

CSE312 - Operating Systems - Homework 2 Report

Desing

```
class Queue
{
public:
    Queue();
    ~Queue();

    void enqueue(uint32_t value);
    uint32_t dequeue();
    bool isEmpty();

    void print();
private:
    uint32_t queue[FRAME_COUNT];
    int size = FRAME_COUNT;
    int front = -1;
    int rear = -1;
};
```

```
struct PageTable
{
    uint32_t frameNumber;
    uint64_t counter;
    bool referenced = false;
    bool present = false;
};

class VirtualMemory
{
public:
    VirtualMemory(uint32_t startAddress, uint8_t size, uint8_t replacementAlgorithm);
    ~VirtualMemory();

    uint32_t& operator[] (uint32_t index);

    uint32_t getSize();
    void fill();
    void showStatistics();

private:
    // Required variables
    PageTable pageTable[256]; // This is static
    uint32_t *startAddress;
    uint32_t size;
```

```

uint8_t pageCount; // Maximum page count is 256
uint8_t replacementAlgorithm; // 0 = FIFO, 1 = SC, 2 = LRU

// Helper variables
uint32_t counter = 0;
Queue queue = Queue();

//Statistic variables
uint32_t hit = 0;
uint32_t miss = 0;
uint32_t pageLoaded = 0;
uint32_t pageWritten = 0;

// Helper functions
void replacePage(uint32_t pageNumber);
uint32_t getIndex(uint32_t index);
};

```

Result Screenshots

FIFO

Bubble Sort

```

-----
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Unsorted array:
22128 43832 21916 10958 5479 35507 17753 8876 37206 51371 58453 29226 14613 7306
36421 18210 41873 53704 59620 29810 47673 56604 28302 14151 7075 3537 34536 172
68 8634 4317 34926 50231 57883 28941 47238 56387 60961 30480 15240 40388

Sorted array:
3537 4317 5479 7075 7306 8634 8876 10958 14151 14613 15240 17268 17753 18210 219
16 22128 28302 28941 29226 29810 30480 34536 34926 35507 36421 37206 40388 41873
43832 47238 47673 50231 51371 53704 56387 56604 57883 58453 59620 60961

Virtual Memory Statistics:
Page Count: 10
Page Loaded: 175
Page Written: 175
Hit: 2853
Miss: 175

```

Insertion Sort

```
-----  
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```

Unsorted array:

```
22128 43832 21916 10958 5479 35507 17753 8876 37206 51371 58453 29226 14613 7306  
36421 18210 41873 53704 59620 29810 47673 56604 28302 14151 7075 3537 34536 172  
68 8634 4317 34926 50231 57883 28941 47238 56387 60961 30480 15240 40388
```

Sorted array:

```
3537 4317 5479 7075 7306 8634 8876 10958 14151 14613 15240 17268 17753 18210 219  
16 22128 28302 28941 29226 29810 30480 34536 34926 35507 36421 37206 40388 41873  
43832 47238 47673 50231 51371 53704 56387 56604 57883 58453 59620 60961
```

Virtual Memory Statistics:

```
Page Count: 10  
Page Loaded: 78  
Page Written: 78  
Hit: 1156  
Miss: 78
```

Quick Sort

```
-----  
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```

Unsorted array:

```
22128 43832 21916 10958 5479 35507 17753 8876 37206 51371 58453 29226 14613 7306  
36421 18210 41873 53704 59620 29810 47673 56604 28302 14151 7075 3537 34536 172  
68 8634 4317 34926 50231 57883 28941 47238 56387 60961 30480 15240 40388
```

Sorted array:

```
3537 4317 5479 7075 7306 8634 8876 10958 14151 14613 15240 17268 17753 18210 219  
16 22128 28302 28941 29226 29810 30480 34536 34926 35507 36421 37206 40388 41873  
43832 47238 47673 50231 51371 53704 56387 56604 57883 58453 59620 60961
```

Virtual Memory Statistics:

```
Page Count: 10  
Page Loaded: 35  
Page Written: 35  
Hit: 573  
Miss: 35
```

Second Chance

Bubble Sort

```
-----  
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```

Unsorted array:

```
22128 43832 21916 10958 5479 35507 17753 8876 37206 51371 58453 29226 14613 7306  
36421 18210 41873 53704 59620 29810 47673 56604 28302 14151 7075 3537 34536 172  
68 8634 4317 34926 50231 57883 28941 47238 56387 60961 30480 15240 40388
```

Sorted array:

```
3537 4317 5479 7075 7306 8634 8876 10958 14151 14613 15240 17268 17753 18210 219  
16 22128 28302 28941 29226 29810 30480 34536 34926 35507 36421 37206 40388 41873  
43832 47238 47673 50231 51371 53704 56387 56604 57883 58453 59620 60961
```

Virtual Memory Statistics:

```
Page Count: 10  
Page Loaded: 10  
Page Written: 10  
Hit: 3018  
Miss: 10
```

Insertion Sort

Queue is empty

```
4294967295 1 2 3 4
```

Queue is empty

Sorted array:

```
3537 4317 5479 7075 7306 8634 8876 10958 14151 14613 15240 17268 17753 18210 219  
16 22128 28302 28941 29226 29810 30480 34536 34926 35507 36421 37206 40388 41873  
43832 47238 47673 50231 51371 53704 56387 56604 57883 58453 59620 60961
```

Virtual Memory Statistics:

```
Page Count: 10  
Page Loaded: 10  
Page Written: 10  
Hit: 1224  
Miss: 10
```

Quick Sort

Queue is empty

```
4294967295 1 2 3 4
```

Queue is empty

Sorted array:

```
3537 4317 5479 7075 7306 8634 8876 10958 14151 14613 15240 17268 17753 18210 219  
16 22128 28302 28941 29226 29810 30480 34536 34926 35507 36421 37206 40388 41873  
43832 47238 47673 50231 51371 53704 56387 56604 57883 58453 59620 60961
```

Virtual Memory Statistics:

```
Page Count: 10  
Page Loaded: 10  
Page Written: 10  
Hit: 598  
Miss: 10
```

Least Recently Used

Bubble Sort

```

-----
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-----

Unsorted array:
22128 43832 21916 10958 5479 35507 17753 8876 37206 51371 58453 29226 14613 7306
 36421 18210 41873 53704 59620 29810 47673 56604 28302 14151 7075 3537 34536 172
68 8634 4317 34926 50231 57883 28941 47238 56387 60961 30480 15240 40388

Sorted array:
3537 4317 5479 7075 7306 8634 8876 10958 14151 14613 15240 17268 17753 18210 219
16 22128 28302 28941 29226 29810 30480 34536 34926 35507 36421 37206 40388 41873
 43832 47238 47673 50231 51371 53704 56387 56604 57883 58453 59620 60961

Virtual Memory Statistics:
Page Count: 10
Page Loaded: 263
Page Written: 263
Hit: 2765
Miss: 263

```

Insertion Sort

```

-----
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-----

Unsorted array:
22128 43832 21916 10958 5479 35507 17753 8876 37206 51371 58453 29226 14613 7306
 36421 18210 41873 53704 59620 29810 47673 56604 28302 14151 7075 3537 34536 172
68 8634 4317 34926 50231 57883 28941 47238 56387 60961 30480 15240 40388

Sorted array:
3537 4317 5479 7075 7306 8634 8876 10958 14151 14613 15240 17268 17753 18210 219
16 22128 28302 28941 29226 29810 30480 34536 34926 35507 36421 37206 40388 41873
 43832 47238 47673 50231 51371 53704 56387 56604 57883 58453 59620 60961

Virtual Memory Statistics:
Page Count: 10
Page Loaded: 162
Page Written: 162
Hit: 1072
Miss: 162

```

Quick Sort

```
-----  
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-----
```

Unsorted array:

```
22128 43832 21916 10958 5479 35507 17753 8876 37206 51371 58453 29226 14613 7306  
36421 18210 41873 53704 59620 29810 47673 56604 28302 14151 7075 3537 34536 172  
68 8634 4317 34926 50231 57883 28941 47238 56387 60961 30480 15240 40388
```

Sorted array:

```
3537 4317 5479 7075 7306 8634 8876 10958 14151 14613 15240 17268 17753 18210 219  
16 22128 28302 28941 29226 29810 30480 34536 34926 35507 36421 37206 40388 41873  
43832 47238 47673 50231 51371 53704 56387 56604 57883 58453 59620 60961
```

Virtual Memory Statistics:

```
Page Count: 10  
Page Loaded: 134  
Page Written: 134  
Hit: 474  
Miss: 134
```