LAB9

Lab 9

- The deadline for lab8 submission is May 10 at 11:59 pm.
- If you have any question, please contact TA (moon4654268@hanyang.ac.kr).
- Folder name : lab9
- Code name: p9.c
- Each code will be tested by 5 different input files.
- 20 score for each input, if you don’t get the answer, you will get 0 score.
- If you don’t print the message, you will get 0 score.

Evaluation criteria

Category	Evaluation	
p9	100	
Total	100	

- *Use GCC **11** version.*
- *No score will be given if the gcc version is different.*

Lab 9 – Binary max heap

Heap CreateHeap(int heapSize) create a heap with the size of ‘heapSize’

void Insert(Heap heap, int value) insert a new key to the max heap. You should find the right position for the new key to maintain the max heap.

int Find (Heap heap, int value) find the key in the heap. Return 1 if the value exists. Otherwise, return 0.

void DeleteMax(Heap heap) delete the max in root node and reconstruct the heap to maintain max heap.

void PrintHeap(Heap heap) print the entire heap in level order traversal.

Lab 9 – Binary max heap

Exception errors that need to be printed.

- Insert
  - When heap is full – "Insertion Error: Max Heap is full."
  - When key is duplicated – "[key] is already in the heap."
- DeleteMax
  - When heap is empty – "Deletion Error: Max Heap is empty!"
- Print
  - When heap is empty – "Max Heap is empty!"

Lab 9 – Binary max heap

- **n x** create a new heap with the size of x. The number x is the maximum size of the MaxHeap. This operation will always be given in the first line of the operations in your input file.
- **i x** insert a new key “x” into the max heap. Print what key you inserted.
- **f x** find the given key to check whether the key exists in the heap and print whether the key exists or not.
- **d** delete the max key in the root node. Print what node you have deleted.
- **p** print the entire max heap in level order traversal.

Lab 9 – Binary max heap

- Structure

```
typedef struct HeapStruct* Heap;
struct HeapStruct{
        int Capacity; //max heap capacity
        int Size; //current heap size
        int *Element;
};
```

- Function

```
Heap CreateHeap(int heapSize);
void Insert(Heap heap, int value);
int Find(Heap heap, int value);
void DeleteMax(Heap heap);
void PrintHeap(Heap heap);
```

Lab 9 – Binary max heap

```c
#include<stdio.h>
#include<stdlib.h>

typedef struct HeapStruct* Heap;
struct HeapStruct
{
    int capacity;
    int size;
    int *elements;
};

Heap CreateHeap(int heapSize);
void Insert(Heap heap, int value);
int Find(Heap heap, int value);
void DeleteMax(Heap heap);
void PrintHeap(Heap heap);
void FreeHeap(Heap heap);

void main(int argc, char* argv[])
{
    FILE *fi = fopen(argv[1], "r");
    char cv;
    Heap maxHeap;
    int value, maxValue;
```

```c
    while(!feof(fi))
    {
        fscanf(fi, "%c", &cv);
        switch(cv){
        case 'n':
            fscanf(fi, "%d", &value);
            maxHeap = CreateHeap(value);
            break;
        case 'i':
            fscanf(fi, "%d", &value);
            Insert(maxHeap, value);
            break;
        case 'd':
             DeleteMax(maxHeap);
             break;
        case 'f':
            fscanf(fi, "%d", &value);
            if(Find(maxHeap, value))
                printf("%d is in the heap.\n", value);
            else
                printf("%d is not in the heap.\n", value);
            break;
        case 'p':
            PrintHeap(maxHeap);
        }
    }
    FreeHeap(maxHeap);
}
```

Lab 9 – Example

- input file : lab9_input.txt

```
n 5
i 10
i 25
i 3
i 3
i 5
i 15
i 20
f 10
f 20
p
d
p
```

- Result

```
root@0607fb0c13ae:/home/2022_ds/code/lab8# ./p8 lab8_input.txt
Insert 10
Insert 25
Insert 3
3 is already in the heap.
Insert 5
Insert 15
Insertion Error: Max Heap is full.
10 is in the heap.
20 is not in the heap.
25 15 3 5 10
Max element(25) deleted.
15 10 3 5
```

Lab 9 – Example

- input file : lab9_input2.txt

```
n 5
d
p
i 5
i 4
i 3
i 2
i 1
p
i 1
d
p
i 1
```

- Result

```
root@0607fb0c13ae:/home/2022_ds/code/lab8# ./p8 lab8_input2.txt
Deletion Error: Max heap is empty!
Max heap is empty!
Insert 5
Insert 4
Insert 3
Insert 2
Insert 1
5 4 3 2 1
Insertion Error: Max Heap is full.
Max element(5) deleted.
4 2 3 1
1 is already in the heap.
```

Lab 9 – Binary max heap

- program name : p9.c
- input : a list of commands in a file.
- output : the corresponding result in the standard output.