**Course: Algorithm  
Prof. Prem Nair  
Student: Binh Van Tran  
ID: 986648  
Homework: Lab 5**

1. **Question 1 –** This question goal is to understand inversions
2. *Bubble Sort*

|  |  |  |
| --- | --- | --- |
| **Iteration** | **Inversions** | **# inversions** |
| 0 | (34,8); (34,32); (34,21); (64,51); (64,32); (64,21); (51,32); (51,21); (32,21) | 9 |
| 1 | (34,32); (34,21); (51,32); (51,21); (32,21) | 5 |
| 2 | (34,32); (34, 21); (32,21) | 3 |
| 3 | (32, 21) | 1 |
| 4 |  | 0 |
| 5 |  | 0 |
| **Total** |  | **18** |

1. *Selection Sort – select minimum index and swap to the first index*

|  |  |  |
| --- | --- | --- |
| **Iteration** | **Inversions** | **# inversions** |
| 0 | (34,8); (34,32); (34,21); (64,51); (64,32); (64,21); (51,32); (51,21); (32,21) | 9 |
| 1 | (34,32); (34,21); (64,51); (64,32); (64,21); (51,32); (51,21); (32,21) | 8 |
| 2 | (64,51); (64, 32); (64,34); (51,32); (51,34) | 5 |
| 3 | (51, 34); (64, 34) | 2 |
| 4 | (64, 51) | 1 |
| 5 |  | 0 |
| **Total** |  | **25** |

1. *Insertion Sort*

|  |  |  |
| --- | --- | --- |
| **Iteration** | **Inversions** | **# inversions** |
| 0 | (34,8); (34,32); (34,21); (64,51); (64,32); (64,21); (51,32); (51,21); (32,21) | 9 |
| 1 | (34,32); (34,21); (64,51); (64,32); (64,21); (51,32); (51,21); (32,21) | 8 |
| 2 | (34,32); (34,21); (64,51); (64,32); (64,21); (51,32); (51,21); (32,21) | 8 |
| 3 | (34,32); (34,21); (51,32); (51,21); (64,32); (64,21); (32,21) | 7 |
| 4 | (32, 21); (34, 21); (51,21); (64, 21) | 4 |
| 5 |  | 0 |
| **Total** |  | **36** |

1. **Question 2 –** Understand amortized cost analysis

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item #** | **Operation** | **Cost for us** | **Customer paid** | **Profit** | **Balance** |
| 1 | Add | We assume we start with 1 slot. We add 1 item at the cost of 1 | 7 | 6 | 6 |
| 2 | Add | 3 to resize (We have two slots) 1 to add | 7 | 6 | 3  9 |
| 3 | Add | 6 to resize (We have 4 slots)  1 to add | 7 | 6 | 3  9 |
| 4 | Add | 1 to add | 7 | 6 | 15 |
| 5 | Add | 12 to resize (We have 8 slots)  1 to add | 7 | 6 | 3  9 |
| 6 | Add | 1 to add | 7 | 6 | 15 |
| 7 | Add | 1 to add | 7 | 6 | 21 |
| 8 | Add | 1 to add | 7 | 6 | 27 |
| 9 | Add | 24 to resize (We have 16 slots)  1 to add | 7 | 6 | 3  9 |
| 10 | Add | 1 to add | 7 | 6 | 15 |
| 11 | Add | 1 to add | 7 | 6 | 21 |
| 12 | Add | 1 to add | 7 | 6 | 27 |
| 13 | Add | 1 to add | 7 | 6 | 33 |
| 14 | Add | 1 to add | 7 | 6 | 39 |
| 15 | Add | 1 to add | 7 | 6 | 45 |
| 16 | Add | 1 to add | 7 | 6 | 51 |
| 17 | Add | 48 to resize (We have 32 slots)  1 to add | 7 | 6 | 3  9 |
| 18 | Add | 1 to add | 7 | 6 | 15 |

The table above shows the minimum value of “Balance” is **9**