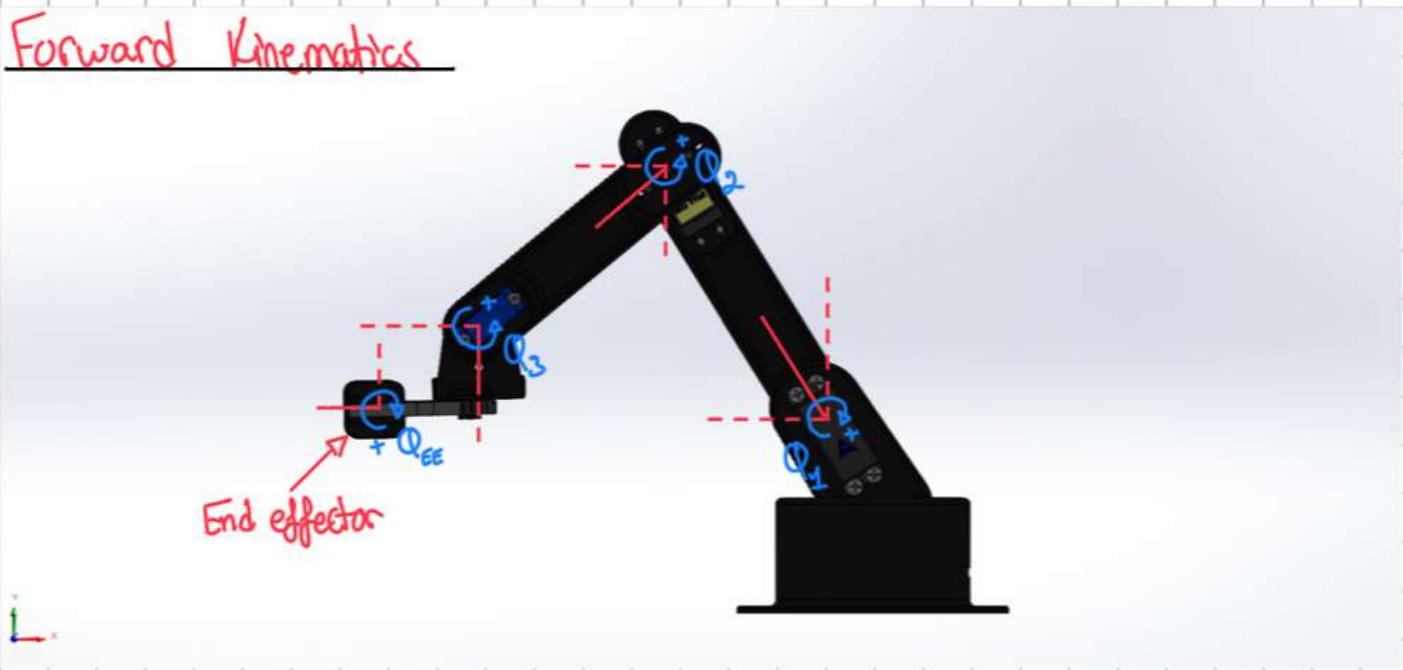
# Forward Kinematics




$Q_1$ = shoulder joint

$Q_2$ = Elbow joint (negative direction relative to shoulder)

$Q_3$ = wrist joint (positive direction relative to elbow)

$Q_{EE}$ = claw (positive direction relative to the ground)

For example in the image above:

$Q_1 = 45°$ , $Q_2 = -45°$ , $Q_{EE} = 0°$ (we want it zero so that it can be parallel relative to the ground)

$Q_3 = ??$

$\Rightarrow Q_{EE} = Q_1 + Q_2 + Q_3 \Rightarrow 0 = \cancel{45} + (\cancel{-45}) + Q_3$

$\Rightarrow \boxed{Q_3 = 0°}$ which makes sense because the rotations of shoulder and elbow cancel out.

Another example:

$Q_1 = 30°$ , $Q_2 = 20°$ , $Q_{EE} = 0°$ , $Q_3 = ??$

$\Rightarrow Q_{EE} = Q_1 + Q_2 + Q_3 \Rightarrow 0 = 20 + 30 + Q_3$

$\Rightarrow \boxed{Q_3 = -50°}$ so when the shoulder and elbow rotate to those positions, the wrist would have to rotate $-50°$ to compensate for these movements.