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Problem 1

(a)

```
function [H] = Hessenberg(A, inter)
% If inter = 1, then it prints out all intermediate results during loop
% If inter = 0, it only returns new matrix in Hessenberg form
[~, m] =size(A);

for k=1:m-2
    tmp = eye(m-k); e1 = tmp(:,1);
    x = A(k+1:m,k);
    vk = sign(x(1)) * norm(x) * e1 + x;
    vk = vk / norm(vk);

    A(k+1:m, k:m) = A(k+1:m, k:m) - 2 * vk * (vk'* A(k+1:m, k:m));
    if inter==1
        A
    end
    A(1:m, k+1:m) = A(1:m, k+1:m) - 2 * (A(1:m, k+1:m) * vk) * vk';
    if inter==1
        A
    end
end
H=A;
end
```

For later use, I put an additional input “inter”, which stands for “intermediate?”.

(b)

```
%%%%% Problem 1 %%%%%
% (b) Check the result of my code for A
A = [4,2,2,1,3;
    2,1,3,0,2;
    2,3,1,1,1;
    1,0,1,1,2;
    3,2,1,2,5]

Hessenberg(A, 1);
```

The result is,

```
A =

     4     2     2     1     3
     2     1     3     0     2
     2     3     1     1     1
     1     0     1     1     2
     3     2     1     2     5


A =

    4.0000    2.0000    2.0000    1.0000    3.0000
   -4.2426   -3.2998   -2.8284   -2.1213   -5.4212
   -0.0000    1.6224   -0.8673    0.3204   -1.3776
   -0.0000   -0.6888    0.0664    0.6602    0.8112
   -0.0000   -0.0664   -1.8009    0.9806    1.4336


A =

    4.0000   -4.2426   -0.0000   -0.0000   -0.0000
   -4.2426    7.2222    0.5426   -0.4358   -0.3646
   -0.0000    0.5426   -1.2132    0.1474   -1.8965
   -0.0000   -0.4358    0.1474    0.7007    0.9328
   -0.0000   -0.3646   -1.8965    0.9328    1.2903

A =

    4.0000   -4.2426   -0.0000   -0.0000   -0.0000
   -4.2426    7.2222    0.5426   -0.4358   -0.3646
   -0.0000   -0.7857    0.0395    0.7198    2.4260
   -0.0000         0   -0.2636    0.5129   -0.4854
   -0.0000         0   -2.2404    0.7757    0.1038


A =

    4.0000   -4.2426   -0.0000   -0.0000   -0.0000
   -4.2426    7.2222   -0.7857    0.0000    0.0000
   -0.0000   -0.7857    1.4978    0.2413    2.0257
   -0.0000         0    0.2413    0.3472   -0.6240
   -0.0000         0    2.0257   -0.6240   -1.0672


A =

    4.0000   -4.2426   -0.0000   -0.0000   -0.0000
   -4.2426    7.2222   -0.7857    0.0000    0.0000
   -0.0000   -0.7857    1.4978    0.2413    2.0257
   -0.0000         0   -2.0400    0.5786    1.1336
   -0.0000         0         0   -0.4186    0.4934


A =

    4.0000   -4.2426   -0.0000    0.0000    0.0000
   -4.2426    7.2222   -0.7857   -0.0000   -0.0000
   -0.0000   -0.7857    1.4978   -2.0400         0
   -0.0000         0   -2.0400   -1.1940   -0.4404
   -0.0000         0         0   -0.4404    0.4740
```

From the above results, we can observe the input matrix A gradually have transformed into Hessenberg form.