Digging Deeper into Fundamentals

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Overview

Work through the logic of a specific machine learning problem

Run programs on different inputs using placeholders and feed dictionaries

Use variables to hold values which the program updates

Make TensorBoards more useful using named scopes

Understanding Linear Regression

X Causes Y

Cause

Independent variable

Effect

Dependent variable

Wealth Increases Life Expectancy

Cause

Wealth of individuals

Effect

How long they expect to live

Lower Home Prices Away from the City

Cause

Distance in miles from the city center

Effect

Price per square foot of homes

X Causes Y

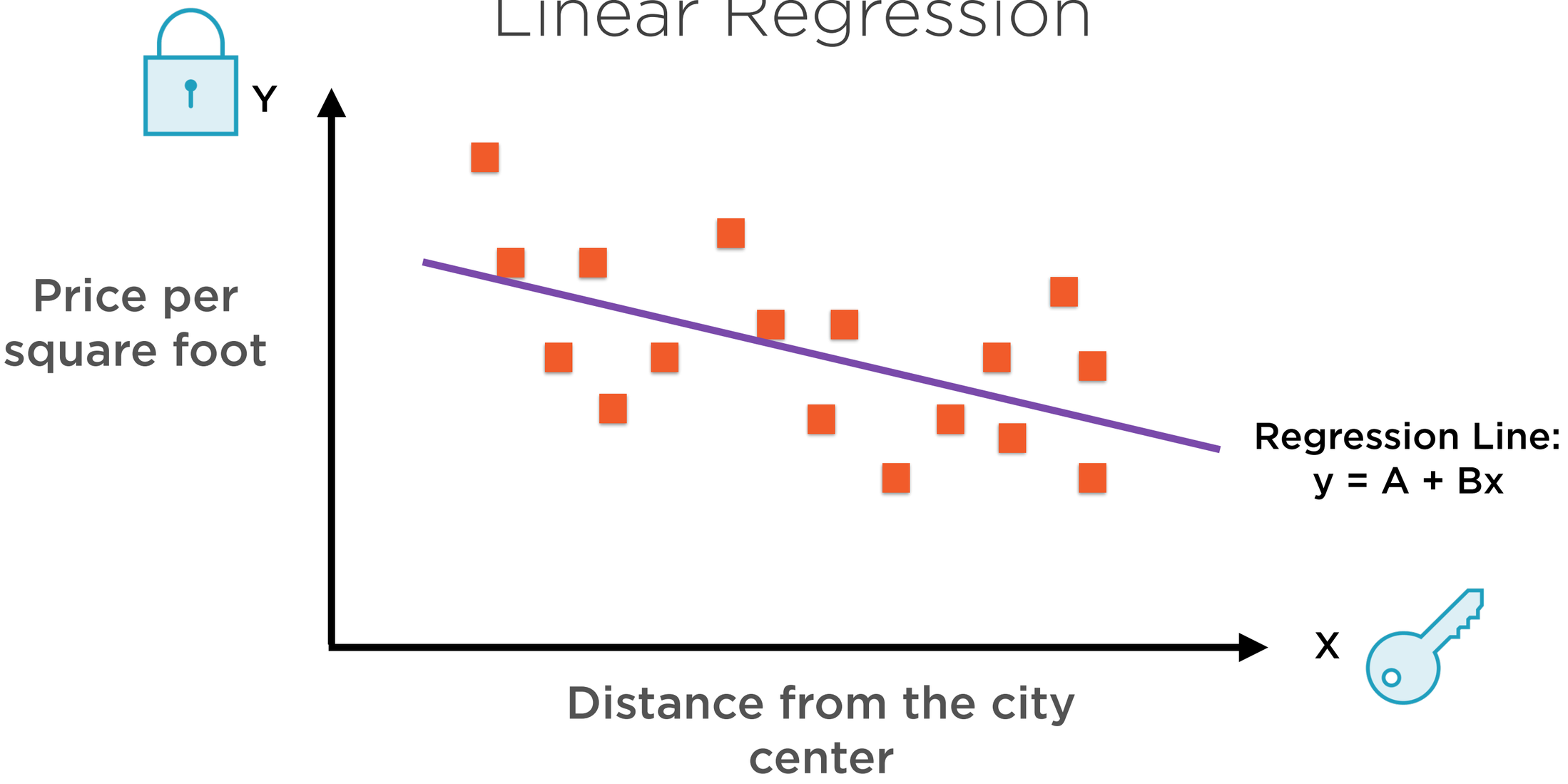
Cause

Explanatory variable

Effect

Dependent variable

Linear Regression



Simple Regression

Regression Equation:

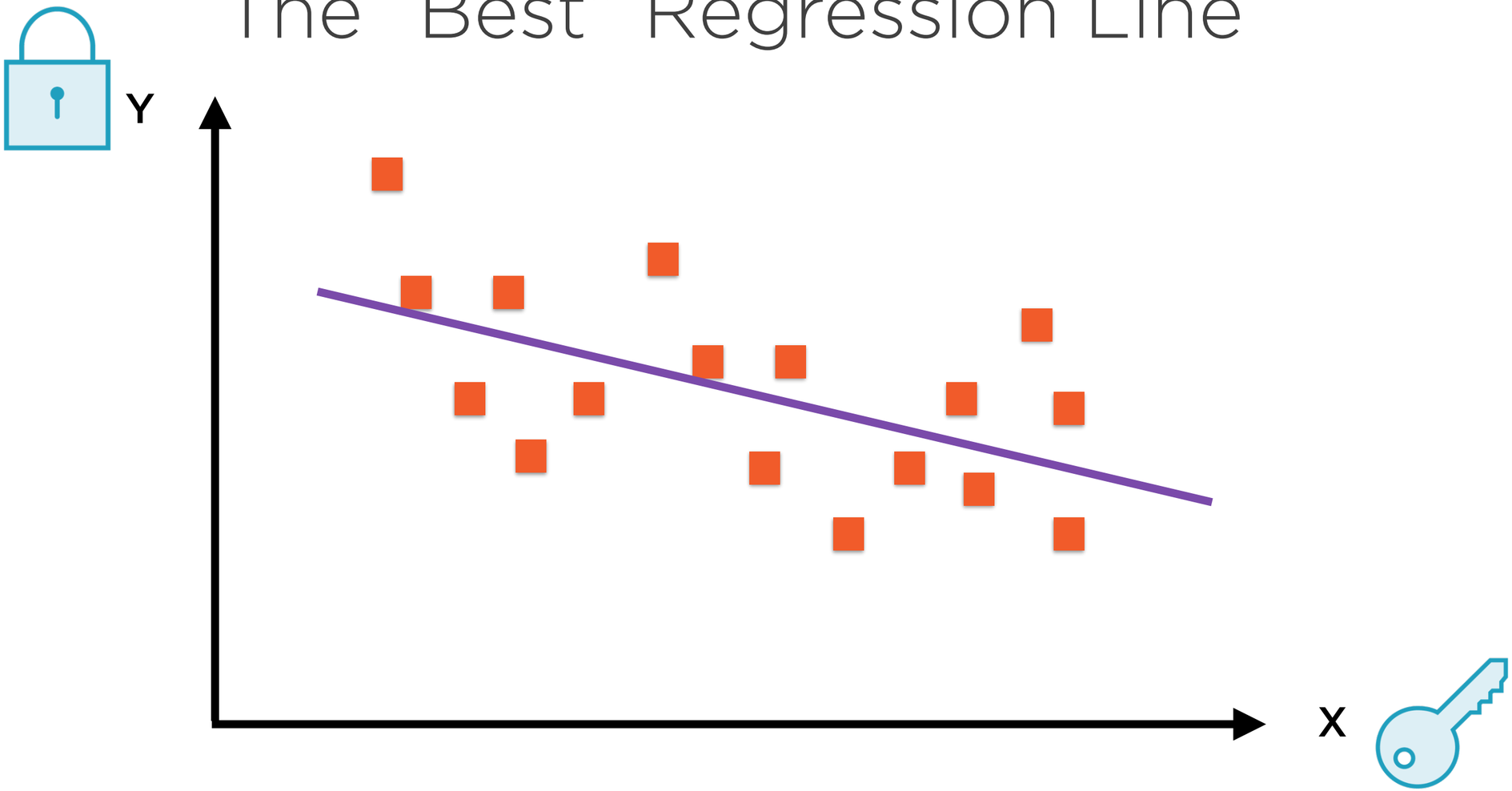
$$y = A + Bx$$

- $y_1 = A + Bx_1$
- $y_2 = A + Bx_2$
- $y_3 = A + Bx_3$

...

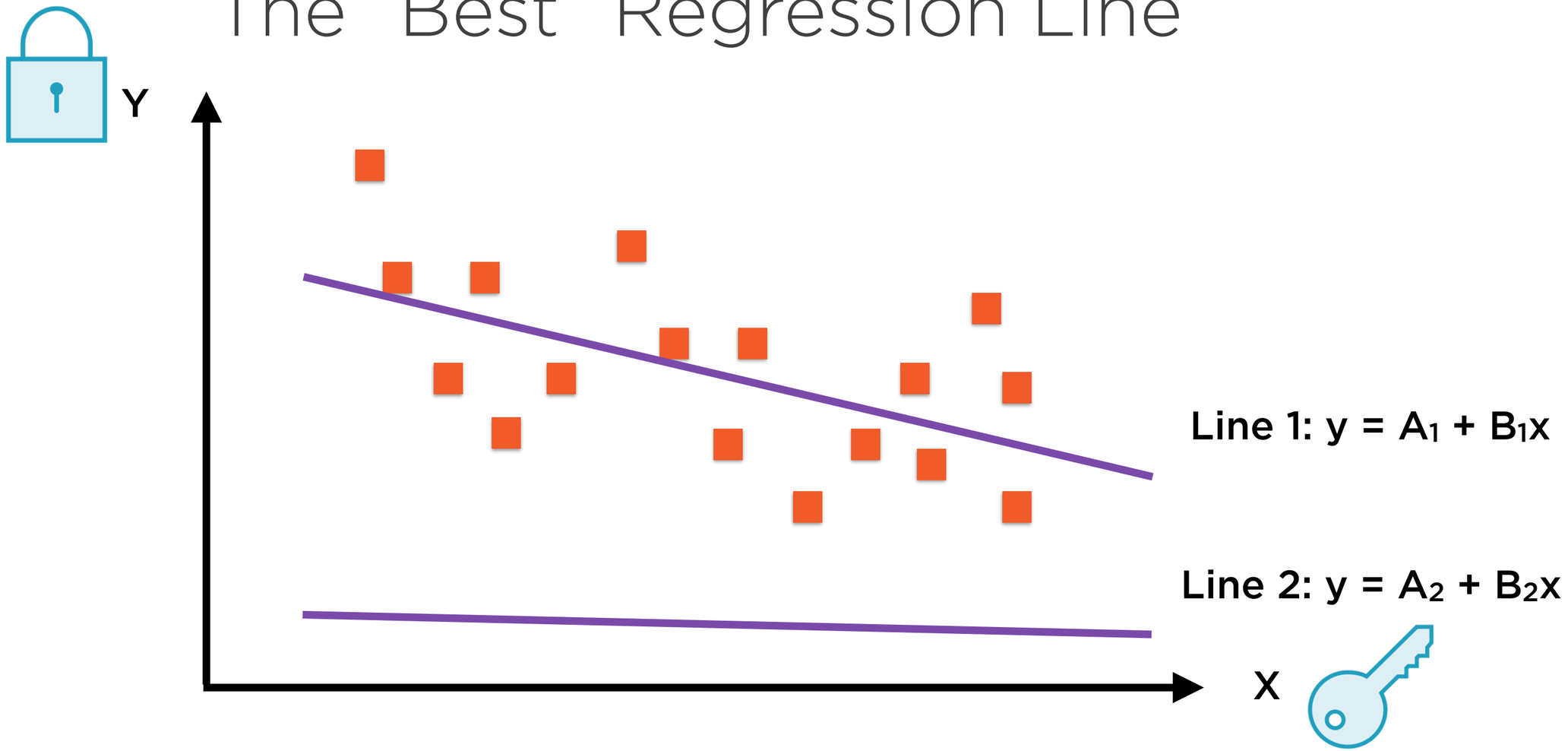
- $y_n = A + Bx_n$

The “Best” Regression Line



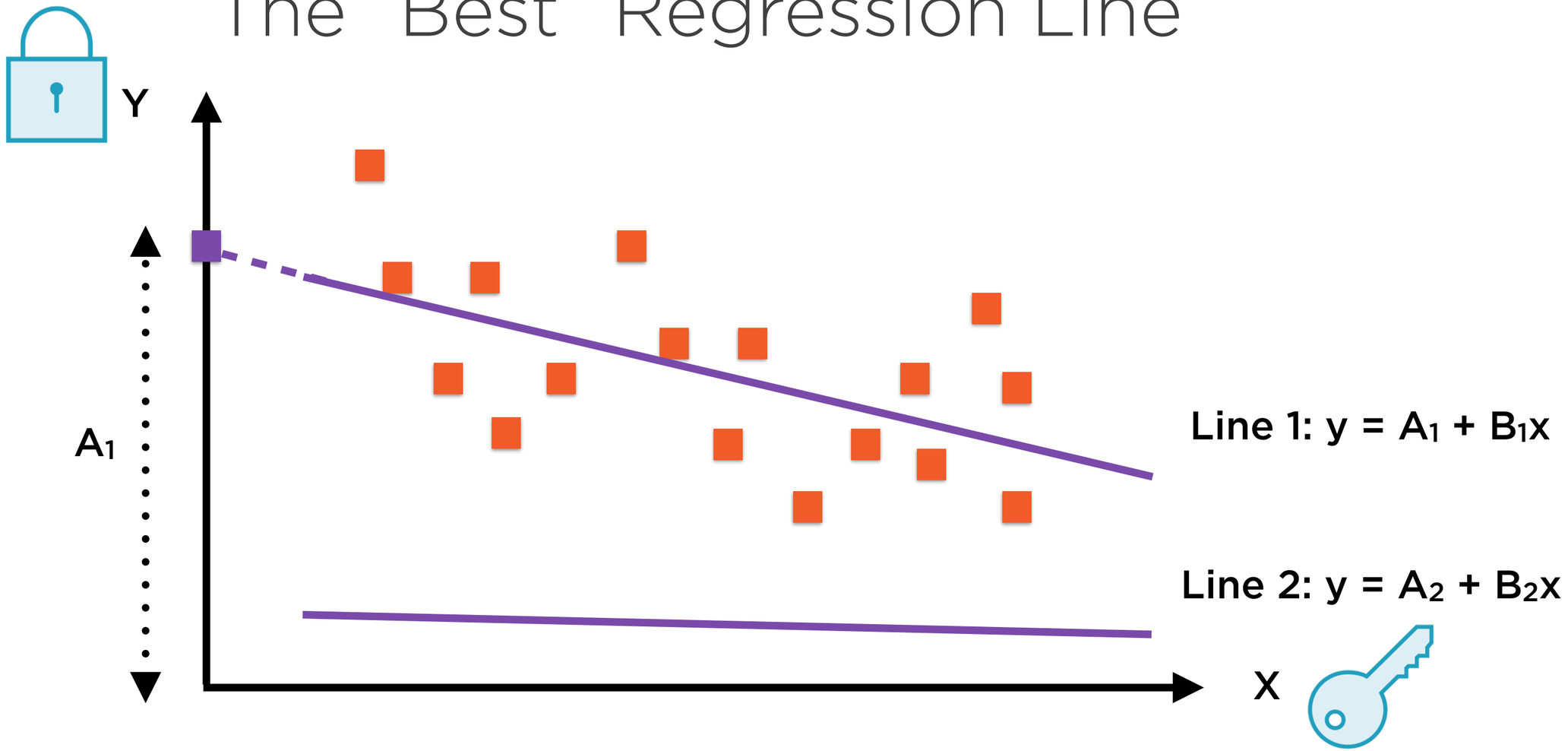
Linear Regression involves finding the “best fit” line

The “Best” Regression Line



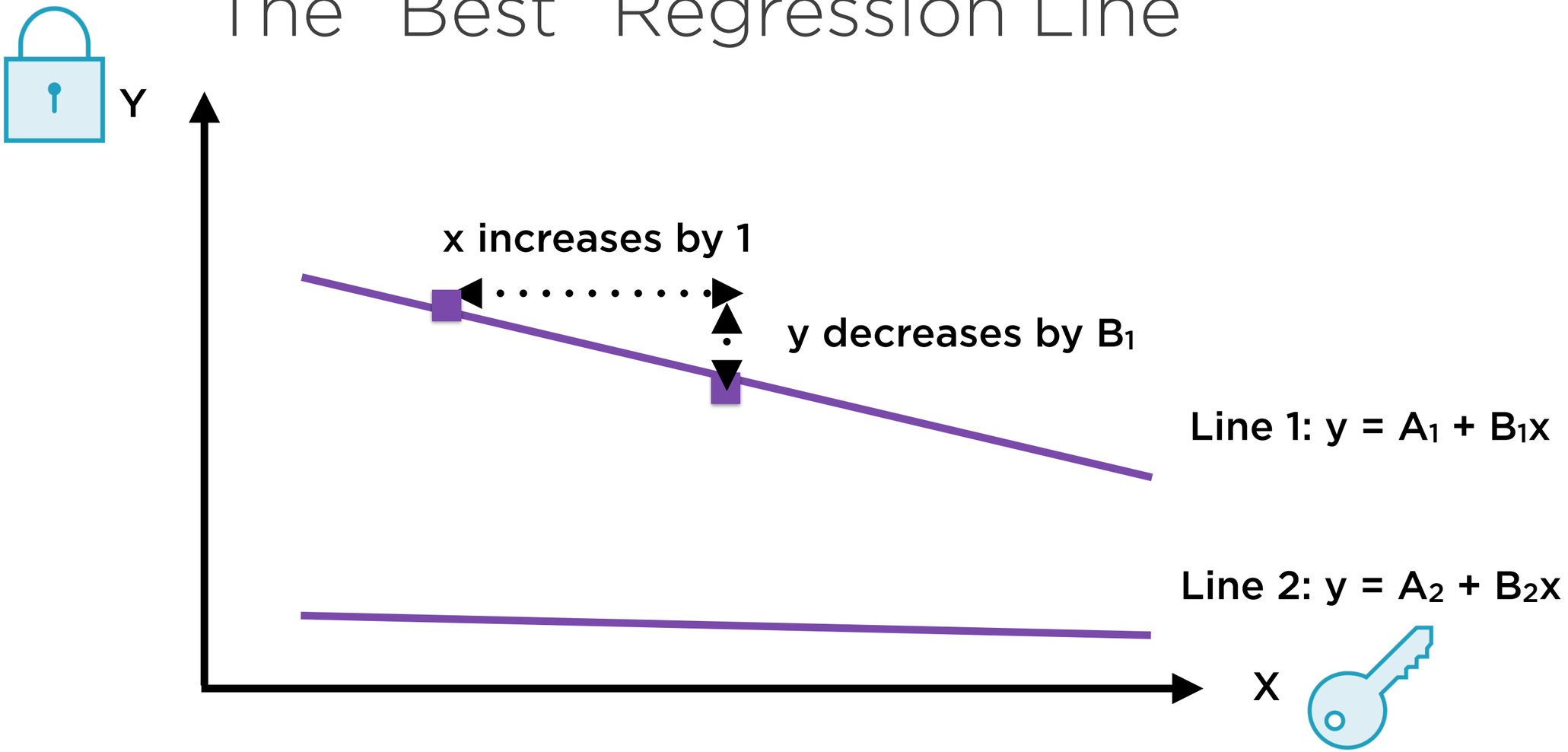
Let’s compare two lines, Line 1 and Line 2

The "Best" Regression Line



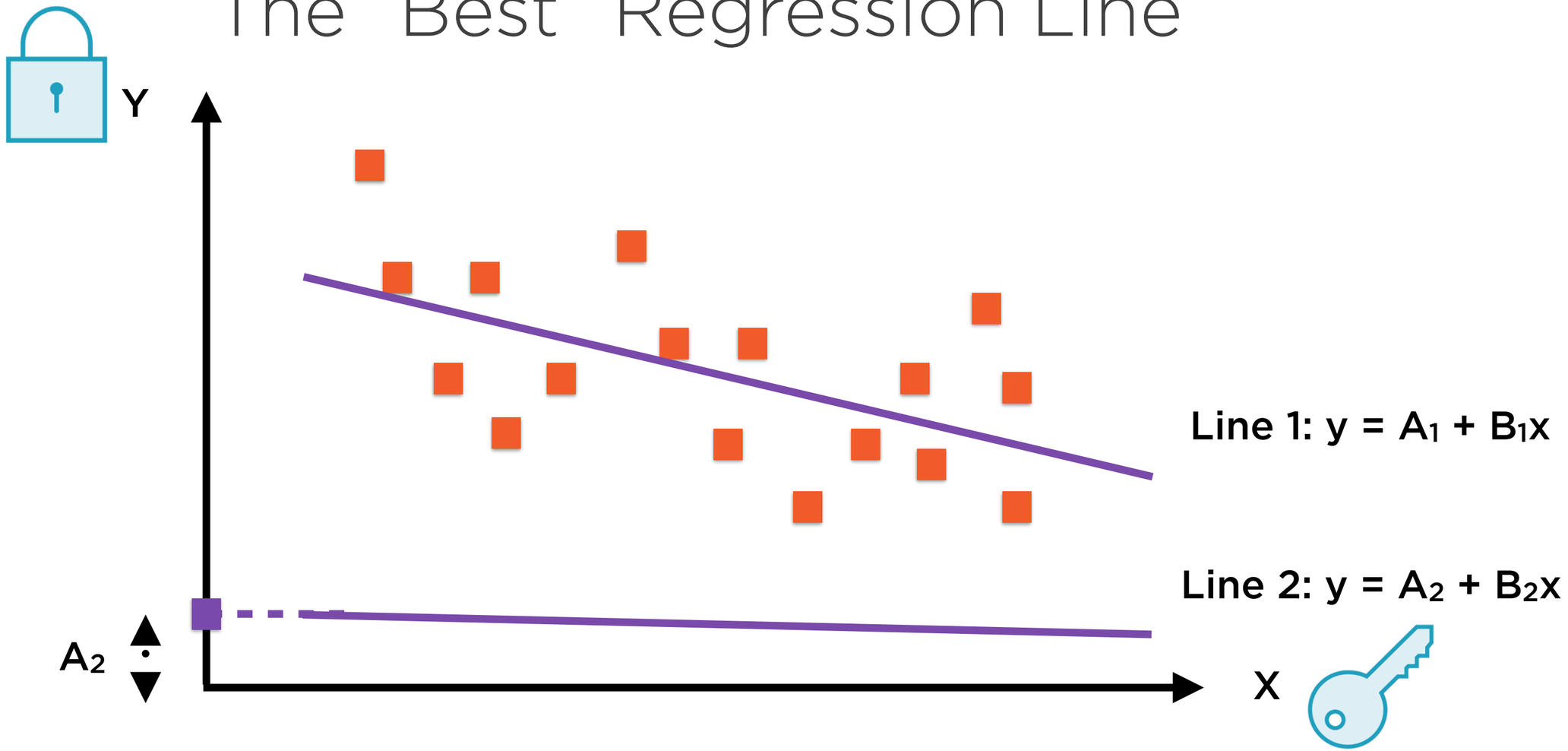
The first line has y-intercept A_1

The "Best" Regression Line



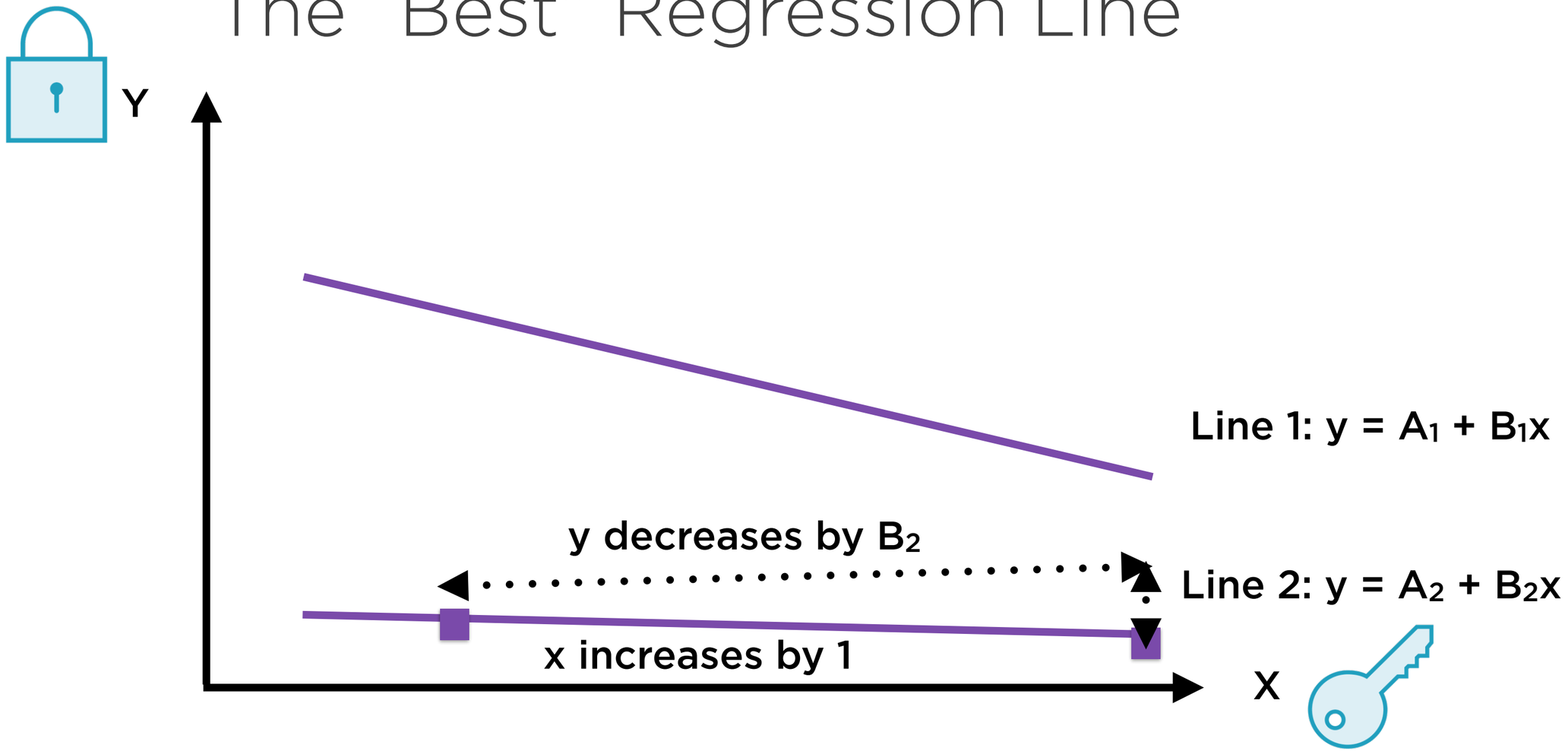
In the first line, if x increases by 1 unit, y decreases by B_1 units

The “Best” Regression Line



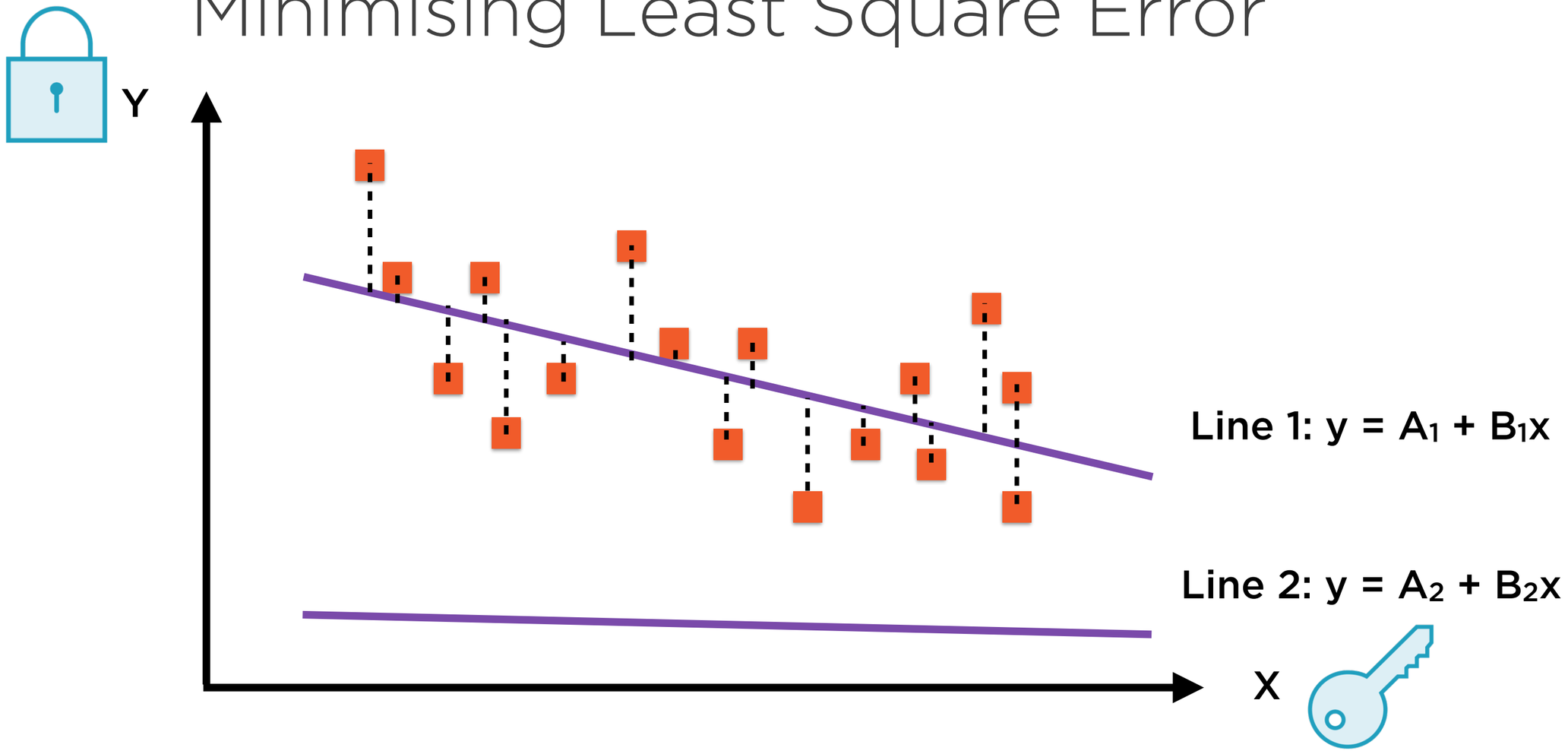
The second line has y-intercept A_2

The “Best” Regression Line



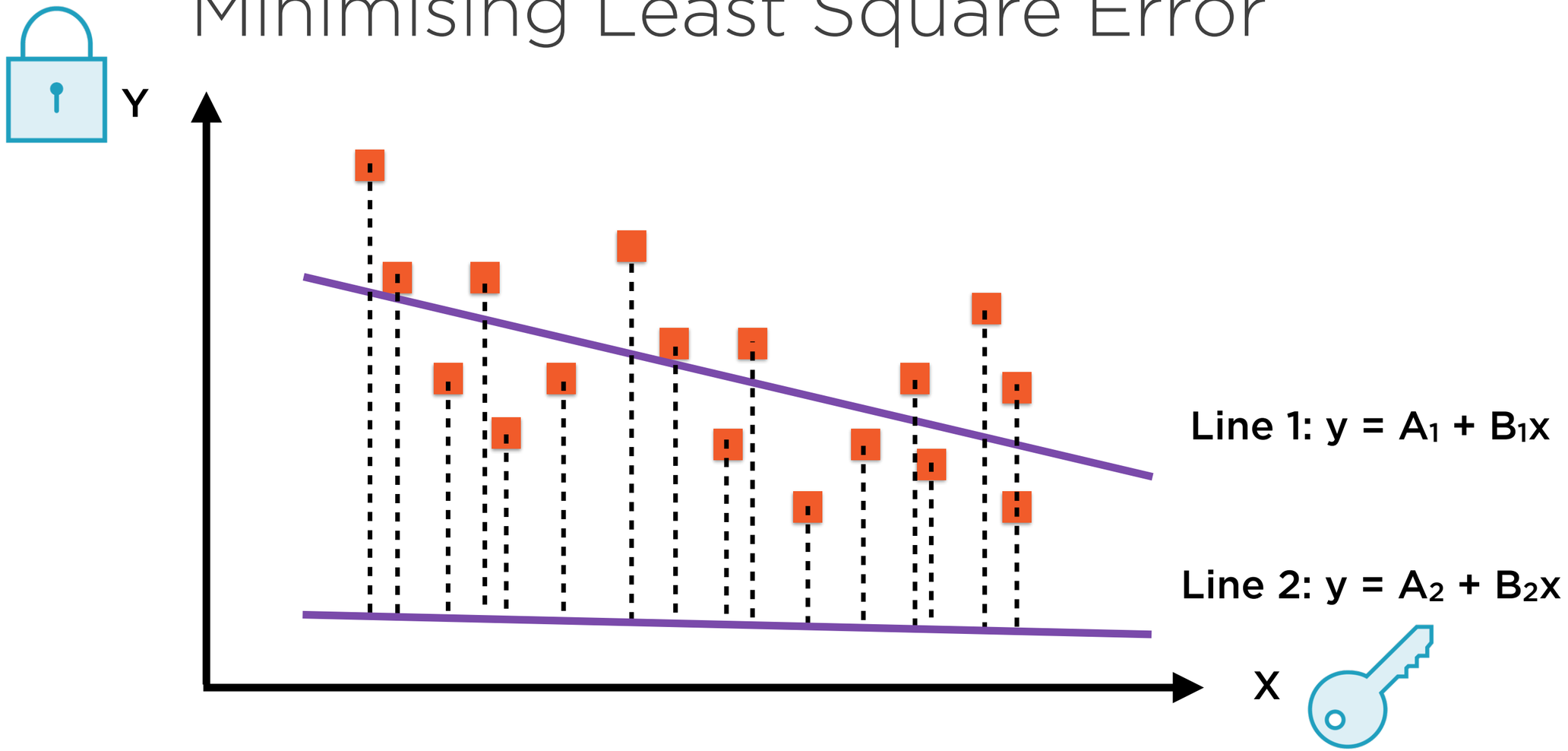
In the second line, if x increases by 1 unit, y decreases by B_2 units

Minimising Least Square Error



Drop vertical lines from each point to the lines 1 and 2

Minimising Least Square Error



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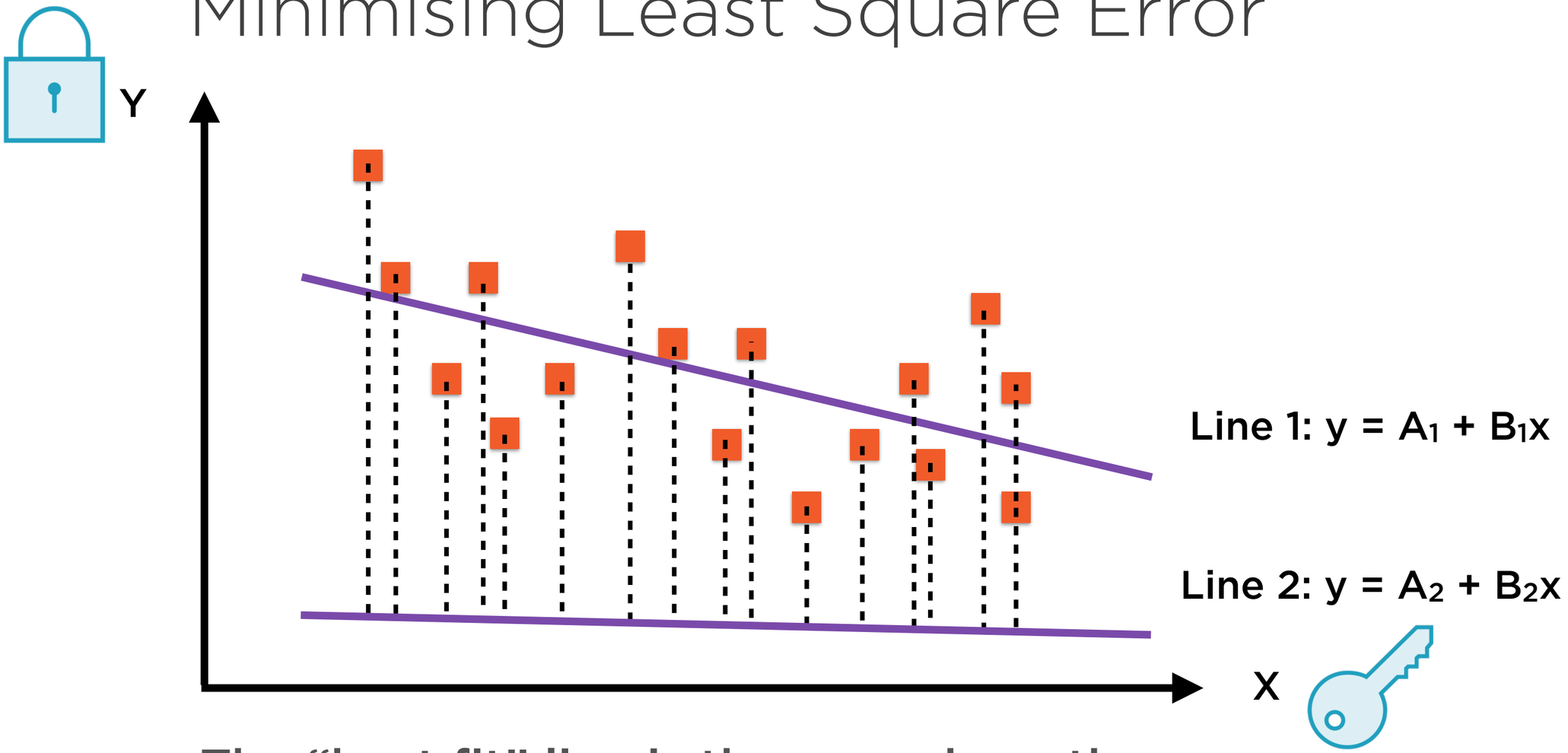
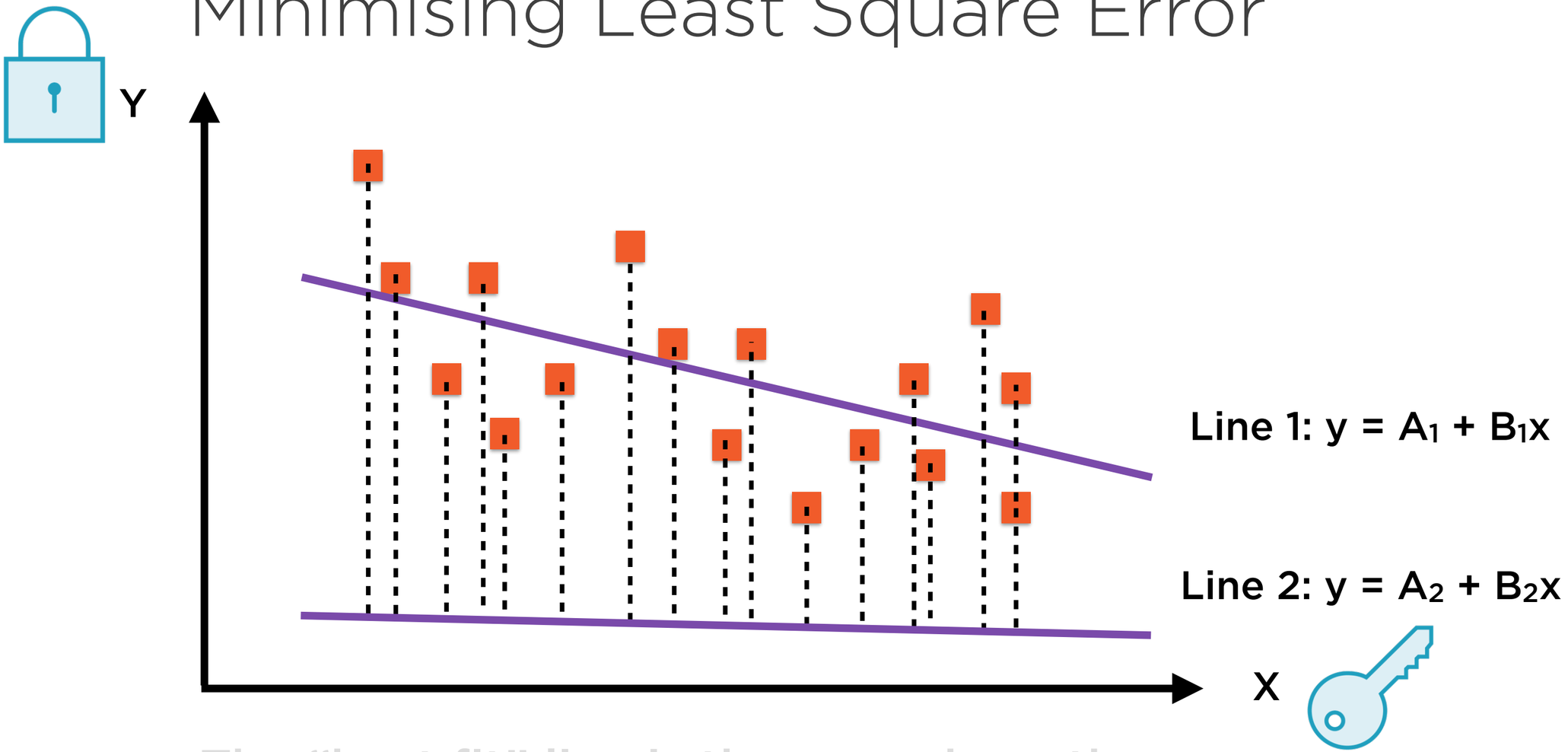


The “best fit” line is the one where the sum of the squares of the lengths of these dotted lines is minimum

Minimising Least Square Error



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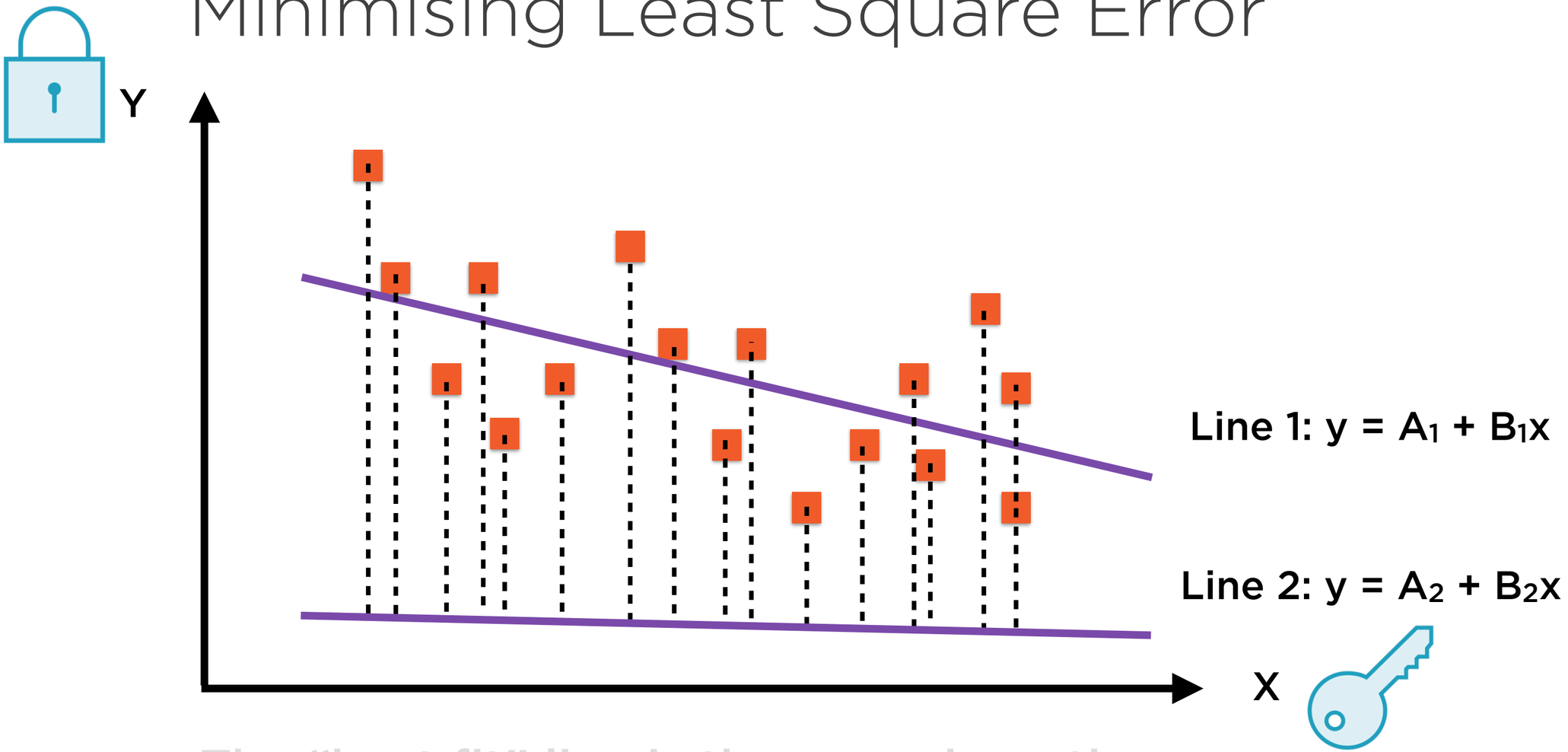
Minimising Least Square Error



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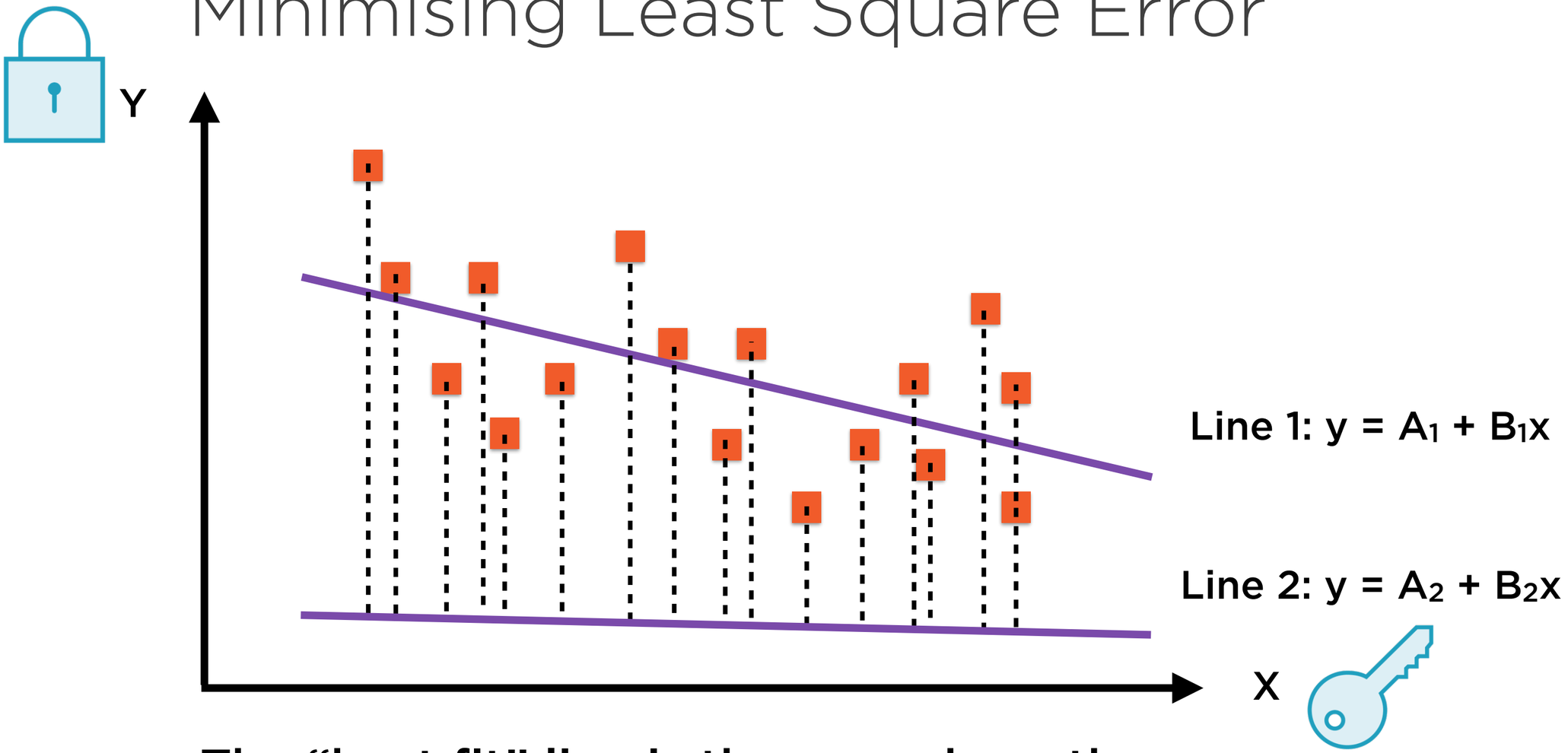

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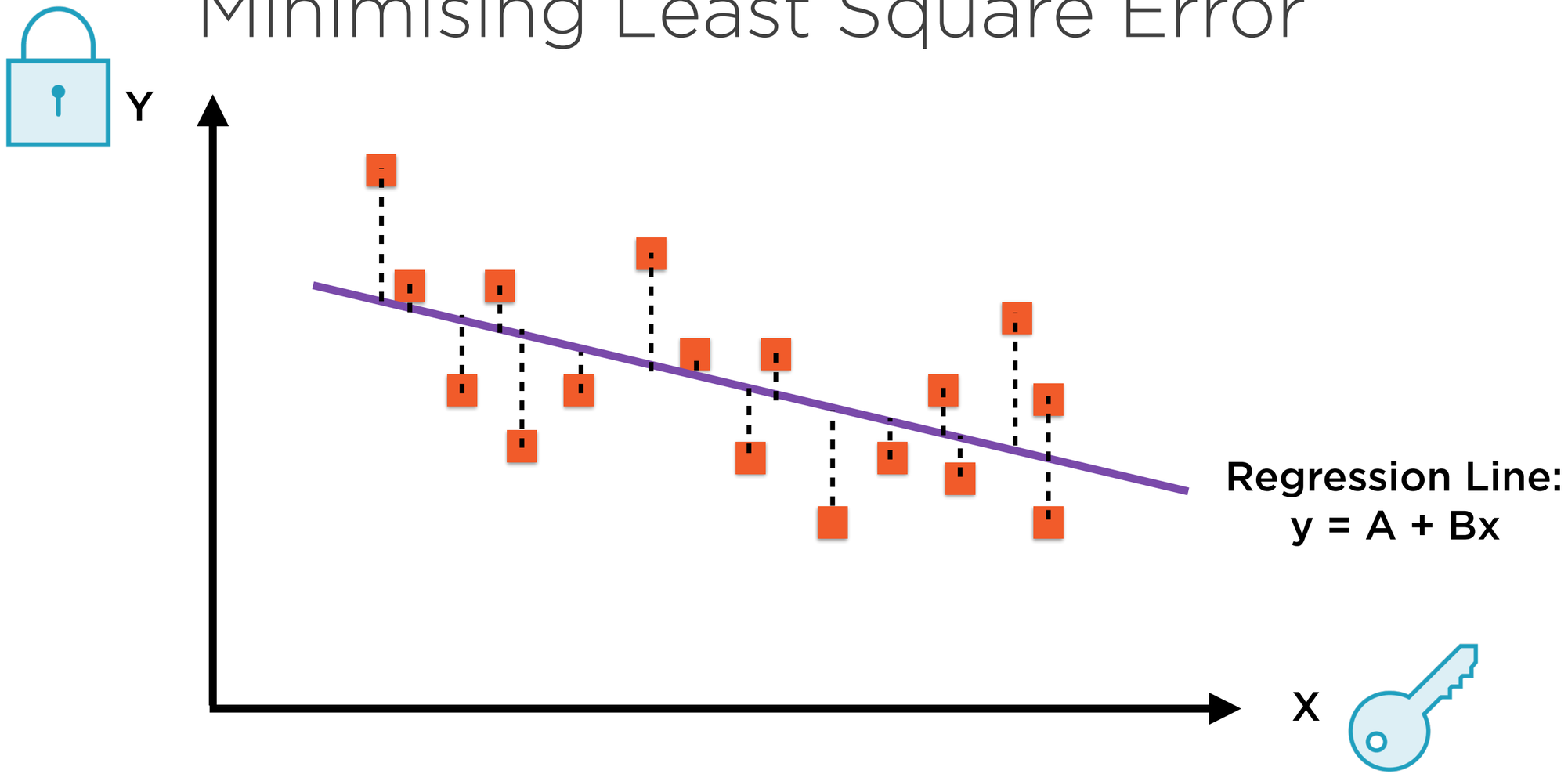
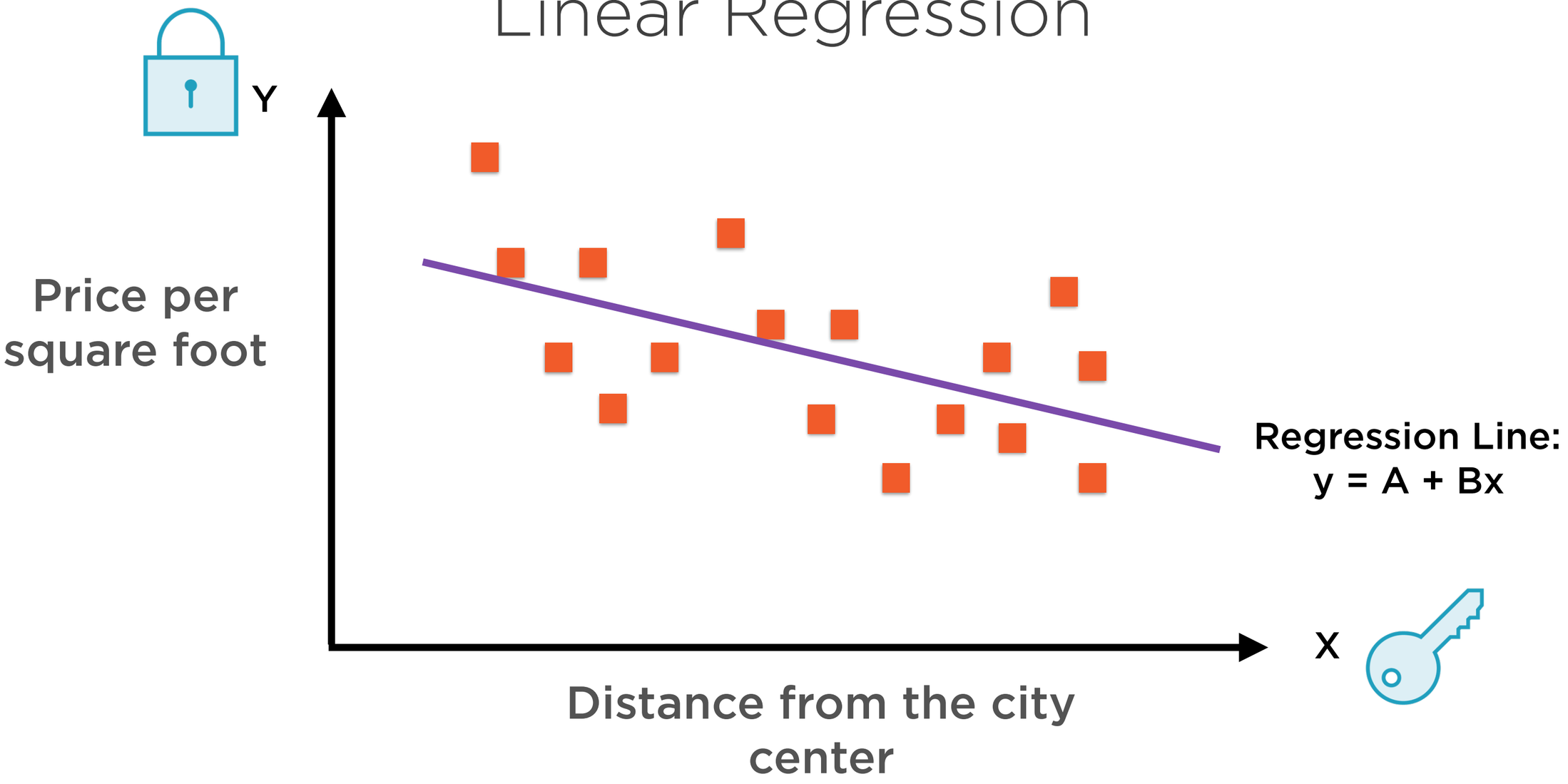


Linear Regression



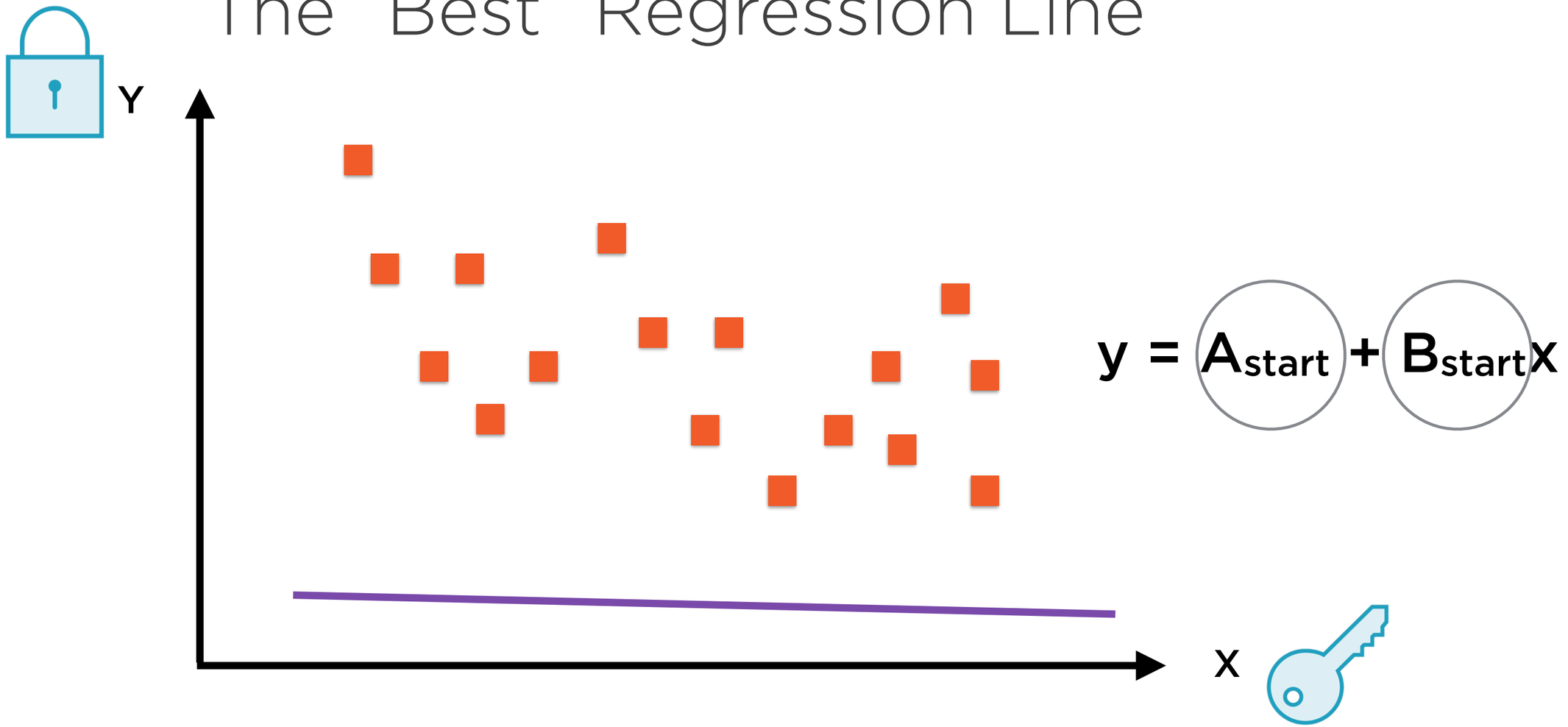
Linear Regression Algorithms in Practice

Estimate initial values for A and B

Find the errors for the regression line with those values

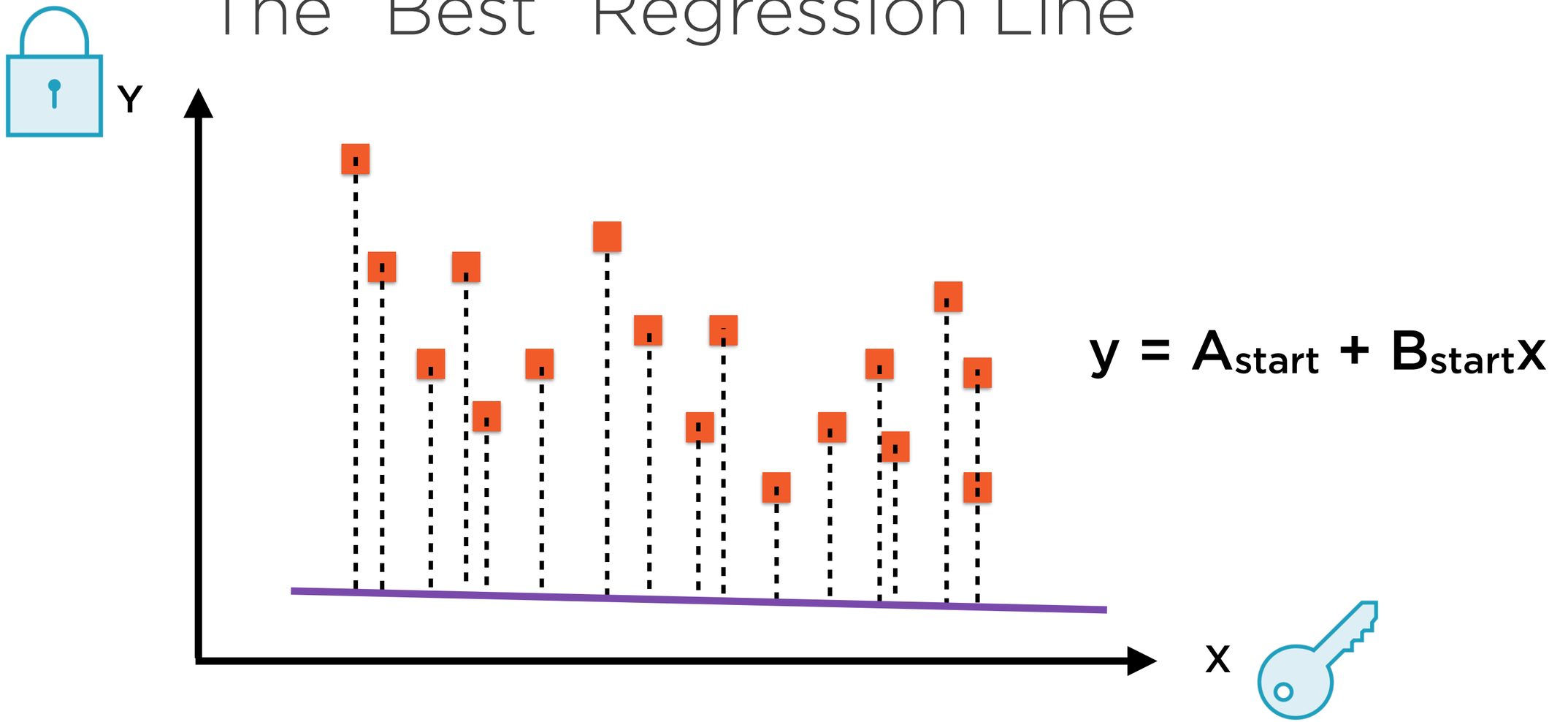
Feed errors back and get new values for A and B

The “Best” Regression Line



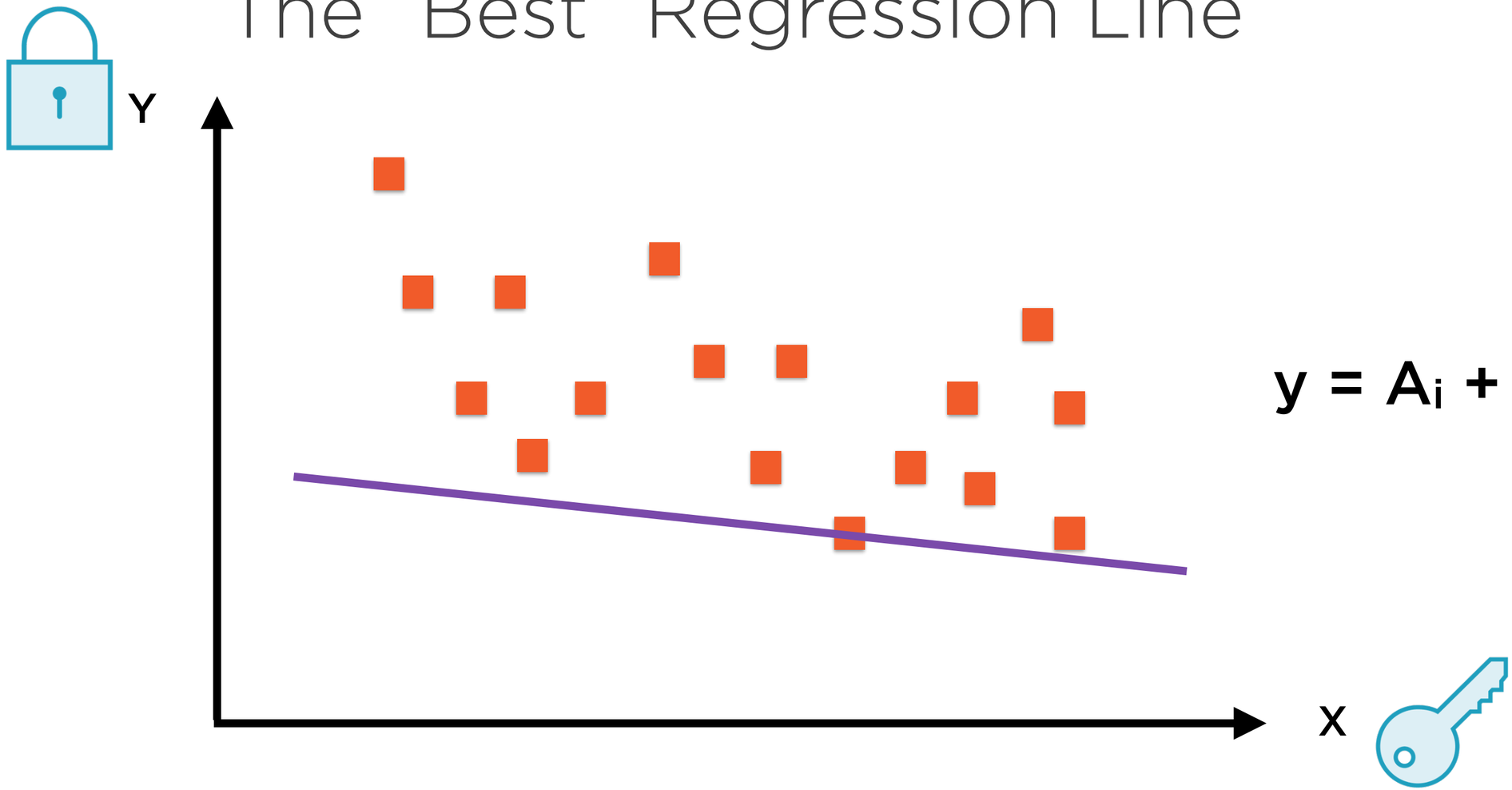
Start off with some values for A and B

The “Best” Regression Line



Calculate the least square error and feed that back

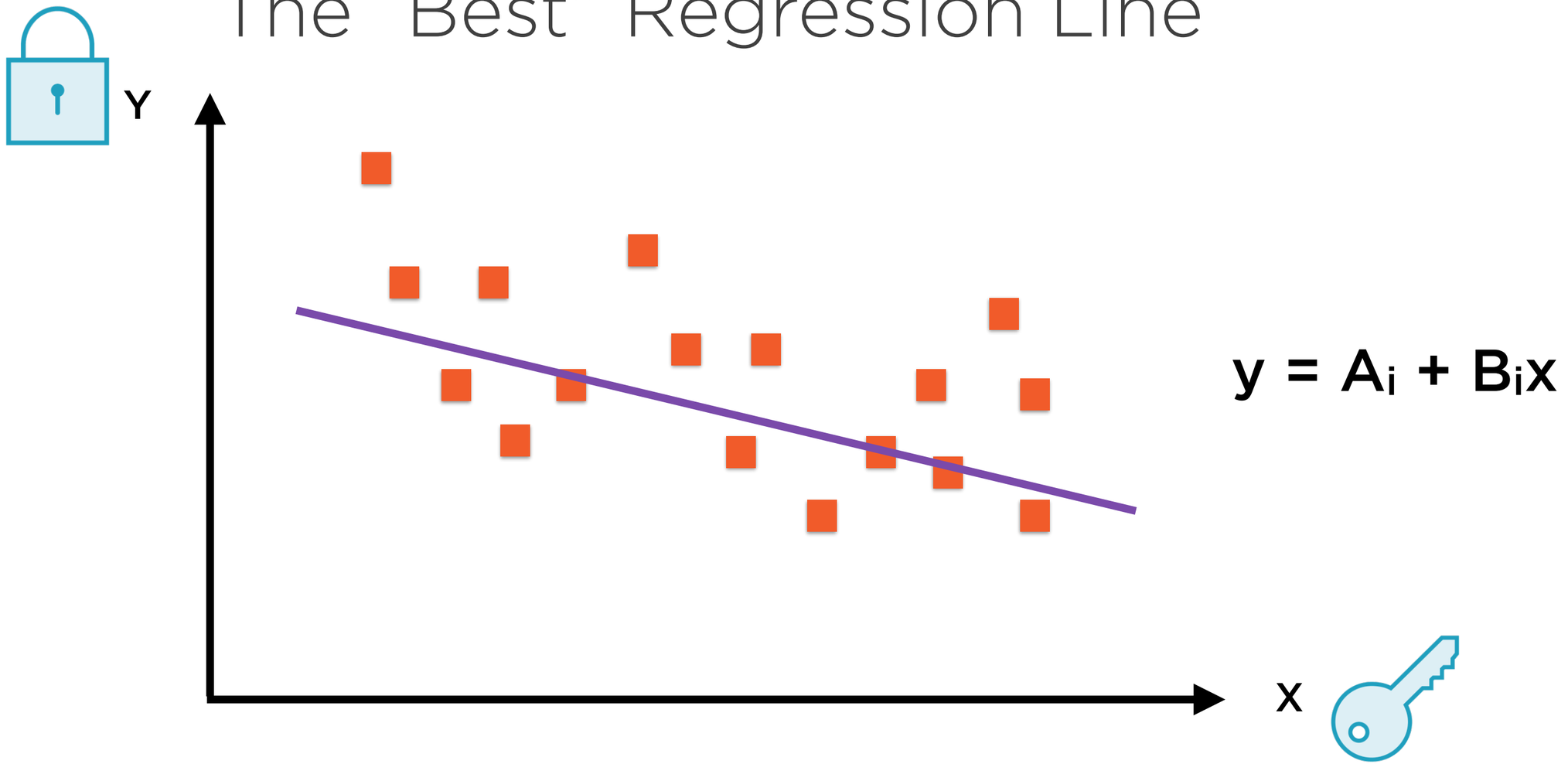
The “Best” Regression Line



$$y = A_i + B_i x$$

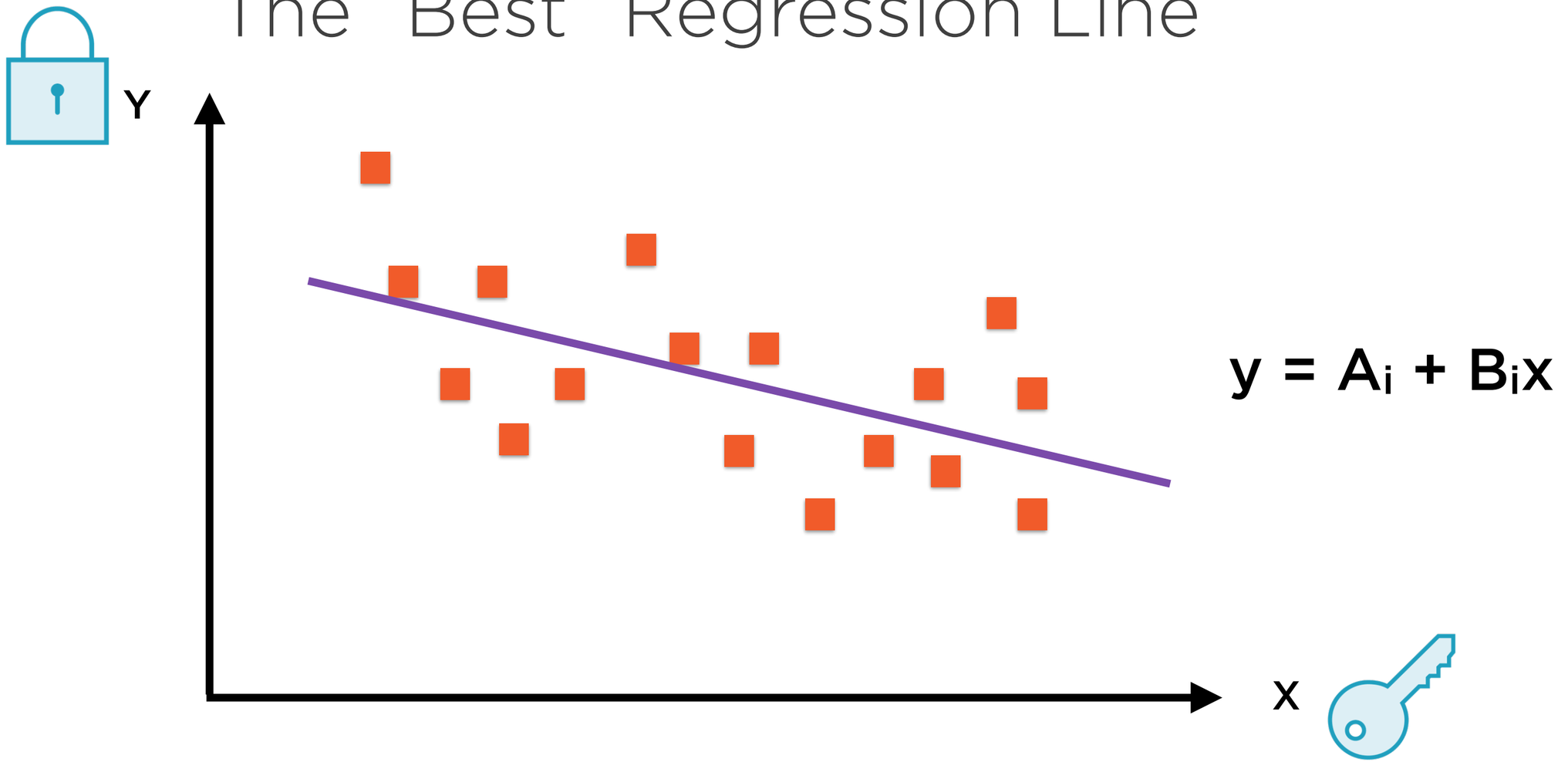
This will give us new values for A and B

The “Best” Regression Line



Adjust values of A and B by feeding back the error values

The “Best” Regression Line



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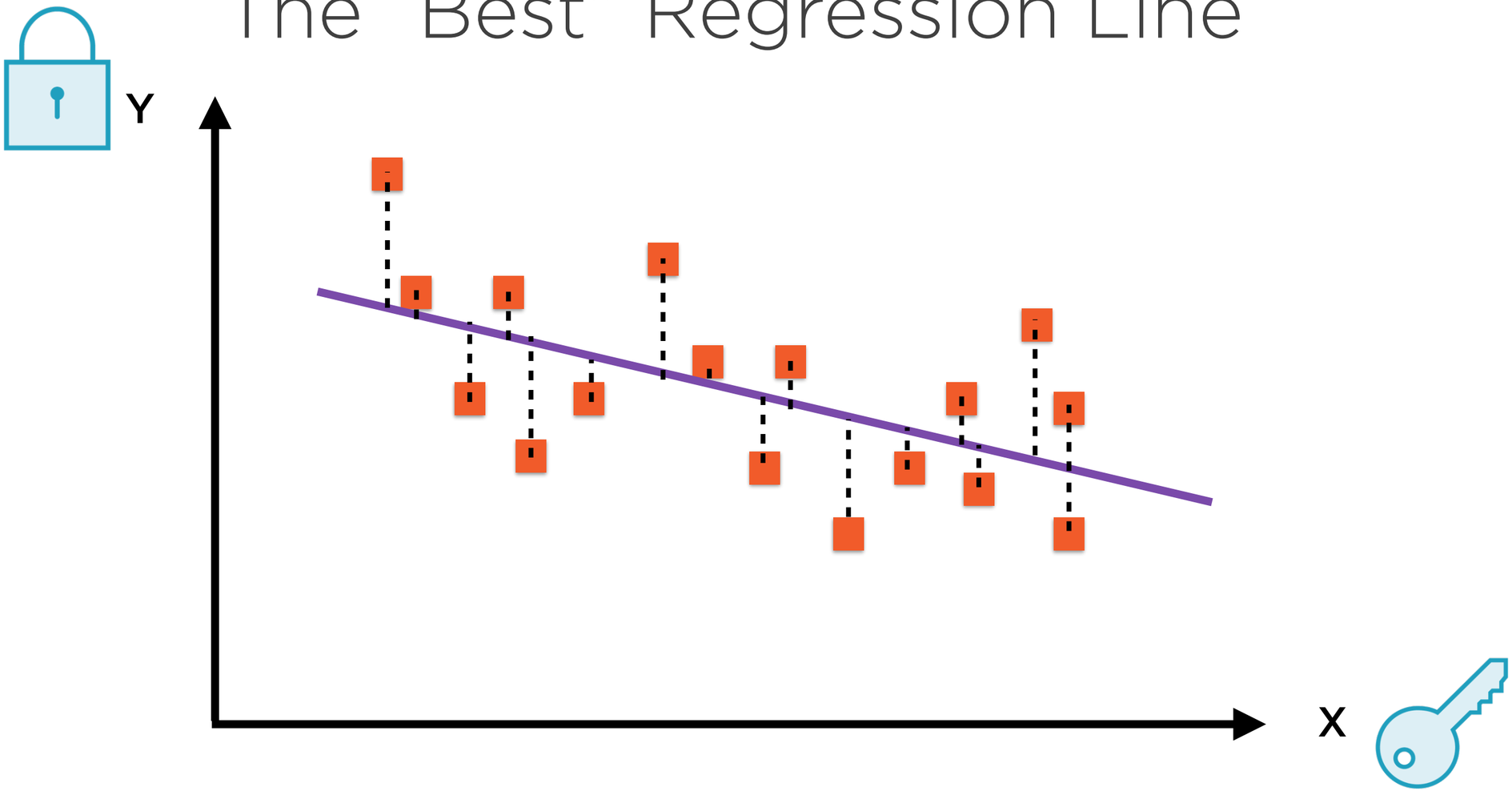
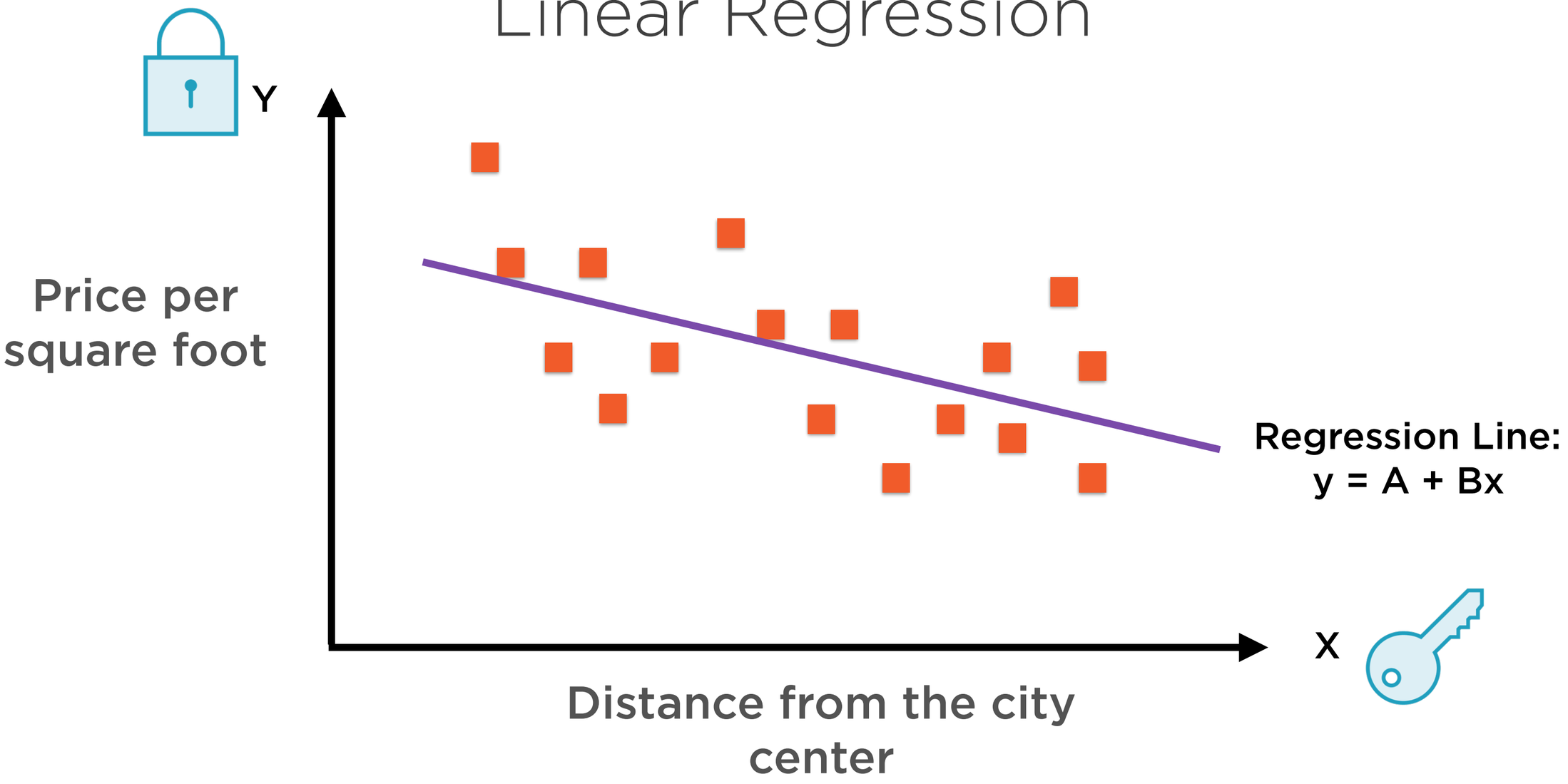


The “best fit” line is called the regression line

Regression is an example of a supervised learning algorithm

Placeholders

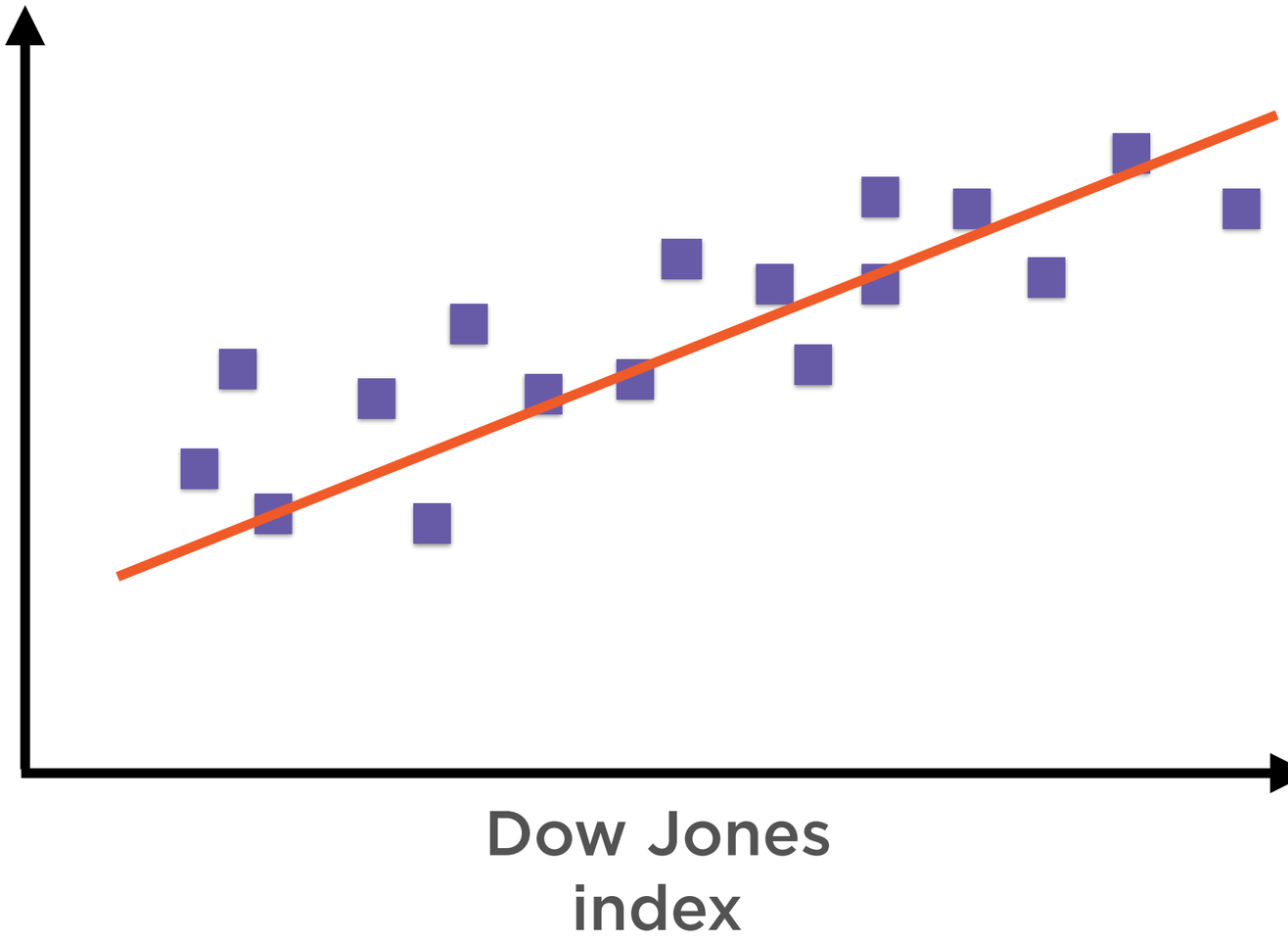
Linear Regression



Linear Regression

Y

Price of GOOG



Regression Line:
y = A + Bx

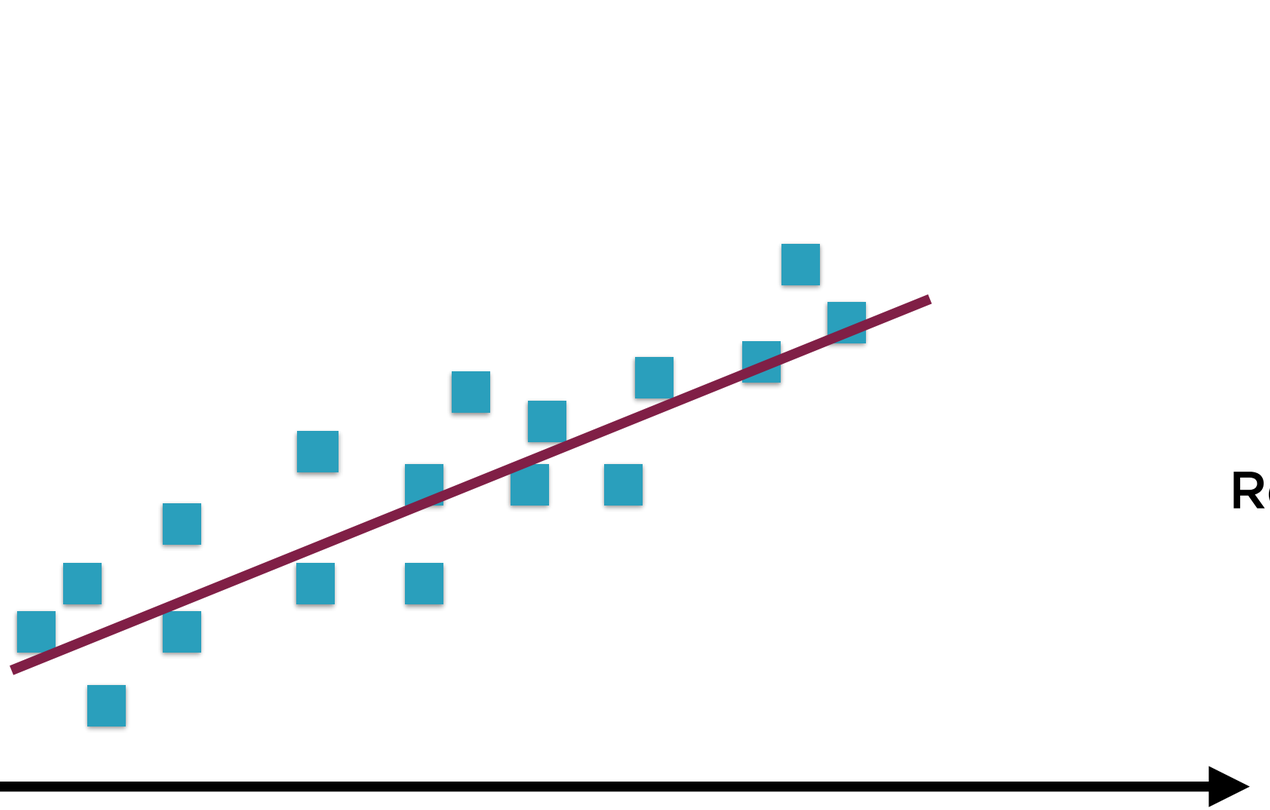
X

Dow Jones index

Linear Regression

Y

Life expectancy



Regression Line:
y = A + Bx

X

Wealth

Machine learning algorithms can
be applied to a variety of problems

The model should have the ability to
accept the different X and Y values

Placeholder

Hold the place for a Tensor that will be fed at runtime, in effect becoming an “input” node

Abrahams, Sam; Hafner, Danijar; Erwitt, Erik; Scarpinelli, Ariel (2016-07-23). TensorFlow For Machine Intelligence: A hands-on introduction to learning algorithms

Demo

Specify placeholders in our simple math operations

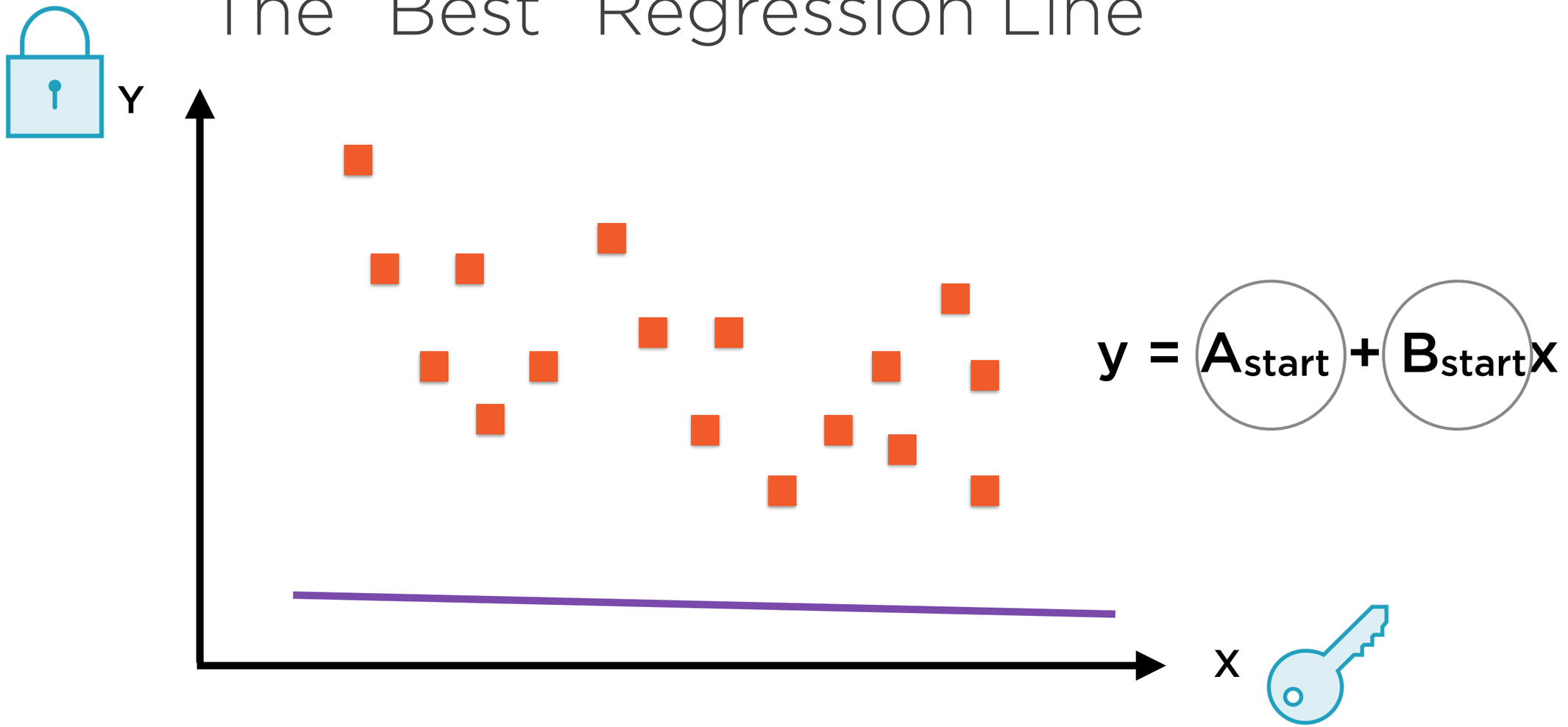
Use a feed dictionary to feed these into TensorFlow operations

Demo

Work with `fetches` and the `feed_dict` passed to `Session.run()` operations

Variables

The “Best” Regression Line



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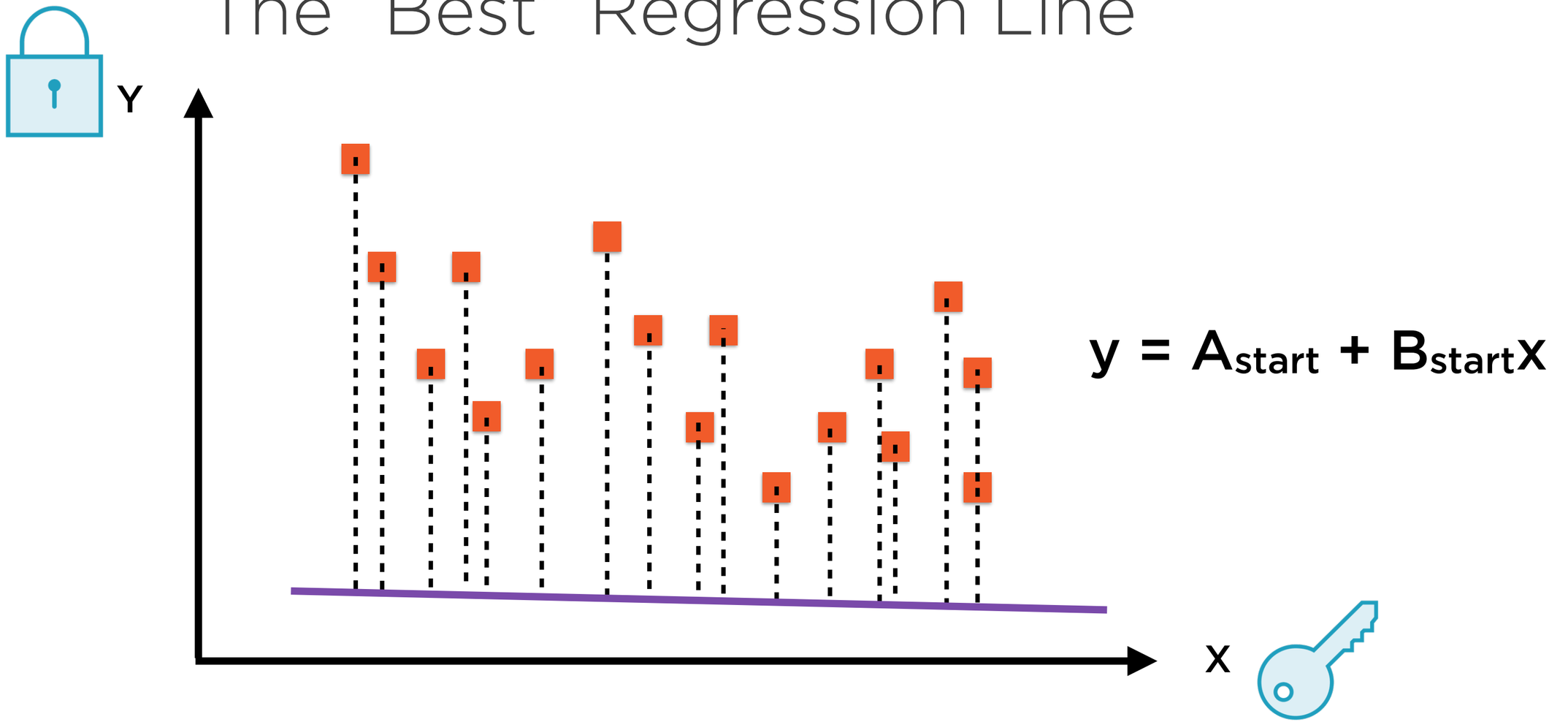
The “Best” Regression Line



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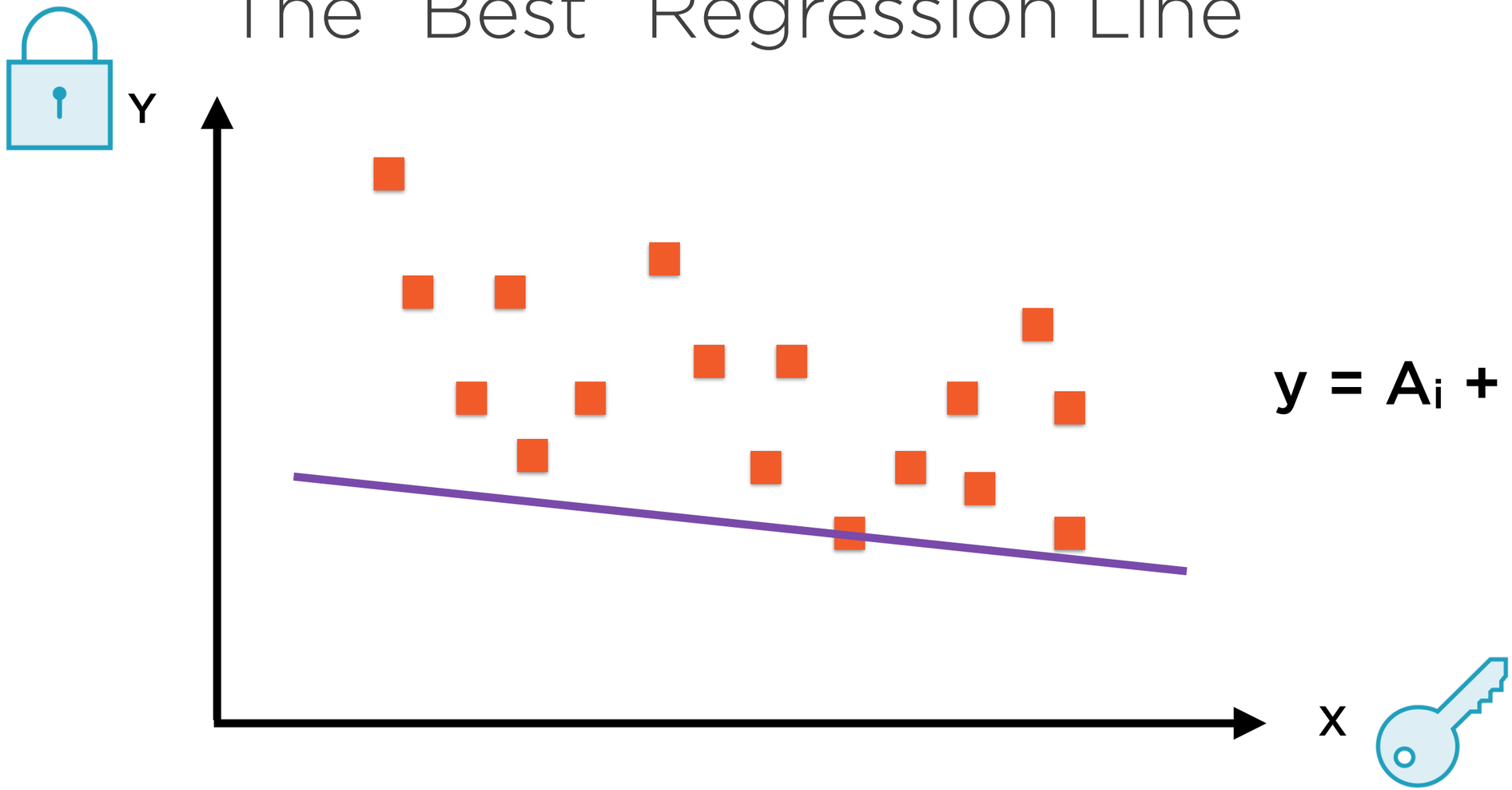

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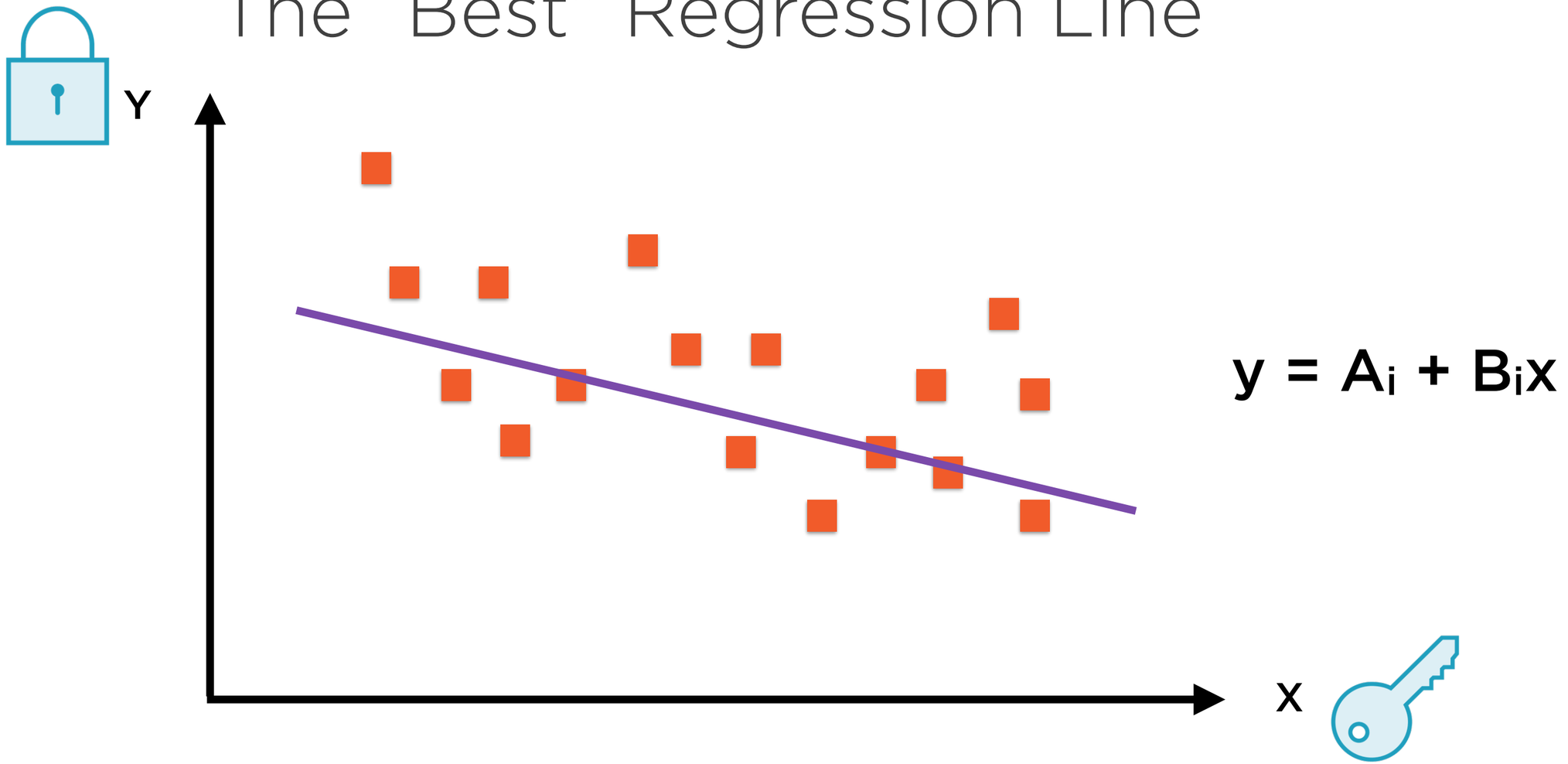
This will give us new values for A and B

The “Best” Regression Line



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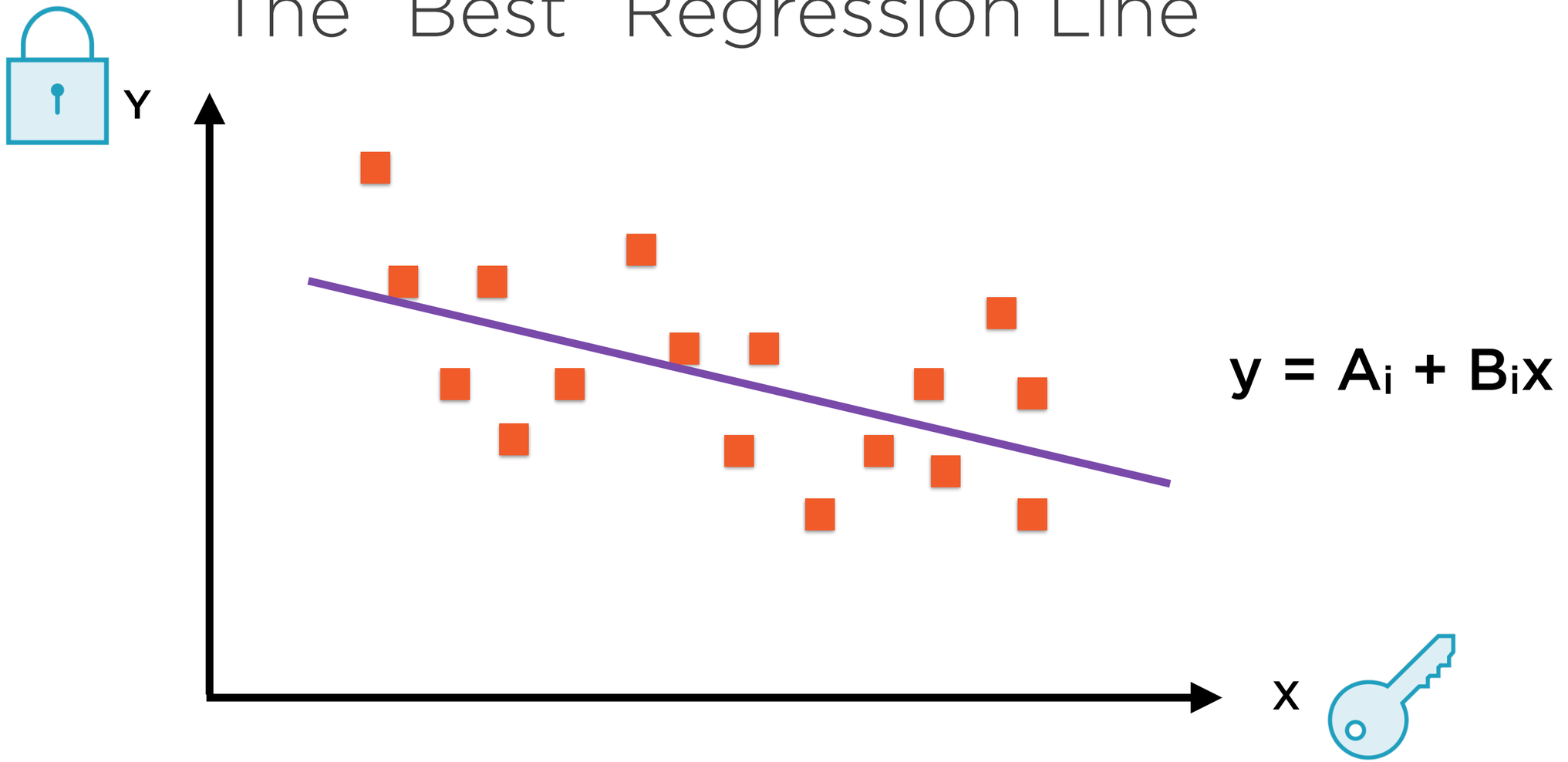
The “Best” Regression Line



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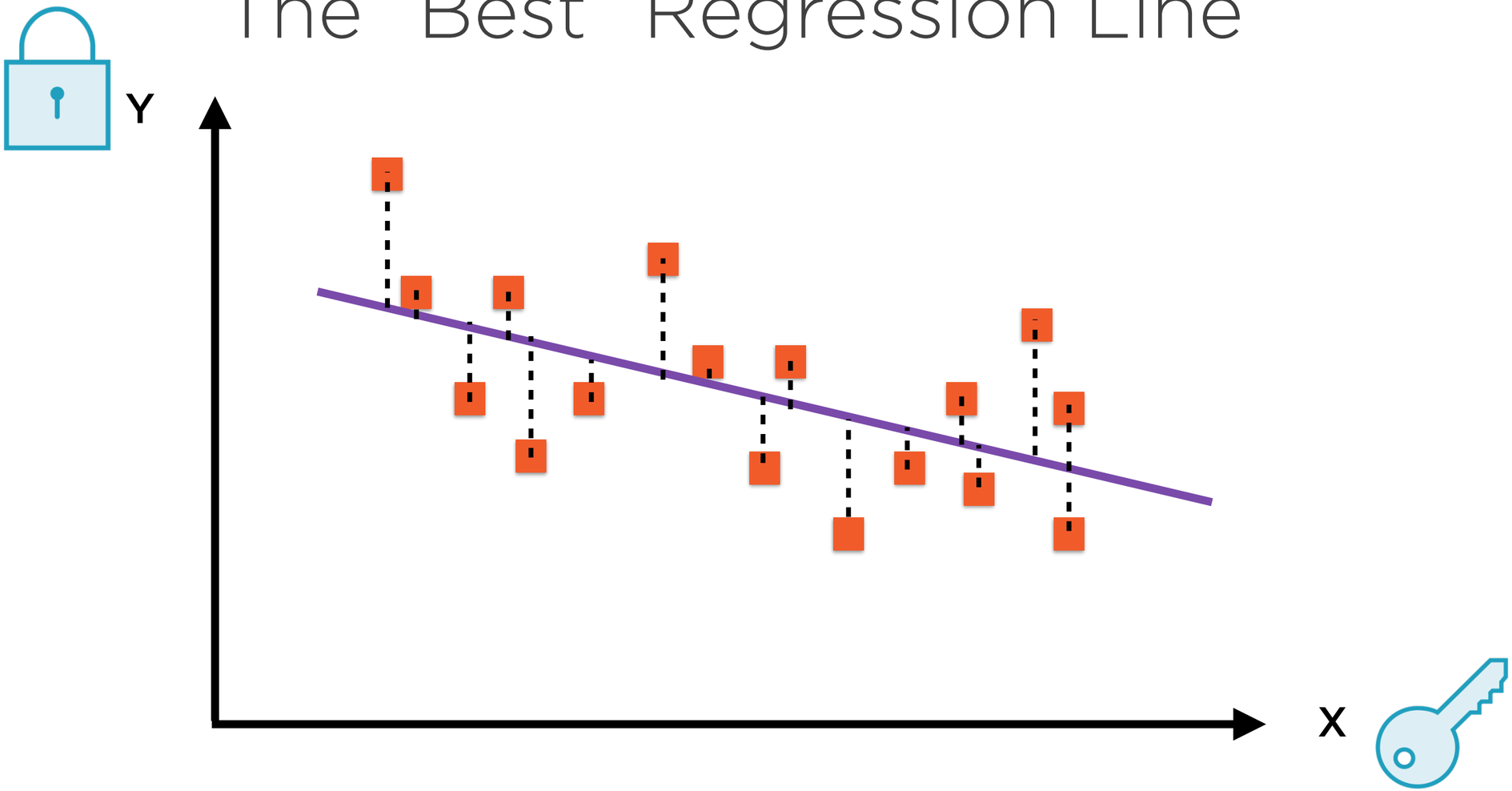

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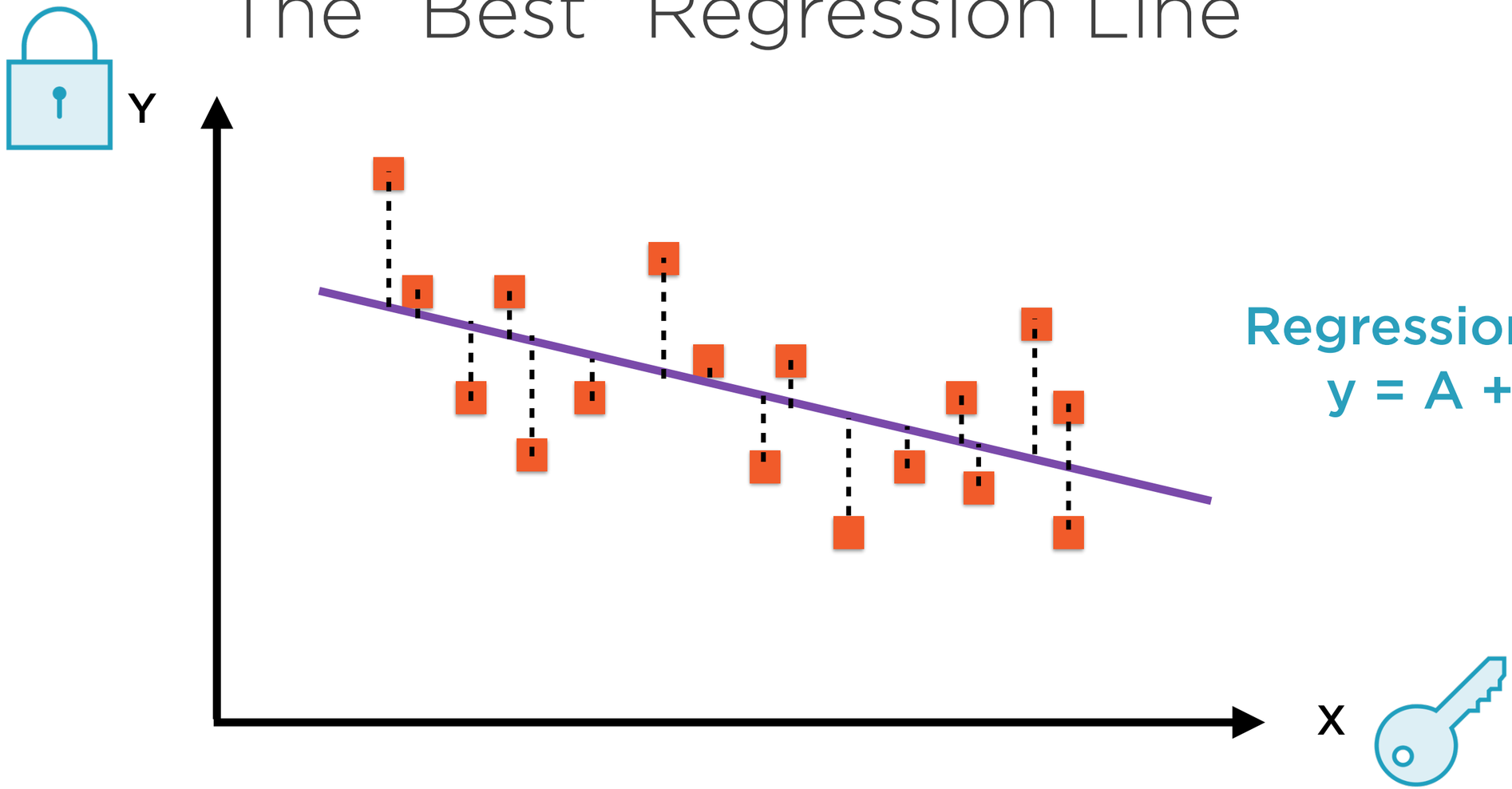

Regression Line:
y = A + Bx

The values of A and B are updated till we get the best fit line

Machine learning algorithms
iterate to get closer to the solution

The model should have the ability to
hold constantly changing values

Constants, Placeholders and Variables

Constants

Immutable values which do not change

Placeholders

Assigned once and do not change after

Variables

Are constantly recomputed

Variables

Mutable Tensor values that persist across multiple calls to Session.run()

Abrahams, Sam; Hafner, Danijar; Erwitt, Erik; Scarpinelli, Ariel (2016-07-23). TensorFlow For Machine Intelligence: A hands-on introduction to learning algorithms

Demo

Use variables and update their values when the program runs

Demo

The default graph and explicitly specified graphs

Demo

Improve debugging using the named scope

Demo

Interactive sessions in TensorFlow

Summary

Implement placeholders and variables in TensorFlow

Make TensorBoards more useful using named scopes