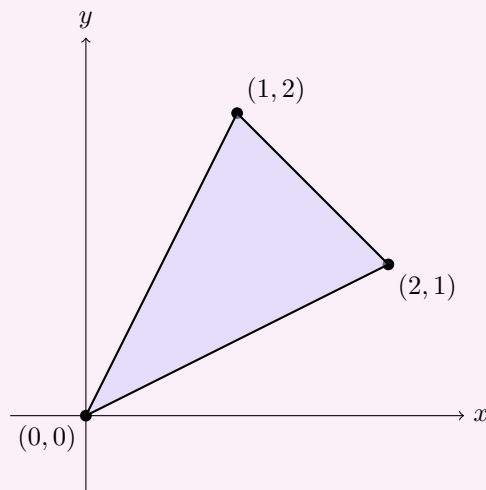


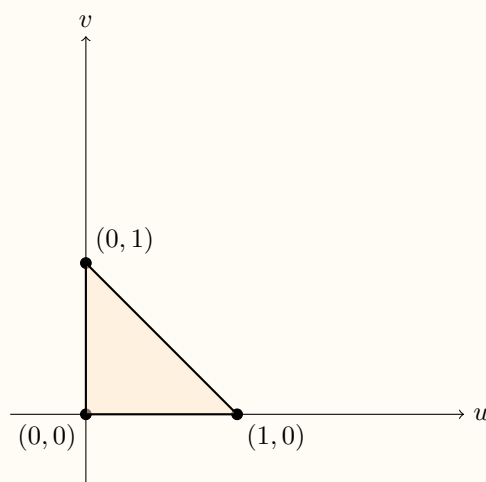
Problem 1

Evaluate $\iint_{\mathcal{R}} x - 3y dA$ where \mathcal{R} is region between $(0,0)$, $(2,1)$, and $(1,2)$. Use transformation $x = 2u + v$ and $y = u + 2v$.



$$\begin{aligned}
 u &= y - 2v \\
 v &= x - 2u \\
 u &= y - 2(x - 2u) \\
 -3u &= y - 2x \\
 &= \frac{2}{3}x - \frac{1}{3}y \\
 v &= x - 2\left(\frac{2}{3}x - \frac{1}{3}y\right) \\
 &= -\frac{1}{3}x + \frac{2}{3}y
 \end{aligned}$$

We can then plug in the functions of all 3 sides, and find $(0,0)$, $(0,1)$, and $(1,0)$.



This is a type 3 region!

$$\begin{aligned}\iint_{\mathcal{R}} x - 3y dA &= \iint_{\mathcal{R}} ((2u + v) - 3(u + 2v)) \cdot \left| \frac{\partial x}{\partial u} \quad \frac{\partial y}{\partial v} \right| dudv \\ &= \int_0^1 \int_0^{-x} (-u - 5v) \cdot \begin{vmatrix} 2 & 1 \\ 1 & 2 \end{vmatrix} dudv \\ &= \int_0^1 \int_0^{-x} (-u - 5v) \cdot 3 dudv \\ &= \int_0^1 \int_0^{-x} (-3u - 15v) dudv\end{aligned}$$