

$$1. \begin{cases} \min -x_1 + x_2^2 \\ -x_1^2 - x_2^2 + 4 \leq 0 \end{cases}$$

```
close all; clc; clear;
matlab.lang.OnOffSwitchState = 1;
```

a) Is it a convex optimization problem?

```
H = [0 0
      0 2];

fprintf("f(x): \n");
```

f(x):

```
fprintf("%i\n", eig(H));
```

```
0
2
```

```
H_constraint = [-2 0
                 0 -2];

fprintf("g(x): \n");
```

g(x):

```
fprintf("%i\n", eig(H_constraint));
```

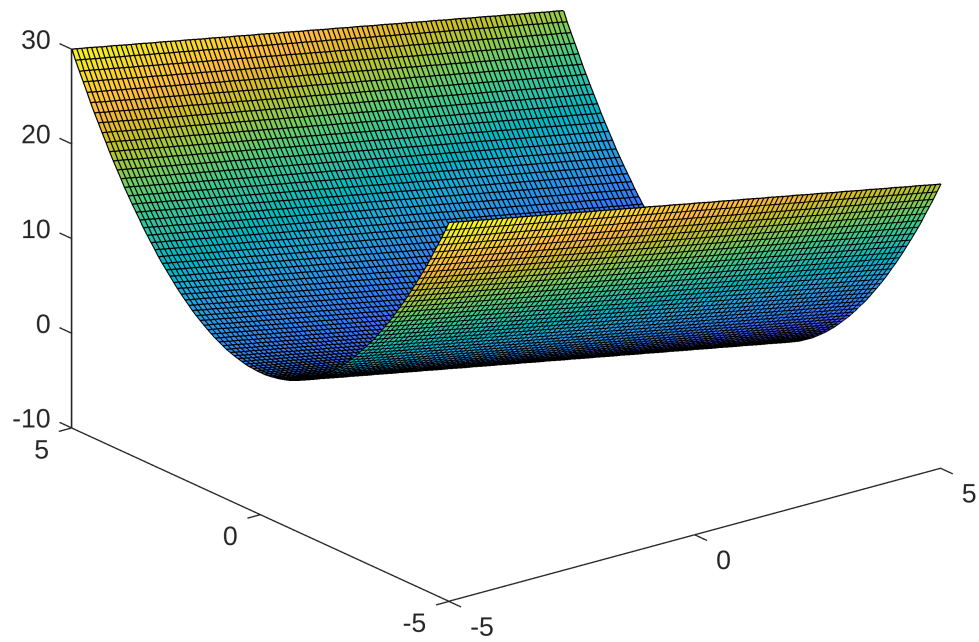
```
-2
-2
```

```
steps = 0.1;
x1 = -5:steps:5;
x2 = -5:steps:5;

[X1, X2] = meshgrid(x1,x2);

X3 = -X1+X2.^2;

surface(X1,X2,X3);
view(3);
```



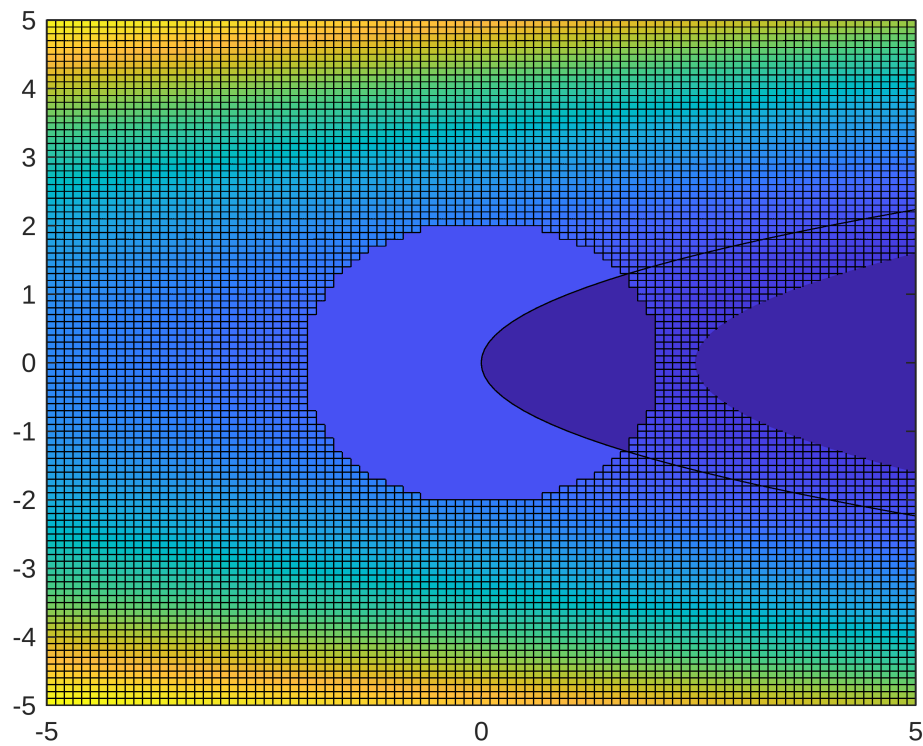
```
contourf(X1,X2,X3);

conditions = zeros(size(X3));
conditions = (-X1.^2-X2.^2+4<=0)
```

```
conditions = 101x101 logical array
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1 ...
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
    ⋮
```

```
X3(conditions == 0) = NaN;

surface(X1,X2,X3);
view(2);
```



- b) Do global optimal solutions exist? Why?
- c) Does the Abadie constraints qualification hold? Why?
- d) Find all the solutions of the KKT system associated with the problem.
- e) Find local and global optimal solutions exploiting the optimality conditions.
- f) Write the Lagrangian dual problem and try to solve it.