Name: _____

Student number: _____ Student email: _____

Deadline **December 6th** right before the final exam, 4:30 PM. If you are ASA, drop your file in the main office. (I will not accept the Quiz once the final exam starts).

1 True or False

- For the following questions, write True or False

1. if $\mathbf{B}$ is a symmetric matrix,

$$\frac{\partial \mathbf{x}^\top \mathbf{B}\,\mathbf{x}}{\partial \mathbf{x}} = 2\,\mathbf{B}\,\mathbf{x}$$

Answer:_____

2. For hermitian matrices with real numbers, $\mathbf{A} \neq \mathbf{A}^\dagger$.

Answer:_____

3. The multiplication of two matrices commutes, meaning $\mathbf{A}\,\mathbf{B} = \mathbf{B}\,\mathbf{A}$.

Answer:_____

4. Can we use the gradient to search the maximum of a function?

Answer:_____

5. The half-life time of a second order reaction does not depend on the initial concentration.

Answer:_____

6. For a linear set of equations ($\mathbf{A}\,\mathbf{x} = \mathbf{y}$,) where we have more equations than variables, meaning the matrix $\mathbf{A}$ has $n-$rows and $m-$columns and $n > m$, can we do matrix inversion to solve for $\mathbf{x}$?

Answer:_____

7. Is the matrix $\mathbf{A}$ an orthogonal matrix?

$$\mathbf{A} = \frac{1}{3}\begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ -2 & 2 & 1 \end{pmatrix}$$

Answer:_____

8. Are the eigenvalues of the following matrix $\mathbf{A}$ real?

$$\mathbf{A} = \begin{pmatrix} 1 & i & i-i \\ -i & 0 & -i+1 \\ 1+i & -1-i & 3 \end{pmatrix}$$

Answer:_____

9. Is the following matrix $\mathbf{A}$ a singular martix?

$$\mathbf{A} = \begin{pmatrix} 1 & 2 & 2 \\ 1 & 2 & 2 \\ 3 & 2 & -1 \end{pmatrix}$$

Answer:_____

10. Is $\mathbf{A}^{-1}$ the correct inverse of $\mathbf{A}$?

$$\mathbf{A}^{-1} = \begin{pmatrix} 5 & 2 \\ -7 & -3 \end{pmatrix} \quad \mathbf{A} = \begin{pmatrix} 3 & 2 \\ -7 & 5 \end{pmatrix} \tag{1}$$

Answer:_____

Cont.

2 Pencil and Paper Questions

• Answer the following questions.

1. What is the following derivative equal to

$$\frac{\partial(\mathbf{x}^\top \mathbf{a})^\top}{\partial \mathbf{x}} = ?$$

Answer:_____

2. What is the following derivative equal to when $\mathbf{W}$ is a symmetric matrix?

$$\frac{\partial \left((\mathbf{x}-\mathbf{s})^\top \mathbf{W}(\mathbf{x}^\top - \mathbf{s})\right)}{\partial \mathbf{x}}$$

Answer:_____

3. How many rows and columns does the Jacobian of $F(\mathbf{x})$ has?

$$F(\mathbf{x}) = \begin{bmatrix} f_1(x_1, x_2, x_3) \\ f_2(x_1, x_2, x_3) \end{bmatrix}$$

Answer:_____

4. Compute the Taylor expansion of $f(x) = x^3 - 10x^2 + 6$ at $x = 3$.

Answer:_____

5. Let's assume $\mathbf{x}$ is an eigenvector of the matrix $\mathbf{A}$ with the eigenvalue λ.
What is $\mathbf{x}^\top \mathbf{A}\,\mathbf{x}$ equal to ?

Answer:_____

6. What type of matrices have real eigenvalues?

Answer:_____

Cont.

7. Compute the eigenvalues and eigenvectors for the matrix $\mathbf{A}$.

$$\mathbf{A} = \begin{pmatrix} 1 & -2 \\ -2 & 1 \end{pmatrix}$$

Answer:_____

8. What are the eigenvalues and eigenvectors for the matrix $\mathbf{A}$.

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

Answer:_____

9. Explain why for the least square problem we set $\frac{\partial\, \mathcal{L}(\mathbf{w})}{\partial\, \mathbf{w}} = 0$.
$\mathcal{L}(\mathbf{w})$ is the mean square error function.

Answer:_____

10. What is the rate law of a second order reaction, choose the correct option(s).

A) $r = k[\mathrm{A}]^2$
B) $r = k[\mathrm{A}]^{\frac{1}{2}}[\mathrm{B}]^{\frac{1}{2}}[\mathrm{C}]$
C) $r = k[\mathrm{A}]^2[\mathrm{B}]$
D) $r = k[\mathrm{A}][\mathrm{B}]$
E) $r = k[\mathrm{A}]^{\frac{1}{2}}[\mathrm{B}]^{\frac{1}{2}}$

Answer:_____

The End.