In class 06, we began to investigate the mathematical tools we will need to describe tensors. Terms used in mechanics can be assigned to orders where scalars are zero-ordered tensors, vectors are first-ordered tensors, and tensors are those ordered second or higher. Tensors in this case are linear transformations that transform a vector from one basis to another. We also discussed why stress and strain are considered tensors which is due to the 9 -components needed to describe the forces applied to the 3-dimensional surfaces of the material. Here, we introduced the summation convention which defines a vector by summing its component basis vectors. The Kronecker Delta is similar to an identity matrix and allows us to define $\delta_{\mathrm{ij}} \hat{\mathrm{e}}_{\mathrm{j}}=\hat{\mathrm{e}}_{\mathrm{i}}$. Using the permutation symbol, we can describe the cross-product of the basis vectors as $\hat{\mathrm{e}}_{\mathrm{i}} \mathrm{x} \hat{\mathrm{e}}_{\mathrm{j}}=\varepsilon_{\mathrm{ijk}} \hat{\mathrm{e}}_{\mathrm{k}}$. From the definition of the permutation symbol, the sign changes when any two subscripts of epsilon change. In order to understand the derivations of these formulas, we must understand dot products, cross products, and the use of determinants. Of note, the magnitude of the cross product is the area defined by the parallelogram created by the two vectors and the triple (box) product defines the volume of the prism created by the tree vectors.

