

Problem E8.8

```
syms x1 x2 real
X = [x1; x2];
f = 0.5*X'*[3 -2;-2 0]*X + [4 4]*X + 2;
```

i.

```
g = gradient(f, X)
```

g =

$$\begin{pmatrix} 3x_1 - 2x_2 + 4 \\ 4 - 2x_1 \end{pmatrix}$$

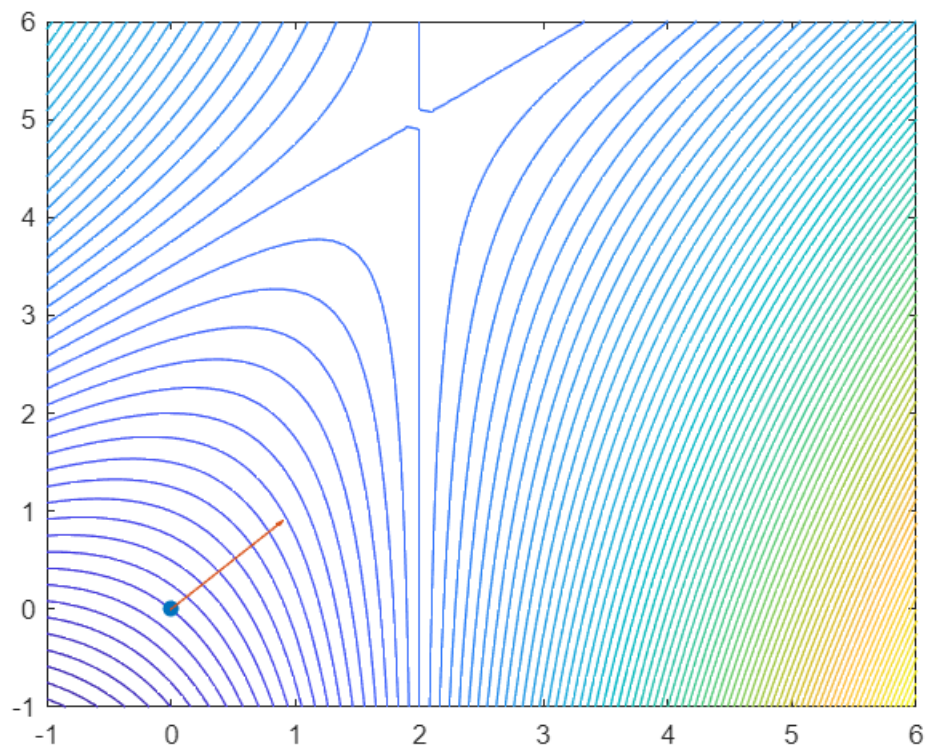
```
h = hessian(f, X)
```

h =

$$\begin{pmatrix} 3 & -2 \\ -2 & 0 \end{pmatrix}$$

ii.

```
fcontour(f, [-1 6 -1 6], 'LevelStep', 1)
hold on
scatter(0, 0, "filled")
quiver(0, 0, 1, 1)
hold off
```



iii.

We will use the formulation presented in the textbook:

directional derivative of (F) at x_0 in direction (p) : $\frac{p^T \nabla F(x)}{\|p\|}$

```
p = [1; 1];
x_0 = [0; 0];
dirderiv = (p'*subs(g,[x1; x2], x_0))/norm(p)
```

```
dirderiv = 4 √2
```

iv.

Indeed, the vector $[1 \ 1]^T$ is not tangent to the contours at x_0 (as displayed above) and therefore the directional derivative is non-zero.