110b HW Due 3/4/20

1. (a) Show that $u^\mu = \frac{dx^\mu}{d\tau}$ and $a^\mu = \frac{du^\mu}{d\tau}$ must satisfy $a_\mu u^\mu = 0$.

   (b) Let $\vec{a}'$ be the space component of a^μ in the objects own (instantaneous) rest frame (the object is accelerating, but at any instant we can go to a frame where it is at rest). What is $a^{0'}$ in that frame?

   (c) Write $\vec{a}' \cdot \vec{a}'$ in terms of a Lorentz invariant quantity.

   (d) Consider the spacetime trajectory $x \equiv x^1 = x_0(\cosh\lambda - 1)$, $ct = x_0 \sinh\lambda$, where λ is a coordinate along the spacetime worldline of the object, proportional to proper time τ (as shown in the previous HW). Compute the 4-vectors u^μ, a^μ for this trajectory, and also $u_\mu u^\mu$ and $a_\mu u^\mu$ and $a_\mu a^\mu$. Using the above results, determine $\vec{a}' \cdot \vec{a}'$ for this trajectory.

2. Taylor 15.74.

3. Taylor 15.92.