hw10

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```
In [90]: N = 10
         A = cat(2,
             [2, -1, 0, 0, 0],
             [-1, 2, -1, 0, 0],
             [0, -1, 2, -1, 0],
             [0, 0, -1, 2, -1],
             [0, 0, 0, -1, 2])
         x = [1, 2, 3, 4, 5]
         b = A * x
```

```
Out[90]: 5-element Array{Int64,1}:
          0
          0
          0
          0
          6
```

```
In [91]: function conjugate_gradient(A, x, b, )
             r = b - (A * x)
             d = r
             res_cond =  * norm(b)
             rs = [norm(r)]
             for i in 1:10
                 r_prev = r
                 x_prev = x
                 _cond =  * norm(x)
                 if dot(d, A*d) != 0
                      = dot(d,r) / dot(d, A*d)
                 else
                     return rs, x
                 end
                 x = x + *d
                 r = b - (A * x)
                 if norm(r) < res_cond && norm(x - x_prev) < _cond
                     return rs,x
                 end
                  = dot(r,r) / dot(r_prev, r_prev)
                 d = r + *d
```

```
            push!(rs, norm(r))
        end
        return rs, x
    end
```

```
WARNING: Method definition conjugate_gradient(Any, Any, Any, Any) in module Main at In[85]:2 ove
```

```
Out[91]: conjugate_gradient (generic function with 1 method)
```

```
In [92]: residuals, x = conjugate_gradient(A, collect(1:5), b, .0001)
         println("Residuals: $residuals\nFinal x: $x\nCompleted in $(length(residuals)-1) iterat
```

```
Residuals: [0.0]
Final x: [1,2,3,4,5]
Completed in 0 iterations.
```

```
In [93]: residuals, x = conjugate_gradient(A, zeros(5), b, .0001)
         println("Residuals: $residuals\nFinal x: $x\nCompleted in $(length(residuals)-1) iterat
```

```
Residuals: [6.0,3.0,2.0,1.5,1.2,6.28037e-16]
Final x: [1.0,2.0,3.0,4.0,5.0]
Completed in 5 iterations.
```

```
In [94]: A = cat(2,
             [2,-1,0,-1,0],
             [-1,3,-1,0,-1],
             [0,-1,2,-1,0],
             [-1,0,-1,3,-1],
             [0,-1,0,-1,3])
```

```
Out[94]: 5×5 Array{Int64,2}:
           2  -1   0  -1   0
          -1   3  -1   0  -1
           0  -1   2  -1   0
          -1   0  -1   3  -1
           0  -1   0  -1   3
```

```
In [95]: residuals, x = conjugate_gradient(A, collect(1:5), b, .0001)
         println("Residuals: $residuals\nFinal x: $x\nCompleted in $(length(residuals)-1) iterat
         residuals, x = conjugate_gradient(A, zeros(5), b, .0001)
         println("Residuals: $residuals\nFinal x: $x\nCompleted in $(length(residuals)-1) iterat
```

```
Residuals: [6.55744,1.32075,1.27839,2.29952,0.875979,7.48392e-15]
Final x: [6.0,6.0,6.0,6.0,6.0]
Completed in 5 iterations.
Residuals: [6.0,2.82843,2.42437,1.29625e-14]
Final x: [6.0,6.0,6.0,6.0,6.0]
Completed in 3 iterations.
```