

# Lie Algebras - Representation Theory of $sl(n; \mathbb{C})$

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## **Abstract**

Abstract goes here

# 1 Lie Groups

## 1.1 Introduction

General description of Lie Groups:

1. [4]
2. [5, Section 1.1]
3. [5, Section 1.6]

Basic definitions of Lie Groups:

1. [4]
2. [2, Section 1.1]
3. [2, Section 1.5]

## 1.2 Matrix Lie Groups

Matrix lie group examples: [2, Section 1.2]

Exponential of a matrix:

1. [2, Section 2.1]
2. [2, Section 2.2] - Example 2.5

## **2 Lie Algebras**

### **2.1 Introduction**

Overview of Lie Algebras: [3]

Motivation for Lie Algebras: [1, Section 8.1]

### **2.2 Basic Definitions**

Definitions and examples:

1. [1, Section 8.1]
2. [2, Section 3.1]

### **2.3 Lie Algebra of a Matrix Lie Group**

Definitions and theorem: [2, Section 3.3]

Examples: [2, Section 3.4]

### **2.4 The Exponential Map**

Define exponential map: [2, Section 3.7]

State theorems regarding exponential map: [2, Section 3.7]

Compute the exponential map onto  $\mathrm{SO}(2)$ : [5, Section 4.1]

### **2.5 Classification of Lie Algebras**

[1, Chapter 9]

### 3 Representations of $sl(2; \mathbb{C})$

Discuss complexification of  $su(2)$  and that  $su(2)$  is isomorphic to  $so(3)$ : [2, Section 4.6]

Discuss physical significance of the representations:

1. [2, Section 4.6]
2. [4, Section 5]
3. [3, Section 4.4]

Basis of  $sl(2; \mathbb{C})$ : [2, Section 4.6]

Characterize irreducible representations: [1, Section 11.1]

## 4 Conclusion

Summarize key ideas here.

## References

- [1] Fulton, William, and Joe Harris. *Representation Theory: A First Course*. Springer, 2004.
- [2] Hall, Brian C. *Lie Groups, Lie Algebras, and Representations: An Elementary Introduction*. Springer, 2016.
- [3] “Lie Algebra.” *Wikipedia*, Wikimedia Foundation, 16 Apr. 2021, [en.wikipedia.org/wiki/Lie\\_algebra](https://en.wikipedia.org/wiki/Lie_algebra).
- [4] “Lie Group.” *Wikipedia*, Wikimedia Foundation, 21 Apr. 2021, [en.wikipedia.org/wiki/Lie\\_algebra](https://en.wikipedia.org/wiki/Lie_algebra).
- [5] Stillwell, John. *Naive Lie Theory*. Springer, 2012.