

The folder "PrimitiveSD\_prime\_power" contains ten files named "SymDes $v$ ",  $v = 16, 27, 64, 121, 243, 256, 343, 1024, 1331, \text{ and } 2187$ . For each  $v$ , SymDes $v$  contains the list "D $v$ " which is a record of all constructed primitive symmetric designs with  $v$  points. The point set of all designs is  $\{1, 2, 3, \dots, v\}$ .

The record of a particular design is an element of the list "D $v$ ", say  $i$ -th element D $v$ [ $i$ ]. For instance, list "D243" from the file "SymDes243" has two elements: D243[1] and D243[2]. The latter is (243, 121, 60) Paley design record.

The abbreviation "**rec**" stands at the beginning of each list element. It separates different designs if the list has more than one element.

The record of a design D $v$ [ $i$ ] has the following two important components:

1. *Aut*D $v$ [ $i$ ] generators' permutation representation;
2. set  $B$  of all blocks of D $v$ [ $i$ ].

Besides, the record gives some other information on the design. Because of the transitivity, any block  $B \in B$  is a base block of D $v$ [ $i$ ] and the other blocks can be obtained by the action of *Aut*D $v$ [ $i$ ] on  $B$ .

The readers not acquainted with GAP can use SymDes $v$  files as text files with information on designs' full automorphism groups permutation representation and basic blocks.

For instance, the first element D243[1] of the list "D243" in the file "SymDes243" contains, among the rest,

1. the full automorphism group of D243[1] given by:

```
...autGroup := Group([( 1, 2, 3)( 4, 5, 6).....(106,180,222,206,177)]),...
```

2. The list of all blocks of D243[1]:

```
...blocks :=
[ [ 1, 2, 3, 4, 5, 6, 7, 8, 11, 21, 24, 25, 27, 28, 29, 31, 34, 35, 36, 38, 39, 40,
42, 45, 46, 49, 50, 51, 52, 53,
54, 55, 57, 60, 61, 68, 69, 71, 80, 81, 83, 84, 85, 88, 91, 93, 94, 95, 97, 99,
100, 103, 104, 105, 106, 112,
113, 114, 115, 116, 120, 121, 124, 125, 129, 130, 132, 133, 134, 135, 136, 137,
138, 140, 141, 144, 147, 148,
149, 151, 152, 155, 157, 159, 162, 165, 167, 171, 173, 174, 176, 177, 178, 182,
183, 188, 189, 191, 194, 196,
198, 199, 201, 202, 208, 210, 213, 214, 215, 218, 221, 222, 223, 225, 227, 232,
233, 234, 240, 241, 243 ],....
....,[ 9, 10, 13, 14, 16, 19, 20, 21, 23, 24, 25, 26, 27, 28, 29, 31,
34, 36, 37, 38, 39, 40, 41, 42, 44, 47, 49, 50, 51, 53, 54, 55, 57, 60, 67, 69, 73,
77, 79, 80, 83, 84, 85,
86, 88, 89, 91, 92, 93, 95, 98, 101, 104, 106, 108, 110, 113, 114, 115, 118, 119,
121, 122, 123, 124, 127,
128, 129, 131, 132, 137, 138, 140, 141, 142, 145, 146, 148, 153, 154, 156, 157,
160, 161, 162, 163, 165, 167,
169, 171, 175, 177, 178, 180, 183, 184, 187, 191, 196, 197, 199, 203, 204, 205,
206, 210, 211, 212, 216, 220,
221, 222, 225, 226, 229, 230, 235, 237, 238, 239, 243 ] ],...
```

The list of designs is read into GAP using `Read("name-file")`. Here is a simple analysis in GAP for the example above:

```

gap> Read("path/SymDes243");;
gap> Length(D243);
2
gap> G:=D243[1].autGroup;;
gap> Size(G);
13365
gap> gen:=GeneratorsOfGroup(G);;
gap> Length(gen);
3
gap> gen[1];
(1,2,3)(4,5,6)(7,8,9)(10,11,12)(13,14,15)(16,17,18)(19,20,21)(22,23,24)(25,26,
27)(28,29,30)(31,32,33)(34,35,36)(37,38,39)(40,41,42)(43,44,45)(46,47,48)(49,
50,51)(52,53,54)(55,56,57)(58,59,60)(61,62,63)(64,65,66)(67,68,69)(70,71,
72)(73,74,75)(76,77,78)(79,80,81)(82,83,84)(85,86,87)(88,89,90)(91,92,93)(94,
95,96)(97,98,99)(100,101,102)(103,104,105)(106,107,108)(109,110,111)(112,113,
114)(115,116,117)(118,119,120)(121,122,123)(124,125,126)(127,128,129)(130,131,
132)(133,134,135)(136,137,138)(139,140,141)(142,143,144)(145,146,147)(148,149,
150)(151,152,153)(154,155,156)(157,158,159)(160,161,162)(163,164,165)(166,167,
168)(169,170,171)(172,173,174)(175,176,177)(178,179,180)(181,182,183)(184,185,
186)(187,188,189)(190,191,192)(193,194,195)(196,197,198)(199,200,201)([...])
gap> blocks:=D243[1].blocks;;
gap> base:=blocks[1];
[ 1, 2, 3, 4, 5, 6, 7, 8, 11, 21, 24, 25, 27, 28, 29, 31, 34, 35, 36, 38, 39,
40, 42, 45, 46, 49, 50, 51, 52, 53, 54, 55, 57, 60, 61, 68, 69, 71, 80, 81,
83, 84, 85, 88, 91, 93, 94, 95, 97, 99, 100, 103, 104, 105, 106, 112, 113,
114, 115, 116, 120, 121, 124, 125, 129, 130, 132, 133, 134, 135, 136, 137,
138, 140, 141, 144, 147, 148, 149, 151, 152, 155, 157, 159, 162, 165, 167,
171, 173, 174, 176, 177, 178, 182, 183, 188, 189, 191, 194, 196, 198, 199,
201, 202, 208, 210, 213, 214, 215, 218, 221, 222, 223, 225, 227, 232, 233,
234, 240, 241, 243 ]
gap> Length(base);
121
*****
*****

```

Should our files be used for more detailed analysis, "GRAPE" and "DESIGN" packages have to be installed under GAP. These packages are loaded within GAP by calling the statement:

```

gap> LoadPackage("grape");
true
gap> LoadPackage("design");
true

```

For more information the reader is pointed to:

L.H. Soicher, The DESIGN package for GAP, Version 1.3, 2006,  
[http://designtheory.org/software/gap\\_design/](http://designtheory.org/software/gap_design/)

L.H. Soicher, The GRAPE package for GAP, Version 4.3, 2006,  
<http://www.maths.qmul.ac.uk/~leonard/grape/>