Exam Sample 1

Due No due date **Points** 15 **Questions** 15 **Time Limit** 45 Minutes
Allowed Attempts Unlimited

Instructions

This is a sample exam, so you can have an impression of the actual exam quiz part. (There is also an optional second oral part of exam.)

Only one question is visible at once, and after you have submitted your answer to a question, you cannot go back to change your choice. You can start the sample exam as many times you wish. But of course on an actual exam, the quiz may be filled only once. The questions of the sample exam are fixed, but the questions and answers of an actual exam will be randomized.

Please also read the description of the course exam requirements announced separately!

Take the Quiz Again

Attempt History

	Attempt	Time	Score
KEPT	Attempt 5	3 minutes	15 out of 15
LATEST	Attempt 5	3 minutes	15 out of 15
	Attempt 4	24 minutes	14 out of 15
	Attempt 3	44 minutes	11 out of 15
	Attempt 2	44 minutes	5 out of 15
	Attempt 1	2 minutes	4 out of 15

Correct answers are hidden.

Submitted May 31 at 4:58pm

Question 1 1 / 1 pts

What is the value of ε_1 in the set of binary machine numbers $M(5, -3, 3)$?

(A) 2^{-8}
(B) 2^{-4}
(C) 2^{-3}
(D) 2^{-1}

- ○ A
- ◉ B
- ○ C
- ○ D

Question 2

1 / 1 pts

What are the operation counts for Gaussian elimination and back substitution?

(A) $\frac{1}{2}n^3 + \mathcal{O}(n^2)$ and $\frac{1}{2}n^2 + \mathcal{O}(n)$.
(B) $\frac{2}{3}n^3 + \mathcal{O}(n^2)$ and $n^3 + \mathcal{O}(n^2)$.
(C) $\frac{1}{3}n^3 + \mathcal{O}(n^2)$ and $\frac{2}{3}n^2 + \mathcal{O}(n)$.
(D) $\frac{2}{3}n^3 + \mathcal{O}(n^2)$ and $n^2 + \mathcal{O}(n)$.

A

B

C

D

Question 3

1 / 1 pts

What is the half-bandwidth of the below matrix?

$$A = \begin{pmatrix} 4 & 0 & 0 & 0 \\ 1 & 2 & 0 & 0 \\ 0 & 1 & 2 & 1 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

(A) 1
(B) 2
(C) 3
(D) this matrix has no half-bandwidth

A

B

C

D

Question 4

1 / 1 pts

Is this matrix strictly diagonally dominant?

$$A = \begin{pmatrix} 4 & 0 & 1 & 0 \\ -1 & 2 & 1 & 0 \\ 0 & -1 & 3 & 1 \\ 0 & 0 & 0 & 2 \end{pmatrix}$$

(A) Yes, by its rows.
(B) Yes, by its columns.
(C) Yes, both by its rows and its columns.
(D) No, neighter by its rows, nor by its columns.

- ○ A
- ◉ B
- ○ C
- ○ D

Question 5

1 / 1 pts

Which one is not a Lagrange base polynomial given by the support points $0, 1, 2$?

(A) $\dfrac{(x-1)(x-2)}{2}$
(B) $\dfrac{x(x-2)}{2}$
(C) $\dfrac{x(x-1)}{2}$
(D) all three are

A

B

C

D

Question 6

1 / 1 pts

Consider the set of binary machine numbers $M(t, k^-, k^+)$, with its special numbers $M_\infty, \varepsilon_0, \varepsilon_1$. Which below formula is correct?

(A) $M_\infty = 2^{k^+}$
(B) $\varepsilon_0 = 2^{k^-}$
(C) $\varepsilon_1 = 2^{1-t}$
(D) $M_\infty = (1 - 2^t) \cdot 2^{k^-}$

A

B

C

D

Question 7

1 / 1 pts

What is the correct value of S in the formula of the general step of Gaussian elimination?

$$a_{i,j}^{(k)} = a_{i,j}^{(k-1)} + S \cdot a_{k,j}^{(k-1)}$$

(A) $S = -a_{i,k}^{(k-1)}$

(B) $S = -a_{i,k}^{(k-1)} / a_{k,k}^{(k-1)}$

(C) $S = a_{i,k}^{(k-1)} / a_{k,k}^{(k-1)}$

(D) $S = -a_{k,k}^{(k-1)} / a_{i,k}^{(k-1)}$

- A
- B
- C
- D

Question 8

1 / 1 pts

Let $||x||$ denote a fixed vector norm, and $||A||$ the matrix norm induced by this vector norm. Furthermore denote by $||A||_m$ another arbitrary matrix norm. If the inequality $||Ax|| \leq ||A||_m \cdot ||x||$ holds for all x vectors, then which one is true from the below relations?

(A) $||A|| = ||A||_m$

(B) $||A|| \leq ||A||_m$

(C) $||A|| > ||A||_m$

(D) $||A|| \neq ||A||_m$

A

B

C

D

Question 9

1 / 1 pts

Choose the incorrect statement about the condition number of matrices! (A denotes an invertible matrix.)

(A) $\text{cond}(A) \geq 1$
(B) $\text{cond}(cA) = c \cdot \text{cond}(A) \quad (0 \neq c \in \mathbb{R})$
(C) $\text{cond}(A) = \text{cond}(A^{-1})$
(D) If A is symm. pos. def. then $\text{cond}(A) = \frac{\max \lambda_i}{\min \lambda_i}$

A

B

C

D

Question 10

1 / 1 pts

What important property of the function $\varphi(x)$ follows from the below condition?

$$\varphi \in C^1[a,b],\ |\varphi'(x)| < 1 \quad (\forall x \in [a,b])$$

(A) φ is strictly increasing on the interval $[a,b]$
(B) $\exists x^* \in [a,b] : x^* = \varphi(x^*)$
(C) φ is a contraction on the interval $[a,b]$
(D) φ has a root on the interval $[a,b]$

- [ ] A
- [ ] B
- [x] C
- [ ] D

Question 11

1 / 1 pts

Which one of the following iterations may converge in order two (with respect to appropriate conditions)?

(A) $x_{n+1} = x_n - \dfrac{f(x_n)}{f'(x_n)}$

(B) $x_{n+1} = x_{n-1} - \dfrac{f(x_n)\cdot(x_n - x_{n-1})}{(f(x_n) - f(x_{n-1}))}$

(C) $x_{n+1} = \varphi(x_n)$, with φ a contraction and $\varphi'(x^*) \neq 0$

(D) $x_{n+1} = \dfrac{x_n + x_{n-1}}{2}$

A

B

C

D

Question 12

1 / 1 pts

What is the appropriate condition about the starting point of the iteration in the monotone convergence theorem of Newton's method? Given $f \in C^2[a, b]$.

(A) $x_0 \in [a, b]$ arbitrary
(B) $x_0 \in [a, b]$ such that $f(x_0) \cdot f''(x_0) < 0$
(C) $x_0 \in [a, b]$ such that $f(x_0) \cdot f''(x_0) > 0$
(D) $x_0 \in [a, b]$ such that $f(x_0) \cdot f''(x_0) = 0$

A

B

C

D

Question 13

1 / 1 pts

Under the conditions of the error formula of polynomial interpolation, what is not true about the function $g_x(z)$ of the proof?

(A) $g_x \in C^{n+1}[a, b]$
(B) $g_x^{(n+1)}(z) = (n+1)!$
(C) g_x has $n+2$ distinct roots in $[a, b]$
(D) g_x' has a root in $[a, b]$.

- ○ A
- ◉ B
- ○ C
- ○ D

Question 14

1 / 1 pts

Considering the Schur complement $[A|A_{11}]$, which below statement is true about the inheritance of symmetry, provided that the matrix A is symmetric?

(A) A_{12} and A_{21} are symmetric too
(B) $A_{12} = A_{21}^\top$
(C) all blocks of A are symmetric
(D) $[A|A_{11}]^\top = A_{22} - A_{21}^\top A_{11}^{-1} A_{12}^\top$

A

B

C

D

Question 15

1 / 1 pts

Let us consider the 3 point interpolatory quadrature formula

$$\int_0^1 f(x)\,dx \approx A_0 f(x_0) + A_1 f(x_1) + A_2 f(x_2).$$

Which formula is false?

(A) $A_0 + A_1 + A_2 = 1$

(B) $A_0 x_0 + A_1 x_1 + A_2 x_2 = \frac{1}{2}$

(C) $A_0 x_0^2 + A_1 x_1^2 + A_2 x_2^2 = 1$

(D) all the above are true

A

B

C

D