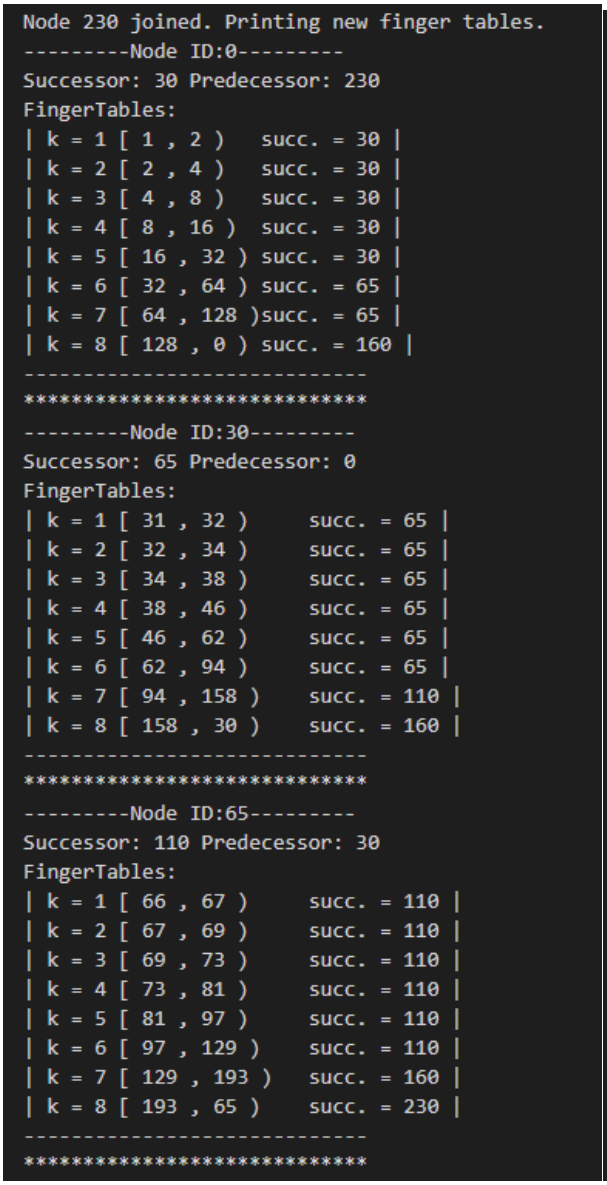
1. **Add nodes to the network using the join function**

```
Node n0(0);
Node n1(30);
Node n2(65);
Node n3(110);
Node n4(160);
Node n5(230);
Node n6(100);

n0.join(NULL);
n1.join(&n0);
n2.join(&n1);
n3.join(&n2);
n4.join(&n3);
n5.join(&n4);
//n6 is not joined yet
```

2. **Print finger table of all nodes**



```
Node 230 joined. Printing new finger tables.
---------Node ID:0---------
Successor: 30 Predecessor: 230
FingerTables:
| k = 1 [ 1 , 2 )   succ. = 30 |
| k = 2 [ 2 , 4 )   succ. = 30 |
| k = 3 [ 4 , 8 )   succ. = 30 |
| k = 4 [ 8 , 16 )  succ. = 30 |
| k = 5 [ 16 , 32 ) succ. = 30 |
| k = 6 [ 32 , 64 ) succ. = 65 |
| k = 7 [ 64 , 128 )succ. = 65 |
| k = 8 [ 128 , 0 ) succ. = 160 |
----------------------------
****************************
---------Node ID:30---------
Successor: 65 Predecessor: 0
FingerTables:
| k = 1 [ 31 , 32 )     succ. = 65 |
| k = 2 [ 32 , 34 )     succ. = 65 |
| k = 3 [ 34 , 38 )     succ. = 65 |
| k = 4 [ 38 , 46 )     succ. = 65 |
| k = 5 [ 46 , 62 )     succ. = 65 |
| k = 6 [ 62 , 94 )     succ. = 65 |
| k = 7 [ 94 , 158 )    succ. = 110 |
| k = 8 [ 158 , 30 )    succ. = 160 |
----------------------------
****************************
---------Node ID:65---------
Successor: 110 Predecessor: 30
FingerTables:
| k = 1 [ 66 , 67 )     succ. = 110 |
| k = 2 [ 67 , 69 )     succ. = 110 |
| k = 3 [ 69 , 73 )     succ. = 110 |
| k = 4 [ 73 , 81 )     succ. = 110 |
| k = 5 [ 81 , 97 )     succ. = 110 |
| k = 6 [ 97 , 129 )    succ. = 110 |
| k = 7 [ 129 , 193 )   succ. = 160 |
| k = 8 [ 193 , 65 )    succ. = 230 |
----------------------------
****************************
---------Node ID:110---------
Successor: 160 Predecessor: 65
FingerTables:
| k = 1 [ 111 , 112 )   succ. = 160 |
| k = 2 [ 112 , 114 )   succ. = 160 |
| k = 3 [ 114 , 118 )   succ. = 160 |
| k = 4 [ 118 , 126 )   succ. = 160 |
| k = 5 [ 126 , 142 )   succ. = 160 |
| k = 6 [ 142 , 174 )   succ. = 160 |
| k = 7 [ 174 , 238 )   succ. = 230 |
| k = 8 [ 238 , 110 )   succ. = 0 |
----------------------------
****************************
---------Node ID:160---------
Successor: 230 Predecessor: 110
FingerTables:
| k = 1 [ 161 , 162 )   succ. = 230 |
| k = 2 [ 162 , 164 )   succ. = 230 |
| k = 3 [ 164 , 168 )   succ. = 230 |
| k = 4 [ 168 , 176 )   succ. = 230 |
| k = 5 [ 176 , 192 )   succ. = 230 |
| k = 6 [ 192 , 224 )   succ. = 230 |
| k = 7 [ 224 , 32 )    succ. = 230 |
| k = 8 [ 32 , 160 )    succ. = 65 |
----------------------------
****************************
---------Node ID:230---------
Successor: 0 Predecessor: 160
FingerTables:
| k = 1 [ 231 , 232 )   succ. = 0 |
| k = 2 [ 232 , 234 )   succ. = 0 |
| k = 3 [ 234 , 238 )   succ. = 0 |
| k = 4 [ 238 , 246 )   succ. = 0 |
| k = 5 [ 246 , 6 )     succ. = 0 |
| k = 6 [ 6 , 38 )      succ. = 30 |
| k = 7 [ 38 , 102 )    succ. = 65 |
| k = 8 [ 102 , 230 )   succ. = 110 |
----------------------------
****************************
```

3. **Insert Keys and add new node joins**

n0.insert(3, 3)
n1.insert(200)
n2.insert(123)
n3.insert(45,3)
n4.insert(99)
n2.insert(60,10)
n0.insert(50,8)
n3.insert(100,5)
n3.insert(101,4)
n3.insert(102,6)
n5.insert(240,8)
n5.insert(250,10)

3.1: print keys that are stored in each node

```
Inserted new key 250 into node 0. Printing all local keys.
----------Node ID:0----------
{240: 8, 250: 10}

----------Node ID:30----------
{3: 3}

----------Node ID:65----------
{45: 3, 50: 8, 60: 10}

----------Node ID:110----------
{99: None, 100: 5, 101: 4, 102: 6}

----------Node ID:160----------
{123: None}

----------Node ID:230----------
{200: None}
```

3.2 Print migrated keys

n6.join(&n5);

```
migrate key 99 and val None from node 110 to node 100
```

4. **Lookup keys**

```
n0.find(3);
n0.find(200);
n0.find(123);
n0.find(45);
n0.find(99);
n0.find(60);
n0.find(50);
n0.find(100);
n0.find(101);
n0.find(102);
n0.find(240);
n0.find(250);

n2.find(3);
n2.find(200);
n2.find(123);
n2.find(45);
n2.find(99);
n2.find(60);
n2.find(50);
n2.find(100);
n2.find(101);
n2.find(102);
n2.find(240);
n2.find(250);

n3.find(3);
n3.find(200);
n3.find(123);
n3.find(45);
n3.find(99);
n3.find(60);
n3.find(50);
n3.find(100);
n3.find(101);
n3.find(102);
n3.find(240);
n3.find(250);
```

4.1 Print key lookup results

```
Look-up result of key 3 from node 0 with path [0,30] value is 3
Look-up result of key 200 from node 0 with path [0,230] value is None
Look-up result of key 123 from node 0 with path [0,160] value is None
Look-up result of key 45 from node 0 with path [0,65] value is 3
Look-up result of key 99 from node 0 with path [0,100] value is None
Look-up result of key 60 from node 0 with path [0,65] value is 10
Look-up result of key 50 from node 0 with path [0,65] value is 8
Look-up result of key 100 from node 0 with path [0,110] value is 5
Look-up result of key 101 from node 0 with path [0,110] value is 4
Look-up result of key 102 from node 0 with path [0,110] value is 6
Look-up result of key 240 from node 0 with path [0] value is 8
Look-up result of key 250 from node 0 with path [0] value is 10

Look-up result of key 3 from node 65 with path [65,30] value is 3
Look-up result of key 200 from node 65 with path [65,230] value is None
Look-up result of key 123 from node 65 with path [65,160] value is None
Look-up result of key 45 from node 65 with path [65] value is 3
Look-up result of key 99 from node 65 with path [65,100] value is None
Look-up result of key 60 from node 65 with path [65] value is 10
Look-up result of key 50 from node 65 with path [65] value is 8
Look-up result of key 100 from node 65 with path [65,110] value is 5
Look-up result of key 101 from node 65 with path [65,110] value is 4
Look-up result of key 102 from node 65 with path [65,110] value is 6
Look-up result of key 240 from node 65 with path [65,0] value is 8
Look-up result of key 250 from node 65 with path [65,0] value is 10

Look-up result of key 3 from node 100 with path [100,30] value is 3
Look-up result of key 200 from node 100 with path [100,230] value is None
Look-up result of key 123 from node 100 with path [100,160] value is None
Look-up result of key 45 from node 100 with path [100,65] value is 3
Look-up result of key 99 from node 100 with path [100] value is None
Look-up result of key 60 from node 100 with path [100,65] value is 10
Look-up result of key 50 from node 100 with path [100,65] value is 8
Look-up result of key 100 from node 100 with path [100,110] value is 5
Look-up result of key 101 from node 100 with path [100,110] value is 4
Look-up result of key 102 from node 100 with path [100,110] value is 6
Look-up result of key 240 from node 100 with path [100,0] value is 8
Look-up result of key 250 from node 100 with path [100,0] value is 10
```