Dror Bar-Natan: Talks: SciRen-1605:

Name What You See: The 17 Tiling Patterns

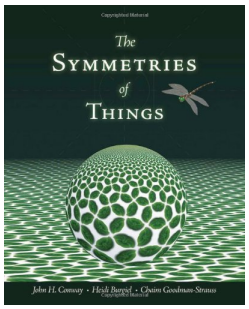
Handout and video at http://drorbn.net/SR16

Science Rendezvous, University of Toronto, May 7, 2016

Abstract. People like identifying and naming the things they see. It's an oak, not just a tree, a hawk, not just a bird, and a tiger, not just an animal. I'll tell you how to identify and name the 17 symmetry patterns you can find on floor tiles and wallpapers all around you (yes, there are exactly 17 of them, no more and no less).

Gotta catch 'em all!

Reading. An excellent book on the subject is *The Symmetries of Things* by J. H. Conway, H. Burgiel, and C. Goodman-Strauss, CRC Press, 2008.



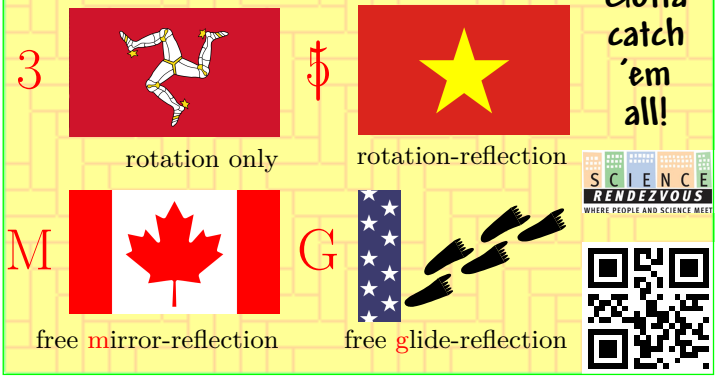
Another nice text is *Classical Tessellations and Three-Manifolds* by J. M. Montesinos, Springer-Verlag, 1987.

Question. In what ways can you make \$2 change, using coins denominated $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, etc.?

Answer. $2 = \frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2} = \frac{2}{3}+\frac{2}{3}+\frac{2}{3} = \frac{3}{4}+\frac{3}{4}+\frac{1}{2} = \frac{5}{6}+\frac{2}{3}+\frac{1}{2}$, and that's it.

Video, handout, links at drorbn.net/SR16

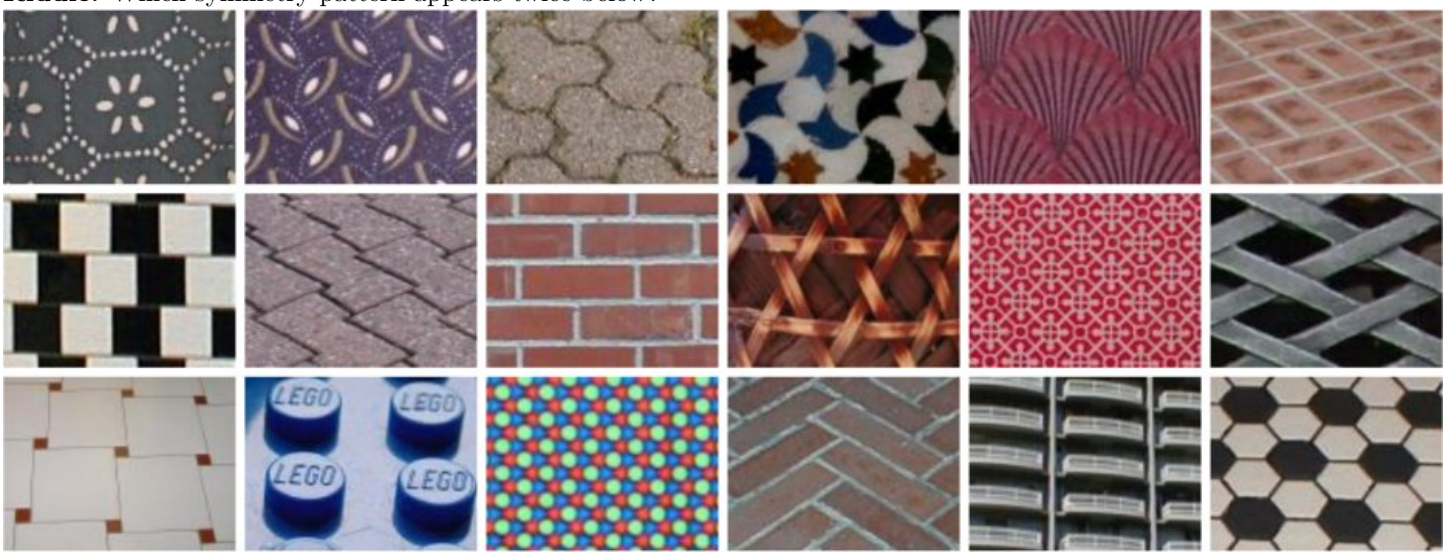
The Basic Features.



Theorem. There are precisely 17 patterns with which to tile the plane, no more, no less. They are all made of combinations of the 10 basic features, 2, 3, 4, 6, ✌, ✋, ✍, ☘, M, and G, as follows:

✓	Dror's	Conway's	crystallographic	✓	Dror's	Conway's	crystallographic
	2222	2222	p2		**33**	3*3	p31m
	333	333	p3		**22**	2*22	cmm
	442	442	p4		**22M**	22*	pmg
	632	632	p6		**MM**	**	pm
	2222	*2222	pmm		**MG**	*o	cm
	333	*333	p3m1		**GG**	oo	pg
	442	*442	p4m		**22G**	22o	pgg
	632	*632	p6m		∅	0	p1
	42	4*2	p4g				

Riddle. Which symmetry pattern appears twice below?



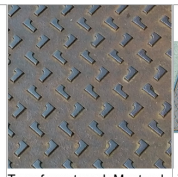
Tilings worksheet. Classify the pictures on the other side according to the following possibilities: **2222**=2222, **333**=333, **442**=442, **632**=632, **2222**=*2222, **333**=*333, **442**=*442, **632**=*632, **42**=4*2, **33**=3*3, **22**=2*22, **22M**=22*, **MM**=**, **MG**=*o, **GG**=oo, **22G**=22o, and ∅=0 (the pictures come in {context, pattern} pairs).

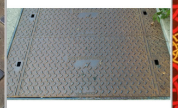

AgaKhan-4


AgaKhan-4


ManholeInLouvain

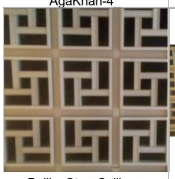

ManholeInLouvain


TransformateursInMontreal


TransformateursInMontreal


AgaKhan-7

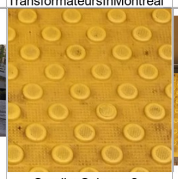

AgaKhan-7


BeijingStoreCeiling

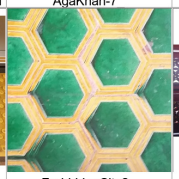

BeijingStoreCeiling


TissueBox

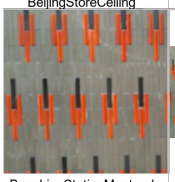

TissueBox


SpadinaSubway-2


SpadinaSubway-2


ForbiddenCity2

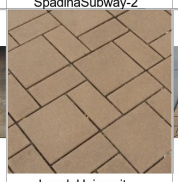

ForbiddenCity2


BeaubienStationMontreal

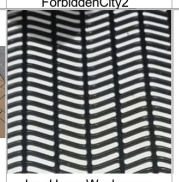

BeaubienStationMontreal

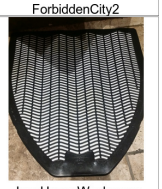

FloorTiles@Starbucks


FloorTiles@Starbucks


LoyolaUniversity

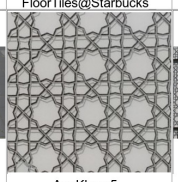

LoyolaUniversity

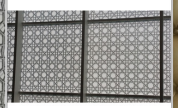

JavaHouseWashroom


JavaHouseWashroom


SummerPalaceBeijing


SummerPalaceBeijing


AgaKhan-5


AgaKhan-5


CollegeStreetStarbucks


CollegeStreetStarbucks


FishQuiltAtAnyWilks


FishQuiltAtAnyWilks


FransRestaurant

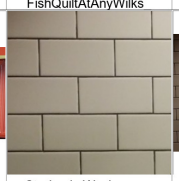

FransRestaurant


SpadinaSubway-1

SpadinaSubway-1


ForbiddenCity1


ForbiddenCity1


StarbucksWashroom


StarbucksWashroom

AtAppleStore

AtAppleStore

HotelRoomRaleigh

HotelRoomRaleigh

TorontoPublicLibrary

TorontoPublicLibrary

MontrealSidewalk

MontrealSidewalk

NonSlid1

NonSlid1

CopenhagenTrainStation

CopenhagenTrainStation

StClairWSubway-1

StClairWSubway-1

RaviOfCornell

RaviOfCornell

SidSmithCafe

SidSmithCafe

RainbowMarketSquare

RainbowMarketSquare

CymbalCase

CymbalCase

KleinBottleSofa

KleinBottleSofa_sm

Tissues

Tissues

RicksCafeKensington

RicksCafeKensington

StClairWSubway-2

StClairWSubway-2

AgaKhan-3_

AgaKhan-3

BeijingBoatCeiling

BeijingBoatCeiling

AgaKhan-6

AgaKhan-6

MahaneYehudaByAssaf

MahaneYehudaByAssaf