (1)

lookup(massinga, X, 858), lookup(braemar, X, 385), lookup(nettlesweed, X, 579), lookup(panorama, X, 158).

```
w(massinga,858,  
  w(braemar,385,_,_),  
  w(nettlesweed,579,_,_  
    w(panorama,158,_,_)  
  )  
).
```

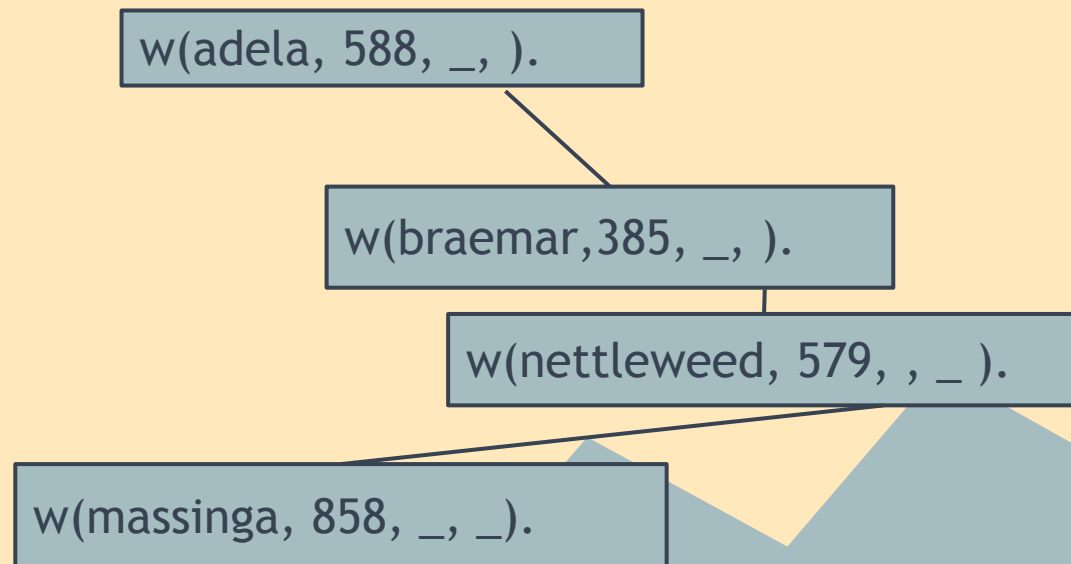


Experiment (2)

lookup(adela, X, 588), lookup(braemar, X, 385), lookup(nettlesweed, X, 579),
lookup(massinga, X, 858).

X = w(adela,588,_,w(braemar,385,_,w(nettlesweed,579,w(massinga,858,_,_),
_))) ?

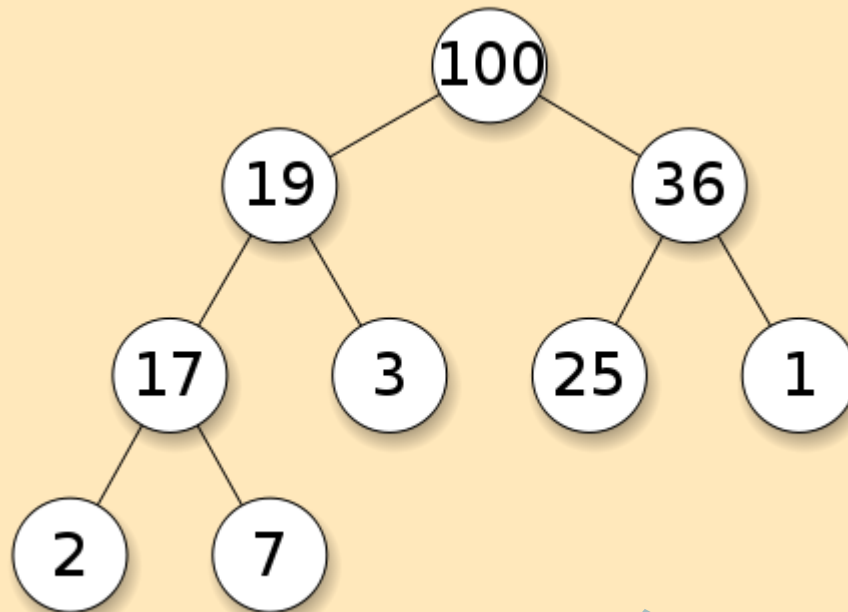
```
w(adela,588,_,  
  w(braemar,385,_,  
    w(nettlesweed,579,  
      w(massinga,858,_,_),  
    _)  
  )  
)
```



Extension: Is it a heap?!

heap:

- Shape property: almost complete binary tree
- Heap property: each node is greater than or equal to each of its children



Extension (2)

| ?- heap1(node(5, node(3, empty, empty), node(4, empty, empty))).

1. The empty tree is a binary heap.
2. For node(K, L, R), it is a heap if:
 - a. L and R are heaps.
 - b. If L and/or R are not empty, then their key is less than or equal to K.
 - c. If L has depth d , then R has depth d or $d - 1$.

Extension (3)

heap1(H) :- heap1(H, _).

heap1(empty, 0).

heap1(node(K, L, R), H) :-
 heap1(L, LH), heap1(R, RH),
 (L = node(LK, _, _) \rightarrow K \geq LK; true),
 (R = node(RK, _, _) \rightarrow K \geq RK; true),
 (LH is RH; LH is RH + 1), H is LH + 1.

Extension (4)

|?- heap1(node(5, node(4, node(6,empty,empty), empty), node(3,empty,empty))).

The image features a solid light orange background. On the left side, there are three overlapping blue geometric shapes that resemble stylized mountain peaks or abstract polygons. Along the bottom edge, there is a continuous blue line composed of several connected triangular and quadrilateral shapes, also resembling a stylized mountain range or a jagged horizon line.

Thank you!