

✓ Congratulations! You passed!

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higher

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1. Using Newton's method, find an approximation recursive formula for $\sqrt{2}$.

1 / 1 point

To help you, remember that $\sqrt{2}$ is the positive solution for $x^2 - 2$, so you can use $f(x) = x^2 - 2$.

- ☐ $x_{k+1} = x_k - \frac{2x_k}{x_k^2 - 2}$
- ☐ $x_{k+1} = \frac{x_k^2 - 2}{2x_k}$
- ☐ $x_{k+1} = \frac{2x_k}{x_k^2 - 2}$
- ☒ $x_{k+1} = x_k - \frac{x_k^2 - 2}{2x_k}$

✓ Correct

Correct! By applying the formula $x_{k+1} = x_k - \frac{f(x_k)}{f'(x_k)}$ with $f(x) = x^2 - 2$ and $f'(x) = 2x$, you got the right result!

2. Regarding the previous question, suppose you don't know any approximation for $\sqrt{2}$ and only that it is a positive real number such that $x^2 = 2$. Which value from the list below will result in the fastest convergence?

1 / 1 point

- ☐ 4
- ☐ 3
- ☒ 2
- ☐ The initial value does not impact in the Newton's method convergence.

✓ Correct

Correct! We know that $\sqrt{2}$ is a number between 1 and 2, so 2 is the closest value in this list of options, therefore is the value that will converge faster!

3. Let's continue investigating the method we are developing to compute the $\sqrt{2}$. Remember that we used the fact that $\sqrt{2}$ is one of the roots of $x^2 - 2$. What would happen if we have chosen a negative value as initial point?

1 / 1 point

- ☐ The algorithm would not converge.
- ☐ The algorithm would converge to $\sqrt{2}$.
- ☒ The algorithm would converge to the negative root of $x^2 - 2$.
- ☐ The algorithm would converge to 0.

✓ Correct

Correct! Any negative number will be closer to $-\sqrt{2}$ instead of $\sqrt{2}$!

4. Did you know that it is possible to calculate the *reciprocal* of any number *without performing division*? (The reciprocal of a non-zero real number a is $\frac{1}{a}$).

1 / 1 point

Setting a non-zero real number a , use the function $f(x) = a - \frac{1}{x} = a - x^{-1}$ to find such formula.

This method was in fact used in older IBM computers to implement division in hardware!

So, the iteration formula to find the reciprocal of a , in this case, is:

- ☒ $x_{k+1} = 2x_k - ax_k^2$
- ☐ $x_{k+1} = 2x_k + ax_k^2$
- ☐ $x_{k+1} = 2x_k - x_k^2$
- ☐ $x_{k+1} = x_k - ax_k^2$

✓ Correct

Correct! By applying the Newton's method formula with function $f(x) = a - \frac{1}{x} = a - x^{-1}$ and $f'(x) = \frac{1}{x^2}$ and some manipulations, you got the result!

5. Suppose we want to find the minimum value (suppose we already know that the minimum exists and is unique) of $x \log(x)$ where $x \in (0, +\infty)$. Using Newton's method, what recursion formula we must use?

1 / 1 point

Hint: $f(x) = x \log(x)$, $f'(x) = \log(x) + 1$ and $f''(x) = \frac{1}{x}$

- ☐ $x_{k+1} = x_k - \frac{x_k \log(x_k)}{\log(x_k)+1}$
- ☐ $x_{k+1} = x_k - x_k^2 \log(x_k)$
- ☐ $x_{k+1} = x_k - \log(x_k)$
- ☒ $x_{k+1} = x_k - x_k (\log(x_k) + 1)$

Correct

Correct! By applying the formula $x_{k+1} = x_k - \frac{f'(x_k)}{f''(x_k)}$ you got the result!

6. Regarding the *Second Derivative Test* to decide whether a point with $f'(x) = 0$ is a local minimum or local maximum, check all that apply.

1/1 point

- ☐ If $f''(x) < 0$ then x is a local minimum.
- ☒ If $f''(x) > 0$ then x is a local minimum.

Correct

Correct! If $f'(x) = 0$ and $f''(x) < 0$ then x is a local maximum!

- ☐ If $f''(x) = 0$ then x is an inflection point.
- ☒ If $f''(x) = 0$ then the test is inconclusive.

Correct

Correct! If $f'(x) = f''(x) = 0$, then the test is inconclusive!

7. Let $f(x, y) = x^2 + y^3$, then the Hessian matrix, $H(x, y)$ is:

1/1 point

- ☐ $H(x, y) = \begin{bmatrix} 2x & 3y^2 \\ 3y^2 & 2x \end{bmatrix}$
- ☒ $H(x, y) = \begin{bmatrix} 2 & 0 \\ 0 & 6y \end{bmatrix}$
- ☐ $H(x, y) = \begin{bmatrix} 0 & 2 \\ 6y & 0 \end{bmatrix}$
- ☐ $H(x, y) = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

Correct

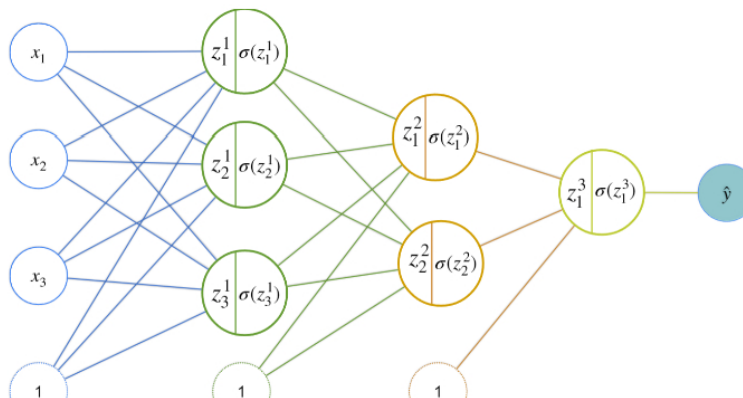
Correct! Using the formula $H(x, y) = \begin{bmatrix} \frac{\partial^2 f}{\partial x^2} & \frac{\partial^2 f}{\partial x \partial y} \\ \frac{\partial^2 f}{\partial y \partial x} & \frac{\partial^2 f}{\partial y^2} \end{bmatrix}$ it is straightforward to obtain the result!

8. How many parameters has a Neural Network with:

1/1 point

- Input layer of size 3
- One hidden layer with 3 neurons
- One hidden layer with 2 neurons
- Output layer with size 1

An image is provided below:



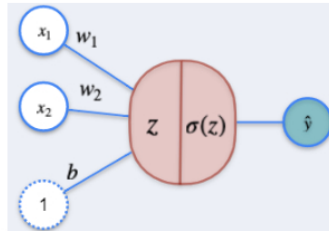
- ☐ 11
- ☐ 8
- ☒ 23
- ☐ 3

✓ Correct

Correct! There are $3 \cdot 3 + 3 = 12$ parameters in the first hidden layer, $3 \cdot 2 + 2 = 8$ parameters in the second hidden layer and $2 + 1 = 3$ parameters in the output layer!

9. Given the following Single Layer Perceptron with Sigmoid function as activation function, and log-loss as Loss Function (L), the value for $\frac{\partial L}{\partial w_1}$ is:

1 / 1 point



- ☐ $-(y - \hat{y})$
- ☒ $-(y - \hat{y})x_1$
- ☐ $-(y - \hat{y})x_2$
- ☐ 1

✓ Correct

Correct! As you saw in the lecture [Classification with Perceptron](#), the value is $-(y - \hat{y})x_1$

10. Suppose you have a function $f(x, y)$ with $\nabla f(x_0, y_0) = (0, 0)$ and such that

1 / 1 point

$$H(x_0, y_0) = \begin{bmatrix} 2 & 0 \\ 0 & 10 \end{bmatrix}$$

Then the point (x_0, y_0) is a:

- ☐ Local maximum.
- ☒ Local minimum.
- ☐ Saddle point.
- ☐ We can't infer anything with the given information.

✓ Correct

Correct! The matrix in that point has two positive eigenvalues, therefore it is a local minimum!