Q2&Q3_Serial_Jacobian

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In [22]:
```
from sympy import *
l_1 = Symbol('l_1')
l_2 = Symbol('l_2')
theta_1 = Symbol('theta_1')
theta_2 = Symbol('theta_2')
x = Symbol('x')
y = Symbol('y')
dxdtheta_1 = Symbol('dxdtheta_1')
dxdtheta_2 = Symbol('dxdtheta_2')
dydtheta_1 = Symbol('dydtheta_1')
dydtheta_2 = Symbol('dydtheta_2')
```

In [23]:
```
x = l_1*cos(theta_1) + l_2*cos(theta_1 + theta_2)
y = l_1*sin(theta_1) + l_2*sin(theta_1 + theta_2)
```

In [24]:
```
dxdtheta_1= simplify(diff(x,theta_1))
print(dxdtheta_1)
dxdtheta_2= simplify(diff(x,theta_2))
print(dxdtheta_2)
dydtheta_1= simplify(diff(y,theta_1))
print(dydtheta_1)
dydtheta_2= simplify(diff(y,theta_2))
print(dydtheta_2)
```

```
-l_1*sin(theta_1) - l_2*sin(theta_1 + theta_2)
-l_2*sin(theta_1 + theta_2)
l_1*cos(theta_1) + l_2*cos(theta_1 + theta_2)
l_2*cos(theta_1 + theta_2)
```

In [28]:
```
pi = 3.14
J_11 = dxdtheta_1.subs([(theta_1,135/180*pi),(theta_2,270/180*pi),(l_1,0.1), (l_2,0.1
J_12 = dxdtheta_2.subs([(theta_1,135/180*pi),(theta_2,270/180*pi),(l_1,0.1), (l_2,0.1
J_21 = dydtheta_1.subs([(theta_1,135/180*pi),(theta_2,270/180*pi),(l_1,0.1), (l_2,0.1
J_22 = dydtheta_2.subs([(theta_1,135/180*pi),(theta_2,270/180*pi),(l_1,0.1), (l_2,0.1
```

In [29]:
```
print(J_11)
print(J_12)
print(J_21)
print(J_22)
```

```
-0.141251925884620
-0.0704568350197770
0.000337448722203815
0.0709636132042043
```

In [ ]: