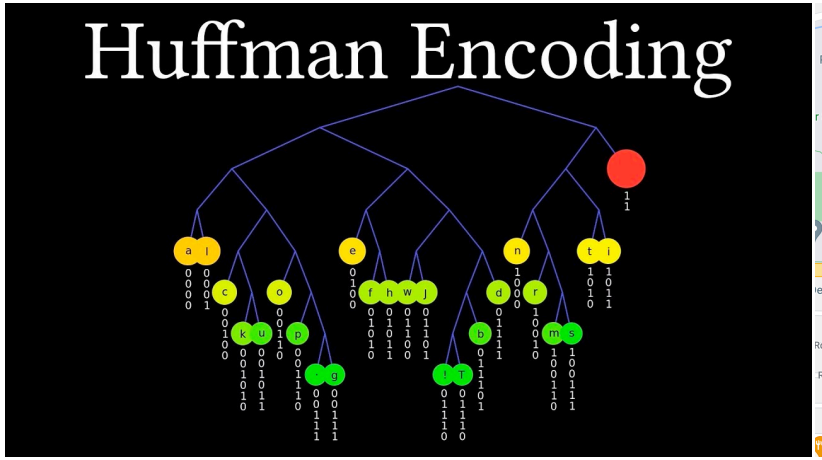
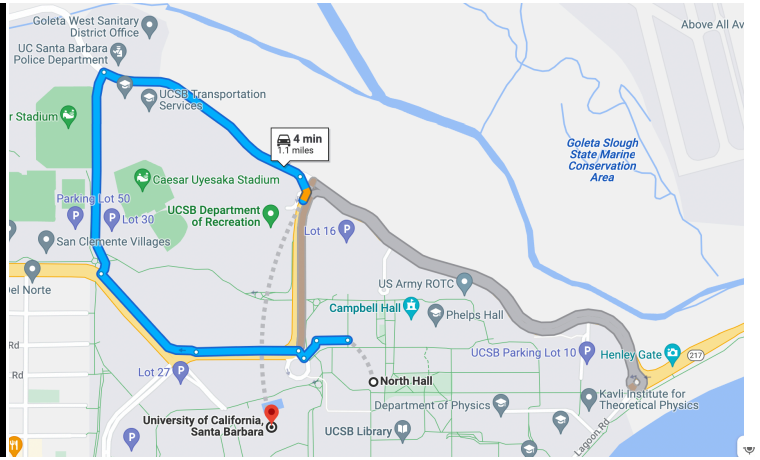
PRACTICE WITH PRIORITY QUEUES & HASHTAEBLE

Problem Solving with Computers-II

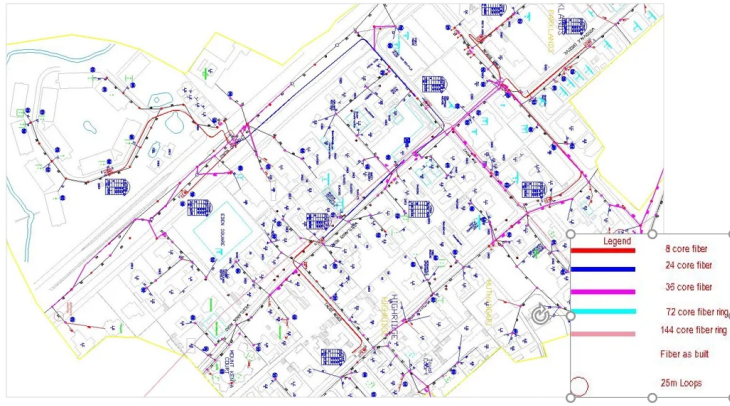


Data Compression



Navigation

Planning Fiber Routes



Network Design

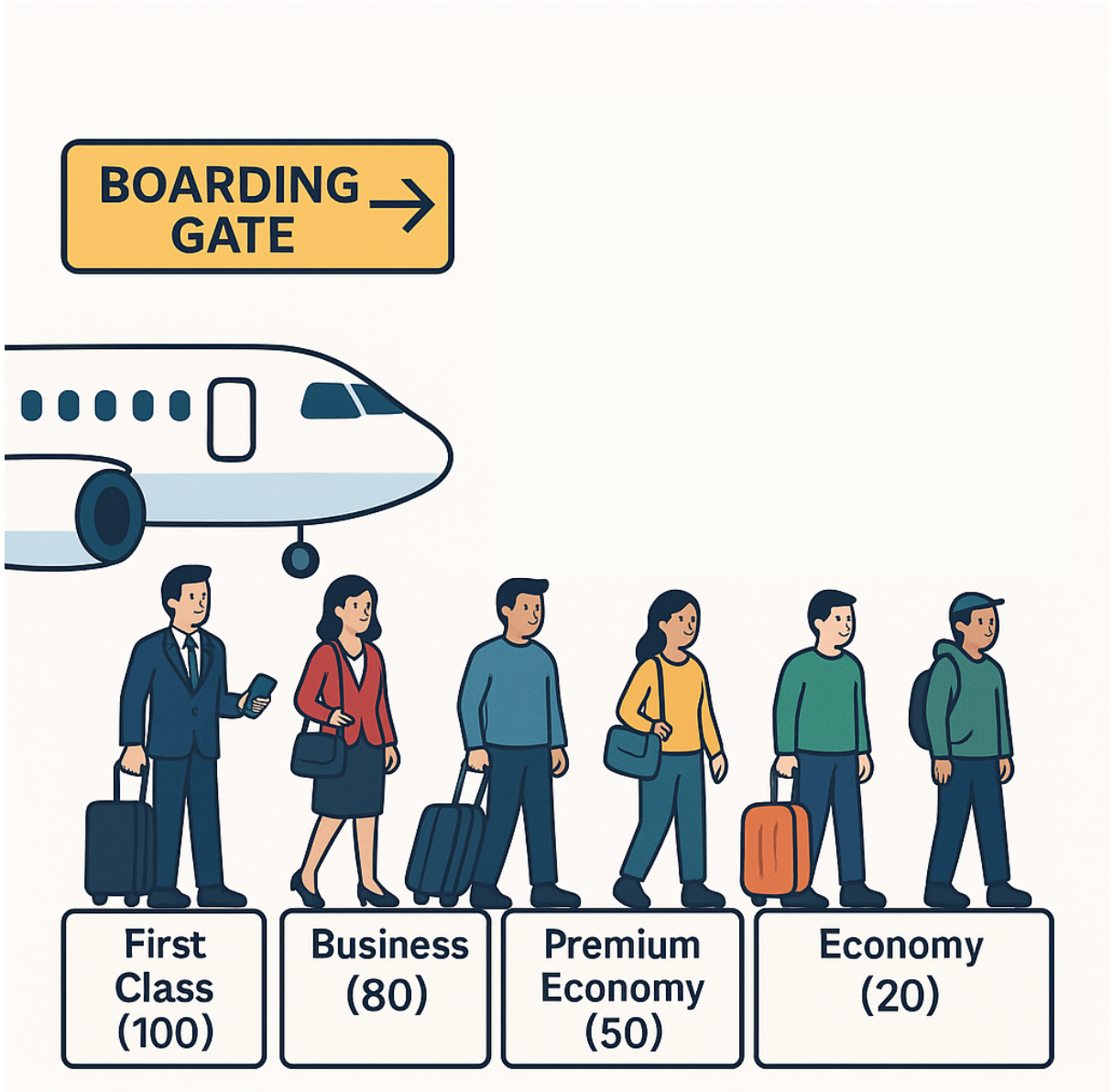
Web traffic analysis

You're back at your job at Amazon. Your boss hands you a log of IP addresses from today's traffic and asks:

1. How many unique visitors did we have?
2. How many times did each IP visit?
3. Which IP visited the most?
4. **Who are our top K most frequent visitors?**
5. Flag any suspicious IPs (visited > threshold times)

Open traffic_activity.cpp

C++ Priority Queue ADT




```
priority_queue<int> pq;

pq.push(20);
pq.push(20);
pq.push(80);
pq.push(50);
pq.push(100);

cout << pq.top();

pq.pop();
```

Configuring std::priority_queue

```
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**

Configuring std::priority_queue

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

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

Trace the output of this code

```
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();
}
```

How can we change the way pq prioritizes pointers?

Write a comparison class to get the desired output

```
class cmpPtr{
      bool operator()(int* a, int* b) const {
            return ____________________;
       }
};
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();
}
```

```
Output: 80
        10
         2
```

215. Kth Largest Element in an Array

Medium | Topics | Companies

Given an integer array `nums` and an integer `k`, return *the* `k^th` *largest element in the array*.

Note that it is the `k^th` largest element in the sorted order, not the `k^th` distinct element.

Can you solve it without sorting?

Example 1:

```
Input: nums = [3,2,1,5,6,4], k = 2
Output: 5
```

Example 2:

```
Input: nums = [3,2,3,1,2,4,5,5,6], k = 4
Output: 4
```

Activity (10 mins): Brainstorm and describe a possible solution in plain English

Trace your approach on the example inputs

Kth Largest Element in an Array (medium):
https://leetcode.com/problems/kth-largest-element-in-an-array/description/

Leetcode practice (LP04)

LP04 (PQ + Hashtables): https://ucsb-cs24.github.io/s25/lp/lp04/

Priority Queues must know problems:

1. Kth Largest Element in an Array (medium): https://leetcode.com/problems/kth-largest-element-in-an-array/description/

2. Top K Frequent Elements (medium): https://leetcode.com/problems/top-k-frequent-elements/description/

* Practice configuring a PQ in different ways using a comparison class