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### **Pop-Up Geometry**

*The Mathematics Behind Pop-Up Cards*

By Joseph O'Rourke

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Most people can identify with the joy that pop-up books or pop-up cards brought as a child (and may still bring to our adult selves). How many of us have opened a pop-up and wondered about the mathematics required for the image inside to jump off the page? *Pop-Up Geometry* lifts the veil to reveal the magic of the mathematics at play.

*Pop-Up Geometry* requires only a high school math background with knowledge of algebra, geometry, and basic trigonometry. Using this as a launching point, it tackles mathematical concepts such as vectors, parametric equations, solving systems of equations, and platonic solids, grounding each topic in its relationship to pop-up cards. The mathematical concepts, theorems, and exercises are all color coded in easy to digest boxes.

Complete with vibrantly colored graphics, companion animations that depict the motion described in the book, and templates for the reader to make the pop-up creations the book is analyzing, this book makes it easy for the reader to engage with the material they are learning. It also includes exercises broken into different categories based on level of difficulty, and the solutions to the exercises can be found in the last chapter of the book. This would be an excellent book for a high school student or undergraduate interested in mathematics and geometry, or to provide inspiration for activities in a math for liberal arts class.

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### **What are Tensors Exactly?**

By Hongyu Guo

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Most complex definitions evolve over time as the theory surrounding them is developed. Tensors are no different in that regard. They were first introduced by J.W. Gibbs in 1884. Woldemar Voigt developed the idea further in the late 1800s and Hassler Whitney defined a tensor product in the late 1930s. As a relatively young topic, the definition of a tensor has taken on many forms in the recent past. To highlight this issue and the dynamic form of the definition, in the first chapter of the book, Guo gives seven definitions, not all of which are equivalent. This book aims to help clarify what tensors are, in a way that is intuitive, yet maintains a high level of mathematical rigor.

Not all tensors are complicated and unfamiliar; linear transformations, for instance, are tensors. The author frequently creates analogies with structures from linear algebra to help the reader better understand. Several chapters of the book are dedicated to exploring how tensors are used in fields such as physics and machine learning. Some of the topics explored include Gibbs dyadics, the inertia tensor, and Riemannian geometry.

This book is written for students at the advanced undergraduate level or higher. The introduction contains a flow chart which indicates which chapters rely on others, allowing readers to skip chapters without missing required background material. The author also includes interesting historical and philosophical notes addressing questions such as "Is math invented or discovered?" These notes coupled with discussions about common misconceptions make it an informative and multi-faceted book.

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