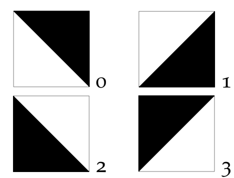
TRUCHET

4×4 patterns with four-fold rotational symmetry

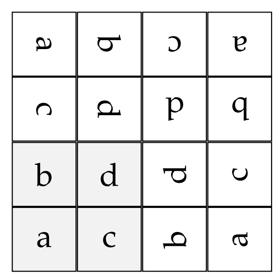
Current printing, February 17, 2025

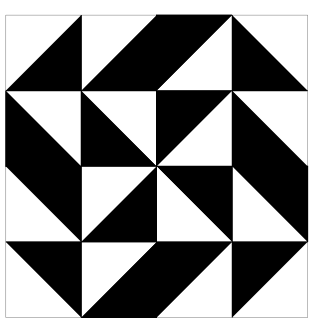
Introduction

Traditionally, Truchet tiles are square tiles that are divided by a diagonal line, and coloured with two colours with a different colour on either side of the diagonal. Each tile can be rotated to one of four positions. Patterns are formed by placing tiles next to each other, rotating individual tiles to create repeated motifs. This booklet presents a complete listing of $4x4$ Truchet tile patterns with four-fold (90°) rotational symmetry (256 patterns). Treating these $4x4$ tile patterns as tiles themselves allows for larger decorative patterns to be constructed from them. For example, a uniform frieze made from a single $4x4$ tile can actually produce interesting secondary patterns which help illustrate some interesting relationships that exist among the tile patterns.



Each $4x4$ Truchet tile pattern with rotational symmetry has a core $2x2$ pattern in one of its quadrants that is rotated to produce the overall pattern. In this booklet, the core pattern, or prototile, is assumed to be in the lower left. Each pattern can identified as a sequence of 4 digits (a, b, c, d), or more succinctly, *abcd*, that list the rotational positions of each tile in the lower left quadrant. This sequence *abcd* will be referred to as the *signature* of the tile pattern.

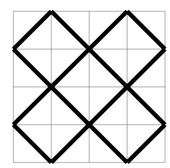




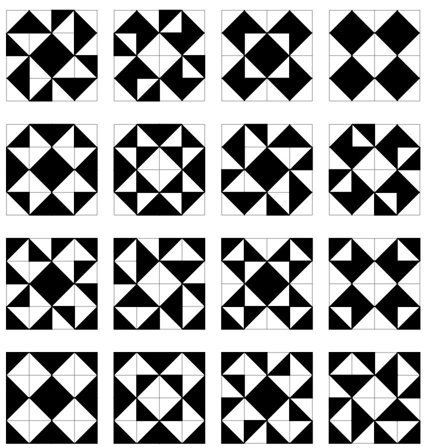
The 0011 pattern

Pattern families

We can group the 4*x*4 Truchet tile patterns with rotational symmetry into families where tile patterns are considered to be in the same family if they would look the same without colour – if each corresponding tile shares the same diagonal direction. The sequence that represents the family of a tile pattern can be found by taking the sequence of the tile pattern *modulo* 2. So, for example, the 16 tile patterns below are all members of the 0110 family.



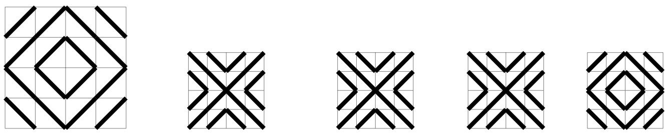
The 0110 family pattern



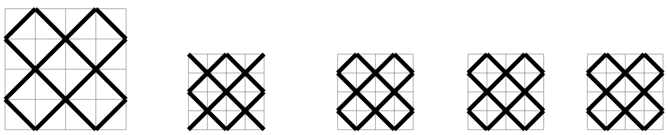
The 0110 pattern family

For a given family, there is corresponding *companion* family, the family of patterns formed by rotating each square in a member of the original family by 90°. There are also two *skew* families, formed by taking the upper left and lower right quadrants of an original family tile pattern as a founding pattern and a *dual* family, formed by taking the upper right quadrant as a founding patterns. A family is always different than its companion, and each family has a distinct companion, but it can happen that skew and duals can coincide. Self-dual families, where the dual family is the same as the original are of particular interest in the frieze patterns of the next chapter.

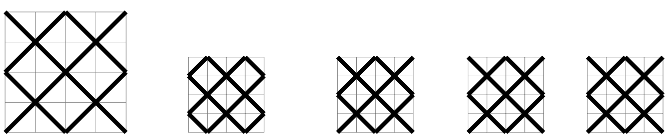
Self-Dual families



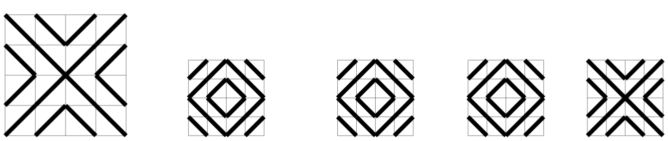
0000	1111	1111	1111	0000
	companion	skew (+)	skew (-)	dual



0110	1001	0110	0110	0110
	companion	skew (+)	skew (-)	dual

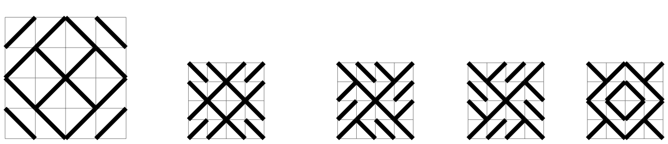


1001	0110	1001	1001	1001
	companion	skew (+)	skew (-)	dual

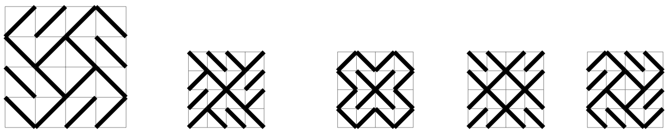


1111	0000	0000	0000	1111
	companion	skew (+)	skew (-)	dual

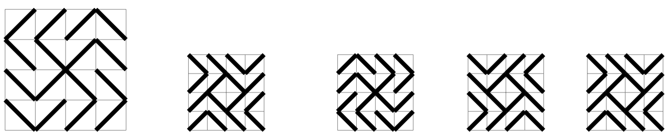
Non self-dual families



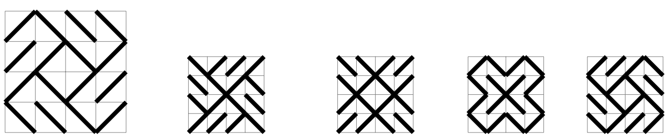
0001	1110	1011	1101	1000
	companion	skew (+)	skew (-)	dual



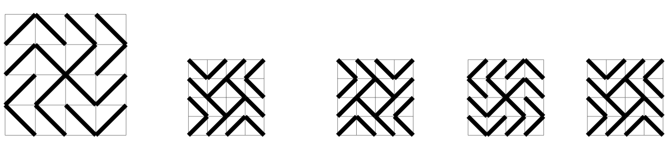
0010	1101	1110	0111	0100
	companion	skew (+)	skew (-)	dual



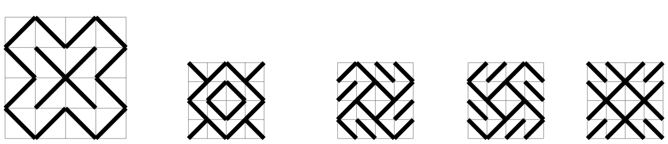
0011	1100	1010	0101	1100
	companion	skew (+)	skew (-)	dual



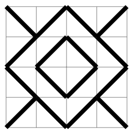
0100	1011	0111	1110	0010
	companion	skew (+)	skew (-)	dual

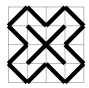


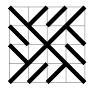
0101	1010	0011	1100	1010
	companion	skew (+)	skew (-)	dual

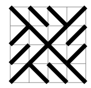


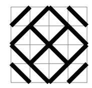
0111	1000	0010	0100	1110
	companion	skew (+)	skew (-)	dual

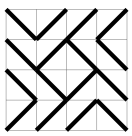

1000

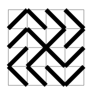

0111
companion

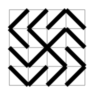

1101
skew (+)

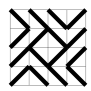

1011
skew (-)

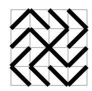

0001
dual

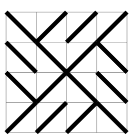

1010


0101
companion


1100
skew (+)


0011
skew (-)


0101
dual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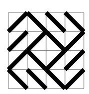
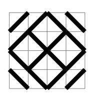
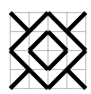
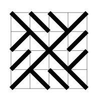
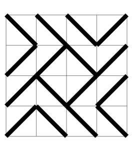
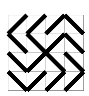

0100
companion

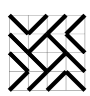

1000
skew (+)

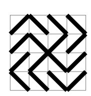

0001
skew (-)

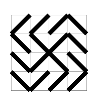

1101
dual

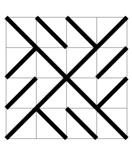

1100

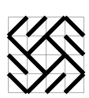

0011
companion

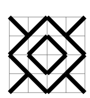

0101
skew (+)

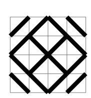

1010
skew (-)

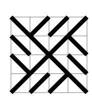

0011
dual

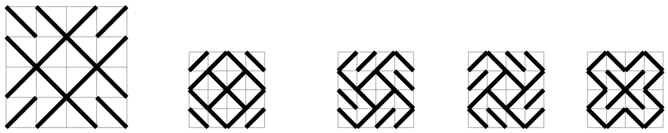

1101


0010
companion


0001
skew (+)

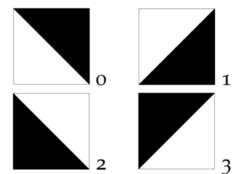

1000
skew (-)


1011
dual



1110 | 0001 companion | 0100 skew (+) | 0010 skew (-) | 0111 dual

Family and tile pattern mappings

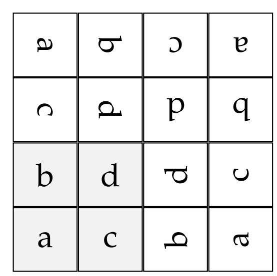


Related families and tiles can be obtained from applying simple mappings on the signature of the tile pattern.

Family mappings

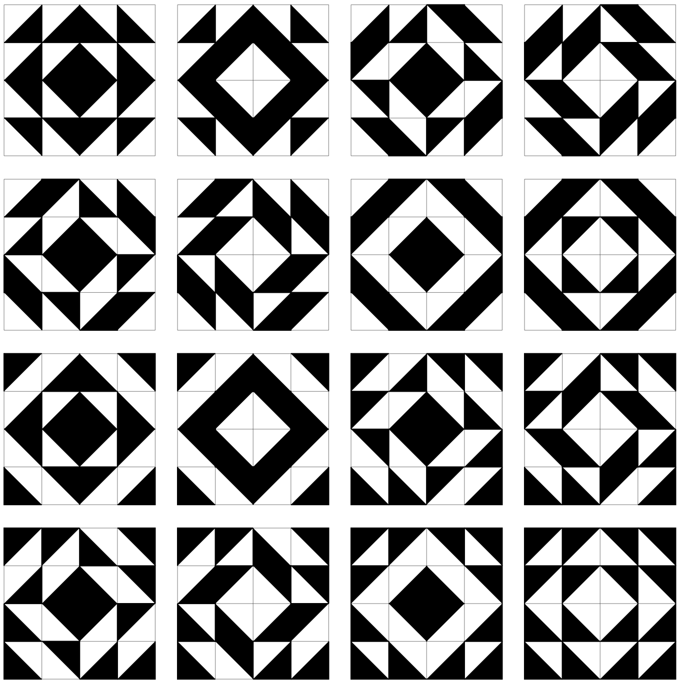
$$
\begin{aligned}
\text{companion}: (a,b,c,d) &\mapsto (a+1,b+1,c+1,d+1) \pmod 2;\\
\text{skew+}: (a,b,c,d) &\mapsto (c+1,a+1,d+1,b+1) \pmod 2;\\
\text{reverse}: (a,b,c,d) &\mapsto (d,c,b,a) \pmod 2;\\
\text{skew}-: (a,b,c,d) &\mapsto (b+1,d+1,a+1,c+1) \pmod 2;
\end{aligned}
$$

Tile pattern mappings

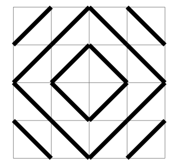


$$
\begin{aligned}
\text{skew+}: (a,b,c,d) &\mapsto (c+1,a+1,d+1,b+1) \pmod 4;\\
\text{dual}: (a,b,c,d) &\mapsto (d+2,c+2,b+2,a+2) \pmod 4;\\
\text{skew}-: (a,b,c,d) &\mapsto (b+3,d+3,a+3,c+3) \pmod 4;\\
\text{opposite}: (a,b,c,d) &\mapsto (a+2,b+2,c+2,d+2) \pmod 4;
\end{aligned}
$$

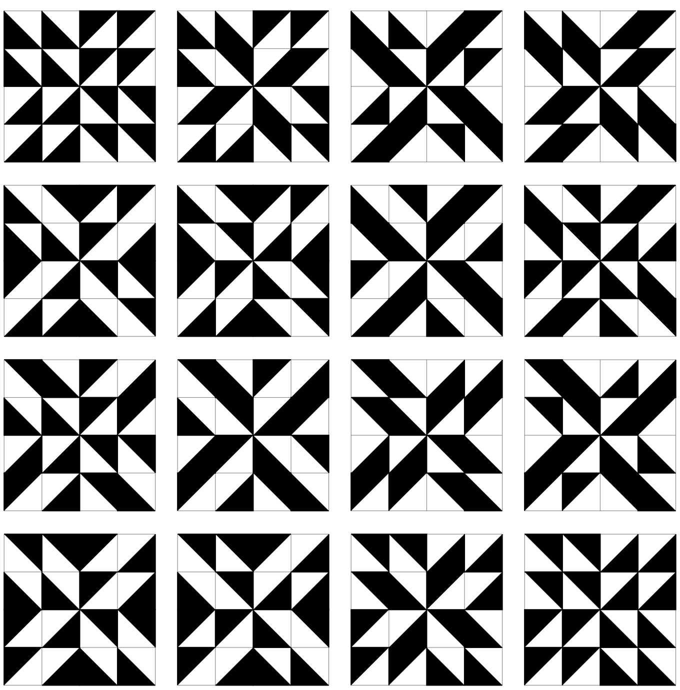
On the following pages each family will be shown along with its corresponding *companion* family, the family of patterns formed by rotating each square in a member of the original family by 90°.



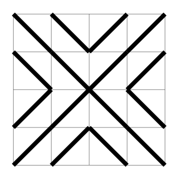
0000



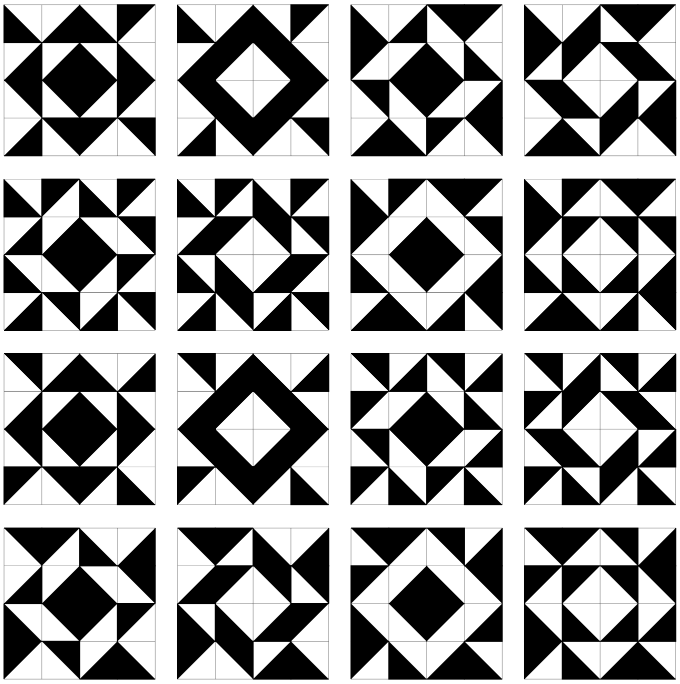
0000 0002 0020 0022
0200 0202 0220 0222
2000 2002 2020 2022
2200 2202 2220 2222



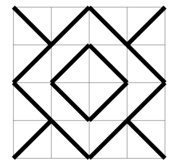
1111



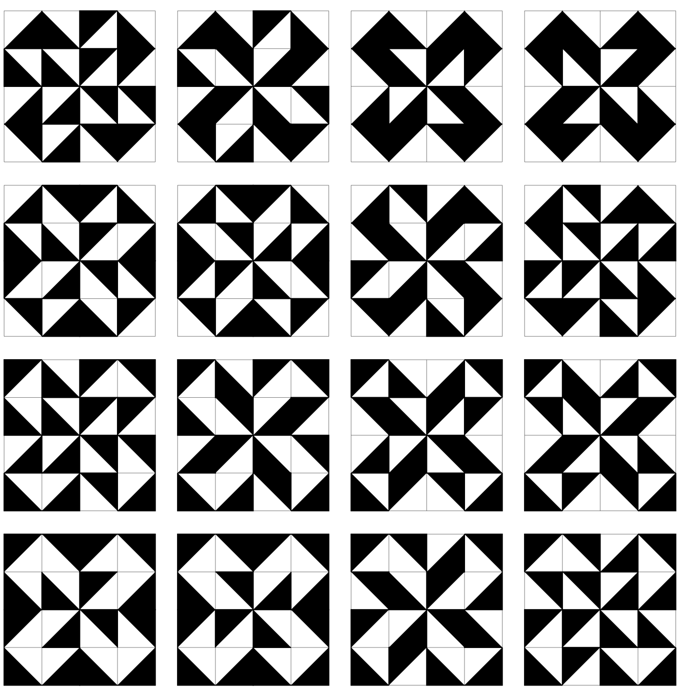
1111 1113 1131 1133
1311 1313 1331 1333
3111 3113 3131 3133
3311 3313 3331 3333



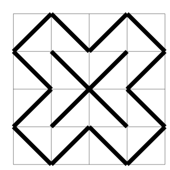
1000



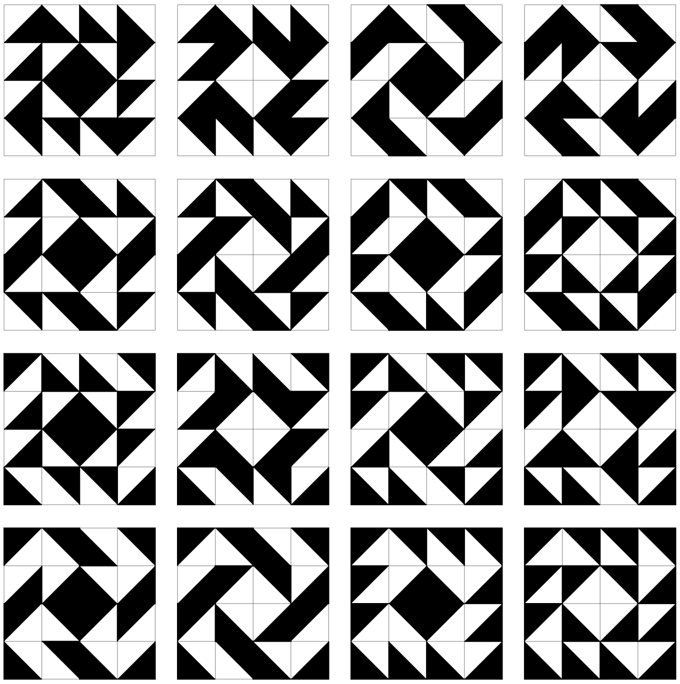
1000	1002	1020	1022
1200	1202	1220	1222
3000	3002	3020	3022
3200	3202	3220	3222



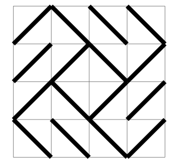
0111



0111	0113	0131	0133
0311	0313	0331	0333
2111	2113	2131	2133
2311	2313	2331	2333



0100



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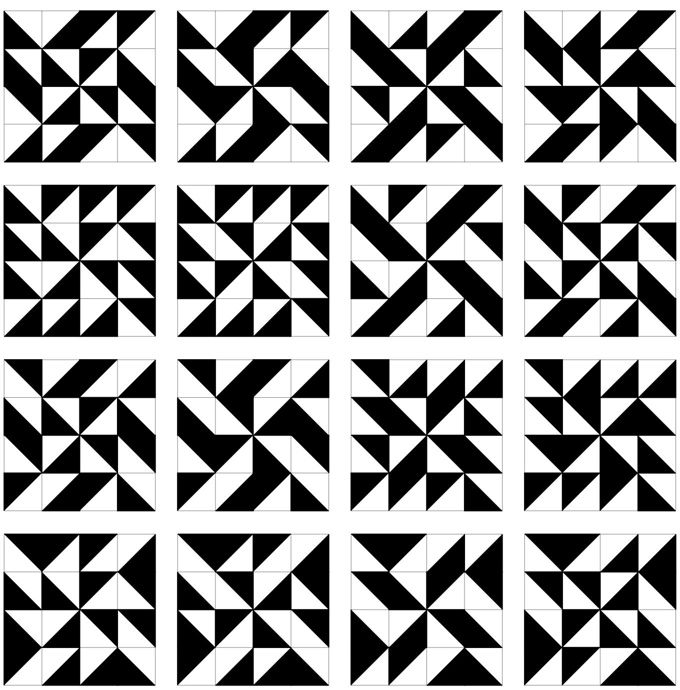
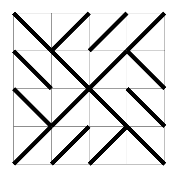
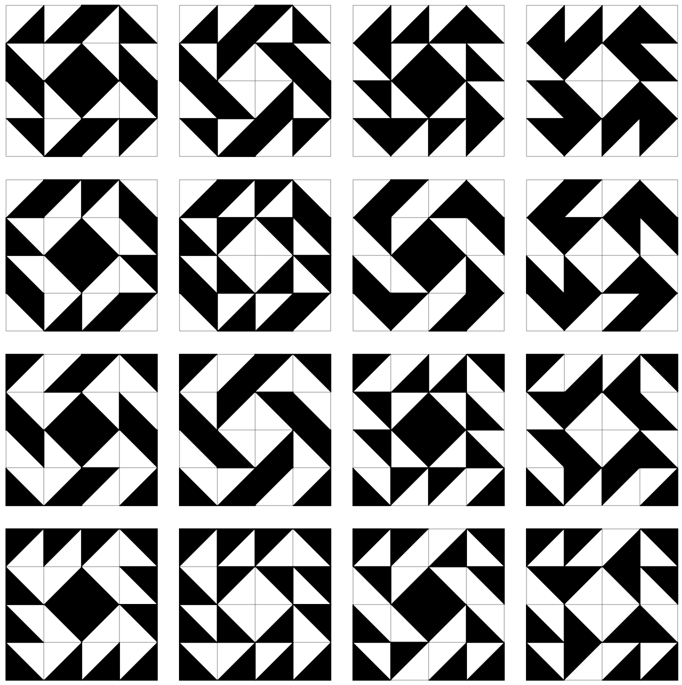
0300	0302	0320	0322
2100	2102	2120	2122
2300	2302	2320	2322



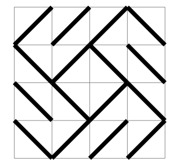
1011



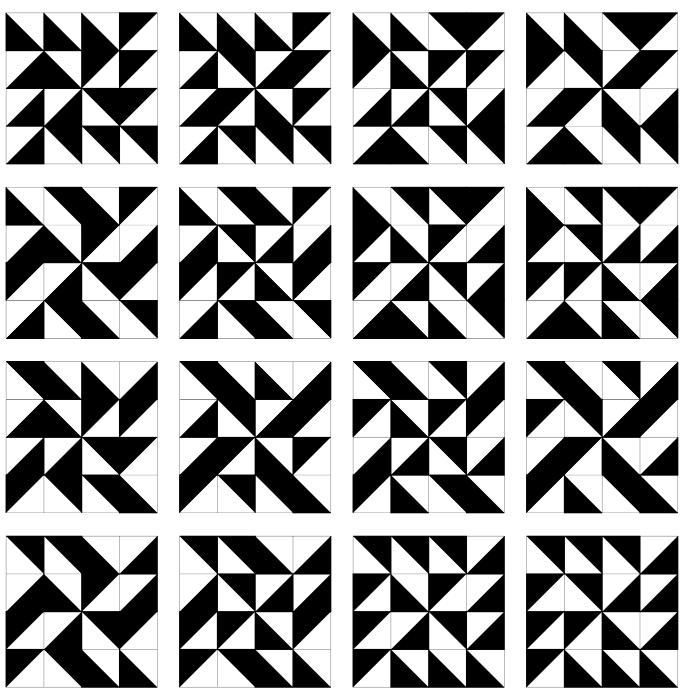
1011	1013	1031	1033
1211	1213	1231	1233
3011	3013	3031	3033
3211	3213	3231	3233



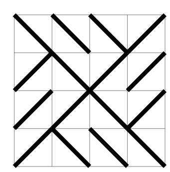
0010



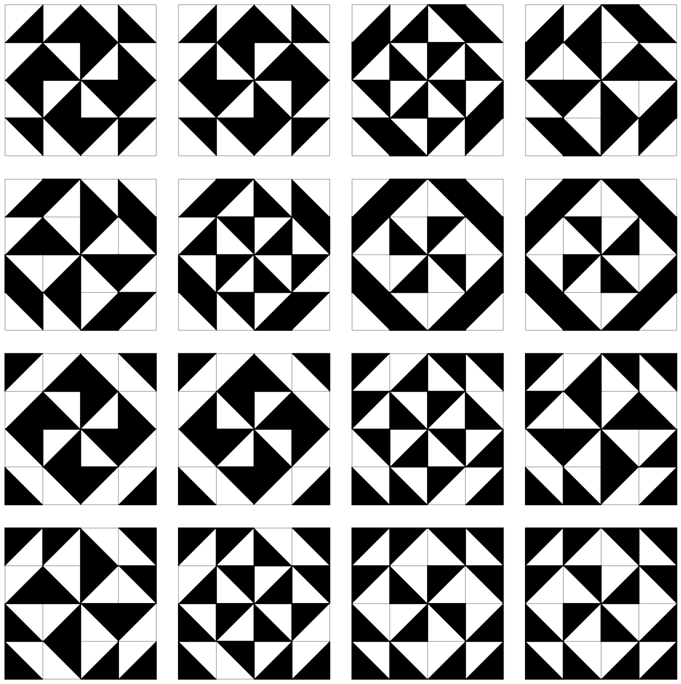
0010	0012	0030	0032
0210	0212	0230	0232
2010	2012	2030	2032
2210	2212	2230	2232



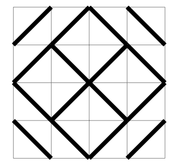
1101



1101	1103	1121	1123
1301	1303	1321	1323
3101	3103	3121	3123
3301	3303	3321	3323



0001



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2001	2003	2021	2023
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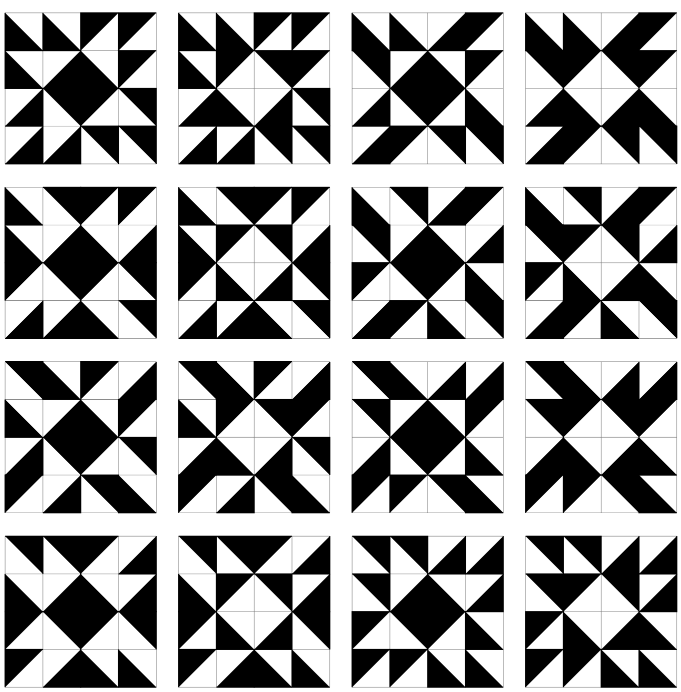

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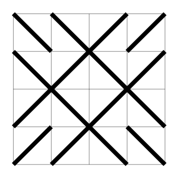

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1310	1312	1330	1332
3110	3112	3130	3132
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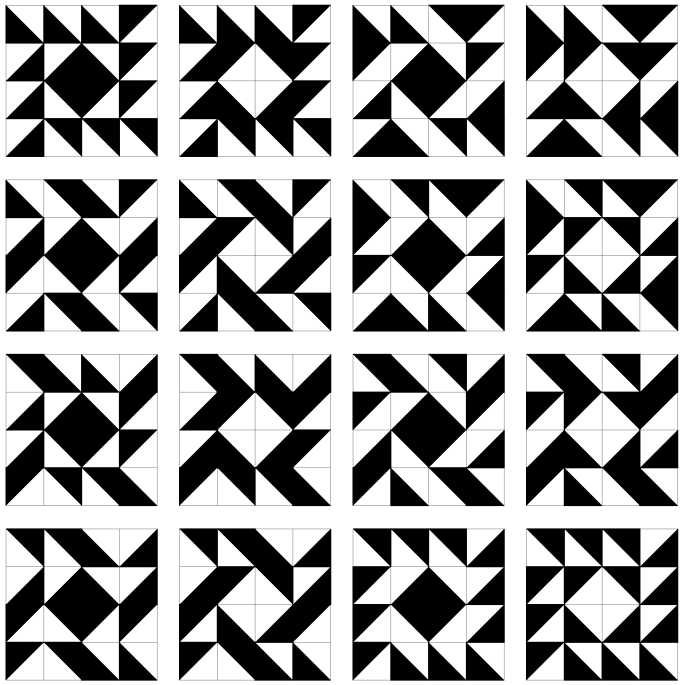

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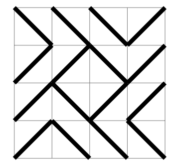

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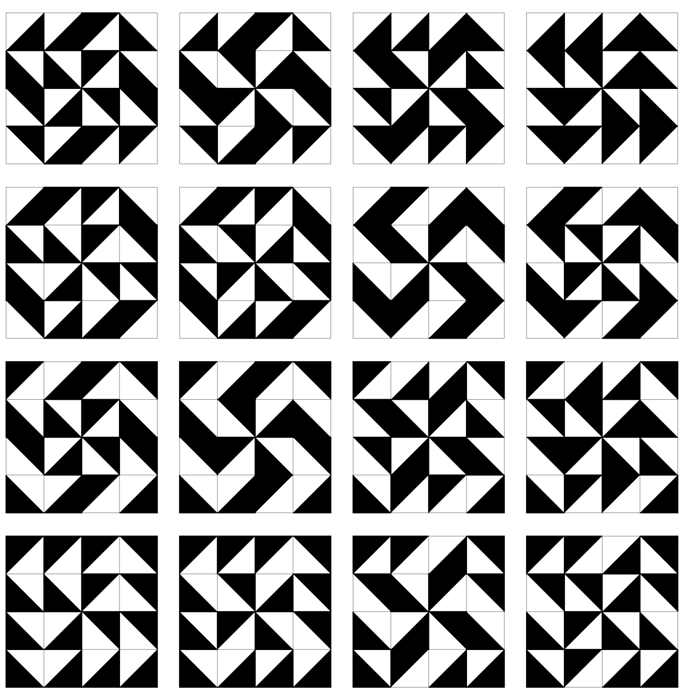
3100	3102	3120	3122
3300	3302	3320	3322



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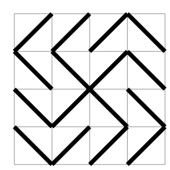

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2011	2013	2031	2033
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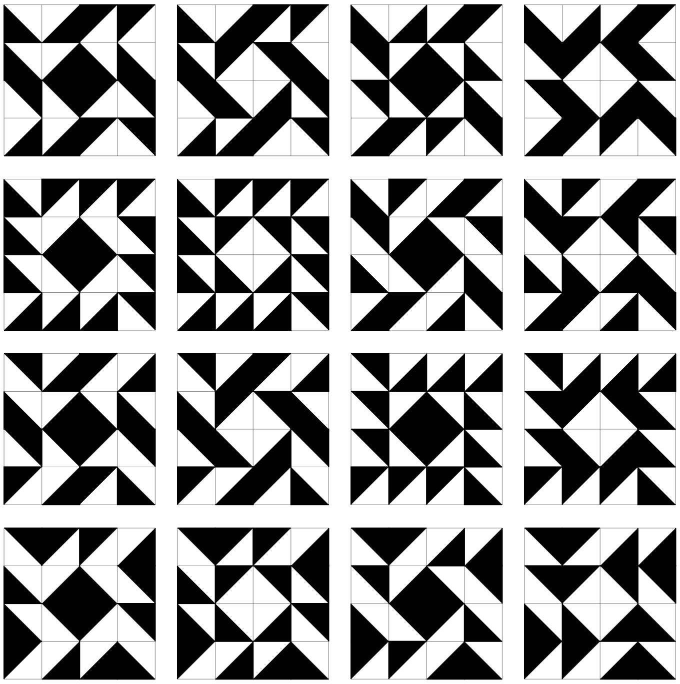

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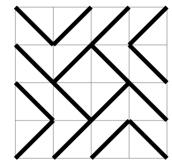

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3010	3012	3030	3032
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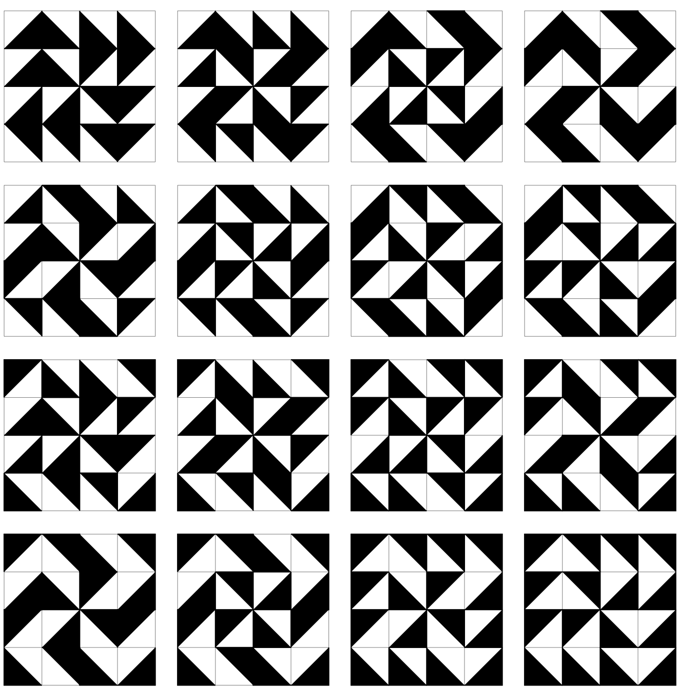
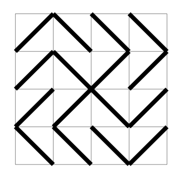


0101



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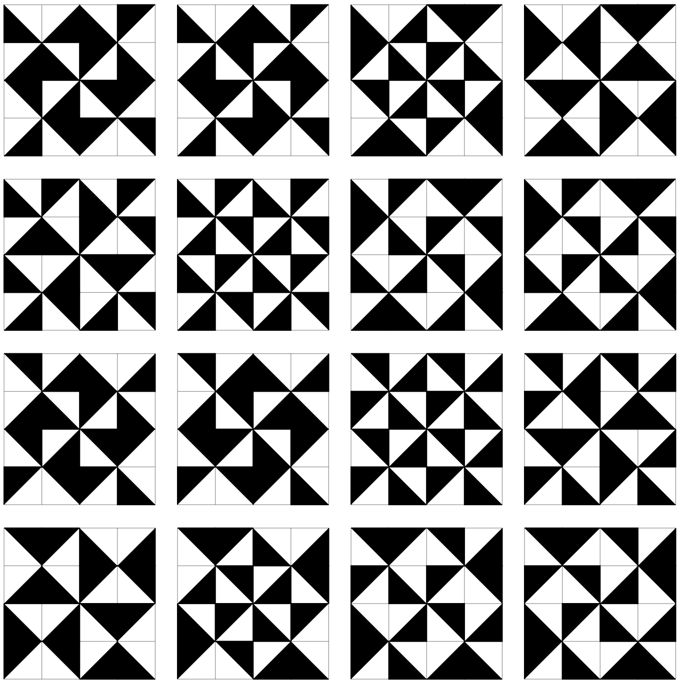
0301	0303	0321	0323
2101	2103	2121	2123
2301	2303	2321	2323



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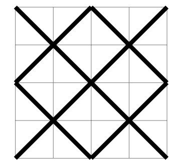

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1201	1203	1221	1223
3001	3003	3021	3023
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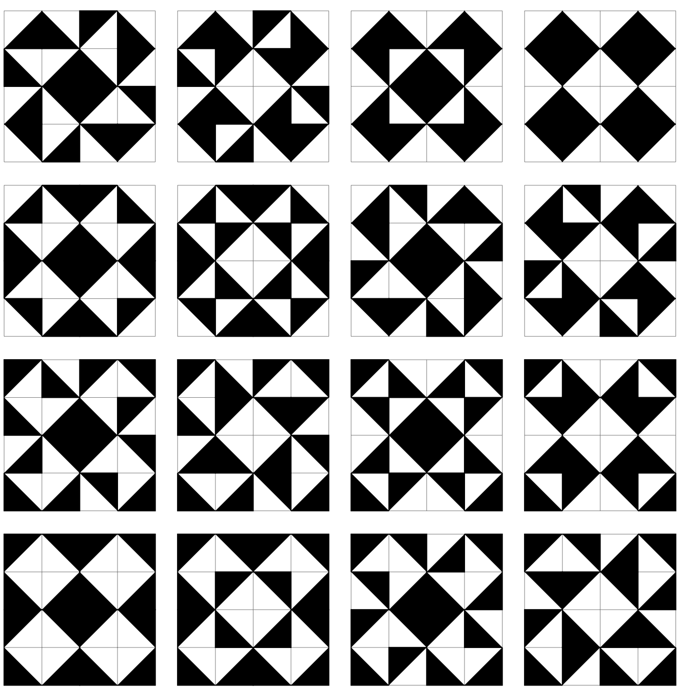

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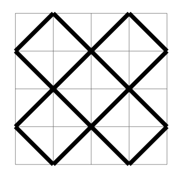
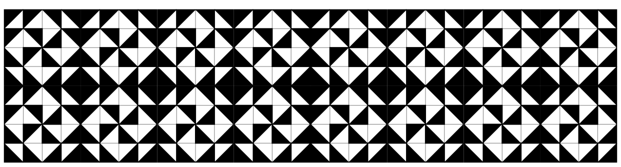


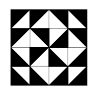
0110	0112	0130	0132
0310	0312	0330	0332
2110	2112	2130	2132
2310	2312	2330	2332

Uniform friezes

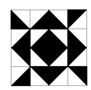
Each 4*x*4 Truchet pattern can be treated like a tile and used in a larger pattern. A uniform *frieze* is a horizontal strip of the same tile pattern repeated. Friezes of 4*x*4 Truchet pattern tiles with rotational symmetry can be quite striking, and have some interesting characteristics.

A frieze of more than one row of a primary tile reveals a secondary tile pattern that appears as another horizontal strip of 4*x*4 Truchet tile patterns nestled between the rows of primary tiles. Below, a frieze of 2223 tiles has a secondary pattern of 1000 tiles.





2223



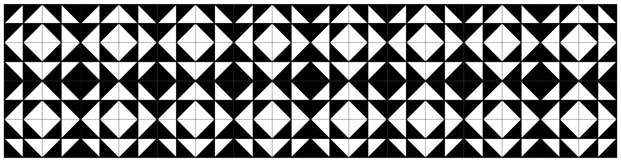
1000

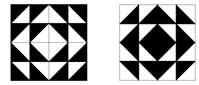
The secondary tile in a frieze pattern is the pattern that has been referred to previously as the *dual* of the original pattern. The dual of a tile pattern is the pattern formed by taking the top right quadrant of the original tile as the prototile of the new tile.

Some tiles are self-dual, and frieze patterns formed by self-dual tiles show a much more uniform pattern, as the extra rows of tiles seemingly nestled between the rows of the original tile are made up of the same original tile. Friezes of self-dual tiles have a third *tertiary* tile pattern with four-fold rotational symmetry that appears to overlap between adjacent tiles of the original tile. These tertiary tile patterns are the *skew* of the original tile pattern. Some self-dual friezes are also self-skew, leading to even more uniform patterns.

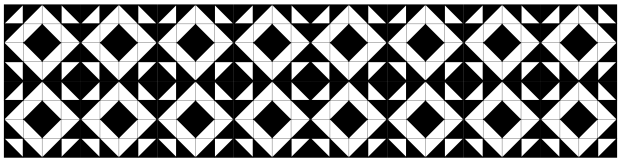
We can consider the uniform friezes formed by the dual tiles as the same pattern. There are 6 pairs of families where the original and dual are not the same, and these pairs of families yield 16 patterns each. The 4 remaining families contain some self-dual patterns, and some patterns that are *opp-dual* (the secondary tile is the opposite tile of the original), also reducing the number of patterns. These 4 remaining families provide 10 distinct frieze patterns each. This means that the 256 tile patterns generate 136 distinct friezes.

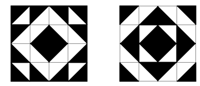
Frieze patterns for family 0000 (secondary, 0000)





2222 0000





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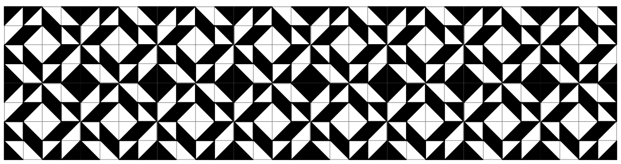
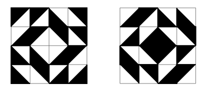
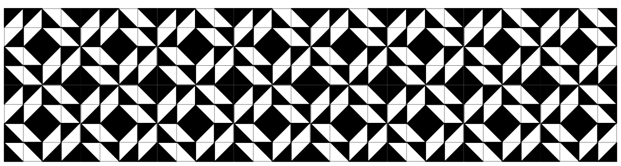
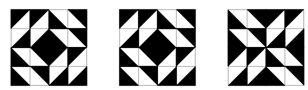


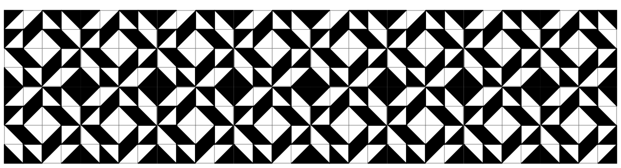


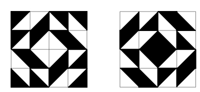
2202 0200



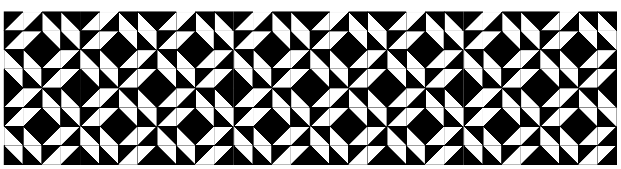


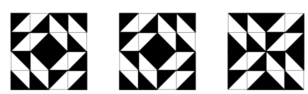
2200 2200 1313





2022 0020





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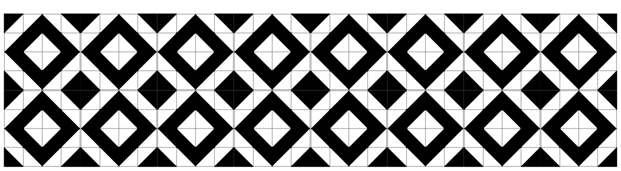

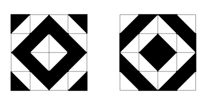

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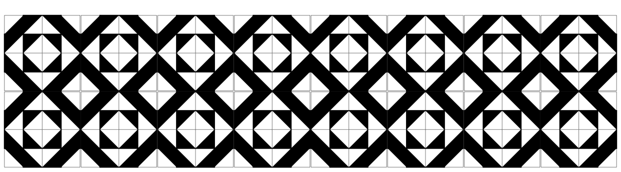

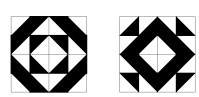

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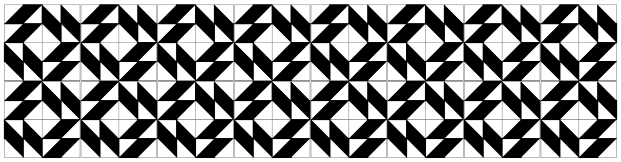

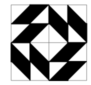

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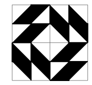

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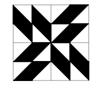

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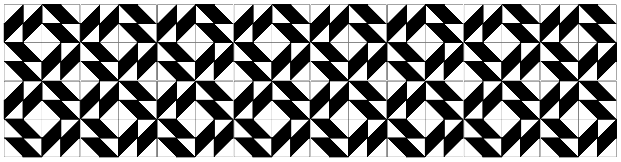

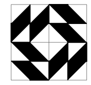

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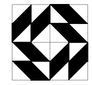

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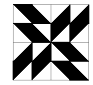
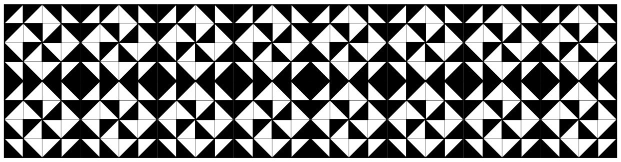
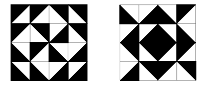


3131

Frieze patterns for family 0001 (secondary, 1000)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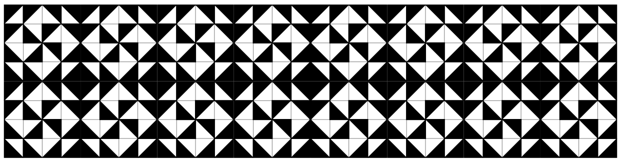
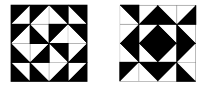
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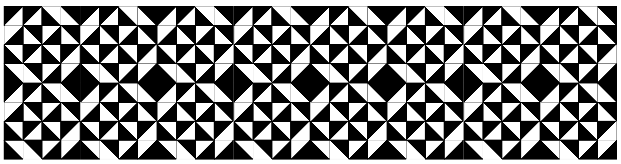
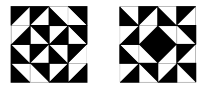
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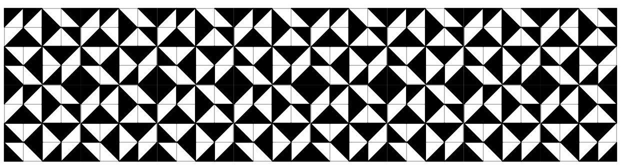
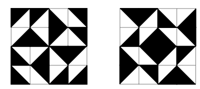
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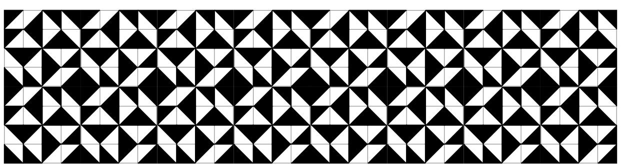
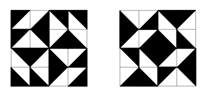
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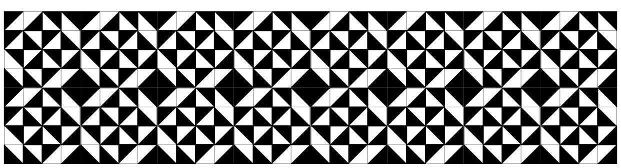
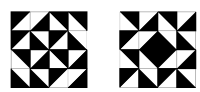
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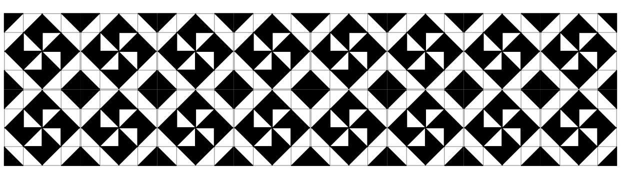
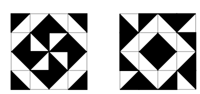
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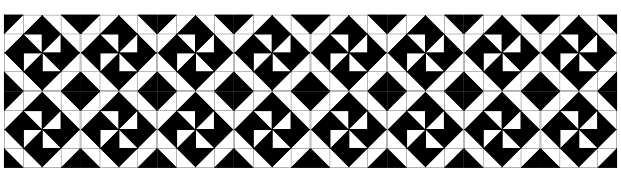
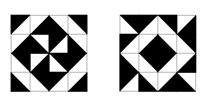
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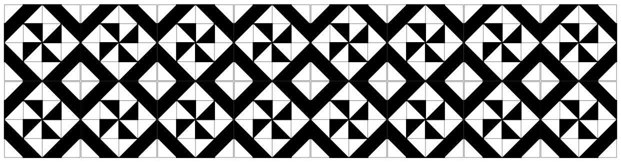

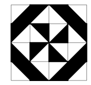

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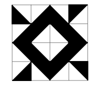

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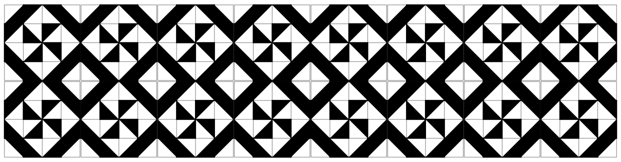

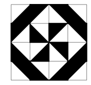

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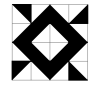

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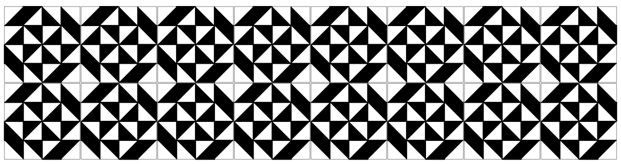

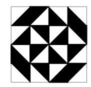

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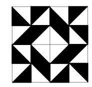
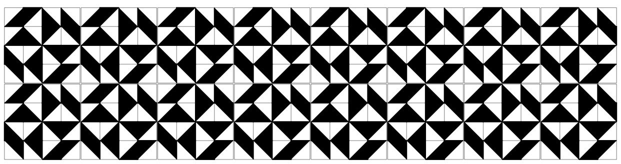
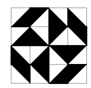


1202





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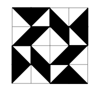

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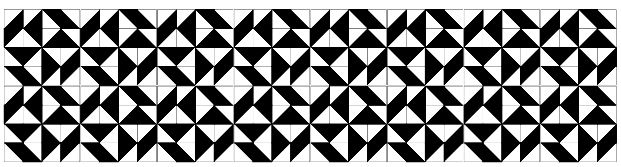

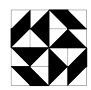

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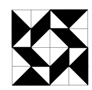

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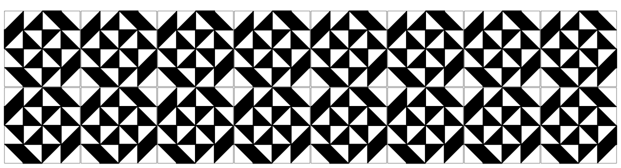

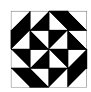

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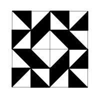

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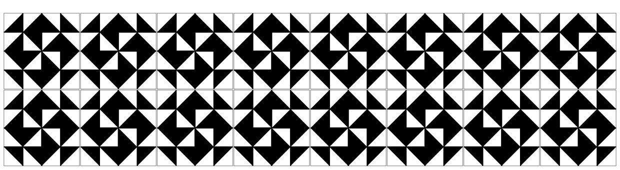

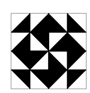

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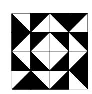

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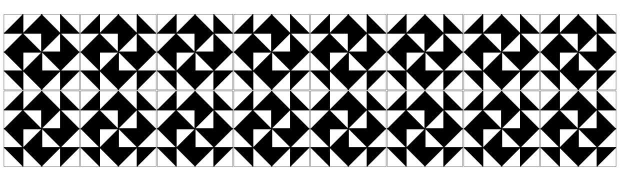

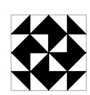

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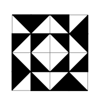
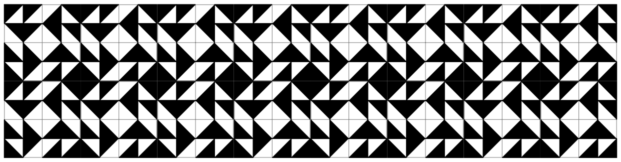
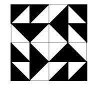


3222

Frieze patterns for family 0010 (secondary, 0100)





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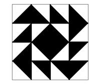
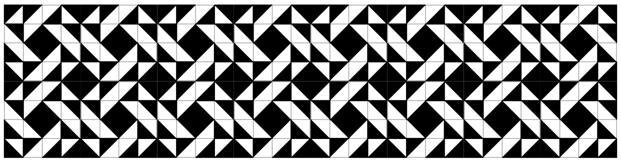
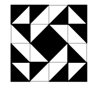


0100





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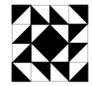
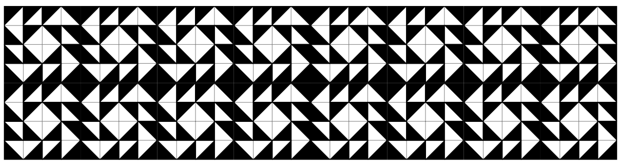
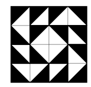


2100





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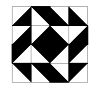
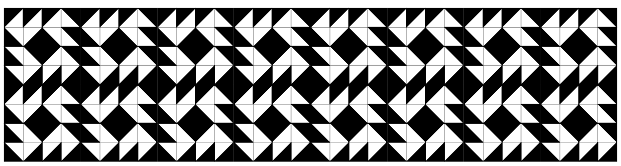
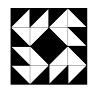


0300





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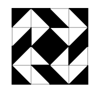

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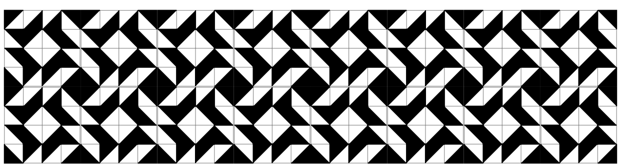

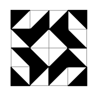

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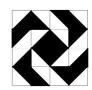

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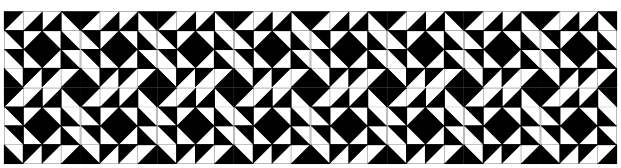

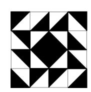

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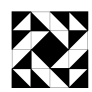

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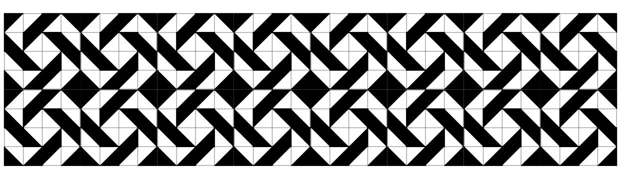
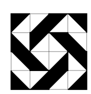
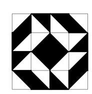




2012



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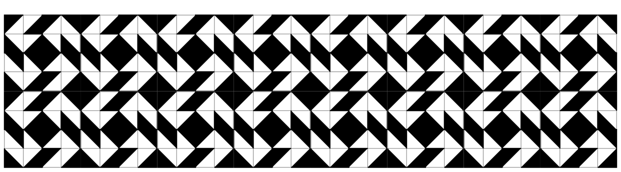

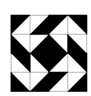

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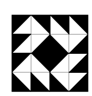

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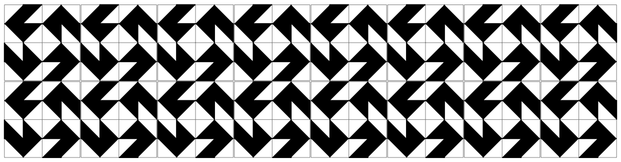

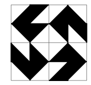

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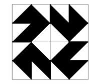

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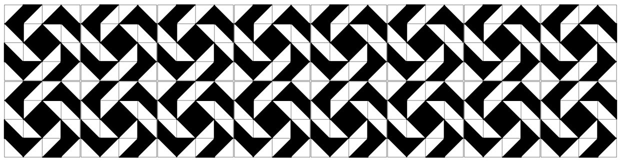

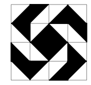

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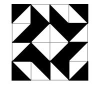

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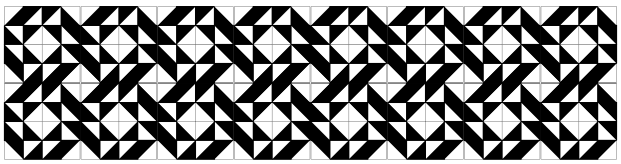

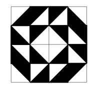

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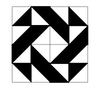

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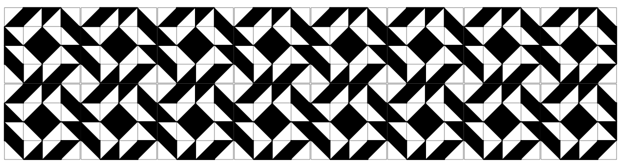

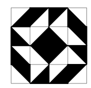

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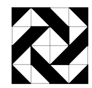

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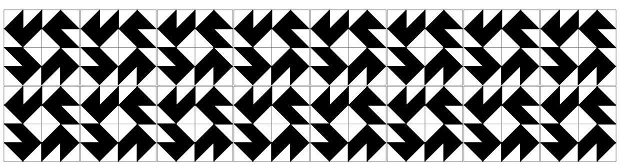

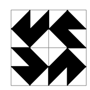

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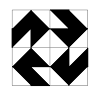

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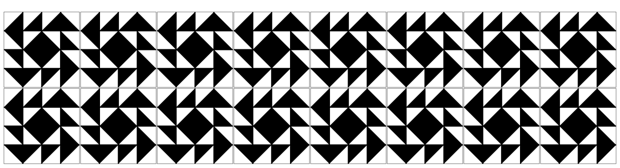

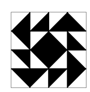

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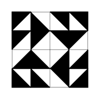

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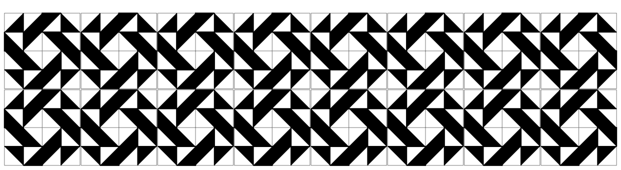

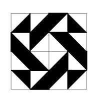

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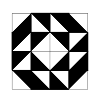

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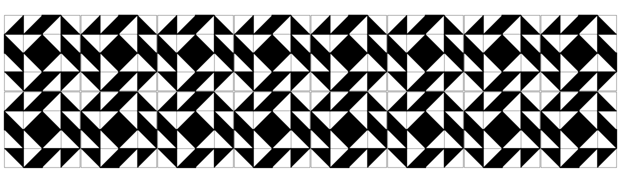

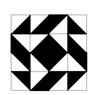

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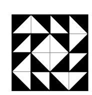
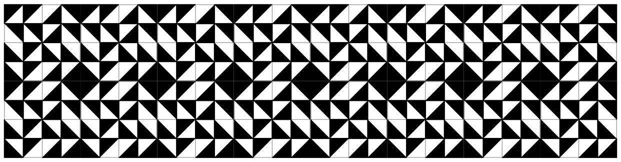
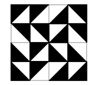


2322

Frieze patterns for family 0011 (secondary, 1100)





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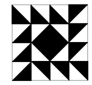
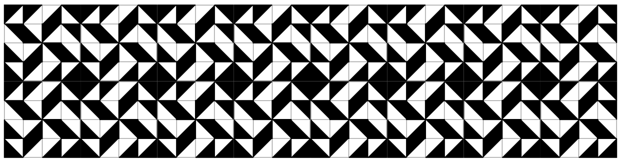
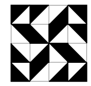


1100





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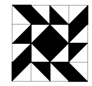

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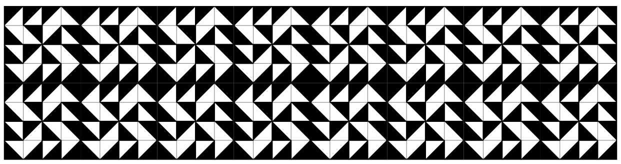

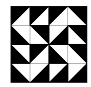

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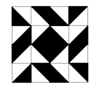
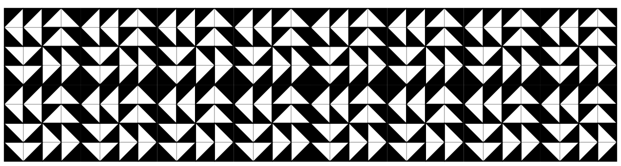
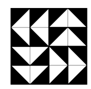


1300





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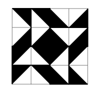

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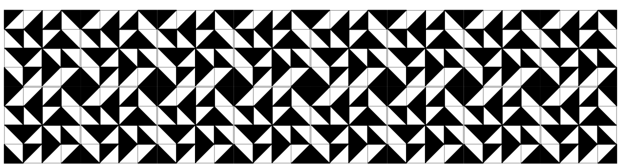

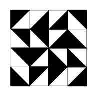

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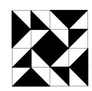

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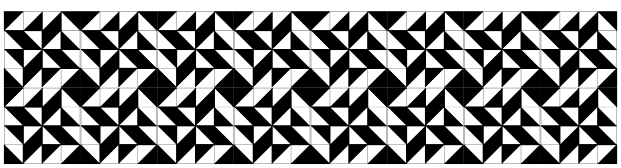

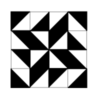

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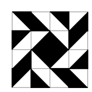

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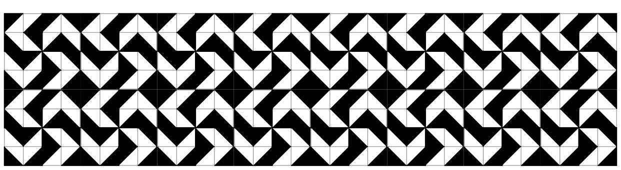

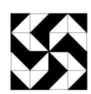

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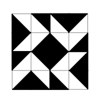

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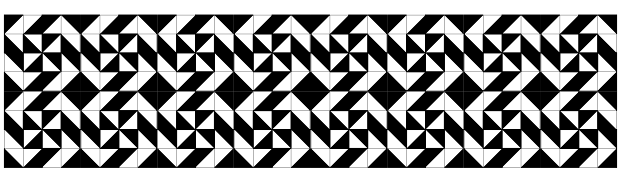

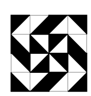

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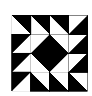

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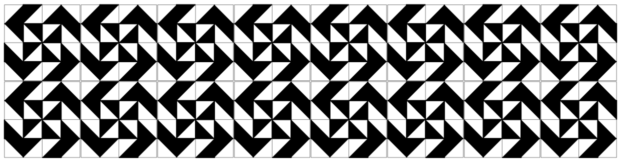

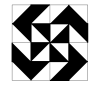

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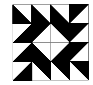

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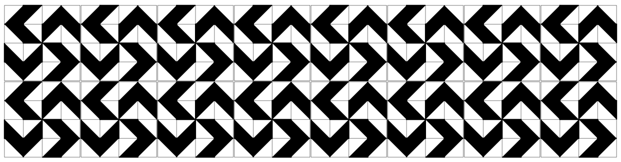

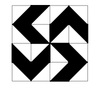

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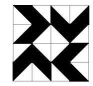

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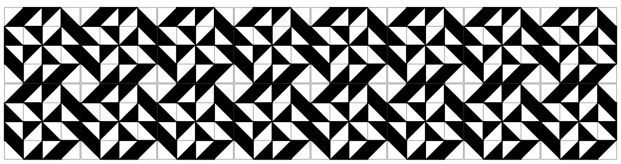

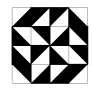

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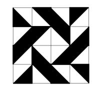

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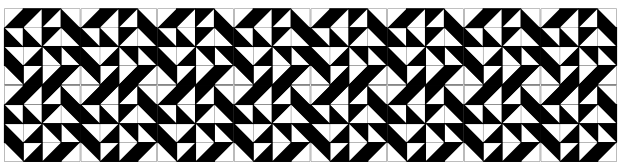

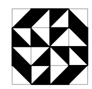

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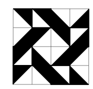

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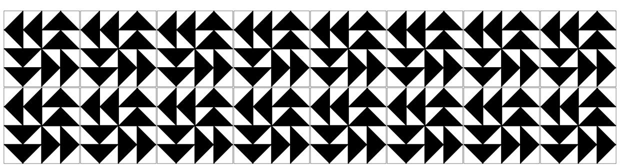

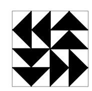

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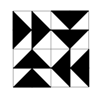

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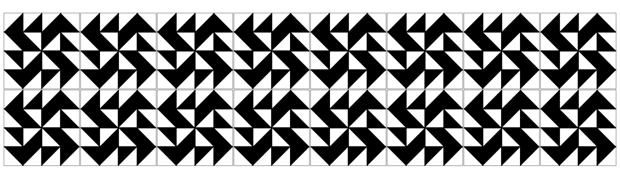

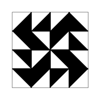

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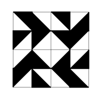

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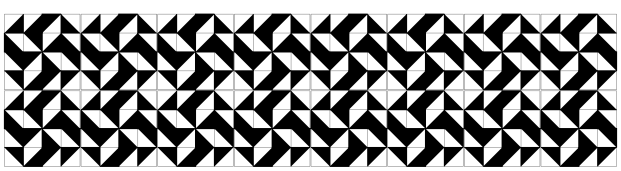

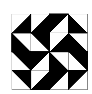

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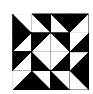

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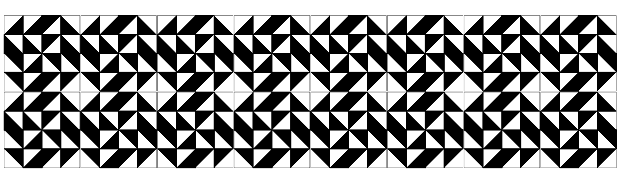

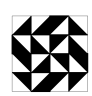

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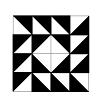
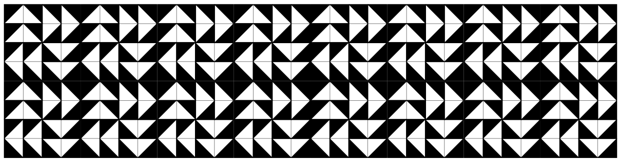
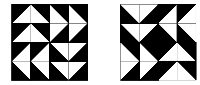


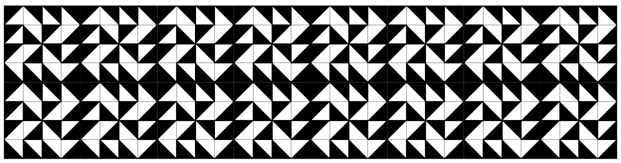
3322

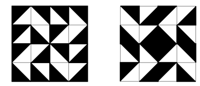
Frieze patterns for family 0101 (secondary, 1010)





2323 1010





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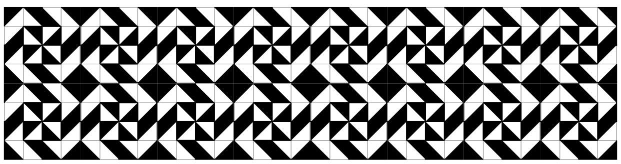

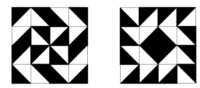

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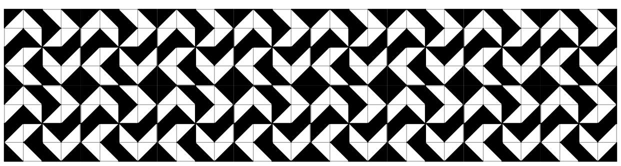

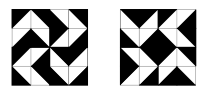

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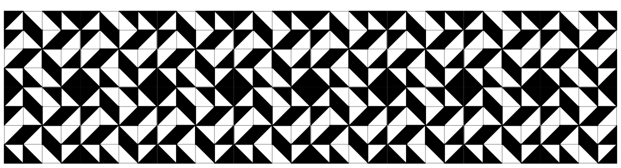

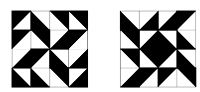

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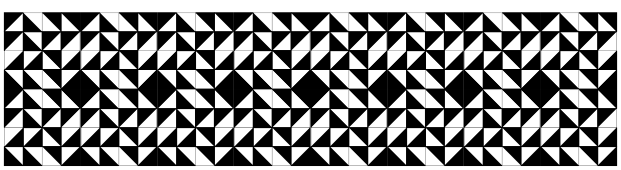

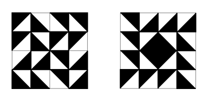

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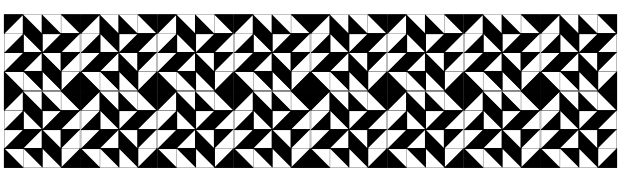

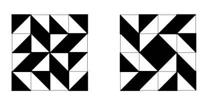

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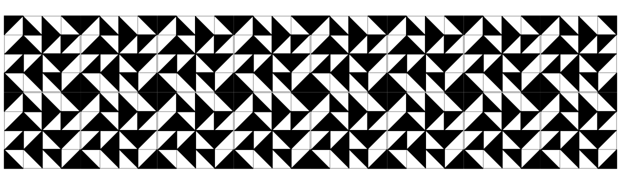

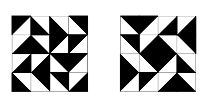

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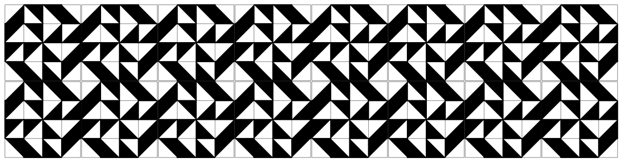

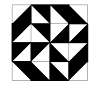

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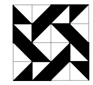

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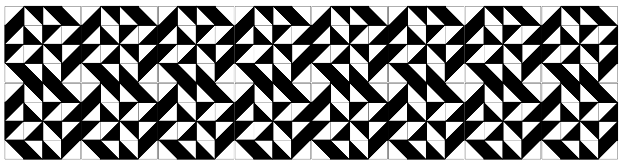

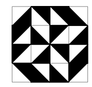

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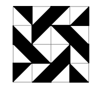

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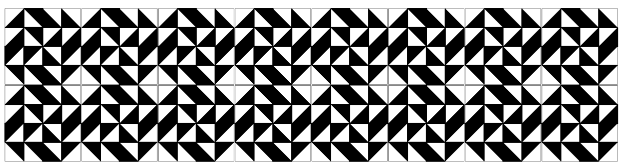

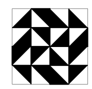

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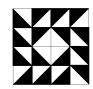

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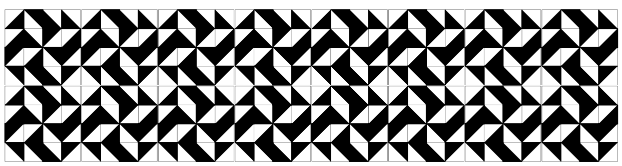

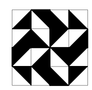

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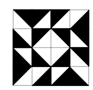

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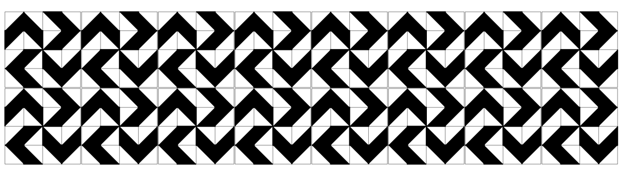

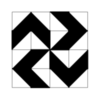

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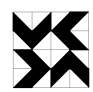

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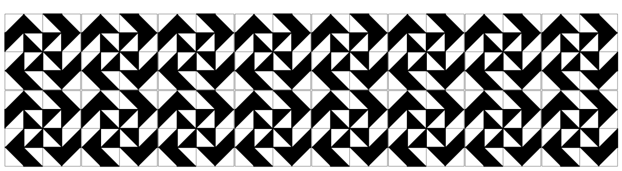

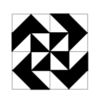

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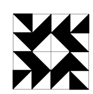

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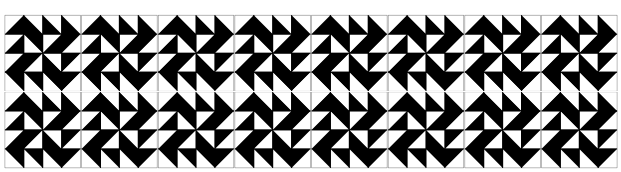

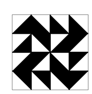

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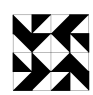

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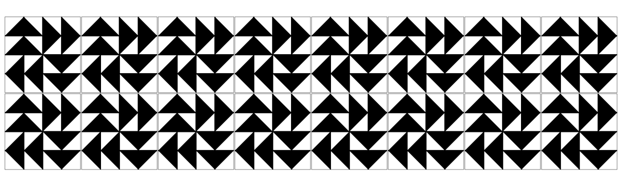
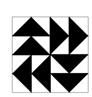
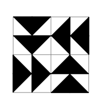


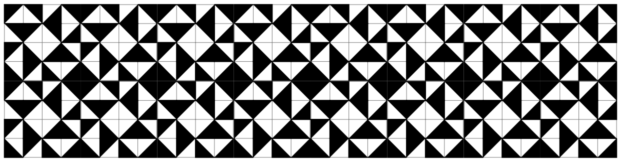


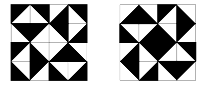
0101



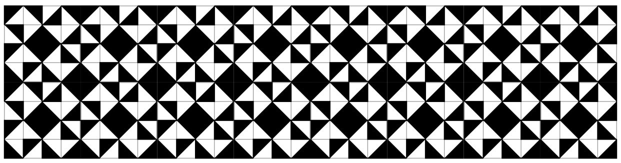
3232

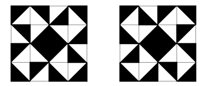
Frieze patterns for family 0110 (secondary, 0110)



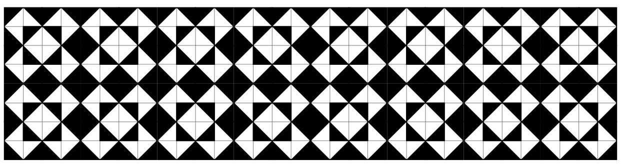


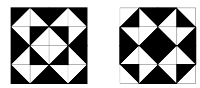
2332 0110



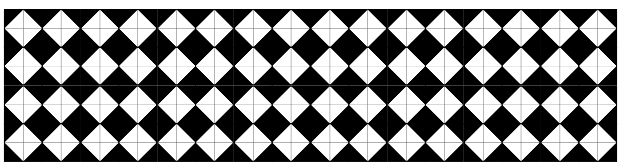


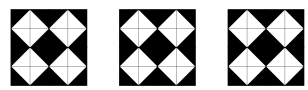
2330 2110



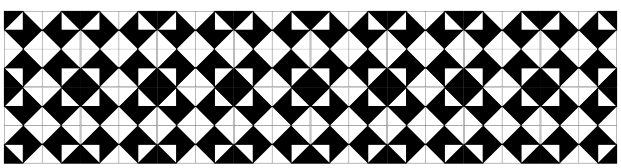


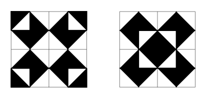
2312 0310



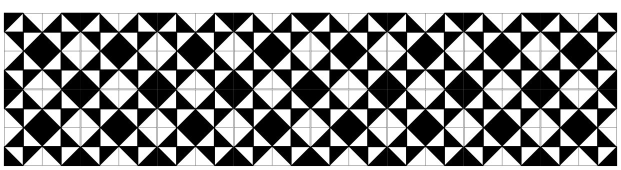


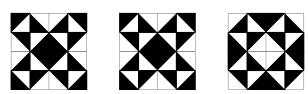
2310 2310 2310



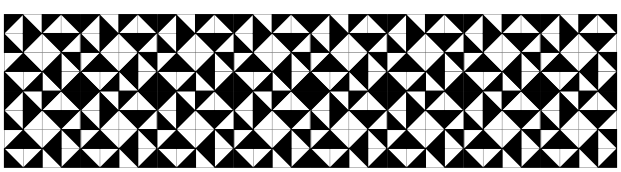


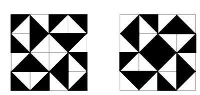
2132 0130



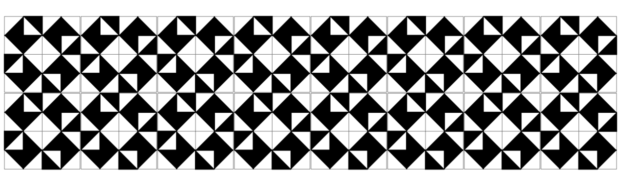


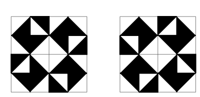
2130 2130 0312



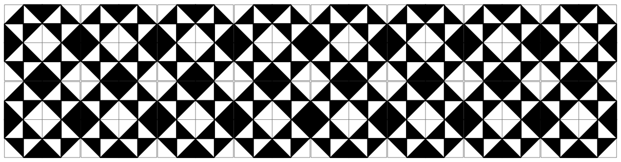


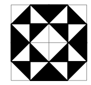
2112 0330





0332 0112





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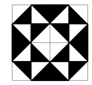

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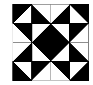

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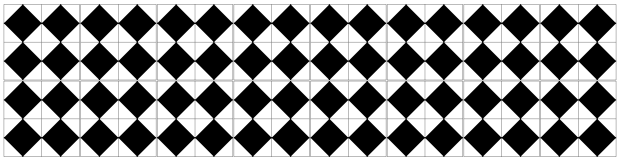

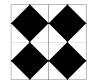

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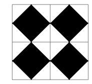

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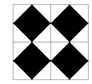
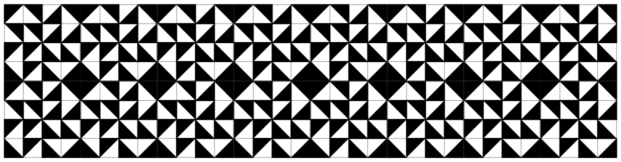
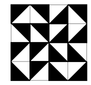


0132

Frieze patterns for family 0111 (secondary, 1110)





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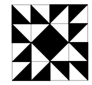

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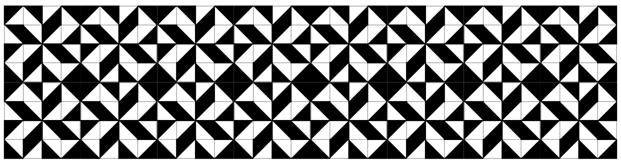

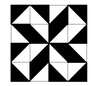

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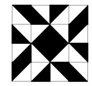

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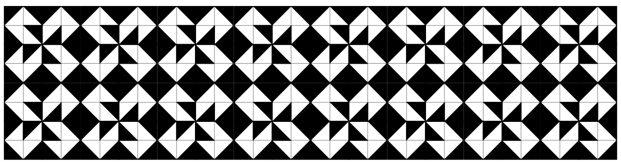

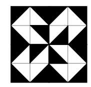

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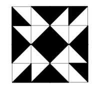

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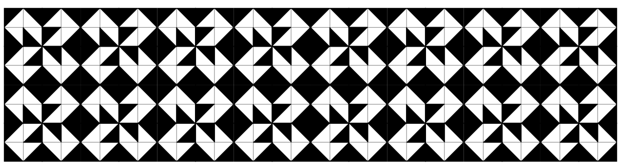

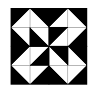

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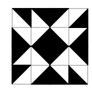

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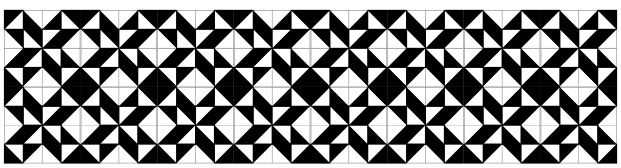

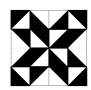

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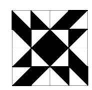

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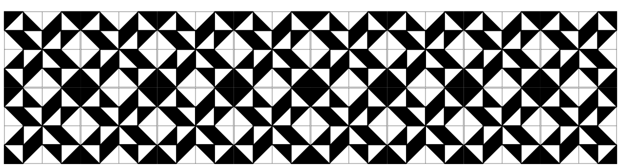

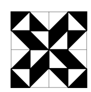

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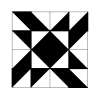

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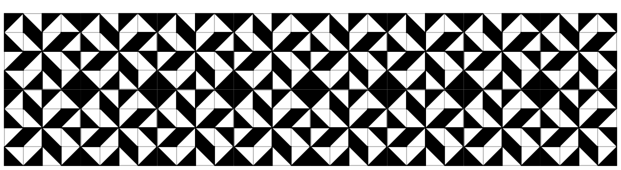

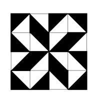

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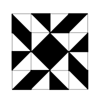

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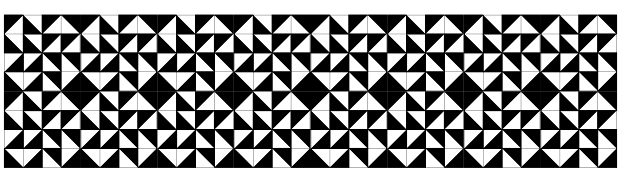

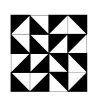

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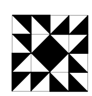

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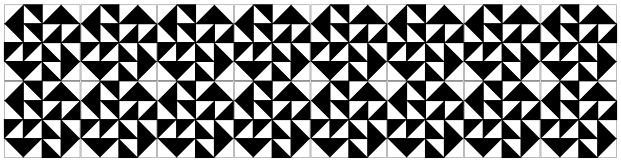

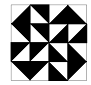

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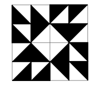

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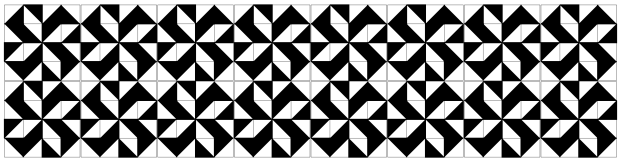

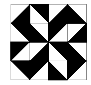

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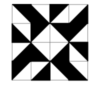

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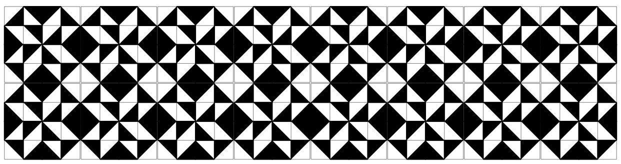

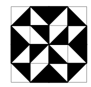

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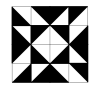

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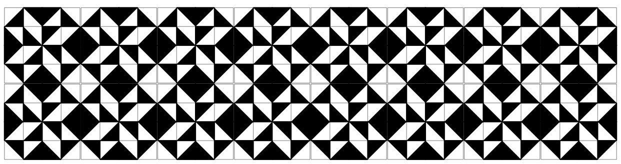

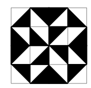

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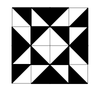

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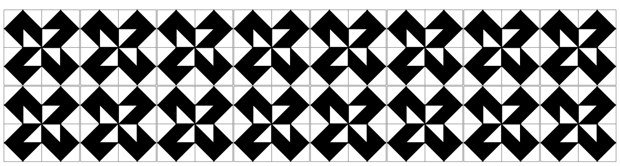

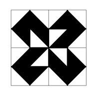

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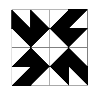

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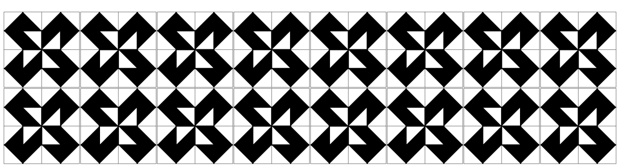

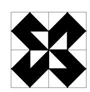

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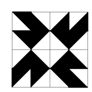

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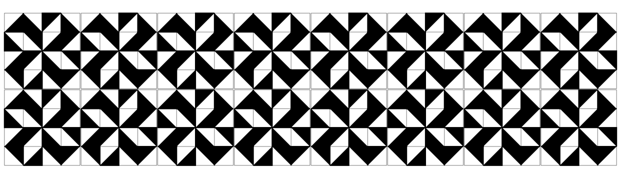

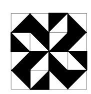

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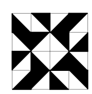

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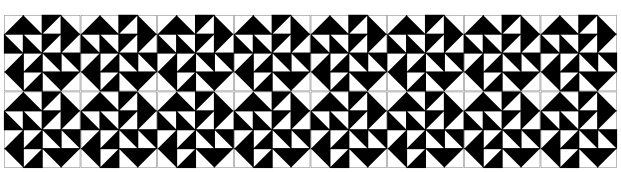

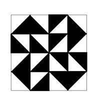

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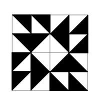
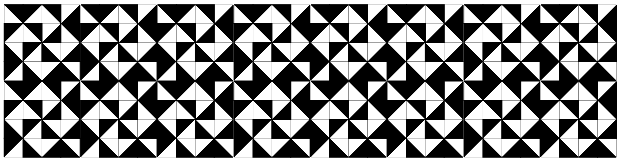
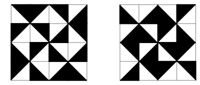


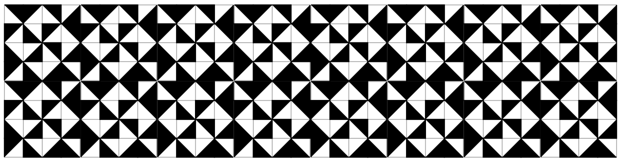
3332

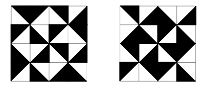
Frieze patterns for family 1001 (secondary, 1001)





3223 1001





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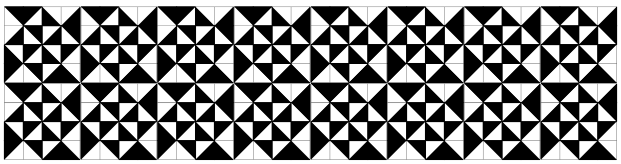

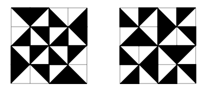

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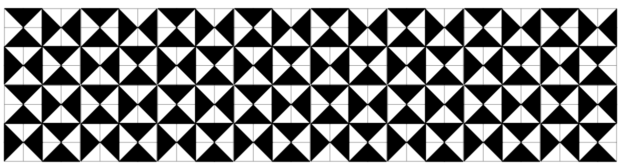

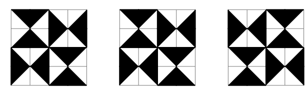

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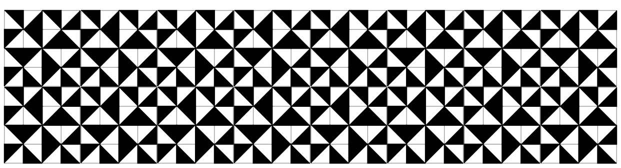

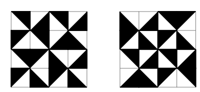

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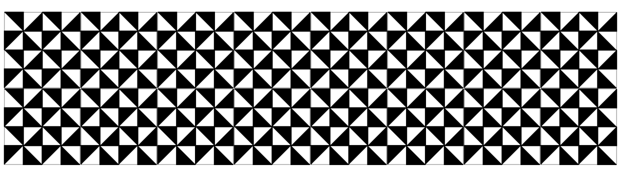

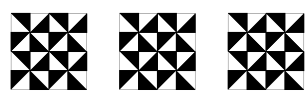

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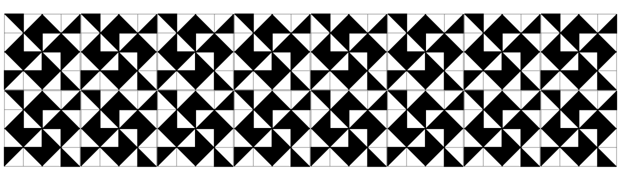

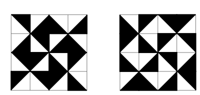

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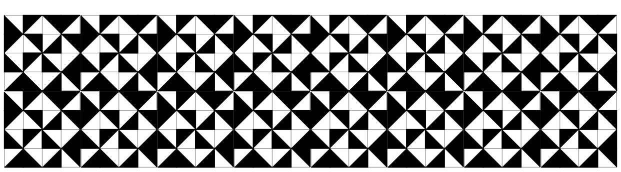

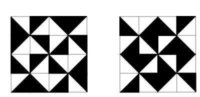

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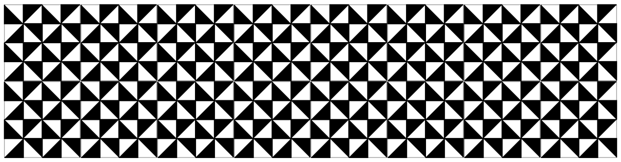

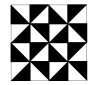

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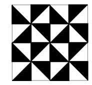

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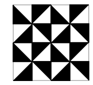

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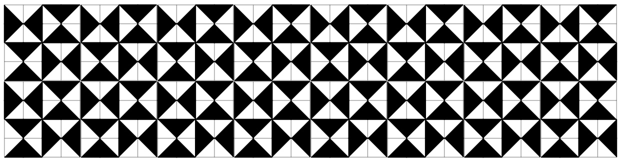

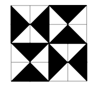

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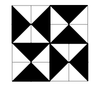

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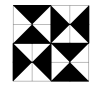
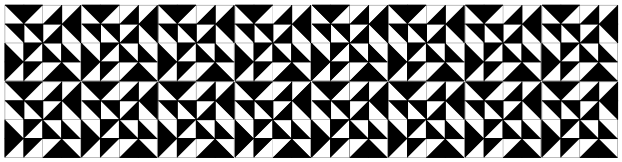
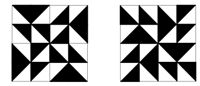


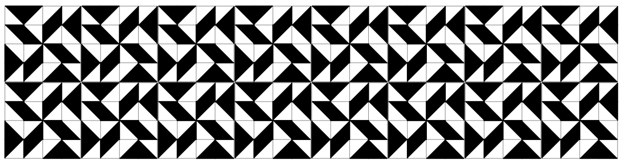
3201

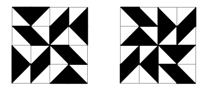
Frieze patterns for family 1011 (secondary, 1101)





3233 1101





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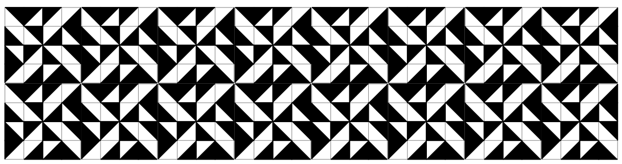

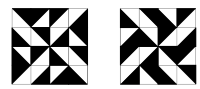

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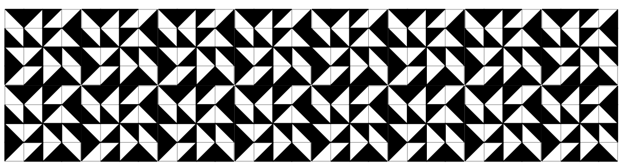

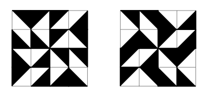

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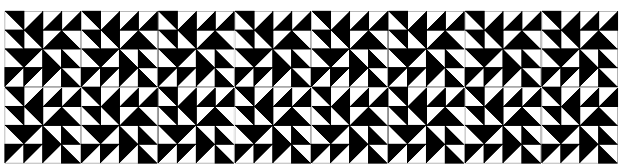

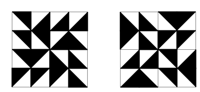

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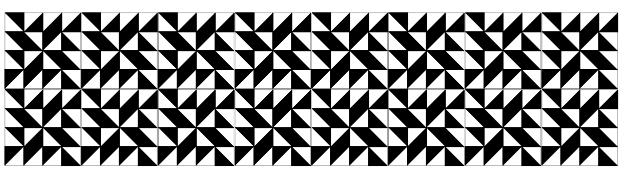

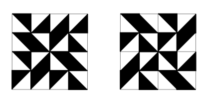

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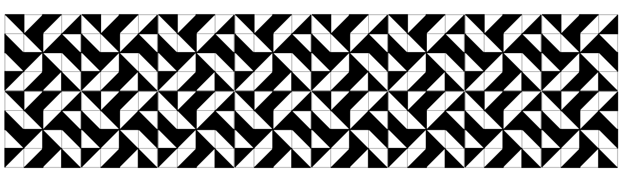

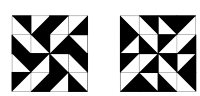

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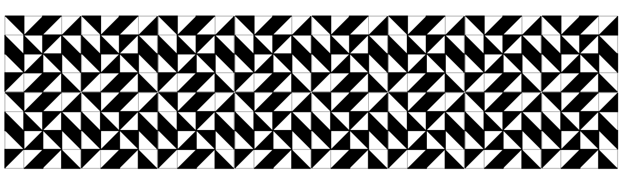

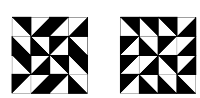

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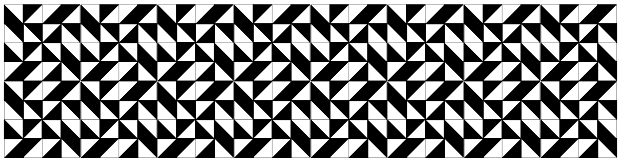

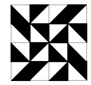

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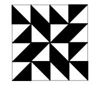

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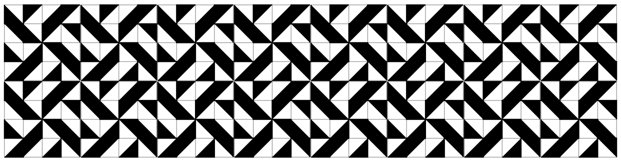

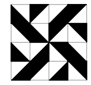

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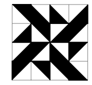

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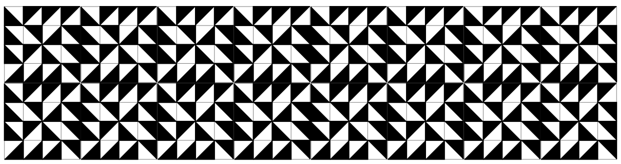

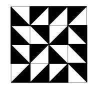

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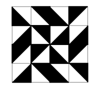

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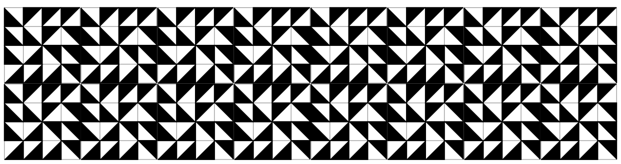

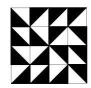

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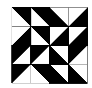

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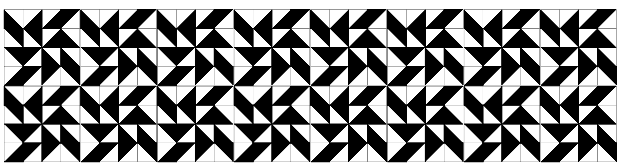

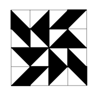

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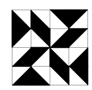

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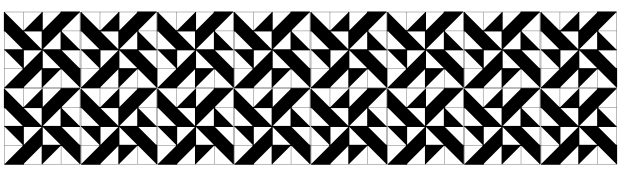

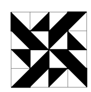

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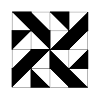

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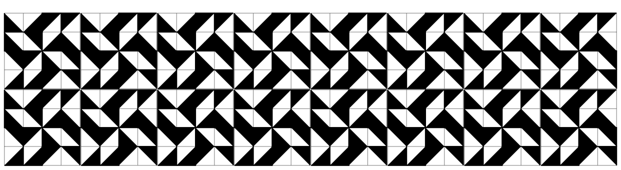

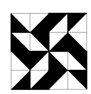

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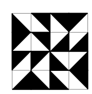

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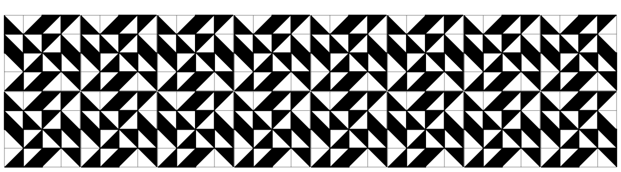

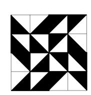

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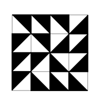
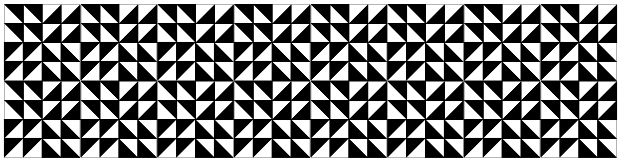
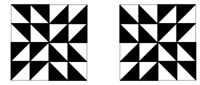
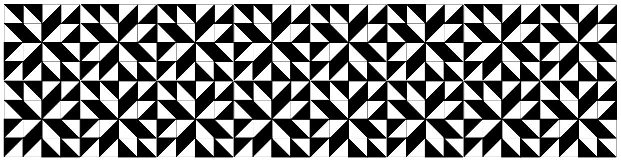
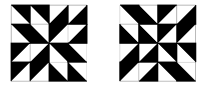


3323

Frieze patterns for family 1111 (secondary, 1111)

3333 1111

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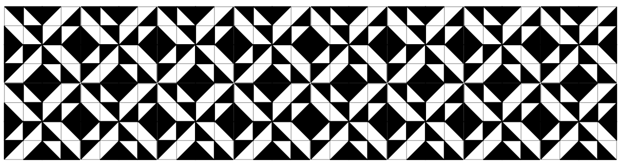
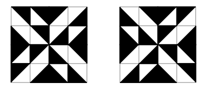

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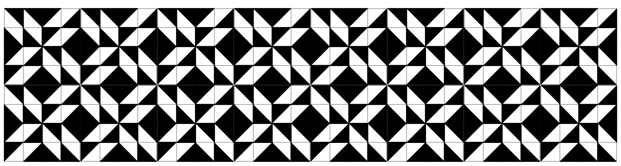
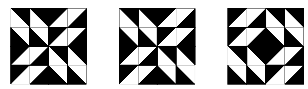
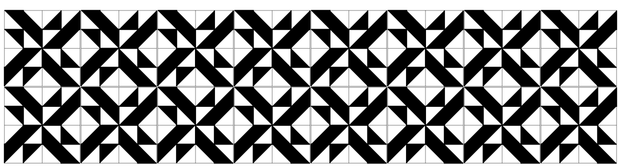
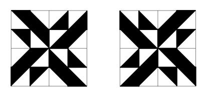



3311 3311 2020

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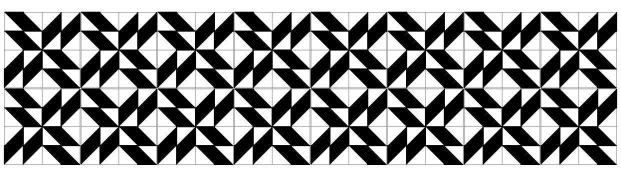
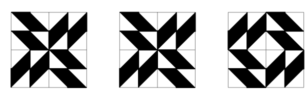

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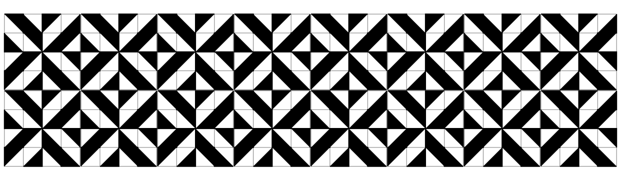
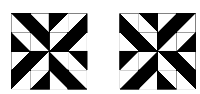

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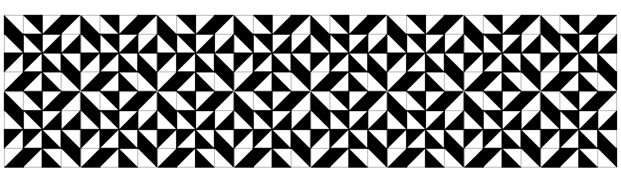
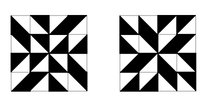

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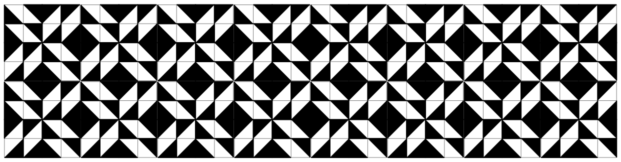

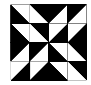

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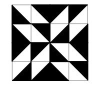

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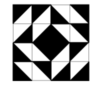

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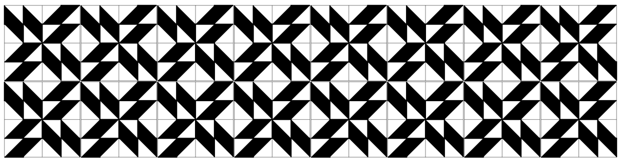

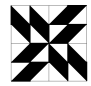

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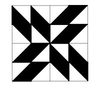

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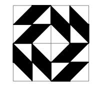


0202

Self-dual tiles

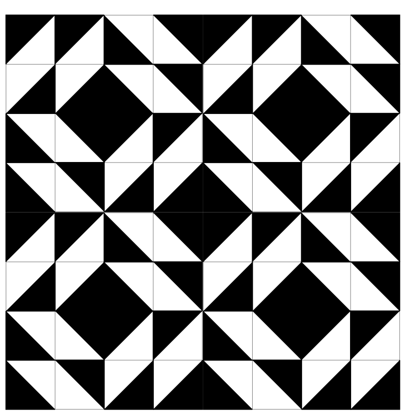
Self-dual tiles are the 4×4 Truchet tile patterns whose 2×2 prototile has two-fold (180°) rotational symmetry. Because of the two-fold rotational symmetry of the prototile, its appearance in the third quadrant of the 4×4 tile is identical to its appearance in the initial quadrant. So the dual tile that emerges when placing four of the tiles together in a larger 2×2 tile array is another copy of the original tile, appearing in the center of the larger 2×2 pattern.

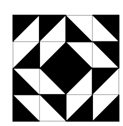
Prototiles with two-fold symmetry

If the original protitle has strict two-fold symmetry, 2×2 patterns made with the four-fold rotationally symmetrical Truchet tile also display another distinct emergent four-fold rotationally symmetrical Truchet tile, which we are calling the *tertiary* tile.

In these patterns, it appears that there are five copies of the primary tile (four placed in a 2×2 array, and another emerging in the center), along with four copies of the tertiary tile pattern.

2200 with 1313





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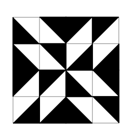

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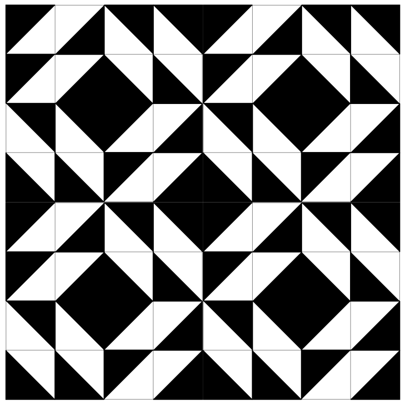
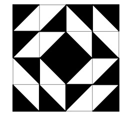
2020 with 3311





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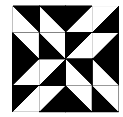

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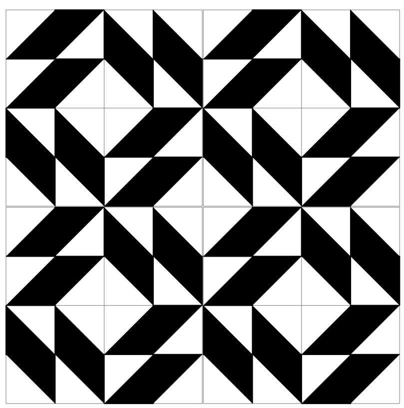
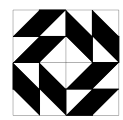
0202 with 1133





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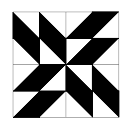

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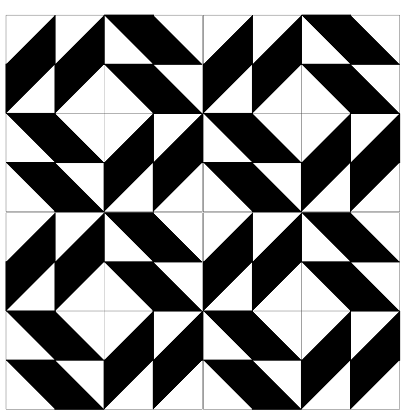
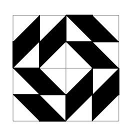
0022 with 3131





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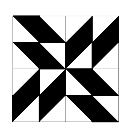

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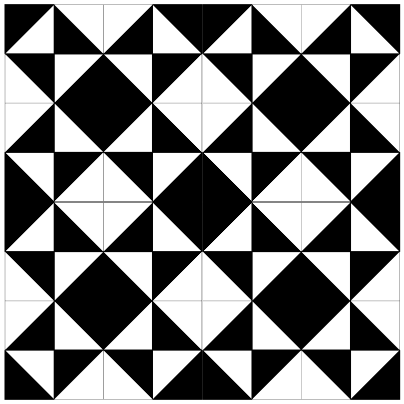
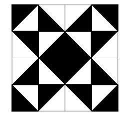
2130 with 0312





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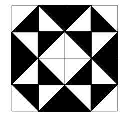

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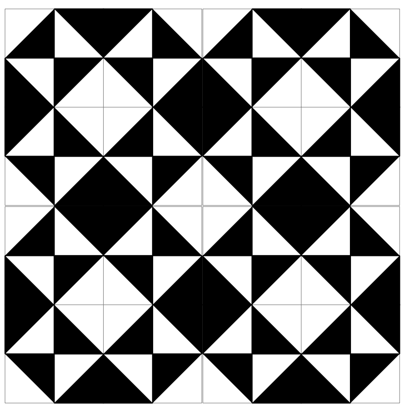
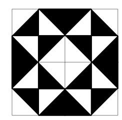
0312 with 2130





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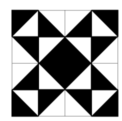

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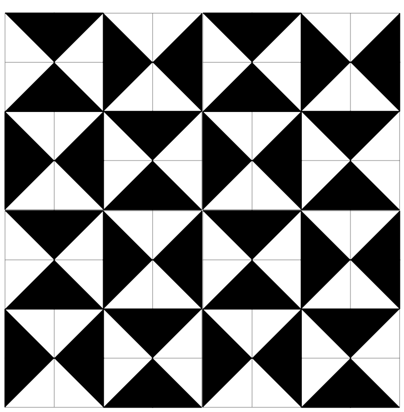
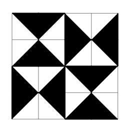
3201 with 1023





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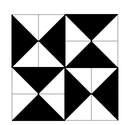

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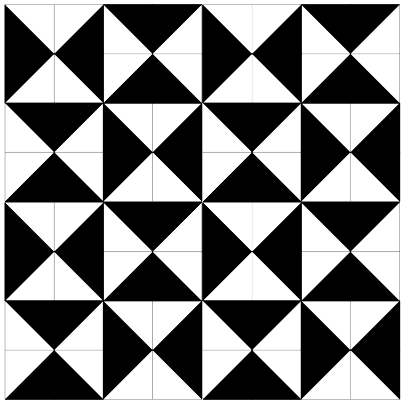
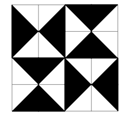
1023 with 3201





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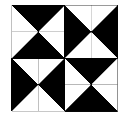

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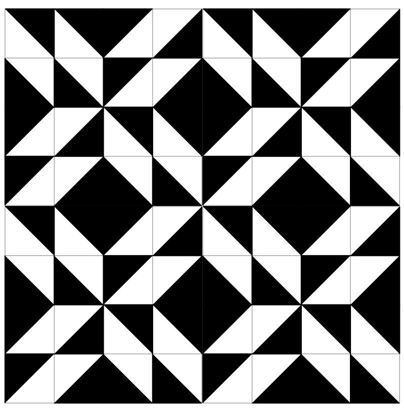
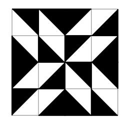
3311 with 2020





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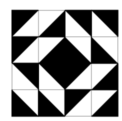

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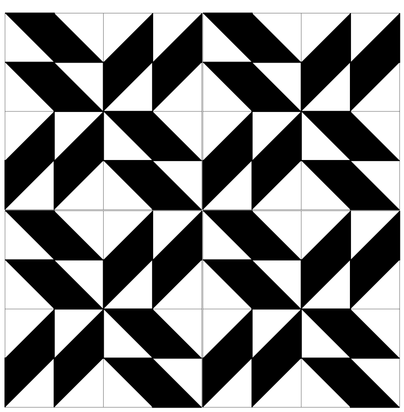
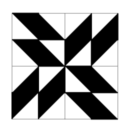
3131 with 0022





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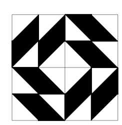

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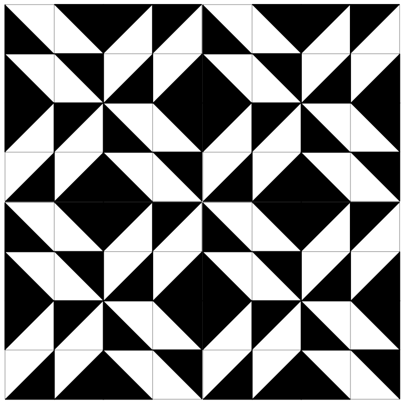
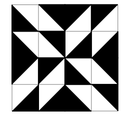
1313 with 2200





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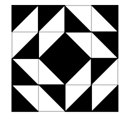

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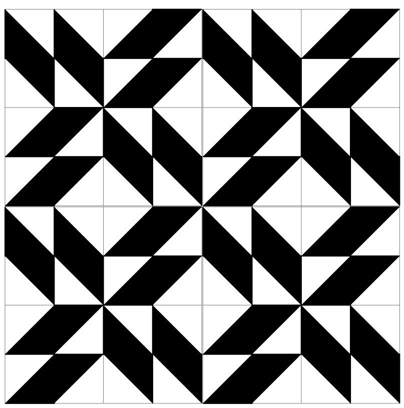
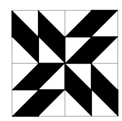
1133 with 0202





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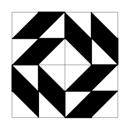
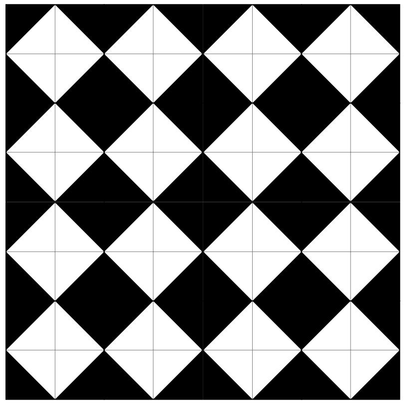


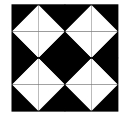
0202

Prototiles with four-fold symmetry

If the original protitle has four-fold symmetry, 2×2 patterns made with the four-fold rotationally symmetrical Truchet the tertiary tile is another copy of the original tile. The pattern becomes very uniform, a 4×4 repeating pattern of the underlying prototile.

2310





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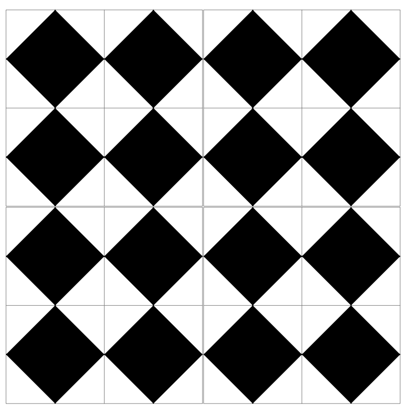

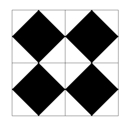

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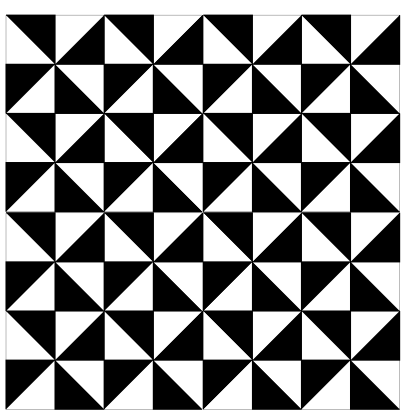

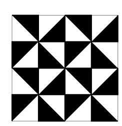

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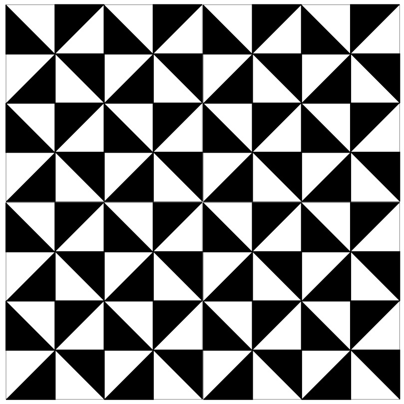
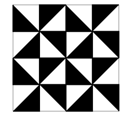
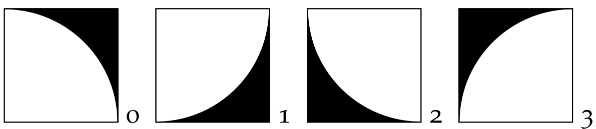




1203

Semicircle Truchet tile patterns



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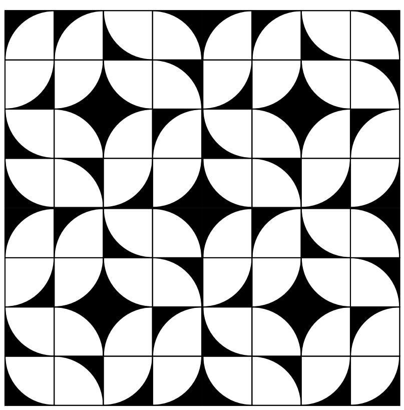

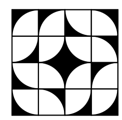

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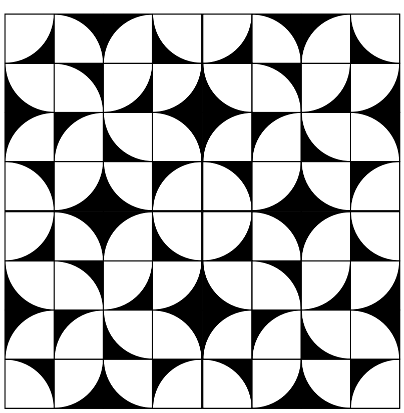

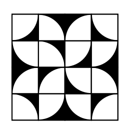

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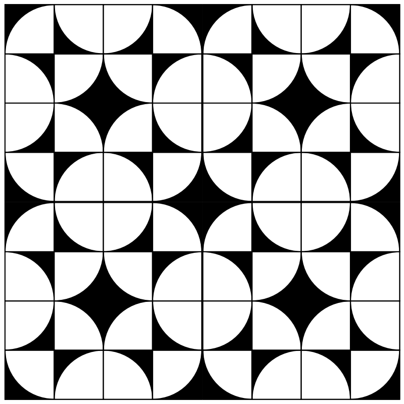

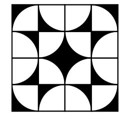

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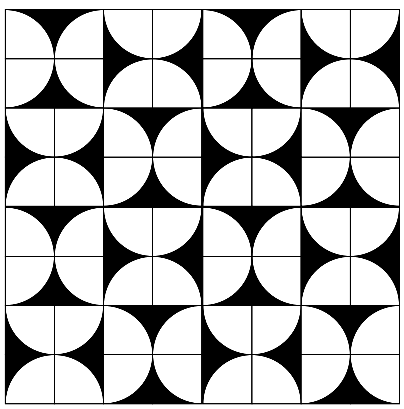

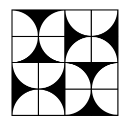

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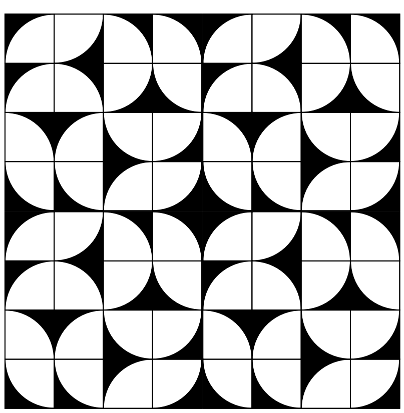

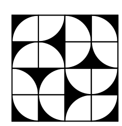

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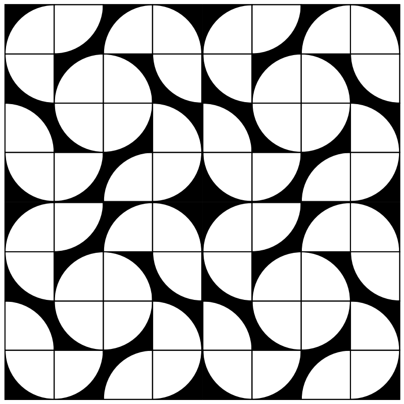

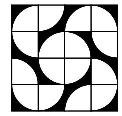

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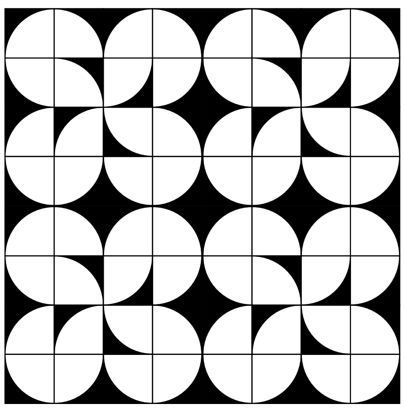

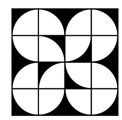

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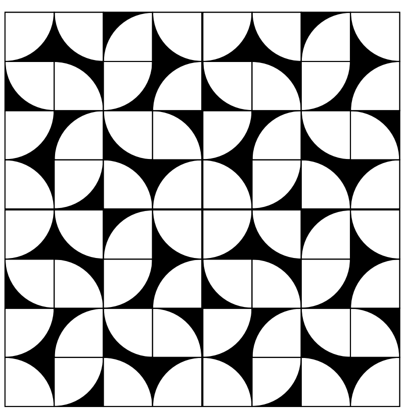

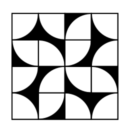

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