```
%solve.m
function [solution] = solve(UV)
    solution = zeros(size(UV, 1), 1);
    for  i = size(UV, 1):-1:1
        UV(i, :) = UV(i, :) / UV(i, i);
        for j = 1:(i - 1)
            UV(j, :) = UV(j, :) - UV(j, i) / UV(i, i) *
UV(i, :);
        end
        solution(i) = UV(i, size(UV, 2));
    end
end
```

3.

```
%p124.m
UV = [4, -1, 2, 2, -1, 4;
    0, -2, 6, 2, 7, 0;
    0, 0, 1, -1, -2, 3;
    0, 0, 0, -2, -1, 10;
    0, 0, 0, 0, 3, 6];
solution = solve(UV);
```

∴ x1 = 5
   x2 = 4
   x3 = 1
   x4 = -6
   x5 = 2

∴ D = 4 * (-2) * 1 * (-2) * 3 = 48

4.(a) c21 = a21 * b11 + a22 * b21 + a23 * b31 = 0
      c31 = a31 * b11 + a32 * b21 + a33 * b31 = 0
      c32 = a31 * b12 + a32 * b22 + a33 * b32 = 0

```
%eliminate.m
function [UY] = eliminate(AB)
    for i = 2:size(AB, 1)
        for j = 1:(i - 1)
            AB(i, :) = AB(i, :) - AB(i, j) / AB(j, j) *
AB(j, :);
        end
    end
    UY = AB;
```

```
end

%p137.m
AB1 = [2, 4, -6, -4;
    1, 5, 3, 10;
    1, 3, 2, 5];
UV1 = eliminate(AB1);
solution1 = solve(UV1);

AB9 = [2, 4, -4, 0, 12;
    1, 5, -5, -3, 18;
    2, 3, 1, 3, 8;
    1, 4, -2, 2, 8];
UV9 = eliminate(AB9);
solution9 = solve(UV9);

1. ∴ 2  4  -6 -4
      0  3  6  12
      0  0  3  3

   ∴ x1 = -3
      x2 = 2
      x3 = 1

2. ∴ 2  4  -4 0  12
      0  3  -3 -3 12
      0  0  4  2  0
      0  0  0  3  -6

   ∴ x1 = 2
      x2 = 3
      x3 = 1
      x4 = -2

1.
%p153t1.m
L = [1, 0, 0;
    1/2, 1, 0;
    1/2, 1/3, 1];
B = [-4;
    10;
    5];
U = [2, 4, -6;
```

```
    0, 3, 6;
    0, 0, 3];
A = [2, 4, -6;
    1, 5, 3;
    1, 3, 2];
Y = L \ B;
X1 = U \ Y;
X2 = A \ B;
```

∴ Y = [-4;12;3]
X1 = [-3;2;1]
X2 = [-3;2;1]
∴ X1 = X2

```
%factorize.m
function [L, U] = factorize(A)
    U = A;
    for i = 2:size(A, 1)
        for j = 1:(i - 1)
            U(i, :) = U(i, :) - U(i, j) / U(j, j) *
U(j, :);
        end
    end
    L = A / U;
end

%p153.m
A4a = [4, 2, 1;
    2, 5, -2;
    1, -2, 7];
[L4a, U4a] = factorize(A4a);

A4b = [1, -2, 7;
    4, 2, 1;
    2, 5, -2];
[L4b, U4b] = factorize(A4b);

A6 = [1, 1, 0, 4;
    2, -1, 5, 0;
    5, 2, 1, 2;
    -3, 0, 2, 6];
[L6, U6] = factorize(A6);
```

```
4. (a)∴ L =
            1         0         0
            0.5       1         0
            0.25     -0.625     1
         U =
            4         2         1
            0         4        -2.5
            0         0         5.1875

   (b)∴ L =
            1         0         0
            4         1         0
            2         0.9       1
         U =
            1        -2         7
            0        10        -27
            0         0         8.3

6. ∴ L =
          1         0         0         0
          2         1         0         0
          5         1         1         0
         -3        -1        -1.75      1
      U =
          1         1         0         4
          0        -3         5        -8
          0         0        -4       -10
          0         0         0        -7.5
```

```
%jacobi.m
function [P] = jacobi(A, B, P0, k)
    P = zeros(size(A, 2), k);
    coef = [-A, B];
    for i = 1:size(A, 1)
        coef(i, :) = coef(i, :) / A(i, i);
        coef(i, i) = 0;
    end
    P(:, 1) =  coef * [P0; 1];
    for i = 2:k
        P(:, i) = coef * [P(:, i - 1); 1];
    end
end
```

```
%gauss_seidel.m
function [P] = gauss_seidel(A, B, P0, k)
    P = zeros(size(A, 2), k);
    coef = [-A, B];
    for i = 1:size(A, 1)
        coef(i, :) = coef(i, :) / A(i, i);
        coef(i, i) = 0;
    end
    P(:, 1) =  P0;
    for j = 1:size(A, 2)
        P(j, 1) = coef(j, :) * [P(:, 1); 1];
    end
    for i = 2:k
        P(:, i) = P(:, i - 1);
        for j = 1:size(A, 2)
            P(j, i) = coef(j, :) * [P(:, i); 1];
        end
    end
end

%gauss_seidel_parallel.m
function [P] = gauss_seidel_parallel(A, B, P0, k)
    P = zeros(size(A, 2), k);
    coef = [-A, B];
    for i = 1:size(A, 1)
        coef(i, :) = coef(i, :) / A(i, i);
        coef(i, i) = 0;
    end
    coef_ex = coef;
    for i = 2:size(A, 1)
        for j = 1:i - 1
            coef_ex(i, :) = coef_ex(i, :) + coef(i, j) *
coef_ex(j, :);
            coef_ex(i, j) = 0;
        end
    end
    P(:, 1) =  coef_ex * [P0; 1];
    for i = 2:k
        P(:, i) = coef_ex * [P(:, i - 1); 1];
    end
end

%d.m
function [res] = d(A)
```

```
    res = zeros(1, size(A, 2) - 1);
    for i = 1:size(A, 2) - 1
        sum(abs(A(:, i + 1) - A(:, i)))
        res(1, i) = sum(abs(A(:, i + 1) - A(:, i)));
    end
end

%p165.m
A1 = [4, -1;
    1, 5];
B1 = [15; 9];
P11 = jacobi(A1, B1, zeros(size(A1, 2), 1), 3);
P12 = gauss_seidel(A1, B1, zeros(size(A1, 2), 1), 3);
P13 = gauss_seidel_parallel(A1, B1, zeros(size(A1, 2),
1), 3);
d11 = d(P11);
d12 = d(P12);

A3 = [-1, 3;
    6, -2];
B3 = [1; 2];
P31 = jacobi(A3, B3, zeros(size(A3, 2), 1), 3);
P32 = gauss_seidel(A3, B3, zeros(size(A3, 2), 1), 3);
P33 = gauss_seidel_parallel(A3, B3, zeros(size(A3, 2),
1), 3);
d31 = d(P31);
d32 = d(P32);

A5 = [5, -1, 1;
    2, 8, -1;
    -1, 1, 4];
B5 = [10; 11; 3];
P51 = jacobi(A5, B5, zeros(size(A5, 2), 1), 3);
P52 = gauss_seidel(A5, B5, zeros(size(A5, 2), 1), 3);
P53 = gauss_seidel_parallel(A5, B5, zeros(size(A5, 2),
1), 3);
d51 = d(P51);
d52 = d(P52);

1. ∴ Jacobi: P1 =  3.75
                   1.8
             P2 =  4.2
                   1.05
```

```
            P3 =  4.0125
                  0.96
   ∴ d = 1.2, 0.2775
     Yes

   ∴ Gauss-Seidel: P1 =  3.75
                         1.05
                   p2 =  4.0125
                         0.9975
                   p3 =  3.999375
                         1.000125
   ∴ d = 0.315, 0.01575
   ∴ Yes

3. ∴ Jacobi: P1 =  -1
                   -1
             P2 =  -4
                   -4
             P3 =  -13
                   -13
   ∴ d = 6, 18
   ∴ No

   ∴ Gauss-Seidel: P1 =  -1
                         -4
                   p2 =  -13
                         -40
                   p3 =  -121
                         -364
   ∴ d = 48, 432
   ∴ No

5. ∴ Jacobi: P1 =  2
                   1.375
                   0.75
             P2 =  2.125
                   0.96875
                   0.90625
             P3 =  2.0125
                   0.95703125
                   1.0390625
```

```
∴ d = 0.6875, 0.25703125
∴ Yes

∴ Gauss-Seidel: P1 =  2
                      0.875
                      1.03125
                p2 =  1.96875
                      1.01171875
                      0.9892578125
                p3 =  2.0044921875
                      0.9975341796875
                      1.00173950195313
∴ d = 0.2099609375, 0.0624084472656249
∴ Yes
```