General Relativity II

1 Preliminaries

- Special Relativity
- Tensor Calculus
- Natural units $c = G = \hbar = 1$, Newtonian gravity
- Local inertial frame: free falling observer Equivalence Principles:
  - Weak EP: Locally, free falling motion under gravitational field is indistinguishable from motion in accelerating frame (inertial mass = gravitational mass)
  - Einstein EP: All laws of physics same under gravitational field and accelerating frame
  - Strong EP

2 Differential Geometry

- Connection Γ Levi-Civita connection

$$\Gamma^{\sigma}_{\mu\nu} = \frac{1}{2} g^{\sigma\rho}(\partial_\mu g_{\nu\rho} + \partial_\nu g_{\rho\mu} - \partial_\rho g_{\mu\nu})$$

- Covariant derivative

$$\nabla_\mu V^\mu = \partial_\mu V^\mu + \Gamma^{\mu}_{\mu\lambda} V^\lambda$$

  Christoffel symbol

- Parallel transport