Section 2 Wrap-Up

Codestates AIB
JHLEE

Sprint 1 Linear Models

Supervised learning

Regression

Regularization(Ridge, Lasso)

Classification

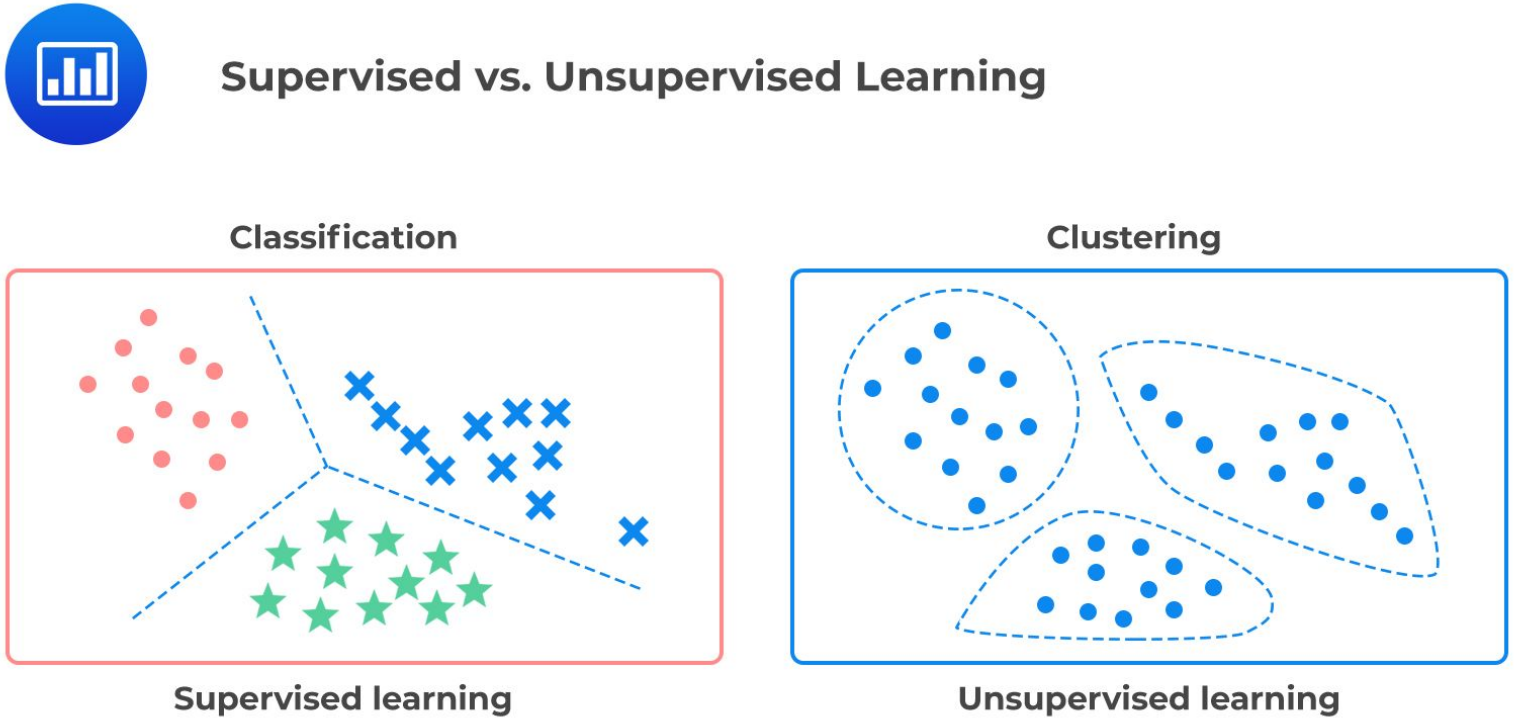
Baseline model

One-hot encoding

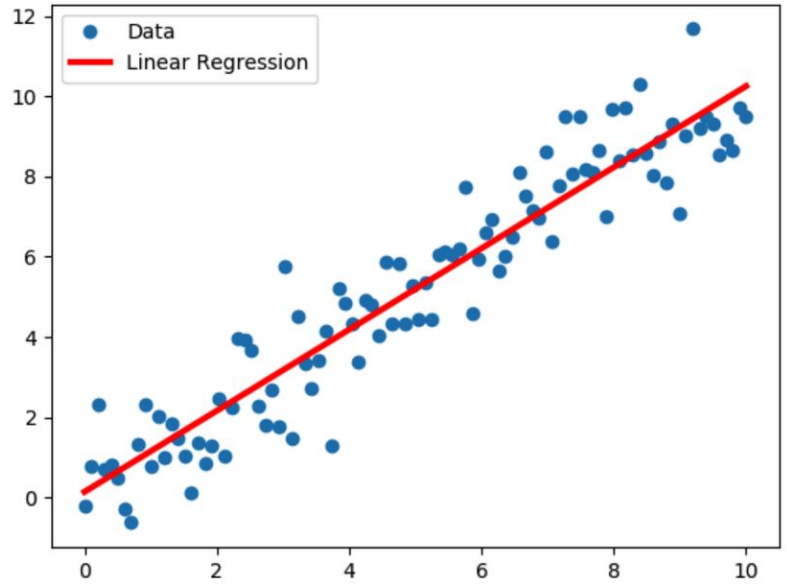
Train/Validation/Test sets

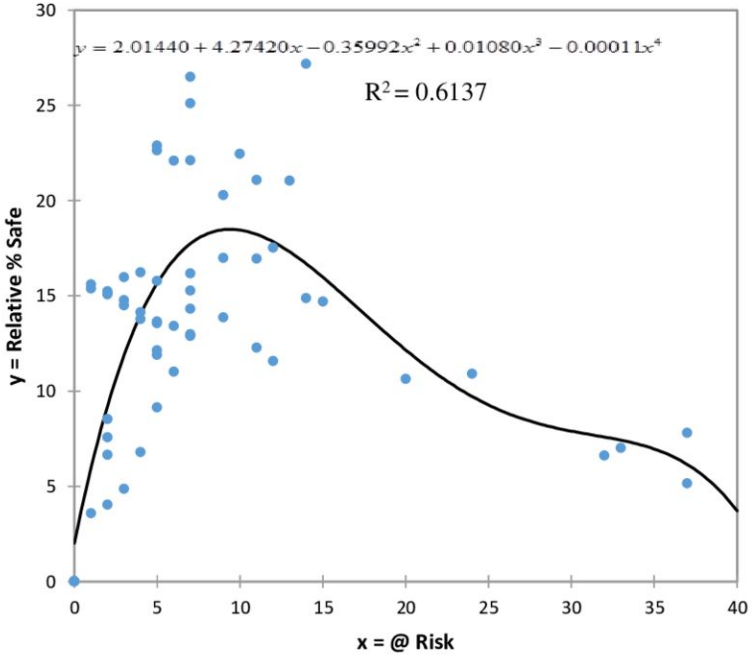
Overfitting/Underfitting

Supervised Learning

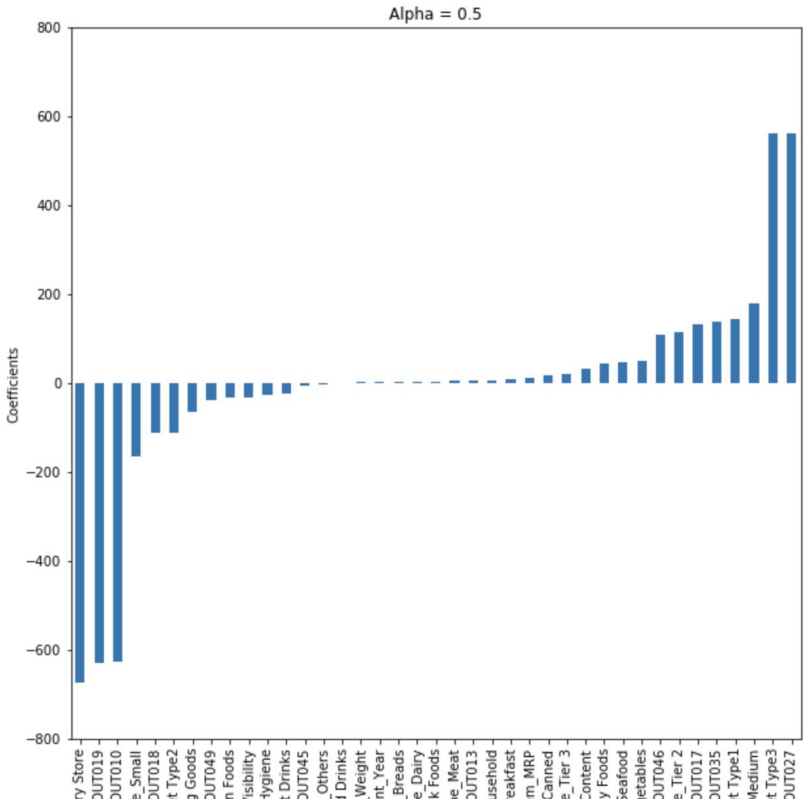


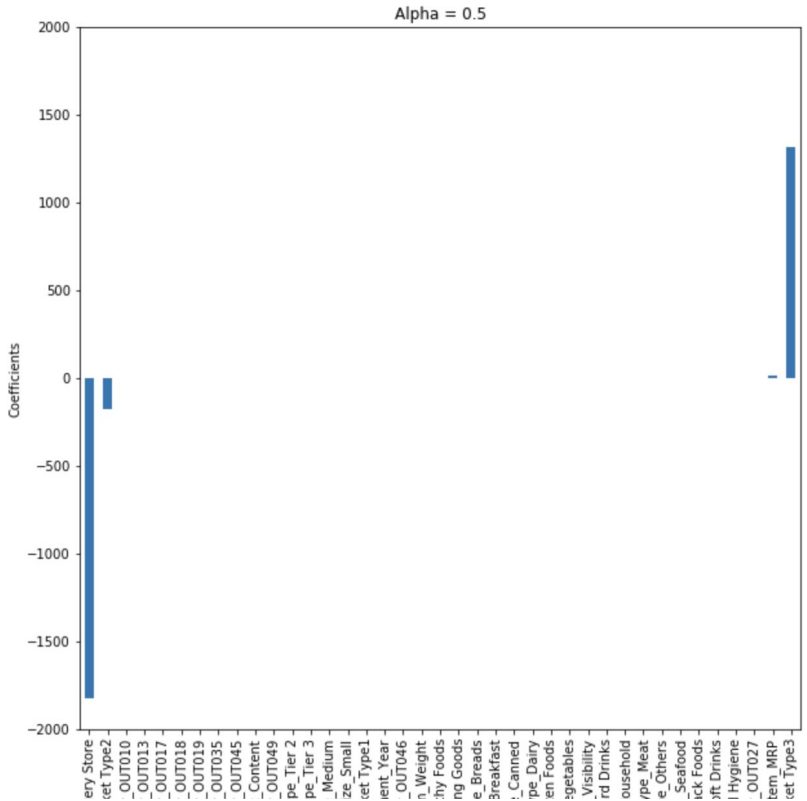
Regression


Data
Linear Regression
0
2
4
6
8
10
12

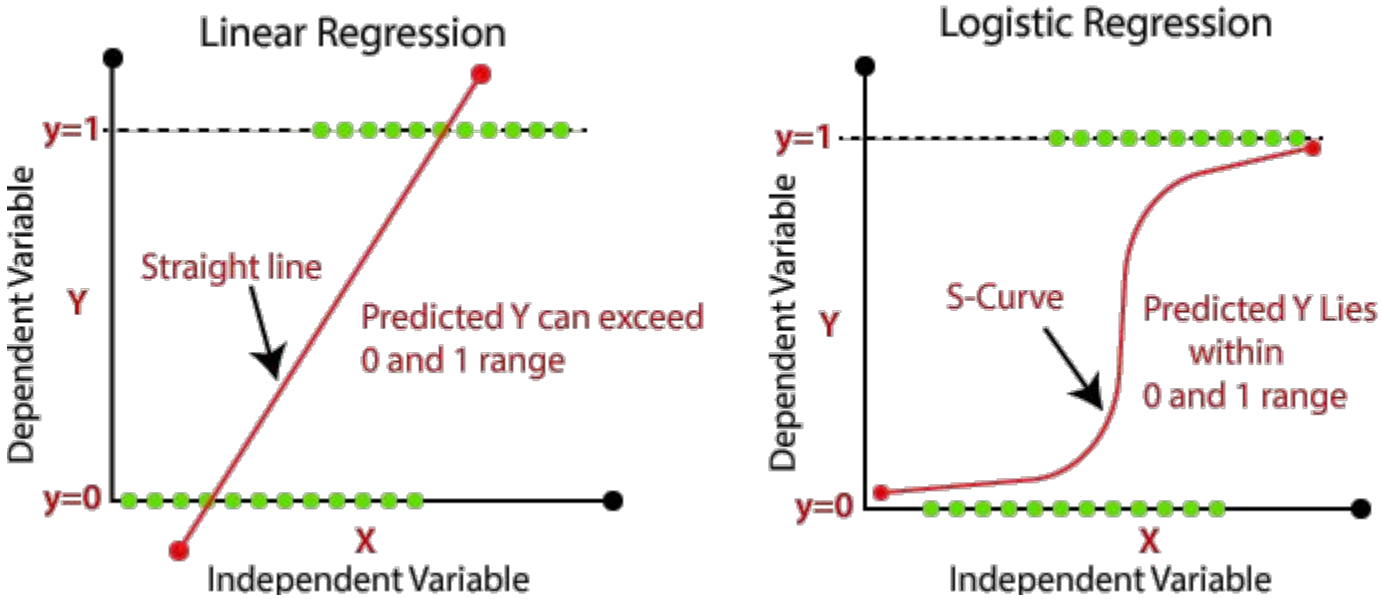

$y = 2.01440 + 4.27420x - 0.35992x^2 + 0.01080x^3 - 0.00011x^4$
$R^2 = 0.6137$
y = Relative % Safe
x = @ Risk
0
5
10
15
20
25
30
35
40

Regularization(Ridge, Lasso)

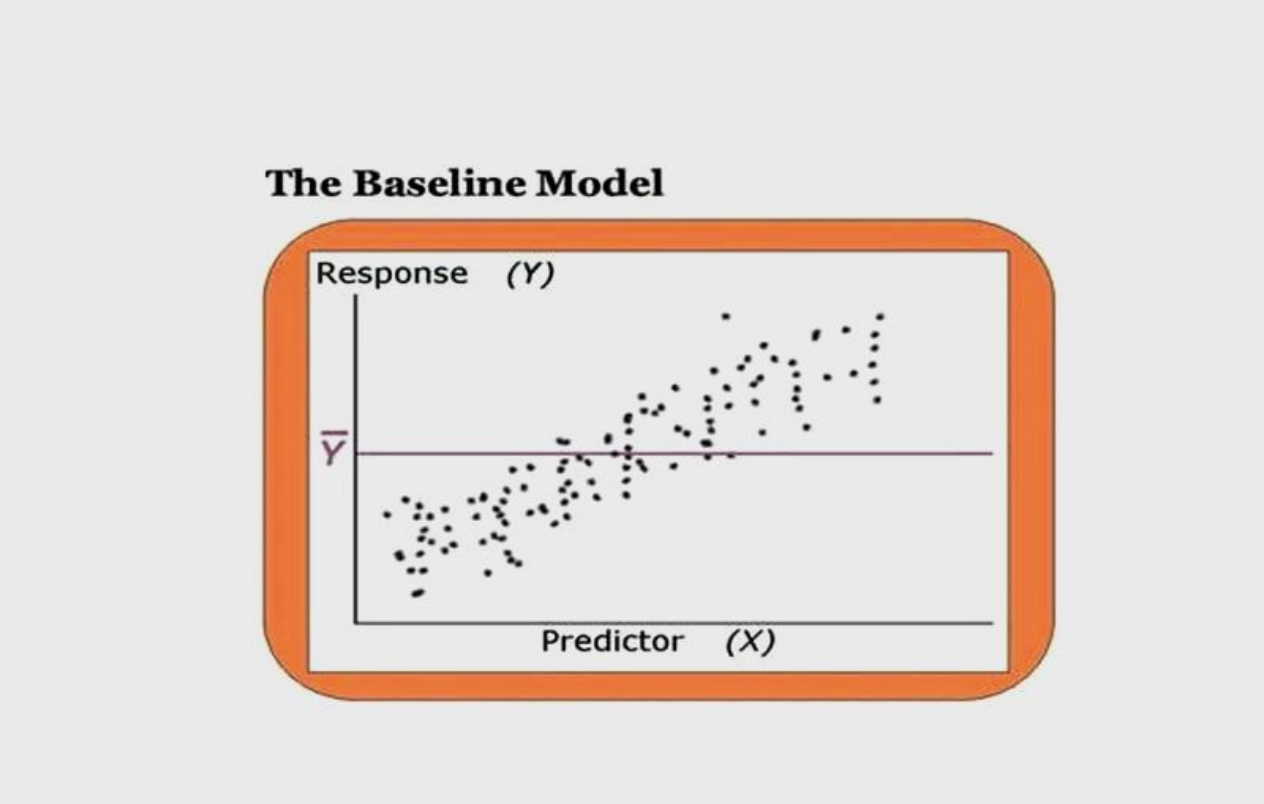




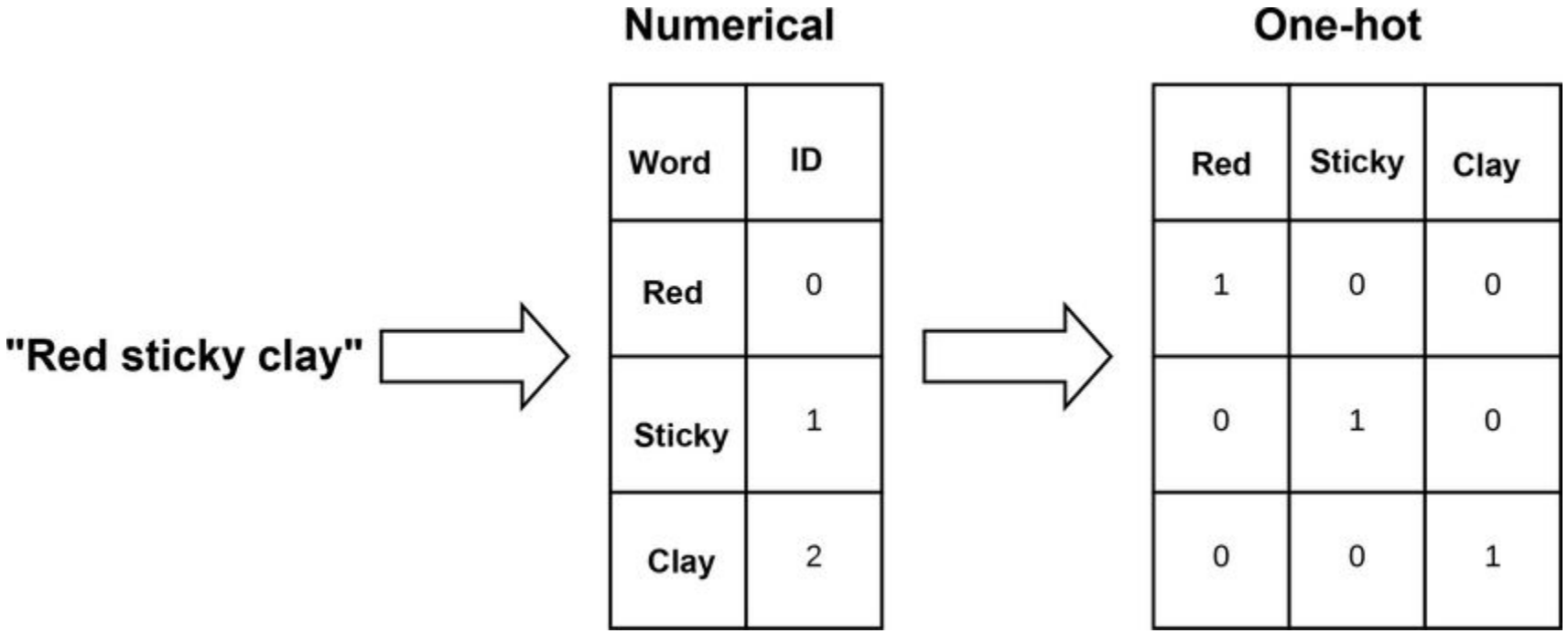
Classification



Baseline model

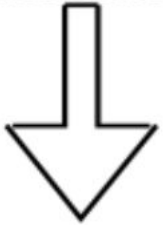


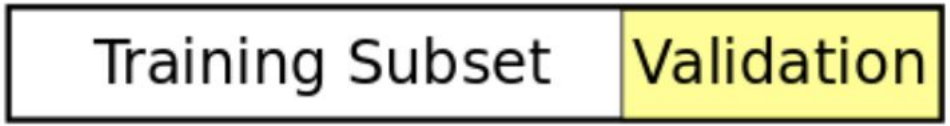
One-hot encoding



Train/Validation/Test sets

Get Test set errorr

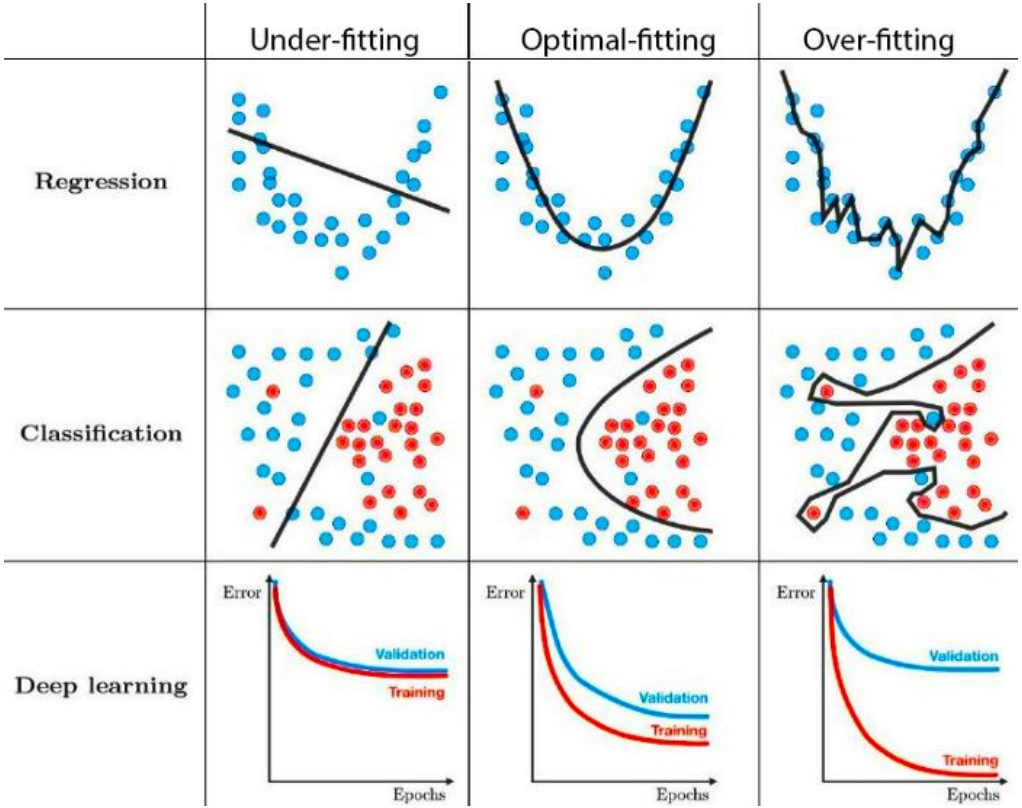




CV Loop

Tune hyperparameters

Overfitting/Underfitting



Sprint 2 Tree Based Models

Decision tree

Sklearn pipeline

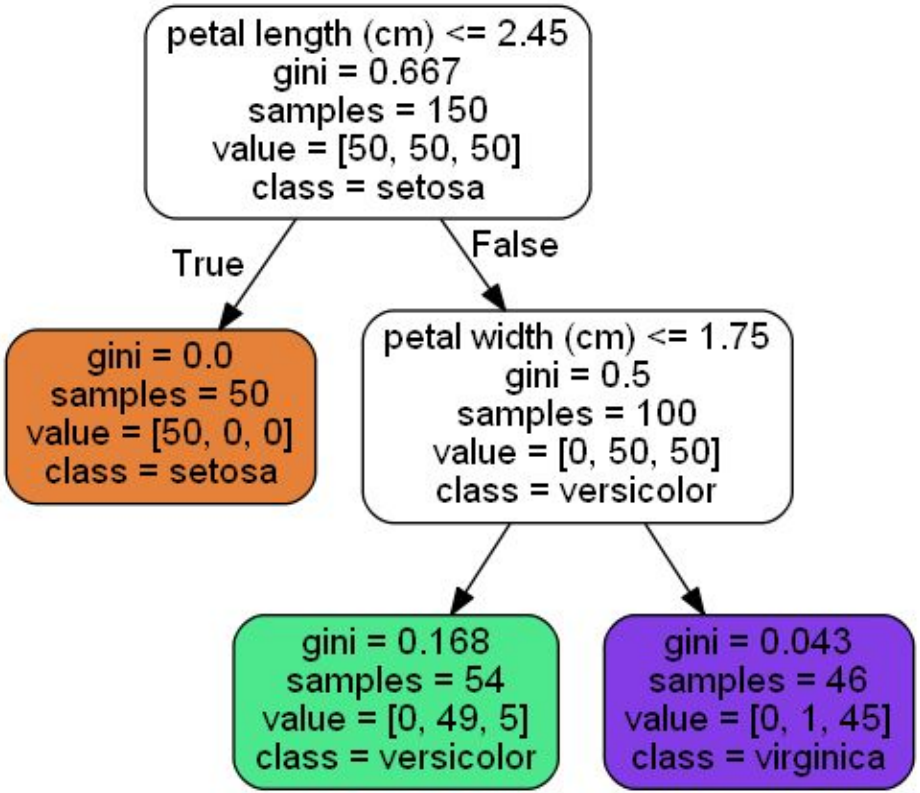
Ensemble(Random forests)

Classification metrics(Accuracy, Precision, Recall, F1, ROC, AUC)

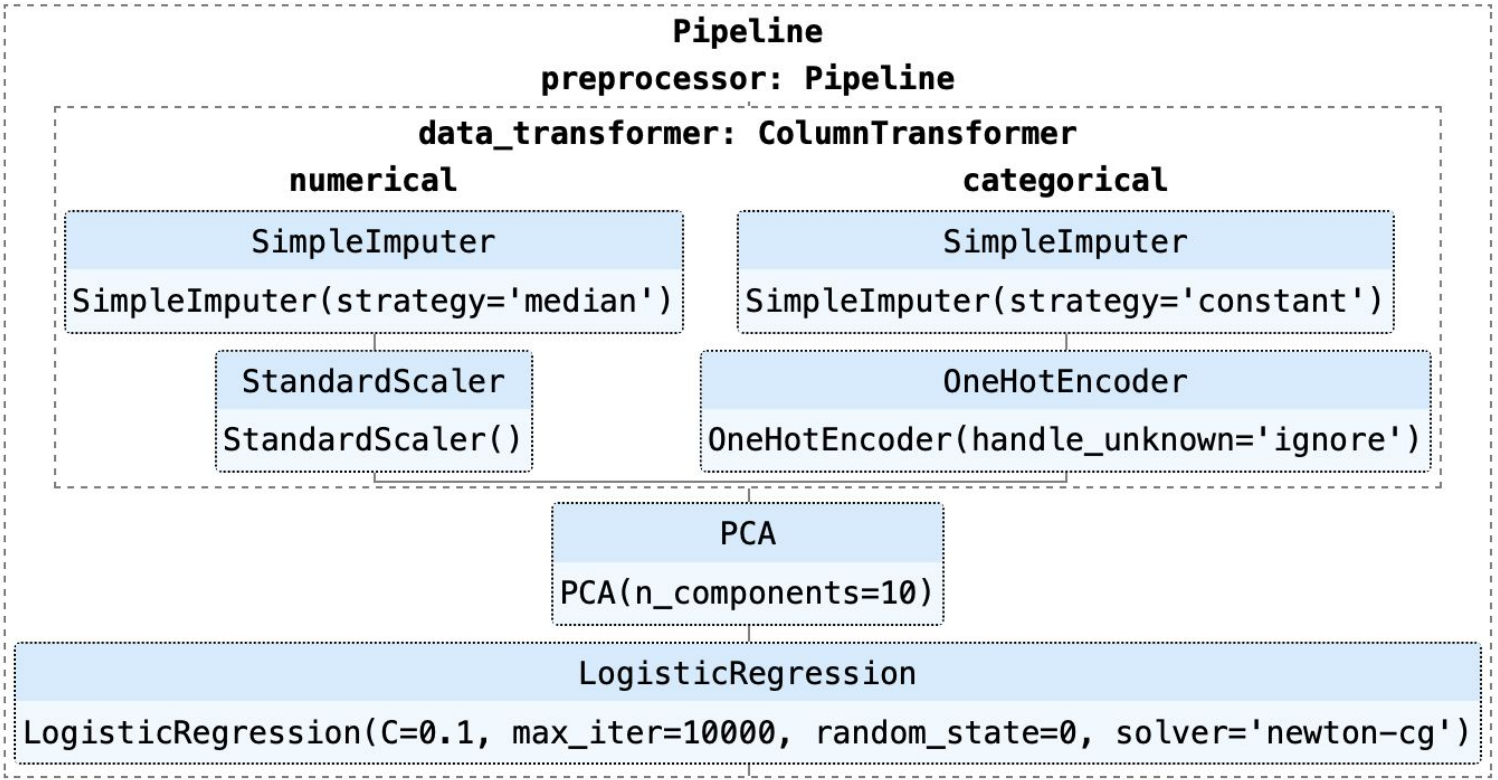
Cross-validation

Hyperparameter tuning

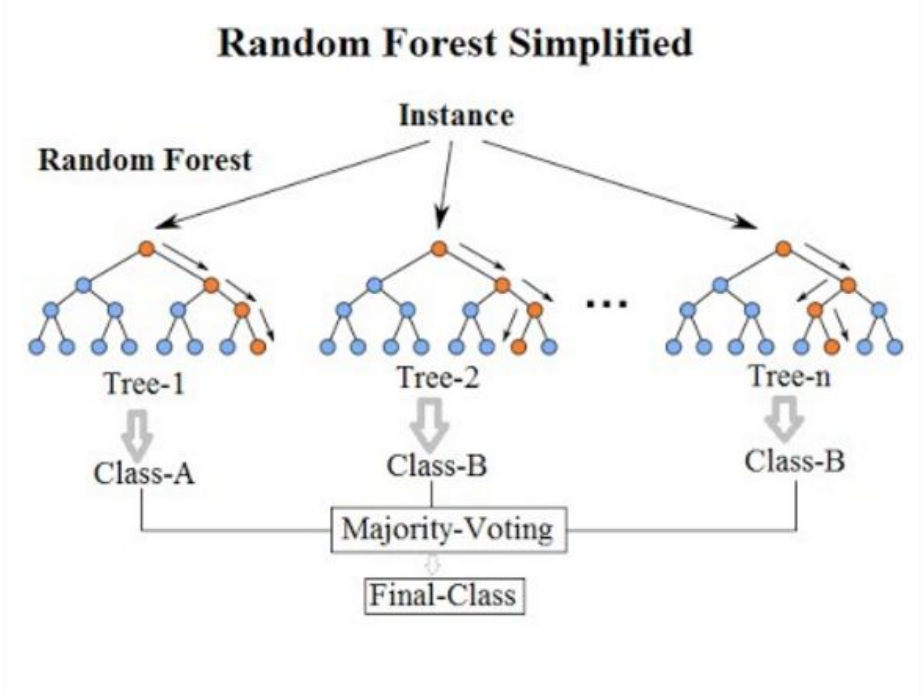
Decision tree

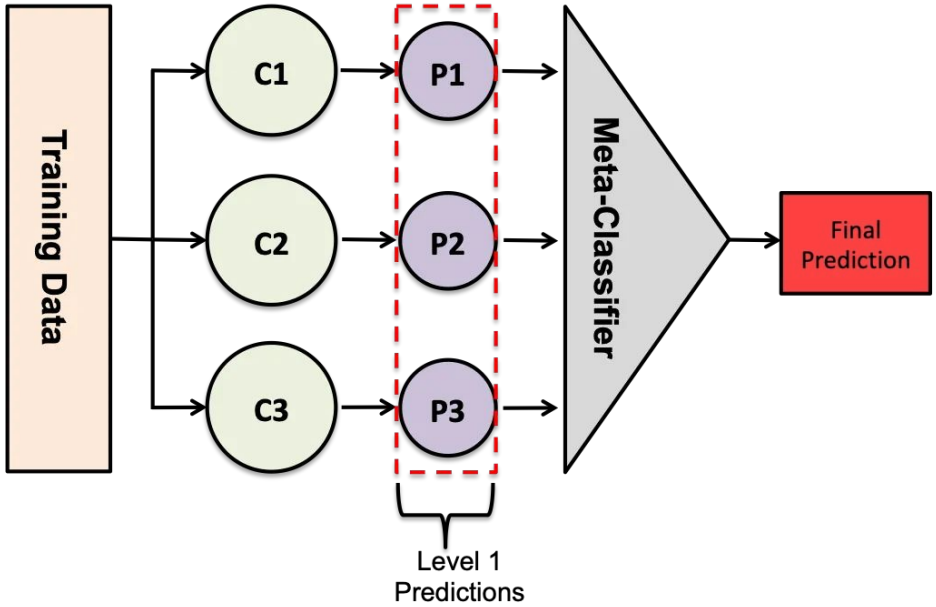


Sklearn pipeline



Ensemble(Random forests, stacked ensemble)





* C1, C2, and C3 are considered level 1 classifiers.

Classification metrics(Accuracy, Precision, Recall, F1, ROC, AUC)

		Predicted condition			
	Total population = P + N	Predicted condition **positive** (PP)	Predicted condition **negative** (PN)	Informedness, bookmaker informedness (BM) = TPR + TNR − 1	Prevalence threshold (PT) = $\frac{\sqrt{TPR \cdot FPR} - FPR}{TPR - FPR}$
Actual condition	Actual condition positive (P)	**True positive (TP),** **hit**	**False negative (FN),** **Type II error,** **miss, underestimation**	True positive rate (TPR), recall, sensitivity (SEN), probability of detection, hit rate, power = $\frac{TP}{P}$ = 1−FNR	False negative rate (FNR), miss rate = $\frac{FN}{P}$ = 1−TPR
	Actual condition negative (N)	**False positive (FP),** **Type I error,** **false alarm, overestimation**	**True negative (TN),** **correct rejection**	False positive rate (FPR), probability of false alarm, fall-out = $\frac{FP}{N}$ = 1−TNR	True negative rate (TNR), specificity (SPC), selectivity = $\frac{TN}{N}$ = 1−FPR
	Prevalence = $\frac{P}{P+N}$	Positive predictive value (PPV), precision = $\frac{TP}{PP}$ = 1−FDR	False omission rate (FOR) = $\frac{FN}{PN}$ = 1−NPV	Positive likelihood ratio (LR+) = $\frac{TPR}{FPR}$	Negative likelihood ratio (LR−) = $\frac{FNR}{TNR}$
	Accuracy (ACC) = $\frac{TP+TN}{P+N}$	False discovery rate (FDR) = $\frac{FP}{PP}$ = 1−PPV	Negative predictive value (NPV) = $\frac{TN}{PN}$ = 1−FOR	Markedness (MK), deltaP (Δp) = PPV + NPV − 1	Diagnostic odds ratio (DOR) = $\frac{LR+}{LR-}$
	Balanced accuracy (BA) = $\frac{TPR+TNR}{2}$	F_1 score = $\frac{2 \cdot PPV \cdot TPR}{PPV+TPR}$ = $\frac{2TP}{2TP+FP+FN}$	Fowlkes–Mallows index (FM) = $\sqrt{PPV \cdot TPR}$	Matthews correlation coefficient (MCC) = $\sqrt{TPR \cdot TNR \cdot PPV \cdot NPV} - \sqrt{FNR \cdot FPR \cdot FOR \cdot FDR}$	Threat score (TS), critical success index (CSI) = $\frac{TP}{TP+FN+FP}$

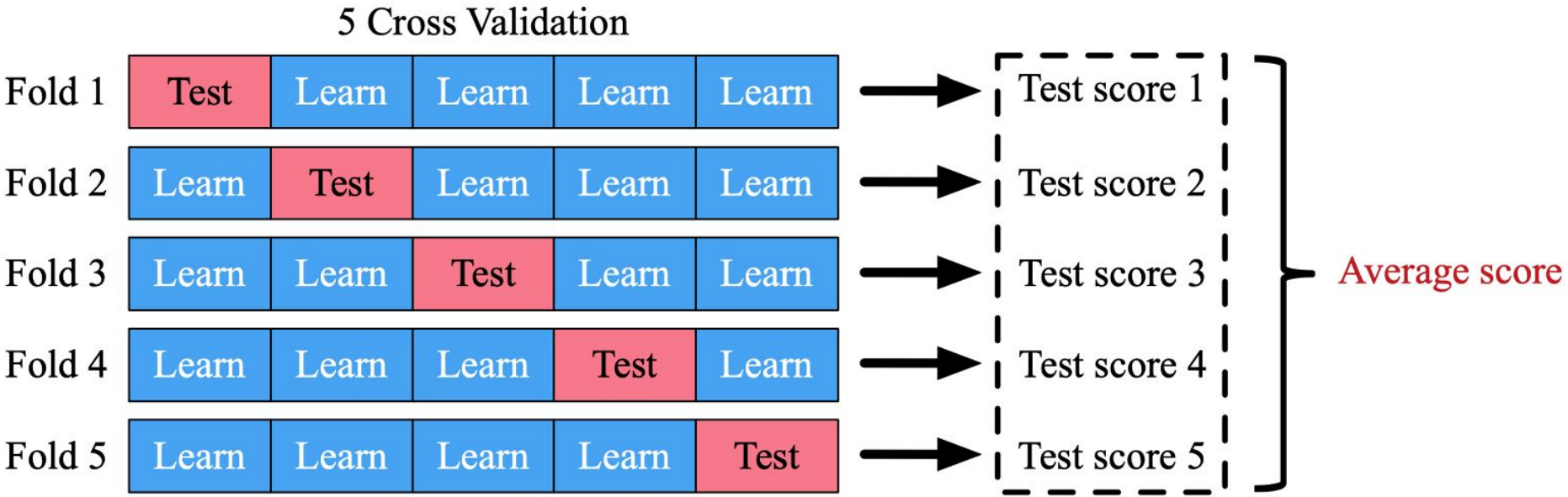
Sources: [5][6][7][8][9][10][11][12]

view · talk · edit

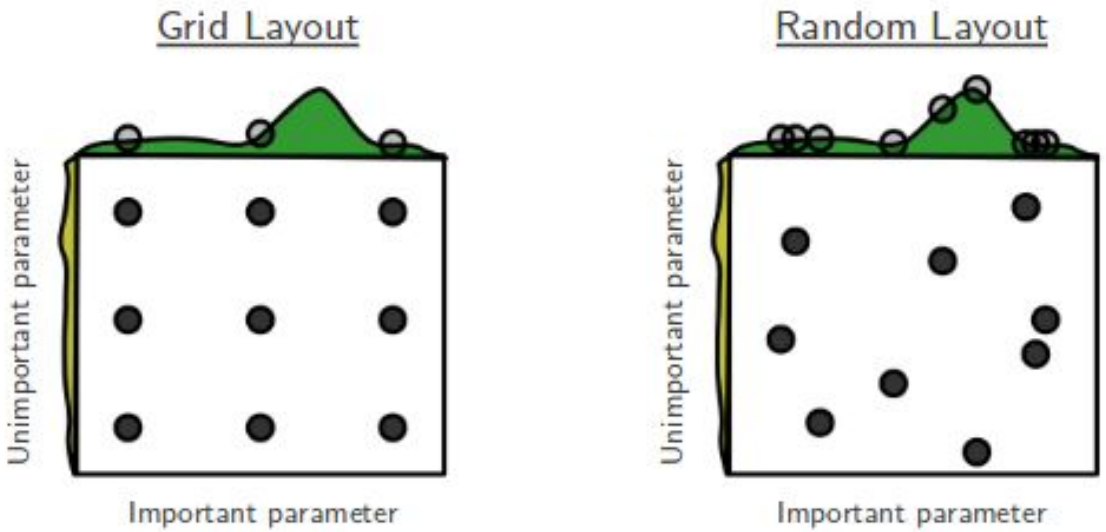
Accuracy, Precision, Recall, F1-score, ROC, AUC, ...

MAE, MSE, RMSE, R2, RMSLE, MPE, MAPE

Cross-validation



Hyperparameter tuning



Sprint 3 Applied Predictive Modeling

Data science workflow

Leakage

Imbalanced data

Data wrangling

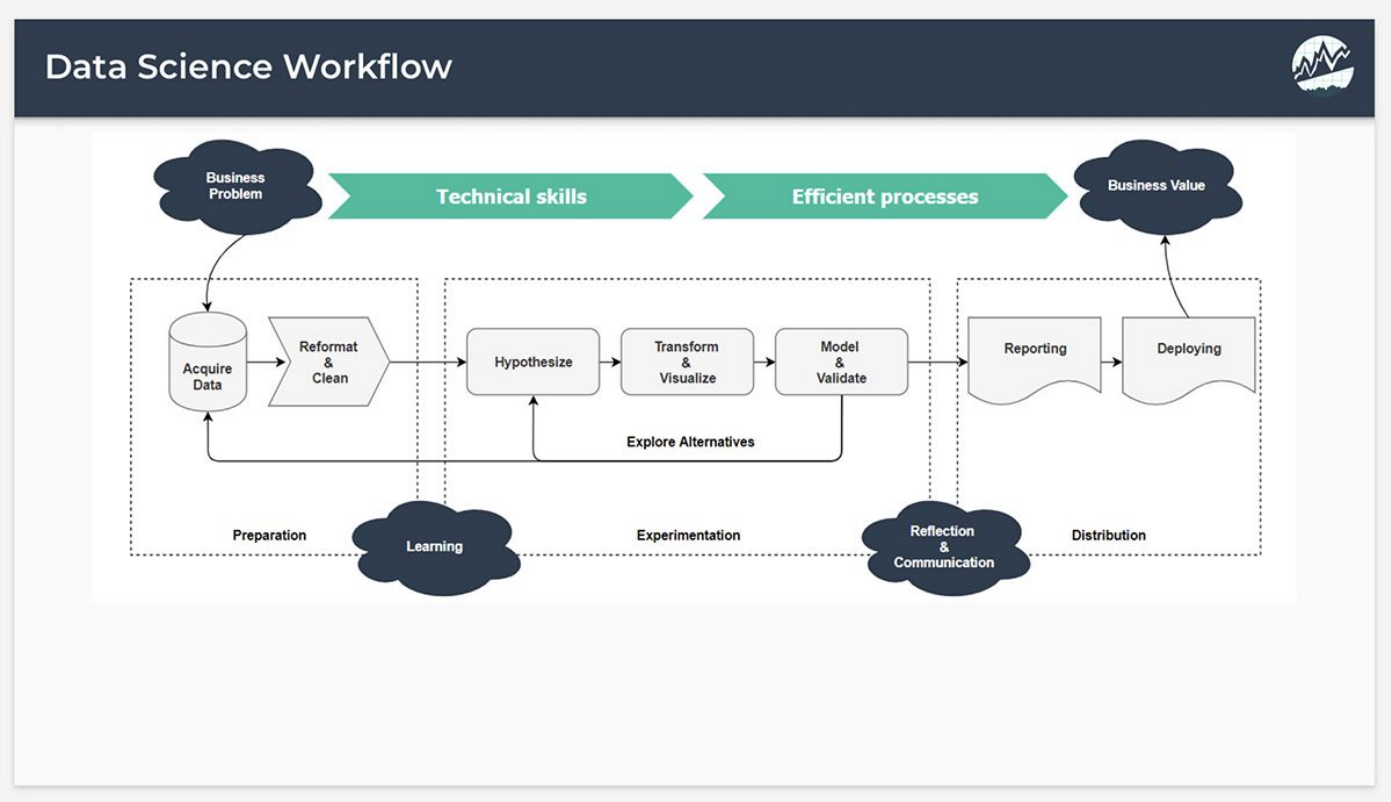
Boosting models

Feature importances

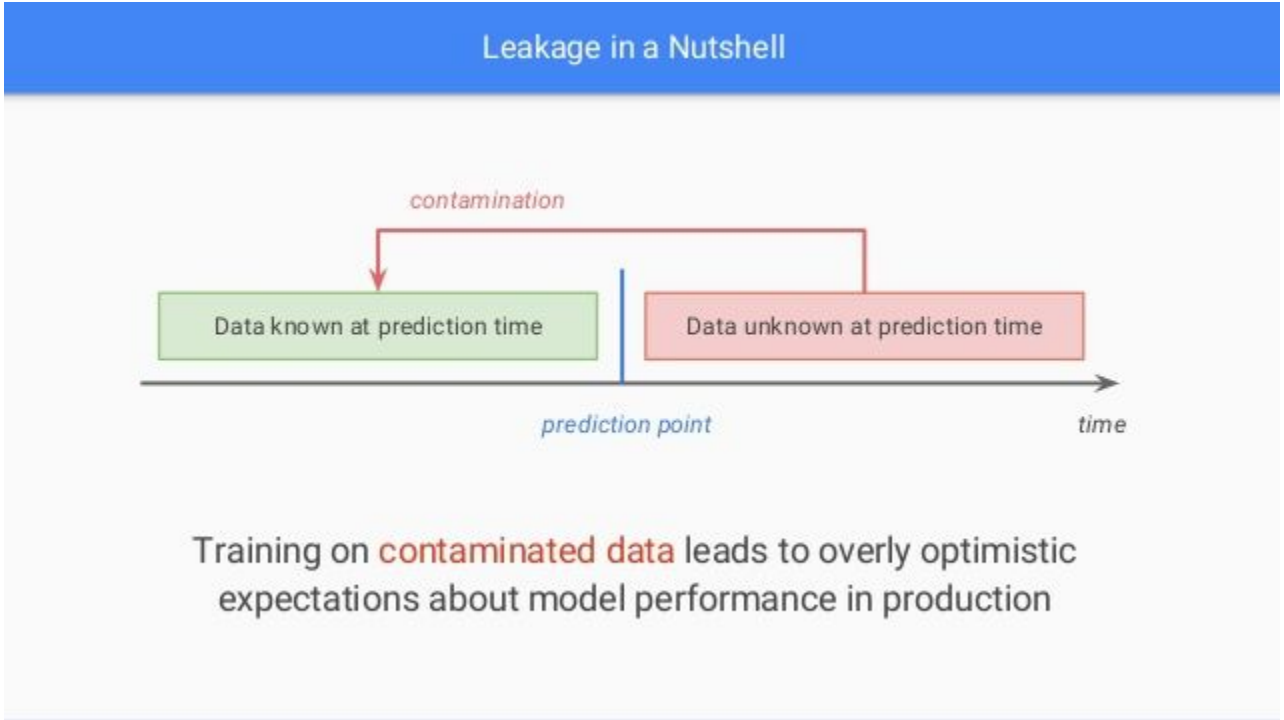
PDP

SHAP

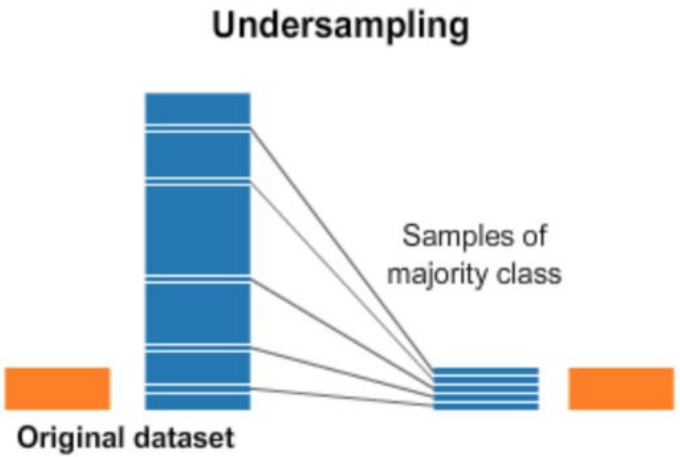
Data science workflow

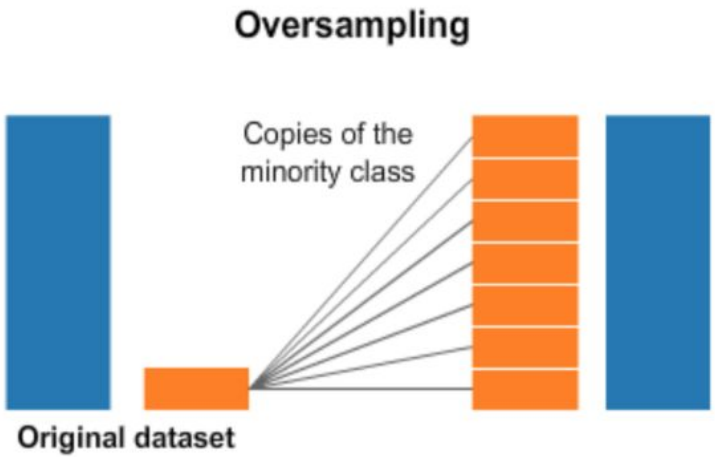


Leakage


Leakage in a Nutshell
contamination
Data known at prediction time
Data unknown at prediction time
prediction point
time
Training on contaminated data leads to overly optimistic
expectations about model performance in production

Imbalanced data





Data wrangling

Data Wrangling with dplyr and tidyr Cheat Sheet

RStudio

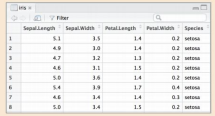
Syntax - Helpful conventions for wrangling

dplyr::tbl_df(iris)
Converts data to tbl class. tbl's are easier to examine than data frames. R displays only the data that fits onscreen:

```
Source: local data frame [150 x 5]

   Sepal.Length Sepal.Width Petal.Length
1           5.1         3.5          1.4
2           4.9         3.0          1.4
3           4.7         3.2          1.3
4           4.6         3.1          1.5
5           5.0         3.6          1.4
..          ...         ...          ...
Variables not shown: Petal.Width (dbl),
  Species (fctr)
```

dplyr::glimpse(iris)
Information dense summary of tbl data.
utils::View(iris)
View data set in spreadsheet-like display (note capital V).



dplyr::%>%
Passes object on left hand side as first argument (or . argument) of function on righthand side.

`x %>% f(y)` *is the same as* `f(x, y)`
`y %>% f(x, ., z)` *is the same as* `f(x, y, z )`

"Piping" with %>% makes code more readable, e.g.

```
iris %>%
  group_by(Species) %>%
  summarise(avg = mean(Sepal.Width)) %>%
  arrange(avg)
```

Tidy Data - A foundation for wrangling in R

In a tidy data set:

Each **variable** is saved in its own **column**

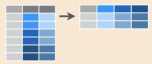
&

Each **observation** is saved in its own **row**

Tidy data complements R's **vectorized operations**. R will automatically preserve observations as you manipulate variables. No other format works as intuitively with R.

Reshaping Data - Change the layout of a data set

tidyr::gather(cases, "year", "n", 2:4)
Gather columns into rows.



tidyr::spread(pollution, size, amount)
Spread rows into columns.

tidyr::separate(storms, date, c("y", "m", "d"))
Separate one column into several.

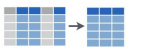
tidyr::unite(data, col, ..., sep)
Unite several columns into one.

dplyr::data_frame(a = 1:3, b = 4
Combine vectors into data fram (optimized).
dplyr::arrange(mtcars, mpg)
Order rows by values of a colun (low to high).
dplyr::arrange(mtcars, desc(mp
Order rows by values of a colun (high to low).
dplyr::rename(tb, y = year)
Rename the columns of a data frame.

Subset Observations (Rows)

dplyr::filter(iris, Sepal.Length > 7)
Extract rows that meet logical criteria.
dplyr::distinct(iris)
Remove duplicate rows.
dplyr::sample_frac(iris, 0.5, replace = TRUE)
Randomly select fraction of rows.
dplyr::sample_n(iris, 10, replace = TRUE)
Randomly select n rows.
dplyr::slice(iris, 10:15)
Select rows by position.
dplyr::top_n(storms, 2, date)
Select and order top n entries (by group if grouped data).

Subset Variables (Columns)



dplyr::select(iris, Sepal.Width, Petal.Length, Species
Select columns by name or helper function.

Helper functions for select - ?select

select(iris, contains("."))
Select columns whose name contains a character string.
select(iris, ends_with("Length"))
Select columns whose name ends with a character string.
select(iris, everything())
Select every column.
select(iris, matches(".t."))
Select columns whose name matches a regular expression.
select(iris, num_range("x", 1:5))
Select columns named x1, x2, x3, x4, x5.
select(iris, one_of(c("Species", "Genus")))
Select columns whose names are in a group of names.
select(iris, starts_with("Sepal"))
Select columns whose name starts with a character string.
select(iris, Sepal.Length:Petal.Width)
Select all columns between Sepal.Length and Petal.Width (inclusive
select(iris, -Species)
Select all columns except Species.

Logic in R - ?Comparison, ?base::Logic

<	Less than	!=	Not equal to
>	Greater than	%in%	Group membership
==	Equal to	is.na	is NA
<=	Less than or equal to	!is.na	is not NA
>=	Greater than or equal to	&, |, !, xor, any, all	Boolean operators

Summarise Data

dplyr::summarise(iris, avg = mean(Sepal.Length))
Summarise data into single row of values.
dplyr::summarise_each(iris, funs(mean))
Apply summary function to each column.
dplyr::count(iris, Species, wt = Sepal.Length)
Count number of rows with each unique value of variable (with or without weights).

Summarise uses **summary functions**, functions that take a vector of values and return a single value, such as:

dplyr::first
First value of a vector.
dplyr::last
Last value of a vector.
dplyr::nth
Nth value of a vector.
dplyr::n
# of values in a vector.
dplyr::n_distinct
# of distinct values in a vector.
IQR
IQR of a vector.
min
Minimum value in a vector.
max
Maximum value in a vector.
mean
Mean value of a vector.
median
Median value of a vector.
var
Variance of a vector.
sd
Standard deviation of a vector.

Group Data

dplyr::group_by(iris, Species)
Group data into rows with the same value of Species.
dplyr::ungroup(iris)
Remove grouping information from data frame.

iris %>% group_by(Species) %>% summarise(...)
Compute separate summary row for each group.

Make New Variables

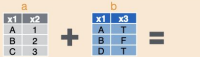
dplyr::mutate(iris, sepal = Sepal.Length + Sepal. Width)
Compute and append one or more new columns.
dplyr::mutate_each(iris, funs(min_rank))
Apply window function to each column.
dplyr::transmute(iris, sepal = Sepal.Length + Sepal. Width)
Compute one or more new columns. Drop original columns.

Mutate uses **window functions**, functions that take a vector of values and return another vector of values, such as:

dplyr::lead
Copy with values shifted by 1.
dplyr::lag
Copy with values lagged by 1.
dplyr::dense_rank
Ranks with no gaps.
dplyr::min_rank
Ranks. Ties get min rank.
dplyr::percent_rank
Ranks rescaled to [0, 1].
dplyr::row_number
Ranks. Ties got to first value.
dplyr::ntile
Bin vector into n buckets.
dplyr::between
Are values between a and b?
dplyr::cume_dist
Cumulative distribution.
dplyr::cumall
Cumulative all
dplyr::cumany
Cumulative any
dplyr::cummean
Cumulative mean
cumsum
Cumulative sum
cummax
Cumulative max
cummin
Cumulative min
cumprod
Cumulative prod
pmax
Element-wise max
pmin
Element-wise min

iris %>% group_by(Species) %>% mutate(...)
Compute new variables by group.

Combine Data Sets



Mutating Joins

dplyr::left_join(a, b, by = "x1")
Join matching rows from b to a.

dplyr::right_join(a, b, by = "x1")
Join matching rows from a to b.

dplyr::inner_join(a, b, by = "x1")
Join data. Retain only rows in both sets.

dplyr::full_join(a, b, by = "x1")
Join data. Retain all values, all rows.

Filtering Joins

dplyr::semi_join(a, b, by = "x1")
All rows in a that have a match in b.

dplyr::anti_join(a, b, by = "x1")
All rows in a that do not have a match in b.

Set Operations

dplyr::intersect(y, z)
Rows that appear in both y and z.

dplyr::union(y, z)
Rows that appear in either or both y and z.

dplyr::setdiff(y, z)
Rows that appear in y but not z.

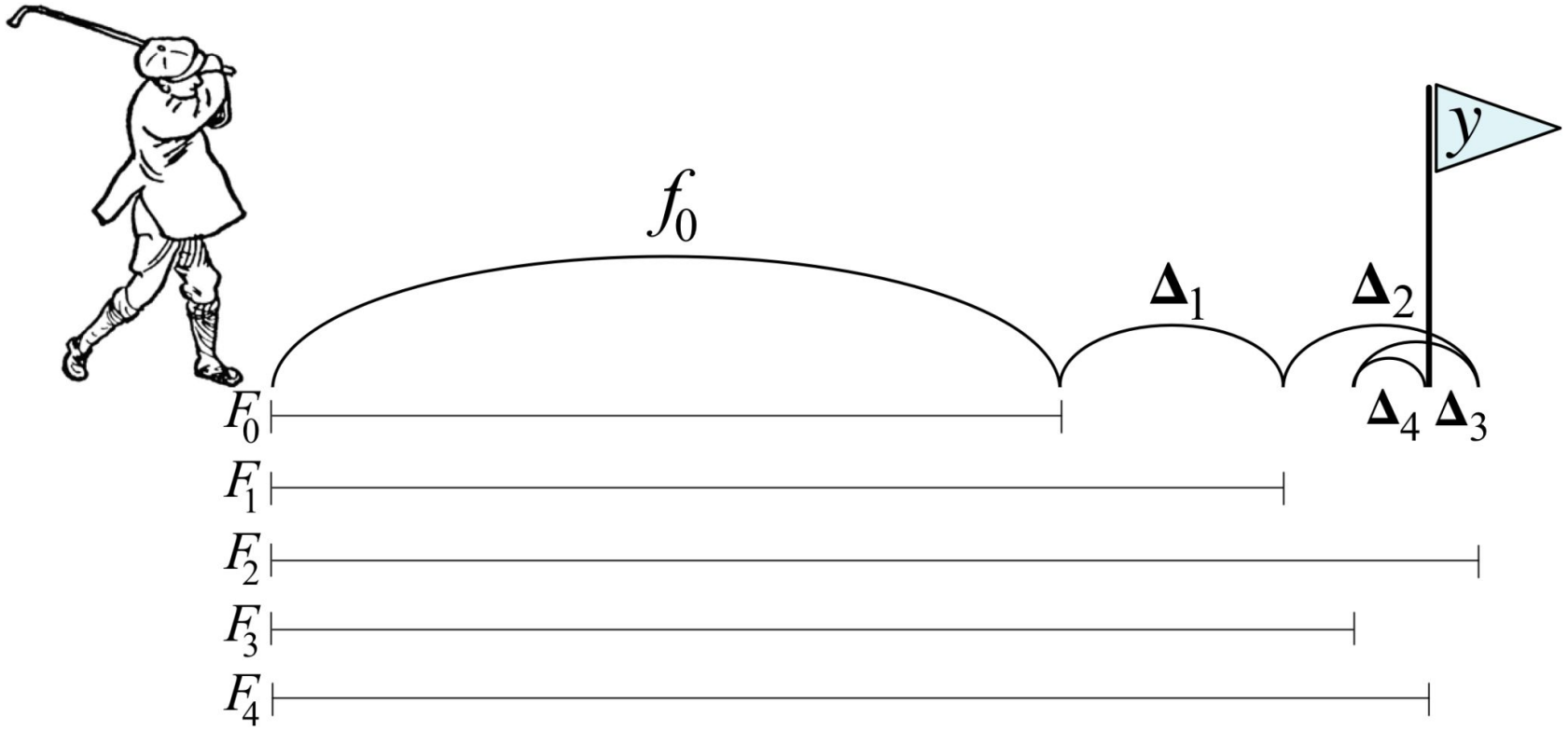
Binding

dplyr::bind_rows(y, z)
Append z to y as new rows.

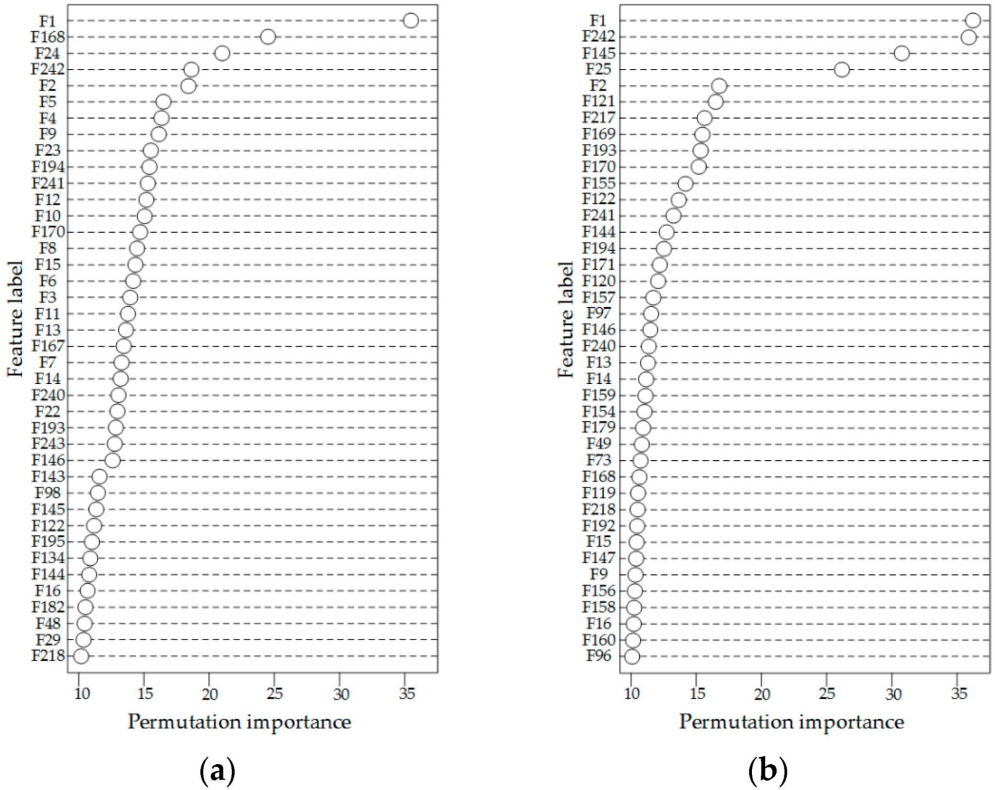
dplyr::bind_cols(y, z)
Append z to y as new columns. Caution: matches rows by position.

devtools::install_github("rstudio/EDAWR") for data sets
Learn more with browseVignettes(package = c("dplyr", "tidyr")) • dplyr 0.4.0• tidyr 0.2.0 • Updated: 1/15

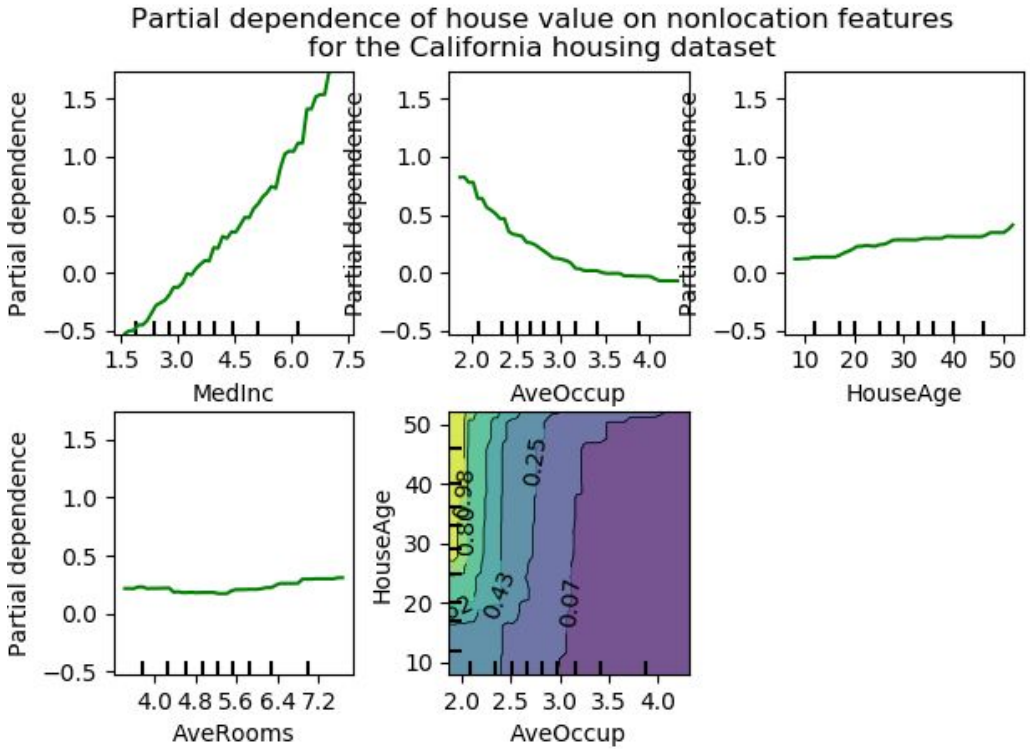
Boosting model



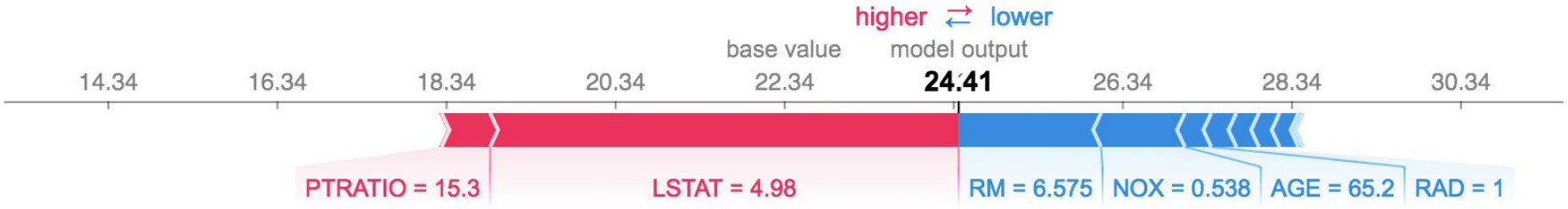
Feature importances

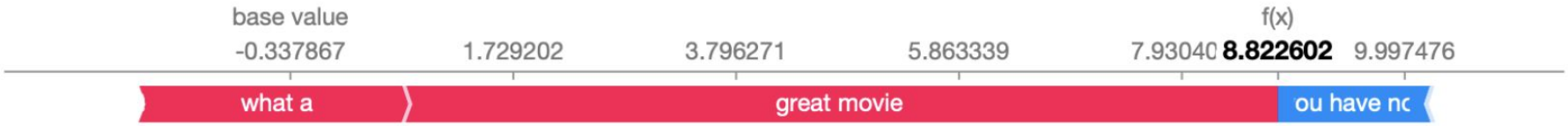


PDP


Partial dependence of house value on nonlocation features
for the California housing dataset
Partial dependence
MedInc
AveOccup
HouseAge
AveRooms
HouseAge
AveOccup
0.98
0.80
0.43
0.25
0.07

SHAP





what a great movie ! . . . if you have no taste .

Deep Learning

Image recognition

Natural language processing

Speech recognition

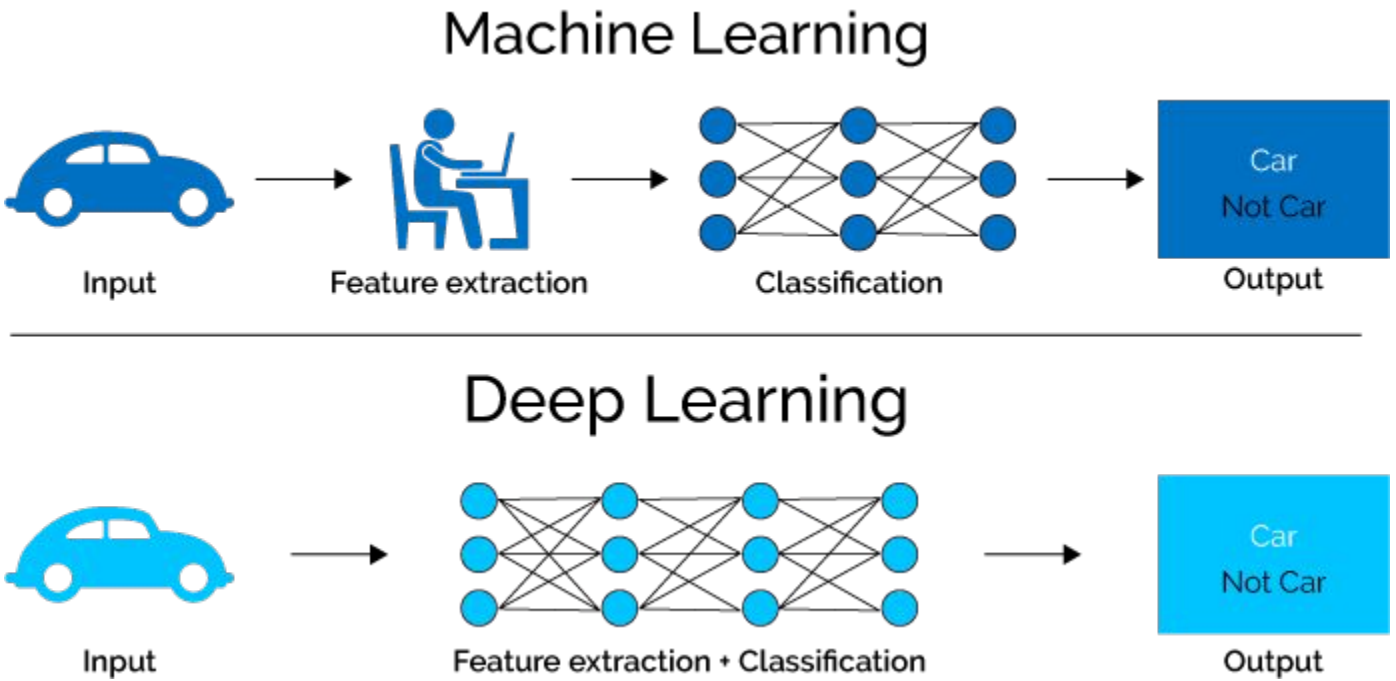
Transfer learning

Semi-Supervised learning

Unsupervised learning, Generative model(GAN, VAE)

....

Machine learning vs Deep learning



Machine learning algorithms