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CAUSWE 2021
Algorithm Course - Class#2
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Midterm Assignment Report

Codes

Time_Checker.py

```
import time, math, sort_bubble, sort_bucket, sort_insertion, sort_merge,
sort_quick, sort_radix

def printtime(label, time):
  print(format(time, 'f'))

arr = list(range(100, 0, -1))

start = time.time()
sort_bubble.bubblesort(arr)
printtime('bubble', time.time()-start)

# start = time.time()
# result = sort_insertion.insertionsort(arr)
# printtime('insertion', time.time()-start)

# start = time.time()
# sort_merge.mergesort(arr)
# printtime('merge', time.time()-start)

# start = time.time()
# sort_quick.quicksort(arr)
# printtime('quick', time.time()-start)

# start = time.time()
# sort_radix.radixsort(arr)
# printtime('radix', time.time()-start)

# start = time.time()
# sort_bucket.bucketsort(arr, 10)
```

bubble sort

```
def bubblesort(arr):
  result = arr
  for i in range(0, len(arr) - 1):
    for j in range(0, len(arr) - i - 1):
      if(result[j] > result[j+1]):
        temp = result[j]
        result[j] = result[j+1]
        result[j+1] = temp
  return result
```

insertion sort

```
def insertionsort(arr):
  result = arr
  for i in range(1, len(result)):
    for j in range(i, 0, -1):

      if(result[j-1] < result[j]):
        break
      else:
        temp = result[j]
        result[j] = result[j-1]
        result[j-1] = temp
  return result
```

Merge sort

```
def mergesort(arr):
  if(len(arr) == 1):
    return arr
  else:
    left = arr[:round(len(arr)/2)]
    right = arr[round(len(arr)/2):]

    left = mergesort(left)
    right = mergesort(right)

    resultArr = []
    l = r = 0
    for _ in range(0, len(arr)):

      if(r >= len(right)):
        resultArr.append(left[l])
        l += 1
        if(l >= len(left)):
          for _ in range(r, len(right)):
            resultArr.append(right[r])
            r += 1
          break

      else:
        resultArr.append(right[r])
        r += 1
        if(r >= len(right)):
          for _ in range(l, len(left)):
            resultArr.append(left[l])
            l += 1
          break
    return resultArr
```

Quick Sort

```
def quicksort(arr):
  if(len(arr) <= 1):
    return arr
  else:
    x = round(len(arr)/2)
    left = []
    right = []

    for i, i_value in enumerate(arr):
      if(i == x):
        continue
      else:
        if(i_value <= arr[x]):
          left.append(i_value)
        else:
          right.append(i_value)
    return quicksort(left) + [arr[x]] + quicksort(right)
```

Radix Sort

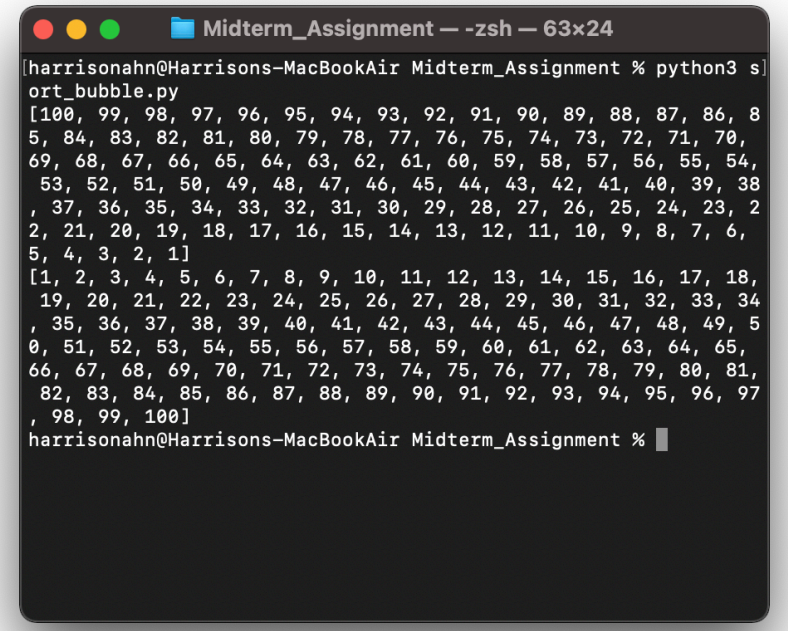
```
def radixsort(arr):
  maxval = max(arr)
  exponent = 1

  result = arr

  while(maxval / exponent >= 1):
    result = countsort(result, exponent)
    exponent *= 10
  return result

def countsort(arr, exponent):
  count = [0,0,0,0,0,0,0,0,0,0]
  result = [0 for i in range(len(arr))]

  for i in arr:
    index = round(((i % (exponent * 10)) - (i % (exponent))) / exponent)
    count[index] += 1

  for i, _ in enumerate(count[:-1]):
    count[i+1] += count[i]

  for i in reversed(arr):
    index = round(((i % (exponent * 10)) - (i % (exponent))) / exponent)
    count[index] -= 1
    result[count[index]] = i

  return result
```

Bucket Sort

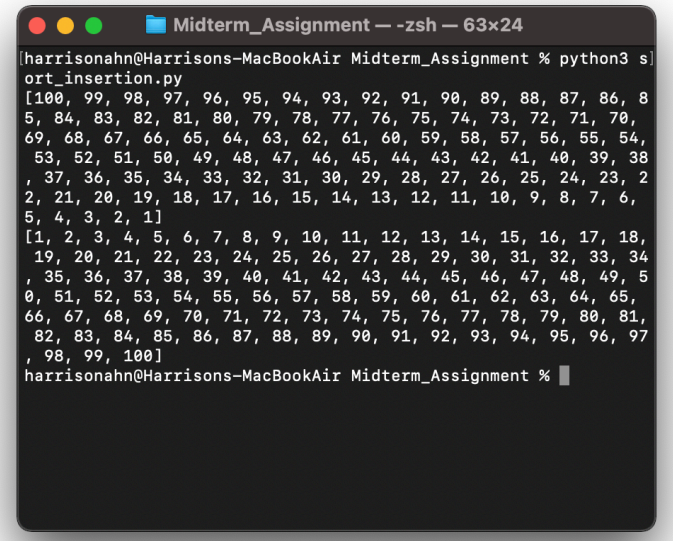
```python
import math
def bucketsort(arr, buckets):
  result = [[] for i in range(buckets)]
  arr_min = min(arr)
  arr_max = max(arr)
  arr_range = arr_max - arr_min
  bucket_range = arr_range/buckets

  for i in arr:
    index = math.floor((i-arr_min)/bucket_range)
    if(index == buckets):
      index -= 1
    insert_index = len(result[index])
    for j_index, j in enumerate(result[index]) :
      if(j >= i):
        insert_index = j_index
        break
    result[index].insert(insert_index, i)

  result_return = []
  for i in result:
    result_return += i

  return result_return
```

Input/Output

Bubble Sort



Insertion Sort



```
Midterm_Assignment — -zsh — 63×24
harrisonahn@Harrisons-MacBookAir Midterm_Assignment % python3 s
ort_insertion.py
[100, 99, 98, 97, 96, 95, 94, 93, 92, 91, 90, 89, 88, 87, 86, 8
5, 84, 83, 82, 81, 80, 79, 78, 77, 76, 75, 74, 73, 72, 71, 70,
69, 68, 67, 66, 65, 64, 63, 62, 61, 60, 59, 58, 57, 56, 55, 54,
 53, 52, 51, 50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38
, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 2
2, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6,
5, 4, 3, 2, 1]
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, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 5
0, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65,
66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81,
 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97
, 98, 99, 100]
harrisonahn@Harrisons-MacBookAir Midterm_Assignment %
```
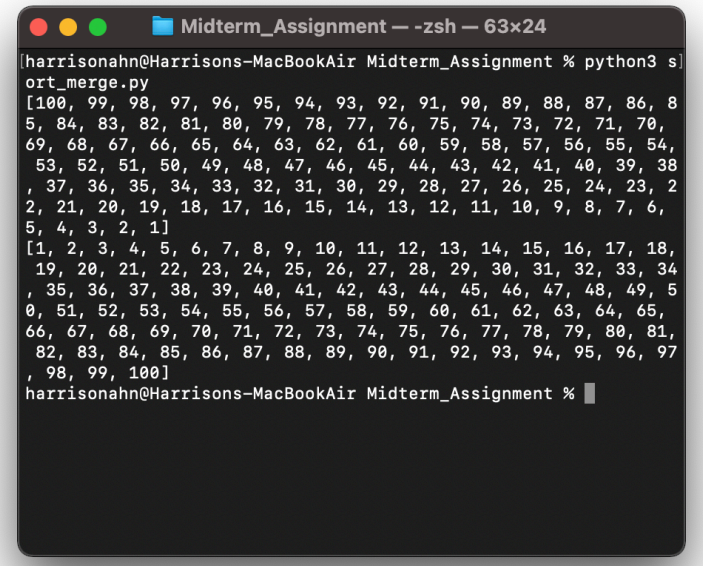

Merge Sort



```
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ort_merge.py
[100, 99, 98, 97, 96, 95, 94, 93, 92, 91, 90, 89, 88, 87, 86, 8
5, 84, 83, 82, 81, 80, 79, 78, 77, 76, 75, 74, 73, 72, 71, 70,
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5, 4, 3, 2, 1]
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66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81,
 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97
, 98, 99, 100]
harrisonahn@Harrisons-MacBookAir Midterm_Assignment %
```

Quick Sort

```
Midterm_Assignment — -zsh — 63×24
harrisonahn@Harrisons-MacBookAir Midterm_Assignment % python3 s
ort_quick.py
[100, 99, 98, 97, 96, 95, 94, 93, 92, 91, 90, 89, 88, 87, 86, 8
5, 84, 83, 82, 81, 80, 79, 78, 77, 76, 75, 74, 73, 72, 71, 70,
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5, 4, 3, 2, 1]
[1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18,
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66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81,
 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97
, 98, 99, 100]
harrisonahn@Harrisons-MacBookAir Midterm_Assignment %
```

Radix Sort

```
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harrisonahn@Harrisons-MacBookAir Midterm_Assignment % python3 s
ort_radix.py
[100, 99, 98, 97, 96, 95, 94, 93, 92, 91, 90, 89, 88, 87, 86, 8
5, 84, 83, 82, 81, 80, 79, 78, 77, 76, 75, 74, 73, 72, 71, 70,
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, 37, 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 2
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66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81,
 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97
, 98, 99, 100]
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```
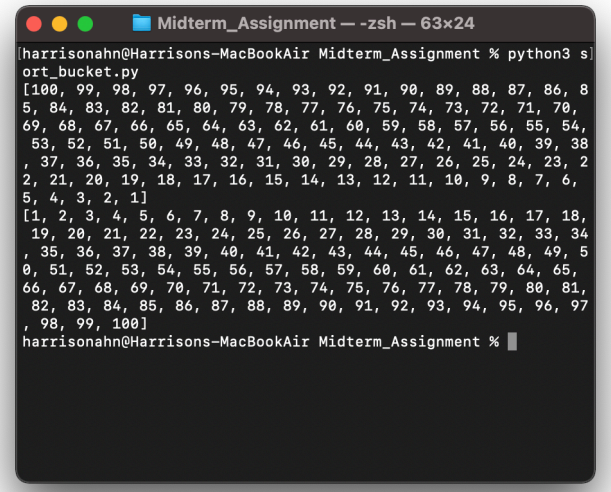

Bucket Sort



Result Table

	Bubble	Insertion	Merge	Quick	Radix	Bucket
100	0.001051	0.000720	0.000305	0.000184	0.000239	0.000105
1000	0.075248	0.069590	0.003497	0.001780	0.002269	0.000795
10000	6.08586	6.097266	0.032284	0.020772	0.030535	0.008429