Homework 3
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1.

2.

3.

```
 function [inform, x] = DoglegTR(fun, x, trparams)
numf = 0;
numg = 0;
numH = 0;
delta_cur = trparams.Delta0;

x.f = feval(fun, x.p, 1);
x.g = feval(fun, x.p, 2);
if norm(x.g) <= trparams.toler
    inform.status = 0;
    return
end
x.h = feval(fun, x.p, 4);
[v,d] = eig(x.h);
for i = 1 : size(d,1)
    d(i,i) = max(d(i,i),trparams.delta);
end
x.h = v' * d * v;

for ite = 1 : trparams.maxit
    inform.iter = ite;
    %% update with dogleg
    p_B = - x.h^(-1) * x.g;
    p_u = - (x.g' * x.g * x.g )  / (x.g' * x.h * x.g);
    if norm(p_B) <= delta_cur
        p_hat = p_B;
    elseif norm(p_u) >= delta_cur
        p_hat = p_u * delta_cur / norm(p_u);
    else
        a = 1.0 * norm(p_B-p_u).^2;
        b = 1.0* 2 *  p_u' * (p_B -p_u);
        c = 1.0 * norm(p_u).^2 - delta_cur.^2;
        tao1 =  (-b + sqrt(b*b - 4*a*c)) / (2*a);
        tao2 =  (-b - sqrt(b*b - 4*a*c)) / (2*a);
        if 0 <= tao1 && tao1 <= 1
            tao = tao1;
        else
            tao = tao2;
        end
        p_hat = p_u + (tao) * (p_B - p_u);
    end
    p_neo = p_hat;

    next_f = feval(fun, x.p+p_neo,1);
    rho_cur = 1.0 * (x.f - next_f) / -(x.g' * p_neo + 0.5 *
       p_neo' * x.h * p_neo );
    if rho_cur < 0.25
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47          delta_next = 0.25 * delta_cur;
48      elseif rho_cur > 0.75 && norm(p_neo) == delta_cur
49          delta_next = min(2*delta_cur,  trparams.hatDelta);
50      else
51          delta_next = delta_cur;
52      end
53      delta_cur = delta_next;
54
55      if rho_cur > trparams.eta
56          x.p = x.p + p_neo;
57          x.f = next_f;
58          x.g = feval(fun, x.p, 2);
59         %% check if stopping criteria meets
60          if norm(x.g) <= trparams.toler
61              inform.status = 1;
62              return
63          end
64          x.h = feval(fun, x.p, 4);
65          [v,d] = eig(x.h);
66          for i = 1 : size(d,1)
67              d(i,i) = max(d(i,i),trparams.delta);
68          end
69          x.h = v' * d * v;
70      end
71      fprintf(1, ' iter %3d: f=%12.5e, ||Df||=%12.5e, Delta=%7.2e
           \n', inform.iter, x.f, norm(x.g), delta_cur);
72
73
74  end
75
76  inform.status = 0;
77  inform.iter = trparams.maxit;
78
79  return;
```

4. Results are show below:

```
Success: 1 steps taken
  Ending point:       -0.5        0.5
  Ending function value:       -1.5
  No. function evaluations: 2, No. gradient evaluations 2
  Norm of ending gradient:          0


 iter   1: f= 2.24365e+00, ||Df||= 3.12576e+00, Delta=2.00e+00
Success: 2 steps taken
  Ending point:   0.586667 -0.0346667
  Ending function value:  -0.362667
  No. function evaluations: 3, No. gradient evaluations 3
  Norm of ending gradient: 1.83103e-15


 iter   1: f= 4.73188e+00, ||Df||= 4.63943e+00, Delta=1.00e+00
 iter   2: f= 4.73188e+00, ||Df||= 4.63943e+00, Delta=2.50e-01
 iter   3: f= 4.30204e+00, ||Df||= 4.83210e+00, Delta=2.50e-01
 iter   4: f= 3.86090e+00, ||Df||= 5.22502e+00, Delta=5.00e-01
 iter   5: f= 3.21731e+00, ||Df||= 1.97064e+01, Delta=5.00e-01
 iter   6: f= 2.52328e+00, ||Df||= 1.07888e+01, Delta=5.00e-01
 iter   7: f= 2.09298e+00, ||Df||= 1.55424e+01, Delta=5.00e-01
 iter   8: f= 1.49705e+00, ||Df||= 4.01627e+00, Delta=5.00e-01
 iter   9: f= 1.49705e+00, ||Df||= 4.01627e+00, Delta=1.25e-01
 iter  10: f= 1.21110e+00, ||Df||= 2.79973e+00, Delta=2.50e-01
 iter  11: f= 1.01835e+00, ||Df||= 1.09569e+01, Delta=2.50e-01
 iter  12: f= 6.09689e-01, ||Df||= 1.50983e+00, Delta=2.50e-01
 iter  13: f= 4.98802e-01, ||Df||= 1.09885e+01, Delta=2.50e-01
 iter  14: f= 2.49038e-01, ||Df||= 7.35042e-01, Delta=2.50e-01
 iter  15: f= 1.82226e-01, ||Df||= 8.81567e+00, Delta=2.50e-01
 iter  16: f= 7.61538e-02, ||Df||= 5.16643e-01, Delta=2.50e-01
 iter  17: f= 5.78820e-02, ||Df||= 7.76035e+00, Delta=2.50e-01
 iter  18: f= 1.15444e-02, ||Df||= 1.50137e-01, Delta=2.50e-01
 iter  19: f= 7.89461e-03, ||Df||= 3.86112e+00, Delta=2.50e-01
 iter  20: f= 7.39536e-05, ||Df||= 9.06330e-03, Delta=2.50e-01
 iter  21: f= 5.37405e-07, ||Df||= 3.26586e-02, Delta=2.50e-01
Success: 22 steps taken
  Ending point:   0.999999   0.999999
  Ending function value: 3.49914e-13
  No. function evaluations: 23, No. gradient evaluations 21
  Norm of ending gradient: 6.22373e-07
```