# Machine Learning

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# Linear Regression

- ▶ Consider the following toy example.

- ▶ It has been known that crickets (an insect species) chirp more frequently on hotter days than on cooler days.

- ▶ Professional and amateur scientists have cataloged data on chirps-per-minute and temperature.

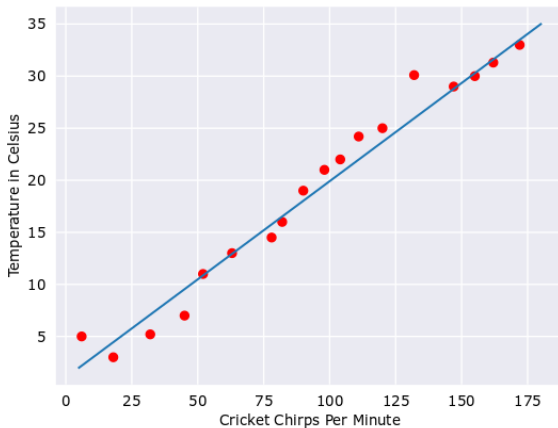- ▶ Using this data, you want to explore this relationship.

# Linear Regression

▶ First, examine your data by plotting it:
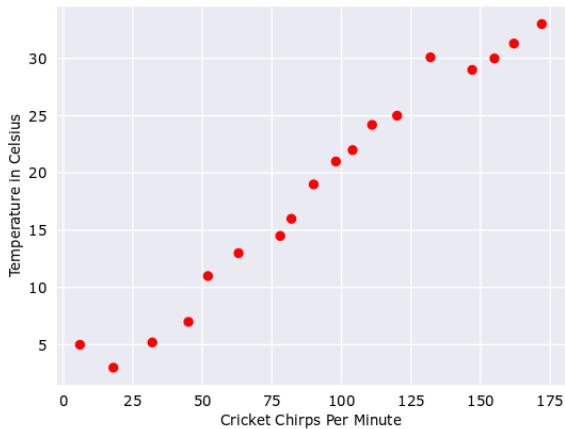
# Linear Regression

▶ You could draw a single straight line like the following to approximate this relationship between chirps and temperature.

# Linear Regression

- The line doesn't pass through every dot, but the line does clearly show the relationship between chirps and temperature.

- Using the equation for a line, you could write down this relationship as follows:

$$y = mx + b$$

where:

- $y$ is the temperature in Celsius – the value we're trying to predict.

- $m$ is the slope of the line.

- $x$ is the number of chirps per minute – the value of our input feature.

- $b$ is the y-intercept.

# Linear Regression

- By convention in ML, you'll write the equation for a model slightly differently:

$$\hat{y} = b + w_1 x_1$$

where:

- $y$ is the predicted label (a desired output).
- $b$ is the bias (the $y$-intercept), sometimes referred to as $w_0$.
- $w_1$ is the weight of feature 1. Weight is the same concept as the "slope" $m$ in the traditional equation of a line.
- $x_1$ is a feature (a known input).

## Linear Regression

- To **infer** (predict) the temperature $y'$ for a new chirps-per-minute value $x_1$, just substitute the $x_1$ value into this model.

- Although this model uses only one feature, a more sophisticated model might rely on multiple features, each having a separate weight $w_1$, $w_2$, etc.

- For example, a model that relies on three features might look as follows:

$$\hat{y} = b + w_1 x_1 + w_2 x_2 + w_3 x_3$$

# Key Terms

- bias
- inference
- linear regression
- weight