Announcements

MP6 - Tue, 04/19 @11:59pm. Lab_hash - Sun, 04/17 @11:59pm, Lab_heap - Sun, 04/24 @11:59pm.

Exam 4 topics:

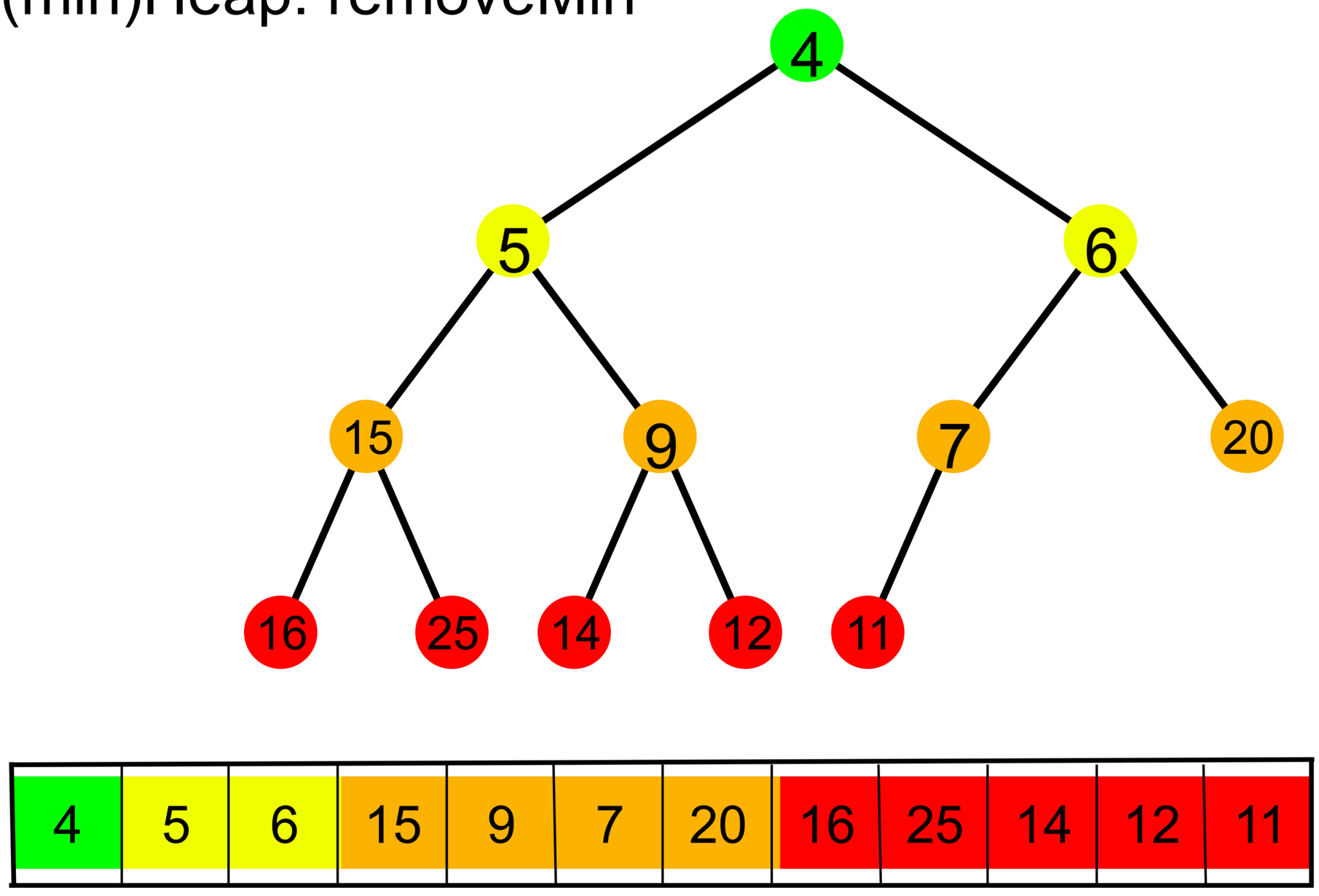
MC: AVL trees, Huffman-trees, b-trees, hash tables, kd-trees, heaps, disjoint sets, run times.

Coding: AVL trees, hash tables, lab heap

Exam 4 Review: Monday 04/18 in both lectures (@11am and @1pm), different reviews!

Watch at home lecture: Watch at home over the weekend: https://chara.cs.illinois.edu/cs225/lectures/

(min)Heap: removeMin

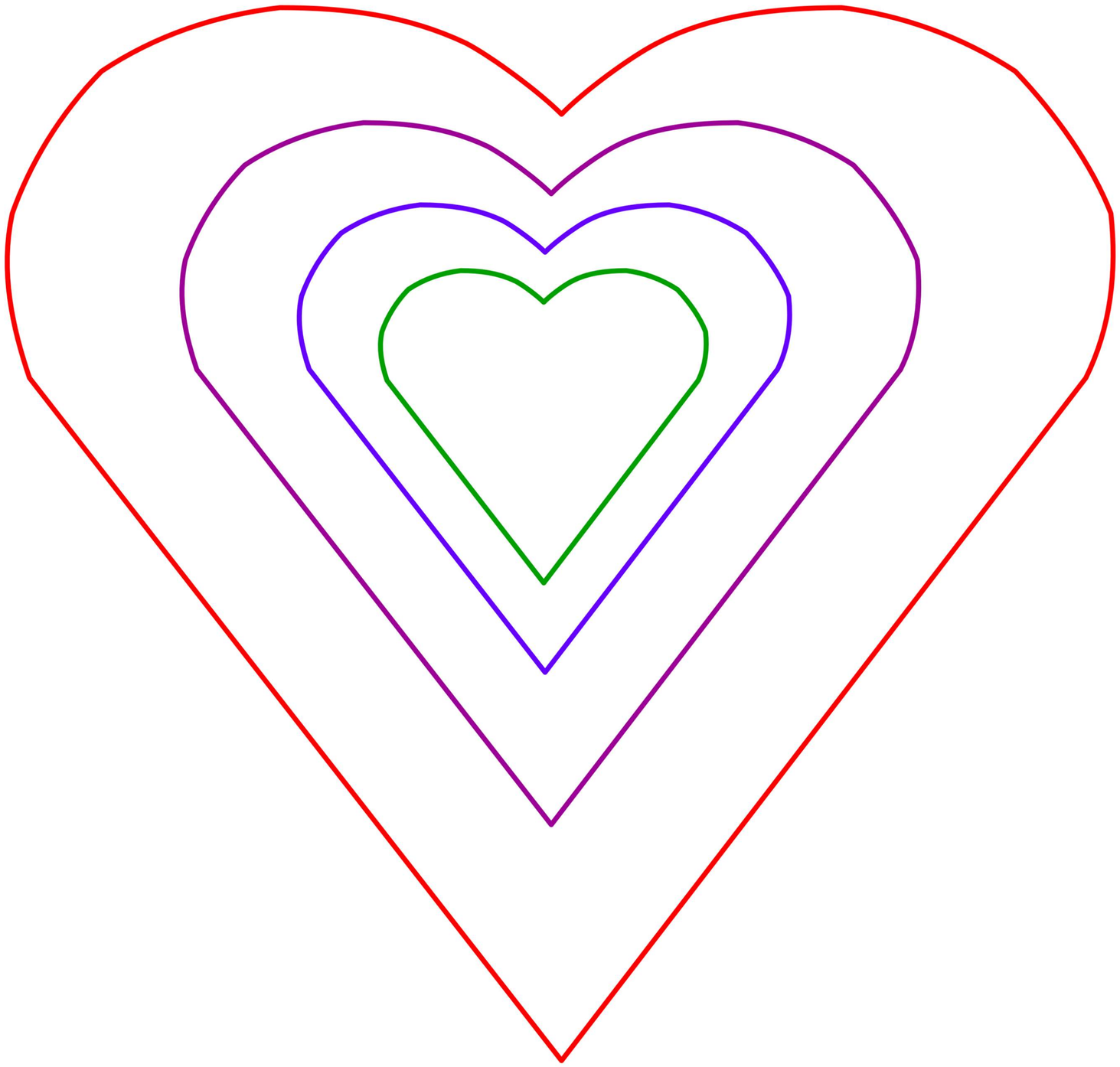


Code:

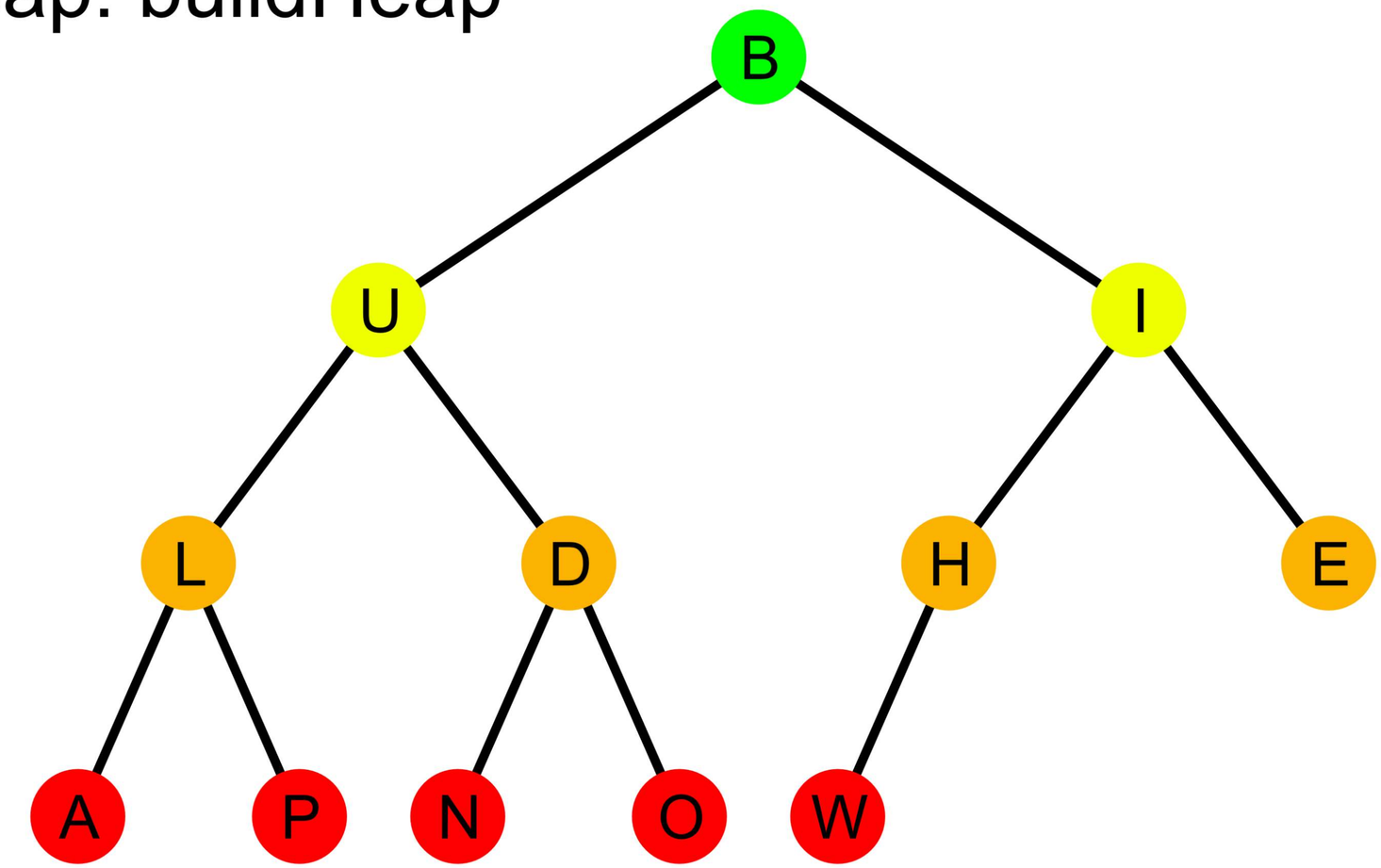
```
template <class T>
T Heap<T>::removeMin(){
   T minVal = items[1];
   items[1] = items[size];
   size--;
   heapifyDown(1);
   return minVal;
}
```

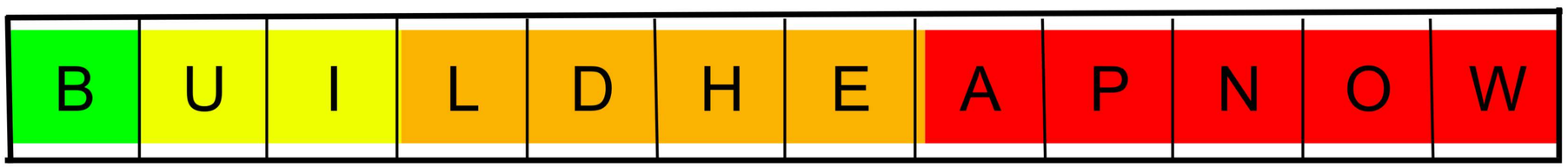
```
template <class T>
void Heap<T>::heapifyDown(int cIndex){
   if (hasAChild(cIndex)){
      minChildIndex = minChild(cIndex);
      if (items[cIndex] ____ items[minChildIndex]{
         swap(_______________,________________);
         ___________________________;
   }
}
```

What have we done?

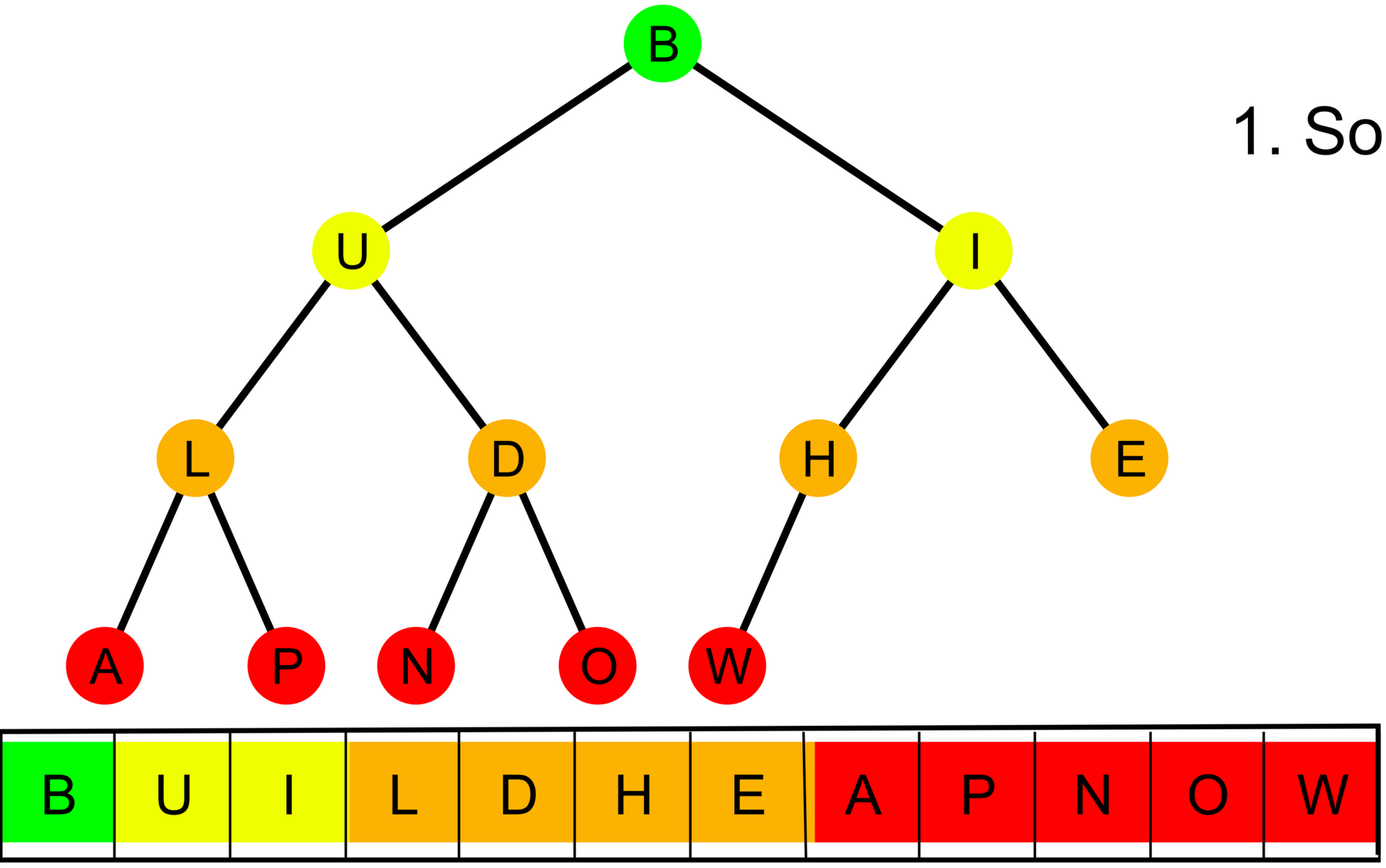


(min)Heap: buildHeap





(min)Heap: buildHeap - 3 alternatives



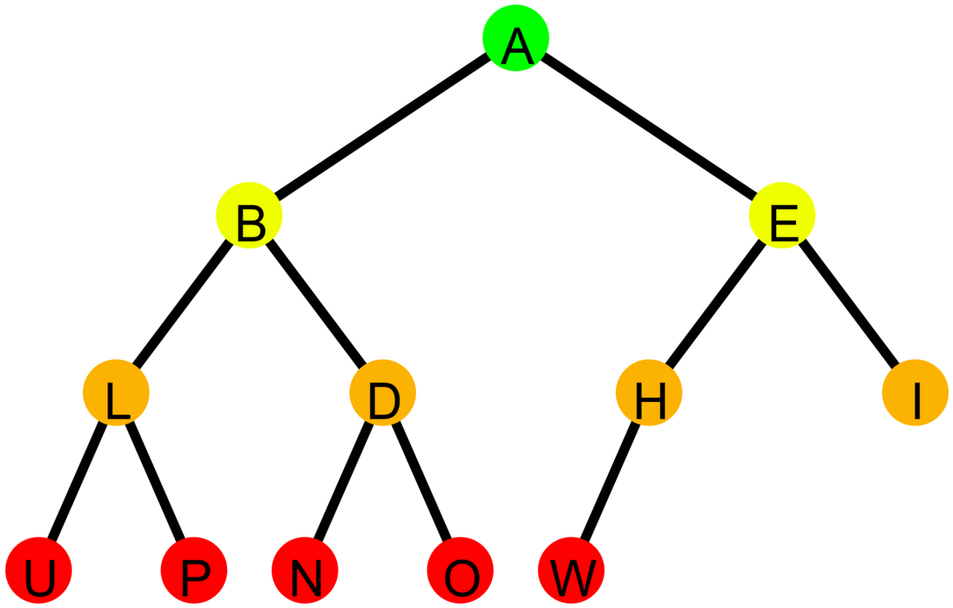
1. Sort the array:

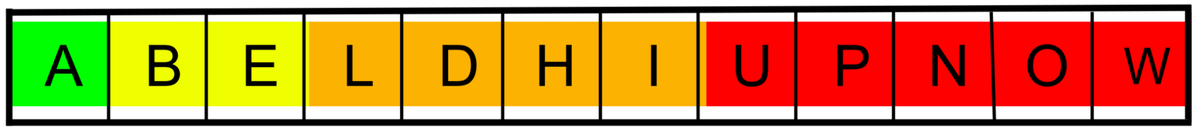
2.
```
template <class T>
void Heap<T>::buildHeap(){
    for (int i=2;i<=size;i++)
        heapifyUp(i)
}
```

3.
```
template <class T>
void Heap<T>::buildHeap(){
    for (int i=parent(size);i>0;i--)
        heapifyDown(i)
}
```

(min)Heap: buildHeap

level height





Thm: The running time of buildHeap on an array of size n is _____.

Instead of focussing specifically on running time, we observe that the time is proportional to the sum of the heights of all of the nodes, which we denote by S(h).

S(h) =

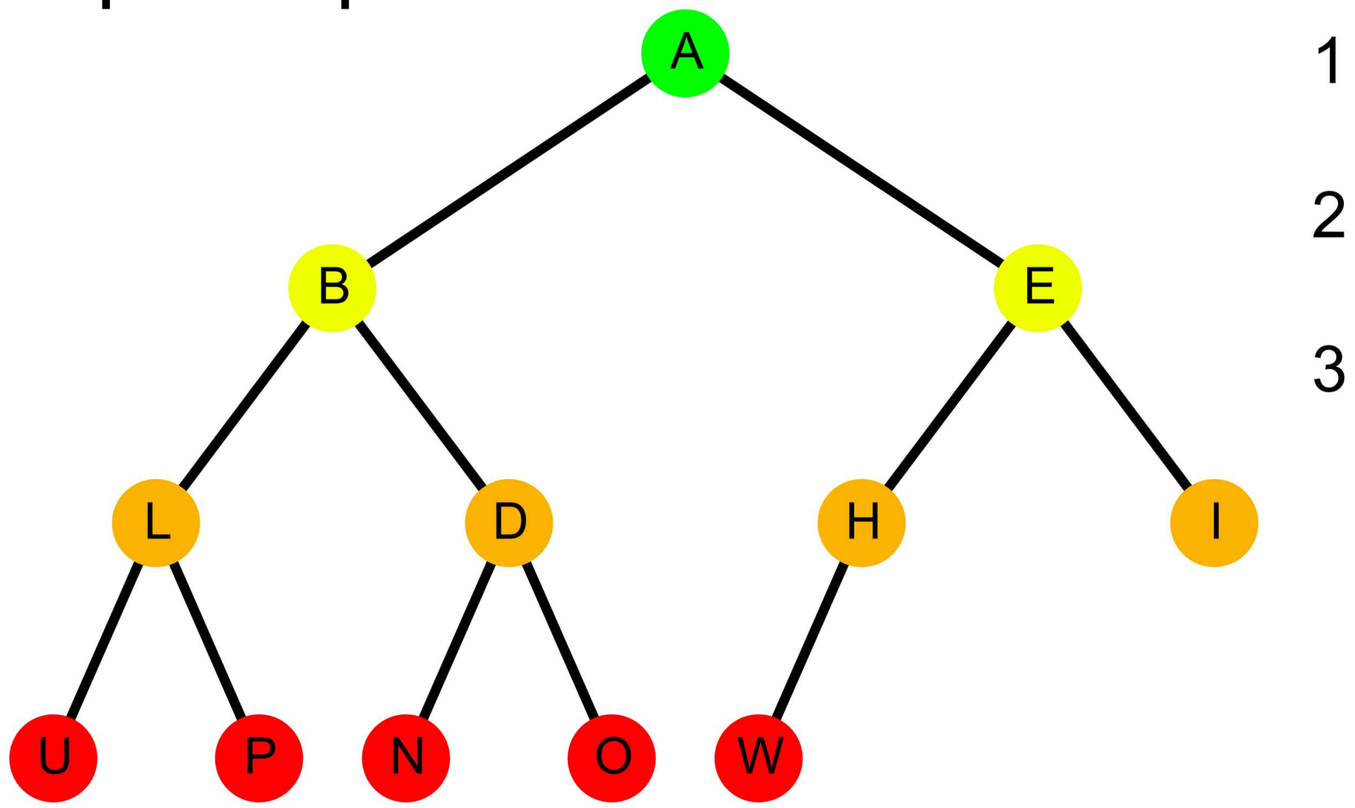
S(0) =

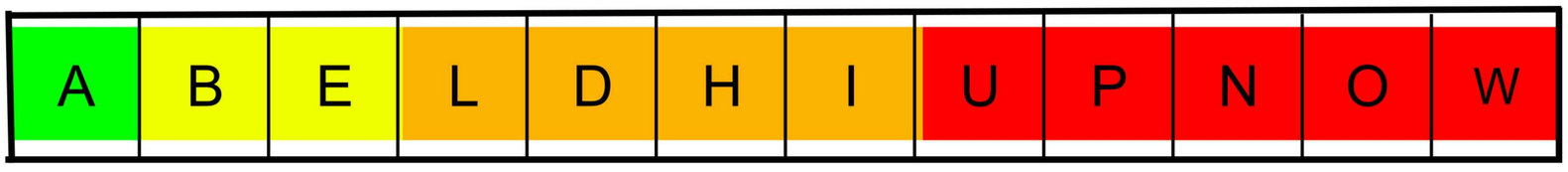
Soln S(h) =

Proof of solution to the recurrence:

But running times are reported in terms of n, the number of nodes...

(min)Heap: heapSort





Running time?

Why do we need another sorting algorithm?

This image reminds us of a _____,

which is one way we can implement ADT _____,

whose functions include _____ and _____,

whose running times are _____.

This structure can be built in time _____,

which helps us do a worst case time _____ sort, in place.