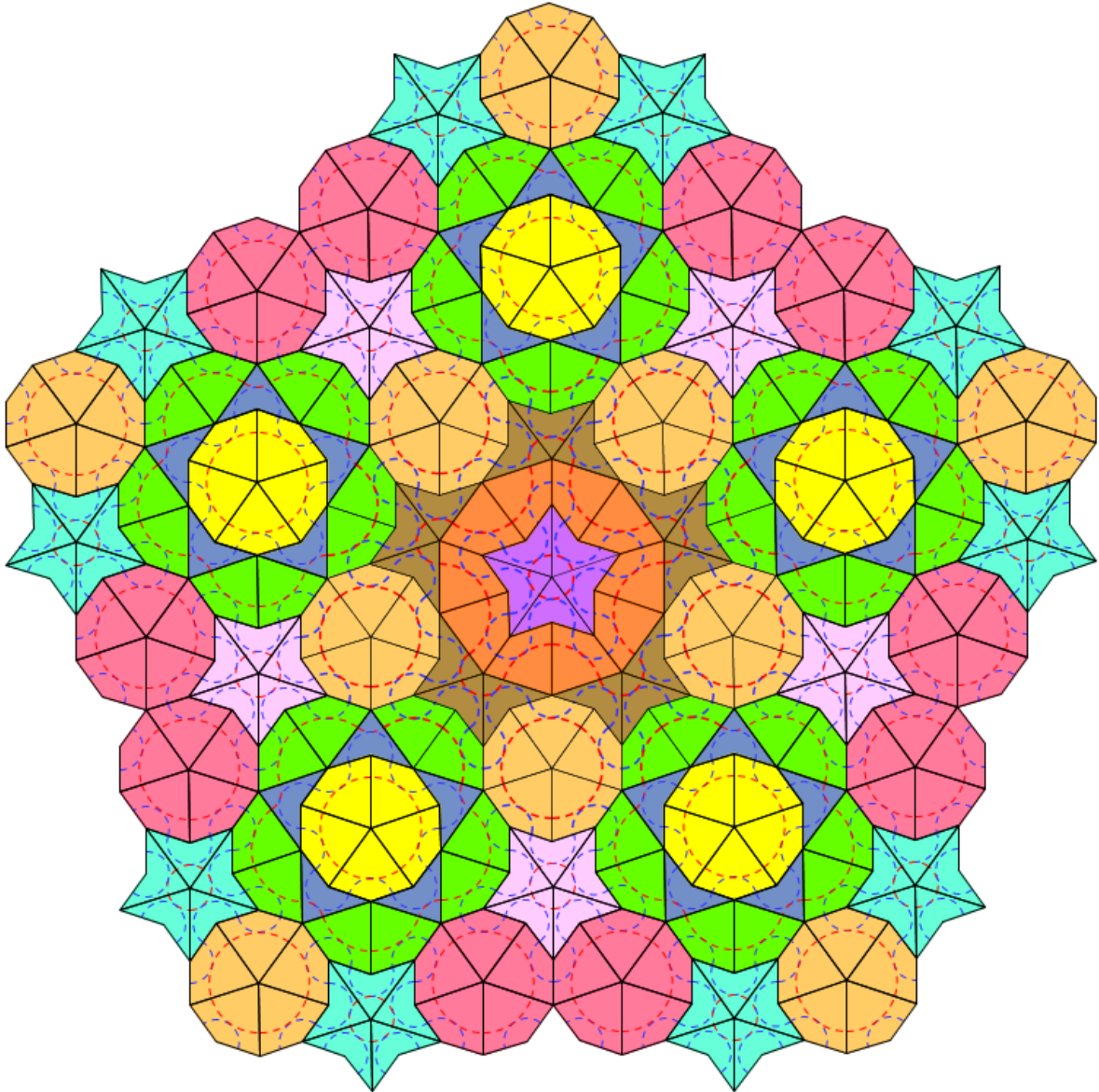


# Counting Penrose dart and kite tiles

Counting polygons



I've constructed this Penrose tiling with GeoGebra (**Mac OS X 10.6.8**, GeoGebra: **4.4.23**), and I've decided to create not only a virtual tiling, but a real mosaic as well. I mean print out the tiles on a flexible magnet sheet and cut out the individual tiles, then compose a mosaic from them, as they were fridge magnets.

The decision is all right, but how much tiles and what color to print and cut out?

This work is about counting GeoGebra objects.

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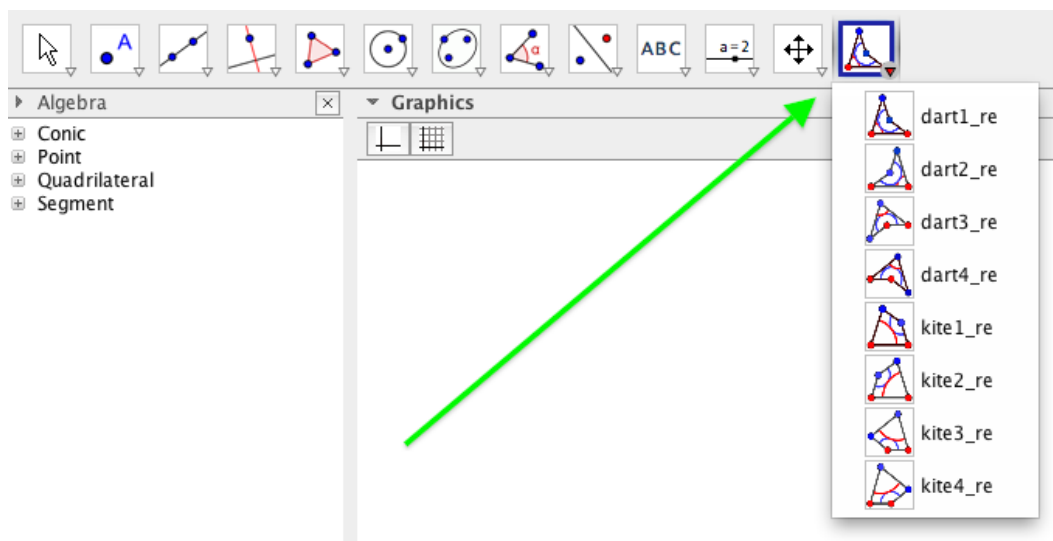
# 1. ANTECEDENT

For the construction of tiling I've created the appropriate commands by the help of GeoGebra's *create new tool* feature. This work doesn't focus on these steps.

These commands are:

dart1\_re, dart2\_re, dart3\_re, dart4\_re, and  
kite1\_re, kite2\_re, kite3\_re, kite4\_re.

They are ready here:



At the end I've constructed the tiling is on the title page.

# 2. COUNTING

## 2.1. Source of information

All the information about a GeoGebra applet is stored in the applet's `geogebra.xml` file. This way we should filter the information we need from it.

The form of information is like this:

```
<command name="dart1_re">
  <input a0="A" a1="B"/>
  <output a0="poly1" a1="C" a2="D" a3="a" a4="b" a5="c" a6="d"
a7="e" a8="f"/>
</command>
<element type="polygon" label="poly1">
  <lineStyle thickness="2" type="0" typeHidden="1"/>
  <show object="true" label="false"/>
  <objColor r="0" g="51" b="153" alpha="0.55"/>
  <layer val="0"/>
  <labelMode val="0"/>
</element>
```

or this:

```
<command name="kite1_re">
  <input a0="A_1" a1="B_1"/>
  <output a0="poly7" a1="C_1" a2="D_1" a3="s_1" a4="t_1"
a5="a_2" a6="b_2" a7="c_2" a8="d_2"/>
</command>
<element type="polygon" label="poly7">
  <lineStyle thickness="2" type="0" typeHidden="1"/>
  <show object="true" label="false"/>
  <objColor r="0" g="204" b="0" alpha="1.0"/>
  <layer val="0"/>
  <labelMode val="0"/>
</element>
```

I've coloured the information which need for counting.

### 3. THE FILTER-COUNTER SCRIPT

```
#!/bin/ksh

#***** cdp.sh *****
# count demo Penrose

if test $# -lt 1
then
  echo "Usage:   $0 ggb-directory"
  exit 1
fi

GGB_DIR=$1
XML_FILE=geogebra.xml

DIR=/Volumes/user/janos/count_demo
OUTPUT_FILE=penrose-objects.txt
OUTPUT_AGGREGATE=penrose-aggregate.txt

echo
cd $GGB_DIR
ls *.ggb
echo
echo ggb-file?
read GGB_FILE
cd $DIR

echo "-----" > $DIR/
$OUTPUT_AGGREGATE
echo $GGB_DIR/$GGB_FILE >> $DIR/$OUTPUT_AGGREGATE

unzip $GGB_DIR/$GGB_FILE $XML_FILE -d $DIR

cat $XML_FILE | \
```

```

sed 's/" /g' | \

##### extract polygons and their colors #####
awk 'substr($0, 1, 8) == "<command"      {printf("%s\t", $3);
                                         while ($1 != "<output")
                                           {getline;}
                                         printf("%s\t", substr($0, index($0,
"poly")))}
     $3 == "polygon"                    {printf("%s\t", $0);
                                         while ($1 != "<objColor")
                                           {getline;}
                                         print $0}' | \

awk '{print $1 " " $2 " " $24 " " $27 " " $28 " " $29 " " $30 " "
$31 " " $32 " " $33 " " $34}' | \
awk '$2 == $3 {printf("%s %-8s %s %+3s %s %+3s %s %+3s %s %s\n",
$1, $2, $4, $5, $6, $7, $8, $9, $10, $11)}' > $DIR/$OUTPUT_FILE

cat $DIR/$OUTPUT_FILE | \
awk '{print substr($1, 1, 4) "___" $3 "___" $4 "___" $5 "___" $6 "___"
$7 "___" $8 "___" $9 "___" $10}' penrose-objects.txt | \
awk '{a[$1]++} END {for (i in a) print i " " a[i]}' | \
tr ' ' '\n' | \
awk '{printf("%s %s%3s %s%3s %s%3s %4s %-5s %3s %s\n", $1, $2,
$3, $4, $5, $6, $7, $8, $9, $10, "pieces")}' | \
sort >> $DIR/$OUTPUT_AGGREGATE

echo "-----" >> $DIR/
$OUTPUT_AGGREGATE
echo "SUM:" >> $DIR/$OUTPUT_AGGREGATE

awk '{a[substr($1, 1, 4)]++} END {for (i in a) print i " " a[i] "
pieces}' $DIR/$OUTPUT_FILE >> $DIR/$OUTPUT_AGGREGATE

cat $DIR/$OUTPUT_AGGREGATE

rm $XML_FILE

```

### 3.1. How to use it?

- Download the `count_demo.ggb` GeoGebra applet.
- With the commands mentioned above (`dart1_re`, etc.) create your own GeoGebra applet (if you want).
- Cut the filter-counter script (`cdp.sh`) from this pdf file, and paste it to a text editor (eg. `vim`) in a terminal window.
- Edit the `DIR` variable depending on your environment, then save the script.
  - Instead of `DIR=/Volumes/user/janos/` write `DIR=your_dir`.
- Make the script executable (`chmod cdp.sh 744`).
- Execute the script with the parameter (`directory_name`) according to your environment, then choose `applet_name` (`ggb-file`).

```
janos$ ./cdp.sh /Volumes/user/janos/count_demo
```

```
count-sample_Penrose.ggb          count_demo.ggb
```

```
ggb-file?
```

```
count_demo.ggb
```

```
Archive: /Volumes/user/janos/count_demo/count_demo.ggb
```

```
  inflating: /Volumes/user/janos/count_demo/geogebra.xml
```

## 4. THE OUTPUT

```
/Volumes/user/janos/count_demo/count_demo.ggb
```

```
dart r= 0  g= 51  b=153  alpha= 0.55  25 pieces
dart r= 51  g=255  b=204  alpha= 0.75  50 pieces
dart r=153  g=102  b=  0  alpha= 0.75  15 pieces
dart r=204  g=102  b=255  alpha= 0.95   5 pieces
dart r=255  g=153  b=255  alpha= 0.5   25 pieces
kite r=102  g=255  b=  0  alpha= 1.0   50 pieces
kite r=255  g= 51  b=102  alpha= 0.65  50 pieces
kite r=255  g=102  b=  0  alpha= 0.75  10 pieces
kite r=255  g=204  b=102  alpha= 1.0   50 pieces
kite r=255  g=255  b=  0  alpha= 1.0   25 pieces
```

```
-----
SUM:
```

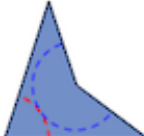
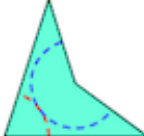
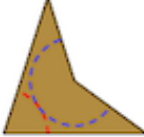
```
dart 120 pieces
```



```
kite 185 pieces
```

### 4.1. How to interpret it?

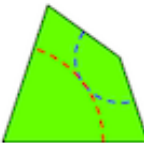



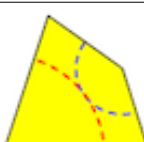
Classifying by shape, color and opacity (alpha) there are 5 kind of darts and 5 kind of kites in this tiling.

#### Darts and their properties

properties				image
red	green	blue	alpha	
0	51	153	0.55	
51	255	204	0.75	
153	102	0	0.75	

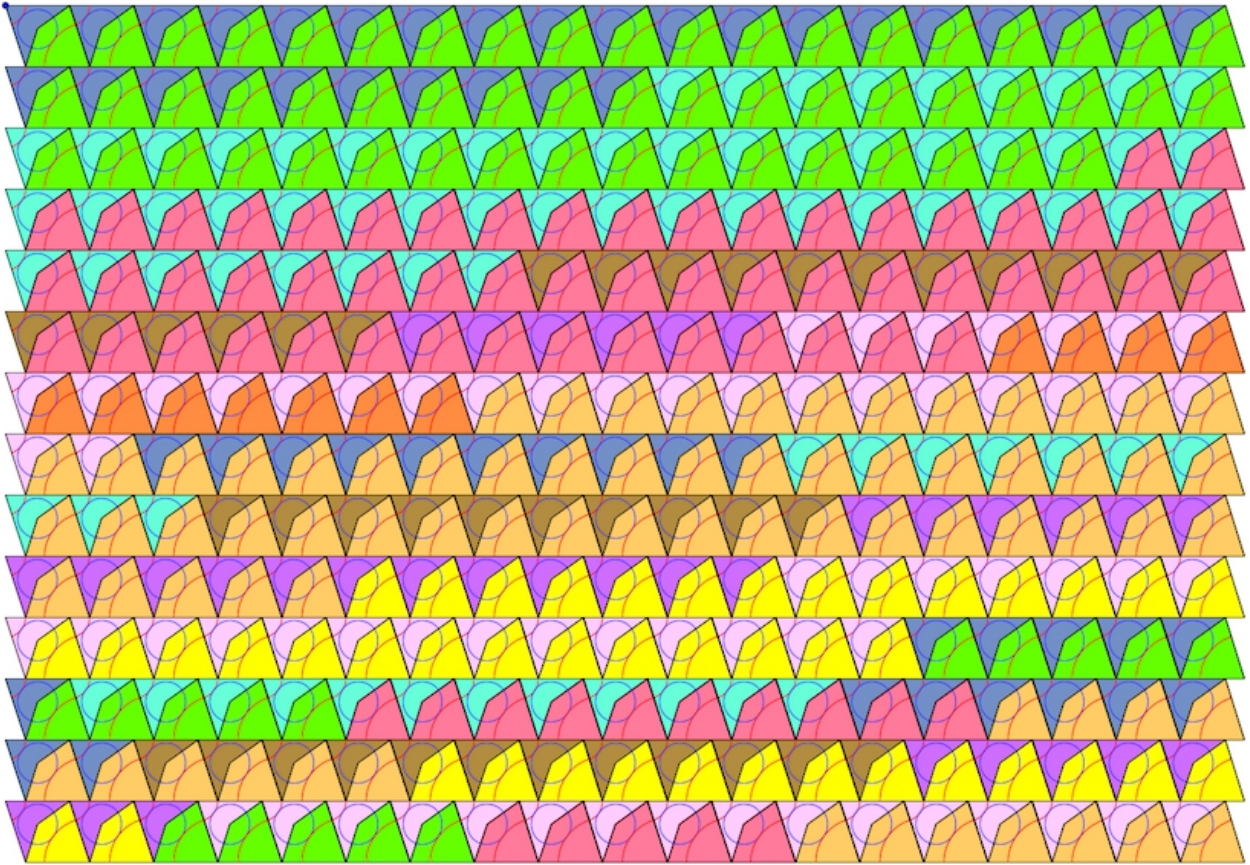
204	102	255	0.95	
255	153	255	0.50	

### Kites and their properties

properties				image
red	green	blue	alpha	
102	255	0	1.0	
255	51	102	0.65	
255	102	0	0.75	
255	204	102	1.0	
255	255	0	1.0	

## 5. PRINT AND CUT OUT TILES

There are at least 120 darts and 185 kites (see: [#4.The output](#)) to print. This is a printable A4 page. Darts and kites can be cut out easily from a page like this.





## 6. COMPOSE THE MOSAIC

This is the the mosaic on a fridge.

