

# GAP Introduction

Gaoli Chen

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# Installation

- ▶ GAP: Groups, Algorithms, Programming - a System for Computational Discrete Algebra
- ▶ Download: <http://www.gap-system.org/>
- ▶ Follow the installation guideline.
  - ▶ For ubuntu system: suggest create a personal folder under /data and install gap in the folder.
- ▶ Manual:  
<https://www.gap-system.org/Manuals/doc/ref/chap0.html>

# Run GAP

- ▶ `gap4r7/bin/gap.sh`
- ▶ Run script directly in terminal
- ▶ Run script from file

# Basic syntax

- ▶ Semicolon: statements end with semicolon.
  - ▶ output results: `1+2;`
  - ▶ not print result: `1+2;;`
- ▶ Assignment: `x:=1+2;`
- ▶ Demo function: `SumOfNumbersBetween`

# List manipulation

- ▶ Create a list: `x := []; y:= [1..9]; z:= [1,2,4]`
- ▶ Create another from existing list: `List(y, e -> e^2); List(y, e -> IsPrime(e));`
- ▶ Update elements: `z[2] := 5; Add(z, 9);`
- ▶ Find prime in the list: `First(y, h -> IsPrime(h));`

## Create a group

- ▶ `g1 := AlternatingGroup(4); g2 := PSL(2,7);`
- ▶ `G := GroupByGenerators([(1, 2, 3), (2, 3, 4)]);`
- ▶ `g := SmallGroup(12, 3);`
- ▶ `CreateGroupDemo`

# Character Table and Representations

- ▶ `charTab := CharacterTable(a4);`
- ▶ `irr := Irr(a4);`
- ▶ `CharacterTableDemo1, CharacterTableDemo12,`
- ▶ `LoadPackage("repsn");`
- ▶ `RepresentationDemo1`

# Finitely Presentation Group

- ▶ A4:  $\langle a, b | a^2 = b^3 = (ab)^3 = e \rangle$
- ▶ FinitelyPresentationDemo



# Automomorphism

- ▶ `autG := AutomorphismGroup(G);`
- ▶ `innG := InnerAutomorphismsAutomorphismGroup(autG);`
- ▶ `AutomorphismDemo();`



# Use GAP from other platform

- ▶ Load GAP data to Mathematica
  - ▶ Demo: `extractGroupData` , `gapdemo.np`
- ▶ SAGE: <http://www.sagemath.org/>

# Demo files

- ▶ `gapdemo.nb` and `gap_demo.gap` are in  
<https://github.com/gaolichen/psl27cg/tree/master/gapdemo>
- ▶ `extractGroupData.gap` is in  
<https://github.com/gaolichen/psl27cg/tree/master/mpackage>
- ▶ `extractGroupData.m` is in  
<https://github.com/gaolichen/psl27cg/tree/master/gapcode>

Thank you!