



MY UNIVERSITY NAME

My Second Report

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1 Introduction

Nothing to introduce here. Just a collection of maths.

2 Products

2.1 Outer product / Tensor product

From [1].

For vectors or column matrices, it is equivalent to a matrix multiplication xy^T :

$$\mathbf{u} \otimes \mathbf{v} = \mathbf{u}\mathbf{v}^T = \begin{bmatrix} u_1v_1 & u_1v_2 & \dots & u_1v_n \\ u_2v_1 & u_2v_2 & \dots & u_2v_n \\ \vdots & \vdots & \ddots & \vdots \\ u_mv_1 & u_mv_2 & \dots & u_mv_n \end{bmatrix} \quad (1)$$

where $u, v \in \mathbb{R}^{n \times 1}$

For higher order tensors:

$$\mathbf{T} = \mathbf{a} \otimes \mathbf{b} \otimes \mathbf{d}, \quad T_{ijk} = a_ib_jd_k \quad (2)$$

For example, if \mathbf{A} is of order 3 with dimensions (3, 5, 7) and \mathbf{B} is of order 2 with dimensions (10, 100), their outer product \mathbf{C} is of order 5 with dimensions (3, 5, 7, 10, 100).

Tensor product is a generalisation of outer product [2]. The outer product of two vectors \mathbf{u} and \mathbf{v} is their tensor product $\mathbf{u} \otimes \mathbf{v}$ [1].

2.1.1 A sub-subsection

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2.1.1.1 A sub-sub-subsection



Figure 1: A logo. Please don't sue me.

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2.1.1.2 Another sub-sub-subsection

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Table 1: A table from Wikibooks.

Day	Min Temp	Max Temp	Summary
Monday	11C	22C	A clear day with lots of sunshine. However, the strong breeze will bring down the temperatures.
Tuesday	9C	19C	Cloudy with rain, across many northern regions. Clear spells across most of Scotland and Northern Ireland, but rain reaching the far northwest.
Wednesday	10C	21C	Rain will still linger for the morning. Conditions will improve by early afternoon and continue throughout the evening.

aliquam accumsan ipsum, nec laoreet dui auctor id. Nullam rutrum augue neque, quis vestibulum tellus dapibus dictum. Vestibulum placerat metus et lectus sagittis venenatis.

A sub-sub-sub-subsection Nunc efficitur, mi id efficitur tempor, nulla diam facilisis risus, sit amet commodo ex arcu eu sem. Aliquam metus nisi, rhoncus in dictum at, posuere ut metus. Nunc tristique nisl eu velit sagittis, ut ornare odio porta. Sed mi nisl, tincidunt nec vehicula eget, accumsan quis urna. In hac habitasse platea dictumst. Praesent commodo sollicitudin pulvinar. Nullam pulvinar aliquam velit, ut fermentum augue convallis eu. Mauris interdum feugiat mollis.

2.1.2 Another sub-subsection

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References

- [1] Wikipedia contributors, 2019. Outer product — Wikipedia, the free encyclopedia. [Online; accessed 28-March-2019].
URL https://en.wikipedia.org/w/index.php?title=Outer_product&oldid=886026441
- [2] Wikipedia contributors, 2019. Tensor product — Wikipedia, the free encyclopedia. [Online; accessed 29-March-2019].
URL https://en.wikipedia.org/w/index.php?title=Tensor_product&oldid=889702125