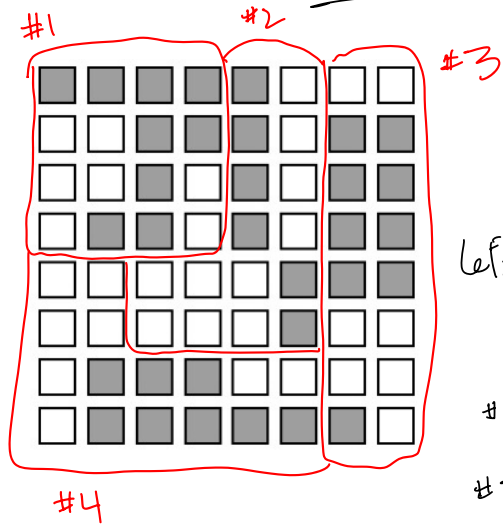


Gerrymandering



64 squares, 32 light,
32 dark.

lets Make 4 districts of 16 voters each.

#1: 9D, 7L

(D)

#3: 9D, 7L (D)

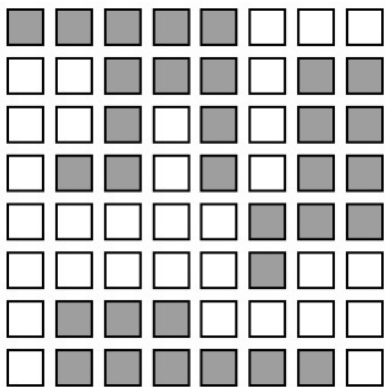
#2: 6D, 10L

(L)

#4: 8D, 8L tie.

D wins 2, L wins 1, 1 tie.

- Which different outcomes are possible / impossible
(can D's win them all?)
- Can we draw all the possible ones?



Which are possible?

32 lights,

32 Darks.

Each district will have 16 voters.

The threshold to win each district is : 9.

(8 would be a tie, need 9 to win)

Can D's win 3 districts?

need 9 voters to win a district, so it
requires $9 \times 3 = 27$ voters to win 3 districts,

So - D's can win 3 districts.

Can D's win all 4?

winning 4 districts requires $4 \times 9 = 36$ voters.

D's have only 32, so D's cannot win 4.

Same for the L's - L's can win 3,
but not 4.

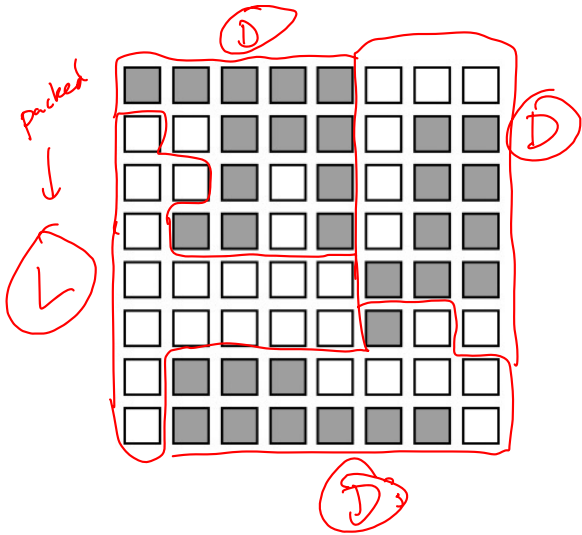
So the possible outcomes are:

3 D / 1 L

2 D / 2 L

1 D / 3 L

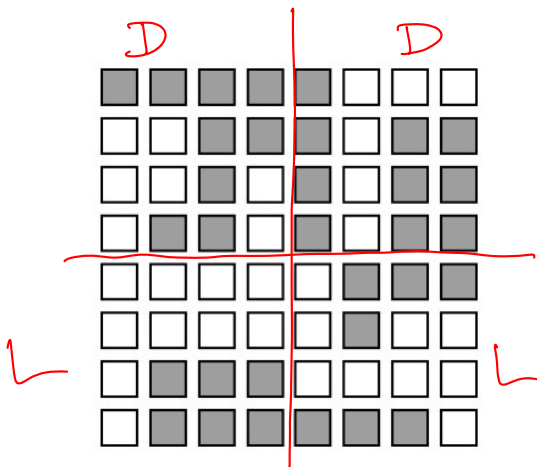
(4/0 or 0/4
are impossible)



Let's try to draw
 3D / 1L

"pack" the 1L full of L's,
 then the L's will lose the rest.

2D/2L



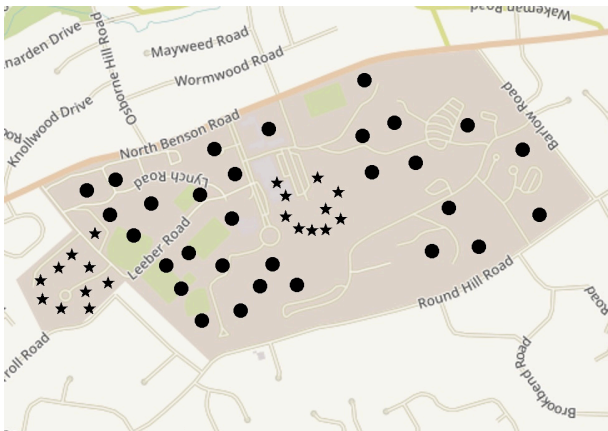
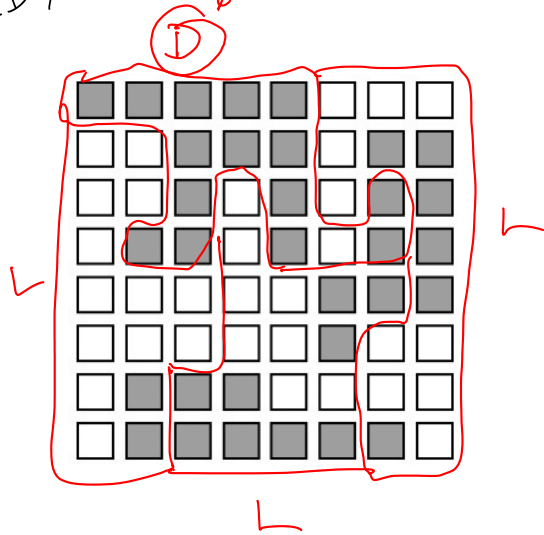
Draw districts with results of

2D / 2L

1D / 3L

pack these D's
 first.

1D / 3L



50 total voters,

20 ★'s

30 o's

Make 5 districts,

10 voters each.

20 *'s
30 O's

Which outcomes are possible?

the threshold to win a district is: 6 per district.

How many can *'s win?

*'s can win up to 3.

(3 requires $3 \times 6 = 18$
but 4 requires $4 \times 6 = 24$)

O's can win up to 5.

Possibilities are:

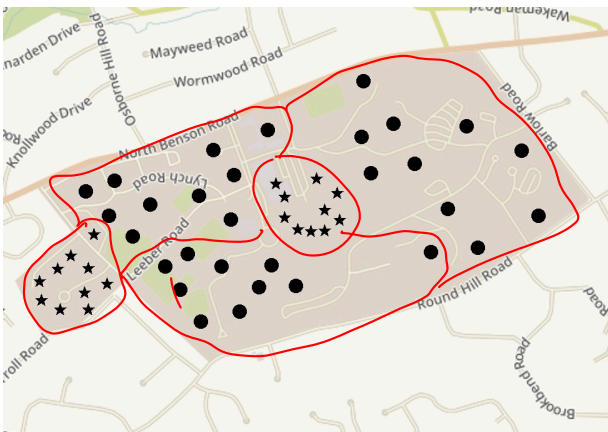
0 *'s / 5 O's ← make O's win narrowly every time.

1 *'s / 4 O's ← pack one * dist.

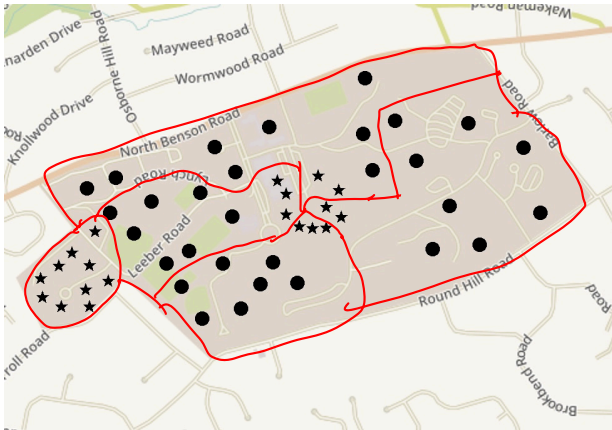
2 *'s / 3 O's

3 *'s / 2 O's

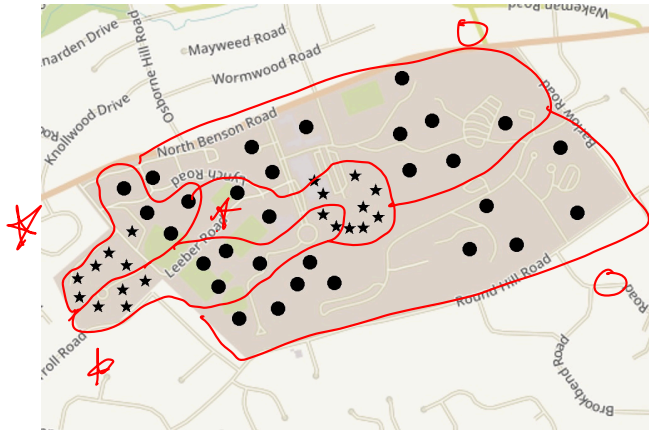
Try to draw these!



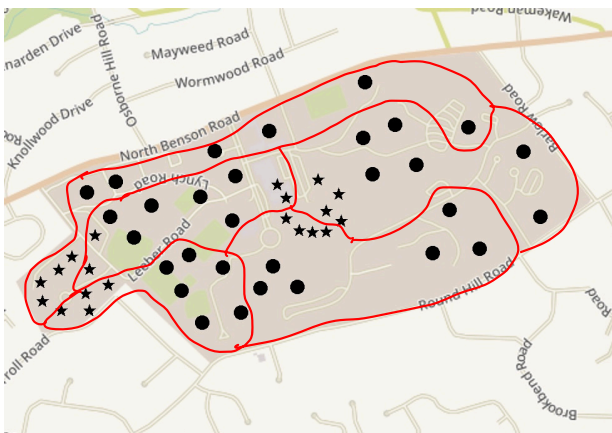
2* / 3 O's



1★/40's



3★/20's



0★'s / 50's

make 4★, 60's in every district.

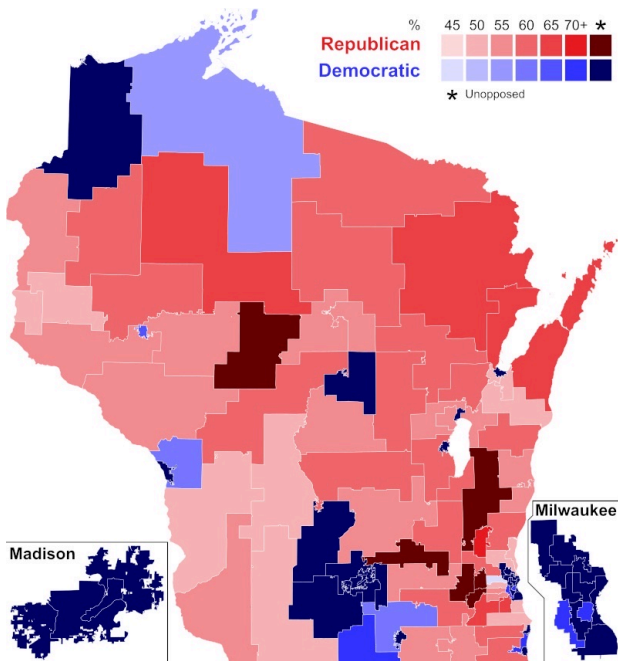
Gerrymandering Detection

Measure unfair maps

• The Efficiency Gap

A statistical measure of packing.

WI state Assembly Map



Map in 2018

Most reds
are light red

Most blues are
dark blue.

Suggests the blues
have been packed
in order for Reds
to win more.

in 2018, 53% of voters were Dem

45% - - - - Rep

but 63 out of 99 were won by Rep.

This map has an efficiency gap

of 11% in favor of Rep's.

↑
R votes are ~ 11% more effective.