Assignment # 5

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Design Document

The basic purpose of the program involves simulating an event – which can be an arrival of a flight into the airport or else departure of a flight from the airport. The critical component in this simulation is the time of arrival or departure, and the allotment of gate numbers to every arrival flight.

To begin with, we begin the time from 0 minutes of the day and have a fixed schedule every hour when flights arrive throughout the day. This fixed schedule of arrivals every hour is used to simulate departure time for every arrival incorporating some random delays. Since all the times when the events will happen are available, we need to find the event that happens nearest in the future and process that event.

Since we need to find the event nearest in the future, it is appropriate that the set of arrivals and departure events waiting to happen be organized in a Priority queue (Binary heap), based on the time component of the event. The next event is thus the next arrival or next departure (whichever is sooner), both are easily available.

The initial construction of heap-ordered tree object is done with N items (N arrivals) using the buildheap function call from within the parameter constructor of the Binaryheap class. The order of this build heap is linear i.e. O (N). There after there would be an insert operation for every new departure event.

The basic data structures used in the program implementation is

(a) Binaryheap class object – for the arrival and departure events which by very nature of the heap property organizes the data in a sorted order, there by finding the minimum just takes O(1) and there by contributes to the efficiency. The binaryHeap-order property places the smallest or earliest event at the root of the heap, i.e. arranges the event as they occur in time of the day.

(b) Stack class object – to have the available gate numbers in a stack object, thereby making it easy to push an available gate number(released on a departure event) into the stack or pop a gate number from the stack to allot to an arrival event.

(c) An event structure is defined that has fields to hold the arrival/departure times, arrival/departure code, flight number, originating location and destination of each flight.

Once the initial heap is built, the minimum element (nearest event arrival/departure) in the heap is found, processed and deleted. The processing involves checking whether the event is an arrival or departure.

If the event is departure, the processing would involve release of a gate that can be utilized for the next arrival and deleting the event from the list of events waiting to happen.

If the event is arrival, then the process would involve allotting a gate number, and computing the departure time of the flight, and adding the new departure event to the set of events waiting to happen. If the arrival event does not find a gate number allotment, then it means the airport is full to its capacity and that aircraft could not be serviced at that time of arrival.

The simulation would end when there are no more arrivals or departures in the heap to be processed and the heap size reduces to zero. This would mean that the number of gates initially entered was sufficient enough for handling all the arrivals throughout the day.

OR

The simulation may end when a particular arrival event could not be allotted any gate numbers due to non availability of gates at that time of occurrence of the arrival event. This would mean that the number of gates initially entered was not adequate for handling all the arrivals throughout the day.

Results of the program simulation and analysis

1. Number of gates less than or equal to 20 (<= 20) – the airport will always have an overcrowded situation and the Airport will not be able to allot gates for all arrivals.

2. Number of gates between 21 and 22 – there is likely chance of running successfully and being able to allot gates for all arrivals.

3. Number of gates above or equal to 23 (>=23) – the airport will always be able to service all aircraft arrivals throughout the day.

Machine details:-

Dell Laptop – year 2009

Processor Intel(R) Core(TM) 2 Duo CPU T6500 @ 2.10 GHz, 2100 MHz, 2 Core(s), 2 Logical Processor(s)

System Manufacturer Dell Inc.

System Model Studio 1737

System Type x64-based PC

Installed Physical Memory (RAM) 4.00 GB