1 - Vectors

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1.1 Vectors

- basic ops: Addition, Subtraction, Vect mult.

Linear Combination: Vector v is a linear combination of vectors $V_1, V_2 \dots V_k$ if there are scalars $c_1, c_2 \dots c_k$ such that $V = c_1V_1 + c_2V_2 + \cdots + c_kV_k$

- Modular Arithmetic: $\mathbb{Z}_m^n$ — n – n dimensions; m modulo m

1.2 Dots & Projections

- **Dot product** $u \cdot v = \|u\|\|v\|\cos\theta = u_1v_1 + u_2v_2 + \cdots + u_nv_n$ | Orthogonal if $u.v = 0$
- normalising: finding the unit vector
- standard unit vectors; $[1,0,0], [0,1,0] \dots$
- distance $d(u,v)$ $d = \|u - v\|$
- $\text{proj}_u(v) = \left(\frac{u.v}{u.u}\right)u$ 'proj of v onto u'

1.3 Lines & Planes

	Normal	General	Vector	Parametric
Lines	$\begin{cases} n_1 \cdot x = n_1 p_1 \\ n_2 \cdot x = n_2 p_2 \end{cases}$ where $n = (a,b,c)$	$\begin{cases} a_1x + b_1y + c_1z = d_1 \\ a_2x + b_2y + c_2z = d_2 \end{cases}$	$\underline{x} = \underline{p} + t\,\underline{d}$	$\begin{cases} \underline{x} = \underline{p}_1 + t\,\underline{d}_1 \\ \underline{y} = \underline{p}_2 + t\,\underline{d}_2 \\ \underline{z} = \underline{p}_3 + t\,\underline{d}_3 \end{cases}$
Planes	$\underline{n} \cdot \underline{x} = \underline{n} \cdot \underline{p}$	$ax + by + cz = d$	$\underline{x} = \underline{p} + s\underline{u} + t\underline{v}$	$\begin{cases} x = p_1 + s\underline{u}_1 + tv_1 \\ y = p_2 + s\underline{u}_2 + tv_2 \\ z = p_3 + s\underline{u}_3 + tv_3 \end{cases}$