ABSTRACT
Groups are applied to everyday life from basic algebra, solutions for Rubik's Cube, to quantum computing and error correcting codes. This project especially focuses on extending the Pgrp2gen package for the GAP system to include a new classification of $p$-groups by Blackburn in 1999.

BACKGROUND
Mathematical Terms
Group:
Set $G$ with a binary operator $\cdot$ that satisfies
(i) $\forall a, b, c \in G, (a \cdot b) \cdot c = a \cdot (b \cdot c)$
(ii) $\exists e \in G, \forall a \in G, e \cdot a = a \cdot e = a$
(iii) $\forall a \in G, \exists b \in G, a \cdot b = b \cdot a = e$
Finite $p$-group:
A group whose size or order is a $p$-power.
$|G| = p^n$ where $p$ is prime, $n > 1$.
Isomorphism:
Algebraic equivalence of groups
$d$-generator:
Groups generated by $d$ elements
Derived subgroups:
\[ G' = \langle [a, b] | a, b \in G \rangle \]
Systems
GAP:
A system for computational discrete algebra
Pgrp2Gen:
The initial package for GAP developed by Dr. Morse and Kelly Brunemann in 2011.

PROBLEM
Classify up to isomorphism all $d$-generator $p$-groups whose derived subgroup has order of size $p$, for $p > 2$. Closely related to 2-generator class 2 groups, clean up, update, refactor, and add PgrpdGendp to the Pgrp2gen package.

LESSONS LEARNED
• Building on an existing system
• Updating of a system
• Debugging on an unfamiliar system
• Regularly rescheduling
• Working both in a group and individually

RESULT
Cleanup & Refactoring
Removed extra code, formatted, and added comments.
Update
Documents are written from TeX to GAPDoc. GAPDoc produces multiple formats.
Testing
Tested group constructors and methods.
Add pgrpdGendp
Implementation is to create $p$-groups by Blackburn’s classification.

CONCLUSION
This project has met the problem and specifications by
• generating PgrpdGendp of order $p^n$ of such group
• improving readability of both packages
• modernizing documentations for the packages
Future work will be Meich groups 2 generator $p$-group with cyclic derived subgroup.