4.6.1 Homework

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Homework 4.6.1.1

1/1 point (graded)

Let $A \in \mathbb{R}^{m \times n}$ and $x \in \mathbb{R}^n$. Then $(Ax)^T = x^T A^T$.

Always ▼ ✔

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✔ Correct (1/1 point)

Homework 4.6.1.2

1 point possible (graded)

Our laff library has a routine

```
laff_gemv( trans, alpha, A, x, beta, y )
```

that has the following property

- `y = laff_gemv( 'No transpose', alpha, A, x, beta, y)` computes $y := \alpha A x + \beta y$.
- `y laff_gemv( 'Tramsponse', alpha, A, x, beta, y)` computes $y := \alpha A^T x + \beta y$.

The routine works regardless of whether x and/or y are column and/or row vectors. Our library does NOT include a routine to compute $y^T = x^T A$. What call could you use to compute $y^T := x^T A$ if y^T is stored in yt and x^T in xt?

- [ ] `laff_gemv( 'No transpose', 1.0 , A, xt, 0.0, yt)`
- [ ] `laff_gemv( 'No transpose', 1.0 , A, xt, 1.0, yt)`
- [ ] `laff_gemv( 'Transpose', 1.0 , A, xt, 1.0, yt)`
- [ ] `laff_gemv( 'Transpose', 1.0 , A, xt, 0.0, yt)` ✔

Answer: `laff_gemv( 'Transpose', 1.0, A, xt, 0.0, yt )` computes $y := A^T x$, where y is stored in `yt` and x is stored in `xt`.

To understand this, transpose both sides: $y^T = (A^T x)^T = x^T {A^T}^T = x^T A$.

For this reason, our `laff` library does not include a routine to compute $y^T := \alpha x^T A + \beta y^T$.

You will need this next week!!!

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Answers are displayed within the problem

Homework 4.6.1.3

12/12 points (graded)

Let $A = \begin{pmatrix} 1 & -1 \\ 1 & -1 \end{pmatrix}$. Compute

$A^2 =$

0 ✔	0 ✔
0 ✔	0 ✔

$A^3 =$

0 ✔	0 ✔
0 ✔	0 ✔

For $k > 1$, $A^k =$

0 ✔	0 ✔
0 ✔	0 ✔

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✔ Correct (12/12 points)

Homework 4.6.1.4

16/16 points (graded)

Let $A = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$. Compute

$A^2 =$

1 ✔	0 ✔
0 ✔	1 ✔

$A^3 =$

0 ✔	1 ✔
1 ✔	0 ✔

For $k \geq 0$, $A^{2k} =$

1 ✔	0 ✔
0 ✔	1 ✔

For $k \geq 0$, $A^{2k+1} =$

0	1
1	0

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Correct (16/16 points)

Homework 4.6.1.5

16/16 points (graded)

Let $A = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$. Compute

$A^2 =$

-1	0
0	-1

$A^3 =$

0	1
-1	0

For $k \geq 0$, $A^{4k} =$

1	0
0	1

For $k \geq 0$, $A^{4k+1} =$

0	-1
1	0

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Correct (16/16 points)

Homework 4.6.1.6

0/1 point (graded)

Let A be a square matrix. If $AA = 0$ (the zero matrix) then A is a zero matrix. (AA is often written as A^2.)

TRUE ▾ **Answer:** FALSE

Answer: False!

$$\begin{pmatrix} 1 & 1 \\ -1 & -1 \end{pmatrix} \begin{pmatrix} 1 & 1 \\ -1 & -1 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}.$$

This may be counter intuitive since if α is a scalar, then $\alpha^2 = 0$ only if $\alpha = 0$.
So, one of the points of this exercise is to make you skeptical about "facts" about scalar multiplications that you may try to transfer to matrix-matrix multiplication.

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Answers are displayed within the problem

Homework 4.6.1.7

0/1 point (graded)

There exists a real value matrix A such that $A^2 = -I$. (Recall: I is the identity)

FALSE ▾ ✖ **Answer:** TRUE

Homework 4.6.1.4 There exists a real valued matrix A such that $A^2 = -I$. (Recall: I is the identity)

True/False

Answer: True! Example: $A = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$.

This may be counter intuitive since if α is a real scalar, then $\alpha^2 \neq -1$.

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Answers are displayed within the problem

Homework 4.6.1.8

1/1 point (graded)

There exists a matrix A that is not diagonal such that $A^2 = I$.

TRUE ▾ ✔ **Answer:** TRUE

Answer: True! An examples of a matrices A that is not diagonal yet $A^2 = I$: $A = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$.

This may be counter intuitive since if α is a real scalar, then $\alpha^2 = 1$ only if $\alpha = 1$ or $\alpha = -1$. Also, if a matrix is 1×1, then it is automatically diagonal, so you cannot look at 1×1 matrices for inspiration for this problem.

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