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% Thomas Satterly
% AAE 550
% HW 1, Part II (b)
clear;
close all;
clc;

% Setup problem
aae550.hw1.partII_setup;

rp = 8e2;
maxErr = 1e-3;
err = inf;
fLast = inf;
x0 = [0.4575; 0.4497];
[isValid, gx] = aae550.hw1.checkConstraints(gs, x0);
assert(isValid, 'Starting point not valid!');
cj = ones(size(gsOrig));

minCount = 0;
iterationCount = 0;
j = 0;
while err > maxErr
    j = j + 1;

    % Update constraint coefficients
    dx = 1e-2;
    gradF = [f(x0 + [dx; 0]) - f(x0 - [dx; 0]); ...
             f(x0 + [0; dx]) - f(x0 - [0; dx])] ./ (2 * dx);
    for i = 1:numel(gsOrig)
        gradG = [gsOrig{i}(x0 + [dx; 0]) - gsOrig{i}(x0 - [dx;
0]); ...
                gsOrig{i}(x0 + [0; dx]) - gsOrig{i}(x0 - [0; dx])] ./ (2 *
dx);
        cj(i) = norm(gradF) / norm(gradG);
        gs{i} = @(x) cj(i) * gsOrig{i}(x);
    end

    % Create pseudo-objective function
    objFunc = @(x) aae550.hw1.intPenalty(f, x, rp, gs);

    options = optimoptions(@fminunc, 'Algorithm', 'quasi-newton', ...
        'Display', 'iter', 'PlotFcns', @optimplotfval, ...
        'MaxFunctionEvaluations', 1e5);

    [x_opt, f_opt, exitFlag, output, grad] = fminunc(objFunc, x0,
options);

    % Record values for table
    data(j).minimization = j;
    data(j).rp = rp;
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    data(j).x0 = x0;
    data(j).xOpt = x_opt;
    data(j).fOpt = f(x_opt);
    [isValid, data(j).gx] = aae550.hw1.checkConstraints(gsOrig,
x_opt);
    data(j).iterations = output.iterations;
    data(j).exitFlag = exitFlag;

    [isValid, gx] = aae550.hw1.checkConstraints(gs, x_opt);
    if ~isValid
        disp('Constraints violated!');
        break;
    end
    err = abs(f_opt - fLast);
    fLast = f_opt;
    x0 = x_opt;
    rp = rp * 1.1;

    % Update counters
    minCount = minCount + 1;
    iterationCount = iterationCount + output.iterations + 1; % Oh, so
now Matlab decides to start indecies at 0
end

[~, gx] = aae550.hw1.checkConstraints(gs, x_opt);

% Post data to excel table

% File name
fName = [mfilename('fullpath'), '.xlsx'];

if exist(fName, 'file') == 2
    delete(fName);
end

% Create table column titles
gCell = {};
for i = 1:numel(gs)
    gCell{i} = sprintf('g%d(x_star)', i);
end
xlswrite(fName, {'Minimization', 'r_p', 'x_0', 'x_star', 'f(x_star)',
    gCell{:}, '# of Iterations', 'Exit Flag'}, 'sheet1');

for i = 1:numel(data)
    dataCell = {};
    dataCell{1} = data(i).minimization;
    dataCell{2} = data(i).rp;
    dataCell{3} = num2str(data(i).x0);
    dataCell{4} = num2str(data(i).xOpt);
    dataCell{5} = data(i).fOpt;
    for j = 1:numel(data(i).gx)
        dataCell{end + 1} = data(i).gx(j);
    end
    dataCell{end + 1} = data(i).iterations;

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dataCell{end + 1} = data(i).exitFlag;  
xlswrite(fName, dataCell, 'sheet1', sprintf('A%d', i + 1));  
end
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*Published with MATLAB® R2016a*