CSCI 585
HomeWork-4

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Q1:

1.

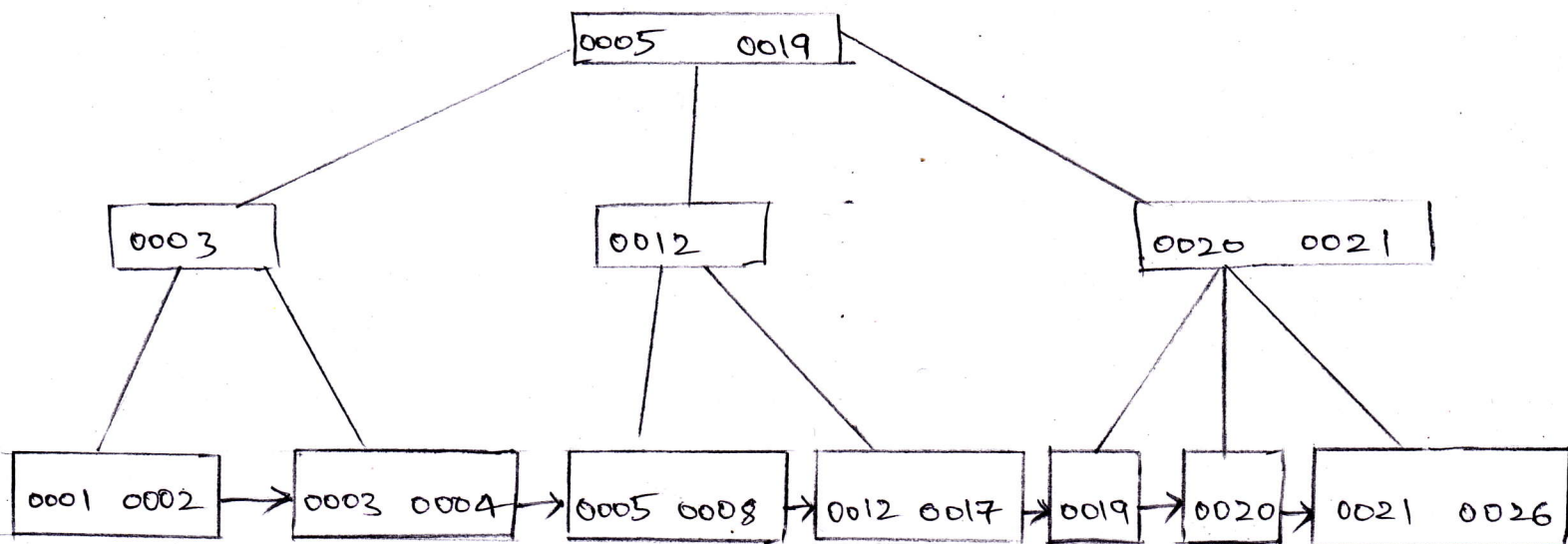|		
Level - 1	25 entries	
Level - 2	25 * 26	650 entries
Level - 3	25 × 26 × 26	16900 entries
Level - 4	25 × 26 × 26 × 26	4 39 400 entries

Atleast Four levels are needed to represent 1,00,000 entries

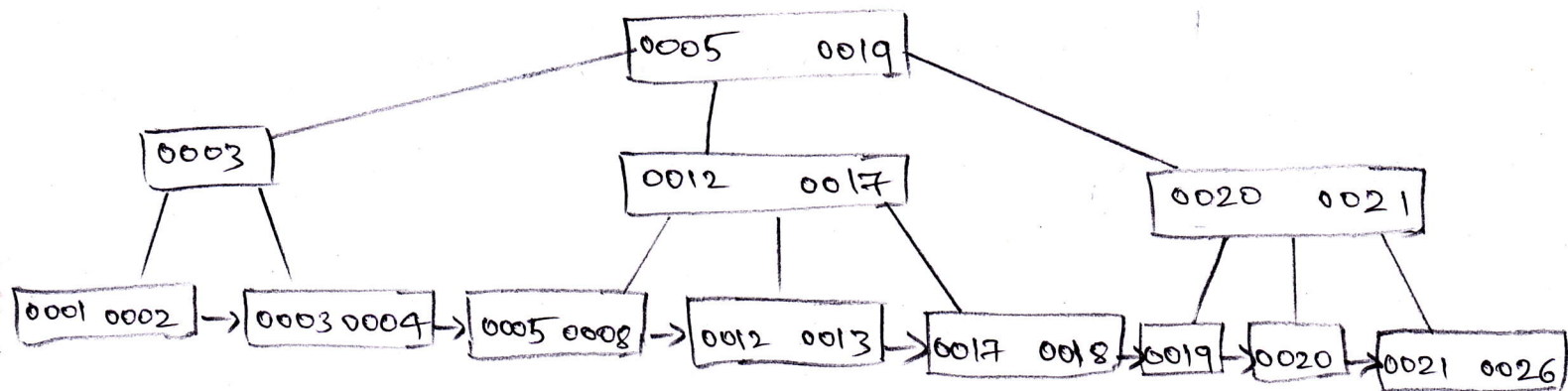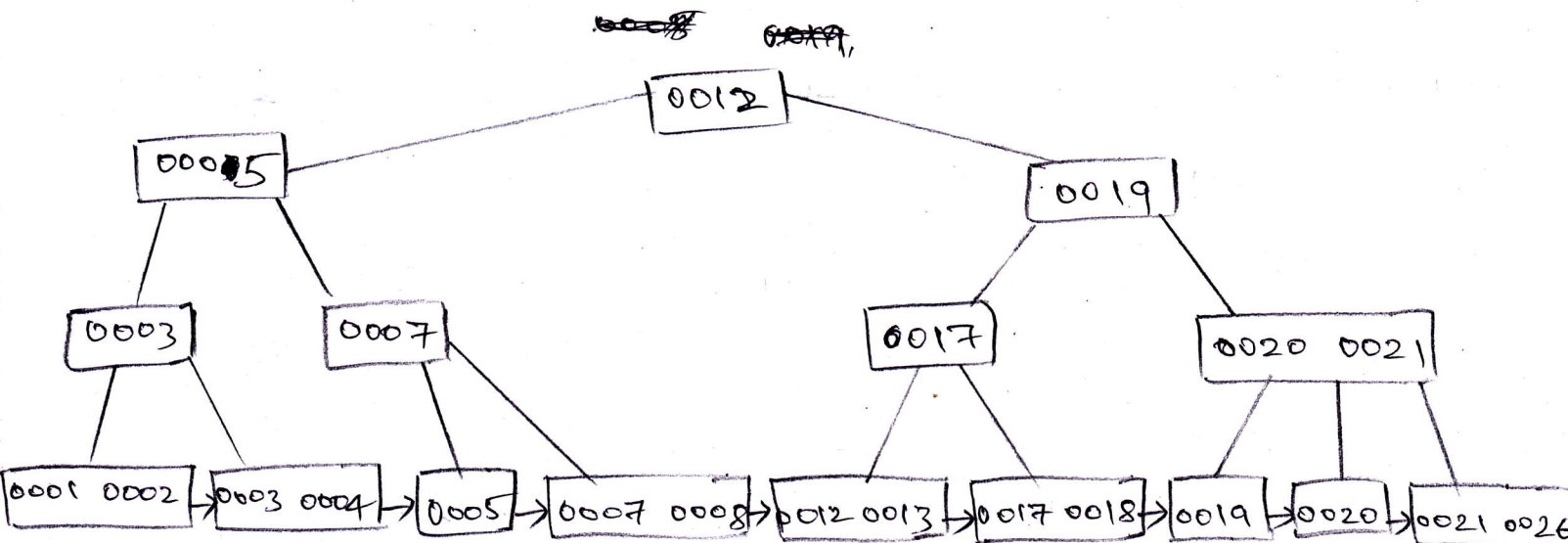2. After Inserting '1':
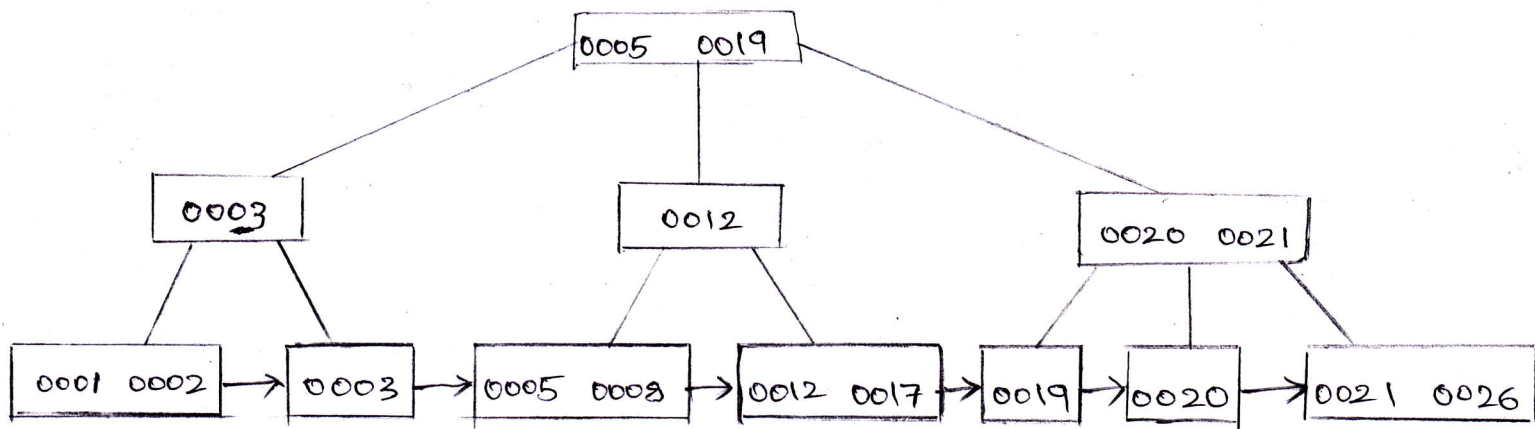
After Inserting 4:

After Inserting 18:

```
                              | 0005    0019 |

     | 0003 |          | 0012  0017 |              | 0020   0021 |

| 0001 0002 |→| 0003  0004 |→| 0005 0008 |→| 0012 |→| 0017 0018 |→| 0019 |→| 0020 |→| 0021  0026 |
```

After Inserting 13:

```
                          | 0005      0019 |

      | 0003 |        | 0012      0017 |              | 0020    0021 |

| 0001 0002 |→| 0003 0004 |→| 0005 0008 |→| 0012  0013 |→| 0017  0018 |→| 0019 |→| 0020 |→| 0021  0026 |
```

After Inserting 7:

```
                              | 0012 |

     | 0005 |                                    | 0019 |

| 0003 |    | 0007 |                | 0017 |        | 0020  0021 |

| 0001 0002 |→| 0003 0004 |→| 0005 |→| 0007 0008 |→| 0012 0013 |→| 0017 0018 |→| 0019 |→| 0020 |→| 0021 0026 |
```
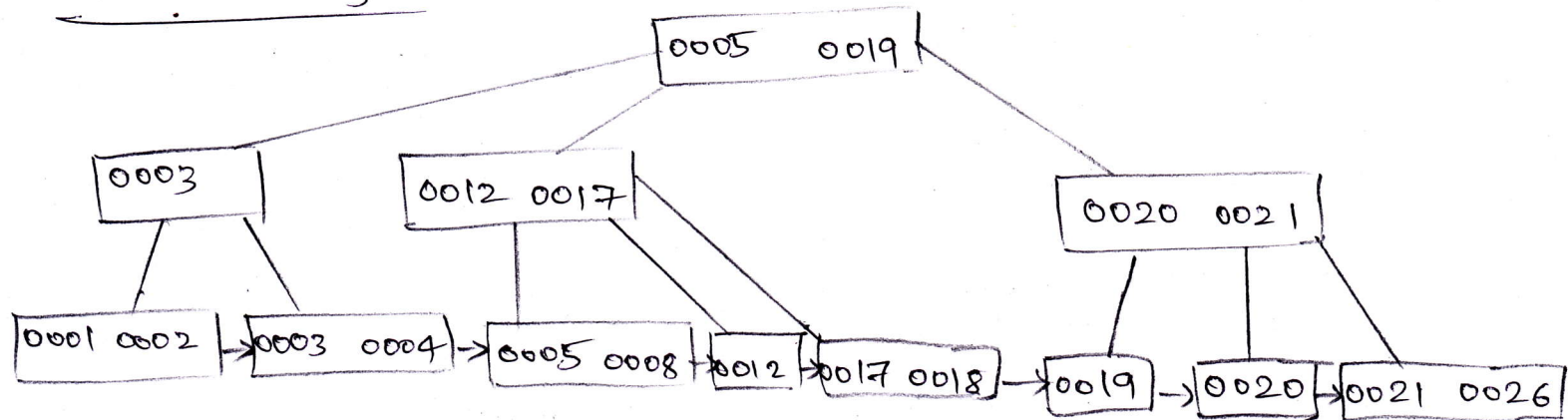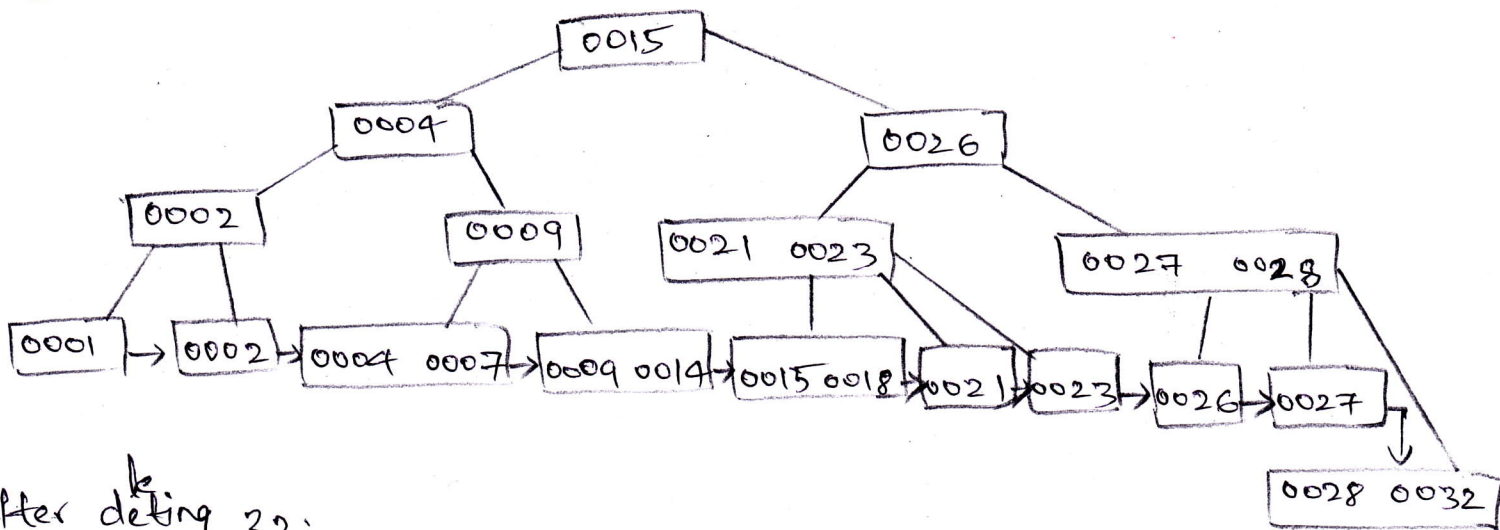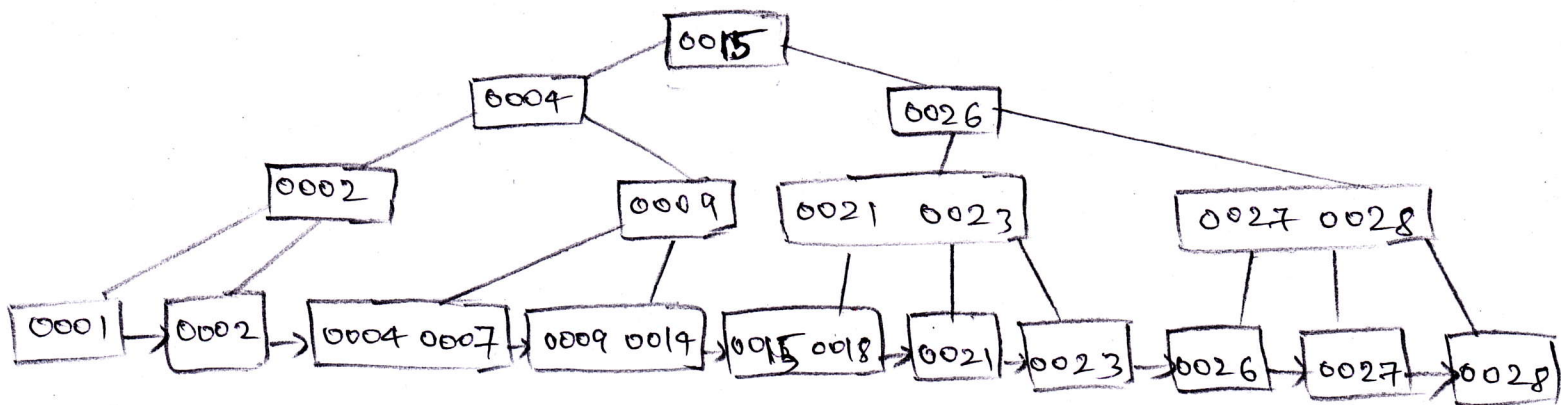
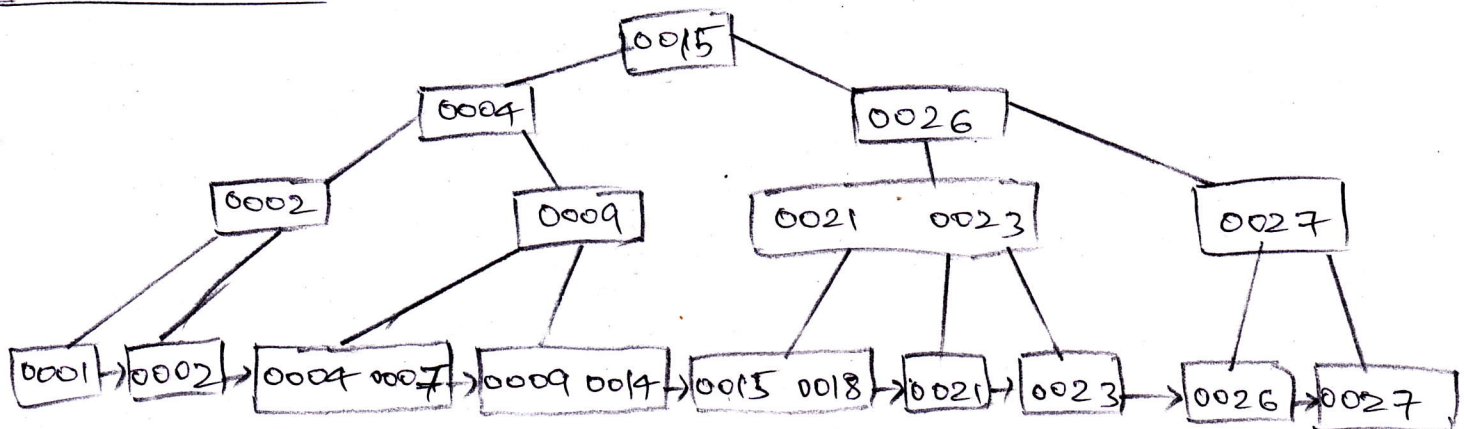**3.** .7, 8, 9, 10, 23, 25, 26, 27, 28, 29, 30, 31, 32.

4. After deleting 24:

After deting 32:

After deleting 28:

After deleting 27:
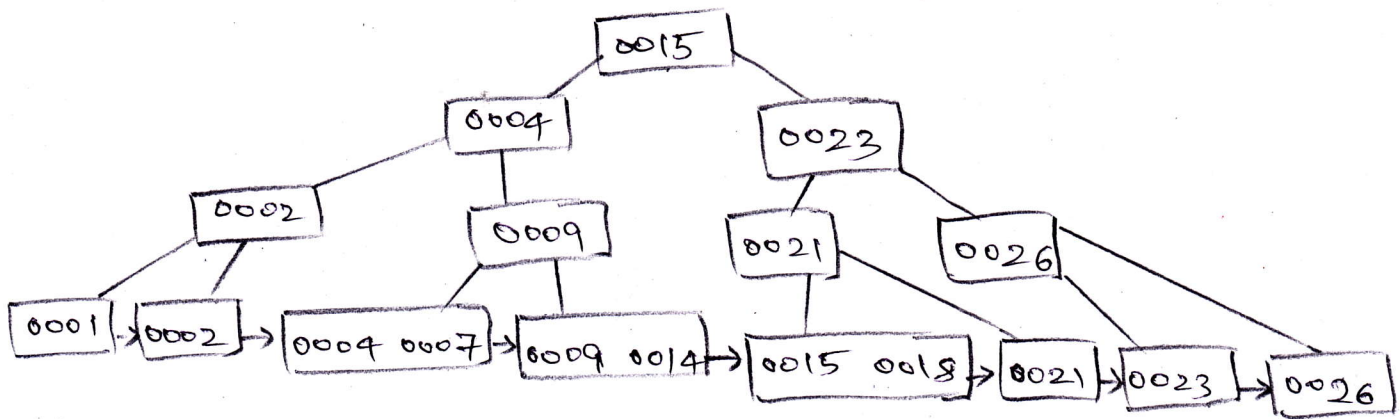
After deleting 26:
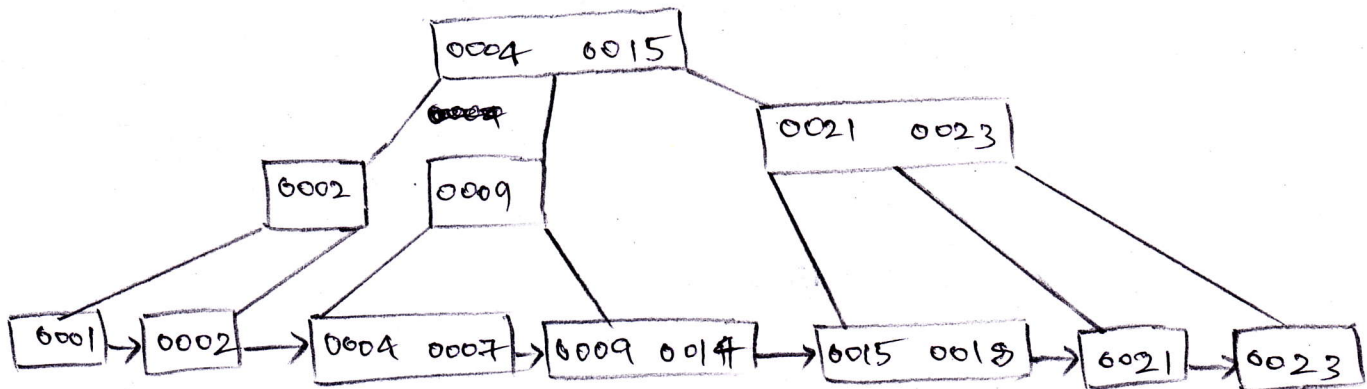
Q₂:

After Inserting 32:

After Inserting 13:

Directory (global depth 3):
- 000
- 001
- 010
- 011
- 100
- 101
- 110
- 111

Buckets:
- (3) 32 | 64 | 16
- (2) 1 | 5 | 21 | 13
- (2) 10
- (2) 15 | 7 | 51
- (3) 4 | 12 | 20 | 36

After Inserting 28:

Directory (global depth 4):
- 0000
- 0001
- 0010
- 0011
- 0100
- 0101
- 0110
- 0111
- 1000
- 1001
- 1010
- 1011
- 1100
- 1101
- 1110
- 1111

Buckets:
- (3) 32 | 64 | 16
- (2) 1 | 5 | 21 | 13
- (2) 10
- (2) 15 | 7 | 51
- (4) 4 | 20 | 36
- (4) 12 | 28

2. After Deleting 64:


```
      3
000  ┌──────────┐────────►  3
001  │          │           ┌──┬──┬──┬──┐
010  │          │           │  │  │  │16│
011  │          │           └──┴──┴──┴──┘
100  │          │        ►  2
101  │          │           ┌──┬──┬──┬──┐
110  │          │           │1 │5 │21│  │
111  │          │           └──┴──┴──┴──┘
     └──────────┘        ►  2
                            ┌──┬──┬──┬──┐
                            │10│  │  │  │
                            └──┴──┴──┴──┘
                         ►  2
                            ┌──┬──┬──┬──┐
                            │15│7 │51│  │
                            └──┴──┴──┴──┘
                         ►  3
                            ┌──┬──┬──┬──┐
                            │4 │12│20│36│
                            └──┴──┴──┴──┘
```
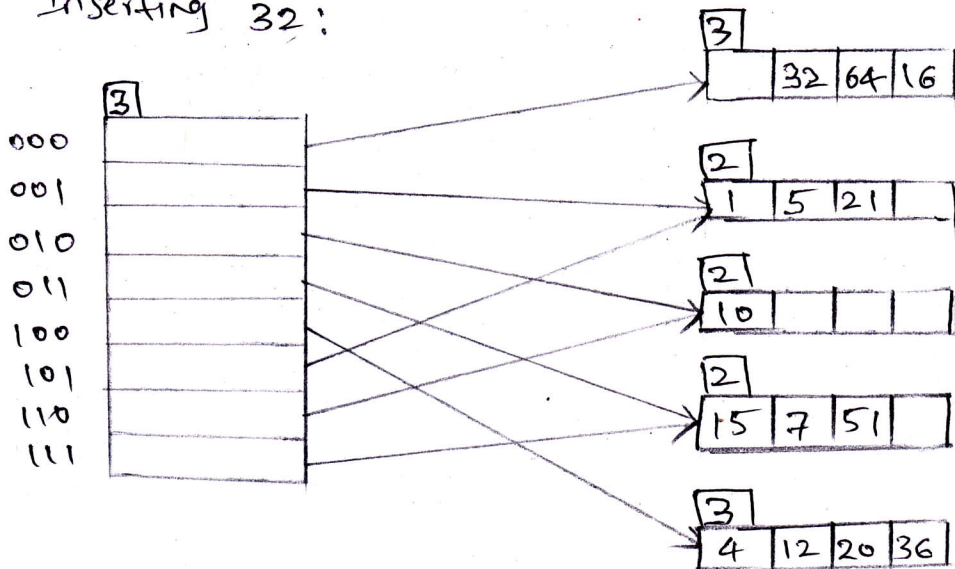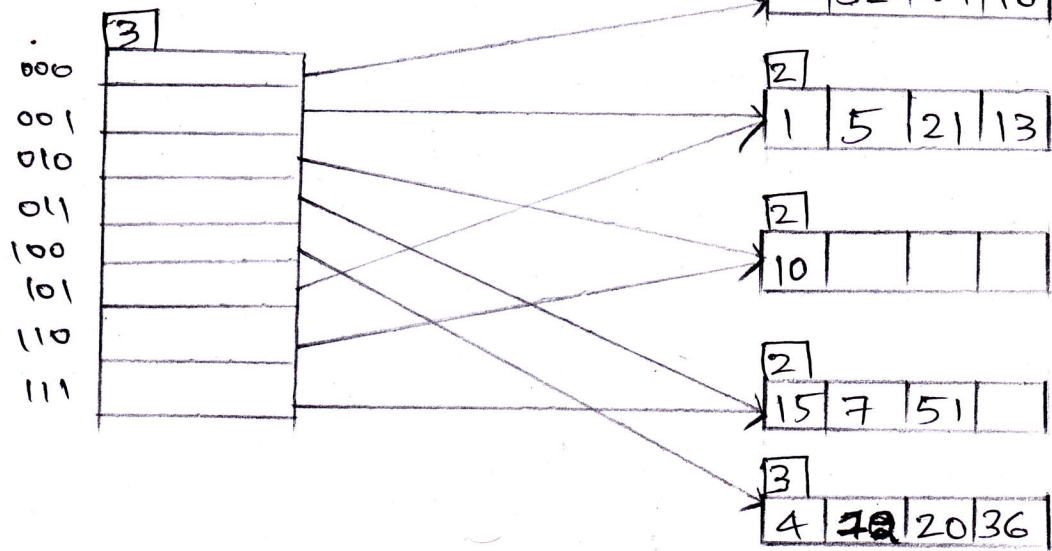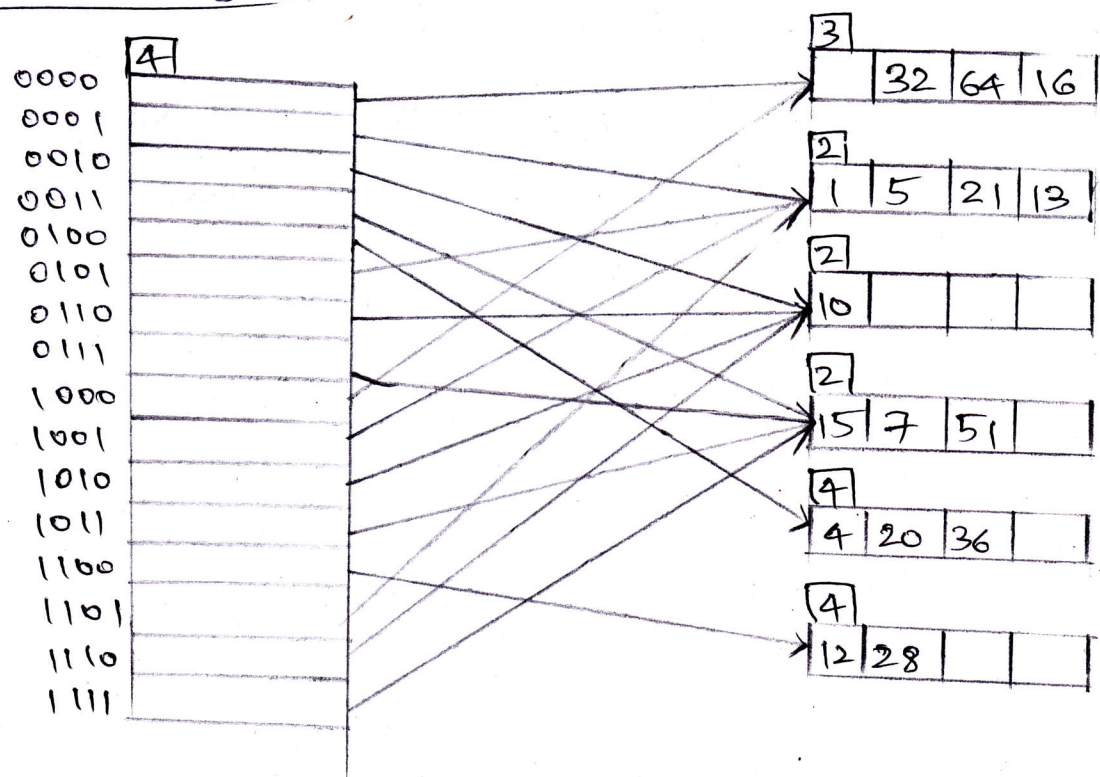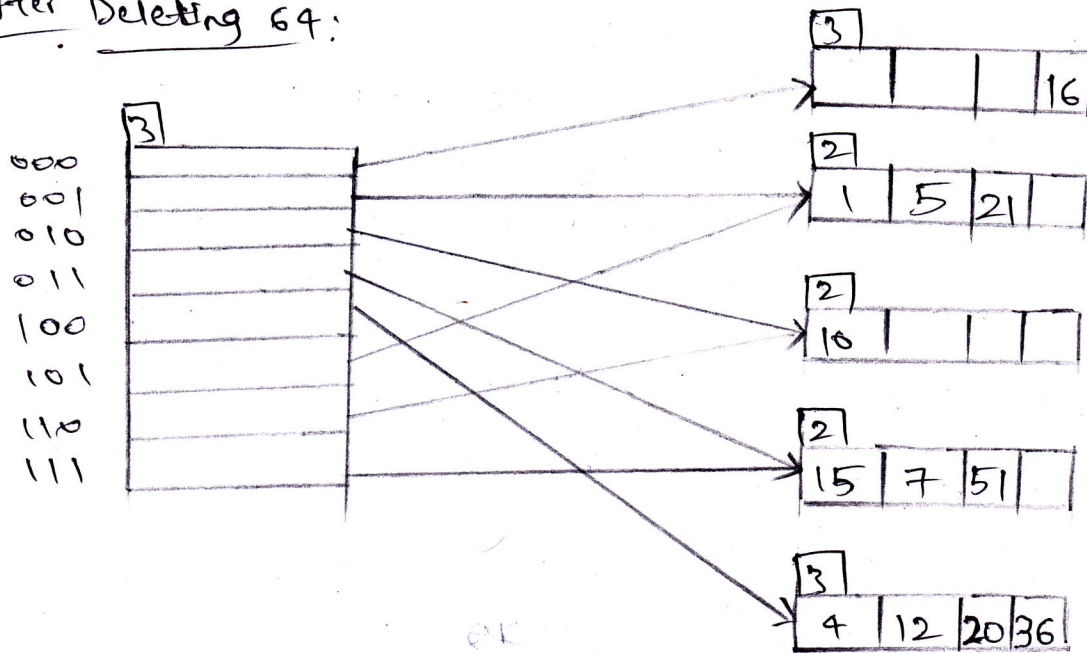
After Deleting 16 global depth reduces to two


```
       2
00   ┌──────────┐────────►  2
01   │          │           ┌──┬──┬──┬──┐
10   │          │           │4 │12│20│36│
11   │          │           └──┴──┴──┴──┘
     └──────────┘        ►  2
                            ┌──┬──┬──┬──┐
                            │1 │5 │21│  │
                            └──┴──┴──┴──┘
                         ►  2
                            ┌──┬──┬──┬──┐
                            │10│  │  │  │
                            └──┴──┴──┴──┘
                         ►  2
                            ┌──┬──┬──┬──┐
                            │15│7 │51│  │
                            └──┴──┴──┴──┘
```
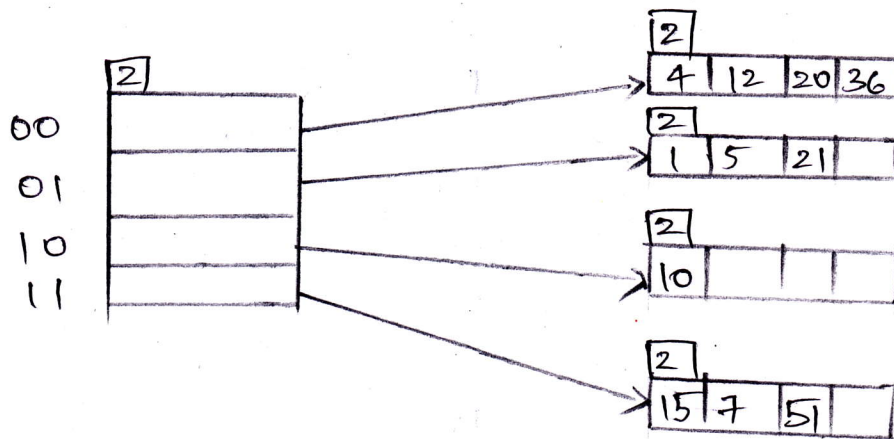
Q3:

1. clustered B+ Indexing on dob, username

2. Hashing technique on username, ad-id

3. Non-clustered B+ Indexing on username, ad-id, price