Introduction to Data Science

Data Science Essentials

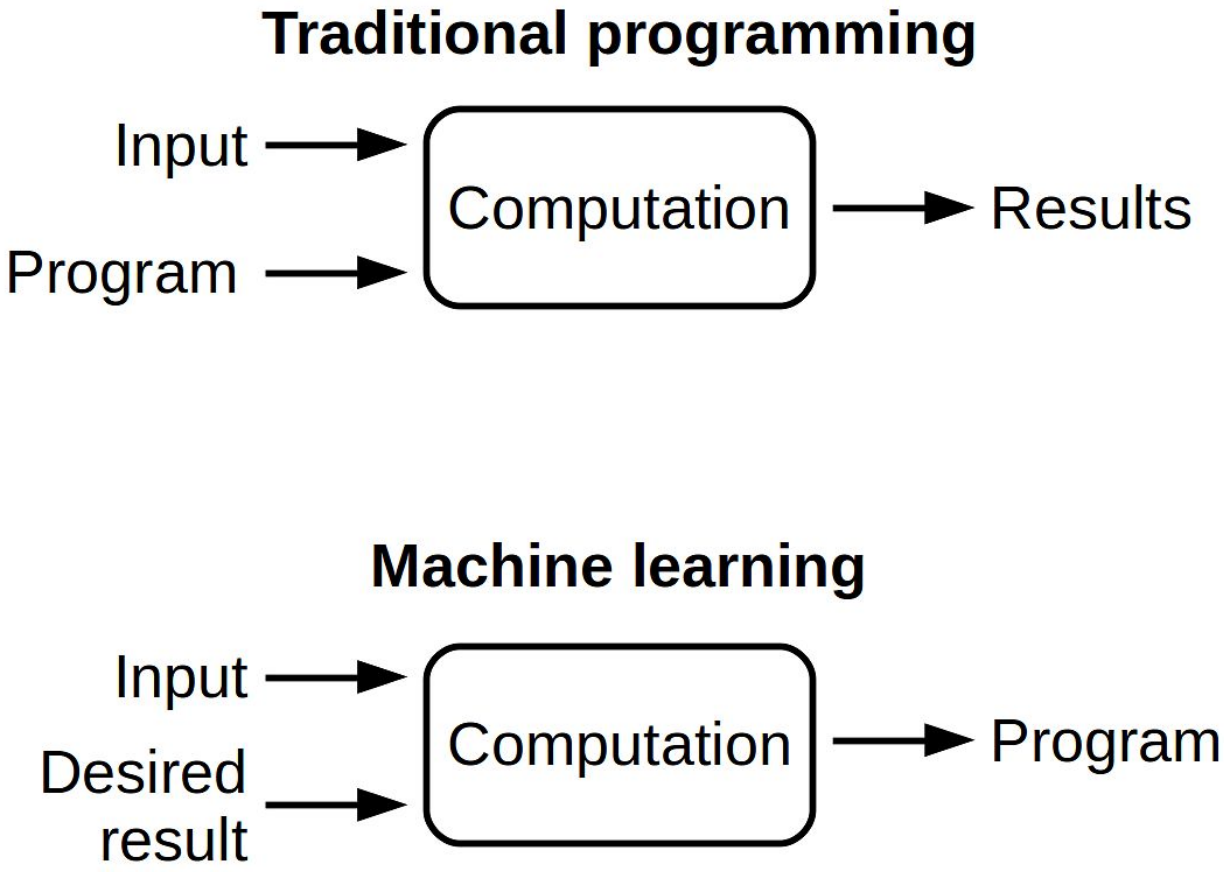
Goals for today

- **Review last session coding tasks**
- **Machine Learning, Part 2 – Tree-Based Models**

Review last session coding tasks

week5_review notebook

Supervised Learning



NASHVILLE SOFTWARE SCHOOL

Recall: Supervised Learning

Logistic Regression: Uses a particular functional form to make predictions. (Predict probabilities using a linear combination of the predictor variables.)

Recall: Supervised Learning

Logistic Regression: Uses a particular functional form to make predictions. (Predict probabilities using a linear combination of the predictor variables.)

But, this is not the only type of model we can use to make predictions.

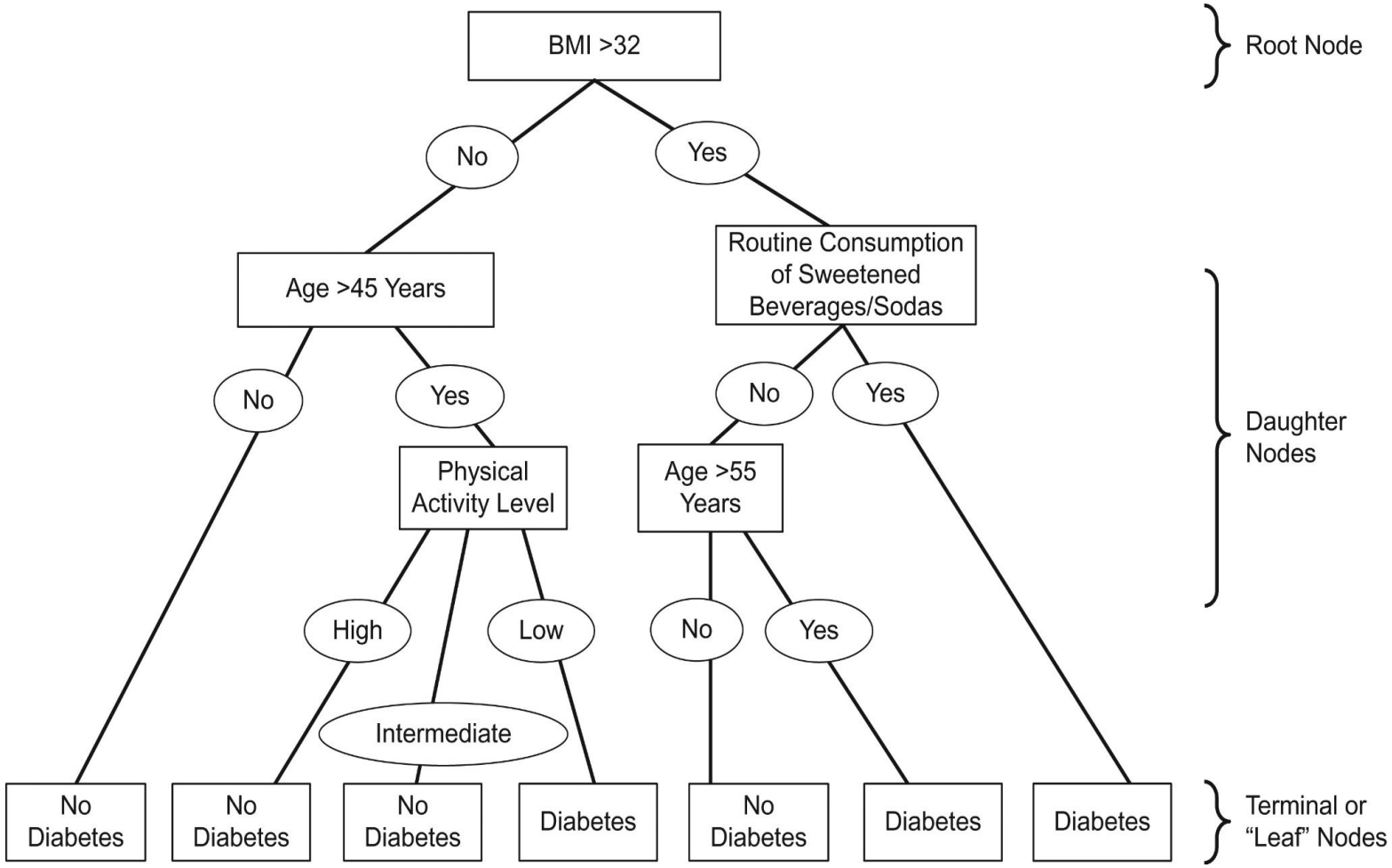
Recall: Supervised Learning

Logistic Regression: Uses a particular functional form to make predictions. (Predict probabilities using a linear combination of the predictor variables.)

But, this is not the only type of model we can use to make predictions.

A **decision tree** makes predictions by partitioning the feature space using one feature at a time.

Decision Trees



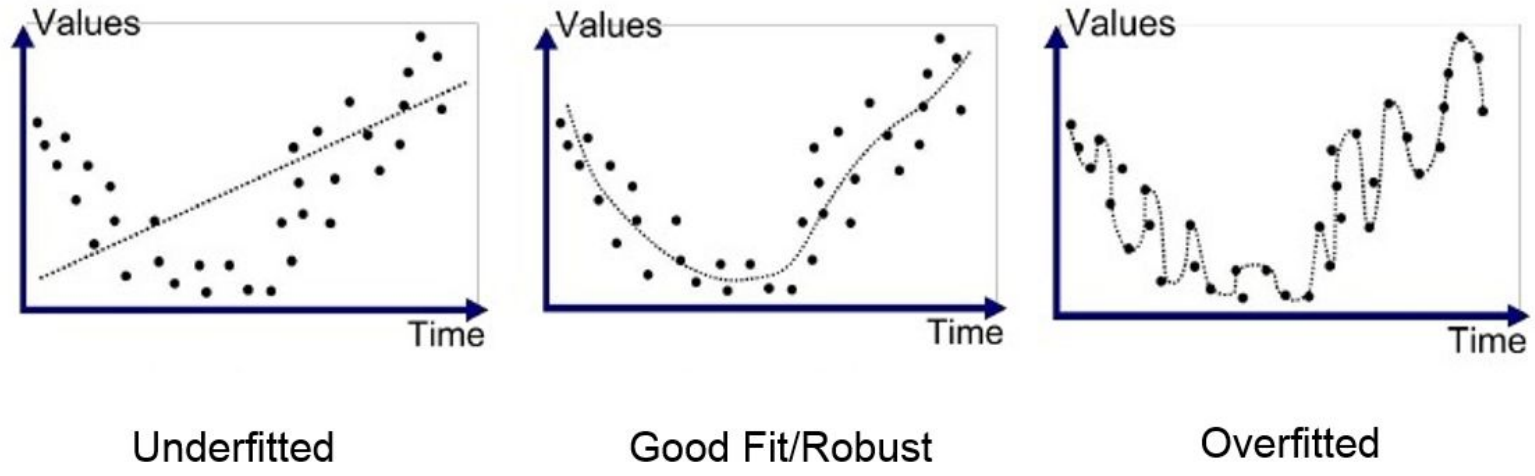
https://academic.oup.com/aje/article/188/12/2222/5567515

NASHVILLE SOFTWARE SCHOOL

Underfitting vs. Overfitting

A model is **underfit** when it does not perform well on either the training or test data.
A model is **overfit** when it performs well on training data but does not perform well on unseen data.

- Can happen when the model “memorizes” the training data or starts fitting to the “noise”
- Often the result of using too flexible of a model.



https://medium.com/greyatom/what-is-underfitting-and-overfitting-in-machine-learning-and-how-to-deal-with-it-6803a989c76

NASHVILLE SOFTWARE SCHOOL

Regularization

One method to mitigate overfitting is **regularization** - forcing your model to be simpler.

Regularization

One method to mitigate overfitting is **regularization** - forcing your model to be simpler.

For example, **ridge** and **LASSO** regression are variants of linear regression which force the model coefficients to not be too large.

$$\log \frac{p}{1-p} = \beta_0 + \beta_1 \cdot (\text{sepal length}) + \beta_2 \cdot (\text{petal length})$$

Penalize based on
how large these are

NASHVILLE SOFTWARE SCHOOL

Random Forests

Single decision trees are extremely flexible and will often not generalize well to new data.

One common way to improve this is by building multiple trees using only subsets of the training data and subsets of predictors at a time and aggregating the predictions (aka creating an **ensemble**).

Random Forests

Single decision trees are extremely flexible and will often not generalize well to new data.

One common way to improve this is by building multiple trees using only subsets of the training data and subsets of predictors at a time and aggregating the predictions (aka creating an **ensemble**).

Random Forest models create a large number of decision trees, each trained on a subset of the training data and a subset of the features in order to decorrelate and reduce the variance of predictions.

To make the final prediction, the predictions from each tree are averaged.

Questions?