✅ **Congratulations! You passed!**

Grade received 80%   **To pass** 80% or higher

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1. In this quiz, you will calculate the Hessian for some functions of 2 variables and functions of 3 variables.

1 / 1 point

For the function $f(x,y) = x^3y + x + 2y$, calculate the Hessian matrix $H = \begin{bmatrix} \partial_{x,x}f & \partial_{x,y}f \\ \partial_{y,x}f & \partial_{y,y}f \end{bmatrix}$

○ $H = \begin{bmatrix} 0 & 3x^2 \\ 3x^2 & 6xy \end{bmatrix}$

◉ $H = \begin{bmatrix} 6xy & 3x^2 \\ 3x^2 & 0 \end{bmatrix}$

○ $H = \begin{bmatrix} 6xy & -3x^2 \\ -3x^2 & 0 \end{bmatrix}$

○ $H = \begin{bmatrix} 0 & -3x^2 \\ -3x^2 & 6xy \end{bmatrix}$

✓ **Correct**
Well done!

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2. For the function $f(x,y) = e^x \cos(y)$, calculate the Hessian matrix.

1 / 1 point

○ $H = \begin{bmatrix} -e^x\cos(y) & e^x\sin(y) \\ -e^x\sin(y) & -e^x\cos(y) \end{bmatrix}$

◉ $H = \begin{bmatrix} e^x\cos(y) & -e^x\sin(y) \\ -e^x\sin(y) & -e^x\cos(y) \end{bmatrix}$

○ $H = \begin{bmatrix} -e^x\cos(y) & -e^x\sin(y) \\ -e^x\sin(y) & e^x\cos(y) \end{bmatrix}$

○ $H = \begin{bmatrix} -e^x\cos(y) & -e^x\sin(y) \\ e^x\sin(y) & -e^x\cos(y) \end{bmatrix}$

✓ **Correct**
Well done!

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3. For the function $f(x,y) = \frac{x^2}{2} + xy + \frac{y^2}{2}$, calculate the Hessian matrix.

1 / 1 point

Notice something interesting when you calculate $\frac{1}{2}[x,y]H\begin{bmatrix} x \\ y \end{bmatrix}$!

◉ $H = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

○ $H = \begin{bmatrix} 1 & 0 \\ -1 & 1 \end{bmatrix}$

○ $H = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

○ $H = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$

✓ **Correct**
Well done! Not unlike a previous question with the Jacobian of linear functions, the Hessian can be used to succinctly write a quadratic equation in multiple variables.

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4. For the function $f(x,y,z) = x^2 e^{-y}\cos(z)$, calculate the Hessian matrix $H = \begin{bmatrix} \partial_{x,x}f & \partial_{x,y}f & \partial_{x,z}f \\ \partial_{y,x}f & \partial_{y,y}f & \partial_{y,z}f \\ \partial_{z,x}f & \partial_{z,y}f & \partial_{z,z}f \end{bmatrix}$

0 / 1 point

○ $H = \begin{bmatrix} 2e^{-y}\cos(z) & -2xe^{-y}\cos(z) & -2xe^{-y}\sin(z) \\ -2xe^{-y}\cos(z) & x^2e^{-y}\cos(z) & x^2e^{-y}\sin(z) \\ -2xe^{-y}\sin(z) & x^2e^{-y}\sin(z) & -x^2e^{-y}\cos(z) \end{bmatrix}$

○ $H = \begin{bmatrix} 2xe^{-y}\cos(z) & x^2e^{-y}\cos(z) & 2xe^{-y}\sin(z) \\ 2xe^{-y}\cos(z) & x^2e^{-y}\cos(z) & x^2xe^{-y}\sin(z) \\ 2xe^{-y}\sin(z) & 2xe^{-y}\sin(z) & 2xe^{-y}\cos(z) \end{bmatrix}$

○ $H = \begin{bmatrix} 2xe^{-y}\cos(z) & -2e^{-y}\cos(z) & -2e^{-y}\sin(z) \\ -2e^{-y}\cos(z) & x^2e^{-y}\cos(z) & x^2e^{-y}\sin(z) \\ -2x^2e^{-y}\sin(z) & x^2e^{-y}\sin(z) & -2xe^{-y}\cos(z) \end{bmatrix}$

◉ $H = \begin{bmatrix} 2e^{-y}\cos(z) & 2xe^{-y}\cos(z) & 2xe^{-y}\sin(z) \\ 2xe^{-y}\cos(z) & x^2e^{-y}\cos(z) & x^2e^{-y}\sin(z) \\ 2xe^{-y}\sin(z) & x^2e^{-y}\sin(z) & x^2e^{-y}\cos(z) \end{bmatrix}$

✗ **Incorrect**
Be careful when calculating partial derivatives.

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5. For the function $f(x,y,z) = xe^y + y^2\cos(z)$, calculate the Hessian matrix.

1 / 1 point

◉ $H = \begin{bmatrix} 0 & e^y & 0 \\ e^y & xe^y + 2\cos(z) & -2y\sin(z) \\ 0 & -2y\sin(z) & -y^2\cos(z) \end{bmatrix}$

○ $H = \begin{bmatrix} 0 & e^y & 0 \\ e^y & xe^y + 2\cos(z) & 2y\sin(z) \\ 0 & 2y\sin(z) & y^2\cos(z) \end{bmatrix}$

○ $H = \begin{bmatrix} 0 & e^y & 0 \\ e^y & xe^y + 2\sin(z) & 2y\cos(z) \\ 0 & 2y\cos(z) & y^2\sin(z) \end{bmatrix}$

○

$$H = \begin{bmatrix} 0 & e^y & 0 \\ e^y & xe^y + 2sin(z) & -2ycos(z) \\ 0 & -2ycos(z) & -y^2sin(z) \end{bmatrix}$$