**Lab #9 – Three Dimensional Plots**

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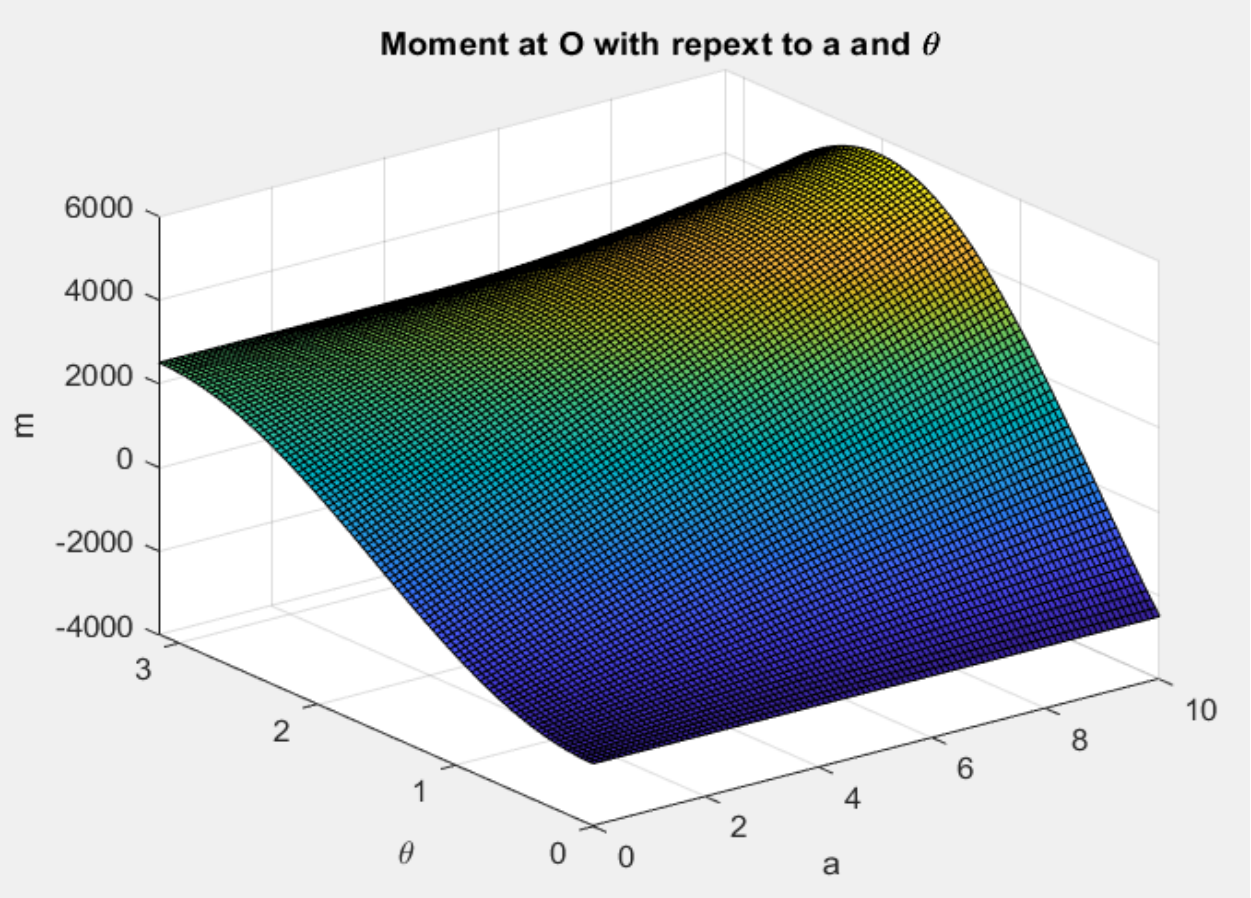
2) Moment Calculation (easier): Consider the situation shown in the figure to the right. Plot the variation of the moment about the base point O caused by the force $F$ as a function of length $a$ and angle $\theta$. It is known that $F$ = 500 N, $b$ = 5 m and $a \leq 10$ m.

$$M_O(a, \theta) = 500(a \sin \theta - 5 \cos \theta)$$

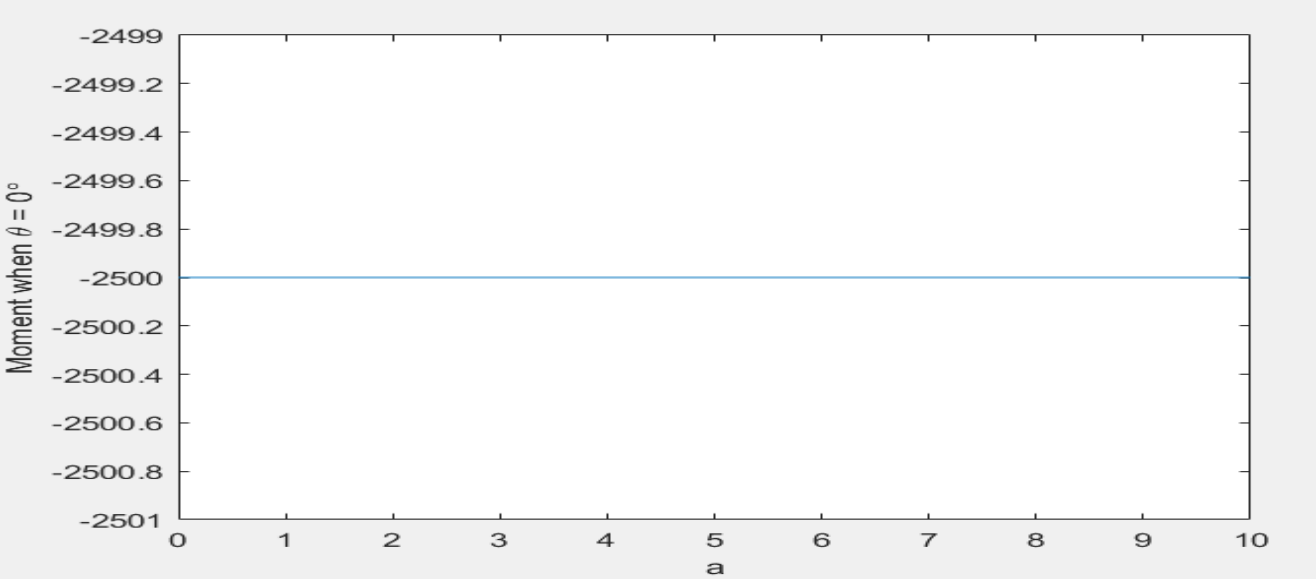
a) Use a 3D plot to visualize how this moment at $O$ changes with respect to $a$ and $\theta$.

```
F = 500;
domain_a = linspace(0,10,101);
domain_theta = linspace(0,pi,101);

[a,theta] = meshgrid(domain_a,domain_theta);

m = F.*(a.*(sin(theta))-5.*(cos(theta)));

surf(a,theta,m);
xlabel('a'); ylabel('\theta'); zlabel('m');
title('Moment at O with repext to a and \theta');
```



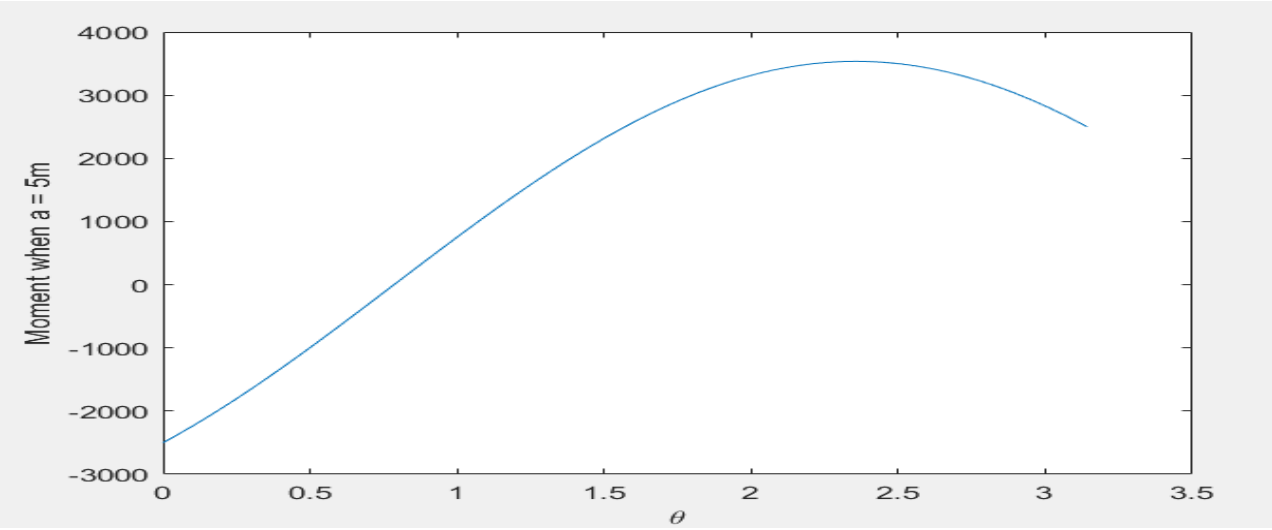
b) Generate three 2D plots that represent the following cases
i. $MO$ ($a$, 0°)

```
figure()
plot(domain_a,m(1,:));
xlabel('a'); ylabel('Moment when \theta = 0\circ')
```



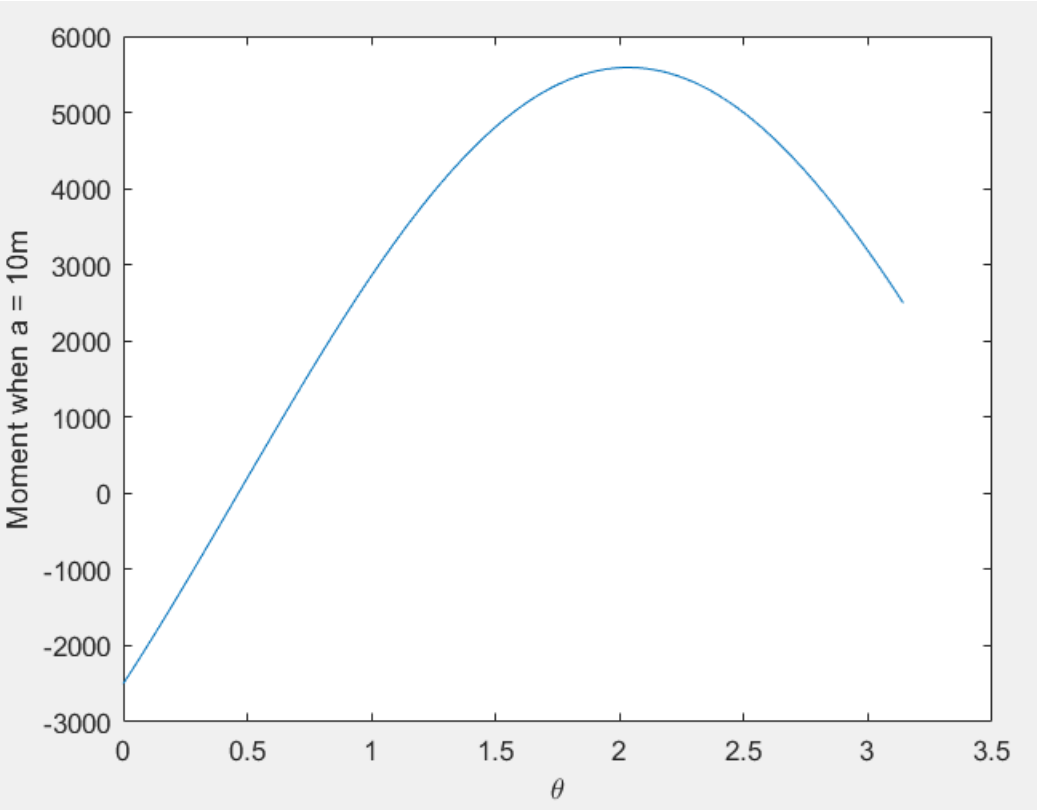

ii. $MO$ (5 m,$\theta$)

```
figure()
plot(domain_theta,m(:,51));
xlabel('\theta'); ylabel('Moment when a = 5m');
```



iii) $MO$ (10 m,$\theta$)

```
figure()
plot(domain_theta,m(:,101));
xlabel('\theta'); ylabel('Moment when a = 10m');
```




c) Use the `min` and `max` commands to find the maximum and minimum values of $Mo(a,\theta)$, and the points $(a,\theta)$, where these occur.

```
[Max,maxIndex] = max(m())
[Min,minIndex] = min(m())
[Max,maxColIndex] = max(transpose(m))
[Min,minColIndex] = min(transpose(m))
```

Max value of $MO(a,\theta)$ = 5583 Nm occurs at (10,116 degrees)

Min value of $MO(a,\theta)$ = -2500 Nm occurs at (:, 0 degrees)

d) A brief description, in your own words, of what the function "meshgrid" does

The meshgrid function creates a matrix in which each possible combination of each value of each variable is utilized to solve the equation.

e) A brief description about why your plots make sense.

The plots make sense since they demonstrate the relationships and patterns for each of the critical points of the graph. For instance, when theta is 0, we know that the Moment will always yield -2500 Nm since $\sin 0 = 0$ and $\cos 0 = 1$. For all critical points similar reasoning backs the graphs.