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Sums of Squares (SOS)

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0.0/10.0 points (graded)

Consider the polynomial:

$$p(x_1, x_2) = 2x_1^4 + 2x_1^3x_2 - x_1^2x_2^2 + 5x_2^4.$$

Prove that this polynomial is nonnegative by finding a representation as follows:

$$p(x_1, x_2) = \begin{bmatrix} x_1^2 \\ x_2^2 \\ x_1x_2 \end{bmatrix}^T Q \begin{bmatrix} x_1^2 \\ x_2^2 \\ x_1x_2 \end{bmatrix},$$

where Q is given by:

$$Q = \begin{bmatrix} 2, & a, & 1 \\ a, & 5, & 0 \\ 1, & 0, & b \end{bmatrix}.$$

Here Q must be positive semidefinite. Type in your values for a and b below. **Make sure that the resulting Q is positive semidefinite.**

```
1 a = ;
2 b = ;
3
```

Unanswered

```
% First, we denote  $v = [x_1^2; x_2^2; x_1x_2]$ . Then, we have:  
%  $v'Qv = 2x_1^3x_2 + 2x_1^4 + 5x_2^4 + 2ax_1^2x_2^2 + bx_1^2x_2^2$ .  
% Since we want  $v'Qv$  to equal  $p(x_1, x_2)$ , we must have  $2a + b = -1$  and  
% hence,  $b = -1 - 2a$ . Thus, we can write  $Q$  as:  
%  $Q = \begin{bmatrix} 2 & a & 1 \\ & a & 5 \\ & 1 & 0 \end{bmatrix} (-1-2a)$ ];  
% Now, all we need to do is choose an  $a$  such that  $Q$  is positive semidefinite.  
% One such choice is  $a = -1, b = 1$   
  
 $a = -1;$   
 $b = 1;$ 
```

Run Code

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You have used 0 of 2 attempts

i Answers are displayed within the problem

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