

Title: Hashing and Graphs

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Section: 1

Assignment: 4

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Separate Chaining

Hash Table with size 13

Table	
0	
1	
2	15 → 41
3	29
4	30 → 17
5	
6	
7	20
8	
9	22
10	
11	
12	12 → 25

Step	Calculation
1	$12 \bmod 13 = 12$
2	$15 \bmod 13 = 2$
3	$20 \bmod 13 = 7$
4	$40 \bmod 13 = 1$
5	$11 \bmod 13 = 11$
6	$29 \bmod 13 = 3$
7	$17 \bmod 13 = 4$
8	$25 \bmod 13 = 12$
9	$22 \bmod 13 = 9$

Open Addressing with Linear Probing

Step	Calculation
1	$12 \bmod 13 = 12$
2	$15 \bmod 13 = 2$
3	$20 \bmod 13 = 7$
4	$40 \bmod 13 = 1$
5	$11 \bmod 13 = 11$
6	$29 \bmod 13 = 3$
7	$17 \bmod 13 = 4$
8	$25 \bmod 13 = 12$
9	$22 \bmod 13 = 9$

Open Addressing with Quadratic Probing

Step	Calculation
1	$12 \bmod 13 = 12$
2	$15 \bmod 13 = 2$
3	$20 \bmod 13 = 7$
4	$40 \bmod 13 = 1$
5	$11 \bmod 13 = 11$
6	$29 \bmod 13 = 3$
7	$17 \bmod 13 = 4$
8	$25 \bmod 13 = 12$
9	$22 \bmod 13 = 9$

Linear ←

Quadratic ←

Linear Probing

Quadratic Probing

Linear Probing Analysis

0	25
1	
2	15
3	41
4	30
5	29
6	12
7	20
8	
9	22
10	
11	
12	12

Successful Search

Try 41, 29, 22, 17, 25, 15, 20, 12, 30

41: 2, 3 29: 3, 4, 5 22: 9

12: 4, 5, 6 25: 12, 0 15: 2

20: 7 12: 12 30: 4

$$\text{Avg} = (2 + 3 + 1 + 3 + 2 + 1 + 1 + 1 + 1) / 9$$

$$25/9 = 11.6 \overline{6}$$

Unsuccessful Search

Try 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 38

0: 0, 1 1: 1 2: 2, 3, 4, 5, 6, 7, 8 3: 3, 4, 5, 6, 7, 8

4: 4, 5, 6, 7, 8 5: 5, 6, 7, 8 6: 6, 7, 8 7: 7, 8 8: 8

9: 9, 10 10: 10 11: 11 38: 12, 0, 1

$$\text{Avg} = 38/13 = 2.9$$

Quadratic Probing Analysis

0	25
1	
2	15
3	41
4	30
5	17
6	29
7	20
8	
9	22
10	
11	
12	12

Successful Search

Try 41, 29, 22, 17, 25, 15, 20, 12, 30

41: 2, 3 29: 3, 4, 7, 12, 6 22: 9

17: 4, 5 25: 12, 0 15: 2

20: 7 12: 12 30: 4

$$\text{Avg} = 16/9 = 11.7$$

Unsuccessful Search

Try 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 38

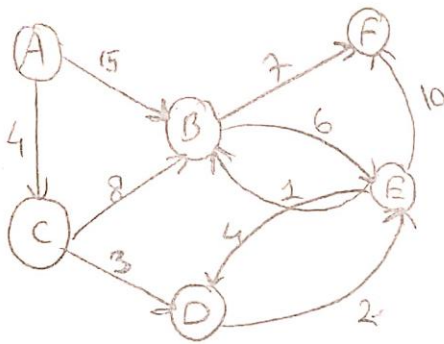
0: 0, 1 1: 1 2: 2, 3, 4, 5, 6, 7, 8 3: 3, 4, 5, 6, 7, 8

4: 4, 5, 6, 7, 8 5: 5, 6, 7, 8 6: 6, 7, 8 7: 7, 8 8: 8

9: 9, 10 10: 10 11: 11 38: 12, 0, 1

$$\text{Avg} = 38/13 = 2.9$$

Dijkstra's Shortest Path



	A	B	C	D	E	F
A	∞	15	4	∞	∞	∞
B	∞	∞	∞	∞	6	7
C	∞	8	∞	3	∞	∞
D	∞	∞	∞	∞	2	∞
E	∞	1	∞	4	∞	10
F	∞	∞	∞	∞	∞	∞

Step	V	vertexSet	[A] [✓]	[C] [✓]	[D] [✓]	[E] [✓]	[F] [✓]
1	-	A	∞	15	4	∞	∞
2	C	A, C	∞	12	4	7	∞
3	D	A, C, D	∞	12	4	7	9
4	E	A, C, D, E	∞	10	4	7	9
5	B	A, C, D, E, B	∞	10	4	7	9
6	F	A, C, D, E, B, F	∞	10	4	7	9