

# On the Convergence of Conjugate Gradient Variants in Finite Precision Arithmetic

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This is a companion piece to the publication:

```
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A preprint will be on ArXiv in the near future.

## Why should I care?

Need new algorithms to deal with modern HPC architecture. But can't sacrifice accuracy.

Take advantage of lower precision for ML type applications.

## Introduction

If you are not familiar with the Conjugate Gradient method, it may be worth reading this page first.

The Conjugate Gradient algorithm is a widely used method for solving  $Ax = b$  when  $A$  is positive definite (all eigenvalues are positive).

## Conjugate Gradient In Finite Precision

- The CG algorithm can be derived by minimizing the  $A$ -norm of the error at each step.

## **Numerical Problems**

- introduction to floating points failing to be associative
- even worse in low precision
- give an example of error analysis for HSCG
- full results in paper

## **Avoiding Communication**

- give example with inner product vs sparse matrix product
- derive CGCG and GVCG by replacing recurrences

## **Concusion**