Question 5

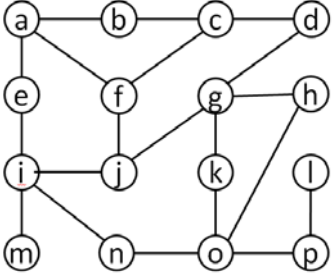
5a. Illustration:

3

4

5

2



15

14

16

13

12

11

10

9

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7

6

1

Sequence: g d c b a e i j f m n o h k p l

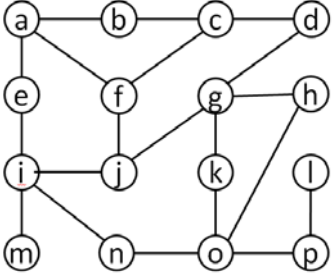
5b. Illustration:

3

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Sequence: b a c e f d i j g m n h k o p l

5c.

Adjacency Matrix

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p |
| a | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| b | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| c | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| d | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| e | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| f | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| g | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| h | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| i | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| j | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| k | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| l | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| n | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| o | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 |
| p | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

Advantages:

1. Programmers can easily follow and implement this representation.
2. Time complexity for removing an edge is O(1).
3. Time complexity for checking if an edge exists from one vertex to another is also O(1).

Disadvantages:

1. Space complexity for this representation is O(V^2).
2. Time complexity for adding a vertex is O(V^2).

Adjacency List:

a 🡪 b 🡪 e 🡪 f

b 🡪 a 🡪 c

c 🡪 b 🡪 d 🡪 f

d 🡪 c 🡪 g

e 🡪 a 🡪 i

f 🡪 a 🡪 c 🡪 j

g 🡪 d 🡪 h 🡪 j 🡪 k

h 🡪 g 🡪 o

i 🡪 e 🡪 j 🡪 m 🡪 n

j 🡪 f 🡪 g 🡪 i

k 🡪 g 🡪 o

l 🡪 p

m 🡪 i

n 🡪 i 🡪 o

o 🡪 h 🡪 k 🡪 n 🡪 p

p 🡪 l 🡪 o

Advantages:

1. Space complexity for this representation is O(|V| + |E|)
2. Worst-case time complexity for adding a vertex is O(V).

Disadvantages:

1. Worst-case time complexity for checking if an edge exists is O(V).

5d.

We can modify the depth first search algorithm to find the path traverses each edge exactly once in each direction. Because the path needs to traverse each edge in both directions, every edge should be marked the first and second time it is traversed. When the edge is marked twice, it cannot be traveled anymore.

We perform a depth-first search of the graph. The path ought to choose the untraveled edge first and only use the second visit of each edge when it needs to go backward to prevent any dead end.

I implement this algorithm in the header file “A3q5.h”