Heaps (computer science) Data Structures Computer Science

What are some real-world applications of a heap data structure?

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Gregory Schoenmakers, I know about arrays, linked-lists and some types of trees.

Answered July 29, 2017

A heap data structure is an implementation of a “priority queue”. Instead of just joining a queue at its tail, a person or object may be inserted further up the queue depending on their priority.

One application of this sort of queue might be one where priority is given to customers who take a short time to serve rather than priority to their arrival time. For example, a licensing centre might give priority to customers who only have a simple bill to pay. This reduces the average waiting time for all customers in the queue.

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4 comments from Dani Richard

Kundan Solanki, Student at Indian Institute of Information Technology, Allahabad (2016-present)

Updated Jan 18 · Upvoted by Muhammad Rana, Masters Computer Science, Georgia Southern University

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algorithm (shortest path), Prim's algorithm (minimum spanning tree) and Huffman encoding (data compression).

- *In order to overcome the Worst-Case Complexity of Quick Sort algorithm from O(n^2) to O(nlog(n)) in Heap Sort.*
- *For finding the order in statistics.*
- *Systems concerned with security and embedded system such as Linux Kernel uses Heap Sort because of the O(nlog(n)).*

Hope this helps...

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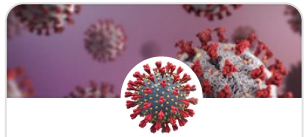

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I used a heap many many (...many) years ago to optimize a program for Bell Canada. The program took in forecasts of future demand for data transfer between nodes in a large network that spanned the country. The program could be configured in terms of the how to choose routes for the data transfer, with the objective of minimizing cost of the required equipment overall. As a simple example, imagine allowing each node to transfer directly to the destination node vs transmitting to a hub which would eventually route the data to it's destination.

The original program was written in Fortran and had been in use for a number of years. The original algorithm was based on multi-dimensional arrays and had been published in a Bell technical journal. It used about 30 minutes of mainframe CPU time to run, and therefore the turnaround time of *tuning* the network to result in an optimal structure took many days. One of the objectives was to make a significant improvement in the performance.

A short time into the project I realized that the arrays in use were what is termed *sparse* arrays (Sparse matrix - Wikipedia) i.e. they contained a lot of zeros that had to be traversed in order to get to cells with values to process. I decided that using a heap to store the data, where every cell would contain data, would eliminate the traversal time and drastically improve performance.

It is anti-climactic to say that after moving the data into a heap, the CPU time used by the algorithm was reduced from 30 minutes to 30 seconds. This had the benefit of allowing the user to try a great many more scenarios in an experimental manner, and even demonstrate these scenarios live during a presentation to execs.

One of the potential consequences of moving the data into a heap was that the resulting tree could become unbalanced. I spent some time looking at tree optimization techniques and ultimately decided that they were too complicated for the situation. I opted instead to use a random number generator to label each node. This produced the desired balancing effect as nodes were inserted into the tree. Another trick that was used was *threading* of the heap (Threaded binary tree - Wikipedia) to allow faster traversal in particular directions.

BTW - for those interested I did change the programming language and introduced a reporting tool which offered other benefits - but those changes were not relevant to the question.


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The operating system may use them to determine what process to do next. The idea being the heap would be ordered by priority.

Anytime you have a group of things, new things coming in to that group, and you want to take out the 'best' of that group. A dynamic to do list: you add items, but the item todo next is the top priority. Manufacturing use this when deciding the next project/object/job to do or the next thing to load into the truck.

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Answered March 4, 2018

whenever you call something like

program's heap.

But hey, that's too much to handle right now. I just want to put the contents of a complete binary tree into an array. What do you call that?

Surprise - A heap!

The Heap Sort is called Heap Sort because you use a Heap for sorting.

A min heap is a DS with smaller root than child
The opposite goes for a max heap.

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