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:

- (selected) $x_{k+1} = 2x_k - ax_k^2$
- $x_{k+1} = 2x_k + ax_k^2$
- $x_{k+1} = 2x_k - x_k^2$
- $x_{k+1} = x_k - ax_k^2$

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** $f''(x) = \frac{1}{x}$

- $x_{k+1} = x_k - \frac{x_k \log(x_k)}{\log(x_k)+1}$
- $x_{k+1} = x_k - x_k^2 \log(x_k)$
- $x_{k+1} = x_k - \log(x_k)$
- (selected) $x_{k+1} = x_k - x_k\left(\log(x_k) + 1\right)$

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.
- [x] 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.
- [x] 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

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

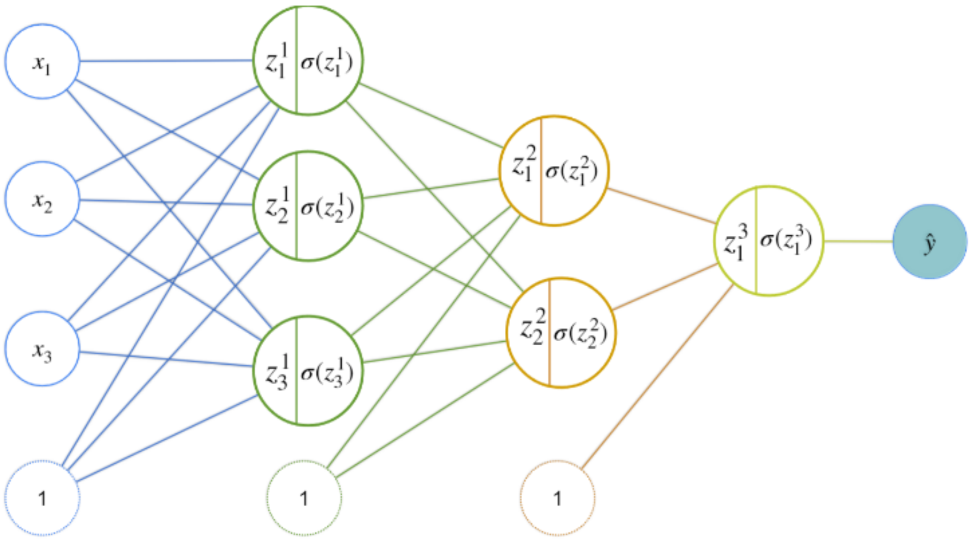
Correct
Correct! Using the formula $H(x,y) = \begin{bmatrix} \frac{\partial^2 f}{\partial x^2} & \frac{\partial^2 f}{\partial x \partial y} \\ \frac{\partial^2 f}{\partial y \partial x} & \frac{\partial^2 f}{\partial y^2} \end{bmatrix}$ it is straightforward to obtain the result!

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:



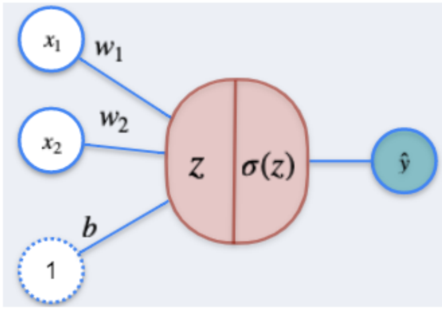
- ○ **11**
- ○ **8**
- ◉ **23**
- ○ **3**

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**

0 / 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.**

Incorrect

Incorrect! Please review the lecture [Hessians and Concavity]().