

1. Add nodes to the network using the join function, $m = 8$

```
C:\Windows\System32\cmd.e  X + v
C:\UCSC\Quarter 2\CN\Samiksha Varpe\PROJECT CHORD IMPLEMENTATION>g++ main.cpp node.
cpp -o chord_dht
C:\UCSC\Quarter 2\CN\Samiksha Varpe\PROJECT CHORD IMPLEMENTATION>chord_dht
1. Add nodes to the network using the join function, m = 8

Node 0 is the first node to join the Chord network.
Node 30 joined with successor 0
-----Node id:30-----
Successor: 0
FingerTables:
| k = 1 [31 , 32)      succ. = 0 |
| k = 2 [32 , 34)      succ. = 0 |
| k = 3 [34 , 38)      succ. = 0 |
| k = 4 [38 , 46)      succ. = 0 |
| k = 5 [46 , 62)      succ. = 0 |
| k = 6 [62 , 94)      succ. = 0 |
| k = 7 [94 , 158)     succ. = 0 |
| k = 8 [158 , 30)     succ. = 0 |
-----
Node 65 joined with successor 0
-----Node id:65-----
Successor: 0
FingerTables:
| k = 1 [66 , 67)      succ. = 0 |
| k = 2 [67 , 69)      succ. = 0 |
| k = 3 [69 , 73)      succ. = 0 |
| k = 4 [73 , 81)      succ. = 0 |
| k = 5 [81 , 97)      succ. = 0 |
| k = 6 [97 , 129)     succ. = 0 |
| k = 7 [129 , 193)    succ. = 0 |
| k = 8 [193 , 65)     succ. = 0 |
-----
Node 110 joined with successor 0
-----Node id:110-----
Successor: 0
FingerTables:
| k = 1 [111 , 112)    succ. = 0 |
| k = 2 [112 , 114)    succ. = 0 |
| k = 3 [114 , 118)    succ. = 0 |
| k = 4 [118 , 126)    succ. = 0 |
| k = 5 [126 , 142)    succ. = 0 |
| k = 6 [142 , 174)    succ. = 0 |
| k = 7 [174 , 238)    succ. = 0 |
| k = 8 [238 , 110)    succ. = 0 |
```

```
C:\Windows\System32\cmd.e  X  +  v

-----
Node 160 joined with successor 0
-----Node id:160-----
Successor: 0
FingerTables:
| k = 1 [161 , 162)      succ. = 0 |
| k = 2 [162 , 164)      succ. = 0 |
| k = 3 [164 , 168)      succ. = 0 |
| k = 4 [168 , 176)      succ. = 0 |
| k = 5 [176 , 192)      succ. = 0 |
| k = 6 [192 , 224)      succ. = 0 |
| k = 7 [224 , 32)       succ. = 0 |
| k = 8 [32 , 160)       succ. = 65 |
-----

Node 230 joined with successor 0
-----Node id:230-----
Successor: 0
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 |
-----
```

2. Print finger table of all nodes

```
C:\Windows\System32\cmd.e  X  +  v

2. Print finger table of all nodes (40pts)

Node id:0 Predecessor: 230
-----Node id:0-----
Successor: 30
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 Predecessor: 0
-----Node id:30-----
Successor: 65
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 Predecessor: 30
-----Node id:65-----
Successor: 110
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 Predecessor: 65

-----Node id:110-----

Successor: 160

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 Predecessor: 110

-----Node id:160-----

Successor: 230

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 Predecessor: 160

-----Node id:230-----

Successor: 0

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

3.1 print keys that stored in each node

3. Insert keys and add new node joins (20pts)

```
Key 3 with value 3 inserted at node 30
Key 200 with value None inserted at node 230
Key 123 with value None inserted at node 160
Key 45 with value 3 inserted at node 65
Key 99 with value None inserted at node 110
Key 60 with value 10 inserted at node 65
Key 50 with value 8 inserted at node 65
Key 100 with value 5 inserted at node 110
Key 101 with value 4 inserted at node 110
Key 102 with value 6 inserted at node 110
Key 240 with value 8 inserted at node 0
Key 250 with value 10 inserted at node 0
```

3.1 print keys that stored in each node (10pts)

```
***** Keys Distribution *****
-----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}
*****
```



C:\Windows\System32\cmd.e X



n6 (id: 100) joins

Node 100 joined with successor 110

Migrate key 99 from node 110 to node 100

Migrate key 100 from node 110 to node 100

-----Node id:100-----

Successor: 110

FingerTables:

k = 1	[101 , 102)	succ. = 110	
k = 2	[102 , 104)	succ. = 110	
k = 3	[104 , 108)	succ. = 110	
k = 4	[108 , 116)	succ. = 110	
k = 5	[116 , 132)	succ. = 160	
k = 6	[132 , 164)	succ. = 160	
k = 7	[164 , 228)	succ. = 230	
k = 8	[228 , 100)	succ. = 230	

Fig.4 An updated circle after n6 joins

Node id:0 Predecessor: 230

-----Node id:0-----

Successor: 30

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 Predecessor: 0

-----Node id:30-----

Successor: 65

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. = 100	
k = 8	[158 , 30)	succ. = 160	



C:\Windows\System32\cmd.e



Node id:65 Predecessor: 30

-----Node id:65-----

Successor: 100

FingerTables:

k = 1	[66 , 67)	succ. = 100	
k = 2	[67 , 69)	succ. = 100	
k = 3	[69 , 73)	succ. = 100	
k = 4	[73 , 81)	succ. = 100	
k = 5	[81 , 97)	succ. = 100	
k = 6	[97 , 129)	succ. = 100	
k = 7	[129 , 193)	succ. = 160	
k = 8	[193 , 65)	succ. = 230	

Node id:110 Predecessor: 100

-----Node id:110-----

Successor: 160

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 Predecessor: 110

-----Node id:160-----

Successor: 230

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	

3.2. Print migrated keys (10pts)

```
C:\Windows\System32\cmd.e  ×  +  ∨

Node id:230 Predecessor: 160
-----Node id:230-----
Successor: 0
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 |
-----
```

```
Node id:100 Predecessor: 65
-----Node id:100-----
Successor: 110
FingerTables:
| k = 1 [101 , 102)      succ. = 110 |
| k = 2 [102 , 104)      succ. = 110 |
| k = 3 [104 , 108)      succ. = 110 |
| k = 4 [108 , 116)      succ. = 110 |
| k = 5 [116 , 132)      succ. = 160 |
| k = 6 [132 , 164)      succ. = 160 |
| k = 7 [164 , 228)      succ. = 230 |
| k = 8 [228 , 100)      succ. = 230 |
-----
```

3.2 Print migrated keys (10pts)

```
***** Keys Distribution *****
-----Node id:0-----
{240: 8, 250: 10}
-----Node id:30-----
{3: 3}
-----Node id:65-----
{45: 3, 50: 8, 60: 10}
-----Node id:110-----
{101: 4, 102: 6}
-----Node id:160-----
{123: None}
-----Node id:230-----
{200: None}
-----Node id:100-----
{99: None, 100: 5}
*****
```

4. Lookup keys (40pts)

4. Lookup keys (40pts)

Print lookup results and sequences of nodes get involved in this procedure (run lookup on node n0, n2, n6 for all keys)

-----node 0-----

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

-----node 65-----

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

-----node 100-----

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


5. Leave (20 pts)

5. Leave (20 pts)

Let one node n2 (ID 65) leave, print the updated finger tables of n0 and n1, and keys distribution

Node 65 is leaving the network.

Migrate key 45 from node 65 to node 100

Migrate key 50 from node 65 to node 100

Migrate key 60 from node 65 to node 100

Node 65 has left the network.

Updated finger table of predecessor:

Node id:30 Predecessor: 0

-----Node id:30-----

Successor: 100

FingerTables:

k = 1 [31 , 32)	succ. = 100
k = 2 [32 , 34)	succ. = 100
k = 3 [34 , 38)	succ. = 100
k = 4 [38 , 46)	succ. = 100
k = 5 [46 , 62)	succ. = 100
k = 6 [62 , 94)	succ. = 100
k = 7 [94 , 158)	succ. = 100
k = 8 [158 , 30)	succ. = 160

Updated finger table of successor:

Node id:100 Predecessor: 30

-----Node id:100-----

Successor: 110

FingerTables:

k = 1 [101 , 102)	succ. = 110
k = 2 [102 , 104)	succ. = 110
k = 3 [104 , 108)	succ. = 110
k = 4 [108 , 116)	succ. = 110
k = 5 [116 , 132)	succ. = 160
k = 6 [132 , 164)	succ. = 160
k = 7 [164 , 228)	succ. = 230
k = 8 [228 , 100)	succ. = 230

C:\Windows\System32\cmd.e

Fig.6 Updated finger table

Node id:0 Predecessor: 230

-----Node id:0-----

Successor: 30

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. = 100	
k = 8	[128 , 0)	succ. = 160	

Node id:30 Predecessor: 0

-----Node id:30-----

Successor: 100

FingerTables:

k = 1	[31 , 32)	succ. = 100	
k = 2	[32 , 34)	succ. = 100	
k = 3	[34 , 38)	succ. = 100	
k = 4	[38 , 46)	succ. = 100	
k = 5	[46 , 62)	succ. = 100	
k = 6	[62 , 94)	succ. = 100	
k = 7	[94 , 158)	succ. = 100	
k = 8	[158 , 30)	succ. = 160	

***** Keys Distribution *****

-----Node id:0-----

{240: 8, 250: 10}

-----Node id:30-----

{3: 3}

-----Node id:65-----

{}

-----Node id:110-----

{101: 4, 102: 6}

-----Node id:160-----

{123: None}

-----Node id:230-----

{200: None}

-----Node id:100-----

{45: 3, 50: 8, 60: 10, 99: None, 100: 5}

C:\UCSC\Quarter 2\CN\Samiksha Varpe\PROJECT CHORD IMPLEMENTATION>