Particle Physics Homework Assignment 2

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Problem 1: Show that $g_{\mu\nu}g^{\mu\nu} = 4$.

Problem 2: Show explicitly that $\Lambda^{\mu}_{\ \alpha}\Lambda^{\ \beta}_{\mu} = \delta^{\ \beta}_{\alpha}$. Use a Lorentz boost in the x-direction ($\vec{\beta} = \frac{v}{c}\hat{x}_0$) in the place of $\Lambda^{\mu}_{\ \nu}$.

Problem 3: Show that the expression $T^{\alpha\beta}x_{\alpha}y_{\beta}$ is a Lorentz invariant provided that $T^{\alpha\beta}$ transforms as a rank-2 tensor and x_{α}, y_{β} transform as covariant vectors.

Problem 4: Show that the 4-derivatives $\frac{\partial}{\partial x^{\mu}}$ and $\frac{\partial}{\partial x_{\mu}}$ transform as Lorentz covariant and contravariant vectors respectively.