

General Relativity Marathon Tentative Plan

"Matter tells spacetime how to curve"

$$G_{\mu\nu} = 8\pi T_{\mu\nu}$$

"Spacetime tells matter how to move"

$$\frac{\partial^2 x^\lambda}{\partial \tau^2} = -\Gamma_{\mu\nu}^\lambda \frac{\partial x^\mu}{\partial \tau} \frac{\partial x^\nu}{\partial \tau}$$

-John Wheeler

Day 1:

Presentation 1 (time: 9:00 - 9:30): Introduction to General Relativity, overview of what's it all about; quick overview of Spacetime, Einstein's field equations, what it roughly means and what it implies.

Break (9:30 - 9:45)

Presentation 2 (time: 9:45 - 10:45): Introduction to vector spaces, dual spaces, coordinate transformations and tensor product spaces.

Discussion/Questions (10:45 - 11:00)

Break (11:00 - 11:15)

Presentation 3 (time: 11:15 - 12:15): Least action principle, Lagrangians and the formalism

Discussion/Questions (12:15 - 12:30)

Lunch break (12:30 - 1:15) (we gotta see if we can get funding for pizza)

Presentation 4 (time: 1:15 - 2:45): Einstein notation, inner products and the metric tensor, covariance and contravariance, tensor transformations, index gymnastics

Discussion/Questions (2:45 - 3:00)

Presentation 5 (time: 03:00 - 4:30): Special Relativity, Spacetime, 4-vectors and Minkowski space

Discussion/Questions (4:30 - 4:45):

Break (4:45 - 5:00)

Presentation 6 (time: 05:00 - 6:15): Manifolds, curves, tangent and cotangent spaces

Discussion/Questions (6:15 - 6:30)

Day 2:

Presentation 1 (time: 9:00 - 10:15): Tensor fields, metric tensor fields and their transformations

Discussion/Questions + break (10:15 - 10:30)

Presentation 2 (time: 10:30 - 12:00): Parallel transport, covariant derivative, the connection, lie dragging and the lie derivative

Discussion/Questions (12:00 - 12:15)

Lunch Break (12:15 - 1:00)

Presentation 3 (time: 1:00 - 2:30): Equivalence principle and the geodesic equation

Discussion/Questions + Break (2:30 - 2:45)

Presentation 4 (time: 2:45 - 4:15): Curvature tensor, Energy-stress tensor and the Einstein field equations

Discussion/Questions + Break (4:15 - 4:30)

Presentation 5 (time 4:45 - 6:15): Schwarzschild solution to the Einstein field equations, worked examples and applications

Discussion/Questions

Possible Dates 12-13th May [?](#)