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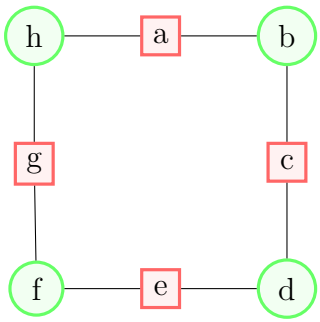
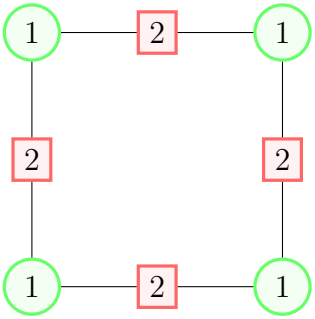
Puzzle

Arranging Flags [1]

Komsomol youths have built a small hydroelectric powerhouse. Preparing for its opening, young Communist boys and girls are decorating the powerhouse on all four sides with garlands, electric bulbs, and small flags. There are 12 flags. At first they arrange the flags 4 to a side, as shown, but then they see that the flags can be arranged 5 or even 6 to a side. How?

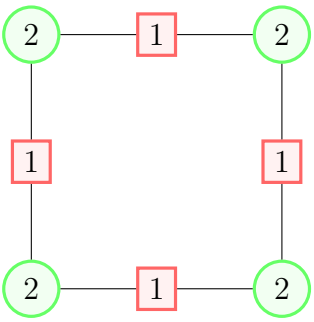


(a) Modelling the problem.

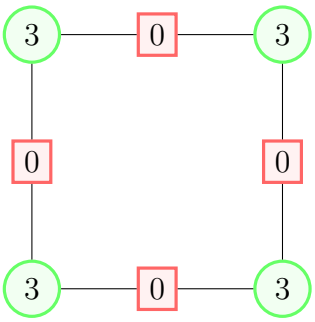


(b) 4 Flags on the same side.

Figure 1: 4 Flags on the same side.



(a) Arranging 5 flags on each side.



(b) Arranging 6 flags on each side.

Figure 2: 5 or 6 flags on the same side

```
1  set(arithmetic).
2  assign(domain_size,7).
3  assign(max_models,-1).
4
5  formulas(assumptions).
6
7  % maximum 12 flags
8  a + b + c + d + e + f + g + h = 12.
9
10 %number of flags for each side.
11 i=6 | i=5.
12
13 a + b + h = i.
14 b + c + d = i.
15 d + e + f = i.
16 f + g + h = i.
17
18 % symmetry conditions:
19
20 % each corner should the same number of flags
21 h=b & b=f & f=d.
22
23 % each middle should the same number of flags
24 a=c & c=e & e=g.
25
26 end_of_list.
```

Solutions

Without considering symmetry, there are 7 solutions for arranging 6 flags on each side.

Models	a	b	c	d	e	f	g	h
1	0	0	0	6	0	0	0	6
2	0	1	0	5	0	1	0	5
3	0	2	0	4	0	2	0	4
4	0	6	0	0	0	6	0	0
5	**0**	**3**	**0**	**3**	**0**	**3**	**0**	**3**
6	0	4	0	2	0	4	0	2
7	0	5	0	1	0	5	0	1

If we add the symmetry conditions that each corner and middle should have the same number of flags (lines 26–28 and 31–33), only model no. 5 remains.
If 5 flags needs to be arranged, there are 37 models without symmetry conditions, respectively 1 model when symmetry conditions are active:

Models	a	b	c	d	e	f	g	h
1	1	2	1	2	1	2	1	2

If we test with number of flags equals 4 (i=4) we indeed obtain the initial configuration:

Models	a	b	c	d	e	f	g	h
1	2	1	2	1	2	1	2	1

Bibliography

[1] Boris A Kordemsky. *The Moscow puzzles: 359 mathematical recreations*. Courier Corporation, 1992.