Introduction to Supervised Learning

Question - Is it going to rain today? Do I need my umbrella?

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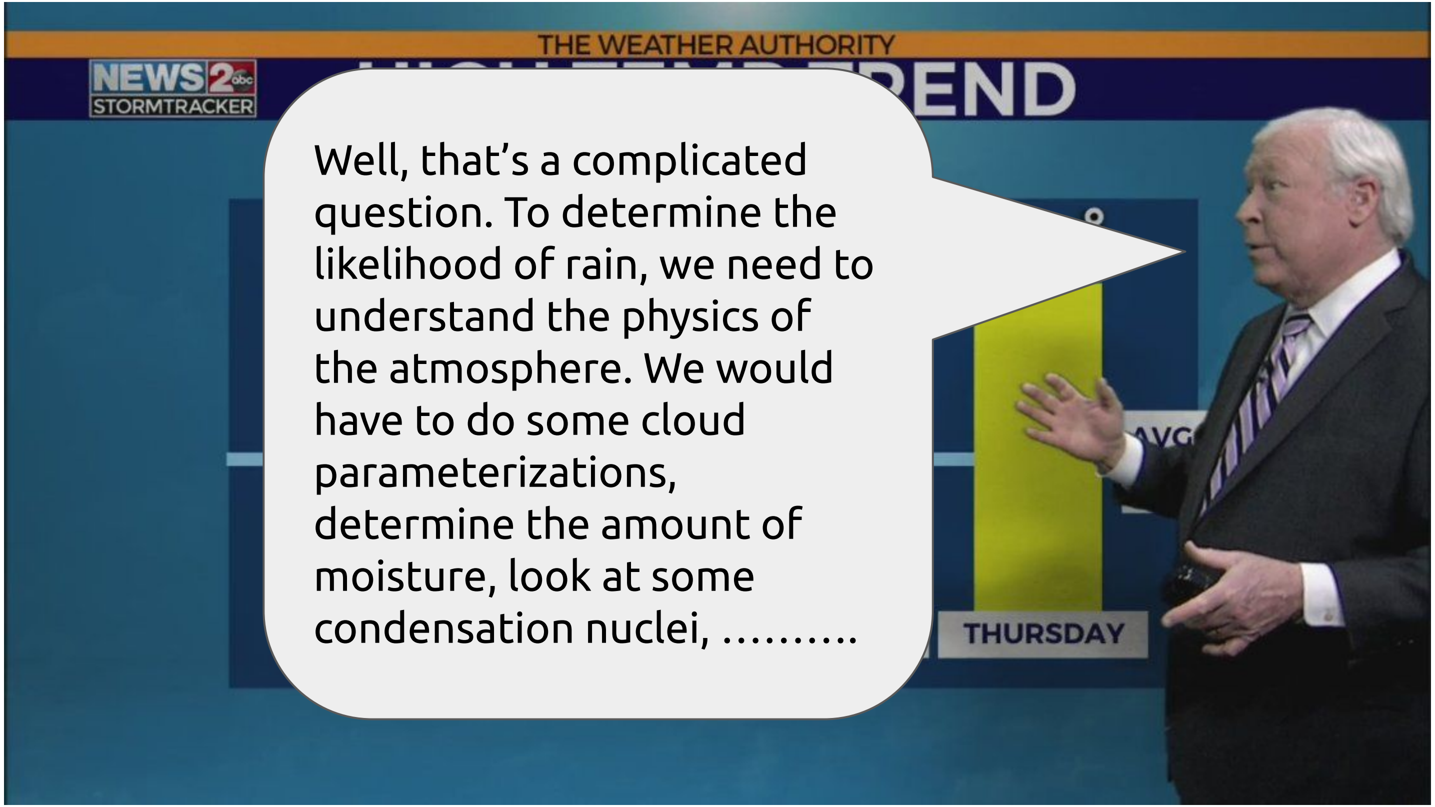

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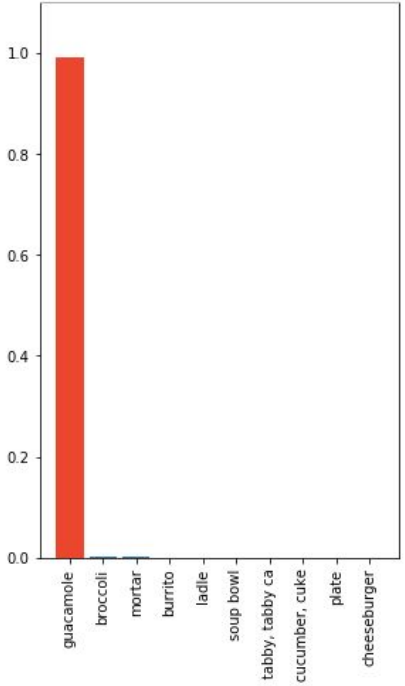
Moral: Given a good set of predictor variables and enough “experience” (training data), we can often make good predictions.

Before we get started, a word of caution: machine learning is more than just dumping a lot of data into a magic black box to make predictions.



https://www.theverge.com/2017/11/2/16597276/google-ai-image-attacks-adversarial-turtle-rifle-3d-printed

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EXCLUSIVE

STAT+

IBM's Watson supercomputer recommended 'unsafe and incorrect' cancer treatments, internal documents show

By Casey Ross and Ike Swetlitz July 25, 2018

Reprints

https://www.statnews.com/2018/07/25/ibm-watson-recommended-unsafe-incorrect-treatments/

Before we get started, a word of caution: machine learning is more than just dumping a lot of data into a magic black box to make predictions.

Amazon ditched AI recruiting tool that favored men for technical jobs

Specialists had been building computer programs since 2014 to review résumés in an effort to automate the search process

https://www.theguardian.com/technology/2018/oct/10/amazon-hiring-ai-gender-bias-recruiting-engine

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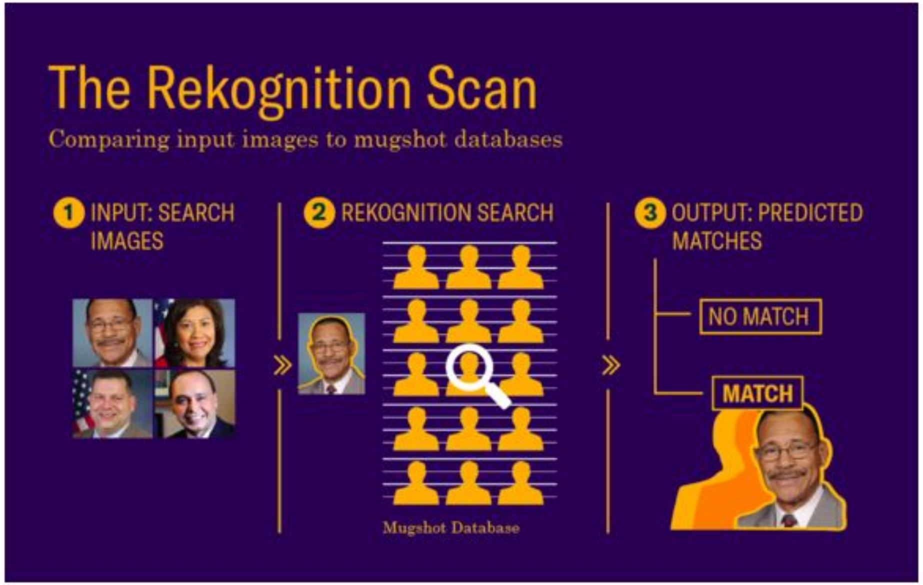

Rep. Sanford Bishop (D-Ga.) was falsely identified by Amazon Rekognition as someone who had been arrested for a crime.

https://www.aclu.org/blog/privacy-technology/surveillance-technologies/amazons-face-recognition-falsely-matched-28

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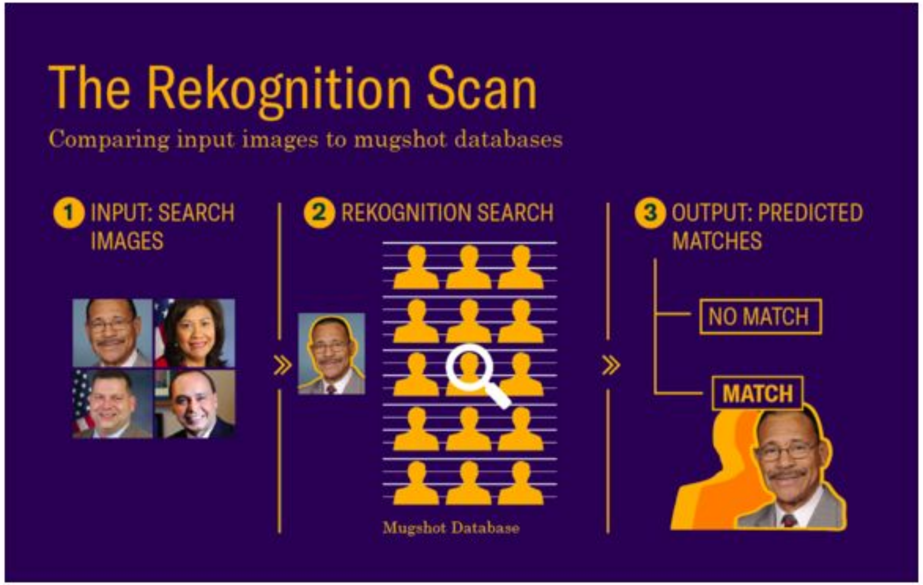

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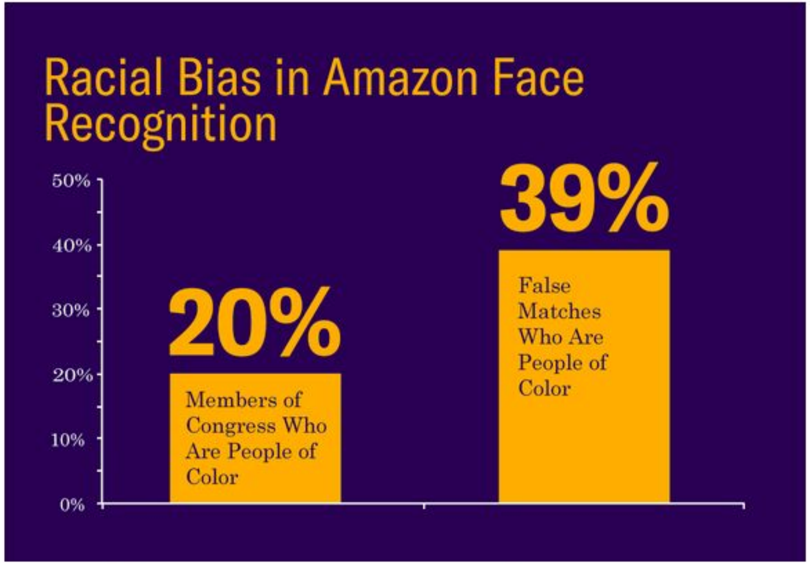

People of color were disproportionately falsely matched in our test.

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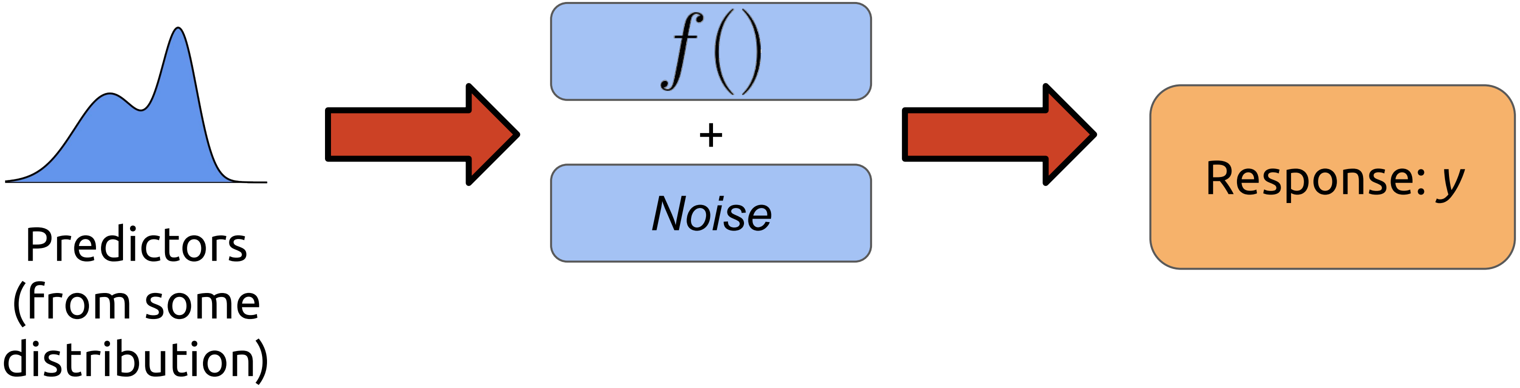
Supervised Learning - Setup



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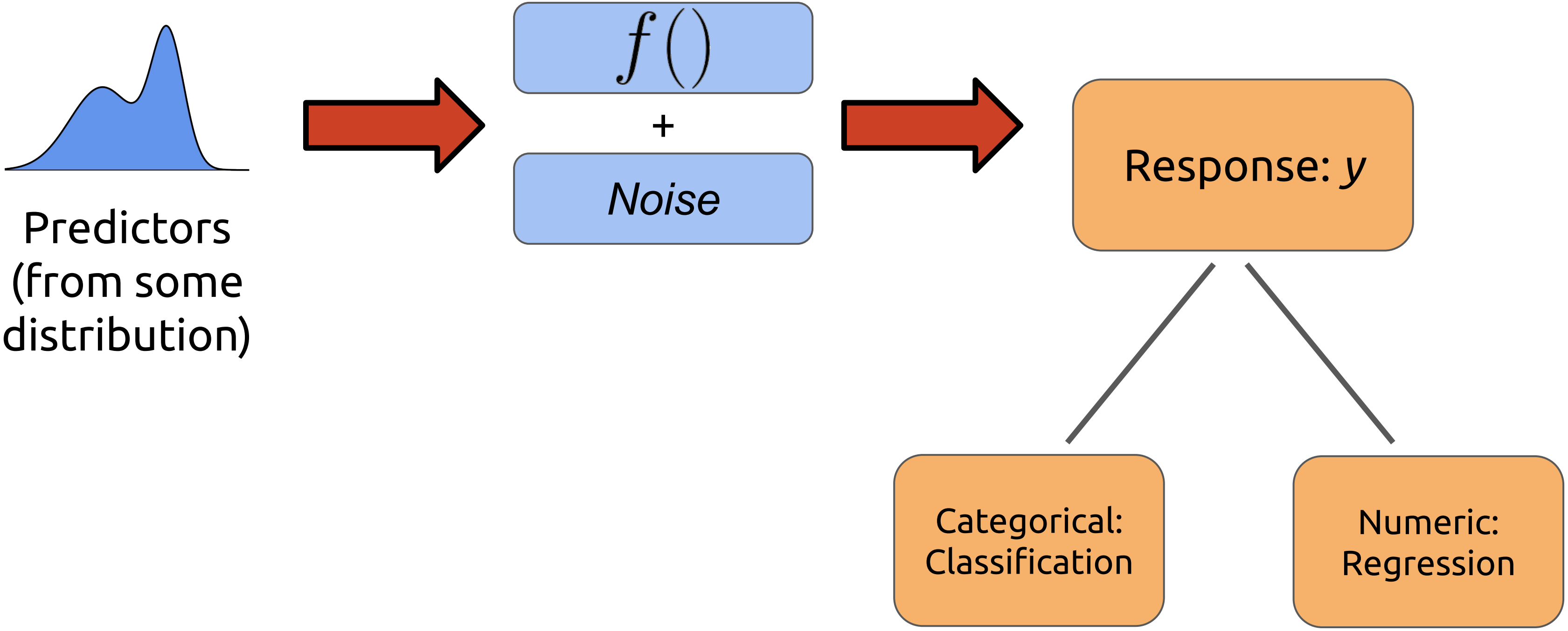

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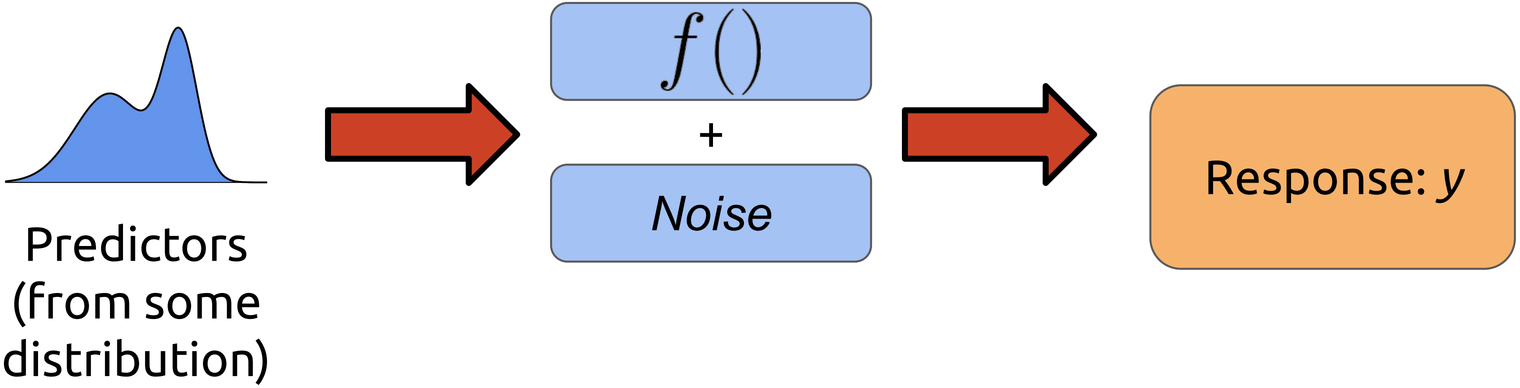
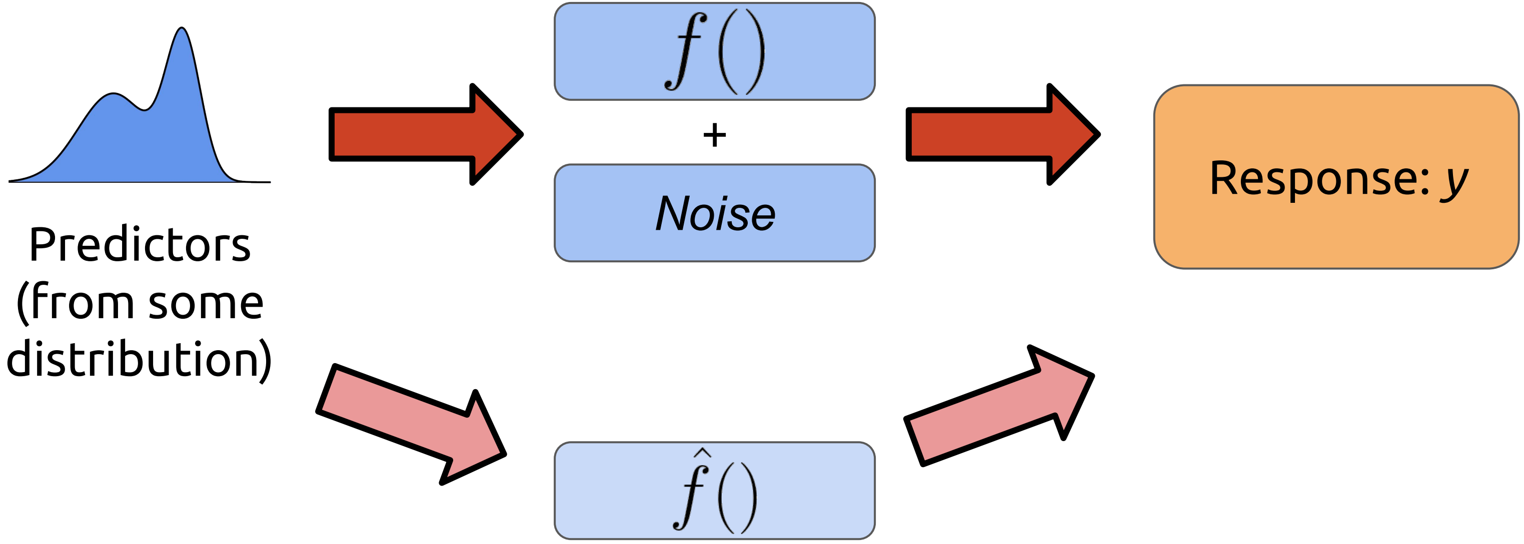


Supervised Learning - Goals



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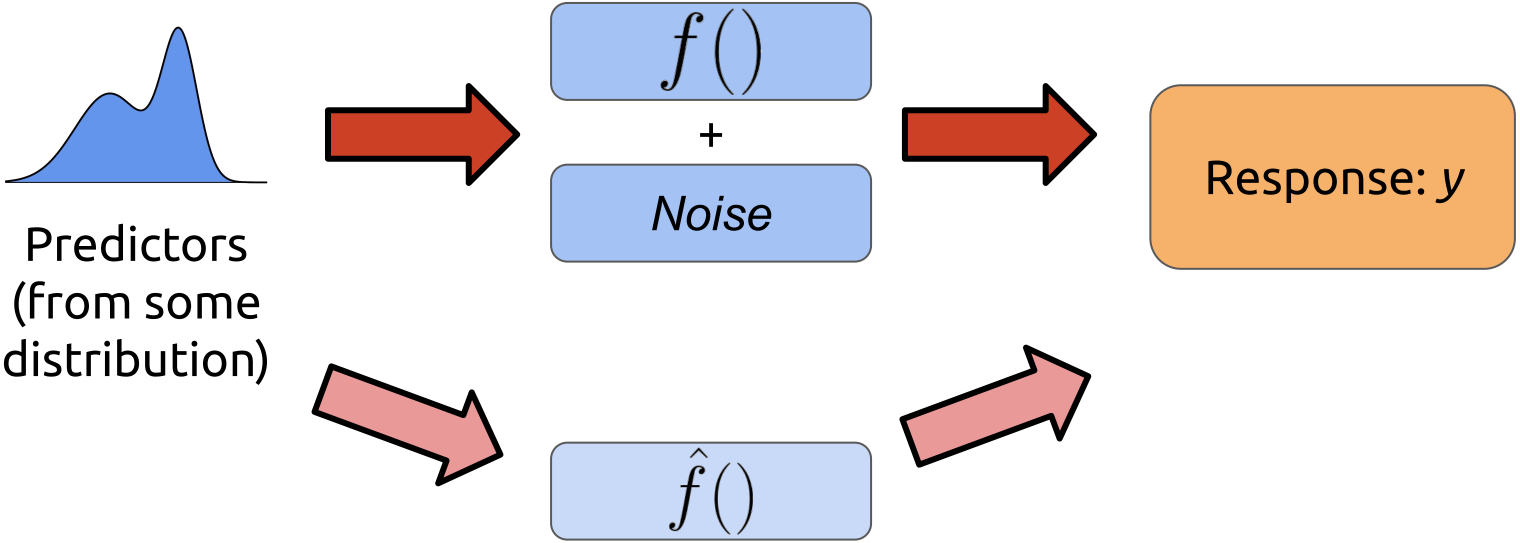
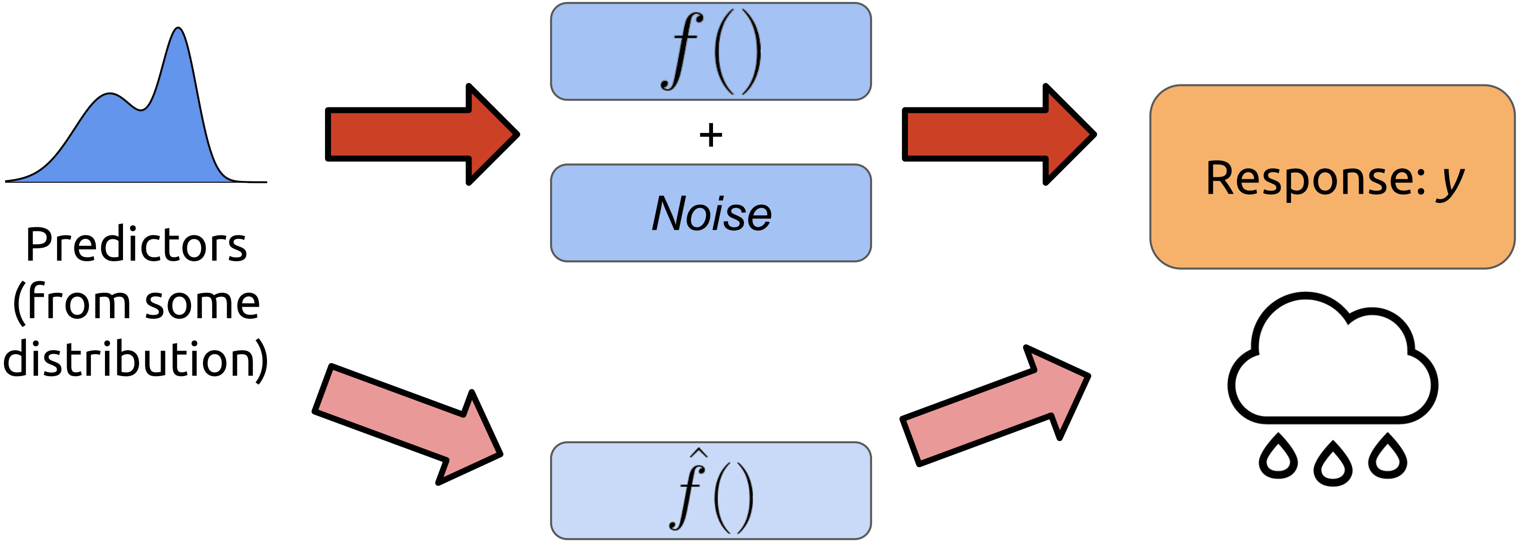


Goal: Choose a function so that the our predictions are close (on average) to the true values.

Supervised Learning - Grossly Oversimplified



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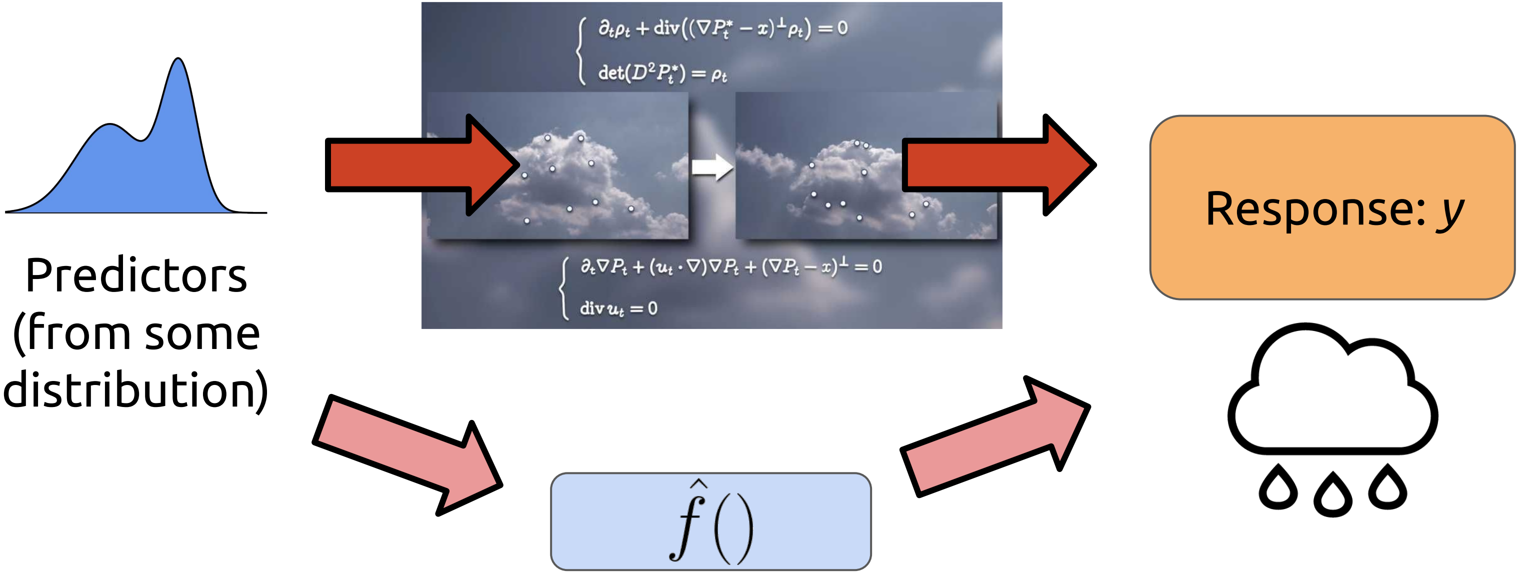

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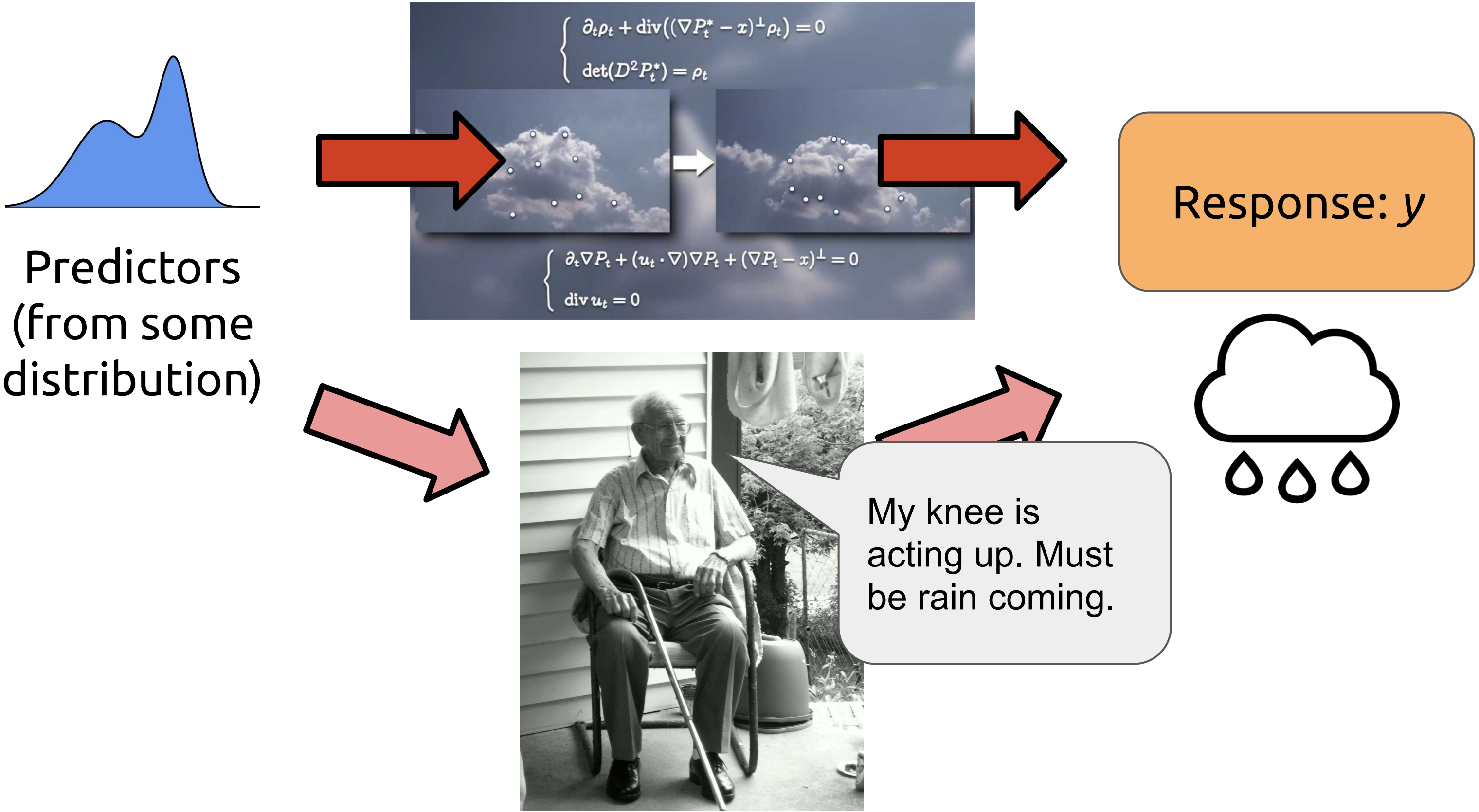
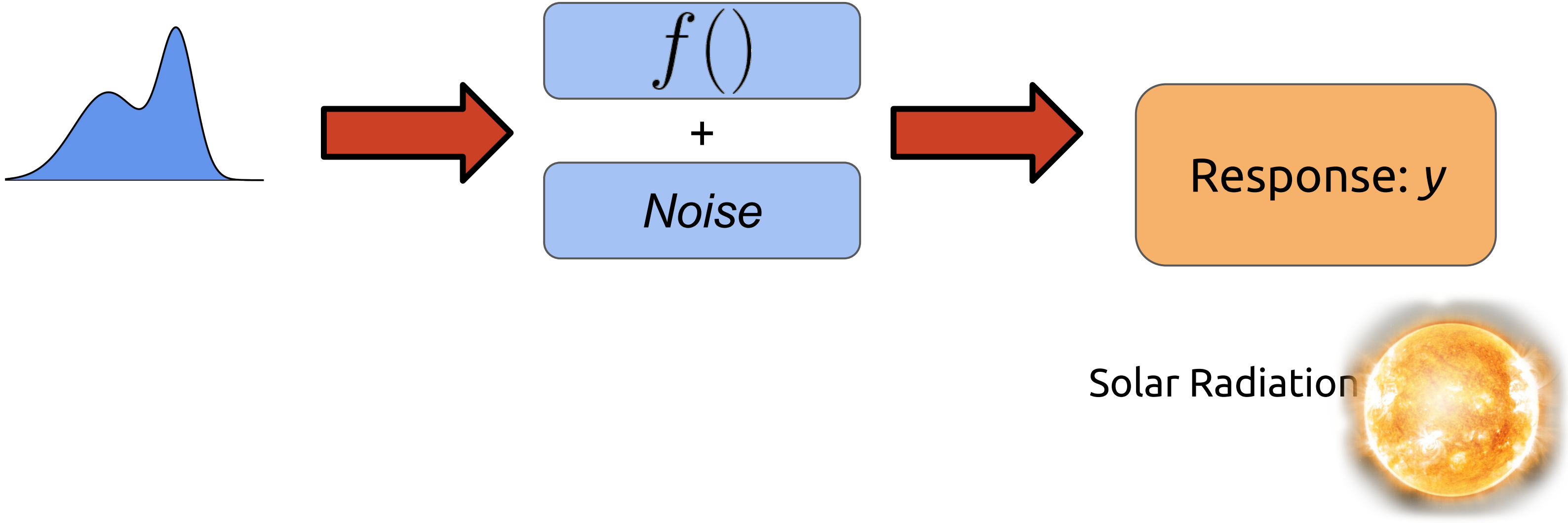


Example - Weather Prediction



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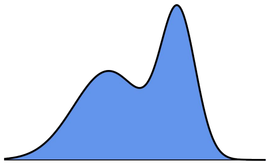

air temperature
precipitation rate
visibility
wind speed
wind direction
dew point
temperature
air pressure
relative humidity

$f()$
+
Noise

Response: y

Solar Radiation

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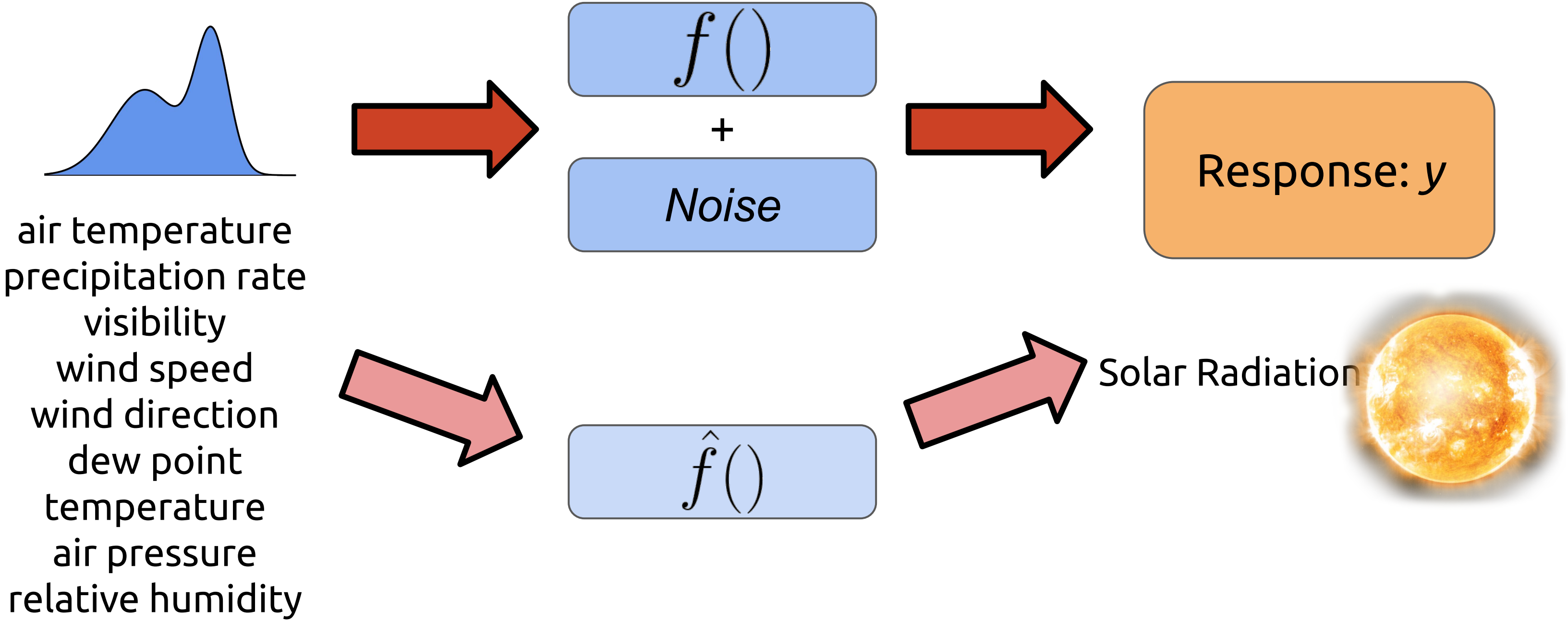

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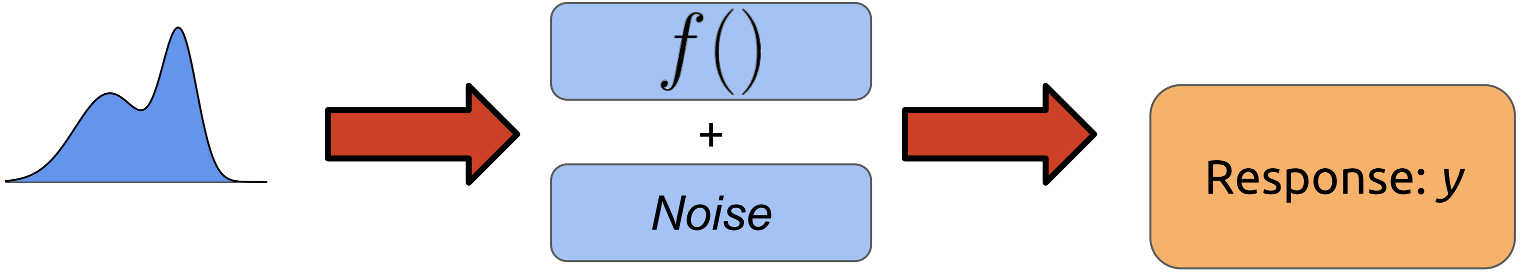
Example - Readmission or Death of Stroke Patients



90 day
readmission or
mortality

https://www.mdpi.com/2076-3417/10/18/6337/pdf

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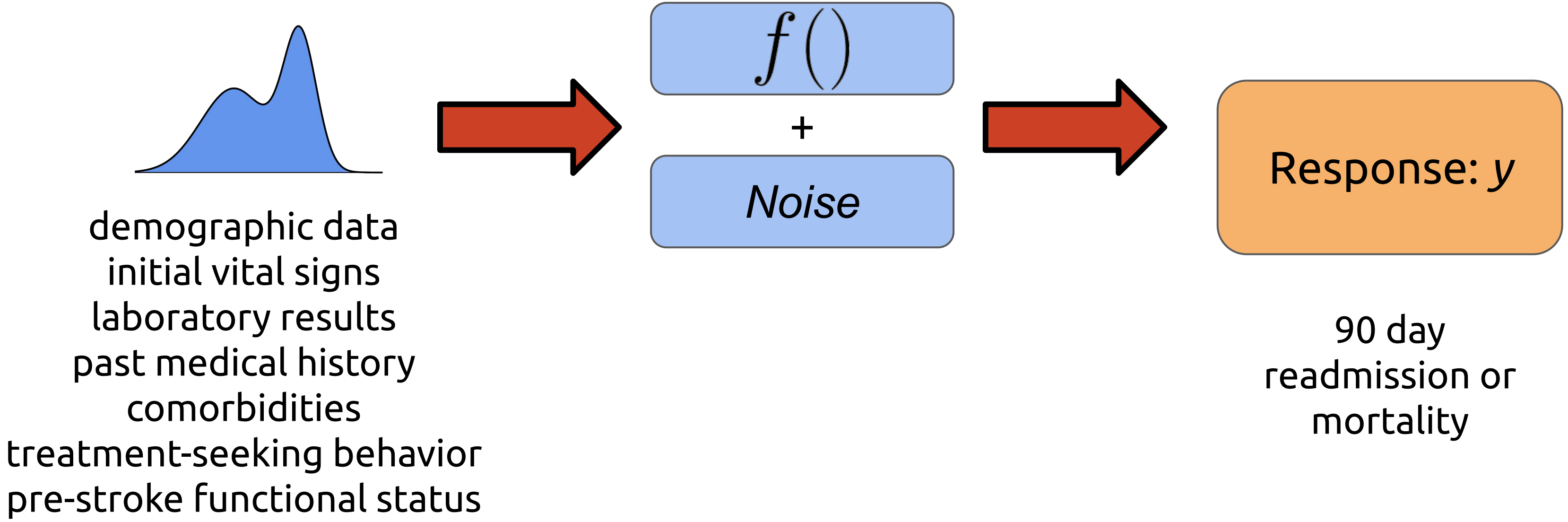

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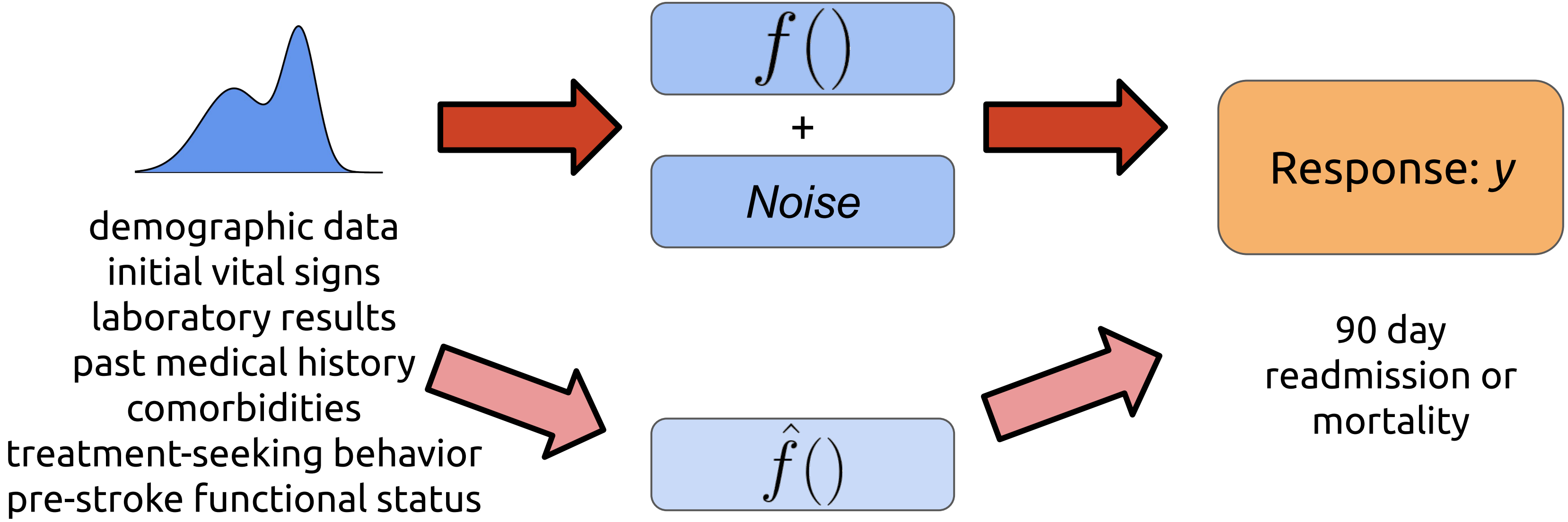

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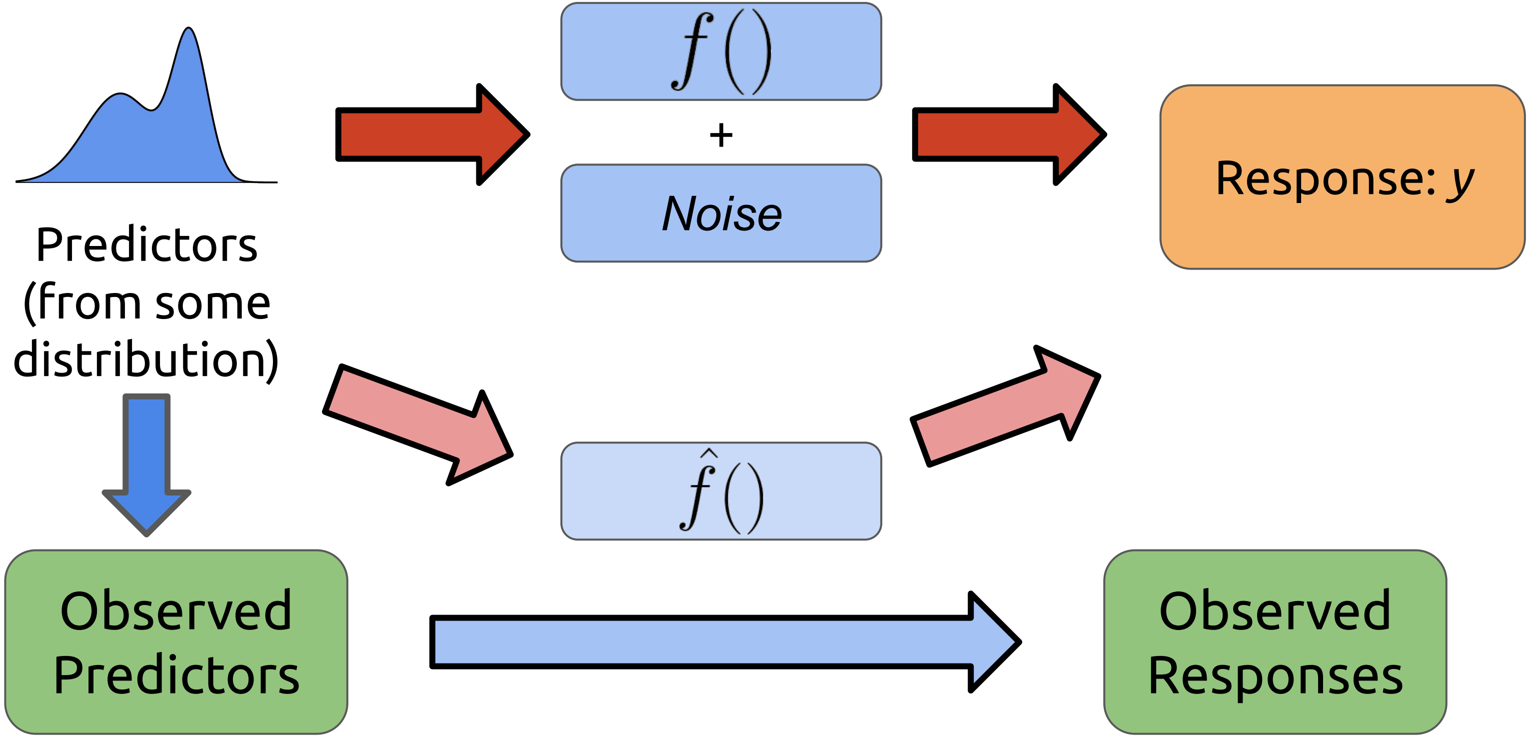
Supervised Learning - How



Supervised Learning - Goals

To measure how “good” our model is, we need some way to measure “error” (eg. mean squared error).

Our goal is to minimize the expected loss over *new* data.

Important: We are not trying to minimize loss over the observed data (which is often very easy to do), but to minimize the *generalization error* - the performance on unseen data.

Measuring Generalization Data - How

If we only care about how well our model performs on unseen data, how do we measure that?

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We can’t - it’s unseen!

But, we can *estimate* it.

Measuring Generalization Error - How

The most simple way to estimate generalization error is through employing a train/test split.

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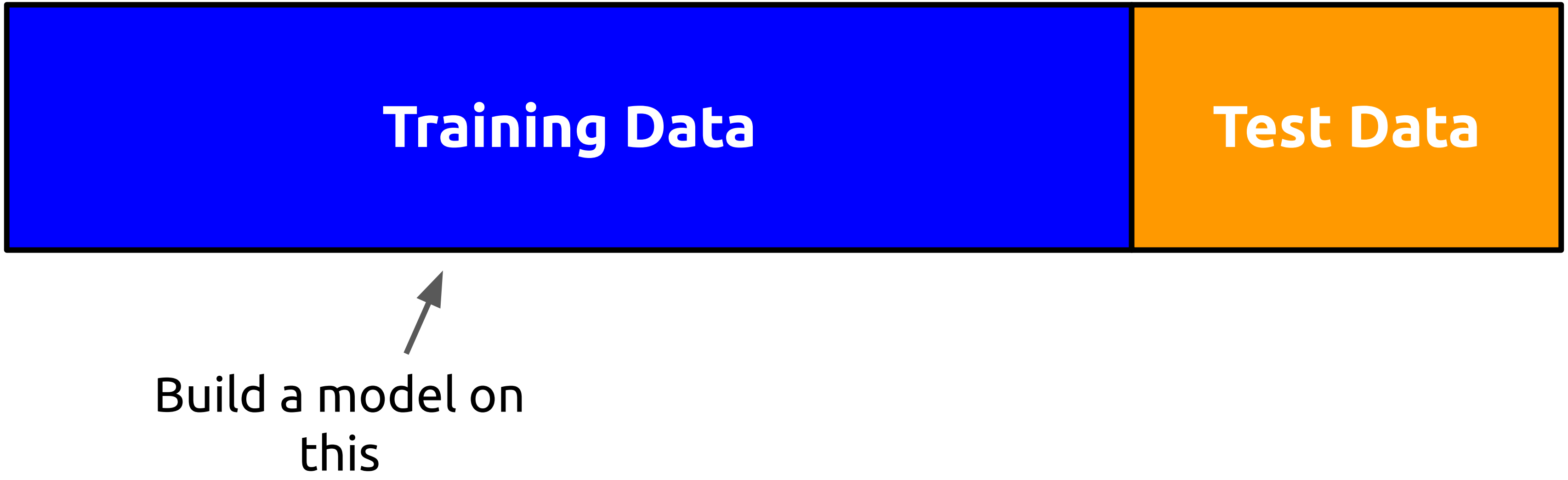

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Build a model on this

Estimate generalization error by seeing how it performs on this.