

FGB3.0 - An Overview Of Features

FGB - Finite Group Behavior is a tool for beginners to play and discover with concrete examples of groups. The program works with a library of all finite groups up to isomorphism of order 16 or less and all non-abelian groups of order 40 or less. The group tables are stored as simple text files in a specialized format and the program allows one to keep notes on the features discovered as part of the file for each group. Many groups can be opened simultaneously and studied for purposes of comparison. Groups can be presented with elements that have abstract names or, in most cases, with elements that have more descriptive names. In particular, there are 7 tabs for analyzing any group: (For a more detailed description of these tabs - please see the attached preprint which discusses FGB version 2 only).¹

- Axiom Check This allows one to verify the axioms for a given group table: associativity, existence of an identity, and inverses. **New in version 3.0 is that all but the associativity check are now done automatically and during this process the inverse and order of each element is calculated for easy reference.** This is an important source of verification for new groups when they are added to the library.
- Calculator All New for Version 3.0! This tab allows one to easily calculate powers and inverses for elements as well as complicated calculations involving lots of elements. Any computation performed is always indicated in full by the program and can be recorded in the notes for later reference. In the next version of FGB (Version 4), we hope that this section will be expanded to allow the program to accept equations with one or more unknowns which it can then search iteratively for solutions.
- Group Table This is where the Cayley table for the group is displayed and where the group can be reordered or the elements renamed.
- Subgroup table This is where subgroups of the open group can be formed. **New for Version 3.0 is the option to single step through with the program as it accepts a collection of elements from the user and seeks to find its closure under the group operation.** Cosets for groups can be viewed in a special colored framework which allows one to easily see whether the resulting collection of cosets forms a group or not. Subgroups can be conjugated by arbitrary elements and both Factor groups and Subgroups can be exported to create their own group files. Subgroups found can be recorded in the notes for later reference.
- Commutativity This is where the center of the group and centralizers of elements can easily be computed.
- Homomorphisms This is where homomorphisms can be constructed (**New for Version 3.0 - and recorded**) between any two group files. To construct a homomorphism from group \mathcal{G} to group \mathcal{H} , make sure both \mathcal{G} and \mathcal{H} are open. Go to the Homomorphism tab of the domain \mathcal{G} and select \mathcal{H} as the range group.
- Notes This is where features about the group can be recorded, sometimes automatically by the program or just with your typing. The notes also contain explanatory information about the groups when this is appropriate including an explanation of the notation for the descriptive elements.

¹The main form is where one can open new groups, change the form of elements, or display all open groups in a tiled fashion.