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Table of Contents

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Lab 1

Aim: To understand the basic graphs and plotting techniques

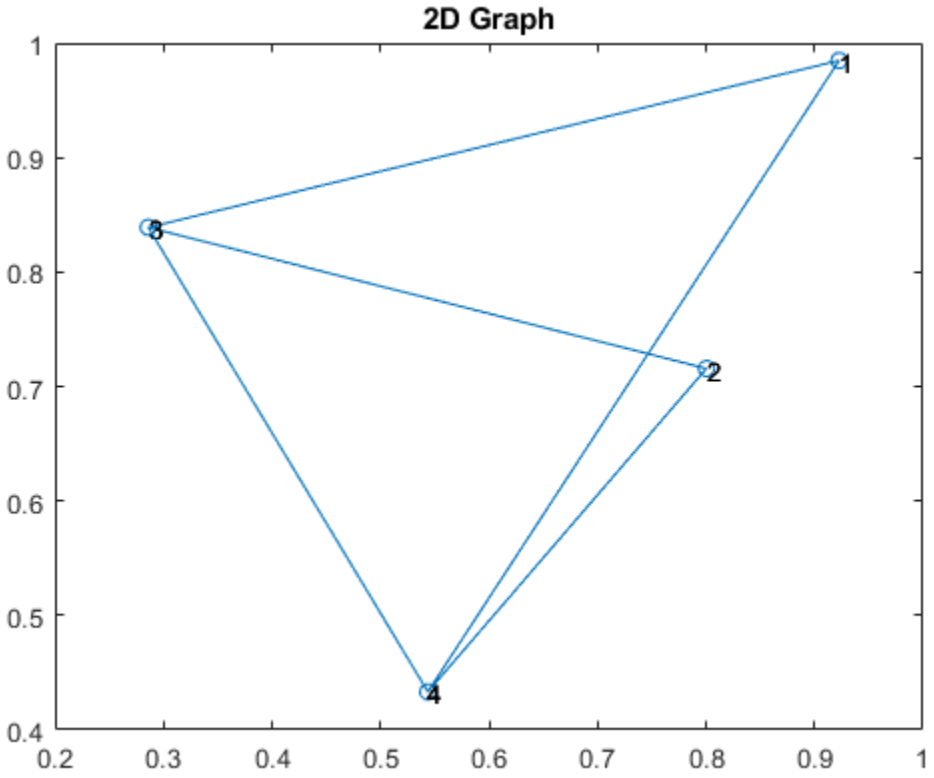
```
clc
clear all
close all
```

Part 1

```
A = [[0 0 1 1];[0 0 1 1];[1 1 0 1];[1 1 1 0]]
ran2D = rand(length(A),2)

plot2DGraph(A,ran2D)
title('2D Graph')
```

```
A =

     0     0     1     1
     0     0     1     1
     1     1     0     1
     1     1     1     0


ran2D =
```

```
0.9227    0.9848
0.8004    0.7157
0.2859    0.8390
0.5437    0.4333
```



Part 2

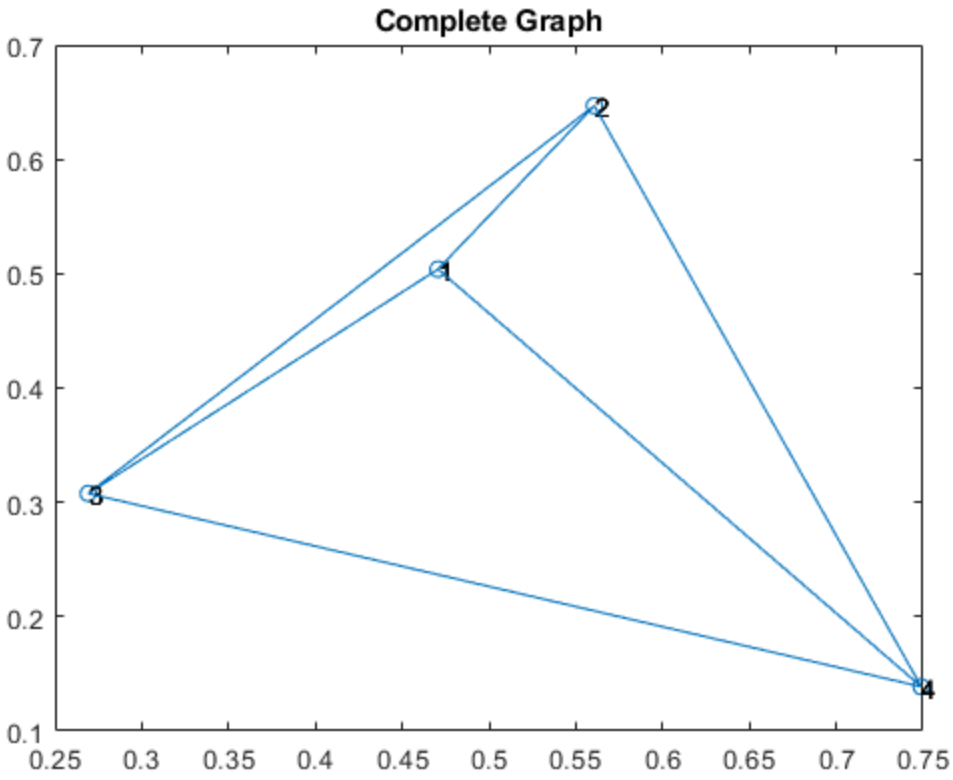
```
complete = [[0 1 1 1];[1 0 1 1];[1 1 0 1];[1 1 1 0]]
ran1 = rand(length(complete),2)

bipartite = [[0 0 0 1 1 1 1];[0 0 0 1 1 1 1];[0 0 0 1 1 1 1];[1 1 1 0
 0 0 0];[1 1 1 0 0 0 0];[1 1 1 0 0 0 0];[1 1 1 0 0 0 0]]
ran2 = rand(length(bipartite),2)

regular = [[0 1 1 1];[1 0 1 1];[1 1 0 1];[1 1 1 0]]
ran3 = rand(length(regular),2)

star = [[0 1 1 1];[1 0 0 0];[1 0 0 0];[1 0 0 0]]
ran4 = rand(length(star),2)

circular = [[0 1 0 1];[1 0 1 0];[0 1 0 1];[0 0 1 1]]
ran5 = rand(length(circular),2)

line = [[0 1 0 0];[1 0 1 0];[0 1 0 1];[0 0 1 0]]
```

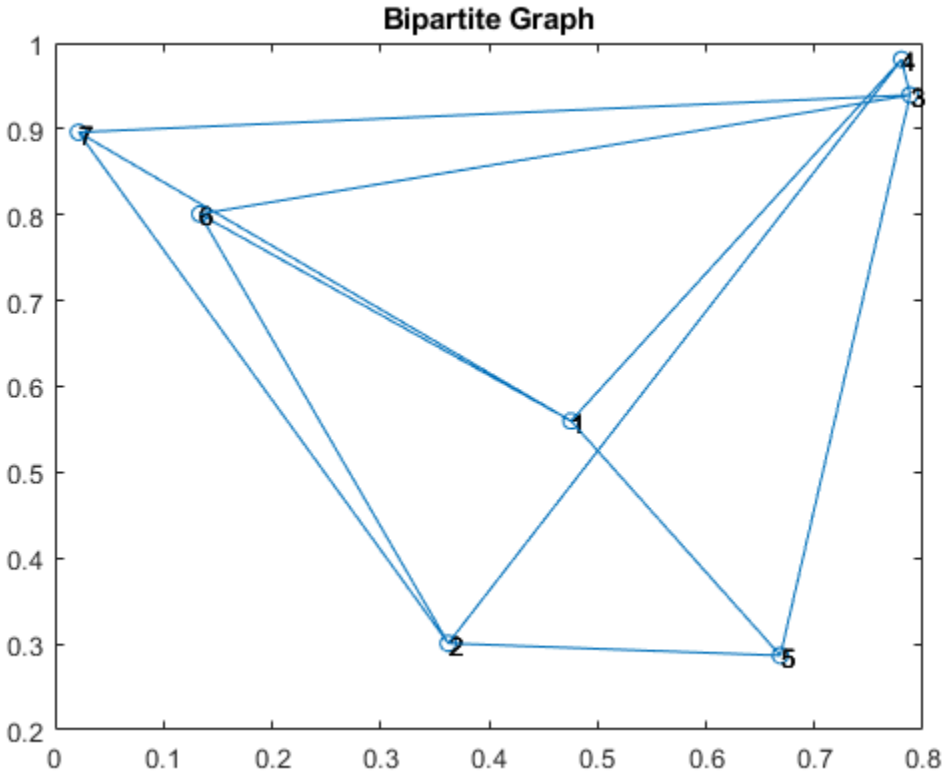
```
ran6 = rand(length(line),2)

plot2DGraph(complete,ran1)
title('Complete Graph')

plot2DGraph(bipartite,ran2)
title('Bipartite Graph')

plot2DGraph(regular,ran3)
title('Regular Graph')

plot2DGraph(star,ran4)
title('Star Graph')

plot2DGraph(circular,ran5)
title('Circular Graph')

plot2DGraph(line,ran6)
title('Line Graph')

% Verification using gplot()
figure
gplot(complete,ran1)
title('Complete Graph using gplot')

figure
gplot(bipartite,ran2)
title('Bipartite Graph using gplot')

figure
gplot(regular,ran3)
title('Regular Graph using gplot')

figure
gplot(star,ran4)
title('Star Graph using gplot')

figure
gplot(circular,ran5)
title('Circular Graph using gplot')

figure
gplot(line,ran6)
title('Line Graph using gplot')
```

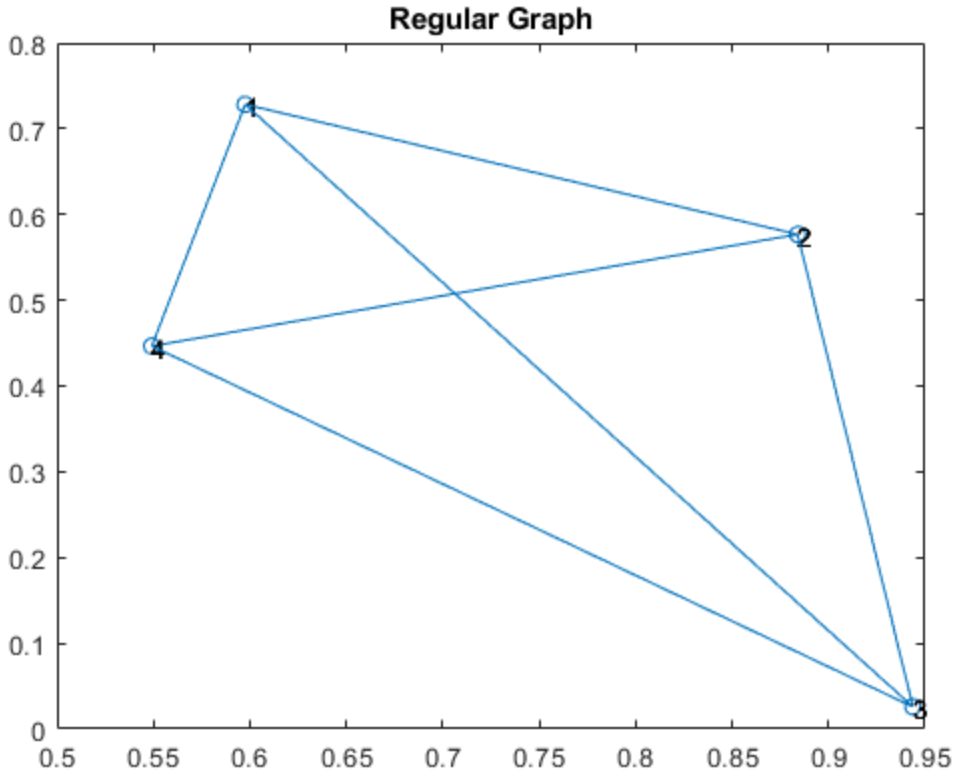
```
complete =

     0     1     1     1
     1     0     1     1
     1     1     0     1
     1     1     1     0
```

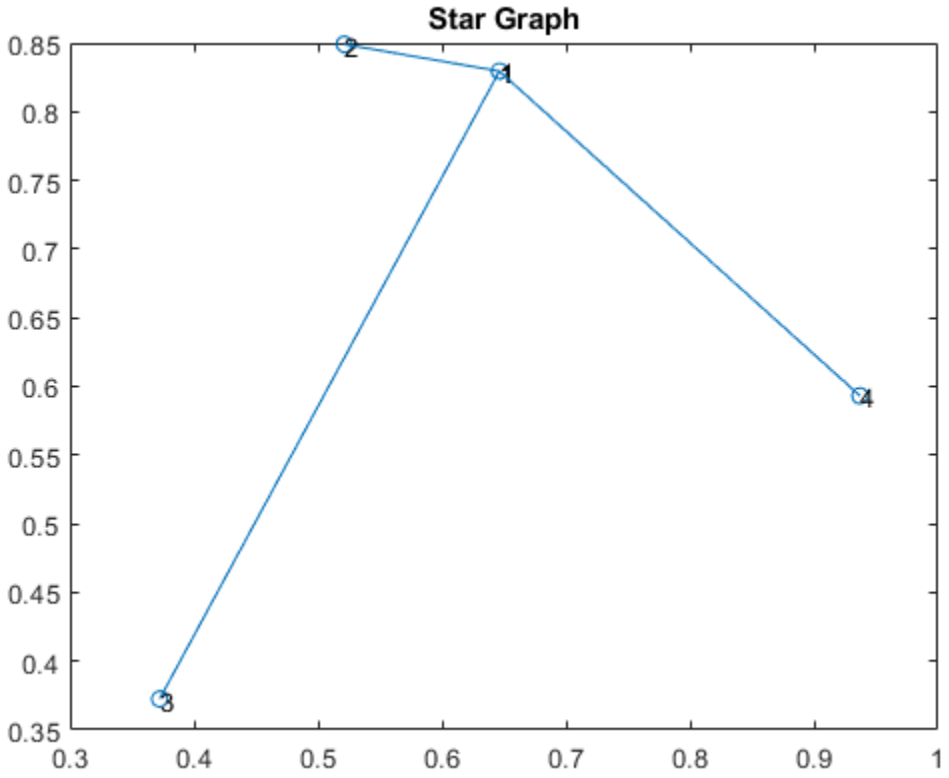
```
ran1 =

    0.4706    0.5039
    0.5607    0.6468
    0.2691    0.3077
    0.7490    0.1387


bipartite =

     0     0     0     1     1     1     1
     0     0     0     1     1     1     1
     0     0     0     1     1     1     1
     1     1     1     0     0     0     0
     1     1     1     0     0     0     0
     1     1     1     0     0     0     0
     1     1     1     0     0     0     0


ran2 =

    0.4756    0.5598
    0.3625    0.3008
    0.7881    0.9394
    0.7803    0.9809
    0.6685    0.2866
    0.1335    0.8008
    0.0216    0.8961


regular =

     0     1     1     1
     1     0     1     1
     1     1     0     1
     1     1     1     0


ran3 =

    0.5975    0.7284
    0.8840    0.5768
    0.9437    0.0259
    0.5492    0.4465


star =

     0     1     1     1
     1     0     0     0
     1     0     0     0
     1     0     0     0
```

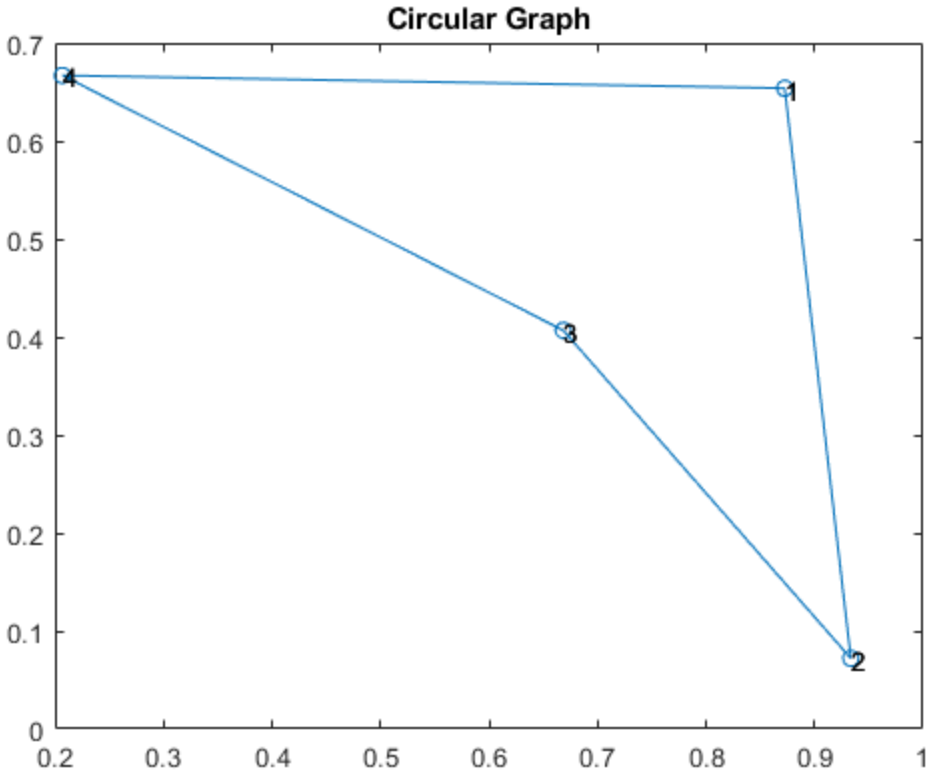
```
ran4 =

    0.6463    0.8295
    0.5212    0.8491
    0.3723    0.3725
    0.9371    0.5932


circular =

     0     1     0     1
     1     0     1     0
     0     1     0     1
     0     0     1     1


ran5 =

    0.8726    0.6539
    0.9335    0.0721
    0.6685    0.4067
    0.2068    0.6669


line =

     0     1     0     0
     1     0     1     0
     0     1     0     1
     0     0     1     0


ran6 =

    0.9337    0.4170
    0.8110    0.9718
    0.4845    0.9880
    0.7567    0.8641
```

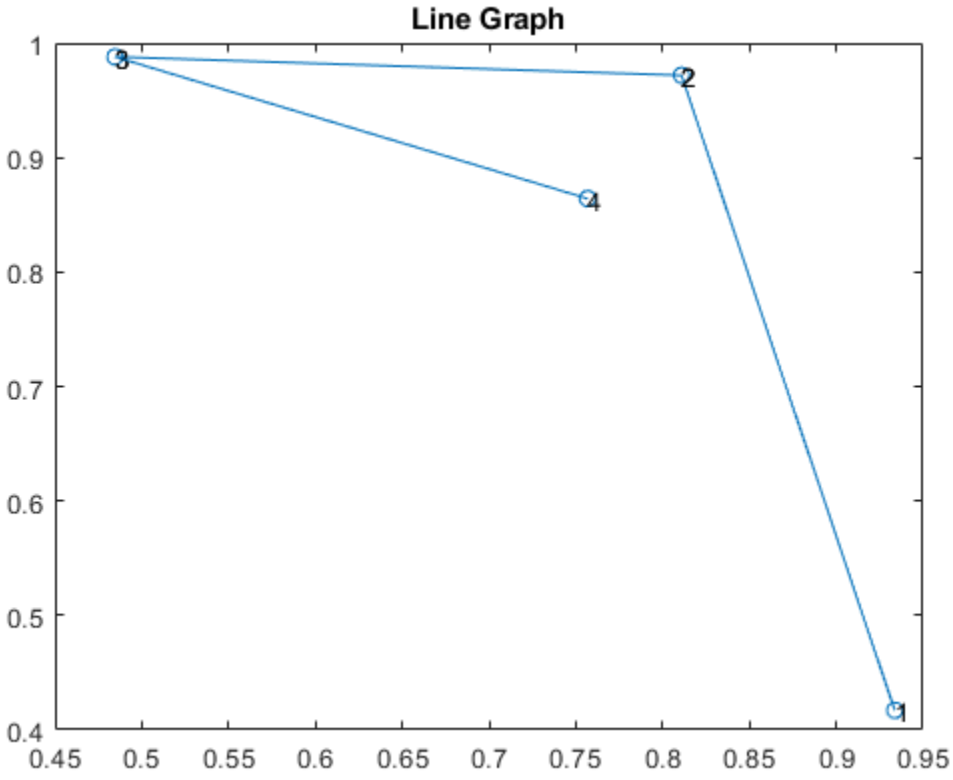

Complete Graph
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
1
2
3
4

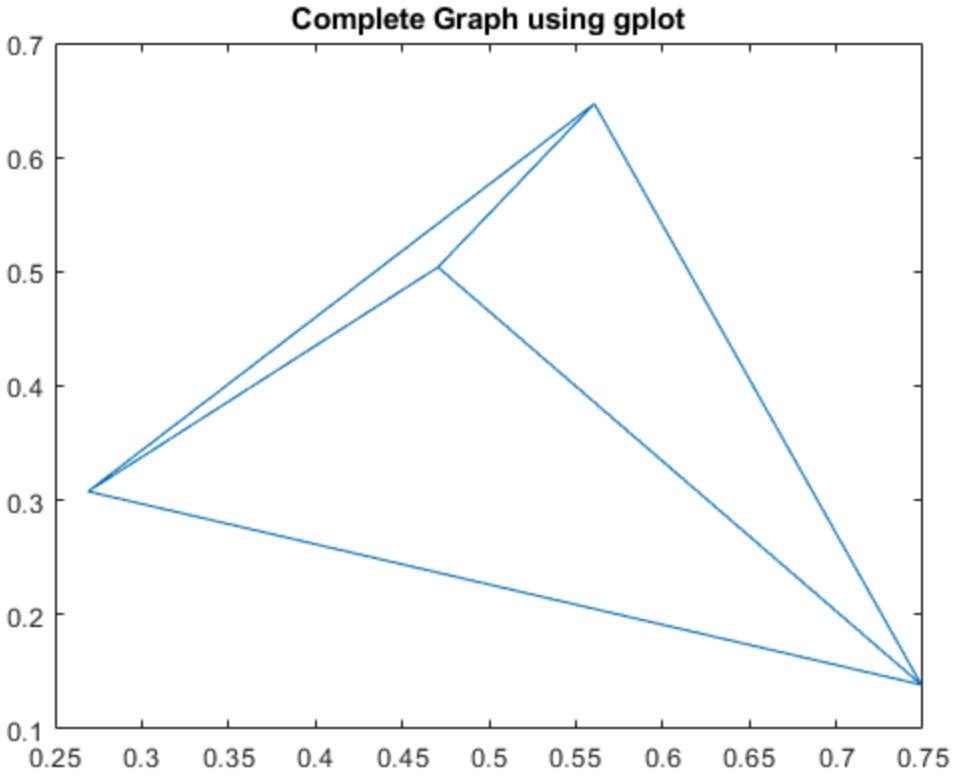

Bipartite Graph
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
1
2
3
4
5
6
7

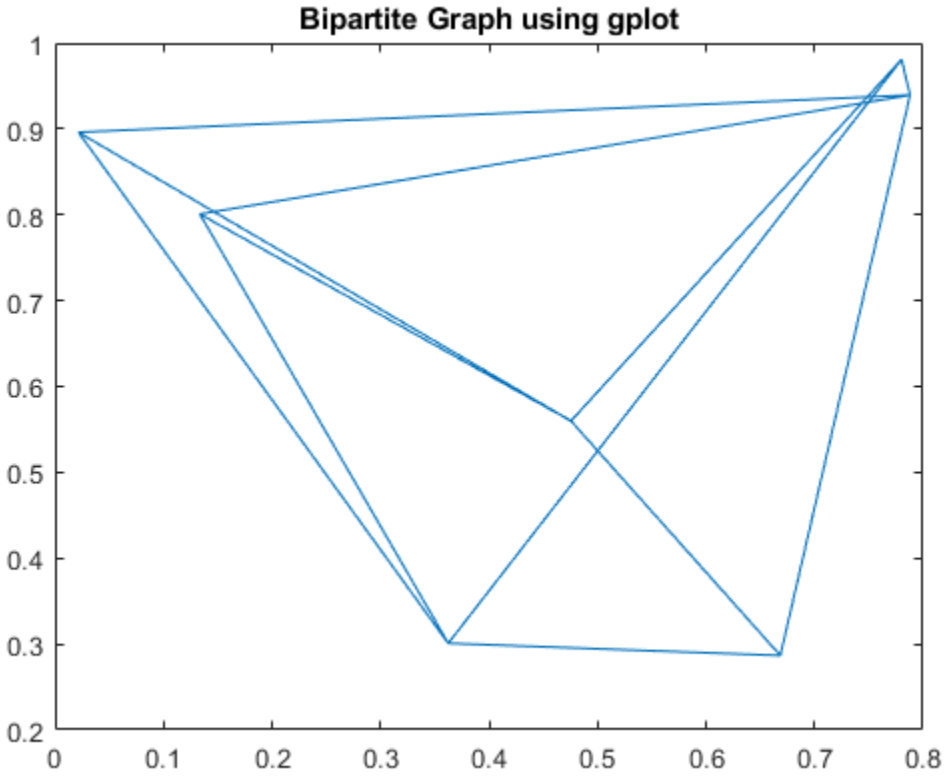

Regular Graph
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
2
3
4

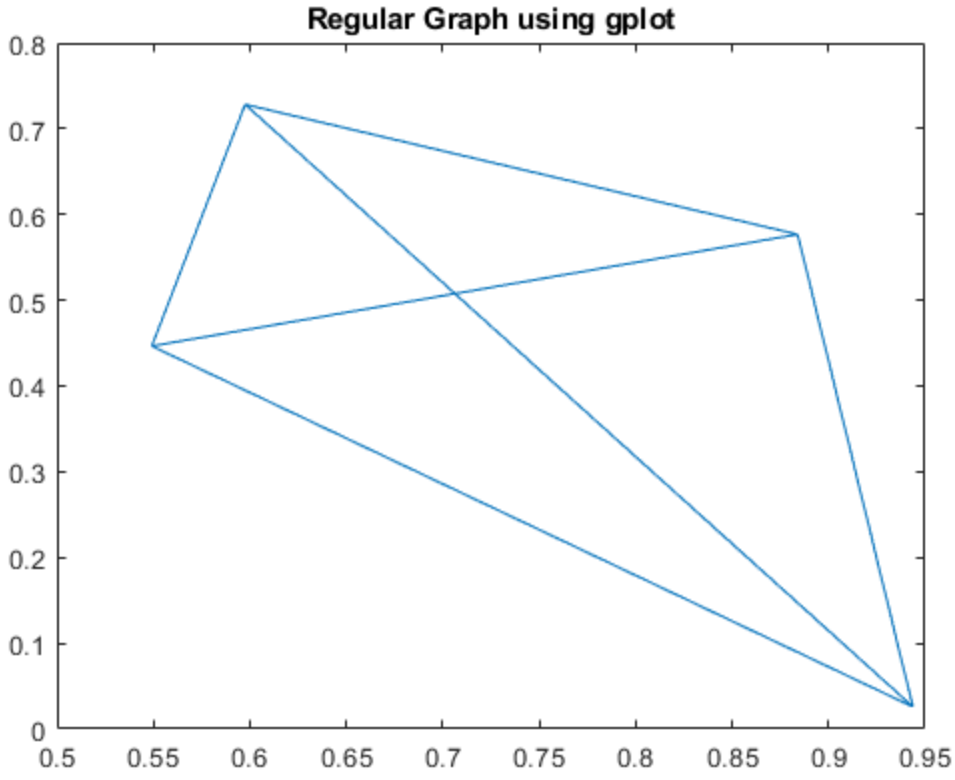

Star Graph
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
2
1
4
3

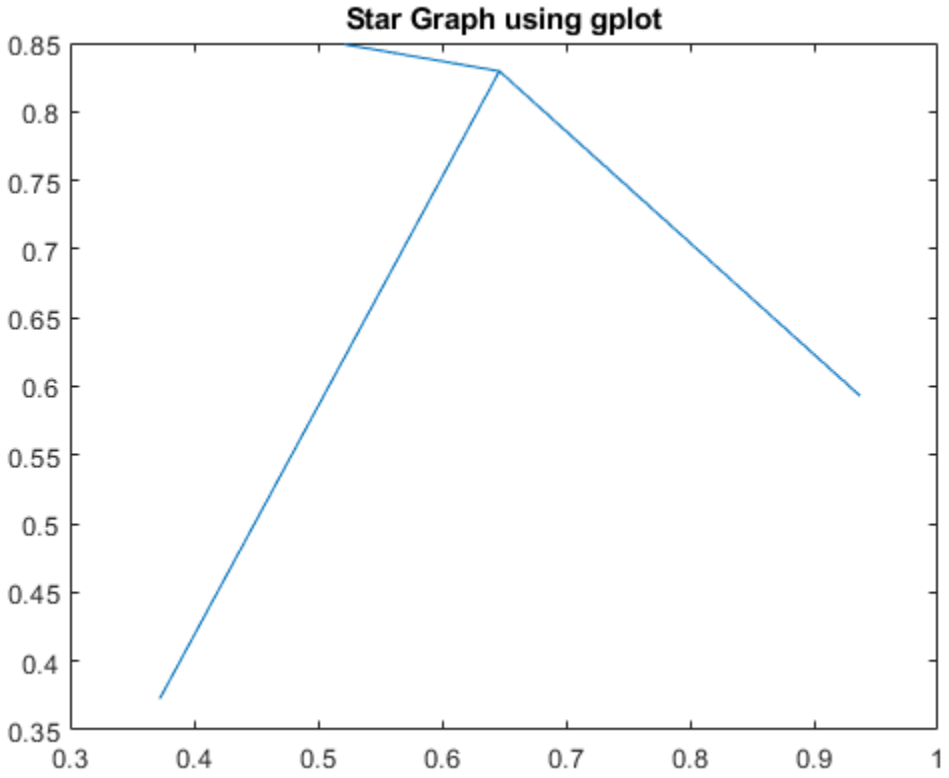

Circular Graph
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
4
1
3
2

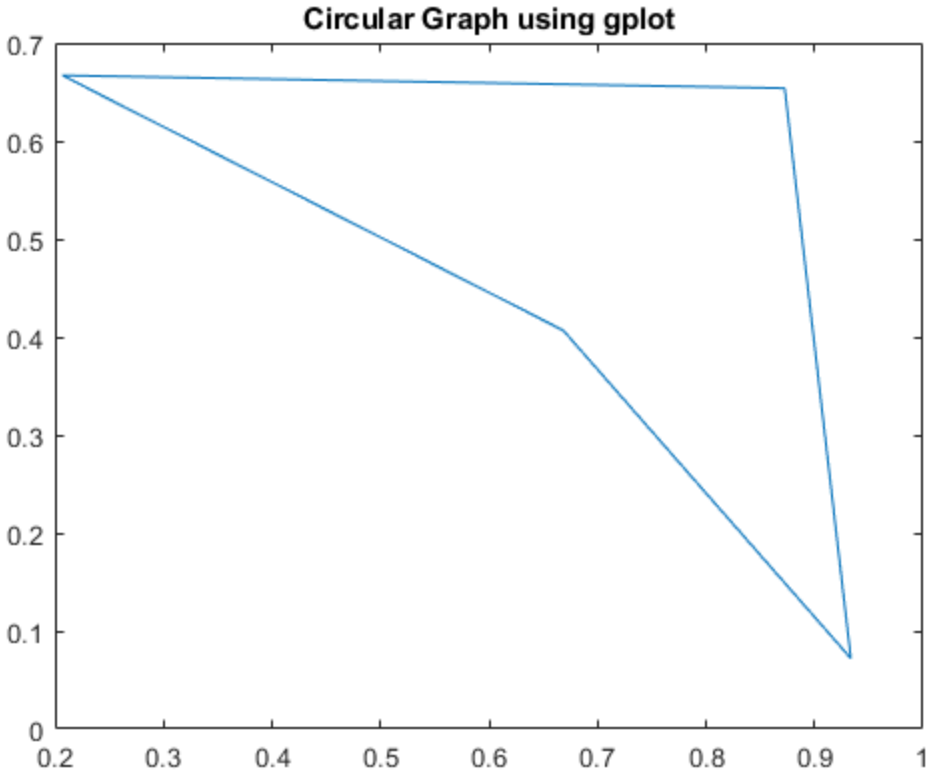

Line Graph
1
0.9
0.8
0.7
0.6
0.5
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
3
2
4
1

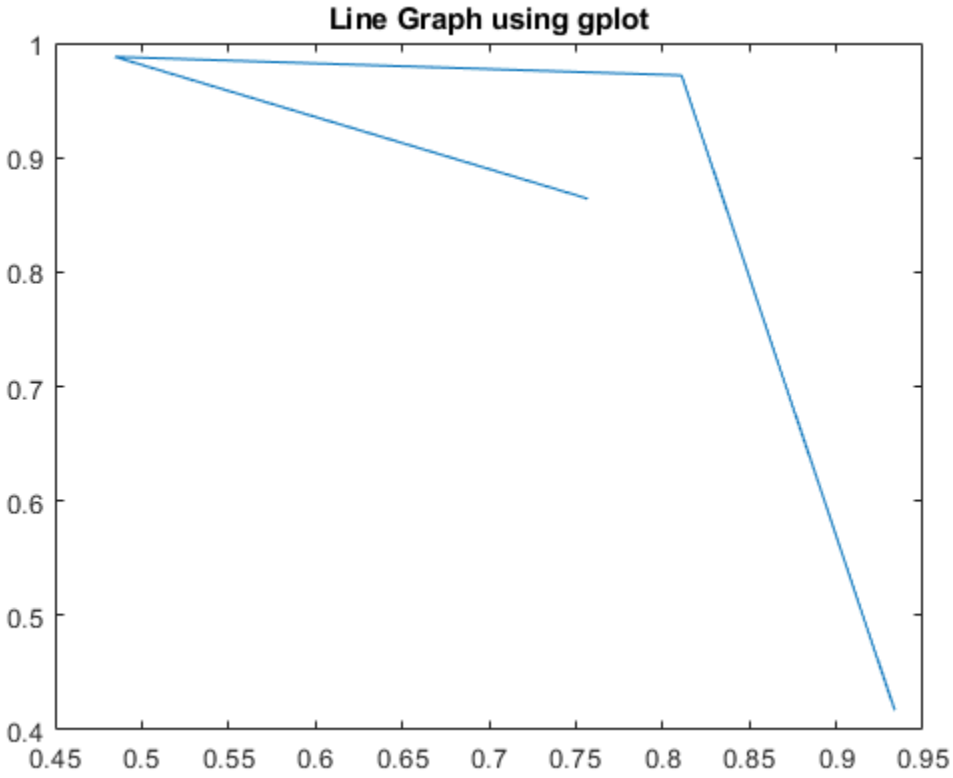

Complete Graph using gplot
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75


Bipartite Graph using gplot
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8


Regular Graph using gplot
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95


Star Graph using gplot
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

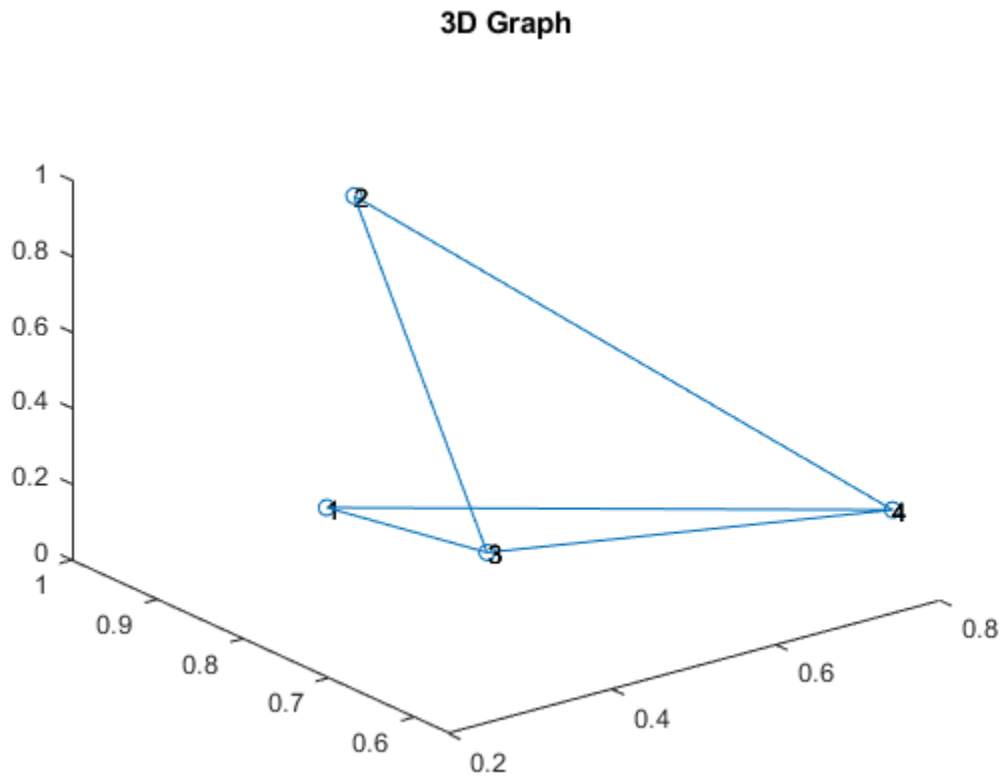

Circular Graph using gplot
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Line Graph using gplot
1
0.9
0.8
0.7
0.6
0.5
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95

Part 3

```
A = [[0 0 1 1];[0 0 1 1];[1 1 0 1];[1 1 1 0]]
ran3D = rand(length(A),3)

plot3DGraph(A,ran3D)
title('3D Graph')
```

```
A =

     0     0     1     1
     0     0     1     1
     1     1     0     1
     1     1     1     0


ran3D =

    0.3889    0.8828    0.1489
    0.4547    0.9137    0.8997
    0.2467    0.5583    0.4504
    0.7844    0.5989    0.2057
```



Part 4

```
[A,ran2D] = bucky

plot2DGraph(A,ran2D)
title('2D Bucky Graph')

[A,ran3D] = bucky

plot3DGraph(A,ran3D)
title('3D Bucky Graph')
```

```
A =

   (2,1)        1
   (5,1)        1
   (6,1)        1
   (1,2)        1
   (3,2)        1
  (11,2)        1
   (2,3)        1
   (4,3)        1
  (16,3)        1
   (3,4)        1
   (5,4)        1
  (21,4)        1
   (1,5)        1
   (4,5)        1
  (26,5)        1
   (1,6)        1
   (7,6)        1
  (10,6)        1
   (6,7)        1
   (8,7)        1
  (30,7)        1
   (7,8)        1
   (9,8)        1
  (42,8)        1
   (8,9)        1
  (10,9)        1
  (38,9)        1
   (6,10)       1
   (9,10)       1
  (12,10)       1
   (2,11)       1
  (12,11)       1
  (15,11)       1
  (10,12)       1
  (11,12)       1
  (13,12)       1
  (12,13)       1
  (14,13)       1
```

```
(37,13)       1
(13,14)       1
(15,14)       1
(33,14)       1
(11,15)       1
(14,15)       1
(17,15)       1
 (3,16)       1
(17,16)       1
(20,16)       1
(15,17)       1
(16,17)       1
(18,17)       1
(17,18)       1
(19,18)       1
(32,18)       1
(18,19)       1
(20,19)       1
(53,19)       1
(16,20)       1
(19,20)       1
(22,20)       1
 (4,21)       1
(22,21)       1
(25,21)       1
(20,22)       1
(21,22)       1
(23,22)       1
(22,23)       1
(24,23)       1
(52,23)       1
(23,24)       1
(25,24)       1
(48,24)       1
(21,25)       1
(24,25)       1
(27,25)       1
 (5,26)       1
(27,26)       1
(30,26)       1
(25,27)       1
(26,27)       1
(28,27)       1
(27,28)       1
(29,28)       1
(47,28)       1
(28,29)       1
(30,29)       1
(43,29)       1
 (7,30)       1
(26,30)       1
(29,30)       1
(32,31)       1
(35,31)       1
```

```
(54,31)	1
(18,32)	1
(31,32)	1
(33,32)	1
(14,33)	1
(32,33)	1
(34,33)	1
(33,34)	1
(35,34)	1
(36,34)	1
(31,35)	1
(34,35)	1
(56,35)	1
(34,36)	1
(37,36)	1
(40,36)	1
(13,37)	1
(36,37)	1
(38,37)	1
 (9,38)	1
(37,38)	1
(39,38)	1
(38,39)	1
(40,39)	1
(41,39)	1
(36,40)	1
(39,40)	1
(57,40)	1
(39,41)	1
(42,41)	1
(45,41)	1
 (8,42)	1
(41,42)	1
(43,42)	1
(29,43)	1
(42,43)	1
(44,43)	1
(43,44)	1
(45,44)	1
(46,44)	1
(41,45)	1
(44,45)	1
(58,45)	1
(44,46)	1
(47,46)	1
(50,46)	1
(28,47)	1
(46,47)	1
(48,47)	1
(24,48)	1
(47,48)	1
(49,48)	1
(48,49)	1
(50,49)	1
```

```
    (51,49)       1
    (46,50)       1
    (49,50)       1
    (59,50)       1
    (49,51)       1
    (52,51)       1
    (55,51)       1
    (23,52)       1
    (51,52)       1
    (53,52)       1
    (19,53)       1
    (52,53)       1
    (54,53)       1
    (31,54)       1
    (53,54)       1
    (55,54)       1
    (51,55)       1
    (54,55)       1
    (60,55)       1
    (35,56)       1
    (57,56)       1
    (60,56)       1
    (40,57)       1
    (56,57)       1
    (58,57)       1
    (45,58)       1
    (57,58)       1
    (59,58)       1
    (50,59)       1
    (58,59)       1
    (60,59)       1
    (55,60)       1
    (56,60)       1
    (59,60)       1


ran2D =

    0.3433         0    0.9392
    0.1061    0.3265    0.9392
   -0.2777    0.2018    0.9392
   -0.2777   -0.2018    0.9392
    0.1061   -0.3265    0.9392
    0.6866         0    0.7271
    0.7926   -0.3265    0.5149
    0.9643   -0.2018    0.1716
    0.9643    0.2018    0.1716
    0.7926    0.3265    0.5149
    0.2122    0.6530    0.7271
    0.5554    0.6530    0.5149
    0.4899    0.8547    0.1716
    0.1061    0.9794    0.1716
   -0.0656    0.8547    0.5149
   -0.5554    0.4035    0.7271
```

```
   -0.4494    0.7300    0.5149
   -0.6615    0.7300    0.1716
   -0.8987    0.4035    0.1716
   -0.8332    0.2018    0.5149
   -0.5554   -0.4035    0.7271
   -0.8332   -0.2018    0.5149
   -0.8987   -0.4035    0.1716
   -0.6615   -0.7300    0.1716
   -0.4494   -0.7300    0.5149
    0.2122   -0.6530    0.7271
   -0.0656   -0.8547    0.5149
    0.1061   -0.9794    0.1716
    0.4899   -0.8547    0.1716
    0.5554   -0.6530    0.5149
   -0.5554    0.6530   -0.5149
   -0.4899    0.8547   -0.1716
   -0.1061    0.9794   -0.1716
    0.0656    0.8547   -0.5149
   -0.2122    0.6530   -0.7271
    0.4494    0.7300   -0.5149
    0.6615    0.7300   -0.1716
    0.8987    0.4035   -0.1716
    0.8332    0.2018   -0.5149
    0.5554    0.4035   -0.7271
    0.8332   -0.2018   -0.5149
    0.8987   -0.4035   -0.1716
    0.6615   -0.7300   -0.1716
    0.4494   -0.7300   -0.5149
    0.5554   -0.4035   -0.7271
    0.0656   -0.8547   -0.5149
   -0.1061   -0.9794   -0.1716
   -0.4899   -0.8547   -0.1716
   -0.5554   -0.6530   -0.5149
   -0.2122   -0.6530   -0.7271
   -0.7926   -0.3265   -0.5149
   -0.9643   -0.2018   -0.1716
   -0.9643    0.2018   -0.1716
   -0.7926    0.3265   -0.5149
   -0.6866    0.0000   -0.7271
   -0.1061    0.3265   -0.9392
    0.2777    0.2018   -0.9392
    0.2777   -0.2018   -0.9392
   -0.1061   -0.3265   -0.9392
   -0.3433    0.0000   -0.9392


A =

   (2,1)        1
   (5,1)        1
   (6,1)        1
   (1,2)        1
   (3,2)        1
  (11,2)        1
```

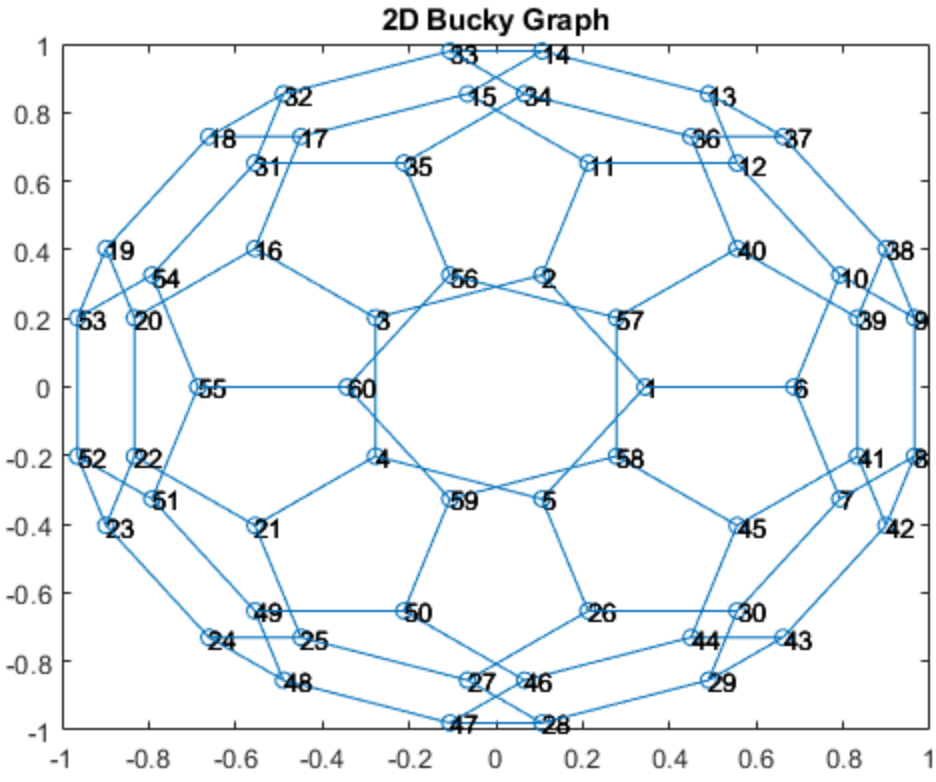
```
 (2,3)       1
 (4,3)       1
(16,3)       1
 (3,4)       1
 (5,4)       1
(21,4)       1
 (1,5)       1
 (4,5)       1
(26,5)       1
 (1,6)       1
 (7,6)       1
(10,6)       1
 (6,7)       1
 (8,7)       1
(30,7)       1
 (7,8)       1
 (9,8)       1
(42,8)       1
 (8,9)       1
(10,9)       1
(38,9)       1
 (6,10)      1
 (9,10)      1
(12,10)      1
 (2,11)      1
(12,11)      1
(15,11)      1
(10,12)      1
(11,12)      1
(13,12)      1
(12,13)      1
(14,13)      1
(37,13)      1
(13,14)      1
(15,14)      1
(33,14)      1
(11,15)      1
(14,15)      1
(17,15)      1
 (3,16)      1
(17,16)      1
(20,16)      1
(15,17)      1
(16,17)      1
(18,17)      1
(17,18)      1
(19,18)      1
(32,18)      1
(18,19)      1
(20,19)      1
(53,19)      1
(16,20)      1
(19,20)      1
(22,20)      1
```

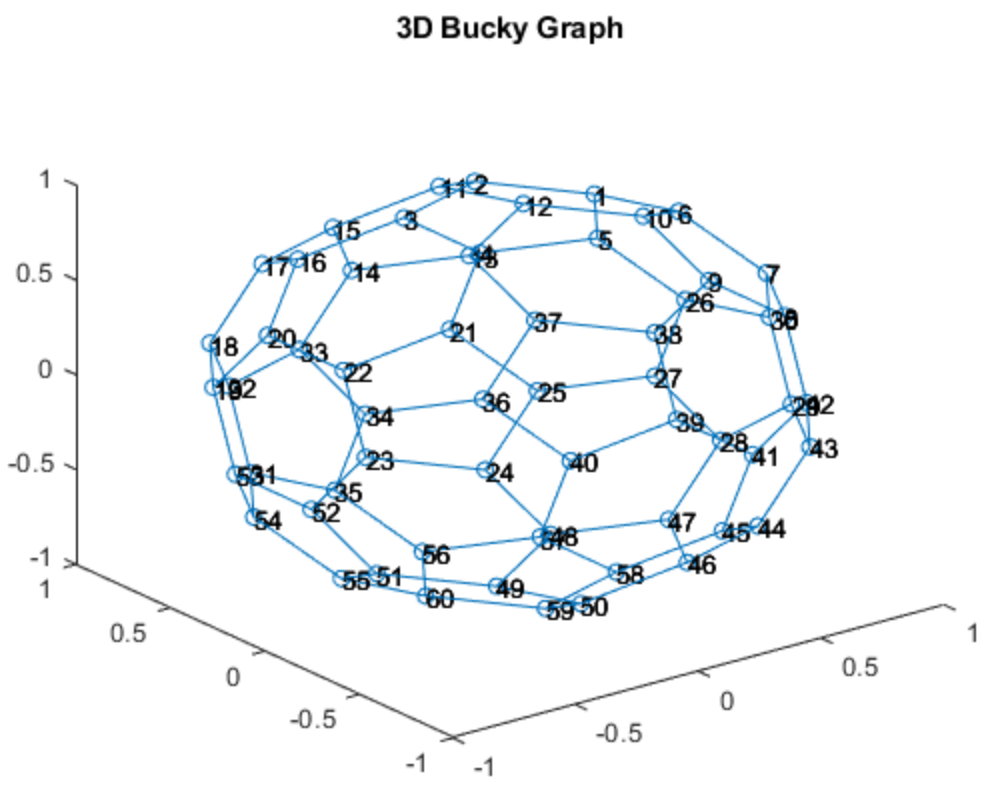
```
 (4,21)      1
(22,21)      1
(25,21)      1
(20,22)      1
(21,22)      1
(23,22)      1
(22,23)      1
(24,23)      1
(52,23)      1
(23,24)      1
(25,24)      1
(48,24)      1
(21,25)      1
(24,25)      1
(27,25)      1
 (5,26)      1
(27,26)      1
(30,26)      1
(25,27)      1
(26,27)      1
(28,27)      1
(27,28)      1
(29,28)      1
(47,28)      1
(28,29)      1
(30,29)      1
(43,29)      1
 (7,30)      1
(26,30)      1
(29,30)      1
(32,31)      1
(35,31)      1
(54,31)      1
(18,32)      1
(31,32)      1
(33,32)      1
(14,33)      1
(32,33)      1
(34,33)      1
(33,34)      1
(35,34)      1
(36,34)      1
(31,35)      1
(34,35)      1
(56,35)      1
(34,36)      1
(37,36)      1
(40,36)      1
(13,37)      1
(36,37)      1
(38,37)      1
 (9,38)      1
(37,38)      1
(39,38)      1
```

```
(38,39)       1
(40,39)       1
(41,39)       1
(36,40)       1
(39,40)       1
(57,40)       1
(39,41)       1
(42,41)       1
(45,41)       1
 (8,42)       1
(41,42)       1
(43,42)       1
(29,43)       1
(42,43)       1
(44,43)       1
(43,44)       1
(45,44)       1
(46,44)       1
(41,45)       1
(44,45)       1
(58,45)       1
(44,46)       1
(47,46)       1
(50,46)       1
(28,47)       1
(46,47)       1
(48,47)       1
(24,48)       1
(47,48)       1
(49,48)       1
(48,49)       1
(50,49)       1
(51,49)       1
(46,50)       1
(49,50)       1
(59,50)       1
(49,51)       1
(52,51)       1
(55,51)       1
(23,52)       1
(51,52)       1
(53,52)       1
(19,53)       1
(52,53)       1
(54,53)       1
(31,54)       1
(53,54)       1
(55,54)       1
(51,55)       1
(54,55)       1
(60,55)       1
(35,56)       1
(57,56)       1
(60,56)       1
```

```
   (40,57)       1
   (56,57)       1
   (58,57)       1
   (45,58)       1
   (57,58)       1
   (59,58)       1
   (50,59)       1
   (58,59)       1
   (60,59)       1
   (55,60)       1
   (56,60)       1
   (59,60)       1


ran3D =

    0.3433         0    0.9392
    0.1061    0.3265    0.9392
   -0.2777    0.2018    0.9392
   -0.2777   -0.2018    0.9392
    0.1061   -0.3265    0.9392
    0.6866         0    0.7271
    0.7926   -0.3265    0.5149
    0.9643   -0.2018    0.1716
    0.9643    0.2018    0.1716
    0.7926    0.3265    0.5149
    0.2122    0.6530    0.7271
    0.5554    0.6530    0.5149
    0.4899    0.8547    0.1716
    0.1061    0.9794    0.1716
   -0.0656    0.8547    0.5149
   -0.5554    0.4035    0.7271
   -0.4494    0.7300    0.5149
   -0.6615    0.7300    0.1716
   -0.8987    0.4035    0.1716
   -0.8332    0.2018    0.5149
   -0.5554   -0.4035    0.7271
   -0.8332   -0.2018    0.5149
   -0.8987   -0.4035    0.1716
   -0.6615   -0.7300    0.1716
   -0.4494   -0.7300    0.5149
    0.2122   -0.6530    0.7271
   -0.0656   -0.8547    0.5149
    0.1061   -0.9794    0.1716
    0.4899   -0.8547    0.1716
    0.5554   -0.6530    0.5149
   -0.5554    0.6530   -0.5149
   -0.4899    0.8547   -0.1716
   -0.1061    0.9794   -0.1716
    0.0656    0.8547   -0.5149
   -0.2122    0.6530   -0.7271
    0.4494    0.7300   -0.5149
    0.6615    0.7300   -0.1716
    0.8987    0.4035   -0.1716
```

```
 0.8332    0.2018   -0.5149
 0.5554    0.4035   -0.7271
 0.8332   -0.2018   -0.5149
 0.8987   -0.4035   -0.1716
 0.6615   -0.7300   -0.1716
 0.4494   -0.7300   -0.5149
 0.5554   -0.4035   -0.7271
 0.0656   -0.8547   -0.5149
-0.1061   -0.9794   -0.1716
-0.4899   -0.8547   -0.1716
-0.5554   -0.6530   -0.5149
-0.2122   -0.6530   -0.7271
-0.7926   -0.3265   -0.5149
-0.9643   -0.2018   -0.1716
-0.9643    0.2018   -0.1716
-0.7926    0.3265   -0.5149
-0.6866    0.0000   -0.7271
-0.1061    0.3265   -0.9392
 0.2777    0.2018   -0.9392
 0.2777   -0.2018   -0.9392
-0.1061   -0.3265   -0.9392
-0.3433    0.0000   -0.9392
```





Part 5

```
A = randAdjMatrix(5)
ran2D = rand(length(A),2)
ran3D = rand(length(A),3)

plot2DGraph(A,ran2D)
title('2D Random Graph')

plot3DGraph(A,ran3D)
title('3D Random Graph')
```

```
A =

     []


B =

     1     1     1     0     1


A =

     1     1     1     0     1
```

```
B =

     0     1     0     0     0


A =

     1     1     1     0     1
     0     1     0     0     0


B =

     0     0     1     0     1


A =

     1     1     1     0     1
     0     1     0     0     0
     0     0     1     0     1


B =

     0     0     0     1     0


A =

     1     1     1     0     1
     0     1     0     0     0
     0     0     1     0     1
     0     0     0     1     0


B =

     0     0     0     0     0


A =

     1     1     1     0     1
     0     1     0     0     0
     0     0     1     0     1
     0     0     0     1     0
     0     0     0     0     0


B =
```

```
     1     0     0     0     0
     1     1     0     0     0
     1     0     1     0     0
     0     0     0     1     0
     1     0     1     0     0
```

```
A =

     0     1     1     0     1
     0     0     0     0     0
     0     0     0     0     1
     0     0     0     0     0
     0     0     0     0     0
```

```
A =

     1     1     1     0     1
     1     1     0     0     0
     1     0     1     0     1
     0     0     0     1     0
     1     0     1     0     0
```

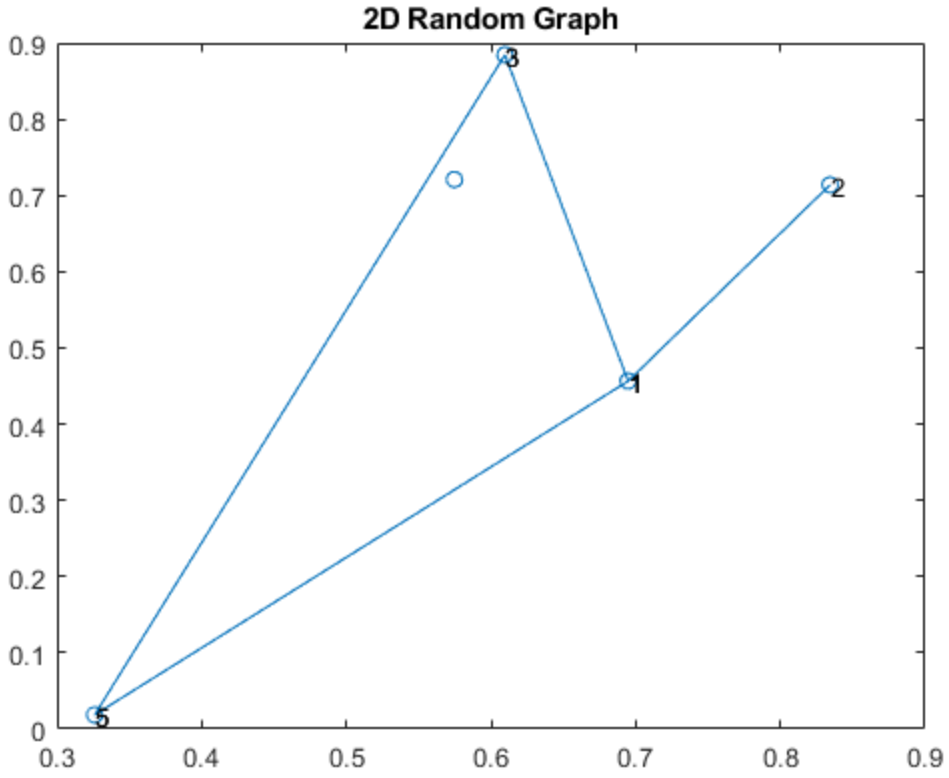
```
A =

     0     1     1     0     1
     1     0     0     0     0
     1     0     0     0     1
     0     0     0     0     0
     1     0     1     0     0
```

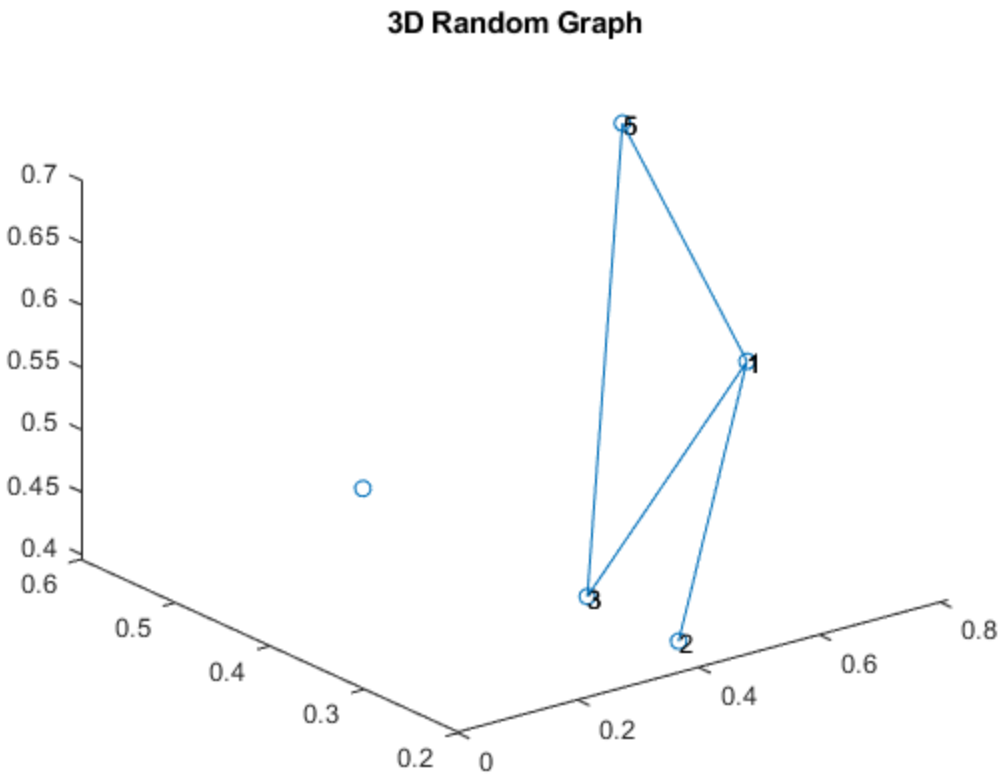
```
A =

     0     1     1     0     1
     1     0     0     0     0
     1     0     0     0     1
     0     0     0     0     0
     1     0     1     0     0
```

```
ran2D =

    0.6948    0.4564
    0.8344    0.7138
    0.6096    0.8844
    0.5747    0.7209
    0.3260    0.0186
```

```
ran3D =
```

```
0.6748    0.3249    0.5619
0.4385    0.2462    0.3958
0.4378    0.3427    0.3981
0.1170    0.3757    0.5154
0.8147    0.5466    0.6575
```





Part 6

```
A = [[0 1 1 1];[1 0 1 1];[1 1 0 1];[1 1 1 0]]

%Degree Matrix
degree = degreeMat(A)

% Laplacian Matrix
laplacian = laplacianMat(A)

% Normalized Laplacian Matrix
normLap = normLapMat(A)

% Random Walk Laplacian Matrix
randWalkLapMat = rwLapMat(A)
```

```
A =

     0     1     1     1
     1     0     1     1
     1     1     0     1
     1     1     1     0


D =
```

```
     []


D =

     3


D =

     3     0
     0     3


D =

     3     0     0
     0     3     0
     0     0     3


D =

     3     0     0     0
     0     3     0     0
     0     0     3     0
     0     0     0     3


degree =

     3     0     0     0
     0     3     0     0
     0     0     3     0
     0     0     0     3


D =

     []


D =

     3


D =

     3     0
     0     3
```

```
D =

     3     0     0
     0     3     0
     0     0     3


D =

     3     0     0     0
     0     3     0     0
     0     0     3     0
     0     0     0     3


L =

     3    -1    -1    -1
    -1     3    -1    -1
    -1    -1     3    -1
    -1    -1    -1     3


laplacian =

     3    -1    -1    -1
    -1     3    -1    -1
    -1    -1     3    -1
    -1    -1    -1     3


D =

     []


D =

     3


D =

     3     0
     0     3


D =

     3     0     0
     0     3     0
     0     0     3
```

```
D =

     3     0     0     0
     0     3     0     0
     0     0     3     0
     0     0     0     3


L =

     3    -1    -1    -1
    -1     3    -1    -1
    -1    -1     3    -1
    -1    -1    -1     3


Ln =

    1.0000   -0.3333   -0.3333   -0.3333
   -0.3333    1.0000   -0.3333   -0.3333
   -0.3333   -0.3333    1.0000   -0.3333
   -0.3333   -0.3333   -0.3333    1.0000


normLap =

    1.0000   -0.3333   -0.3333   -0.3333
   -0.3333    1.0000   -0.3333   -0.3333
   -0.3333   -0.3333    1.0000   -0.3333
   -0.3333   -0.3333   -0.3333    1.0000


D =

     []


D =

     3


D =

     3     0
     0     3


D =

     3     0     0
     0     3     0
     0     0     3
```

```
D =

     3     0     0     0
     0     3     0     0
     0     0     3     0
     0     0     0     3


L =

     3    -1    -1    -1
    -1     3    -1    -1
    -1    -1     3    -1
    -1    -1    -1     3


Lrw =

    1.0000   -0.3333   -0.3333   -0.3333
   -0.3333    1.0000   -0.3333   -0.3333
   -0.3333   -0.3333    1.0000   -0.3333
   -0.3333   -0.3333   -0.3333    1.0000


randWalkLapMat =

    1.0000   -0.3333   -0.3333   -0.3333
   -0.3333    1.0000   -0.3333   -0.3333
   -0.3333   -0.3333    1.0000   -0.3333
   -0.3333   -0.3333   -0.3333    1.0000
```

Functions

```
% To find degree matrix

%function D = degreeMat(A)
%D = []
%Creating degree matrix
%for i = 1:length(A)
%    D(i,i) = sum(A(i,:))
%end
%end

% To find laplacian matrix

%function L = laplacianMat(A)
%D = []
%Creating diagonal matrix
%for i = 1:length(A)
%    D(i,i) = sum(A(i,:))
%end
```

```
%Creating laplacian matrix
%L = D-A
%end

% To find normalized laplacian matrix

%function Ln = normLapMat(A)
%D = []
%Creating degree matrix
%for i = 1:length(A)
%    D(i,i) = sum(A(i,:))
%end
%Creating laplacian matrix
%L = D-A
%Creating normalised laplacian matrix
%Ln = (D^(-1/2))*L*(D^(-1/2))
%end

% To find laplacian random walk

%function Lrw = rwLapMat(A)
%D = []
%Creating Degree matrix
%for i = 1:length(A)
%    D(i,i) = sum(A(i,:))
%end
%Creating laplacian matrix
%L = D-A
%Creating random walk laplacian matrix
%Lrw = inv(D)*L
%end

% To create a random NxN adjacency matrix

%function A = randAdjMatrix(N)
%A = []
% Creating upper triangular random matrix
%for i=N:-1:1
%    B = [zeros(1,N-i) round(rand(1,i))]
%    A = [A;B]
%end
%B = A.'  % Taking transpose of upper triangular matrix
%A = A - diag(diag(A)) %Making diagonal 0
%A = A + B %Adding transpose to the original triangular matrix
%A = A - diag(diag(A)) %Making diagonal 0
%end

% To plot 2D graph

%function plot2DGraph(A,ran)
%figure
%plot(ran(:,1),ran(:,2),'O')  %Creating random points in 2D space
%for k = 1: length(A)
%    row = A(k,:); %Extracting kth row
```

```
%    for i = 1:length(row)
%        if A(k,i) == 1              % If weight is 1
%            x = [ran(k,1) ran(i,1)];
%            y = [ran(k,2) ran(i,2)]; %x,y-axes stores random points
%            k1 = int2str(k);         % Converting node number to
%                                                 string
%            text(ran(k,1),ran(k,2),k1)     % Naming the node
%            line(x,y);                % Drawing line
%        end
%    end
%end
%end

% To plot 3D graph

%function plot3DGraph(A,ran)
%figure
%plot3(ran(:,1),ran(:,2),ran(:,3),'O') %Creating random points in 3D
 space
%for k = 1: length(A)
%    row = A(k,:); %Extracting kth row
%    for i = 1:length(row)
%        if A(k,i) == 1    % If weight is 1
%            x = [ran(k,1) ran(i,1) ran(k,1)];   %x,y,z-axes stores
 random
%                                                  points
%            y = [ran(k,2) ran(i,2) ran(k,2)];
%            z = [ran(k,3) ran(i,3) ran(k,3)];
%            k1 = int2str(k);                %Converting node number
 to
%                                                 string
%            text(ran(k,1),ran(k,2),ran(k,3),k1) % Naming the node
%            line(x,y,z); % Drawing line
%        end
%    end
%end
%end
```

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