

CS583A: Quiz 1 (Sample Questions)

Name:

Policy: Books and printed materials are allowed. Do not use electronic device, including phone, laptop, and tablet.

Hint: (i) $\frac{\partial e^a}{\partial a} = e^a$, (ii) $\frac{\partial \log_e(a)}{\partial a} = \frac{1}{a}$, (iii) $\frac{\partial \frac{1}{a}}{\partial a} = -\frac{1}{a^2}$, (iv) $\frac{\partial a^4}{\partial a} = 4a^3$, and (v) $\frac{\partial \cos(a)}{\partial a} = -\sin(a)$.

Q1 (5%). (Fill in the blank.) What is the output of the following Python program?

Answer: _____

```
1 import numpy
2 a = numpy.array([1, 2, 3, 4, 5])
3 b = numpy.sum(a * a)
4 print(b)
```

Q2 (5%). (Fill in the blank.) What is the output of the following Python program?

Answer: _____

```
1 import numpy
2 a = numpy.random.rand(6, 7) # generate a random matrix
3 b = numpy.random.rand(7, 8) # generate a random matrix
4 c = numpy.dot(a, b)
5 print(c.shape[1])
```

Q3 (12%). (Fill in the blanks.) $\mathbf{a} = [-1, 2, 0, 0, -3]^T$ is a vector. Calculate the following vector norms.

- The squared ℓ_2 norm: $\|\mathbf{a}\|_2^2 =$ _____ .
- The ℓ_1 norm: $\|\mathbf{a}\|_1 =$ _____ .
- The ℓ_∞ norm: $\|\mathbf{a}\|_\infty =$ _____ .

Q4 (16%). (Fill in the blanks.) Let \mathbf{I}_5 be the 5×5 identity matrix. Calculate the following values.

- The largest eigenvalue: $\lambda_{\max}(\mathbf{I}_5) =$ _____ .
- The smallest eigenvalue: $\lambda_{\min}(\mathbf{I}_5) =$ _____ .

- The trace: $\text{tr}(\mathbf{I}_5) = \underline{\hspace{2cm}}$.
- The squared Frobenius norm: $\|\mathbf{I}_5\|_F^2 = \underline{\hspace{2cm}}$.

Q4 (12%). (Fill in the blanks.) $\mathbf{x} = [x_1, x_2, x_3]^T$ is a 3-dimensional vector. What is the derivative of

$$f(\mathbf{x}) = e^{x_1} + x_2^4 + x_2 x_3 + 5 \cos(x_3)$$

w.r.t. the vector \mathbf{x} ? Answer:

$$\frac{\partial f(\mathbf{x})}{\partial \mathbf{x}} = \begin{bmatrix} \underline{\hspace{2cm}} \\ \underline{\hspace{2cm}} \\ \underline{\hspace{2cm}} \end{bmatrix} .$$