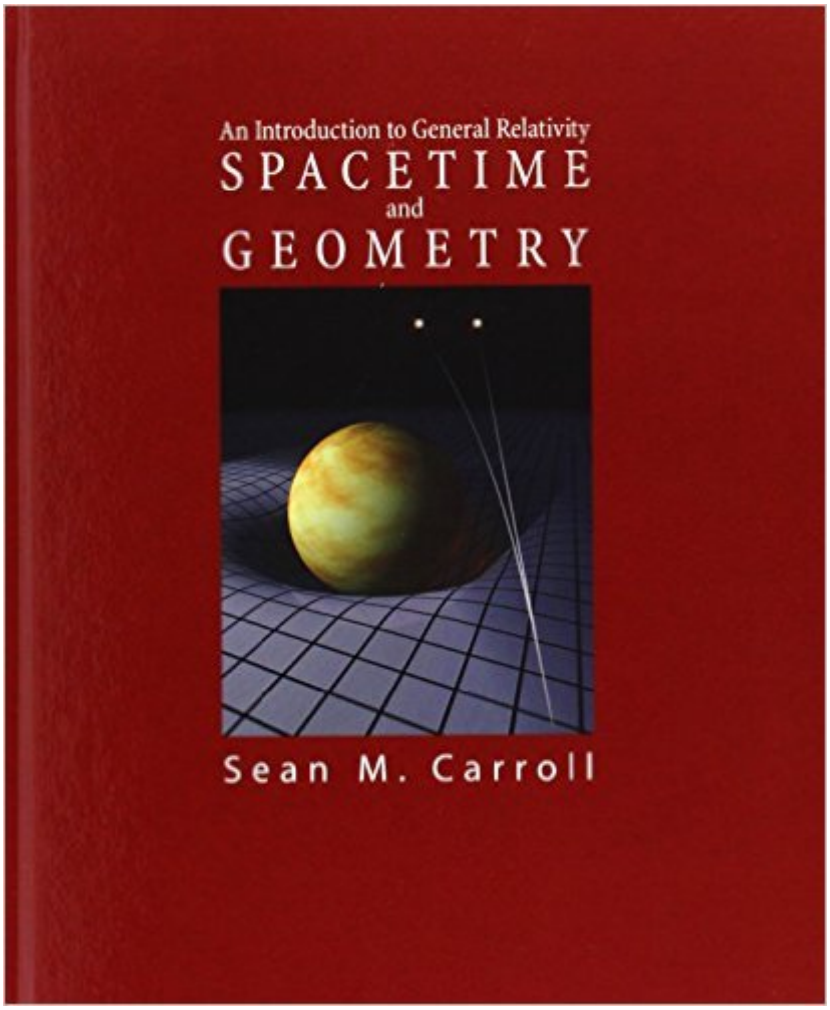
Spacetime And Geometry: An Introduction To General Relativity



Synopsis

Spacetime and Geometry: An Introduction to General Relativity provides a lucid and thoroughly modern introduction to general relativity. With an accessible and lively writing style, it introduces modern techniques to what can often be a formal and intimidating subject. Readers are led from the physics of flat spacetime (special relativity), through the intricacies of differential geometry and Einstein's equations, and on to exciting applications such as black holes, gravitational radiation, and cosmology.

Book Information

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Customer Reviews

I had a course based on that book and I've read chapters 1-6 (out of 9 chapters total) plus all the appendices. Also, I've solved some of the problems.The math chapters 2 and 3 will teach you tensor analysis on manifolds in much clearer way than other books. The book makes a clear distinction between assumptions, choices (like working with a metric compatible connection), or derived facts. It also makes a difference between a Christoffel connection and a generic connection. The appendices will give you a feeling for some new to you math on manifolds like pullbacks, Lie Derivatives, hypersurfaces etc.Chapter 4 is worth reading too cause it makes clear that Einstein's equations are just the simplest guess out of many other possibilities. It shows how we generalize physical laws from special relativity to GR making it clear our choices are the simplest ones but not the only ones possible.The chapters after that discuss applications of GR like black holes, gravitational radiation, cosmology etc. Of these, I've read only the black holes chapters 5 and 6 and I wasn't able to understand 100% what was goin on. The problem was that the book uses concepts

that you still don’t quite understand if you are a beginner like ’spacelike singularity’ or ’conformal diagrams’. That is informative but the book doesn’t provide the necessary level of detail and examples for beginners so you could really master such concepts and use them in your practice.There are problems after each chapter but not the necessary beginners problems that increase your conceptual understanding of the theory. Instead, some are just tedious algebra of type ’find the curvature for some general form of the metric’ for which specialists in the field use symbolic programs like Mathematica. Solving these by hand proves that you can take derivatives and you are a mazochist but not that you understand GR. Other problems are really relevant to your education but are not dirrectly connected to the discussion in the text. Because of that you have to solve them from scratch and it will take you ages ...In retrospective, Carroll’s book is a middle level GR, I sometimes use it as a starting reference for my research (GR applications to Cosmology). It is a book written to inform you and give you the general logical outline of GR together with the differential geometry. It is not constructed to train you to actually apply this stuff in practice - you end up "understanding" indices and geometrical constructs but when the time comes to apply them, you can’t solve a simple physical problem. Being informed well does not equal understanding does not equal mastery.The books that covers the conceptual beginner level and will actually teach you how to apply GR in simple physical situations are James Hartle’s "Gravity: An Introduction to Einstein’s General Relativity" and Bernard Schutz’s "A first course in General Relativity". The Inverno text is with more diff. geometry like Carroll. Is is not as diverse in topics but is more focused and will teach you applications instead of just informing you.

My comments come with a few caveats.1. This is my fourth GR book.2. I’m not hardcore into physics. I’m not a physic grad and I’m reading GR for fun. I have a decent graduate math background but I’ve been corrupted with 10+ years in working in various roles software engineering, electronics engineering and marketing.3. I assume that since you’re considering buying this book, you’re goal is to get at the "real" GR, not the watered down discover channel version.With these caveats in mind, here are my comments.First, on a scale of 1-5, I rank Carroll at level 3 in terms of math/physics maturity and thoroughness. Here is my full ranking of authors from my limited reading: 1. schutz 2. hartle 3. penrose 3. carroll 4. wald 5. physics journal articlesSecond, using the rankings above, I recommend Carroll as the second port of entry. If you’re comfortable with multivariable calculus, start with schutz (#1). You’ll get warm fuzzies doing the toy exercises. But Schutz is tensor/math-lite. If you’ve had advanced calculus and geometry already, jump in with carroll (#3). But you’ll be hard-pressed to find anyone else as polite to the reader. He won’t prepare you for 80

percent of what's published. If you're ready to throw off the training wheels and jump dive into mainstream GR go with Wald (#4).Note that Hartle (#2) is a good "tweener" book with feel-good exercises and some of the full-on GR equations at the end. I bet most instructors teaching a first year grad course would go with Hartle along with a dose of supplementary material.Third, don't expect Carroll to be your last GR book purchase if you want to reach the promised land (see caveat #4). Living and breathing GR is found in physics journals and for that you'll need Wald or another advanced GR book.

This book has helped me long before it was ever published! It is based off of lecture notes that Carroll gave for a graduate level General Relativity course. These notes are still freely available at:[...]But you miss out on extras like better diagrams, more examples and exercises, so this is still a great buy!

I may be biased (as a student there), but the University of Chicago has the market for textbooks on GR cornered. Between Sean Carroll and Bob Wald, the student has everything he needs. I do have to reccomend reading this one first though, as the explanations are more physical (where Wald is more formal) and the style is more readable and easier to digest. In short it is probably the best book on the market from which to learn GR. Once you finish this book, add Wald's to your library for a more complete reference set (Wald's book is likely the best on the market once you already know GR).

In my graduate studies in physics, I had never taken a course in general relativity or differential geometry. Carroll's book is the right place to start. It is very clearly written and it has a wealth of diagrams to help when the discussion tends to get somewhat abstract. I found it enlightening, entertaining, at times deep and always worth the effort. The material on differential geometry and the appendices are examples of textbook writing at its best. If you have the proper background, go here before attempting Wald's General Relativity or any other more advanced treatise. Joseph R. Dell'Aquila, PhD

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