

### Axioms For Vector Spaces

To show that a given set with two operations is **NOT** a vector space, we need to show properly that at least one property of the ten above is violated.

(1) If  $u, v \in V$ , then  $u \oplus v \in V$  [CLOSURE UNDER ADDITION]

(2) If  $u \oplus v = v \oplus u$  [COMMUTATIVE LAW]

(3) If  $(u \oplus v) \oplus w = u \oplus (v \oplus w)$  [' $\oplus$ ' IS ASSOCIATIVE]

(4)  $V$  contains the object "0" which satisfies  $u \oplus 0 = 0 \oplus u$

For each  $u \in V$ , there exist an object '-u' such that  $u \oplus -u = 0$  [ADDITIVE INVERSE]

(6) If  $u \in V^*$  and  $k \in K$ , then  $k \odot u \in V$  [CLOSURE UNDER MULTIPLICATION]

(7)  $k \odot (u \oplus v) = (k \odot u) \oplus (k \odot v)$  [DISTRIBUTIVE LAW]

(8)  $(k+l) \odot u = (k \odot u) \oplus (l \odot u)$

(9)  $k \odot (l \odot u) = (kl) \odot u$

(10)  $1 \odot u = u$

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