EG measures packing

Ex CT US House Reps in 2020 in thousands. Find the EG.

District	D	R	total	thres	D wasted	R wasted
1	223	122	345	173	50	122
2	218	140	358	179	39	140
3	203	138	341	171	32	138
4	224	131	355	178	46	131
5	192	152	344	172	20	152
			1743		187	683

The EG is: $\frac{683-187}{1743} = \frac{496}{1743} = 29\%$

29% in favor of D's.

super high, but all districts are D in CT.

EG is statistically meaningful when we have many districts with diverse population

A "normal range" is 0-5%

Over 7% is a red flag

The 2018 WI state Rep map has EG 10%

EG is used in court cases.

J. Roberts called it "gobbledigook"

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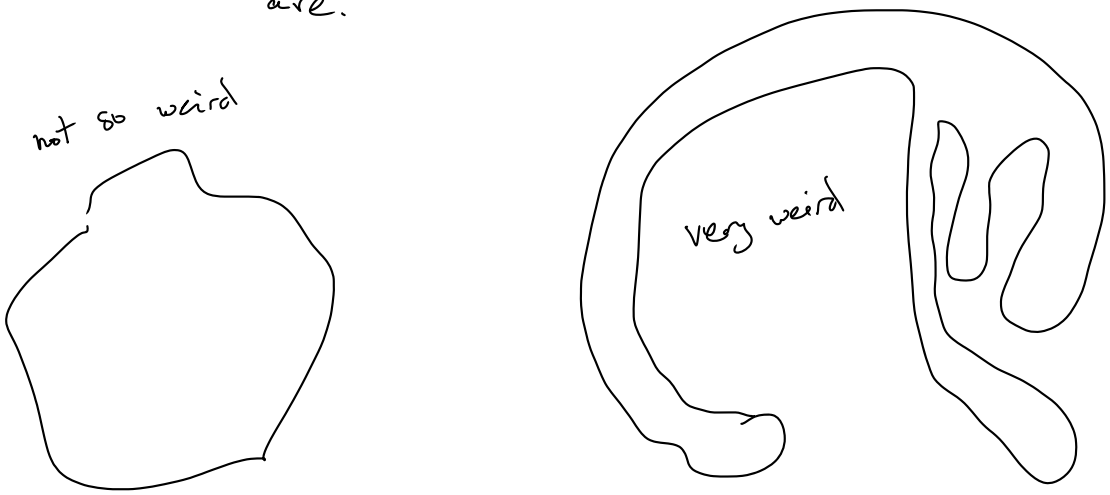
2 more geometric measures

Trying to measure how weird the shapes are.



How weird is it?

- The Convex Hull Ratio
- The isoperimetric quotient

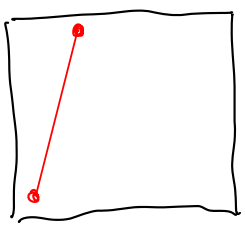
Each one is a number from 0 to 1

1 is "best" ← not weird

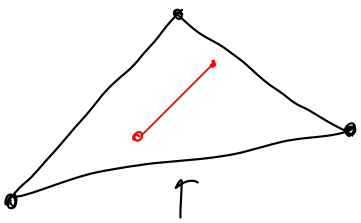
0 is "worst" ← very weird.

Convex Hull ratio

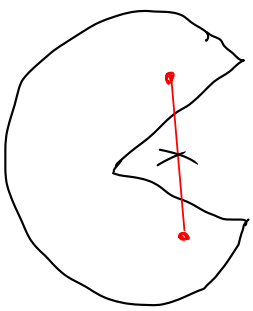
Basic geometry: A shape is convex when:
the straight line connecting any 2 points
in the shape lies entirely inside the shape.



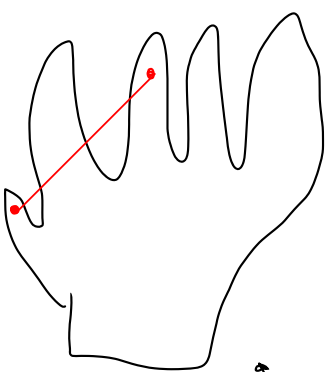
convex

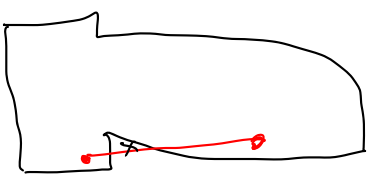


convex

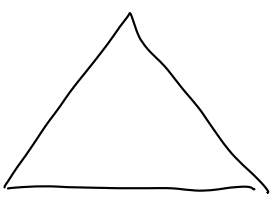


not convex

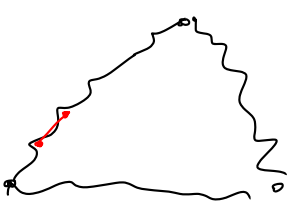




not convex



Convex

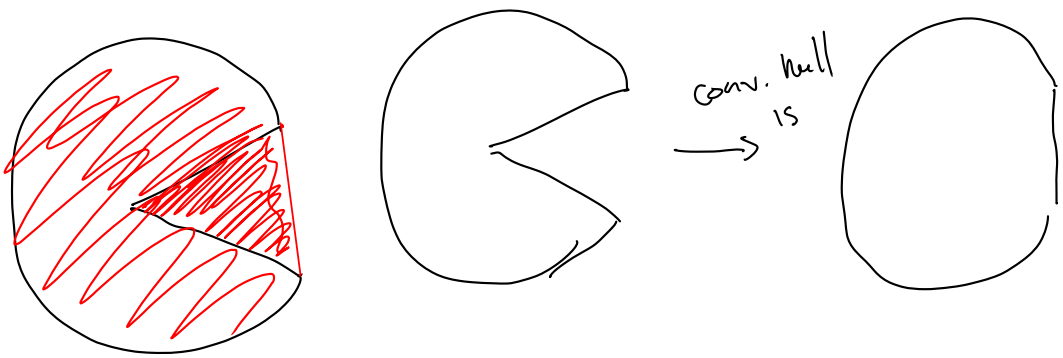


not convex.

Every shape has a convex hull

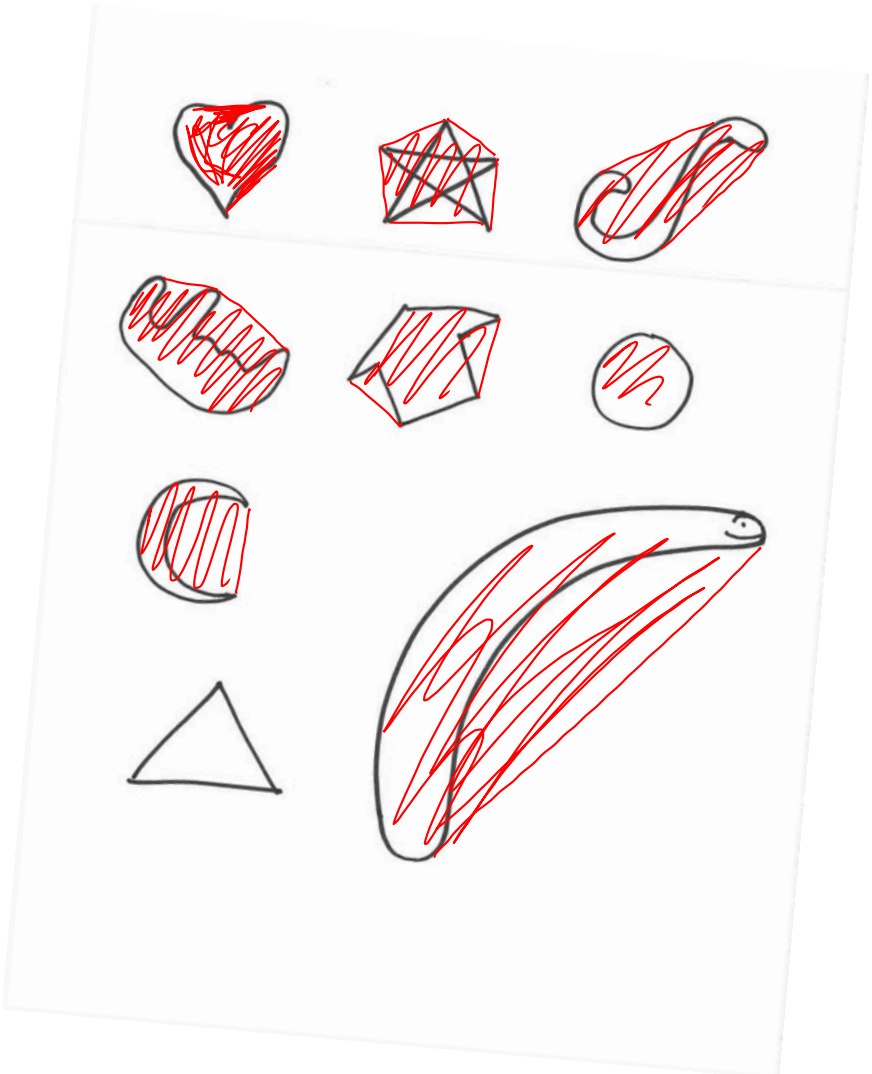
The smallest shape which contains the original shape, but is convex.

Convex hull is obtained by "filling in" portions of the original.

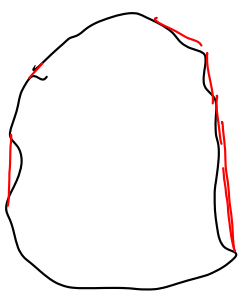


Conv. hull is always equal or bigger to the original shape

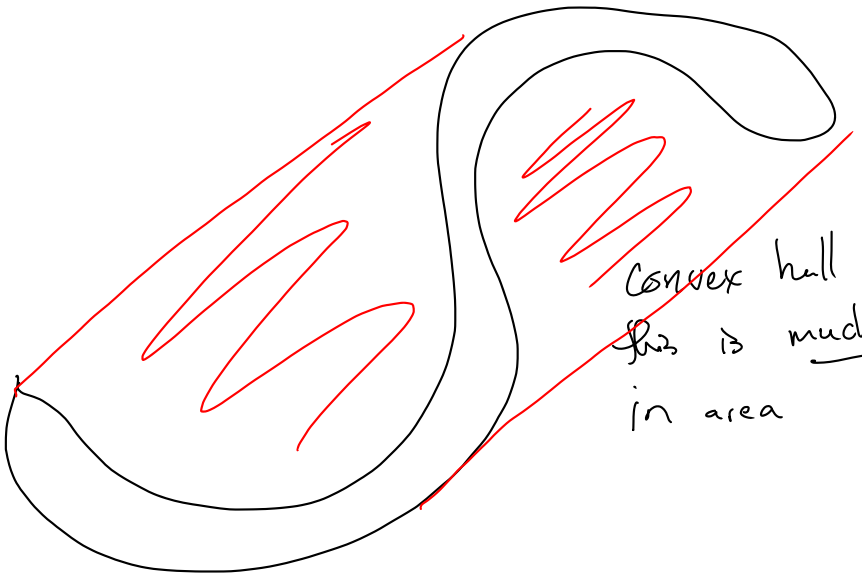
Conv. Hull is the shape you get if you wrap a rubber band around the shape



Note: If a shape is "nice"



the convex hull is not so different



Convex hull ratio

it's $CH = \dfrac{\text{area of the shape}}{\text{area of the convex hull}}$

When the shape is not so weird, num is a little bit smaller than denom
so CH is close to 1.

When the shape is weird, denom. is much bigger,
so CH is close to 0.