Sistemas de ecuaciones lineales con matrices positivas definidas

```
A = [4, -1, 0 ; -1, 4, -1 ; 0, -1, 4]
```

```
A = 3×3
     4    -1     0
    -1     4    -1
     0    -1     4
```

```
b = [2 ; 6 ; 2]
```

```
b = 3×1
     2
     6
     2
```

Solución con \

```
x = A \ b
```

```
x = 3×1
     1
     2
     1
```

Verificación PD

```
esPositivaDefinida(A)
```

```
ans = logical
   1
```

Solución con máximo descenso

```
x0 = [3 ; 5 ; 7]
```

```
x0 = 3×1
     3
     5
     7
```

```
[x, i] = maximoDescenso(A, b, x0)
```

```
x = 3×1
     1
     2
     1
i = 36
```

Solución con gradiente conjugado

```
[x, i] = gradienteConjugado(A, b, x0)
```

```
x = 3×1
     1
     2
     1
i = 4
```

Más ejercicios

$6x + 15y + 55z = 76$

$15x + 55y + 225z = 295$

$55x + 225y + 979z = 1259$

```
A = [6, 15, 55 ; 15, 55, 225 ; 55, 225, 979]
```

```
A = 3×3
     6    15    55
    15    55   225
    55   225   979
```

```
b = [76 ; 295 ; 1259]
```

```
b = 3×1
          76
         295
        1259
```

```
x = A \ b
```

```
x = 3×1
    1.0000
    1.0000
    1.0000
```

```
x0 = [3 ; 5 ; 7]
```

```
x0 = 3×1
     3
     5
     7
```

```
[x, i] = maximoDescenso(A, b, x0)
```

```
x = 3×1
    1.0000
    1.0000
    1.0000
i = 80
```

```
[x, i] = gradienteConjugado(A, b, x0)
```

```
x = 3×1
    1.0000
    1.0000
    1.0000
i = 11
```

$25x + 15y - 5z = 35$

$15x + 18y + 0z = 33$

$-5x + 0y + 11z = 6$

```
A = [25, 15, -5 ; 15, 18, 0 ; -5, 0, 11]
```

```
A = 3×3
    25    15    -5
    15    18     0
    -5     0    11
```

```
b = [35 ; 33 ; 6]
```

```
b = 3×1
    35
    33
     6
```

```
x = A \ b
```

```
x = 3×1
     1
     1
     1
```

```
x0 = [3 ; 5 ; 7]
```

```
x0 = 3×1
     3
     5
     7
```

```
[x, i] = maximoDescenso(A, b, x0)
```

```
x = 3×1
    1.0000
    1.0000
    1.0000
i = 80
```

```
[x, i] = gradienteConjugado(A, b, x0)
```

```
x = 3×1
    1.0000
    1.0000
    1.0000
i = 8
```

```
A = [10, -1, 2, 0 ; -1, 11, -1, 3 ; 2, -1, 10, -1 ; 0, 3, -1, 8]
```

```
b = [6 , 25, -11, 15]
```

```
A = [10, -1, 2, 0 ; -1, 11, -1, 3 ; 2, -1, 10, -1 ; 0, 3, -1, 8]
```

```
A = 4×4
    10    -1     2     0
    -1    11    -1     3
     2    -1    10    -1
     0     3    -1     8
```

```
b = [6 , 25, -11, 15]
```

```
b = 1×4
     6    25   -11    15
```

```
x = A \ b'
```

```
x = 4×1
    1.0000
    2.0000
   -1.0000
    1.0000
```

```
x0 = [3 ; 5 ; 7 ; 9]
```

```
x0 = 4×1
     3
     5
     7
     9
```

```
[x, i] = maximoDescenso(A, b', x0)
```

```
x = 4×1
    1.0000
    2.0000
   -1.0000
    1.0000
i = 41
```

```
[x, i] = gradienteConjugado(A, b', x0)
```

```
x = 4×1
     1
     2
    -1
     1
i = 5
```

Escribe aquí tus funciones de descenso máximo y gradiente conjugado

```
function posDef = esPositivaDefinida(A)
    [m, n] = size(A);
    posDef = m == n && issymmetric(A) && all(eig(A) > 0);
end

function [x, i] = maximoDescenso(A, b, x)
    if ~esPositivaDefinida(A)
        error('La matriz no es positiva definida.');
    end

    MAX_ITER = 80;
    TOLER = eps;
    r = b - A * x;

    i = 0;
    flag = norm(r) ~= 0;
    while flag
        xp = x;
        alpha = dot(r, r) / (r' * A * r);
```

```
        x = x + alpha * r;
        r = b - A * x;
        i = i + 1;
        flag = norm(r) ~= 0 && norm((x - xp) / x, inf) > TOLER && i < MAX_ITER;
    end
end

function [x, i] = gradienteConjugado(A, b, x)
    if ~esPositivaDefinida(A)
        error('La matriz no es positiva definida.');
    end

    MAX_ITER = 50;
    TOLER = eps;
    r = b - A * x;
    d = r;

    i = 0;
    flag = norm(r) ~= 0;
    while flag
        xp = x;
        rr = dot(r, r);
        alpha = rr / (d' * A * d);
        x = x + alpha * d;
        r = b - A * x;
        d = r + (dot(r, r) / rr) * d;
        i = i + 1;
        flag = norm(r) ~= 0 && norm((x - xp) / x, inf) > TOLER && i < MAX_ITER;
    end
end
```