Bigger Jacobians!

5/5 points (100%)

Practice Quiz, 5 questions

Congratulations! You passed!

Next Item



1/1 points

In this guiz, you will calculate the Jacobian matrix for some vector valued functions.

For the function $u(x,y)=x^2-y^2$ and v(x,y)=2xy, calculate the Jacobian matrix

$$J = egin{bmatrix} rac{\partial u}{\partial x} & rac{\partial u}{\partial y} \ rac{\partial v}{\partial x} & rac{\partial v}{\partial y} \end{bmatrix}.$$



Well done!

$$J=egin{bmatrix} 2x & 2y \ 2y & 2x \end{bmatrix}$$

$$J=egin{bmatrix} 2x & 2y \ -2y & 2x \end{bmatrix}$$

$$J=egin{bmatrix} 2x & -2y \ -2y & 2x \end{bmatrix}$$



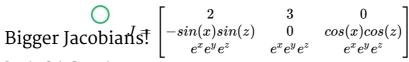
1/1 points

For the function u(x,y,z)=2x+3y, v(x,y,z)=cos(x)sin(z) and $w(x,y,z)=e^xe^ye^z$

, calculate the Jacobian matrix $J = \begin{bmatrix} \frac{\partial u}{\partial x} & \frac{\partial u}{\partial y} & \frac{\partial u}{\partial z} \\ \frac{\partial v}{\partial x} & \frac{\partial v}{\partial y} & \frac{\partial z}{\partial z} \\ \frac{\partial w}{\partial x} & \frac{\partial w}{\partial y} & \frac{\partial z}{\partial z} \\ \frac{\partial w}{\partial x} & \frac{\partial w}{\partial y} & \frac{\partial w}{\partial z} \end{bmatrix}$

$$J = egin{bmatrix} 2 & 3 & 0 \ cos(x)sin(z) & 0 & -sin(x)cos(z) \ e^x e^y e^z & e^x e^y e^z & e^x e^y e^z \end{bmatrix}$$

$$J=egin{bmatrix} 2&3&0\ -cos(x)sin(z)&0&-sin(x)cos(z)\ e^xe^ye^z&e^xe^ye^z&e^xe^ye^z \end{bmatrix}$$



5/5 points (100%)

Practice Quiz, 5 questions

Correct

Well done!

$$J = egin{bmatrix} 2 & 3 & 0 \ sin(x)sin(z) & 0 & -cos(x)cos(z) \ e^x e^y e^z & e^x e^y e^z & e^x e^y e^z \end{bmatrix}$$



1/1 points

Consider the pair of linear equations u(x,y)=ax+by and v(x,y)=cx+dy, where a,b,c and d are all constants. Calculate the Jacobian, and notice something kind of interesting!

Correct

Well done!

A succinct way of writing this down is the following:

$$egin{bmatrix} u \ v \end{bmatrix} = J \cdot egin{bmatrix} x \ y \end{bmatrix}$$

This is a generalisation of the fact that a simple linear function $f(x) = a \cdot x$ can be re-written as $f(x) = f'(x) \cdot x$, as the Jacobian matrix can be viewed as the multidimensional derivative. Neat!

$$J = \begin{bmatrix} b & c \\ d & a \end{bmatrix}$$

$$\bigcirc \quad J = \begin{bmatrix} b & c \\ a & d \end{bmatrix}$$



1/1 points

For the function $u(x,y,z)=9x^2y^2+ze^x, v(x,y,z)=xy+x^2y^3+2z$ and $w(x,y,z)=cos(x)sin(z)e^{y}$, calculate the Jacobian matrix and evaluate at the point (0,0,0).



01/06/2018

$$J = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$
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Practice Quiz, 5 questions

$$J = egin{bmatrix} 0 & 0 & 0 \ 0 & 0 & 0 \ 1 & 2 & 1 \end{bmatrix}$$

$$J = egin{bmatrix} 0 & 0 & 1 \ 0 & 0 & 1 \ 0 & 0 & 1 \end{bmatrix}$$

$$J = egin{bmatrix} 0 & 0 & 1 \ 0 & 0 & 2 \ 0 & 0 & 1 \end{bmatrix}$$

Correct

Well done!



1/1 points

5.

In the lecture, we calculated the Jacobian of the transformation from Polar co-ordinates to Cartesian co-ordinates in 2D. In this question, we will do the same, but with Spherical coordinates to 3D.

For the functions $x(r,\theta,\phi)=rcos(\theta)sin(\phi), y(r,\theta,\phi)=rsin(\theta)sin(\phi)$ and $z(r, \theta, \phi) = rcos(\phi)$, calculate the Jacobian matrix.

$$J = \begin{bmatrix} r^2 cos(\theta) sin(\phi) & -sin(\theta) sin(\phi) & cos(\theta) cos(\phi) \\ rsin(\theta) sin(\phi) & rcos(\theta) sin(\phi) & rsin(\theta) cos(\phi) \\ cos(\phi) & 1 & rsin(\phi) \end{bmatrix}$$

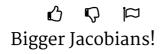
$$J = \begin{bmatrix} cos(\theta) sin(\phi) & -rsin(\theta) sin(\phi) & rcos(\theta) cos(\phi) \\ sin(\theta) sin(\phi) & rcos(\theta) sin(\phi) & rsin(\theta) cos(\phi) \\ cos(\phi) & 0 & -rsin(\phi) \end{bmatrix}$$

$$J = egin{bmatrix} cos(heta)sin(\phi) & -rsin(heta)sin(\phi) & rcos(heta)cos(\phi) \ sin(heta)sin(\phi) & rcos(heta)sin(\phi) & rsin(heta)cos(\phi) \ cos(\phi) & 0 & -rsin(\phi) \end{bmatrix}$$

Well done! The determinant of this matrix is $-r^2 sin(\phi)$, which does not vary only with θ .

$$J = egin{bmatrix} rcos(heta)sin(\phi) & -rsin(heta)sin(\phi) & rcos(heta)cos(\phi) \ rsin(heta)sin(\phi) & r^2cos(heta)sin(\phi) & sin(heta)cos(\phi) \ cos(\phi) & -1 & -rsin(\phi) \end{bmatrix} \ J = egin{bmatrix} rcos(heta)sin(\phi) & -sin(heta)sin(\phi) & cos(heta)cos(\phi) \ rsin(heta)sin(\phi) & cos(heta)sin(\phi) & sin(heta)cos(\phi) \ rcos(\phi) & 0 & -sin(\phi) \end{bmatrix} \ \end{pmatrix}$$

$$J = egin{bmatrix} rcos(heta)sin(\phi) & -sin(heta)sin(\phi) & cos(heta)cos(\phi) \ rsin(heta)sin(\phi) & cos(heta)sin(\phi) & sin(heta)cos(\phi) \ rcos(\phi) & 0 & -sin(\phi) \end{bmatrix}$$



Practice Quiz, 5 questions

5/5 points (100%)