Exercise sheet 7

Computer algebra.

Most commercial computer algebra systems like Mathematica, Maple,...either contain or can load external packages for calculations in GR. Free alternatives are Maxima or packages written for Python. You can find a basic example for Python on `http://web.phys.ntnu.no/~mika/QF/software.html`, Hartle's webpage `http://web.physics.ucsb.edu/~gravitybook/mathematica.html` contains Mathematica notebooks.

a.) Familiarize yourself with a package of your choice

b.) Calculate the Christoffel symbols, the Riemann and the Ricci tensor as well as the scalar curvature for the FLRW metric,

$$\mathrm{d}s^2 = \mathrm{d}t^2 - R^2(t) \left[\frac{\mathrm{d}r^2}{1 - kr^2} + r^2(\sin^2 \vartheta \mathrm{d}\phi^2 + \mathrm{d}\vartheta^2) \right] \tag{1}$$

with $k = \pm 1$ (positive/negative curvature) or $k = 0$ (flat three-dimensional space).

Solutions are discussed Thursday, 07.03.24