



General Relativity

by precise approach

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Contents

1	Preliminaries	2
1.1	Manifolds	2



1. Preliminaries

1.1. Manifolds

Def 1.1 Topological Manifolds

A manifold M of dimension n is a topological space with the following properties.

- 1) M is Hausdorff
- 2) M is locally Euclidean of dimension n
- 3) M has a countable basis of open sets

Why?

- **Hausdorff** : In Hausdorff space, convergent sequences converge to only one point. If you want to do calculus, you should need Hausdorff space.
- **Locally Euclidean** : This is the main reason that why we require manifolds.
- **Countable Basis** : We need *partition of unity* to bring many properties of Euclidean space. For Hausdorff space, existence of partition of unity require *paracompactness*. And paracompactness follows from *second countability*. It is same as have countable basis.