

Ren Nilsson - 10783 - Compulsory Assignment

Contents

- Exercise 1
- Exercise 2
- Exercise 3
- SECTION TITLE

Exercise 1

Optimization using the simplex method:

```
% The augmented matrix:
clc; clear;
A = [1  2  0  1  0  0  0  28;
     2  0  4  0  1  0  0  16;
     0  1  1  0  0  1  0  12;
    -2 -5 -3  0  0  0  1  0]
```

A =

1	2	0	1	0	0	0	28
2	0	4	0	1	0	0	16
0	1	1	0	0	1	0	12
-2	-5	-3	0	0	0	1	0

We want to bring x_2 in, since $A(4,2) < A(4,3) < A(4,1)$, and thus increases $A(4,8)$ the most. The pivot row should be $A(3,2)$, since

$$\frac{A(3,8)}{A(3,2)} = 12 < \frac{A(1,8)}{A(1,2)} = 14$$

```
A(1,:) = A(1,:)-2*A(3,:);
```

```
A(4,:) = A(4,:) + 5*A(3,:)
```

A =

1	0	-2	1	0	-2	0	4
2	0	4	0	1	0	0	16
0	1	1	0	0	1	0	12
-2	0	2	0	0	5	1	60

Next, we bring in x_1 , since $A(4, 1)$ is the only negative value in $A(4, :)$. $A(1, 1)$ is the new pivot, since

$$\frac{A(1, 8)}{A(1, 1)} = 4 < \frac{A(2, 8)}{A(2, 1)} = 8$$

$A(2, :) = A(2, :) - 2 * A(1, :);$

$A(4, :) = A(4, :) + 2 * A(1, :)$

A =

1	0	-2	1	0	-2	0	4
0	0	8	-2	1	4	0	8
0	1	1	0	0	1	0	12
0	0	-2	2	0	1	1	68

Last, we bring in x_3 , with pivot $A(2, 3)$, since $A(1, 3)$ is negative and

$$\frac{A(2, 8)}{A(2, 1)} = 1 < \frac{A(3, 8)}{A(3, 1)} = 12$$

$A(2, :) = A(2, :)/8;$

$A(1, :) = A(1, :) + 2 * A(2, :);$

$A(3, :) = A(3, :) - A(2, :);$

$A(4, :) = A(4, :) + 2 * A(2, :)$

A =

Columns 1 through 7

1.0000	0	0	0.5000	0.2500	-1.0000	0
0	0	1.0000	-0.2500	0.1250	0.5000	0
0	1.0000	0	0.2500	-0.1250	0.5000	0
0	0	0	1.5000	0.2500	2.0000	1.0000

Column 8

6.0000
1.0000
11.0000
70.0000

Thus the maximum of the problem is 70, which is achieved when $x_1 = 6$, $x_2 = 1$ and $x_3 = 11$.

Exercise 2

Minimizing the function $f(x) = x_1^2 + 3 * x_2^2 - 2 * x_1 * x_2 + 3 * x_2$. 1. Write f on the form: $\frac{1}{2} * x^T * Q * x - x^T * b$:

Q = [2 -2;-2 6]
b = [0;-3]

Q =

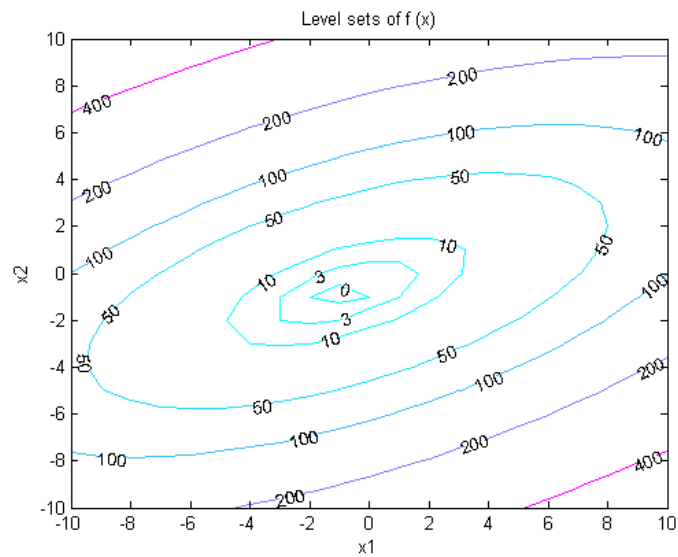
2 -2
-2 6

b =

0
-3

2. Sketch the levels set for f and the gradient of f in the point $(1,1)^T$ in a x_1, x_2 -coordinate system.

```
[x1, x2] = meshgrid(-10:1:10,-10:1:10);
x = [x1;x2];
f1 = x1.^2+3*x2.^2-2*x1.*x2+3*x2;
[C,h1] = contour(x1,x2,f1,[0 3 10 50 100 200 400]);
set(h1,'ShowText','on','TextStep',get(h1,'LevelStep')*2)
colormap cool
title('Level sets of f (x)')
xlabel('x1')
ylabel('x2')
```



Gradient of f in the point $(1, 1)^T$:

$$g_1 = Q * [1; 1] - b$$

$$g_1 =$$

$$\begin{pmatrix} 0 \\ 7 \end{pmatrix}$$

3. Find all point satisfying the FONC. Do these points satisfy the SONC?

The gradient of f is found to be:

$$f'(x) = Q * x - b$$

Finding the point satisfying the FONC equals solving the following:

$$Q * x - b = 0$$

This gives the following point:

$$x = \text{inv}(Q) * b$$

x =

-0.7500
-0.7500

The Hessian is found to be $F(x) = Q$. Thus, the SONC is to test whether $Q > 0$:

```
format short  
eigs(Q)
```

ans =

6.8284
1.1716

Since $Q > 0$ then the SONC is satisfied in all points satisfying the FONC.

4. Find the minimum of f over R^2

Since both the FONC and SOSC is satisfied by the previous point, this is the global minimum:

x

x =

-0.7500
-0.7500

Exercise 3

$$x^2 + e^{\pi i}$$

MONOSPACED TEXT

ITALIC TEXT

BOLD TEXT

SECTION TITLE

DESCRIPTIVE TEXT

PREFORMATTED
TEXT

```
for x = 1:10
    disp(x)
end
```

$$e^{\pi i} + 1 = 0$$