STORAGE VECTORS

MEANING OF STORAGE VECTOR

A *vector* is an ordered list of data (or n-tuple) and is usually denoted by a lower case letter.
eg. $\mathbf{a} = (72, 64, 87)$.

A *storage vector* is a vector which stores information.
Eg. End of semester exam results may be given as $\mathbf{a} = (\text{Maths B}, \text{Maths C}, \text{English})$.
If $\mathbf{a} = (72, 64, 87)$ for Ian, then he received:
72 in Maths B, 64 in Maths C and 87 in English.

Each element of a vector can be *nominal* or *numeric*.
Eg. $\mathbf{b} = (\text{Peter}, 523788, 120879, \text{Mackay})$ gives for a particular person $(\text{name}, \text{telephone number}, \text{date of birth}, \text{place of residence})$.

The position of an element is sometimes referred to as a *dimension*.

The set of all possible values that an element can take is called the *domain* of the element.

Vectors may also be considered as a *row matrix* or *column matrix*.

Eg. $\mathbf{a} = (72,64,87)$ may also be written as $\mathbf{a} = \begin{pmatrix} 72 & 64 & 87 \end{pmatrix}$ or $\mathbf{a} = \begin{pmatrix} 72 \\ 64 \\ 87 \end{pmatrix}$.

☺ Ex 4.1 p 128 qu 1,2,4,5,6,7,8

OPERATIONS WITH VECTORS

The permitted operations with numeric vectors follow from considering vectors as matrices. Of course, operations with vectors are only possible if they make sense in the particular context.

- Two vectors are equal ⇔ the vectors are the same size and all the corresponding elements are equal.
  eg. $(3, m, n) = (k, 5, 1) \Rightarrow k = 3, m = 5, n = 1$
- Vectors of the same size can be added or subtracted by adding or subtracting the corresponding elements.
  eg. $(6, {}^{-}2, 9, 10) + (1, 5, {}^{-}7, 4) = (7, 3, 2, 14)$
- The zero vector **0** has all of its elements equal to 0.
  eg. $\mathbf{0} = (0,0,0,0,0,0)$
- Vector addition is associative and commutative. The set of vectors of a certain size form an Abelian group under addition.
- A vector can be multiplied by a scalar. Each element is multiplied by the scalar.
  eg. $5 \times (4, 9, {}^{-}2) = (20, 45, {}^{-}10)$

☺ Ex 4.2 p 132 qu 2j-o,4,7,10de,11-15

SCALAR PRODUCT (DOT PRODUCT) OF TWO VECTORS

Sometimes we need to multiply corresponding elements of two vectors of the same size and sum the individual products. This is called the *scalar product* or *dot product* and is represented by a dot.

If $\mathbf{a} = (a_1, a_2, \ ... \ , a_n)$ and $\mathbf{b} = (b_1, b_2, ..., b_n)$, then $\mathbf{a}.\mathbf{b} = a_1 b_1 + a_2 b_2 + ... + a_n b_n$ or $\sum_{i=1}^{n} a_i b_i$.

The scalar product is of course a scalar (not a vector). The symbol x must not be used because there is also a vector product and this is written as $\mathbf{a} \times \mathbf{b}$.

Eg. Suppose a student buys three 64-page exercise books at 39 cents each, four 96-page exercise books at 45 cents each and five 128-page exercise books at 55 cents each.

Let:

the number of books be represented by $\mathbf{n} = (3, 4, 5)$

the number of pages in each book be represented by $\mathbf{p} = (64, 96, 128)$

the price per book ($) be represented by $\mathbf{c} = (0 \cdot 39, 0 \cdot 45, 0 \cdot 55)$

The total number of pages is given by:

$\mathbf{n}.\mathbf{p} = 3 \times 64 + 4 \times 96 + 5 \times 128 = 1216$ pages

The total cost is given by:

$\mathbf{n}.\mathbf{c} = 3 \times 0 \cdot 39 + 4 \times 0 \cdot 45 + 5 \times 0 \cdot 55 = \$5 \cdot 72$

NB. The scalar product $\mathbf{p}.\mathbf{c}$ has no meaning.

Some results for the scalar product:

- The scalar product is commutative:
  $\mathbf{a}.\mathbf{b} = \mathbf{b}.\mathbf{a}$
- The scalar product is distributive over addition:
  $\mathbf{a}.(\mathbf{b} + \mathbf{c}) = \mathbf{a}.\mathbf{b} + \mathbf{a}.\mathbf{c}$
  $(\mathbf{d} + \mathbf{e}).\mathbf{f} = \mathbf{d}.\mathbf{f} + \mathbf{e}.\mathbf{f}$

☺ Ex 4.3 p 138 qu 1acefij,2,4,6,7,9,13,15,16,17