/

Congratulations! You passed!

Next Item



1/1 point

1

In this quiz, you will practice calculating the multivariate chain rule for various functions.

For the following functions, calculate the expression $\frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \frac{d\mathbf{x}}{dt}$ in matrix form, where $\mathbf{x} = (x_1, x_2)$.

$$f(\mathbf{x}) = f(x_1, x_2) = x_1^2 x_2^2 + x_1 x_2$$

$$x_1(t) = 1 - t^2$$

$$x_2(t) = 1 + t^2$$

$$egin{aligned} rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{d\mathbf{x}}{dt} = \left[2x_1^2x_2 + x_1, 2x_1x_2^2 + x_2
ight] egin{bmatrix} 2t \ -2t \end{bmatrix} \end{aligned}$$

$$egin{aligned} rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{d\mathbf{x}}{dt} = \left[2x_1x_2^2 + x_2, 2x_1^2x_2 + x_1
ight] egin{bmatrix} 2t \ -2t \end{bmatrix} \end{aligned}$$

$$egin{aligned} rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{d\mathbf{x}}{dt} = \left[2x_1^2x_2 + x_1, 2x_1x_2^2 + x_2
ight] egin{bmatrix} -2t \ 2t \end{aligned}$$

$$egin{aligned} egin{aligned} rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{d\mathbf{x}}{dt} = \left[2x_1x_2^2 + x_2, 2x_1^2x_2 + x_1
ight]iggl[rac{-2t}{2t} iggr] \end{aligned}$$



Correct

Well done!

Multivariate chain rule exercise For the following functions, calculate the expression $\frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \frac{d\mathbf{x}}{dt}$ in matrix form, where $\mathbf{x} = (x_1, \mathbf{575}, \mathbf{points})$ (100%) Practice Quiz, 5 questions

$$f(\mathbf{x}) = f(x_1, x_2, x_3) = x_1^3 cos(x_2) e^{x_3}$$

$$x_1(t) = 2t$$

$$x_2(t) = 1 - t^2$$

$$x_3(t) = e^t$$

$$egin{aligned} rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{d\mathbf{x}}{dt} = \left[3x_1^2 cos(x_2)e^{x_3}, -x_1^3 cos(x_2)e^{x_3}, x_1^3 cos(x_2)e^{x_3}
ight] egin{bmatrix} 2 \ 2t \ e^t \end{bmatrix} \end{aligned}$$

$$egin{aligned} egin{aligned} rac{df}{dt} &= rac{\partial f}{\partial \mathbf{x}} rac{d\mathbf{x}}{dt} = \left[3x_1^2 cos(x_2)e^{x_3}, -x_1^3 sin(x_2)e^{x_3}, x_1^3 cos(x_2)e^{x_3}
ight] egin{bmatrix} 2 \ -2t \ e^t \end{bmatrix} \end{aligned}$$

Correct

Well done!

$$rac{df}{dt}=rac{\partial f}{\partial \mathbf{x}}rac{d\mathbf{x}}{dt}=[3x_1^2cos(x_2)e^{x_3},x_1^3cos(x_2)e^{x_3},x_1^3sin(x_2)e^{x_3}] \left[egin{array}{c} 2\ 2t\ -e^t \end{array}
ight]$$

$$egin{aligned} rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{d\mathbf{x}}{dt} = \left[3x_1^2 cos(x_2)e^{x_3}, -x_1^3 sin(x_2)e^{x_3}, x_1^3 sin(x_2)e^{x_3}
ight] egin{bmatrix} 2 \ 2t \ e^t \end{bmatrix} \end{aligned}$$



1/1 point

3.

For the following functions, calculate the expression $\frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \frac{\partial \mathbf{x}}{\partial \mathbf{u}} \frac{d\mathbf{u}}{dt}$ in matrix form, where $\mathbf{x} = (x_1, x_2)$ and U = (u_1, u_2) .

Practice Quiz, 5 questions

$$f(\mathbf{x}) = f(x_1, x_2) = x_1^2 - x_2^2$$

$$x_1(u_1,u_2)=2u_1+3u_2$$

$$x_2(u_1,u_2)=2u_1-3u_2$$

$$u_1(t) = cos(t/2)$$

$$u_2(t) = sin(2t)$$

$$egin{aligned} rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{\partial \mathbf{x}}{\partial \mathbf{u}} rac{d\mathbf{u}}{dt} = [2x_1, 2x_2] egin{bmatrix} 2 & -3 \ -2 & -3 \end{bmatrix} egin{bmatrix} -cos(t/2)/2 \ 2sin(2t) \end{bmatrix} \end{aligned}$$

$$\frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \; \frac{\partial \mathbf{x}}{\partial \mathbf{u}} \; \frac{d\mathbf{u}}{dt} = [-2x_1, -2x_2] \begin{bmatrix} -2 & 3 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} -sin(t/2)/2 \\ 2cos(t) \end{bmatrix}$$

$$rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{\partial \mathbf{x}}{\partial \mathbf{u}} rac{d\mathbf{u}}{dt} = [2x_1, 2x_2] egin{bmatrix} 2 & -3 \ 2 & 3 \end{bmatrix} egin{bmatrix} sin(t/2) \ 2cos(2t) \end{bmatrix}$$

$$\begin{array}{c|c} \hline & \frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \; \frac{\partial \mathbf{x}}{\partial \mathbf{u}} \; \frac{d\mathbf{u}}{dt} = [2x_1, -2x_2] \begin{bmatrix} 2 & 3 \\ 2 & -3 \end{bmatrix} \begin{bmatrix} -sin(t/2)/2 \\ 2cos(2t) \end{bmatrix} \end{array}$$

Correct

Well done!



1/1 point

4.

For the following functions, calculate the expression $\frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \frac{\partial \mathbf{x}}{\partial \mathbf{u}} \frac{d\mathbf{u}}{dt}$ in matrix form, where $\mathbf{x} = (x_1, x_2)$ and Practice Quiz, 5 questions

$$f(\mathbf{x}) = f(x_1, x_2) = cos(x_1)sin(x_2)$$

$$x_1(u_1,u_2)=2u_1^2+3u_2^2-u_2$$

$$x_2(u_1,u_2)=2u_1-5u_2^3$$

$$u_1(t)=e^{t/2}$$

$$u_2(t) = e^{-2t}$$

$$egin{aligned} egin{aligned} rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{\partial \mathbf{x}}{\partial \mathbf{u}} rac{d\mathbf{u}}{dt} = \left[-sin(x_1)sin(x_2),cos(x_1)cos(x_2)
ight] egin{bmatrix} 4u_1 & 6u_2 - 1 \ 2 & -15u_2^2 \end{bmatrix} egin{bmatrix} e^{t/2}/2 \ -2e^{-2t} \end{bmatrix} \end{aligned}$$

Correct

Well done!

$$\frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \ \frac{\partial \mathbf{x}}{\partial \mathbf{u}} \ \frac{d\mathbf{u}}{dt} = \left[-cos(x_1)sin(x_2), cos(x_1)cos(x_2)\right] \begin{bmatrix} u_1 & 6u_2 - 1 \\ 2 & -15u_2^2 \end{bmatrix} \begin{bmatrix} e^t \\ e^t \end{bmatrix}$$

$$egin{aligned} rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{\partial \mathbf{x}}{\partial \mathbf{u}} rac{d\mathbf{u}}{dt} = \left[-sin(x_1)cos(x_2),cos(x_1)cos(x_2)
ight] egin{bmatrix} u_1 & 6u_2 - 1 \ 2 & -u_2^2 \end{bmatrix} egin{bmatrix} e^{t^2/2}/2 \ -2e^{-2t} \end{bmatrix} \end{aligned}$$

$$rac{df}{dt} = rac{\partial f}{\partial \mathbf{x}} rac{\partial \mathbf{x}}{\partial \mathbf{u}} rac{d\mathbf{u}}{dt} = \left[-sin(x_1)cos(x_2),cos(x_1)cos(x_2)
ight] egin{bmatrix} 41u_1 & 6u_2-1 \ 2 & -15u_2 \end{bmatrix} egin{bmatrix} e^{t/2}/8 \ -2e^{2t} \end{bmatrix}$$



1/1

point

5.

$$f(\mathbf{x}) = f(x_1, x_2, x_3) = sin(x_1)cos(x_2)e^{x_3}$$

$$x_1(u_1,u_2)=sin(u_1)+cos(u_2)$$

$$x_2(u_1,u_2) = cos(u_1) - sin(u_2)$$

$$x_3(u_1,u_2)=e^{u_1+u_2}$$

$$u_1(t) = 1 + t/2$$

$$u_2(t)=1-t/2$$

$$[cos(x_1)cos(x_2)e^{x_3}, sin(x_1)sin(x_2)e^{x_3}, sin(x_1)cos(x_2)e^{x_3}] egin{bmatrix} -cos(u_1) & -sin(u_2) \ -sin(u_1) & -cos(u_2) \ e^{u_1+u_2} & 2e^{u_1+u_2} \end{bmatrix} egin{bmatrix} 1/2 \ 1/2 \end{bmatrix}$$

$$\frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \frac{\partial \mathbf{x}}{\partial \mathbf{u}} \frac{d\mathbf{u}}{dt} =$$

$$[cos(x_1)cos(x_2)e^{x_3}, -sin(x_1)cos(x_2)e^{x_3}, sin(x_1)cos(x_2)e^{x_3}] egin{bmatrix} cos(u_1) & sin(u_2) \ -sin(u_1) & -cos(u_2) \ e^{u_1+u_2} & -e^{u_1+u_2} \end{bmatrix} egin{bmatrix} 1/2 \ -1/2 \end{bmatrix}$$

$$\frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \frac{\partial \mathbf{x}}{\partial \mathbf{u}} \frac{d\mathbf{u}}{dt} =$$

$$[cos(x_1)cos(x_2)e^{x_3}, -sin(x_1)sin(x_2)e^{x_3}, sin(x_1)cos(x_2)e^{x_3}] egin{bmatrix} cos(u_1) & -sin(u_2) \ -sin(u_1) & -cos(u_2) \ e^{u_1+u_2} & e^{u_1+u_2} \end{bmatrix} egin{bmatrix} 1/2 \ -1/2 \end{bmatrix}$$

Correct

Well done!

$$\frac{df}{dt} = \frac{\partial f}{\partial \mathbf{x}} \frac{\partial \mathbf{x}}{\partial \mathbf{u}} \frac{d\mathbf{u}}{dt} =$$

$$\left[cos(x_1)cos(x_2)e^{x_3}, -sin(x_1)^2sin(x_2)e^{x_3}, sin(x_1)cos(x_2)e^{x_3}
ight] \left[egin{array}{ccc} sin(u_1) & -sin(u_2) \ -sin(u_1) & -cos(u_2) \ 3e^{u_1+u_2} & e^{u_1+u_2} \end{array}
ight] \left[egin{array}{ccc} -1/2 \ -1/2 \end{array}
ight]$$

Multivariate chain rule exercise

Practice Quiz, 5 questions

5/5 points (100%)



