*You mentioned that E_{1111} Young's modulus. Why is that?. This is correct E_{1111} Young's modulus. If you consider the strain that arises due to a uniaxial stress applied (say in the x_1 direction - so σ_{11}), there should be a strain of $\varepsilon_{11} = \dfrac{\sigma_{11}}{E}$ and $\varepsilon_{22} = \varepsilon_{33=} \dfrac{-v\sigma_{11}}{E}$ in the transverse directions.   But the tensor stiffness form of the stress-strain relationship for an isotropic material gives:

$$\sigma_{11} = E_{1111}\varepsilon_{11} + E_{1122}\varepsilon_{22} + E_{1133}\varepsilon_{33} = E_{1111}\frac{\sigma_{11}}{E} - vE_{1122}\frac{\sigma_{11}}{E} - vE_{1133}\frac{\sigma_{11}}{E}$$

i.e. the axial stress picks up contributions from the off-axis stress. Another way to look at this is to consider what would happen if $\varepsilon_{22} = \varepsilon_{33} = 0$, which would imply that $\sigma_{22} = \sigma_{33} = 0$. This is an important point, so it is worth convincing yourself of the reasoning.

*The different forms of notation are confusing. Why are they useful? I agree that it is a bit confusing, and in some ways it would make life easier if there was a consistent set of notation. The reason for the two types of notation is that tensor notation is mathematically more straightforward. However, the engineering notation and the engineering elastic constants correspond more directly to what can be experimentally measured.

*What kinds of things would anisotropic materials be used for? Or is it made just to see if it can be made? It would potentially be useful to be able to tailor a materials to have exactly the correct properties in every direction, according to the load that it will be expected to carry. However in practice it is not feasible to create fully anisotropic materials. Note, that if an orthotropic material is loaded in directions other than the orthogonal directions, it behaves as a fully anisotropic material, i.e. the stiffness matrix ceases to have zero's in it.

*Are the 4 quadrants of the 6x6 matrix the same for compliance and stiffness forms? For all but fully anisotropic and monoclinic materials only the top left and bottom right quadrants are populated and the two off-diagonal quadrants just contain zeroes. This means that the top left and bottom right quadrants behave independently as 3x3 matrices and can be inverted separately to go from the stiffness to the compliance forms.

*How does one take the inverse of a tensor. I would advise converting to matrix form and using Matlab or a similar code to invert the 6x6 matrix!.

$\sigma_{mn} = \sigma_{nm} \Rightarrow E_{mn\,pq} = E_{nmqp}$ **why switch the pq's?** I made a mistake on the board it should have read $\sigma_{mn} = \sigma_{nm} \Rightarrow E_{mn\,pq} = E_{nm\,pq}$. I.e. only the m and n indices should have been switched.

Why is there a factor of 1/2 on Mohr's circle relating E to G for γ? This is because tensor shear strains are defined as being half engineering shear strains.

Why write μ instead of G if they are equal? Blame Monsieur Lame', they are his constants. It is just convention.

What is uniaxial mean? Uni – means one, so it implies loading on a single axis, loading in a single direction.

Why is the effect of thermal exansion included in the stiffness matrix, but not in the compliance matrix? We will discuss this at the beginning of Monday's lecture. The simple answer is that I had not yet said anything about thermal expansion and how it is included in the tensor/matrix description of elasticity, but we will need to be able to handle this. Well done in reading ahead in the notes.

What do λ and μ describe in the E matrix? We will discuss this at the beginning of Monday's lecture.

What is the matrix (I assume in the sense of the polymer matrix in a composite) **important for? It keeps the fibers joined together, allowing stress to be transferred between fibers.** If you think about the fibers not being joined together ina matrix then the resulting material would have no shear stiffness, or transverse strength or stiffness. Even with the matrix present the transverse and shear moduli and strengths are low, which is why composites are generally used in a laminated form, consisting of layers (plies) of unidirectional fibers.

Whoa generally confused. Sorry to hear that. I suggest some R&R over Thanksgiving and a relaxed reading of your Unified M&S notes. Seriously, the material we are covering can be a little intimidating, but it is really not that difficult. We are just dealing with systems of linear equations linking stress and strain, that we can represent in matrix or tensor form.

Turkey and potatoes will get a higher turnout than the doughnuts. Agreed – but there are limits to my largesse!