

# 1 BLT set 7 over GF(47)

Points on the quadric  $x_0^2 + x_1x_2 + x_3x_4$ :

$$P_1 = (0, 1, 0, 0, 0)$$

$$P_2 = (0, 0, 1, 0, 0)$$

$$P_3 = (0, 1, 28, 46, 28)$$

$$P_4 = (0, 1, 7, 23, 14)$$

$$P_5 = (0, 1, 42, 35, 27)$$

$$P_6 = (1, 2, 24, 4, 23)$$

$$P_7 = (1, 22, 19, 40, 33)$$

$$P_8 = (1, 31, 29, 45, 27)$$

$$P_9 = (1, 22, 41, 27, 24)$$

$$P_{10} = (1, 12, 18, 7, 16)$$

$$P_{11} = (1, 36, 34, 15, 28)$$

$$P_{12} = (1, 22, 26, 19, 2)$$

$$P_{13} = (1, 1, 7, 8, 46)$$

$$P_{14} = (1, 5, 19, 44, 32)$$

$$P_{15} = (1, 21, 2, 39, 23)$$

$$P_{16} = (1, 45, 30, 27, 37)$$

$$P_{17} = (1, 37, 42, 37, 38)$$

$$P_{18} = (1, 4, 42, 10, 16)$$

$$P_{19} = (1, 33, 11, 6, 2)$$

$$P_{20} = (1, 42, 16, 27, 36)$$

$$P_{21} = (1, 43, 46, 24, 37)$$

$$P_{22} = (1, 34, 8, 20, 31)$$

$$P_{23} = (1, 4, 8, 35, 38)$$

$$P_{24} = (1, 27, 16, 41, 33)$$

$$P_{25} = (1, 25, 17, 44, 1)$$

$$P_{26} = (1, 10, 38, 7, 6)$$

$$P_{27} = (1, 14, 8, 32, 42)$$

$$P_{28} = (1, 10, 26, 22, 33)$$

$$P_{29} = (1, 16, 34, 22, 3)$$

$$P_{30} = (1, 26, 11, 1, 42)$$

$$P_{31} = (1, 33, 44, 26, 11)$$

$$P_{32} = (1, 31, 40, 29, 35)$$

$$P_{33} = (1, 7, 36, 32, 20)$$

$$P_{34} = (1, 1, 42, 33, 40)$$

$$P_{35} = (1, 8, 27, 2, 9)$$

$$P_{36} = (1, 5, 23, 29, 43)$$

$$P_{37} = (1, 23, 15, 31, 4)$$

$$P_{38} = (1, 33, 40, 40, 41)$$

$$P_{39} = (1, 25, 27, 17, 10)$$

$$P_{40} = (1, 35, 5, 43, 44)$$

$$P_{41} = (1, 39, 30, 17, 3)$$

$$P_{42} = (1, 41, 45, 10, 41)$$

$$P_{43} = (1, 18, 4, 35, 10)$$

$$P_{44} = (1, 26, 39, 6, 11)$$

$$P_{45} = (1, 32, 34, 23, 16)$$

$$P_{46} = (1, 10, 31, 44, 41)$$

$$P_{47} = (1, 38, 45, 35, 29)$$

$$P_{48} = (1, 3, 25, 43, 19)$$

Stabilizer of order 12 is generated by:

$$g_1 = \begin{pmatrix} 28 & 0 & 0 & 22 & 5 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 27 & 1 & 10 & 2 \\ 26 & 2 & 0 & 9 & 45 \\ 11 & 10 & 0 & 44 & 9 \end{pmatrix}$$

$$g_2 = \begin{pmatrix} 3 & 37 & 0 & 31 & 24 \\ 0 & 8 & 36 & 39 & 36 \\ 42 & 12 & 8 & 28 & 41 \\ 12 & 41 & 36 & 38 & 39 \\ 39 & 28 & 39 & 24 & 38 \end{pmatrix}$$

$$g_3 = \begin{pmatrix} 3 & 22 & 46 & 16 & 42 \\ 12 & 21 & 34 & 21 & 33 \\ 33 & 8 & 42 & 12 & 34 \\ 30 & 23 & 7 & 44 & 9 \\ 40 & 14 & 36 & 27 & 30 \end{pmatrix}$$

The induced group has order 12 and is generated by:

$$g_1 = (2, 4)(5, 24)(6, 11)(7, 16)(8, 15)(9, 12)(10, 41)(13, 43)(14, 23)(17, 28)(18, 32)(19, 42)(20, 44)(21, 37)(22, 47)(25, 27)(26, 48)(29, 38)(30, 33)(31, 35)(34, 36)(39, 45)(40, 46)$$

$$g_2 = (1, 3)(2, 33)(4, 30)(5, 21)(6, 47)(7, 27)(8, 39)(9, 38)(10, 36)(11, 22)(12, 29)(13, 23)(14, 43)(15, 45)(16, 25)(17, 48)(18, 42)(19, 32)(20, 35)(24, 37)(26, 28)(31, 44)(34, 41)$$

$$g_3 = (1, 17, 28)(2, 31, 14)(3, 26, 48)(4, 23, 35)(5, 10, 38)(6, 19, 39)(7, 27, 46)(8, 32, 47)(9, 36, 21)(11, 45, 42)(12, 37, 34)(13, 30, 20)(15, 22, 18)(16, 40, 25)(24, 29, 41)(33, 43, 44)$$

group order is small, so we list all elements  $a_1 = \text{id}$

$$a_2 = (2, 4)(5, 24)(6, 11)(7, 16)(8, 15)(9, 12)(10, 41)(13, 43)(14, 23)(17, 28)(18, 32)(19, 42)(20, 44)(21, 37)(22, 47)(25, 27)(26, 48)(29, 38)(30, 33)(31, 35)(34, 36)(39, 45)(40, 46)$$

$$a_3 = (1, 3)(2, 33)(4, 30)(5, 21)(6, 47)(7, 27)(8, 39)(9, 38)(10, 36)(11, 22)(12, 29)(13, 23)(14, 43)(15, 45)(16, 25)(17, 48)(18, 42)(19, 32)(20, 35)(24, 37)(26, 28)(31, 44)(34, 41)$$

$$a_4 = (1, 3)(2, 30)(4, 33)(5, 37)(6, 22)(7, 25)(8, 45)(9, 29)(10, 34)(11, 47)(12, 38)(13, 14)(15, 39)(16, 27)(17, 26)(18, 19)(20, 31)(21, 24)(23, 43)(28, 48)(32, 42)(35, 44)(36, 41)(40, 46)$$

$$a_5 = (1, 17, 28)(2, 31, 14)(3, 26, 48)(4, 23, 35)(5, 10, 38)(6, 19, 39)(7, 27, 46)(8, 32, 47)(9, 36, 21)(11, 45, 42)(12, 37, 34)(13, 30, 20)(15, 22, 18)(16, 40, 25)(24, 29, 41)(33, 43, 44)$$

$$a_6 = (1, 17)(2, 23)(3, 26)(4, 31)(5, 29)(6, 45)(7, 40)(8, 22)(9, 37)(10, 24)(11, 19)(12, 36)(13, 44)(14, 35)(15, 32)(16, 27)(18, 47)(20, 33)(21, 34)(25, 46)(30, 43)(38, 41)(39, 42)$$

$$a_7 = (1, 26)(2, 43)(3, 17)(4, 20)(5, 9)(6, 8)(7, 46)(10, 21)(11, 18)(12, 41)(13, 35)(14, 44)(15, 42)(19, 47)(22, 45)(23, 30)(24, 34)(25, 40)(28, 48)(29, 37)(31, 33)(32, 39)(36, 38)$$

$$a_8 = (1, 26, 28, 3, 17, 48)(2, 20, 14, 30, 31, 13)(4, 43, 35, 33, 23, 44)(5, 34, 38, 37, 10, 12)(6, 18, 39, 22, 19, 15)(7, 16, 46, 25, 27, 40)(8, 42, 47, 45, 32, 11)(9, 41, 21, 29, 36, 24)$$

$$a_9 = (1, 28)(2, 35)(3, 48)(4, 14)(5, 41)(6, 42)(7, 25)(8, 18)(9, 34)(10, 29)(11, 39)(12, 21)(13, 33)(15, 47)(16, 46)(19, 45)(20, 43)(22, 32)(23, 31)(24, 38)(27, 40)(30, 44)(36, 37)$$

$$a_{10} = (1, 28, 17)(2, 14, 31)(3, 48, 26)(4, 35, 23)(5, 38, 10)(6, 39, 19)(7, 46, 27)(8, 47, 32)(9, 21, 36)(11, 42, 45)(12, 34, 37)(13, 20, 30)(15, 18, 22)(16, 25, 40)(24, 41, 29)(33, 44, 43)$$

$$a_{11} = (1, 48)(2, 44)(3, 28)(4, 13)(5, 36)(6, 32)(8, 19)(9, 10)(11, 15)(12, 24)(14, 33)(16, 40)(17, 26)(18, 45)(20, 23)(21, 38)(22, 42)(27, 46)(29, 34)(30, 35)(31, 43)(37, 41)(39, 47)$$

$$a_{12} = (1, 48, 17, 3, 28, 26)(2, 13, 31, 30, 14, 20)(4, 44, 23, 33, 35, 43)(5, 12, 10, 37, 38, 34)(6, 15, 19, 22, 39, 18)(7, 40, 27, 25, 46, 16)(8, 11, 32, 45, 47, 42)(9, 24, 36, 29, 21, 41)$$

and now the elements themselves:  $a_1 = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$

$$a_2 = \begin{pmatrix} 28 & 0 & 0 & 22 & 5 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 27 & 1 & 10 & 2 \\ 26 & 2 & 0 & 9 & 45 \\ 11 & 10 & 0 & 44 & 9 \end{pmatrix}$$

$$a_3 = \begin{pmatrix} 3 & 37 & 0 & 31 & 24 \\ 0 & 8 & 36 & 39 & 36 \\ 42 & 12 & 8 & 28 & 41 \\ 12 & 41 & 36 & 38 & 39 \\ 39 & 28 & 39 & 24 & 38 \end{pmatrix}$$

$$a_4 = \begin{pmatrix} 26 & 10 & 0 & 38 & 28 \\ 0 & 8 & 36 & 39 & 36 \\ 5 & 36 & 8 & 5 & 22 \\ 14 & 22 & 36 & 3 & 31 \\ 19 & 5 & 39 & 34 & 3 \end{pmatrix}$$

$$a_5 = \begin{pmatrix} 3 & 22 & 46 & 16 & 42 \\ 12 & 21 & 34 & 21 & 33 \\ 33 & 8 & 42 & 12 & 34 \\ 30 & 23 & 7 & 44 & 9 \\ 40 & 14 & 36 & 27 & 30 \end{pmatrix}$$

$$a_6 = \begin{pmatrix} 4 & 17 & 24 & 0 & 20 \\ 12 & 21 & 34 & 21 & 33 \\ 32 & 34 & 21 & 39 & 41 \\ 10 & 41 & 33 & 1 & 4 \\ 0 & 39 & 21 & 27 & 1 \end{pmatrix}$$

$$a_7 = \begin{pmatrix} 40 & 12 & 33 & 17 & 43 \\ 40 & 24 & 16 & 45 & 5 \\ 6 & 14 & 24 & 22 & 13 \\ 45 & 13 & 5 & 27 & 34 \\ 32 & 22 & 45 & 2 & 27 \end{pmatrix}$$

$$a_8 = \begin{pmatrix} 14 & 27 & 37 & 46 & 19 \\ 40 & 24 & 16 & 45 & 5 \\ 2 & 37 & 32 & 7 & 25 \\ 4 & 10 & 46 & 19 & 17 \\ 6 & 14 & 20 & 10 & 6 \end{pmatrix}$$

$$a_9 = \begin{pmatrix} 22 & 24 & 46 & 27 & 30 \\ 23 & 42 & 34 & 36 & 7 \\ 12 & 2 & 42 & 24 & 14 \\ 15 & 14 & 7 & 18 & 16 \\ 37 & 24 & 36 & 30 & 18 \end{pmatrix}$$

$$a_{10} = \begin{pmatrix} 3 & 19 & 24 & 33 & 13 \\ 23 & 42 & 34 & 36 & 7 \\ 11 & 8 & 21 & 14 & 23 \\ 21 & 34 & 33 & 30 & 9 \\ 8 & 12 & 21 & 27 & 44 \end{pmatrix}$$

$$a_{11} = \begin{pmatrix} 11 & 39 & 37 & 1 & 35 \\ 42 & 32 & 16 & 20 & 46 \\ 43 & 37 & 32 & 23 & 3 \\ 41 & 3 & 46 & 10 & 39 \\ 24 & 23 & 20 & 28 & 10 \end{pmatrix}$$

$$a_{12} = \begin{pmatrix} 14 & 4 & 33 & 12 & 8 \\ 42 & 32 & 16 & 20 & 46 \\ 37 & 37 & 24 & 14 & 10 \\ 33 & 25 & 5 & 6 & 17 \\ 23 & 7 & 45 & 10 & 19 \end{pmatrix}$$

Kernel has order 1 and is generated by:

There are 5 orbits on the BLT set.

The orbit length are  $[12^3, 6^2]$

The orbits are:

$$O_0 = \{1, 3, 17, 26, 28, 48\} \text{ (length 6)}$$

$$O_1 = \{2, 4, 13, 14, 20, 23, 30, 31, 33, 35, 43, 44\} \text{ (length 12)}$$

$$O_2 = \{5, 9, 10, 12, 21, 24, 29, 34, 36, 37, 38, 41\} \text{ (length 12)}$$

$$O_3 = \{6, 8, 11, 15, 18, 19, 22, 32, 39, 42, 45, 47\} \text{ (length 12)}$$

$$O_4 = \{7, 16, 25, 27, 40, 46\} \text{ (length 6)}$$

The actions induced on the orbits are:

$$\text{Induced action on orbit } O_0 = \{1, 3, 17, 26, 28, 48\} \text{ (length 6)}$$

The induced group has order 12 and is generated by:

$$g_1 = (3, 5)(4, 6)$$

$$g_2 = (1, 2)(3, 6)(4, 5)$$

$$g_3 = (1, 3, 5)(2, 4, 6)$$

group order is small, so we list all elements  $a_1 = \text{id}$

$$a_2 = (3, 5)(4, 6)$$

$$a_3 = (1, 2)(3, 6)(4, 5)$$

$$a_4 = (1, 2)(3, 4)(5, 6)$$

$$a_5 = (1, 3, 5)(2, 4, 6)$$

$$a_6 = (1, 3)(2, 4)$$

$$a_7 = (1, 4)(2, 3)(5, 6)$$

$$a_8 = (1, 4, 5, 2, 3, 6)$$

$$a_9 = (1, 5)(2, 6)$$

$$a_{10} = (1, 5, 3)(2, 6, 4)$$

$$a_{11} = (1, 6)(2, 5)(3, 4)$$

$$a_{12} = (1, 6, 3, 2, 5, 4)$$

and now the elements themselves:  $a_1 = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$

$$a_2 = \begin{pmatrix} 28 & 0 & 0 & 22 & 5 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 27 & 1 & 10 & 2 \\ 26 & 2 & 0 & 9 & 45 \\ 11 & 10 & 0 & 44 & 9 \end{pmatrix}$$

$$a_3 = \begin{pmatrix} 3 & 37 & 0 & 31 & 24 \\ 0 & 8 & 36 & 39 & 36 \\ 42 & 12 & 8 & 28 & 41 \\ 12 & 41 & 36 & 38 & 39 \\ 39 & 28 & 39 & 24 & 38 \end{pmatrix}$$

$$a_4 = \begin{pmatrix} 26 & 10 & 0 & 38 & 28 \\ 0 & 8 & 36 & 39 & 36 \\ 5 & 36 & 8 & 5 & 22 \\ 14 & 22 & 36 & 3 & 31 \\ 19 & 5 & 39 & 34 & 3 \end{pmatrix}$$

$$a_5 = \begin{pmatrix} 3 & 22 & 46 & 16 & 42 \\ 12 & 21 & 34 & 21 & 33 \\ 33 & 8 & 42 & 12 & 34 \\ 30 & 23 & 7 & 44 & 9 \\ 40 & 14 & 36 & 27 & 30 \end{pmatrix}$$

$$a_6 = \begin{pmatrix} 4 & 17 & 24 & 0 & 20 \\ 12 & 21 & 34 & 21 & 33 \\ 32 & 34 & 21 & 39 & 41 \\ 10 & 41 & 33 & 1 & 4 \\ 0 & 39 & 21 & 27 & 1 \end{pmatrix}$$

$$a_7 = \begin{pmatrix} 40 & 12 & 33 & 17 & 43 \\ 40 & 24 & 16 & 45 & 5 \\ 6 & 14 & 24 & 22 & 13 \\ 45 & 13 & 5 & 27 & 34 \\ 32 & 22 & 45 & 2 & 27 \end{pmatrix}$$

$$a_8 = \begin{pmatrix} 14 & 27 & 37 & 46 & 19 \\ 40 & 24 & 16 & 45 & 5 \\ 2 & 37 & 32 & 7 & 25 \\ 4 & 10 & 46 & 19 & 17 \\ 6 & 14 & 20 & 10 & 6 \end{pmatrix}$$

$$a_9 = \begin{pmatrix} 22 & 24 & 46 & 27 & 30 \\ 23 & 42 & 34 & 36 & 7 \\ 12 & 2 & 42 & 24 & 14 \\ 15 & 14 & 7 & 18 & 16 \\ 37 & 24 & 36 & 30 & 18 \end{pmatrix}$$

$$a_{10} = \begin{pmatrix} 3 & 19 & 24 & 33 & 13 \\ 23 & 42 & 34 & 36 & 7 \\ 11 & 8 & 21 & 14 & 23 \\ 21 & 34 & 33 & 30 & 9 \\ 8 & 12 & 21 & 27 & 44 \end{pmatrix}$$

$$a_{11} = \begin{pmatrix} 11 & 39 & 37 & 1 & 35 \\ 42 & 32 & 16 & 20 & 46 \\ 43 & 37 & 32 & 23 & 3 \\ 41 & 3 & 46 & 10 & 39 \\ 24 & 23 & 20 & 28 & 10 \end{pmatrix}$$

$$a_{12} = \begin{pmatrix} 14 & 4 & 33 & 12 & 8 \\ 42 & 32 & 16 & 20 & 46 \\ 37 & 37 & 24 & 14 & 10 \\ 33 & 25 & 5 & 6 & 17 \\ 23 & 7 & 45 & 10 & 19 \end{pmatrix}$$

Kernel has order 1 and is generated by:

Induced action on orbit  $O_1 = \{2, 4, 13, 14, 20, 23, 30, 31, 33, 35, 43, 44\}$  (length 12)

The induced group has order 12 and is generated by:

$$g_1 = (1, 2)(3, 11)(4, 6)(5, 12)(7, 9)(8, 10)$$

$$g_2 = (1, 9)(2, 7)(3, 6)(4, 11)(5, 10)(8, 12)$$

$$g_3 = (1, 8, 4)(2, 6, 10)(3, 7, 5)(9, 11, 12)$$

group order is small, so we list all elements  $a_1 = \text{id}$

$$a_2 = (1, 2)(3, 11)(4, 6)(5, 12)(7, 9)(8, 10)$$

$$a_3 = (1, 9)(2, 7)(3, 6)(4, 11)(5, 10)(8, 12)$$

$$a_4 = (1, 7)(2, 9)(3, 4)(5, 8)(6, 11)(10, 12)$$

$$a_5 = (1, 8, 4)(2, 6, 10)(3, 7, 5)(9, 11, 12)$$

$$a_6 = (1, 6)(2, 8)(3, 12)(4, 10)(5, 9)(7, 11)$$

$$a_7 = (1, 11)(2, 5)(3, 10)(4, 12)(6, 7)(8, 9)$$

$$a_8 = (1, 5, 4, 7, 8, 3)(2, 11, 10, 9, 6, 12)$$

$$a_9 = (1, 10)(2, 4)(3, 9)(5, 11)(6, 8)(7, 12)$$

$$a_{10} = (1, 4, 8)(2, 10, 6)(3, 5, 7)(9, 12, 11)$$

$$a_{11} = (1, 12)(2, 3)(4, 9)(5, 6)(7, 10)(8, 11)$$

$$a_{12} = (1, 3, 8, 7, 4, 5)(2, 12, 6, 9, 10, 11)$$

and now the elements themselves:  $a_1 = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$

$$a_2 = \begin{pmatrix} 28 & 0 & 0 & 22 & 5 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 27 & 1 & 10 & 2 \\ 26 & 2 & 0 & 9 & 45 \\ 11 & 10 & 0 & 44 & 9 \end{pmatrix}$$

$$a_3 = \begin{pmatrix} 3 & 37 & 0 & 31 & 24 \\ 0 & 8 & 36 & 39 & 36 \\ 42 & 12 & 8 & 28 & 41 \\ 12 & 41 & 36 & 38 & 39 \\ 39 & 28 & 39 & 24 & 38 \end{pmatrix}$$

$$a_4 = \begin{pmatrix} 26 & 10 & 0 & 38 & 28 \\ 0 & 8 & 36 & 39 & 36 \\ 5 & 36 & 8 & 5 & 22 \\ 14 & 22 & 36 & 3 & 31 \\ 19 & 5 & 39 & 34 & 3 \end{pmatrix}$$

$$a_5 = \begin{pmatrix} 3 & 22 & 46 & 16 & 42 \\ 12 & 21 & 34 & 21 & 33 \\ 33 & 8 & 42 & 12 & 34 \\ 30 & 23 & 7 & 44 & 9 \\ 40 & 14 & 36 & 27 & 30 \end{pmatrix}$$

$$a_6 = \begin{pmatrix} 4 & 17 & 24 & 0 & 20 \\ 12 & 21 & 34 & 21 & 33 \\ 32 & 34 & 21 & 39 & 41 \\ 10 & 41 & 33 & 1 & 4 \\ 0 & 39 & 21 & 27 & 1 \end{pmatrix}$$

$$a_7 = \begin{pmatrix} 40 & 12 & 33 & 17 & 43 \\ 40 & 24 & 16 & 45 & 5 \\ 6 & 14 & 24 & 22 & 13 \\ 45 & 13 & 5 & 27 & 34 \\ 32 & 22 & 45 & 2 & 27 \end{pmatrix}$$

$$a_8 = \begin{pmatrix} 14 & 27 & 37 & 46 & 19 \\ 40 & 24 & 16 & 45 & 5 \\ 2 & 37 & 32 & 7 & 25 \\ 4 & 10 & 46 & 19 & 17 \\ 6 & 14 & 20 & 10 & 6 \end{pmatrix}$$

$$a_9 = \begin{pmatrix} 22 & 24 & 46 & 27 & 30 \\ 23 & 42 & 34 & 36 & 7 \\ 12 & 2 & 42 & 24 & 14 \\ 15 & 14 & 7 & 18 & 16 \\ 37 & 24 & 36 & 30 & 18 \end{pmatrix}$$

$$a_{10} = \begin{pmatrix} 3 & 19 & 24 & 33 & 13 \\ 23 & 42 & 34 & 36 & 7 \\ 11 & 8 & 21 & 14 & 23 \\ 21 & 34 & 33 & 30 & 9 \\ 8 & 12 & 21 & 27 & 44 \end{pmatrix}$$

$$a_{11} = \begin{pmatrix} 11 & 39 & 37 & 1 & 35 \\ 42 & 32 & 16 & 20 & 46 \\ 43 & 37 & 32 & 23 & 3 \\ 41 & 3 & 46 & 10 & 39 \\ 24 & 23 & 20 & 28 & 10 \end{pmatrix}$$

$$a_{12} = \begin{pmatrix} 14 & 4 & 33 & 12 & 8 \\ 42 & 32 & 16 & 20 & 46 \\ 37 & 37 & 24 & 14 & 10 \\ 33 & 25 & 5 & 6 & 17 \\ 23 & 7 & 45 & 10 & 19 \end{pmatrix}$$

Kernel has order 1 and is generated by:

Induced action on orbit  $O_2 = \{5, 9, 10, 12, 21, 24, 29, 34, 36, 37, 38, 41\}$  (length 12)

The induced group has order 12 and is generated by:

$$g_1 = (1, 6)(2, 4)(3, 12)(5, 10)(7, 11)(8, 9)$$

$$g_2 = (1, 5)(2, 11)(3, 9)(4, 7)(6, 10)(8, 12)$$

$$g_3 = (1, 3, 11)(2, 9, 5)(4, 10, 8)(6, 7, 12)$$

group order is small, so we list all elements  $a_1 = \text{id}$

$$a_2 = (1, 6)(2, 4)(3, 12)(5, 10)(7, 11)(8, 9)$$

$$a_3 = (1, 5)(2, 11)(3, 9)(4, 7)(6, 10)(8, 12)$$

$$a_4 = (1, 10)(2, 7)(3, 8)(4, 11)(5, 6)(9, 12)$$

$$a_5 = (1, 3, 11)(2, 9, 5)(4, 10, 8)(6, 7, 12)$$

$$a_6 = (1, 7)(2, 10)(3, 6)(4, 9)(5, 8)(11, 12)$$

$$a_7 = (1, 2)(3, 5)(4, 12)(6, 8)(7, 10)(9, 11)$$

$$a_8 = (1, 8, 11, 10, 3, 4)(2, 12, 5, 7, 9, 6)$$

$$a_9 = (1, 12)(2, 8)(3, 7)(4, 5)(6, 11)(9, 10)$$

$$a_{10} = (1, 11, 3)(2, 5, 9)(4, 8, 10)(6, 12, 7)$$

$$a_{11} = (1, 9)(2, 3)(4, 6)(5, 11)(7, 8)(10, 12)$$

$$a_{12} = (1, 4, 3, 10, 11, 8)(2, 6, 9, 7, 5, 12)$$

and now the elements themselves:  $a_1 = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$

$$a_2 = \begin{pmatrix} 28 & 0 & 0 & 22 & 5 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 27 & 1 & 10 & 2 \\ 26 & 2 & 0 & 9 & 45 \\ 11 & 10 & 0 & 44 & 9 \end{pmatrix}$$

$$a_3 = \begin{pmatrix} 3 & 37 & 0 & 31 & 24 \\ 0 & 8 & 36 & 39 & 36 \\ 42 & 12 & 8 & 28 & 41 \\ 12 & 41 & 36 & 38 & 39 \\ 39 & 28 & 39 & 24 & 38 \end{pmatrix}$$

$$a_4 = \begin{pmatrix} 26 & 10 & 0 & 38 & 28 \\ 0 & 8 & 36 & 39 & 36 \\ 5 & 36 & 8 & 5 & 22 \\ 14 & 22 & 36 & 3 & 31 \\ 19 & 5 & 39 & 34 & 3 \end{pmatrix}$$

$$a_5 = \begin{pmatrix} 3 & 22 & 46 & 16 & 42 \\ 12 & 21 & 34 & 21 & 33 \\ 33 & 8 & 42 & 12 & 34 \\ 30 & 23 & 7 & 44 & 9 \\ 40 & 14 & 36 & 27 & 30 \end{pmatrix}$$

$$a_6 = \begin{pmatrix} 4 & 17 & 24 & 0 & 20 \\ 12 & 21 & 34 & 21 & 33 \\ 32 & 34 & 21 & 39 & 41 \\ 10 & 41 & 33 & 1 & 4 \\ 0 & 39 & 21 & 27 & 1 \end{pmatrix}$$

$$a_7 = \begin{pmatrix} 40 & 12 & 33 & 17 & 43 \\ 40 & 24 & 16 & 45 & 5 \\ 6 & 14 & 24 & 22 & 13 \\ 45 & 13 & 5 & 27 & 34 \\ 32 & 22 & 45 & 2 & 27 \end{pmatrix}$$

$$a_8 = \begin{pmatrix} 14 & 27 & 37 & 46 & 19 \\ 40 & 24 & 16 & 45 & 5 \\ 2 & 37 & 32 & 7 & 25 \\ 4 & 10 & 46 & 19 & 17 \\ 6 & 14 & 20 & 10 & 6 \end{pmatrix}$$

$$a_9 = \begin{pmatrix} 22 & 24 & 46 & 27 & 30 \\ 23 & 42 & 34 & 36 & 7 \\ 12 & 2 & 42 & 24 & 14 \\ 15 & 14 & 7 & 18 & 16 \\ 37 & 24 & 36 & 30 & 18 \end{pmatrix}$$

$$a_{10} = \begin{pmatrix} 3 & 19 & 24 & 33 & 13 \\ 23 & 42 & 34 & 36 & 7 \\ 11 & 8 & 21 & 14 & 23 \\ 21 & 34 & 33 & 30 & 9 \\ 8 & 12 & 21 & 27 & 44 \end{pmatrix}$$

$$a_{11} = \begin{pmatrix} 11 & 39 & 37 & 1 & 35 \\ 42 & 32 & 16 & 20 & 46 \\ 43 & 37 & 32 & 23 & 3 \\ 41 & 3 & 46 & 10 & 39 \\ 24 & 23 & 20 & 28 & 10 \end{pmatrix}$$

$$a_{12} = \begin{pmatrix} 14 & 4 & 33 & 12 & 8 \\ 42 & 32 & 16 & 20 & 46 \\ 37 & 37 & 24 & 14 & 10 \\ 33 & 25 & 5 & 6 & 17 \\ 23 & 7 & 45 & 10 & 19 \end{pmatrix}$$

Kernel has order 1 and is generated by:

Induced action on orbit  $O_3 = \{6, 8, 11, 15, 18, 19, 22, 32, 39, 42, 45, 47\}$  (length 12)

The induced group has order 12 and is generated by:

$$g_1 = (1, 3)(2, 4)(5, 8)(6, 10)(7, 12)(9, 11)$$

$$g_2 = (1, 12)(2, 9)(3, 7)(4, 11)(5, 10)(6, 8)$$

$$g_3 = (1, 6, 9)(2, 8, 12)(3, 11, 10)(4, 7, 5)$$

group order is small, so we list all elements  $a_1 = \text{id}$

$$a_2 = (1, 3)(2, 4)(5, 8)(6, 10)(7, 12)(9, 11)$$

$$a_3 = (1, 12)(2, 9)(3, 7)(4, 11)(5, 10)(6, 8)$$

$$a_4 = (1, 7)(2, 11)(3, 12)(4, 9)(5, 6)(8, 10)$$

$$a_5 = (1, 6, 9)(2, 8, 12)(3, 11, 10)(4, 7, 5)$$

$$a_6 = (1, 11)(2, 7)(3, 6)(4, 8)(5, 12)(9, 10)$$

$$a_7 = (1, 2)(3, 5)(4, 10)(6, 12)(7, 11)(8, 9)$$

$$a_8 = (1, 5, 9, 7, 6, 4)(2, 10, 12, 11, 8, 3)$$

$$a_9 = (1, 10)(2, 5)(3, 9)(4, 12)(6, 11)(7, 8)$$

$$a_{10} = (1, 9, 6)(2, 12, 8)(3, 10, 11)(4, 5, 7)$$

$$a_{11} = (1, 8)(2, 6)(3, 4)(5, 11)(7, 10)(9, 12)$$

$$a_{12} = (1, 4, 6, 7, 9, 5)(2, 3, 8, 11, 12, 10)$$

and now the elements themselves:  $a_1 = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$

$$a_2 = \begin{pmatrix} 28 & 0 & 0 & 22 & 5 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 27 & 1 & 10 & 2 \\ 26 & 2 & 0 & 9 & 45 \\ 11 & 10 & 0 & 44 & 9 \end{pmatrix}$$

$$a_3 = \begin{pmatrix} 3 & 37 & 0 & 31 & 24 \\ 0 & 8 & 36 & 39 & 36 \\ 42 & 12 & 8 & 28 & 41 \\ 12 & 41 & 36 & 38 & 39 \\ 39 & 28 & 39 & 24 & 38 \end{pmatrix}$$

$$a_4 = \begin{pmatrix} 26 & 10 & 0 & 38 & 28 \\ 0 & 8 & 36 & 39 & 36 \\ 5 & 36 & 8 & 5 & 22 \\ 14 & 22 & 36 & 3 & 31 \\ 19 & 5 & 39 & 34 & 3 \end{pmatrix}$$

$$a_5 = \begin{pmatrix} 3 & 22 & 46 & 16 & 42 \\ 12 & 21 & 34 & 21 & 33 \\ 33 & 8 & 42 & 12 & 34 \\ 30 & 23 & 7 & 44 & 9 \\ 40 & 14 & 36 & 27 & 30 \end{pmatrix}$$

$$a_6 = \begin{pmatrix} 4 & 17 & 24 & 0 & 20 \\ 12 & 21 & 34 & 21 & 33 \\ 32 & 34 & 21 & 39 & 41 \\ 10 & 41 & 33 & 1 & 4 \\ 0 & 39 & 21 & 27 & 1 \end{pmatrix}$$

$$a_7 = \begin{pmatrix} 40 & 12 & 33 & 17 & 43 \\ 40 & 24 & 16 & 45 & 5 \\ 6 & 14 & 24 & 22 & 13 \\ 45 & 13 & 5 & 27 & 34 \\ 32 & 22 & 45 & 2 & 27 \end{pmatrix}$$

$$a_8 = \begin{pmatrix} 14 & 27 & 37 & 46 & 19 \\ 40 & 24 & 16 & 45 & 5 \\ 2 & 37 & 32 & 7 & 25 \\ 4 & 10 & 46 & 19 & 17 \\ 6 & 14 & 20 & 10 & 6 \end{pmatrix}$$

$$a_9 = \begin{pmatrix} 22 & 24 & 46 & 27 & 30 \\ 23 & 42 & 34 & 36 & 7 \\ 12 & 2 & 42 & 24 & 14 \\ 15 & 14 & 7 & 18 & 16 \\ 37 & 24 & 36 & 30 & 18 \end{pmatrix}$$

$$a_{10} = \begin{pmatrix} 3 & 19 & 24 & 33 & 13 \\ 23 & 42 & 34 & 36 & 7 \\ 11 & 8 & 21 & 14 & 23 \\ 21 & 34 & 33 & 30 & 9 \\ 8 & 12 & 21 & 27 & 44 \end{pmatrix}$$

$$a_{11} = \begin{pmatrix} 11 & 39 & 37 & 1 & 35 \\ 42 & 32 & 16 & 20 & 46 \\ 43 & 37 & 32 & 23 & 3 \\ 41 & 3 & 46 & 10 & 39 \\ 24 & 23 & 20 & 28 & 10 \end{pmatrix}$$

$$a_{12} = \begin{pmatrix} 14 & 4 & 33 & 12 & 8 \\ 42 & 32 & 16 & 20 & 46 \\ 37 & 37 & 24 & 14 & 10 \\ 33 & 25 & 5 & 6 & 17 \\ 23 & 7 & 45 & 10 & 19 \end{pmatrix}$$

Kernel has order 1 and is generated by:

Induced action on orbit  $O_4 = \{7, 16, 25, 27, 40, 46\}$  (length 6)

The induced group has order 12 and is generated by:

$$g_1 = (1, 2)(3, 4)(5, 6)$$

$$g_2 = (1, 4)(2, 3)$$

$$g_3 = (1, 4, 6)(2, 5, 3)$$

group order is small, so we list all elements  $a_1 = \text{id}$

$$a_2 = (1, 2)(3, 4)(5, 6)$$

$$a_3 = (1, 4)(2, 3)$$

$$a_4 = (1, 3)(2, 4)(5, 6)$$

$$a_5 = (1, 4, 6)(2, 5, 3)$$

$$a_6 = (1, 5)(2, 4)(3, 6)$$

$$a_7 = (1, 6)(3, 5)$$

$$a_8 = (1, 2, 6, 3, 4, 5)$$

$$a_9 = (1, 3)(2, 6)(4, 5)$$

$$a_{10} = (1, 6, 4)(2, 3, 5)$$

$$a_{11} = (2, 5)(4, 6)$$

$$a_{12} = (1, 5, 4, 3, 6, 2)$$

and now the elements themselves:  $a_1 = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$

$$a_2 = \begin{pmatrix} 28 & 0 & 0 & 22 & 5 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 27 & 1 & 10 & 2 \\ 26 & 2 & 0 & 9 & 45 \\ 11 & 10 & 0 & 44 & 9 \end{pmatrix}$$

$$a_3 = \begin{pmatrix} 3 & 37 & 0 & 31 & 24 \\ 0 & 8 & 36 & 39 & 36 \\ 42 & 12 & 8 & 28 & 41 \\ 12 & 41 & 36 & 38 & 39 \\ 39 & 28 & 39 & 24 & 38 \end{pmatrix}$$

$$a_4 = \begin{pmatrix} 26 & 10 & 0 & 38 & 28 \\ 0 & 8 & 36 & 39 & 36 \\ 5 & 36 & 8 & 5 & 22 \\ 14 & 22 & 36 & 3 & 31 \\ 19 & 5 & 39 & 34 & 3 \end{pmatrix}$$

$$a_5 = \begin{pmatrix} 3 & 22 & 46 & 16 & 42 \\ 12 & 21 & 34 & 21 & 33 \\ 33 & 8 & 42 & 12 & 34 \\ 30 & 23 & 7 & 44 & 9 \\ 40 & 14 & 36 & 27 & 30 \end{pmatrix}$$

$$a_6 = \begin{pmatrix} 4 & 17 & 24 & 0 & 20 \\ 12 & 21 & 34 & 21 & 33 \\ 32 & 34 & 21 & 39 & 41 \\ 10 & 41 & 33 & 1 & 4 \\ 0 & 39 & 21 & 27 & 1 \end{pmatrix}$$

$$a_7 = \begin{pmatrix} 40 & 12 & 33 & 17 & 43 \\ 40 & 24 & 16 & 45 & 5 \\ 6 & 14 & 24 & 22 & 13 \\ 45 & 13 & 5 & 27 & 34 \\ 32 & 22 & 45 & 2 & 27 \end{pmatrix}$$

$$a_8 = \begin{pmatrix} 14 & 27 & 37 & 46 & 19 \\ 40 & 24 & 16 & 45 & 5 \\ 2 & 37 & 32 & 7 & 25 \\ 4 & 10 & 46 & 19 & 17 \\ 6 & 14 & 20 & 10 & 6 \end{pmatrix}$$

$$a_9 = \begin{pmatrix} 22 & 24 & 46 & 27 & 30 \\ 23 & 42 & 34 & 36 & 7 \\ 12 & 2 & 42 & 24 & 14 \\ 15 & 14 & 7 & 18 & 16 \\ 37 & 24 & 36 & 30 & 18 \end{pmatrix}$$

$$a_{10} = \begin{pmatrix} 3 & 19 & 24 & 33 & 13 \\ 23 & 42 & 34 & 36 & 7 \\ 11 & 8 & 21 & 14 & 23 \\ 21 & 34 & 33 & 30 & 9 \\ 8 & 12 & 21 & 27 & 44 \end{pmatrix}$$

$$a_{11} = \begin{pmatrix} 11 & 39 & 37 & 1 & 35 \\ 42 & 32 & 16 & 20 & 46 \\ 43 & 37 & 32 & 23 & 3 \\ 41 & 3 & 46 & 10 & 39 \\ 24 & 23 & 20 & 28 & 10 \end{pmatrix}$$

$$a_{12} = \begin{pmatrix} 14 & 4 & 33 & 12 & 8 \\ 42 & 32 & 16 & 20 & 46 \\ 37 & 37 & 24 & 14 & 10 \\ 33 & 25 & 5 & 6 & 17 \\ 23 & 7 & 45 & 10 & 19 \end{pmatrix}$$

Kernel has order 1 and is generated by: