# Problem Set 2

Deadline: March 25, 2021

March 11, 2021

## Problem 1

Show that if $g_{\mu\nu}$ is diagonal, then $g^{\mu\nu}$ is diagonal with corresponding reciprocal diagonal elements.
(Introducing Einstein's Relativity, Ray D' Inverno, Oxford University Press, 1992)

## Problem 2

Two space described by the metric $\tilde{g}_{\mu\nu}$ and $g_{\mu\nu}$ are said to be conformally related if

$$\tilde{g}_{\mu\nu}(x) = \Omega^2(x)g_{\mu\nu} \tag{1}$$

Show that, given two infinitesimal line segments originating from a point, the angle between them is preserved by this conformal transformation.
(Einstein Gravity In A Nutshell, A.Zee, Princeton University Press, 2013)

## Problem 3

$3+1$ Minkowski metric is
$$ds^2 = -dt^2 + dx^2 + dy^2 + dz^2. \tag{2}$$
Find the components $g_{\mu\nu}$ and $g^{\mu\nu}$, of the metric and inverse metric in:

- Rotating coordinates:

$$t' = t \tag{3}$$
$$x' = \sqrt{x^2 + y^2}\cos{(\phi - \omega t)}$$
$$y' = \sqrt{x^2 + y^2}\sin{(\phi - \omega t)}$$
$$z' = z$$

  (General Relativity, R.Wald, University of Chicago Press, 1984)

- Boosted (along x) coordinates:
  Find the boosted coordinates yourself.