**Appendix**

(note we’re using Einstein summation convention, implicitly; maybe see Appendix at bottom)

**Appendix: implicit summation and putting things in matrix multiplication form**

Here’s a few matrix equations, reduced to summation notation:



etc. Can verify these equations at leisure. Note that last, for instance, can be written as a­mn = bmacabdbn = cabbmadbn = dbnbmacab, etc. Basically, it doesn’t matter the order of the terms, since multiplication is commutative. But, that doesn’t mean (a) = (b)(c)(d) = (c)(b)(d) = (d)(b)(c), where, e.g., (z) means the matrix z. Rather, in order to interpret the summation notation terms as matrix multiplication, the repeated indices must be side by side. This only happens when you have the terms in the order amn = bmacabdbn. So that’s how we know it is (a) = (b)(c)(d), which is the correct matrix representation. So consider, if you will, an expression like:



If α, β run over indices 1, 2, then this would represent two separate equations:



And we can clearly write this in matrix form,



Now consider,



This represents four different equations.



This can also be expressed in matrix form, but to do so, we have to write the symbols so that repeated indices are side by side. So,



which is:



which can verify is equivalent to the set of four equations we wrote further up. What about expressions like,



Again this represents two equations – going to put prime on the greek indices.



If we agree to say that:



Then we could combine these two equations into matrix form,



And what about coordinate transformations of tensor components. Consider,



This represents four separate equations,



How do we put this in matrix form? Could start by saying,



(XT)nβ is bad notation since it suggests the primed variable is in the denominator, like ∂xn/∂x´β, but that not what we mean here – it’s just the transpose of Xβn = ∂x´β/∂xn. So just keep in mind. Then we can say,



Explicitly,



which agrees with our expressions for T´ab above.