

The Representations of GF(8) in $GL_3(2)$

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1 Introduction

$GL_3(2)$ is the set of all 3×3 nonsingular matrices over the field GF(2). Each representation consists of a cyclic group of seven nonsingular matrices, plus the zero matrix. This list was generated using the following GF2Matrices code.

```
Group3 G3,G3x;  
G3.GenerateOrder(7);  
GroupList3 GL3;  
Matrix3 Z(0);  
for (Matrix3 * Temp = G3.GetFirstMatrix() ; Temp ; Temp = G3.GetNextMatrix())  
{  
    G3x.Clear();  
    G3x.Add(*Temp);  
    G3x.Close();  
    G3x.Add(Z);  
    G3x.Sort();  
    if (!GL3.Contains(G3x))  
    {  
        GL3.Add(G3x);  
    }  
}  
cout<<GL3->SerializeNL();
```

There are 8 groups of 8 matrices each. The identity element and the zero matrix are shared between all representations. Otherwise, the representations are disjoint.

2 The representations

000 001 010 011 100 101 110 111
000 011 111 100 010 001 101 110
000 110 011 101 001 111 010 100

000 001 010 011 100 101 110 111
000 011 101 110 010 001 111 100
000 111 011 100 001 110 010 101

000 001 010 011 100 101 110 111
000 100 101 001 010 110 111 011
000 011 100 111 001 010 101 110

000 001 010 011 100 101 110 111
000 100 011 111 010 110 001 101
000 110 100 010 001 111 101 011

000 001 010 011 100 101 110 111
000 101 011 110 010 111 001 100
000 010 101 111 001 011 100 110

000 001 010 011 100 101 110 111
000 101 001 100 010 111 011 110
000 111 101 010 001 110 100 011

000 001 010 011 100 101 110 111
000 110 111 001 010 100 101 011
000 010 110 100 001 011 111 101

000 001 010 011 100 101 110 111
000 110 001 111 010 100 011 101
000 011 110 101 001 010 111 100