Amrita School of Engineeing Amaravati
Department of Mathematics
Discrete Lab Manual
23MAT116

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S.NO	Title	PG.NO	SIGNATURE
1	Write Mat Lab program to generate a truth table that consists of 3 statements: p,q,r.		
2	Write recursive program for Fibonacci series in Mat Lab.		
3	Implement the binary search as a recursive function in Mat Lab.		
4	Write a Mat Lab program for permutation and combinations. Apply this implementation to the following problem. How many ways are there to select five players from a10-member tennis team to make a trip to a match at another school?		
5	Write a MatLab program to compute f_n for $n = 1, 2, \ldots, 10$. The recurrence for this question is $f(0) = 25$, $f_n = f(n-1) + 7 - \frac{7(n+1)}{n}$, $n \geq 2$.		
6	Create a directed graph using an edge list, and then find the equivalent adjacency matrix representation of the graph.		
7	Create a graph using an edge list, and then calculate the graph incidence matrix.		
8	Create a directed graph using an edge list, and then calculate the incidence matrix.		
9	Create and plot a graph, and then find the degree of each node.		
10	Create and plot a directed graph. Calculate the shortest path between nodes.		
11	Create and plot a graph with weight edges. Find the shortest path between nodes, and specify two outputs to also return the length of the path.		

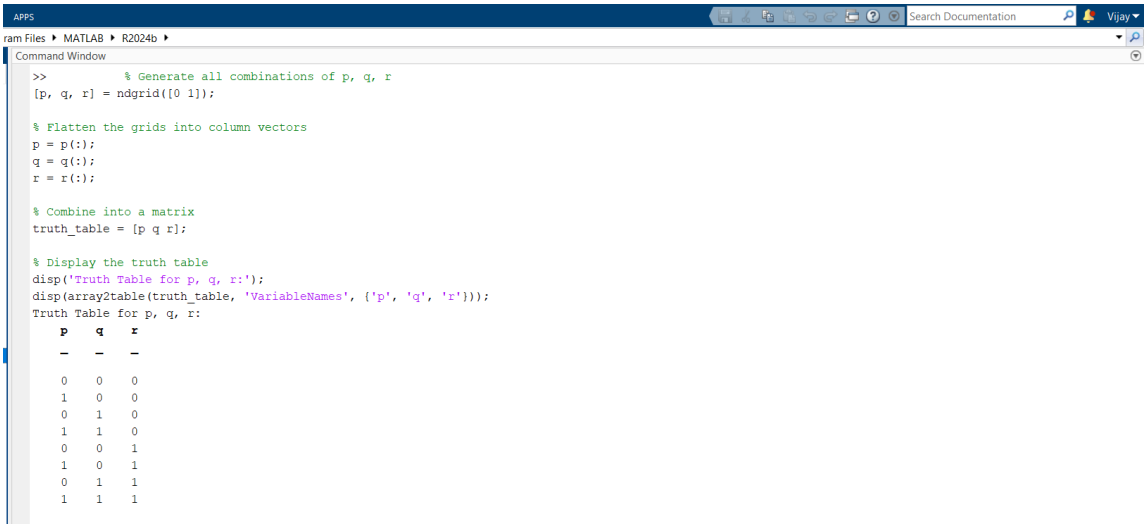
➢ Question:1

Write MatLab program to generate a truth table that consists of 3 statements: *p*, *q*, *r*.

Solution:

```
% Generate all combinations of p, q, r
[p, q, r] = ndgrid([0 1]);

% Flatten the grids into column vectors
p = p(:);
q = q(:);
r = r(:);

% Combine into a matrix
truth_table = [p q r];

% Display the truth table
disp('Truth Table for p, q, r:');
disp(array2table(truth_table, 'VariableNames', {'p', 'q', 'r'}));
```

Output:



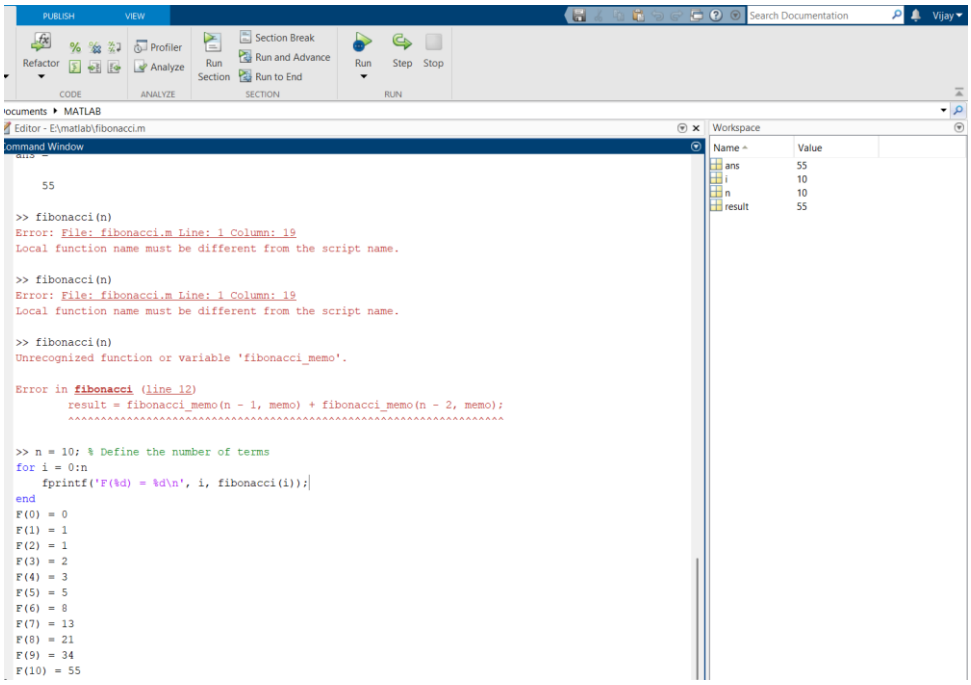
➢ Question:2

Write recursive program for Fibonacci series in MatLab.

Solution:

```
function result = fibonacci(n)
    % Recursive function to compute the nth Fibonacci number
    if n == 0
        result = 0;
    elseif n == 1
        result = 1;
    else
        result = fibonacci(n - 1) + fibonacci(n - 2);
    end
end

n = 10; % Define the number of terms
for i = 0:n
    fprintf('F(%d) = %d\n', i, fibonacci(i));
end
```

Output:



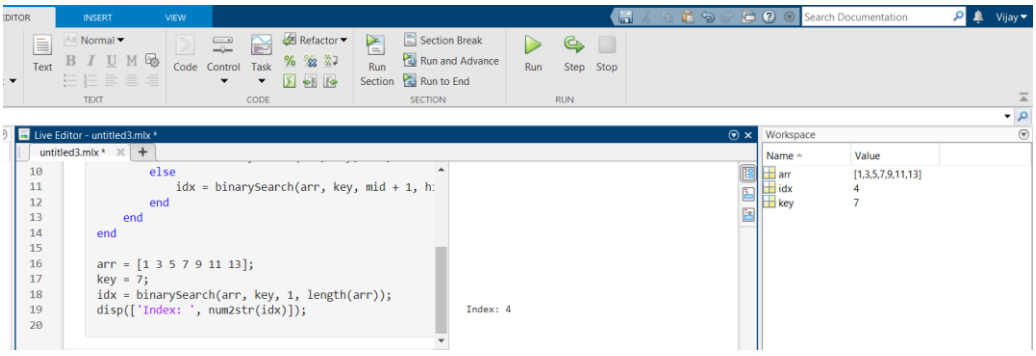
➢ Question:3

Implement the binary search as a recursive function in Ma Lab.

Solution:

```
function idx = binarySearch(arr, key, low, high)
    if low > high
        idx = -1; % Not found
    else
        mid = floor((low + high)/2);
        if arr(mid) == key
            idx = mid;
        elseif arr(mid) > key
            idx = binarySearch(arr, key, low, mid - 1);
        else
            idx = binarySearch(arr, key, mid + 1, high);
        end
    end
end

Ex: arr = [1 3 5 7 9 11 13];
      key = 7;
      idx = binarySearch(arr, key, 1, length(arr));
     disp(['Index: ', num2str(idx)]);
```

Output:



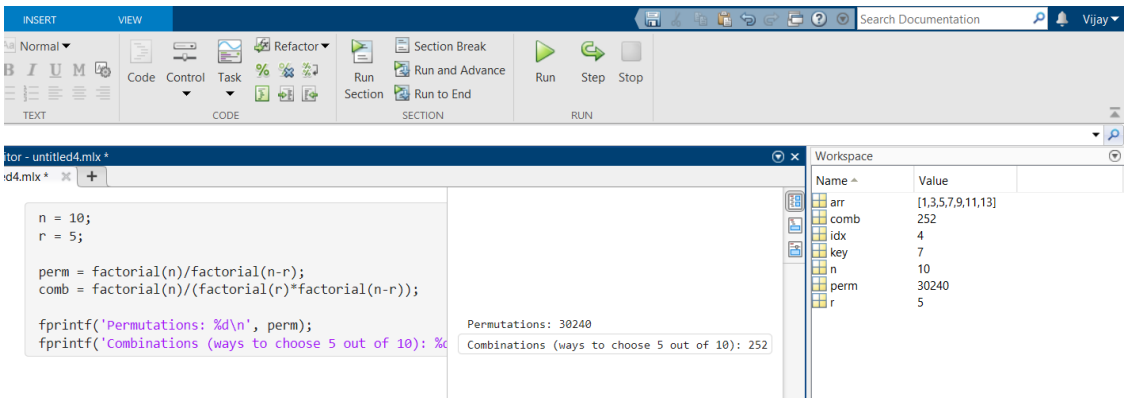
➢ Question:4

Write a MatLab program for permutation and combinations. Apply this implement--tation to the following problem.
How many ways are there to select five players from a 10-member tennis team to make a trip to a match at another school?

Solution:

```
n = 10;
r = 5;

perm = factorial(n)/factorial(n-r);
comb = factorial(n)/(factorial(r)*factorial(n-r));

fprintf('Permutations: %d\n', perm);
fprintf('Combinations (ways to choose 5 out of 10): %d\n', comb);
```

Output:



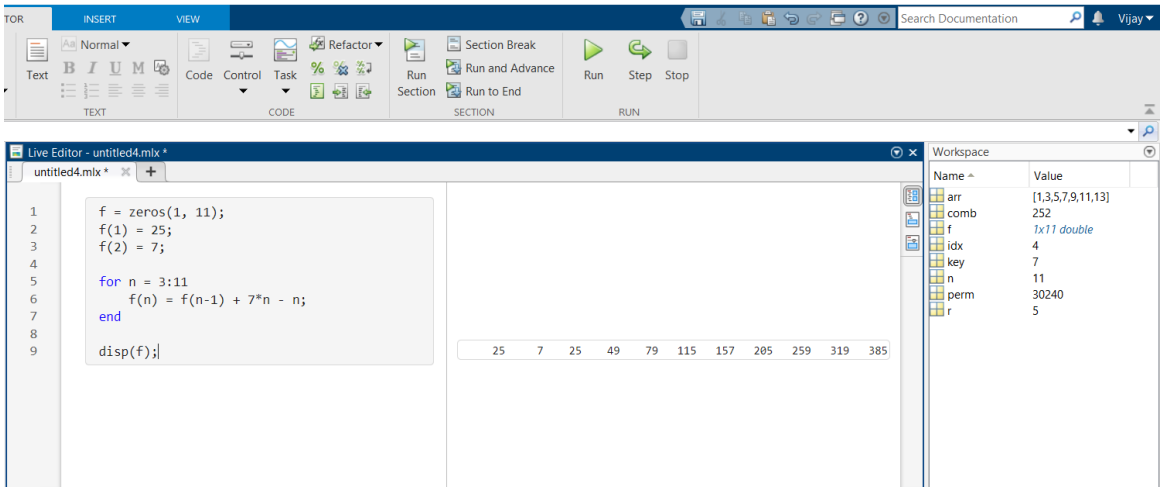
➢ Question:5

Write a MatLab program to compute f_n for $n = 1, 2, \ldots, 10$. The recurrence for this question is $f(0) = 25$, $f_n = f(n-1) + 7 - \frac{7(n+1)}{n}$, $n \geq 2$.

Solution:

```
f = zeros(1, 11);
f(1) = 25;
f(2) = 7;

for n = 3:11
    f(n) = f(n-1) + 7*n - n;
end

disp(f);
```

Output:



➢ Question:6

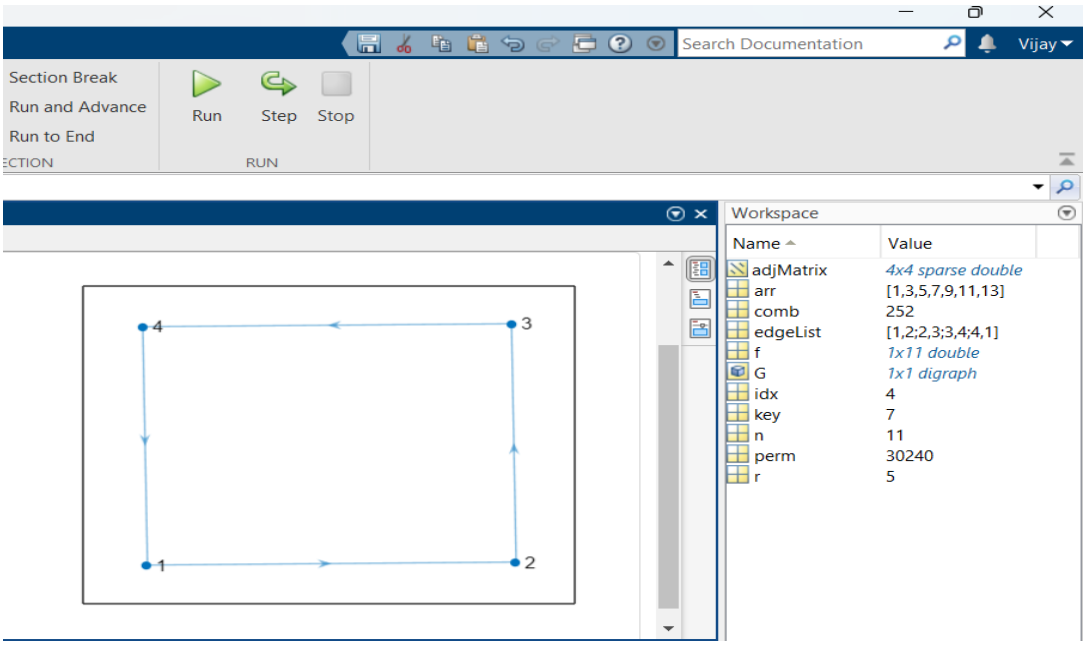
Create a directed graph using an edge list, and then find the equivalent adjacency matrix representation of the graph.

Solution:

```
edgeList = [1 2; 2 3; 3 4; 4 1];
G = digraph(edgeList(:,1), edgeList(:,2));
adjMatrix = adjacency(G)

plot(G)
```

```
4x4 sparse double matrix (4 nonzeros)

  (4,1)        1
  (1,2)        1
  (2,3)        1
  (3,4)        1
```

Output:



➢ Question:7

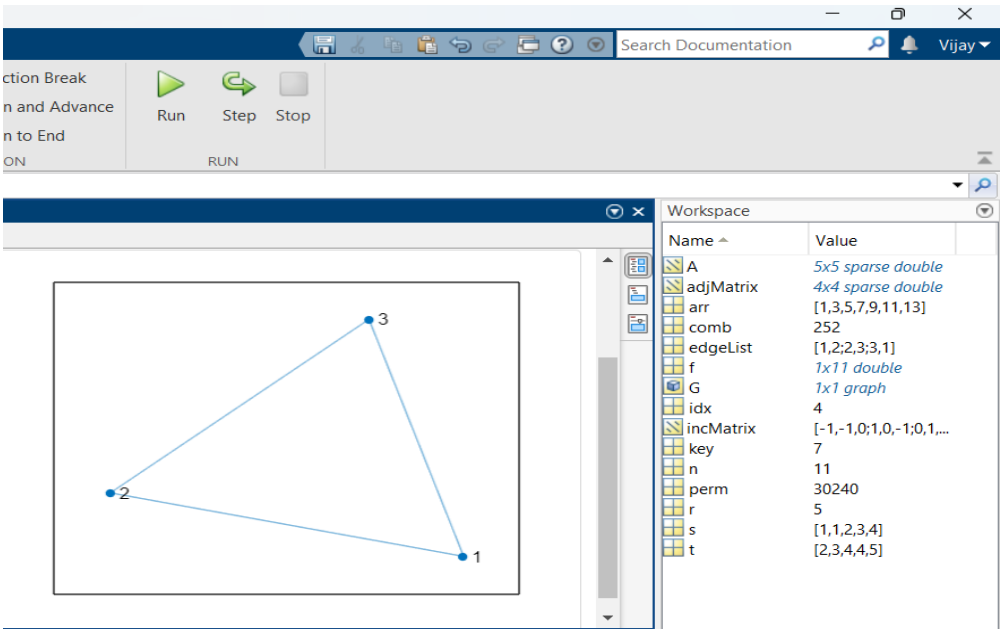
Create a graph using an edge list, and then calculate the graph incidence matrix.

Solution:

```
edgeList = [1 2; 2 3; 3 1];
G = graph(edgeList(:,1), edgeList(:,2));
incMatrix = incidence(G)

plot(G)
```

```
incMatrix =

  3x3 sparse double matrix (6 nonzeros)

   (1,1)       -1
   (2,1)        1
   (1,2)       -1
   (3,2)        1
   (2,3)       -1
   (3,3)        1
```

Output:



➢ Question:8

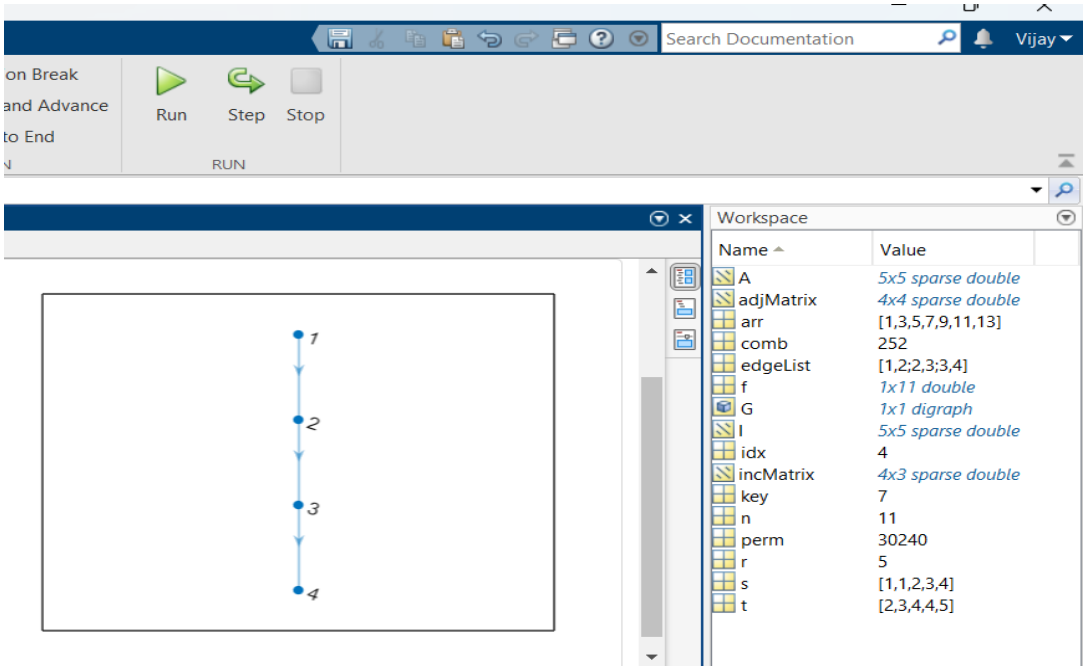
Create a directed graph using an edge list, and then calculate the incidence matrix.

Solution:

```
edgeList = [1 2; 2 3; 3 4];
G = digraph(edgeList(:,1), edgeList(:,2));
incMatrix = incidence(G)

plot(G)
```

```
incMatrix =

  4x3 sparse double matrix (6 nonzeros)

   (1,1)       -1
   (2,1)        1
   (2,2)       -1
   (3,2)        1
   (3,3)       -1
   (4,3)        1
```

Output:



➢ Question:9

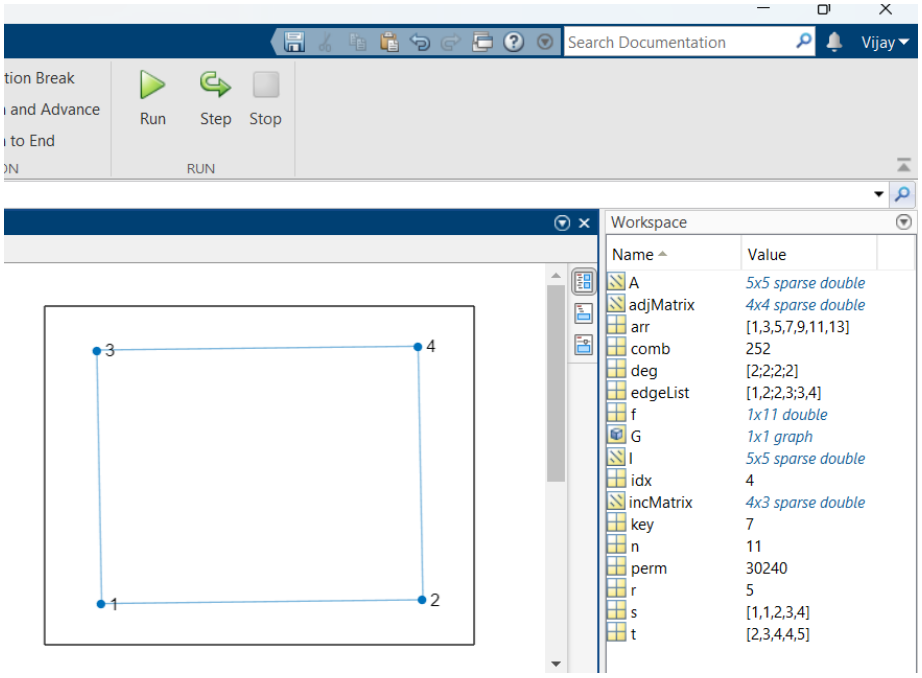
Create and plot a graph, and then find the degree of each node.

Solution:

```
G = graph([1 1 2 3], [2 3 4 4]);
plot(G)
deg = degree(G)
```

```
deg =

     2
     2
     2
     2

>>
```

Output:



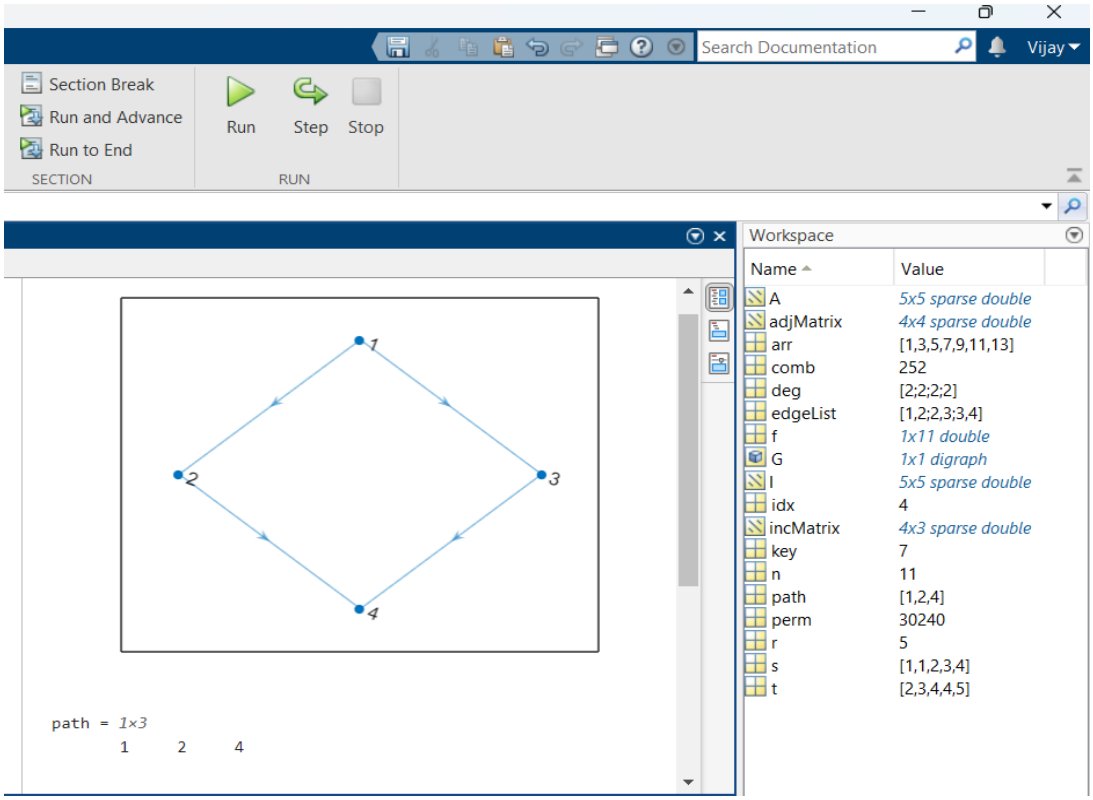
➢ Question:10

Create and plot a directed graph. Calculate the shortest path between nodes.

Solution:

```
G = digraph([1 1 2 3], [2 3 4 4]);
plot(G)
path = shortestpath(G, 1, 4)
```

Output:



➢ Question:11

Create and plot a graph with weighted edges. Find the shortest path between nodes, and specify two outputs to also return the length of the path.

Solution:

```
s = [1 1 2 3];
t = [2 3 4 4];
weights = [2 3 1 5];

G = digraph(s, t, weights);
plot(G, 'EdgeLabel', G.Edges.Weight)

[path, d] = shortestpath(G, 1, 4);
fprintf('Shortest Path: %s\n', mat2str(path));
fprintf('Path Length: %d\n', d);
```

Output: