Lie Groups And Lie Algebras Chapters 7 9 Elements Of Mathematics

Éléments de mathématique

Groupes et algèbres de Lie: Chapitres 7 et 8. Springer. Bourbaki, Nicolas (2005). Lie Groups and Lie Algebras: Chapters 7-9. Elements of Mathematics.

Éléments de mathématique (English: Elements of Mathematics) is a series of mathematics books written by the pseudonymous French collective Nicolas Bourbaki. Begun in 1939, the series has been published in several volumes, and remains in progress. The series is noted as a large-scale, self-contained, formal treatment of mathematics.

The members of the Bourbaki group originally intended the work as a textbook on analysis, with the working title Traité d'analyse (Treatise on Analysis). While planning the structure of the work they became more ambitious, expanding its scope to cover several branches of modern mathematics. Once the plan of the work was expanded to treat other fields in depth, the title Éléments de mathématique was adopted. Topics treated in the series include set theory, abstract...

Lie algebra

y]=xy-yx} . Lie algebras are closely related to Lie groups, which are groups that are also smooth manifolds: every Lie group gives rise to a Lie algebra, which

In mathematics, a Lie algebra (pronounced LEE) is a vector space

g

{\displaystyle {\mathfrak {g}}}

together with an operation called the Lie bracket, an alternating bilinear map

g

×

g

→

g

{\displaystyle {\mathfrak {g}}\times {\mathfrak {g}}\rightarrow {\mathfrak {g}}}

, that satisfies the Jacobi identity. In other words, a Lie algebra is an algebra over a field for which the multiplication operation (called the Lie bracket) is alternating and satisfies the Jacobi identity. The Lie bracket of two vectors...

Lie group

Nicolas, Elements of mathematics: Lie groups and Lie algebras. Chapters 1–3 ISBN 3-540-64242-0, Chapters 4–6 ISBN 3-540-42650-7, Chapters 7–9 ISBN 3-540-43405-4

In mathematics, a Lie group (pronounced LEE) is a group that is also a differentiable manifold, such that group multiplication and taking inverses are both differentiable.

A manifold is a space that locally resembles Euclidean space, whereas groups define the abstract concept of a binary operation along with the additional properties it must have to be thought of as a "transformation" in the abstract sense, for instance multiplication and the taking of inverses (to allow division), or equivalently, the concept of addition and subtraction. Combining these two ideas, one obtains a continuous group where multiplying points and their inverses is continuous. If the multiplication and taking of inverses are smooth (differentiable) as well, one obtains a Lie group.

Lie groups provide a natural model...

Representation of a Lie group

In mathematics and theoretical physics, a representation of a Lie group is a linear action of a Lie group on a vector space. Equivalently, a representation

In mathematics and theoretical physics, a representation of a Lie group is a linear action of a Lie group on a vector space. Equivalently, a representation is a smooth homomorphism of the group into the group of invertible operators on the vector space. Representations play an important role in the study of continuous symmetry. A great deal is known about such representations, a basic tool in their study being the use of the corresponding 'infinitesimal' representations of Lie algebras.

Semisimple Lie algebra

In mathematics, a Lie algebra is semisimple if it is a direct sum of simple Lie algebras. (A simple Lie algebra is a non-abelian Lie algebra without any

In mathematics, a Lie algebra is semisimple if it is a direct sum of simple Lie algebras. (A simple Lie algebra is a non-abelian Lie algebra without any non-zero proper ideals.)

Throughout the article, unless otherwise stated, a Lie algebra is a finite-dimensional Lie algebra over a field of characteristic 0. For such a Lie algebra

g

{\displaystyle {\mathfrak {g}}}

, if nonzero, the following conditions are equivalent:

g

{\displaystyle {\mathfrak {g}}}

is semisimple;

the Killing form

κ

(

x

,

y

)

=

tr

(

ad...

Split Lie algebra

(2005), "VIII: Split Semi-simple Lie Algebras", Elements of Mathematics: Lie Groups and Lie Algebras: Chapters 7–9, Springer, ISBN 978-3-540-43405-4

In the mathematical field of Lie theory, a split Lie algebra is a pair

(

g

,

h

)

{\displaystyle ({\mathfrak {g}},{\mathfrak {h}})}

where

g

{\displaystyle {\mathfrak {g}}}

is a Lie algebra and

h

<

g

{\displaystyle {\mathfrak {h}}<{\mathfrak {g}}}

is a splitting Cartan subalgebra, where "splitting" means that for all

x

∈

h...

Principal subalgebra

sl2-triple. Bourbaki, Nicolas (2005) [1975], Lie groups and Lie algebras. Chapters 7–9, Elements of Mathematics (Berlin), Berlin, New York: Springer-Verlag

In mathematics, a principal subalgebra of a complex simple Lie algebra is a 3-dimensional simple subalgebra whose non-zero elements are regular.

A finite-dimensional complex simple Lie algebra has a unique conjugacy class of principal subalgebras, each of which is the span of an sl2-triple.

Free Lie algebra

"Free Lie algebra over a ring", Encyclopedia of Mathematics, EMS Press Bourbaki, Nicolas (1989). "Chapter II: Free Lie Algebras". Lie Groups and Lie Algebras

In mathematics, a free Lie algebra over a field K is a Lie algebra generated by a set X, without any imposed relations other than the defining relations of alternating K-bilinearity and the Jacobi identity.

Representation theory of semisimple Lie algebras

In mathematics, the representation theory of semisimple Lie algebras is one of the crowning achievements of the theory of Lie groups and Lie algebras. The

In mathematics, the representation theory of semisimple Lie algebras is one of the crowning achievements of the theory of Lie groups and Lie algebras. The theory was worked out mainly by E. Cartan and H. Weyl and because of that, the theory is also known as the Cartan–Weyl theory. The theory gives the structural description and classification of a finite-dimensional representation of a semisimple Lie algebra (over

C

{\displaystyle \mathbb {C} }

); in particular, it gives a way to parametrize (or classify) irreducible finite-dimensional representations of a semisimple Lie algebra, the result known as the theorem of the highest weight.

There is a natural one-to-one correspondence between the finite-dimensional representations of a...

Steinberg formula

of writing a vector as a sum of positive roots. Bourbaki, Nicolas (2005) [1975], Lie groups and Lie algebras. Chapters 7–9, Elements of Mathematics (Berlin)

In mathematical representation theory, Steinberg's formula, introduced by Steinberg (1961), describes the multiplicity of an irreducible representation of a semisimple complex Lie algebra in a tensor product of two irreducible representations.

It is a consequence of the Weyl character formula, and for the Lie algebra sl2 it is essentially the Clebsch–Gordan formula.

Steinberg's formula states that the multiplicity of the irreducible representation of highest weight ν in the tensor product of the irreducible representations with highest weights λ and μ is given by

∑

w

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w

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∈

W

ϵ...

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