Astro 260, Spring 207
Homework Set 2
Due at the beginning of Class, 02/22

- Problems marked [***Solo Problem***] must be completed without consulting anybody other than Prof. Knop.
- You may freely speak with each other about the other problems. However, the solution you turn in must be your own solution. As a rule of thumb, it should express what you understand, and you should be able to explain your solution if asked. Clearly, if you are sitting next to a friend and just making sure that you both have the same things written down, you aren't just turning in your own work. However, I do encourage you to talk to each other as you try to understand the non-solo problems.

1. [***Solo Problem***] Consider the static weak-field metric (eq. 6.20 in Hartle). Consider the $\Phi(x^i)$ for the Earth. Ignore the Sun, the Galaxy, the orbit of the Earth, the rotation of the Earth, the rotation of the Galaxy, Harry Boxlee's playtime, etc. for purposes of this problem.

(a) Consider two points, one on the surface of the Earth, one a distance 300km (or 0.001 light-seconds) directly above it. Call Δr the difference in the r coordinate value of these two points. What is the value of $(\Delta r - 300\text{km})$?

(b) By what factor $d\tau/dt$ are you time dilated with respect to a very distant observer (who's $d\tau$ is equal to dt)? (Express your answer as $1-$something, since to any reasonable number of significant figures the answer itself is just gonna be 1, which isn't interesting.)

(c) OK, I lied. Consider the Sun, and consider if you were at the same distance from the Sun the Earth is, but nowhere near Earth (so you don't have to worry about Earth's gravity for this part of the problem). (Continue to assume that everything is at rest and not orbiting about anything, which is of course nutty, but hey, the purpose of all of this problem is to play around with gravity, not special relativity.) By what factor $d\tau/dt$ are you time dilated with respect to a very distant observer?

Look up numbers as needed. You may or may not be surprised to find out they are all in the Particle Data Book.... Yes, the Sun is now a particle.

2. Hartle problem 6.6.

3. Hartle problem 6.13. Start this problem by drawing a spacetime diagram that shows the worldlines of the three clocks.

4. Hartle problem 7.12.

5. [***Solo Problem***] Hartle problem 8.2. If you use any computer algebra code to calculate the Christoffel Symbols, be sure to include the code! It won't be too hard to do this one case truly by hand, though, as you've only got two dimensions to worry about.