```
function [] = Hessian()
clear all; close all;
disp('=======================================');
disp('      HESSIAN BY FINITE DIFFERENCES Assignment1 Q5    ');
disp('      AML 771 Desgin Opimization and Decision Theory  ');
disp('      Student: Debjit Hore      ');
disp('=======================================');

     N = 3; epsilon = 0.01;
%    ===== READ POINT
     X(1:N) = [1 2 3];             % Initial vector
     [F] = GETFUN(X);
     F0 = F;
     [H] = HESIAN(X);
%     ----- CENTRAL DIFFERNCE FOR DIAGONAL
%           FORWARD DIFF. FOR OFF DIAGONAL
     for I = 1: N
    A1 = X(I);
    D1 = epsilon;
    if (X(I) ~= 0)
      D1 = epsilon * abs(X(I));
       end
    X(I) = X(I) - D1;
    [F] = GETFUN(X);
    F1 = F;
    X(I) = A1;
    X(I) = X(I) + D1;
    [F] = GETFUN(X);
    F2 = F;
    X(I) = A1;
    HA(I, I) = (F1 - 2 * F0 + F2) / (D1 * D1);
    if (I < N)
      for J = I + 1 : N
        HA(I, J) = F0 - F2;
        A2 = X(J);
        D2 = epsilon;
        if (X(J) ~= 0)
       D2 = epsilon * abs(X(J));
           end
        X(J) = X(J) + D2;
        [F] = GETFUN(X);
        HA(I, J) = HA(I, J) - F;
        X(I) = X(I) + D1;
        [F] = GETFUN(X);
        HA(I, J) = HA(I, J) + F;
        X(I) = A1;
        X(J) = A2;
        HA(I, J) = HA(I, J) / (D1 * D2);
        HA(J, I) = HA(I, J);
         end
      end
     end
```

```
     disp('  ')
     disp('HESSIAN')
% ---PRINT RESULTS
     H
     disp('APPROXIMATE HESSIAN')
     HA


     function [F] = GETFUN(X)
%    ===== DEFINE FUNCTION
     F = X(1)^3 * X(2) + X(2)^3 * X(3) + X(3)^2 * X(1)^2;
     F = 2*X(1)^2 + 5*X(2)^2 + 3*X(3)^2 -2*X(1)*X(2)-4*X(2)*X(3);

     function [H] = HESIAN(X)
%    ===== HESSIAN
     H(1, 1) = 4 ;
     H(1, 2) = -2;
     H(1, 3) = 0;
     H(2, 1) = -2;
     H(2, 2) = 10;
     H(2, 3) = -4;
     H(3, 1) = 0;
     H(3, 2) = -4;
     H(3, 3) = 6;
```

```
========================================
      HESSIAN BY FINITE DIFFERENCES Assignment1 Q5
      AML 771 Desgin Opimization and Decision Theory
      Student: Debjit Hore
========================================

HESSIAN

H =

     4    -2     0
    -2    10    -4
     0    -4     6

APPROXIMATE HESSIAN

HA =

    4.0000   -2.0000         0
   -2.0000   10.0000   -4.0000
         0   -4.0000    6.0000
```

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