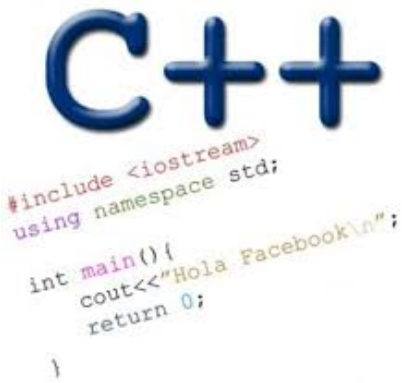
HEAPS: IMPLEMENTATION
PRIORITY QUEUES
COMPARISON CLASSES

Problem Solving with Computers-II



STL Heap implementation: Priority Queues in C++

What is the output of this code?

```
priority_queue<int> pq;
pq.push(10);
pq.push(2);
pq.push(80);
cout<<pq.top();
pq.pop();
cout<<pq.top();
pq.pop();
cout<<pq.top();
pq.pop();
```

A. 10 2 80
B. 2 10 80
C. 80 10 2
D. 80 2 10
E. None of the above

std::priority_queue template arguments

```
template <
      class T,
      class Container= vector<T>,
      class Compare = less <T>
      > class priority_queue;
```

The template for priority_queue takes 3 arguments:

1. Type elements contained in the queue.
2. Container class used as the internal store for the priority_queue, the default is **vector<T>**
3. Class that provides priority comparisons, the default is **less**

Comparison class

- Comparison class: A class that implements a function operator for comparing objects

```
class compareClass{
        bool operator()(int& a, int & b) const {
                return a<b;
        }
};
```

Comparison class

```
class compareClass{
        bool operator()(int& a, int & b) const {
                return a<b;
        }
};
```

```
int main(){
    compareClass c;
    cout<<c(10, 20)<<endl;
}
```

What is the output of this code?

A. 1

B. 0

C. Error

STL Heap implementation: Priority Queues in C++

```
class cmp{
        bool operator()(int& a, int & b) const {
                return a<b;
        }
};
 priority_queue<int, vector<int>, cmp> pq;
 pq.push(10);
 pq.push(2);
 pq.push(80);
 cout<<pq.top();
 pq.pop();
 cout<<pq.top();
 pq.pop();
 cout<<pq.top();
 pq.pop();
```

This code prints the numbers in descending order: 80 10 2 (max-Heap)

How would you change it so that the top element is always the min value (min-Heap

std::priority_queue template arguments

```
//Template parameters for a max-heap
priority_queue<int, vector<int>, std::less<int>> pq;

//Template parameters for a min-heap
priority_queue<int, vector<int>, std::greater<int>> pq;
```

Practice functors and PQs:

```
int main(){
      int arr[]={10, 2, 80};
      priority_queue<int*> pq;
      for(int i=0; i < 3; i++)
            pq.push(arr+i);

      while(!pq.empty()){
            cout<<*pq.top()<<endl;
          pq.pop();
      }
      return 0;
}
```

What is the output of this code?

A. 10 2 80
B. 2 10 80
C. 80 10 2
D. 80 2 10
E. None of the above

Sort array elements using a pq storing pointers

```
int main(){
      int arr[]={10, 2, 80};
      priority_queue<int*> pq;
      for(int i=0; i < 3; i++)
            pq.push(arr+i);

      while(!pq.empty()){
            cout<<*pq.top()<<endl;
           pq.pop();
      }
      return 0;
}
```

How can we change the way pq prioritizes pointers?

Write a comparison class to print the integers in the array in sorted order

```
int main(){
      int arr[]={10, 2, 80};
      priority_queue<int*, vector<int*>, cmpPtr> pq;
      for(int i=0; i < 3; i++)
            pq.push(arr+i);

      while(!pq.empty()){
            cout<<*pq.top()<<endl;
           pq.pop();
      }
      return 0;
}
```