

# Schwarzschild metric

This is how Einstein tensor  $G_{\mu\nu}$  is calculated from metric tensor  $g_{\mu\nu}$ .

1. Calculate  $g^{\mu\nu} = (g_{\mu\nu})^{-1}$ .

2. Calculate connection coefficients.

$$\Gamma^{\alpha}_{\beta\gamma} = \frac{1}{2}g^{\alpha\mu}(g_{\mu\beta,\gamma} + g_{\mu\gamma,\beta} - g_{\beta\gamma,\mu})$$

3. Calculate Riemann tensor.

$$R^{\alpha}_{\beta\gamma\delta} = \Gamma^{\alpha}_{\beta\delta,\gamma} - \Gamma^{\alpha}_{\beta\gamma,\delta} + \Gamma^{\alpha}_{\mu\gamma}\Gamma^{\mu}_{\beta\delta} - \Gamma^{\alpha}_{\mu\delta}\Gamma^{\mu}_{\beta\gamma}$$

4. Calculate Ricci tensor.

$$R_{\mu\nu} = R^{\alpha}_{\mu\alpha\nu}$$

5. Calculate Ricci scalar.

$$R = R^{\mu}_{\mu}$$

6. Calculate Einstein tensor.

$$G_{\mu\nu} = R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R$$

This is the Schwarzschild metric.

$$g_{\mu\nu} = \begin{pmatrix} 2M/r - 1 & 0 & 0 & 0 \\ 0 & (1 - 2M/r)^{-1} & 0 & 0 \\ 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & r^2 \sin^2 \theta \end{pmatrix}$$

The Einstein tensor vanishes for the Schwarzschild metric.

$$G_{\mu\nu} = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$