最优化第十三次作业

张晋 15091060

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5.22 (a) 由 f 连续可微且严格凸可知:

$$g[x^{(k+1)}] > g[x^{(k)}] + \nabla^2 f(x^{(k)})[x^{(k+1)} - x^{(k)}]$$

于是有:

$$\begin{aligned} {s^{(k)}}^T y^{(k)} &= [x^{(k+1)} - x^{(k)}][g^{(k+1)} - g^{(k)}] && (1) \\ &> [x^{(k+1)} - x^{(k)}]^T \nabla^2 f(x^{(k)})[x^{(k+1)} - x^{(k)}] > 0 && (2) \end{aligned}$$

(b) 设 $f(x) = -x^2 + \frac{7}{4}x - 1$, 其满足 $f(0) = -1, f(1) = -1/4$, 且 $g(x) = -2x + \frac{7}{4}$, $s^{(k)} = 1 - 0 = 1$, $y^{(k)} = g(1) - g(0) = -2$, ${s^{(k)}}^T y^{(k)} = -2 < 0$.

5.23 Matlab 程序结果运行如下，验证了题干命题：

```
step =
    2

x =
    0
    0

ans =
    0

H =
    0.0500  -0.0000
   -0.0000   0.5000
```

代码如下:

```
%  5.23:  精确步长的DFP法
clc;
clear;
N=200;
step=0;
x=[0.1,1]';
H=eye(2);
e=0.000001;
g=gg(x);
G=[20,0;0,2];
while (norm(g)>e && step < N)
    step=step+1;
    p=-H*g;
    s=Alpha(p,g,G)*p;
    y=gg(x+s)-g;
    x=x+s;
    g=gg(x);
    H=H_update(H,s,y);
end
step
x
f(x)
H

function y=f(x)
y=10*x(1)^2+x(2)^2;
end
function y=gg(x)
y=[20*x(1),2*x(2)]';
end
function h=H_update(H,s,y)
h=H+(s*s')/(s'*y)-(H*y*y'*H)/(y'*H*y);
end
function a=Alpha(p,g,G)
a=-(p'*g)/(p'*G*p);
a=double(a);
end
```