HW5

Exercise 25.6

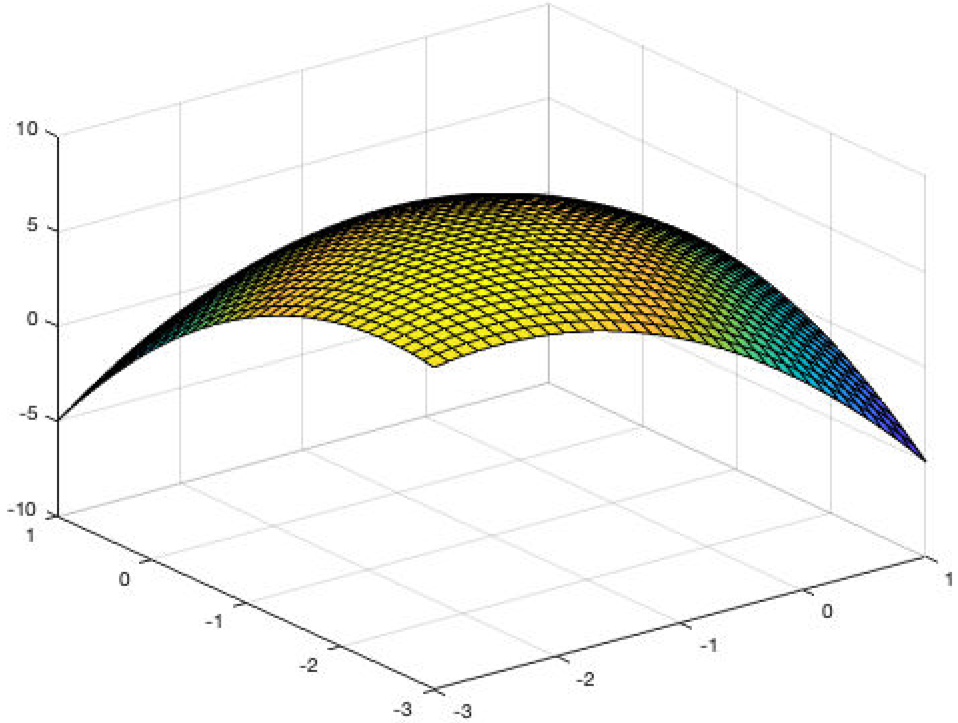
```
xyinterval = [-3, 1]
```

```
xyinterval = 1×2
    -3     1
```

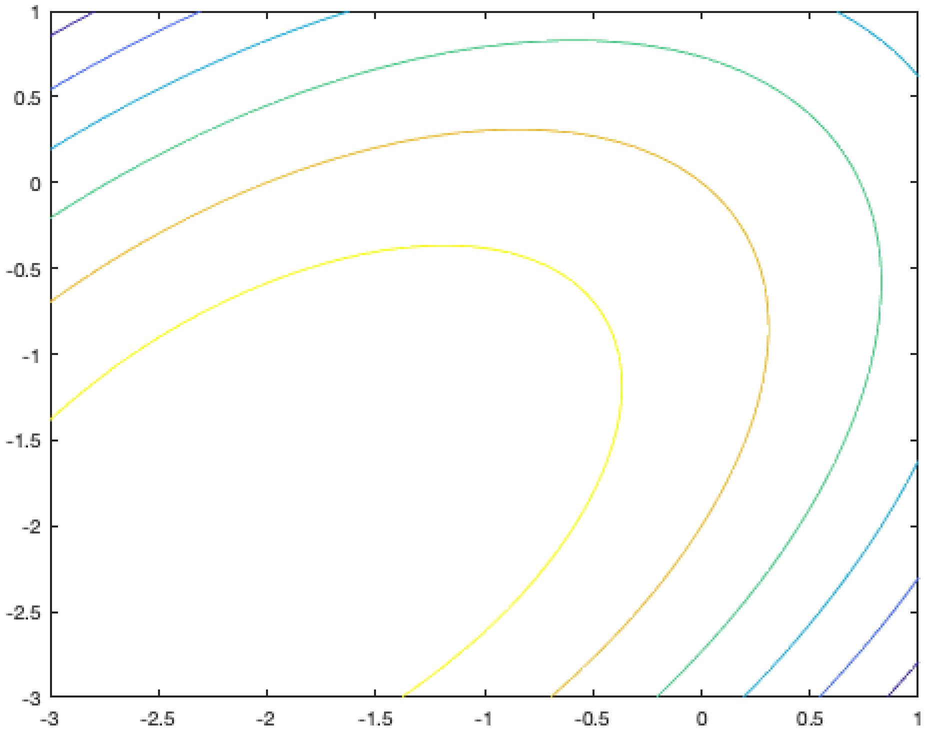
```
d = 0.235; % m, diameter of the neato
syms f(x,y) r(i) lambda(i) sigma
f(x,y) = (x * y) - x^2 - y^2 - (2 * x) - (2 * y) + 4
```

f(x, y) = $-x^2 + x\,y - 2\,x - y^2 - 2\,y + 4$

```
figure(1); clf;
fsurf(f, xyinterval)
zlim([-10, 10])
```



```
%%% Exercise 25.6.1
figure(2); clf;
fcontour(f, xyinterval)
```

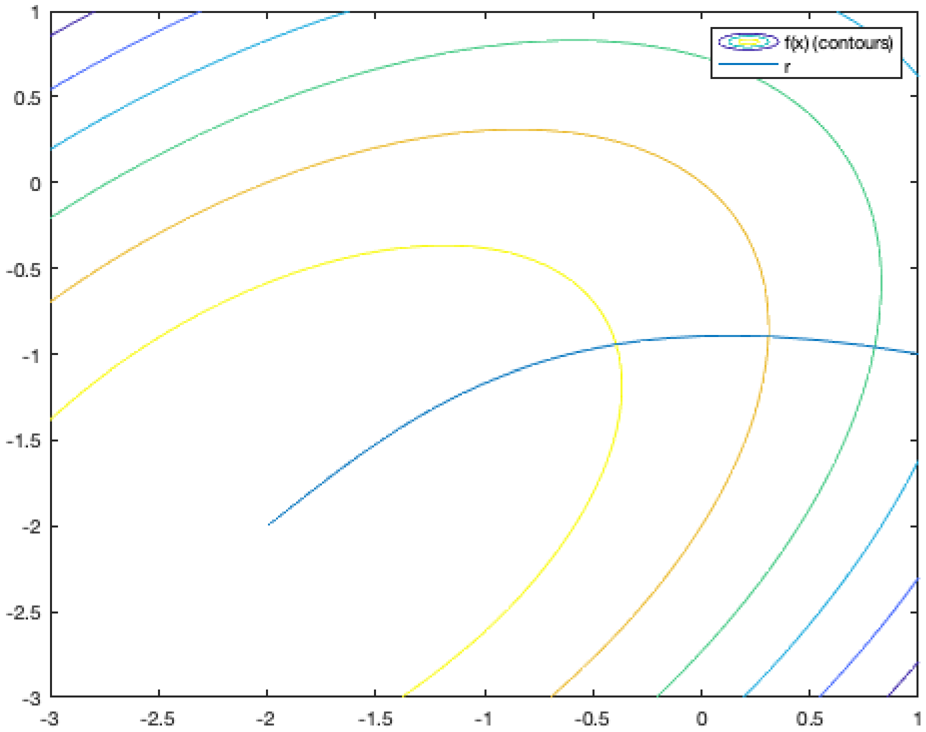


```
%%% Exercise 25.6.2 is drawn in OneNote

%%% Exercise 25.6.3
grad = matlabFunction([diff(f, x); diff(f, y)])
```

```
grad = function_handle with value:
    @(x,y)[x.*-2.0+y-2.0;x-y.*2.0-2.0]
```

```

%%% Exercise 25.6.4
r_0 = [1, -1];

grad(r_0(1), r_0(2)); % Gradient at r(0)


%%% Calculate the path

% These values were chosen experimentally
dtdi = 1; % every i is this many seconds
i_max = 200; % We'll calculate this many time steps. It may take fewer to reach the pea
sigma = 1;
lambda_0 = 0.05;
rs = zeros(i_max, 2);
lambdas = zeros(i_max, 1);

rs(1, :) = r_0;
lambdas(1) = lambda_0;
```

```
for i=2:i_max
    lambdas(i) = lambdas(i − 1) .∗ sigma;
    gradient = grad(rs(i − 1, 1), rs(i − 1, 2))';
    rs(i, :) = rs(i − 1, :) + (lambdas(i − 1) .∗ gradient);
end

figure(3); clf;
fcontour(f, xyinterval); hold on; % draw the contours again
plot(rs(:, 1), rs(:, 2)); legend("f(x) (contours)", "r"); hold off;
```



```
%%% Exercise 25.6.5

% To figure out the needed turning, we need to calculate the tangent line at i = 0
% I think there's a better, linear algebra way to do this
drs = diff(rs);
dts = ones(size(drs)) ∗ dtdi;
vs = drs ./ dts;
thetas = atan(vs(:, 2) ./ vs(:, 1)) + pi;
theta_0 = pi / 2;

dtheta_0 = thetas(1) − theta_0;

fprintf("If the Neato started at (1, −1) pointing in the +Y direction, you'd need to r
```

```
If the Neato started at (1, −1) pointing in the +Y direction, you'd need to rotate it 1.37 radians CCW to
```

```
max_speed = 0.1; % m/s, max wheel velocity
max_omega = max_speed ∗ (2 / d) % max rotational speed for given wheel velocity
max_omega = 0.8511
```

```
t_to_align = dtheta_0 / max_omega
```

```
t_to_align = 1.6137
```

```
%%% Exercise 25.6.6
speeds = vecnorm(vs, 2, 2)
```

```
speeds = 199×1
    0.2550
    0.2249
    0.1995
    0.1780
    0.1598
    0.1443
    0.1312
    0.1199
    0.1102
    0.1018
      ⋮
```