In [1]:
```
#Jacobian matrix
#If u = xy/z, v = yz/x, w = zx/y then prove that J = 4
from sympy import *
x ,y , z= symbols('x,y,z')
u=x*y/z
v=y*z/x
w=z*x/y
# find the all first order partial derivates
dux = diff(u , x)
duy = diff(u , y)
duz = diff(u , z)
dvx = diff(v , x)
dvy = diff(v , y)
dvz = diff(v , z)
dwx = diff(w , x)
dwy = diff(w , y)
dwz = diff(w , z)
# construct the Jacobian matrix
J= Matrix([[dux , duy , duz],[dvx , dvy , dvz],[dwx , dwy , dwz]])
print("The Jacobian matrix is")
display( J )
# Find the determinat of Jacobian Matrix
Jac=det( J )
print('J = ', Jac )
```

The Jacobian matrix is

$$\begin{bmatrix} \frac{y}{z} & \frac{x}{z} & -\frac{xy}{z^2} \\ -\frac{yz}{x^2} & \frac{z}{x} & \frac{y}{x} \\ \frac{z}{y} & -\frac{xz}{y^2} & \frac{x}{y} \end{bmatrix}$$

J = 4

In [2]:

```
#If  u=x+3y2-z3,  v=4x2yz,  w=2z2-xy
from sympy import *
x ,y , z= symbols('x,y,z')
u=x+3*y**2-z**3
v=4*x**2*y*z
w=2*z**2-x*y
dux = diff(u , x)
duy = diff(u , y)
duz = diff(u , z)
dvx = diff(v , x)
dvy = diff(v , y)
dvz = diff(v , z)
dwx = diff(w , x)
dwy = diff(w , y)
dwz = diff(w , z)
J= Matrix([[dux , duy , duz],[dvx , dvy , dvz],[dwx , dwy , dwz]])
print("The Jacobian matrix is")
display(J)
Jac = det(J)
print('J =', Jac)
display(Jac)
```

```
The Jacobian matrix is
```

$$\begin{bmatrix} 1 & 6y & -3z^2 \\ 8xyz & 4x^2z & 4x^2y \\ -y & -x & 4z \end{bmatrix}$$

```
J = 4*x**3*y - 24*x**2*y**3 + 12*x**2*y*z**3 + 16*x**2*z**2 - 192*x*y**2*z**2
```

$$4x^3y - 24x^2y^3 + 12x^2yz^3 + 16x^2z^2 - 192xy^2z^2$$

In [ ]: