Side Talk: Implementation of The Binary Heap

Yufei Tao

ITEE
University of Queensland
As it should have been clear from our earlier tutorial discussion on how to implement the linked list, coding is about translating an algorithm we have designed into an actual program. The translation could be labor-intensive and error-prone, but may not always be intellectually challenging, provided that appropriate class encapsulation has been done.

In this side talk, we discuss one possible way to implement the binary heap (the tree version, which achieves $O(\log n)$ time per insertion and delete-min in the worst case). We will not go to the same level of details as we did for the linked list. The discussion will stay at the level of class definitions, which provide clear guidance on how the algorithm-to-code translation should take place.

In the jargon of programming, class definitions are often referred to “abstract data types”.
class heapNode{
    int key;
    [Type of heapnode Pointer] leftChild;
    [Type of heapnode Pointer] rightChild;
    [Type of heapnode Pointer] parent;

    [Type of heapnode Pointer] getLeftChild();
    [Type of heapnode Pointer] getRightChild();
    [Type of heapnode Pointer] getParentChild();
    bool isLeaf();
};

Discuss: The four functions are not compulsory; do you think it would make sense to have them?
class heap{
    [Type of lnode Pointer] root;
    int n;

    int insert(int e);
    int deletemin();

    [Type of heapnode Ptr] findBottomRightLeaf(bool insMode);
    ...
};

Recall that the insertion and deletemin algorithms both need something extremely similar. The former needs to create a new “rightmost” leaf at the bottom level, while the latter needs to identify the leaf in the current heap. The two tasks can essentially be done in the same manner. This is the rationale behind the parameter insMode.
That is all!

Now let us discuss:

- Why do the class definitions offer guidance on how to translate our algorithms into actual code lines? Is the guidance clear enough?
- Why did the instructor say in Slide 1 of the notes for Lecture 1 that programming is the last step in software development?
- Is computer science about programming?