

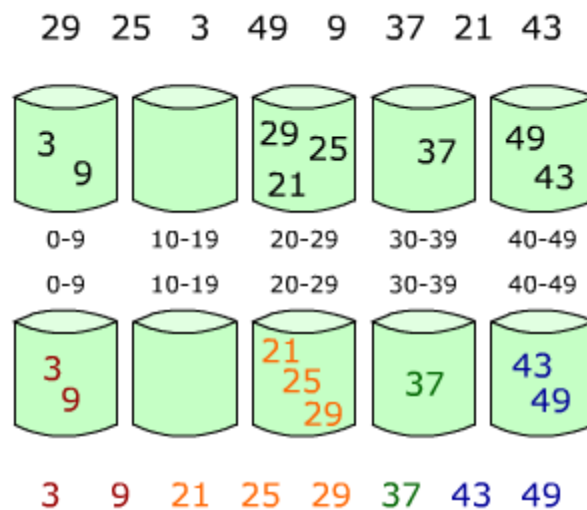
Bucket Sort

Bucket sort, or bin sort, is a sorting algorithm that works by partitioning an array into a number of buckets. Each bucket is then sorted individually, either using a different sorting algorithm, or by recursively applying the bucket sorting algorithm. It is a cousin of radix sort in the most to least significant digit flavor. Bucket sort is a generalization of pigeonhole sort. Since bucket sort is not a comparison sort, the $O(n \log n)$ lower bound is inapplicable. The computational complexity estimates involve the number of buckets.

Bucket sort works as follows:

1. Set up an array of initially empty “buckets.”
2. **Scatter:** Go over the original array, putting each object in its bucket in sorted order.
3. **Gather:** Visit the buckets in order and put all elements back into the original array.

This is shown in the figure below. Realize in the figures that the numbers in the buckets don't appear to be sorted. In your implementation, each will be sorted. The data to be sort is shown in the top line.



The most common variant of bucket sort operates on a list of n numeric inputs between zero and some maximum value M and divides the value range into n buckets each of size M/n .

Each bucket will be implemented as a linked list. Thus you will need to have an array of pointers to a linked lists and the size of the array is The size of the array is dependent on M .

You must:

1. Dynamically allocate the array of buckets.
2. Randomly generate integers to sort.
 - a. You should try data sets of the following sizes: 1024, 2048, 4096, 8192.
 - b. If a duplicate is generated, the duplicate is ignored.
3. Try the above data sets with the following bucket sizes: 10, 20, 30, 40.
4. Time your bucket sort function and plot the running times using Excel.
5. Analyze the data, and in a report talk about what you have learned.
6. Given a data size, how do you pick the best number of buckets?
7. The timings functions, available from the course web page, are: `hr_time.h` and `hr_time.cpp`. If you need more information about using these function, please visit the following web site.
<http://cplus.about.com/od/howtothingsi2/a/timing.htm>

Submit a zip file that contains your program and the document that describes the results of your tests to eagle.