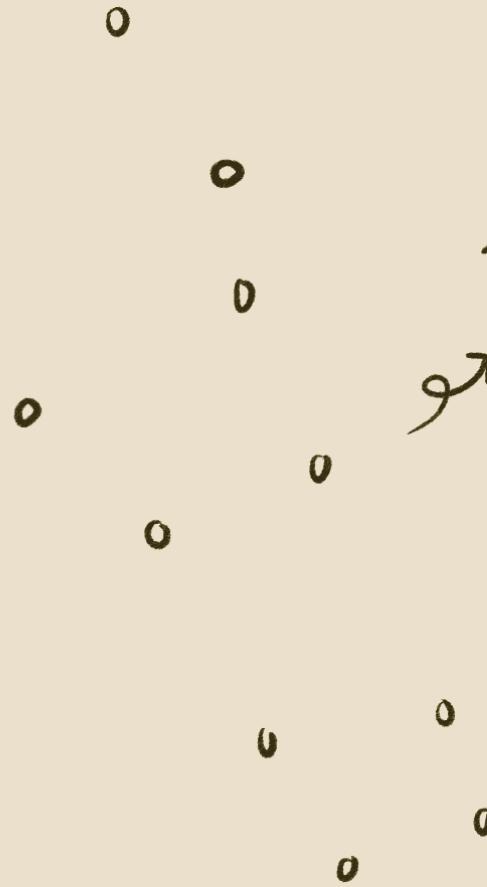


Residual  
Sum of  
Squares

$$\sum_{i=1}^N (y_i - \hat{y}_i)^2$$

for Imagines<sup>5</sup>

IMAGINE YOU  
SEE A BUNCH  
OF POINTS!



There are  
N of them.

1<sup>st</sup>  
point  
 $y_1$

$y_3$  → 3<sup>rd</sup> point  
and so  
on...

stack these  
points up in a  
single symbol:

$y$

$$y = \begin{bmatrix} y_1 \\ \vdots \\ y_N \end{bmatrix}$$

$y_i$   
i<sup>th</sup> point

$y_N$  → last point

AND IMAGINE YOU  
HAVE A MAGIC WAND  
THAT CAN GENERATE  
NEW POINTS TO  
MIMIC  $y$ !



can't we  
have more  
flexible line?

yes we can.  
there may be  
infinite  
magic wands!



CALL THESE  
POINTS  
 $\hat{y}$ -hat !

$$\hat{\mathbf{y}} = \begin{bmatrix} \hat{y}_1 \\ \vdots \\ \hat{y}_N \end{bmatrix}$$

There are  
N points again.

WE CAN MEASURE "HOW  
DIFFERENT" MAGIC WAND'S  
POINTS  $\hat{y}$  FROM THE ACTUAL  
POINTS  $y$ . AND IT IS CALLED:

RESIDUAL  
Sum  
OF  
SQUARES

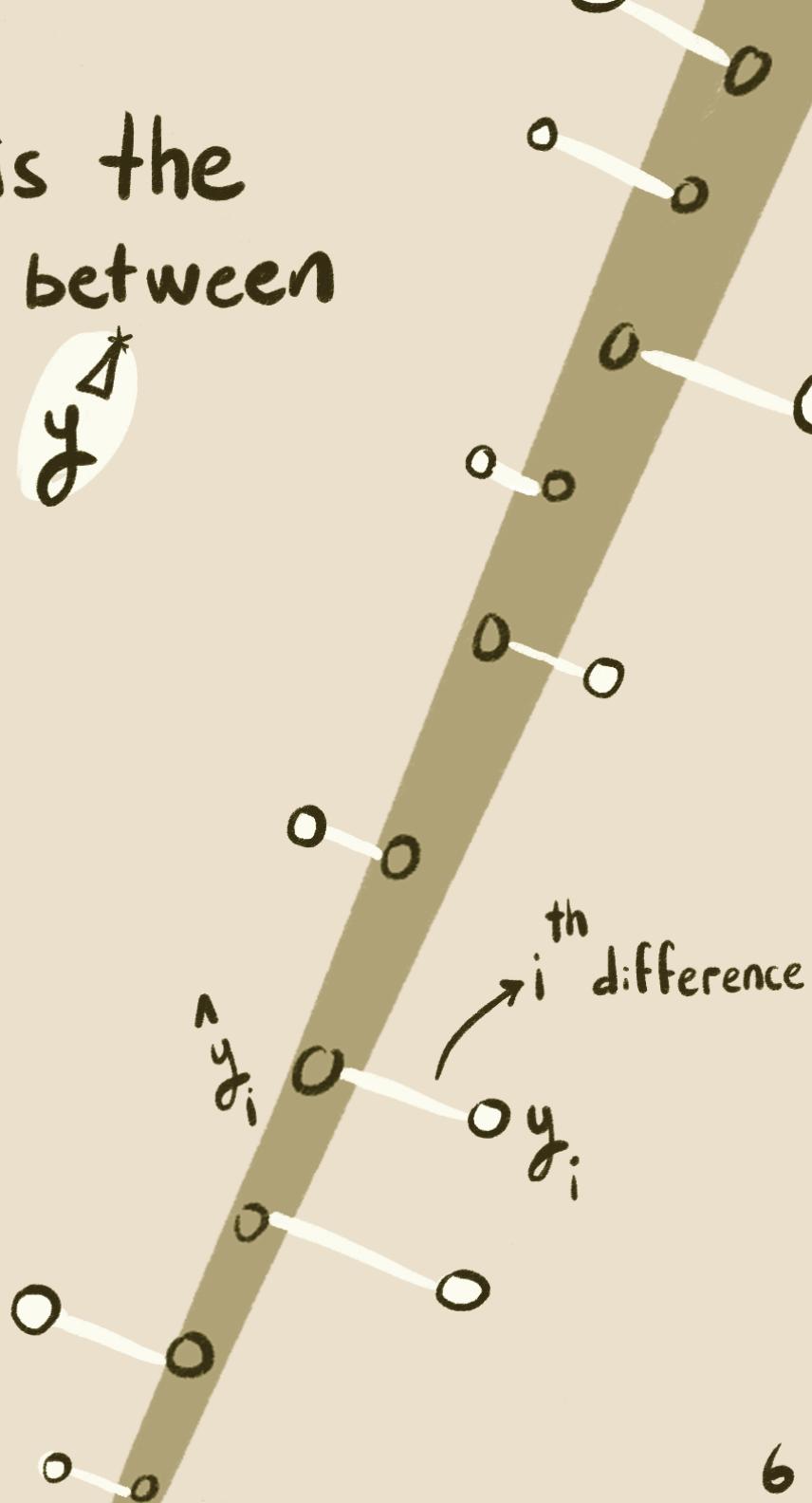


"RESIDUAL" is the difference between  $y$  and  $\hat{y}$

Symbolized as:

$$y - \hat{y}$$

$$\begin{bmatrix} y_1 - \hat{y}_1 \\ \vdots \\ y_N - \hat{y}_N \end{bmatrix}$$



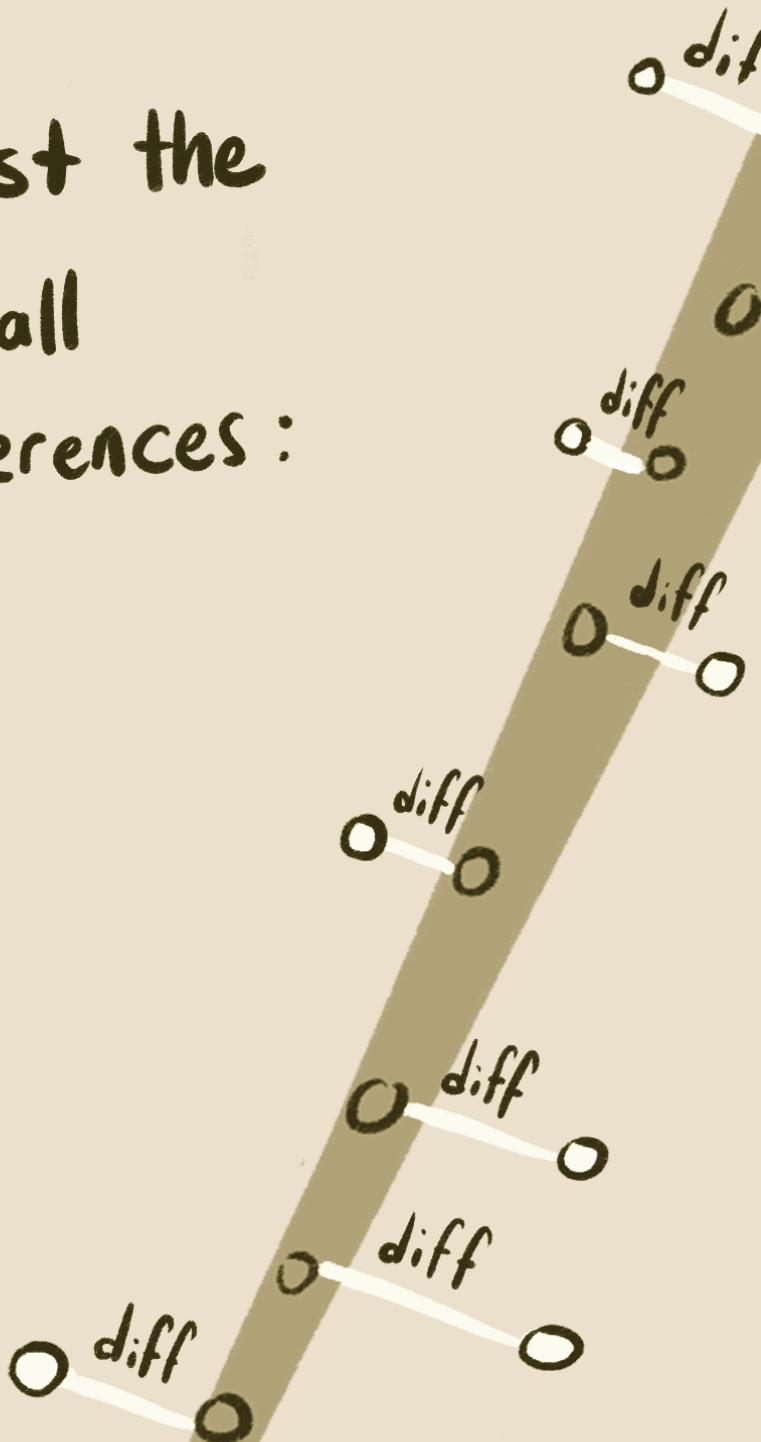
"sum" is just the summation of all these little differences:

$$\sum_{i=1}^N \hat{y}_i - y_i$$



fancy symbol  
of:

$$\underbrace{(y_1 - \hat{y}_1)}_{1^{\text{st}} \text{ difference}} + \dots + \underbrace{(y_N - \hat{y}_N)}_{N^{\text{th}} \text{ difference}}$$

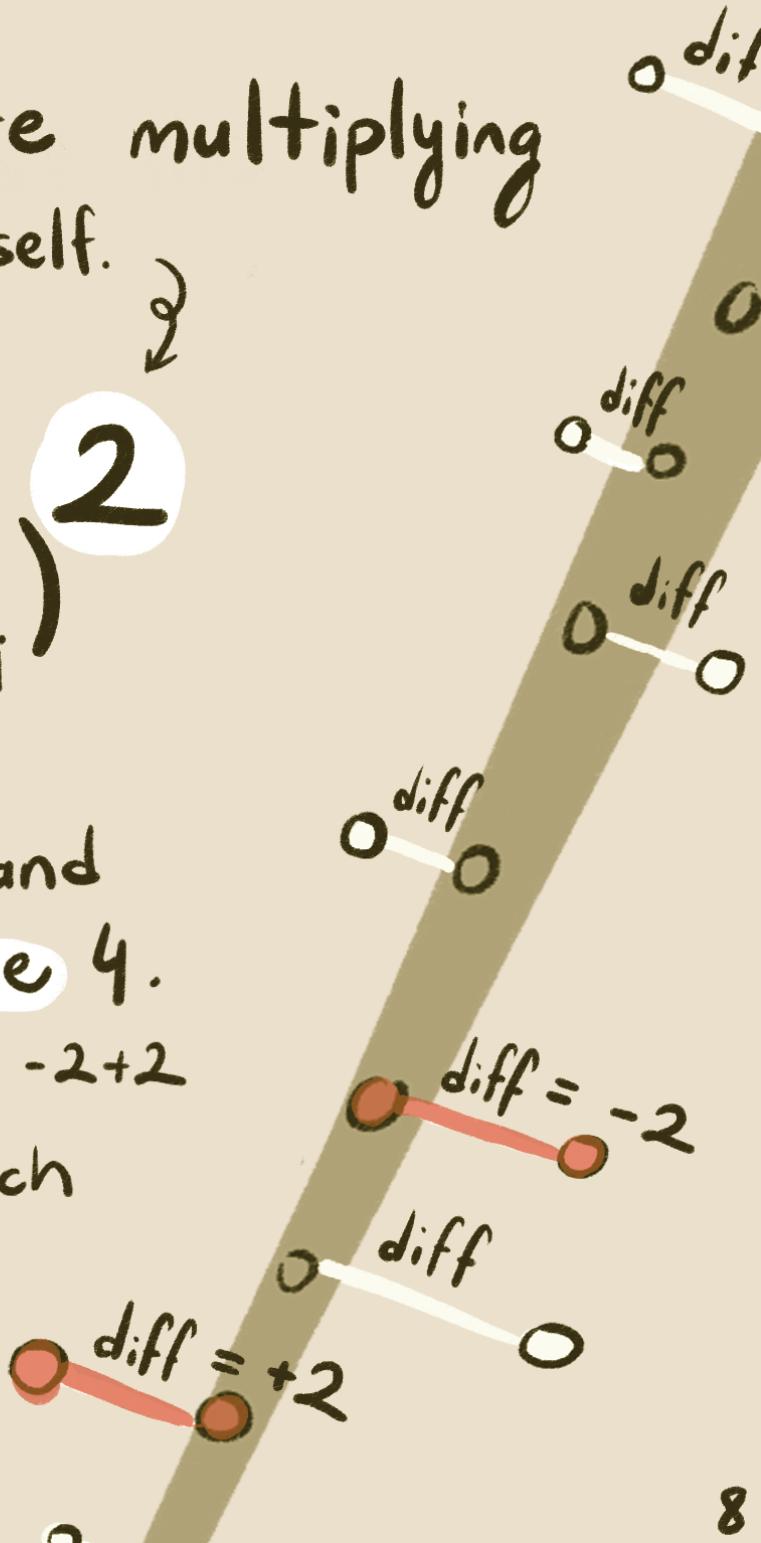


"SQUARES" are multiplying each distance by itself.

$$\sum_{i=1}^N (y_i - \hat{y}_i)^2$$

so that both +2 and -2 differences become 4.

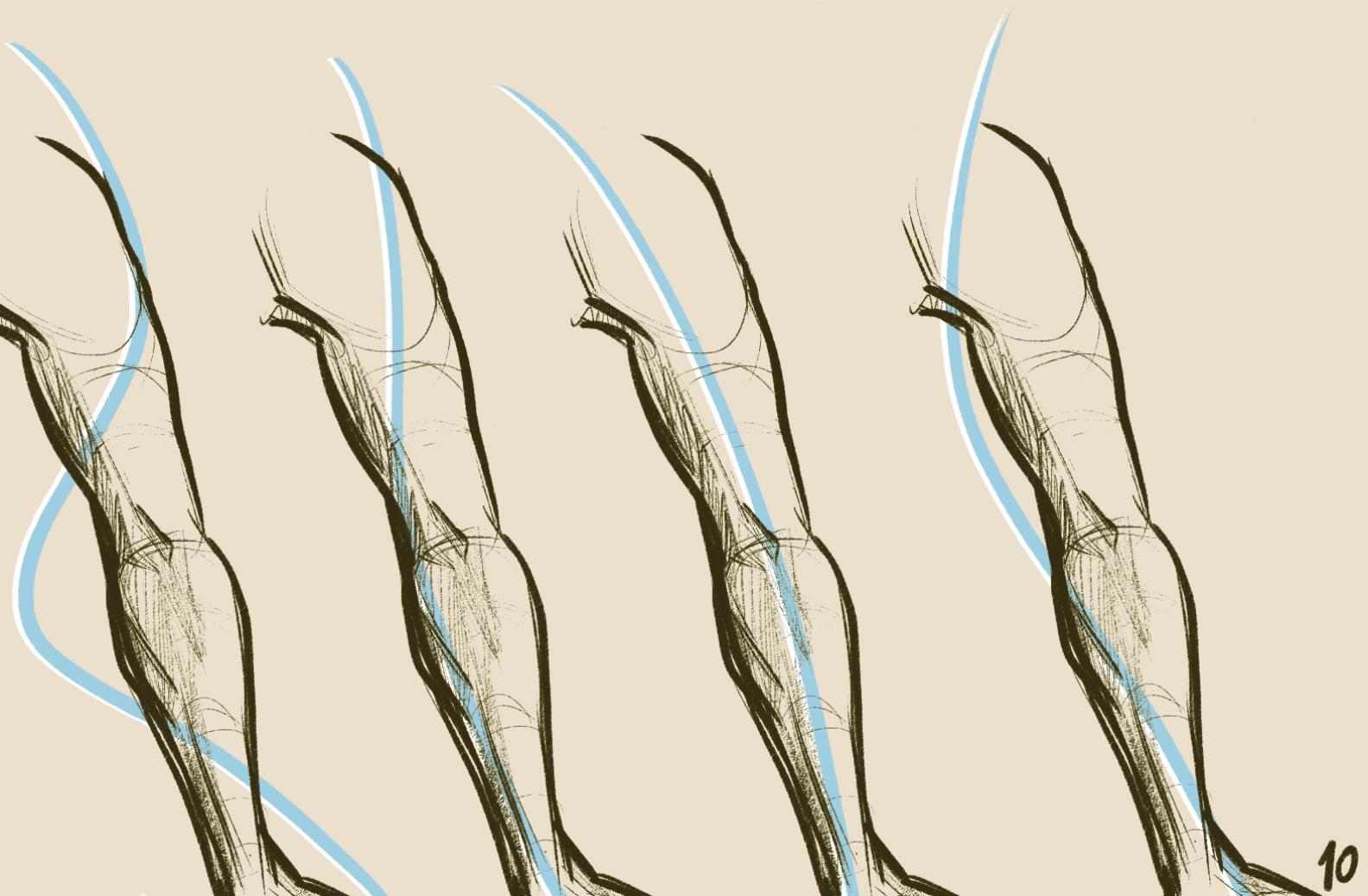
Otherwise, when we add -2+2 we would have zero which is misleading.



GREAT! WE WILL USE RSS TO  
CHOOSE THE BEST LINE  
COMING OUT OF OUR MAGIC  
WAND!



MY WAND CAN PRODUCE BUNCH OF  
CURVES TO CAPTURE THE "MOTION"  
OF THIS  . WHICH ONE DO YOU  
THINK FITS THE **BEST?**





IT IS THE LINE  
WHOSE RSS  
IS THE SMALLEST!

but **H O W**  
that magic wand works?



Next, we will see even fancier  
notation:  $\operatorname{argmin}_{\theta} \text{RSS}(\theta)$

Bonus:

there was a line...  
↓



but I arbitrarily erased it:

and you want to sketch this line:

now, where  
do you  
start?

would you try to estimate  
individual changes at first?

Or would you try to find a general  
line that fits well to that squiggly  
line?

FIN.