**Multiple Integration**
***Iteration of Double Integrals***

**Question**
Find the volume for the solid defined by
The space over the $xy$-plane and below the surface $z = 1 - x^2 - 2y^2$.
**Answer**

$$\begin{aligned}
\text{Vol} &= \iint_E (1 - x^2 - 2y^2)\, dA \\
&= 4\int_0^1 dx \int_0^{\sqrt{(1-x^2)/2}} (1 - x^2 - 2y^2)\, dy \\
&= 4\int_0^1 \left( \frac{1}{\sqrt{2}}^{3/2} - \frac{2}{3}\frac{(1-x^2)^{3/2}}{2\sqrt{2}} \right) dx \\
&= \frac{4\sqrt{2}}{3}\int_0^1 (1-x^2)^{3/2}\, dx \\
\text{Let } x &= \sin\theta \\
du &= \cos\theta d\theta
\end{aligned}$$

$$\begin{aligned}
\Rightarrow V &= \frac{4\sqrt{2}}{3}\int_0^{\pi/2} \cos^4\theta \\
&= \frac{4\sqrt{2}}{3}\int_0^{\pi/2} \left( \frac{1+\cos 2\theta}{2} \right)^2 d\theta \\
&= \frac{\sqrt{2}}{3}\int_0^{\pi/2} \left( 1 + 2\cos\theta + \frac{1+\cos\theta}{2} \right) d\theta \\
&= \frac{\sqrt{2}}{3}\left[ \frac{3\theta}{2} + \sin\theta + \frac{1}{8}\sin 4\theta \right)\Bigg|_0^{\pi/2} \\
&= \frac{\pi}{2\sqrt{2}} \text{cu. units}
\end{aligned}$$