Star MEDIA GROUP

Introduction to Python and Machine Learning

31st July 2019

Koh Wyhow

Agenda

- Introduction to Python
- Data visualization using seaborn

  Creating statistical plots easily with seaborn
- Hypothesis testing: z-test

  Getting started with statistical hypothesis testing – a simple z-test
- Correlation: Contingency table & chi-square test

  Estimating the correlation between two variables with a contingency table and a chi-square test
- Predictive analytics: Logistic regression

  Logistic regression using Python
- Predictive analytics: Natural Language Processing

  Learning from text from Naïve Bayes for NLP
- Predictive analytics: GCP AutoML

  Introduction to Google Cloud Platform's AutoML
- Recommendations

About me:

- Koh Wyhow (not SIR – I have a name =P)
- Manager, Data Science @ Star Media Group
- Formerly:
  - *Data Scientist @ INVOKE Malaysia*
  - *Consultant @ EY Data and Analytics*
  - *Further Mathematics lecturer @ Taylor's College*
- Majored in Mathematics @ National University of Singapore, 2013

About you:

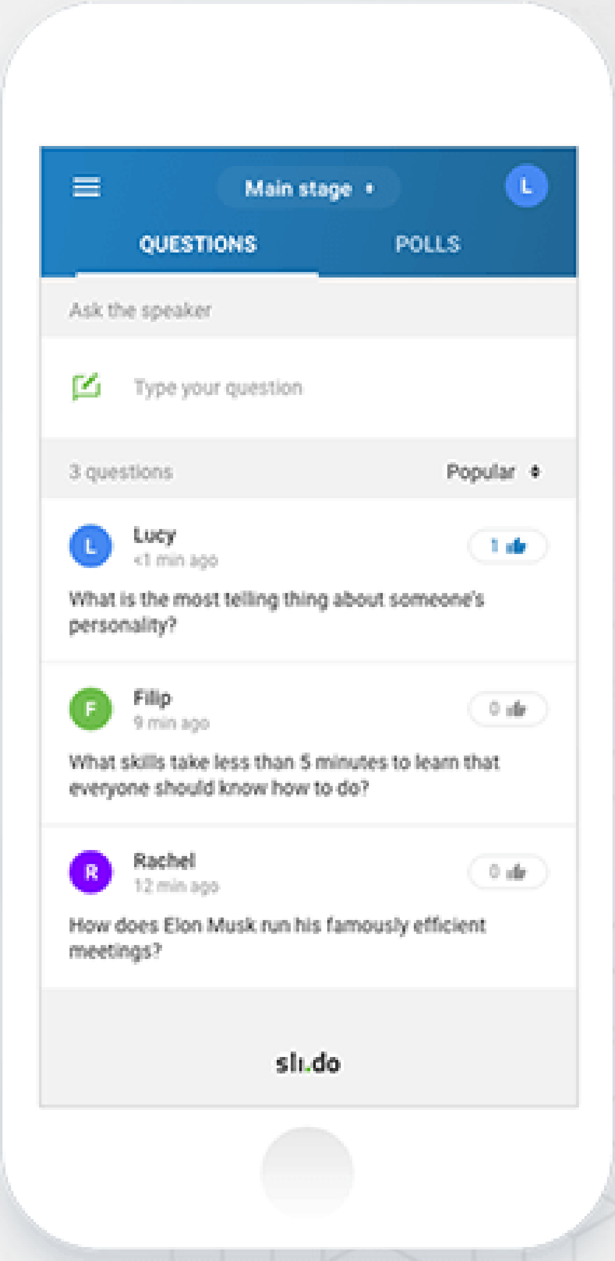
- https://padlet.com/kohwyhow/python20190731
  - *What's your name?*
  - *What do you do?*
  - *What's your email?*
  - *How do you plan to use Python?*

Introduction to Python and Machine Learning

For geeks, by geeks

Questions:

- www.sli.do code: #T458



Lucy
<1 min ago
1
What is the most telling thing about someone's personality?

Filip
9 min ago
0
What skills take less than 5 minutes to learn that everyone should know how to do?

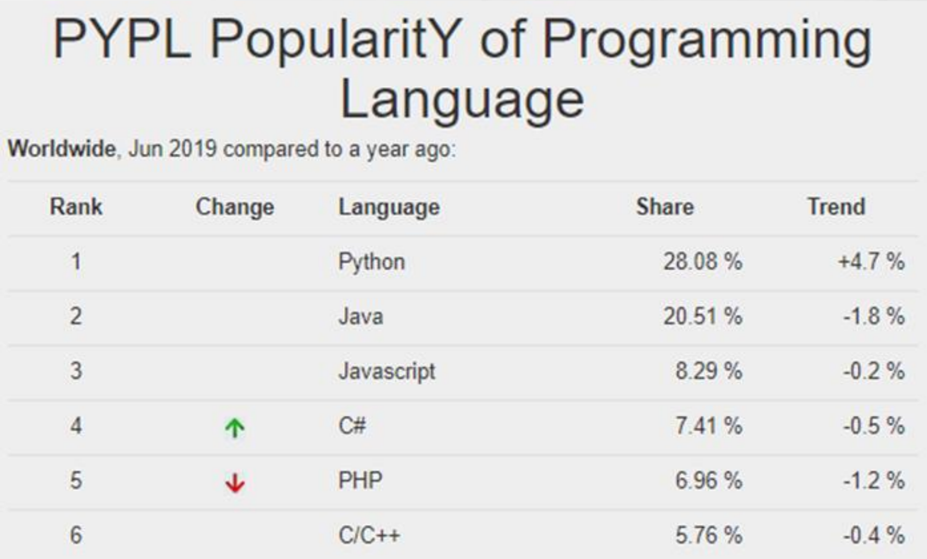
Rachel
12 min ago
0
How does Elon Musk run his famously efficient meetings?

Introduction to Python

Star
MEDIA GROUP

Why Python?

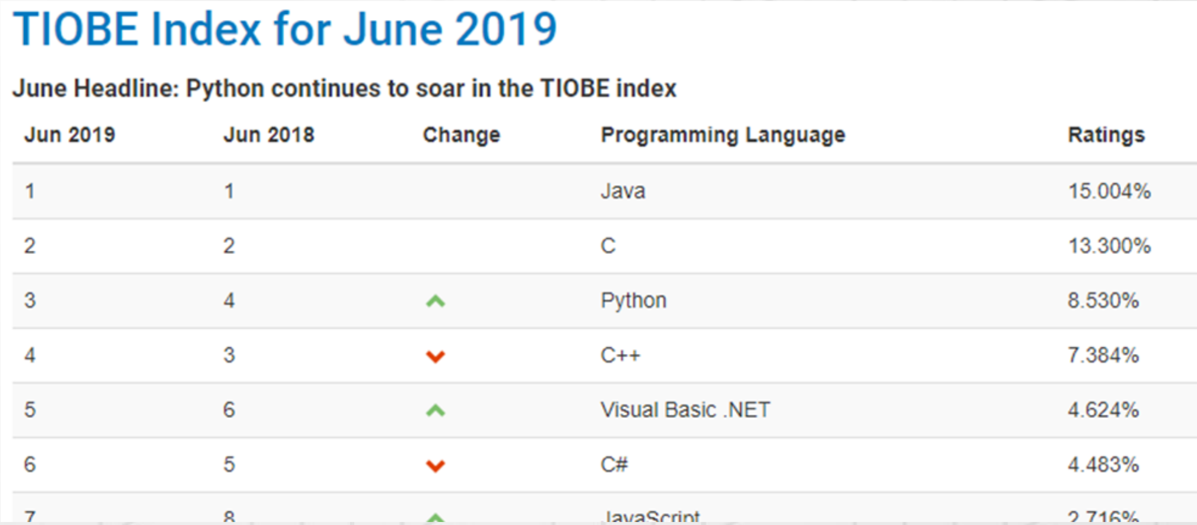
- Free!
- It’s easy to learn (my first language was Java)
- Large community to support, and extensive libraries and documentation
- scikit-learn
- Giants are using it (e.g. NASA, Disney, Netflix, Electronic Arts, Google etc.)
- Reasons:
  - *Machine learning and AI*
  - *Compatible with major platforms and systems*
  - *As a first language, easy to branch out to other languages*
- Sources: PYPL, TIOBE



PYPL PopularitY of Programming Language

Worldwide, Jun 2019 compared to a year ago:

Rank	Change	Language	Share	Trend
1		Python	28.08 %	+4.7 %
2		Java	20.51 %	-1.8 %
3		Javascript	8.29 %	-0.2 %
4	↑	C#	7.41 %	-0.5 %
5	↓	PHP	6.96 %	-1.2 %
6		C/C++	5.76 %	-0.4 %



TIOBE Index for June 2019

June Headline: Python continues to soar in the TIOBE index

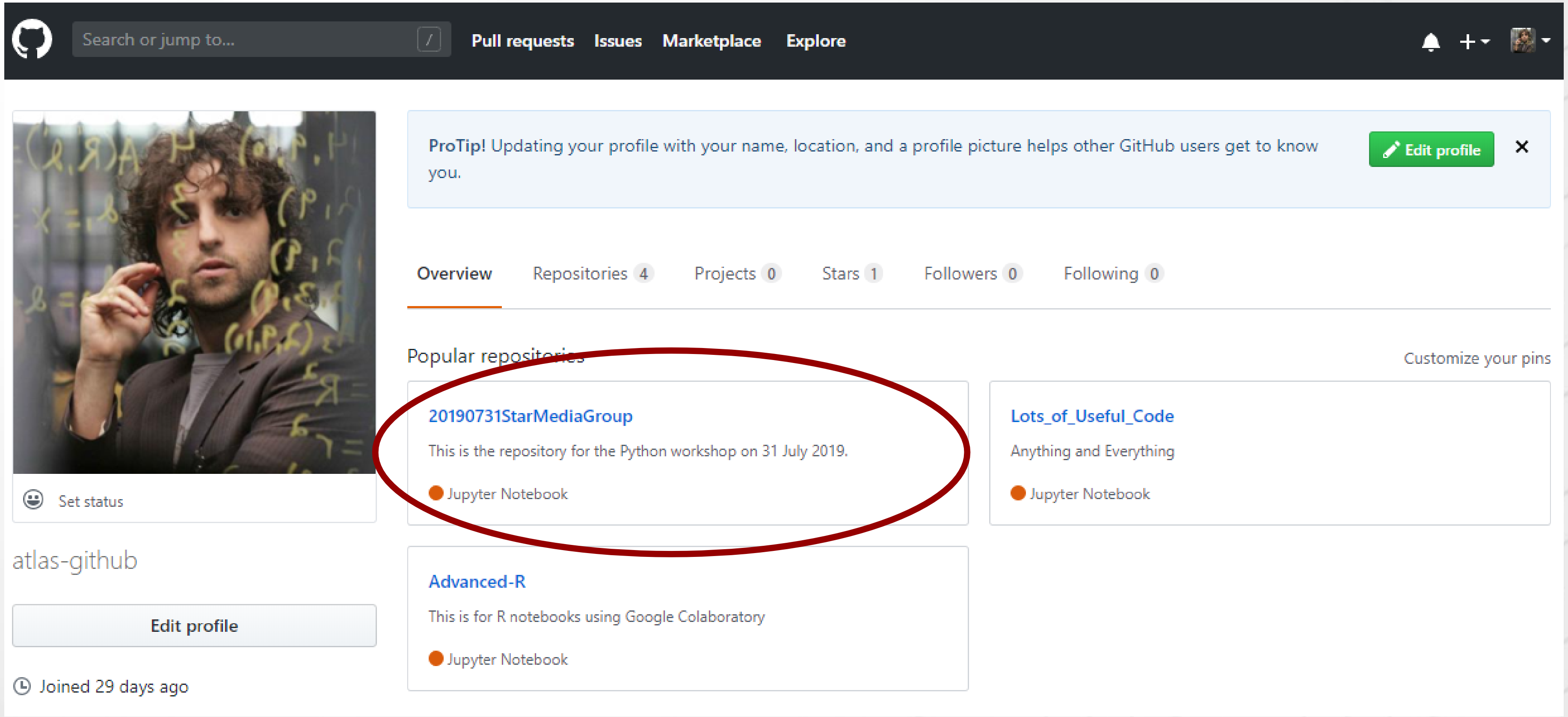
Jun 2019	Jun 2018	Change	Programming Language	Ratings
1	1		Java	15.004%
2	2		C	13.300%
3	4	⌃	Python	8.530%
4	3	⌄	C++	7.384%
5	6	⌃	Visual Basic .NET	4.624%
6	5	⌄	C#	4.483%
7	8	⌃	JavaScript	2.716%

Star MEDIA GROUP

www.sli.do: #T458

GitHub:

- www.github.com/atlas-github



ProTip! Updating your profile with your name, location, and a profile picture helps other GitHub users get to know you.

Joined 29 days ago

20190731StarMediaGroup
This is the repository for the Python workshop on 31 July 2019.
● Jupyter Notebook

Lots_of_Useful_Code
Anything and Everything
● Jupyter Notebook

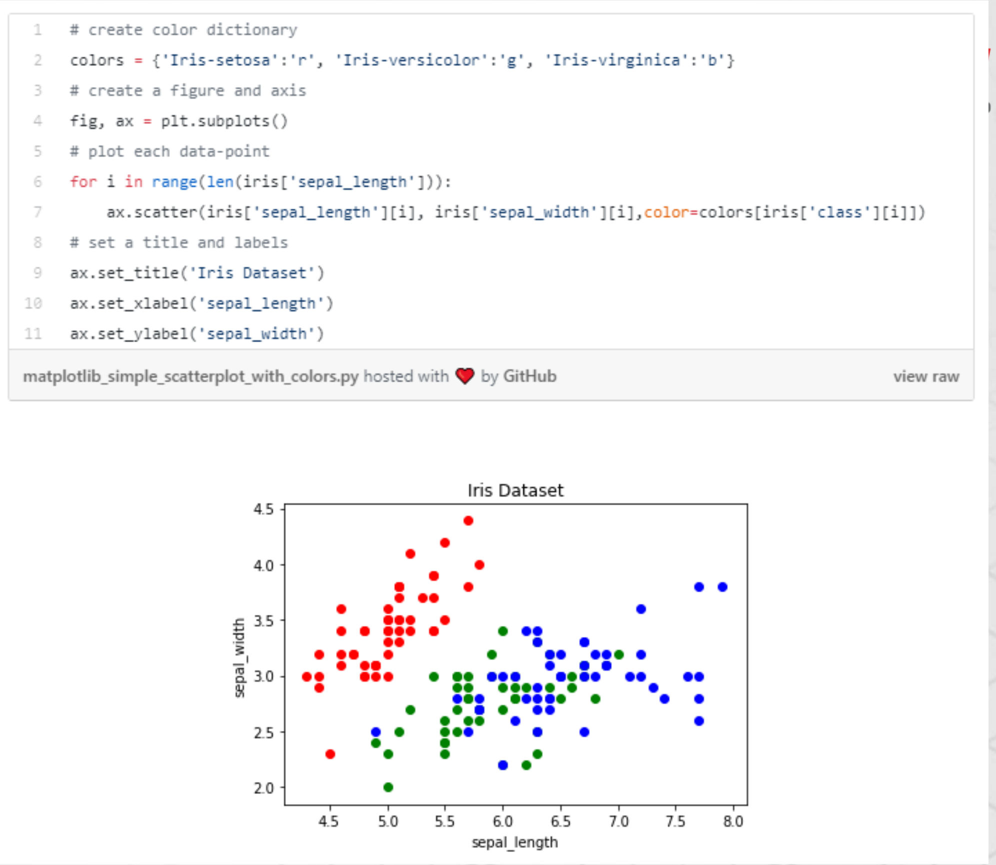
Advanced-R
This is for R notebooks using Google Colaboratory
● Jupyter Notebook

Data visualization using seaborn

Star
MEDIA GROUP

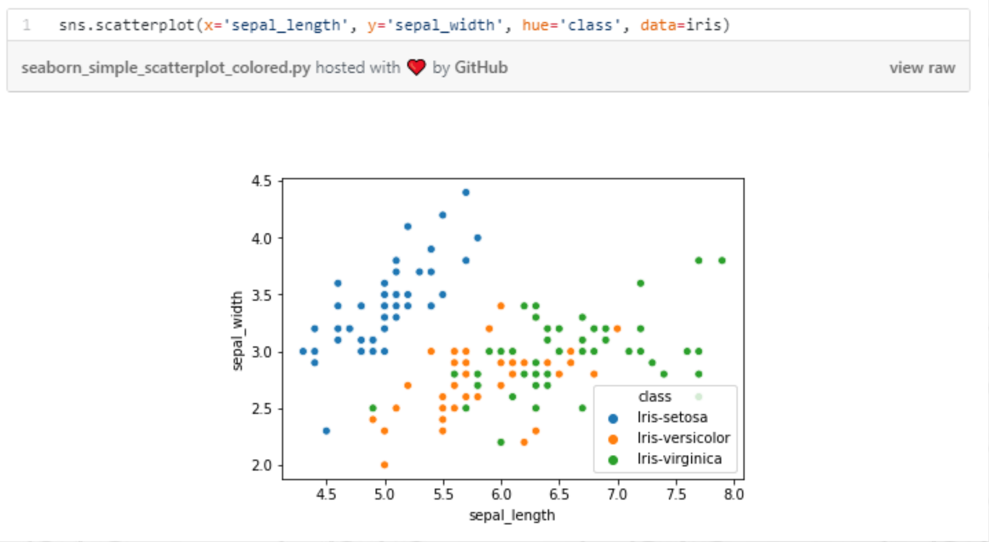
What is seaborn?

- Numerous other data visualization packages
  - *Matplotlib, pandas visualization, ggplot, plotly*
- Reasons to use seaborn
  - *Can create graphs in 1 line of code which takes 10 in matplotlib*
  - *Awesome standard designs and colour palettes*
  - *Easy to learn here*
- Source: Medium



```
# create color dictionary
colors = {'Iris-setosa':'r', 'Iris-versicolor':'g', 'Iris-virginica':'b'}
# create a figure and axis
fig, ax = plt.subplots()
# plot each data-point
for i in range(len(iris['sepal_length'])):
    ax.scatter(iris['sepal_length'][i], iris['sepal_width'][i],color=colors[iris['class'][i]])
# set a title and labels
ax.set_title('Iris Dataset')
ax.set_xlabel('sepal_length')
ax.set_ylabel('sepal_width')
```

matplotlib_simple_scatterplot_with_colors.py hosted with ❤ by GitHub view raw



```
sns.scatterplot(x='sepal_length', y='sepal_width', hue='class', data=iris)
```

seaborn_simple_scatterplot_colored.py hosted with ❤ by GitHub view raw

How to use seaborn?

seaborn.**boxplot(x=None, y=None, hue=None, data=None, order=None, hue_order=None, orient=None, color=None, palette=None, saturation=0.75, width=0.8, dodge=True, fliersize=5, linewidth=None, whis=1.5, notch=False, ax=None, **kwargs)**

Parameters:

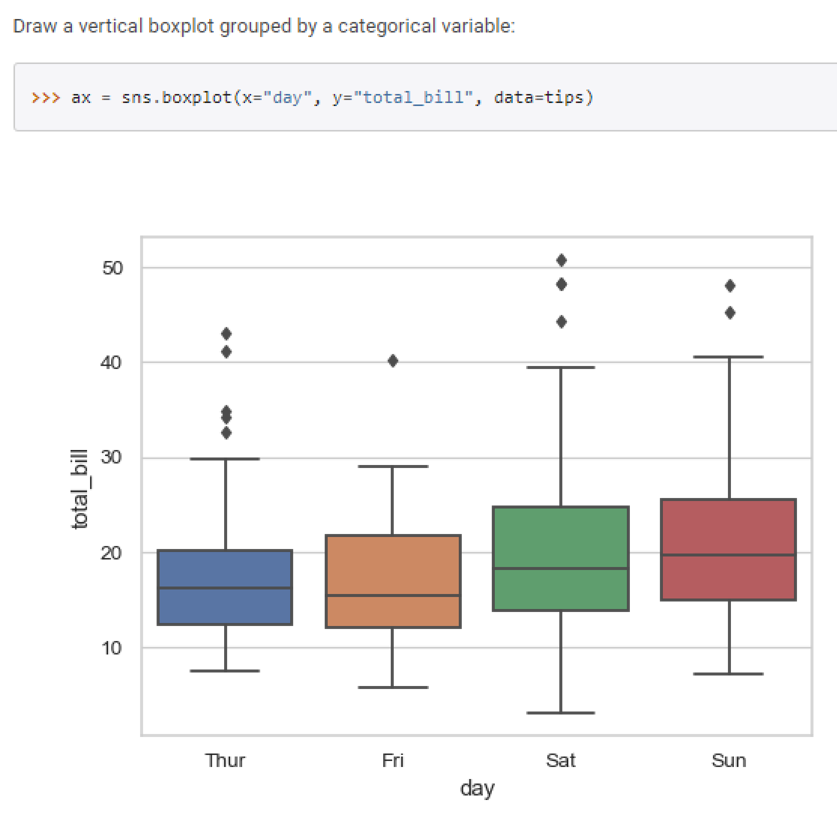
x, y, hue : names of variables in data or vector data, optional
Inputs for plotting long-form data. See examples for interpretation.

data : DataFrame, array, or list of arrays, optional
Dataset for plotting. If x and y are absent, this is interpreted as wide-form. Otherwise it is expected to be long-form.

order, hue_order : lists of strings, optional
Order to plot the categorical levels in, otherwise the levels are inferred from the data objects.

orient : “v” | “h”, optional
Orientation of the plot (vertical or horizontal). This is usually inferred from the dtype of the input variables, but can be used to specify when the “categorical” variable is a numeric or when plotting wide-form data.

color : matplotlib color, optional
Color for all of the elements, or seed for a gradient palette.



Draw a vertical boxplot grouped by a categorical variable:

```
>>> ax = sns.boxplot(x="day", y="total_bill", data=tips)
```

- Source: Seaborn

Hypothesis testing – z-test

Hypothesis-testing

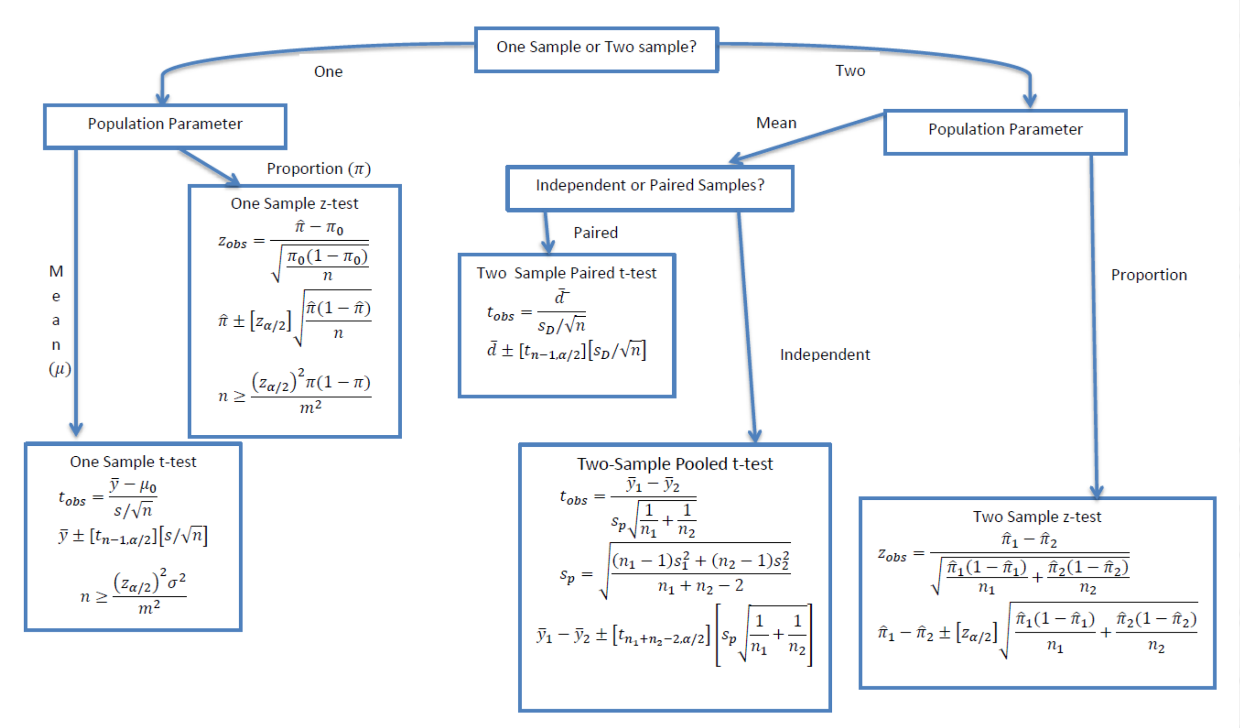
- A few types:
  - *Normality*

    Sample size > 30, population variance known
  - *T-test*

    Sample size < 30, population variance unknown
  - *Chi-square test*

    To test whether variables are independent
  - *ANOVA*

    To analyse the differences among group means in a sample



One Sample or Two sample?

One

Two

Population Parameter

Mean (μ)

Proportion (π)

One Sample z-test

$$z_{obs} = \frac{\hat{\pi} - \pi_0}{\sqrt{\frac{\pi_0(1-\pi_0)}{n}}}$$

$$\hat{\pi} \pm [z_{\alpha/2}]\sqrt{\frac{\hat{\pi}(1-\hat{\pi})}{n}}$$

$$n \geq \frac{(z_{\alpha/2})^2 \pi(1-\pi)}{m^2}$$

One Sample t-test

$$t_{obs} = \frac{\bar{y} - \mu_0}{s/\sqrt{n}}$$

$$\bar{y} \pm [t_{n-1,\alpha/2}][s/\sqrt{n}]$$

$$n \geq \frac{(z_{\alpha/2})^2 \sigma^2}{m^2}$$

Population Parameter

Mean

Independent or Paired Samples?

Paired

Two Sample Paired t-test

$$t_{obs} = \frac{\bar{d}}{s_D/\sqrt{n}}$$

$$\bar{d} \pm [t_{n-1,\alpha/2}][s_D/\sqrt{n}]$$

Independent

Two-Sample Pooled t-test

$$t_{obs} = \frac{\bar{y}_1 - \bar{y}_2}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$s_p = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1 + n_2 - 2}}$$

$$\bar{y}_1 - \bar{y}_2 \pm [t_{n_1+n_2-2,\alpha/2}]\left[s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}\right]$$

Proportion

Two Sample z-test

$$z_{obs} = \frac{\hat{\pi}_1 - \hat{\pi}_2}{\sqrt{\frac{\hat{\pi}_1(1-\hat{\pi}_1)}{n_1} + \frac{\hat{\pi}_2(1-\hat{\pi}_2)}{n_2}}}$$

$$\hat{\pi}_1 - \hat{\pi}_2 \pm [z_{\alpha/2}]\sqrt{\frac{\hat{\pi}_1(1-\hat{\pi}_1)}{n_1} + \frac{\hat{\pi}_2(1-\hat{\pi}_2)}{n_2}}$$

- Source: Towards Data Science

How to use statsmodels.stats?

statsmodels.stats.proportion.**proportions_ztest(count, nobs, value=None, alternative='two-sided', prop_var=False)**

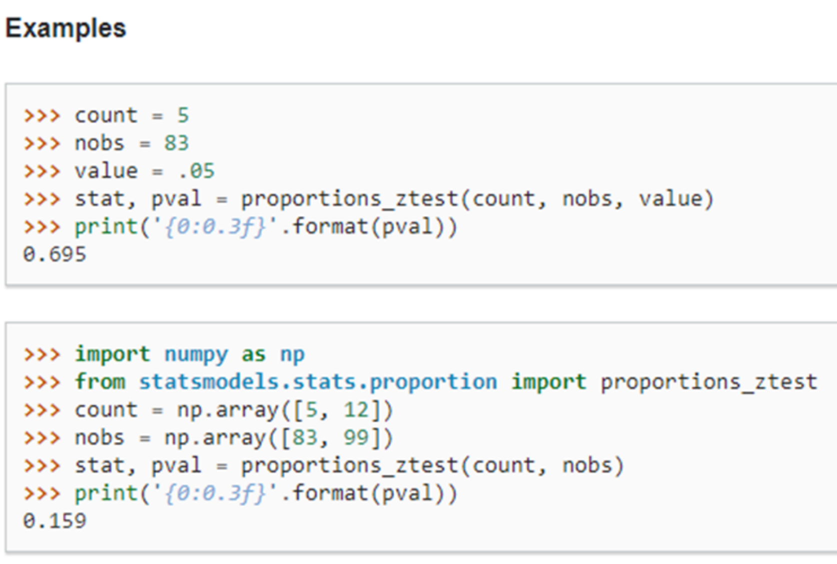
Parameters:

count : *integer or array_like*
the number of successes in nobs trials. If this is array_like, then the assumption is that this represents the number of successes for each independent sample

nobs : *integer or array-like*
the number of trials or observations, with the same length as count.

value : *float, array_like or None, optional*
This is the value of the null hypothesis equal to the proportion in the case of a one sample test. In the case of a two-sample test, the null hypothesis is that prop[0] - prop[1] = value, where prop is the proportion in the two samples. If not provided value = 0 and the null is prop[0] = prop[1]

alternative : *string in ['two-sided', 'smaller', 'larger']*
The alternative hypothesis can be either two-sided or one of the one-sided tests, smaller means that the alternative hypothesis is prop <value and larger means prop > value. In the two sample test, smaller means that the alternative hypothesis is p1 < p2 and larger means p1> p2 where p1 is the proportion of the first sample and p2 of the second one.



Examples

```
>>> count = 5
>>> nobs = 83
>>> value = .05
>>> stat, pval = proportions_ztest(count, nobs, value)
>>> print('{0:0.3f}'.format(pval))
0.695
```

```
>>> import numpy as np
>>> from statsmodels.stats.proportion import proportions_ztest
>>> count = np.array([5, 12])
>>> nobs = np.array([83, 99])
>>> stat, pval = proportions_ztest(count, nobs)
>>> print('{0:0.3f}'.format(pval))
0.159
```

- Source: statsmodels.stats

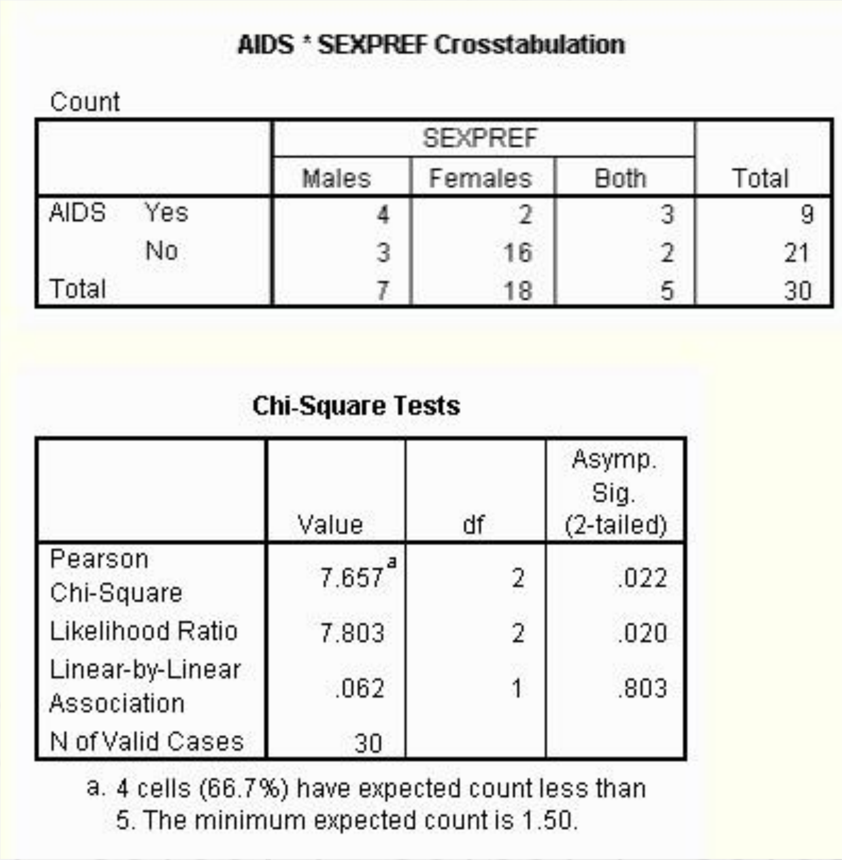
Contingency table & chi-square test

Star
MEDIA GROUP

Contingency table and chi-square test

www.sli.do: #T458

- Contingency table
  - *Aka. cross tabulation*
  - *A table in a matrix format to display frequency distribution of variables*
- Chi-square test
  - *Aka. Pearson's chi-squared test*
  - *Used to determine whether there is significant difference between expected and observed frequencies in one or more categories*
- Applications:
  - *Data exploration*
- Source: Statistics How To



AIDS * SEXPREF Crosstabulation

Count

		SEXPREF			Total
		Males	Females	Both	
AIDS	Yes	4	2	3	9
	No	3	16	2	21
Total		7	18	5	30

Chi-Square Tests

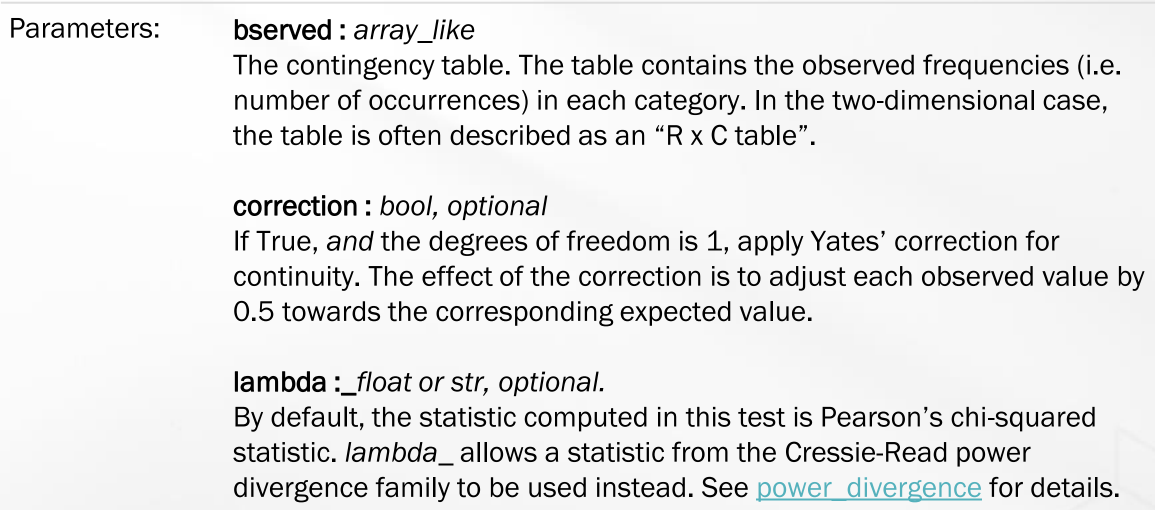
	Value	df	Asymp. Sig. (2-tailed)
Pearson Chi-Square	7.657[a]	2	.022
Likelihood Ratio	7.803	2	.020
Linear-by-Linear Association	.062	1	.803
N of Valid Cases	30		

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is 1.50.

www.sli.do: #T458

How to use scipy.stats?

scipy.stats.chi2_contingency(observed, correction=True, lambda_=None)



Parameters:

bserved : *array_like*
The contingency table. The table contains the observed frequencies (i.e. number of occurrences) in each category. In the two-dimensional case, the table is often described as an "R x C table".

correction : *bool, optional*
If True, *and* the degrees of freedom is 1, apply Yates' correction for continuity. The effect of the correction is to adjust each observed value by 0.5 towards the corresponding expected value.

lambda :_*float or str, optional.*
By default, the statistic computed in this test is Pearson's chi-squared statistic. *lambda_* allows a statistic from the Cressie-Read power divergence family to be used instead. See power_divergence for details.

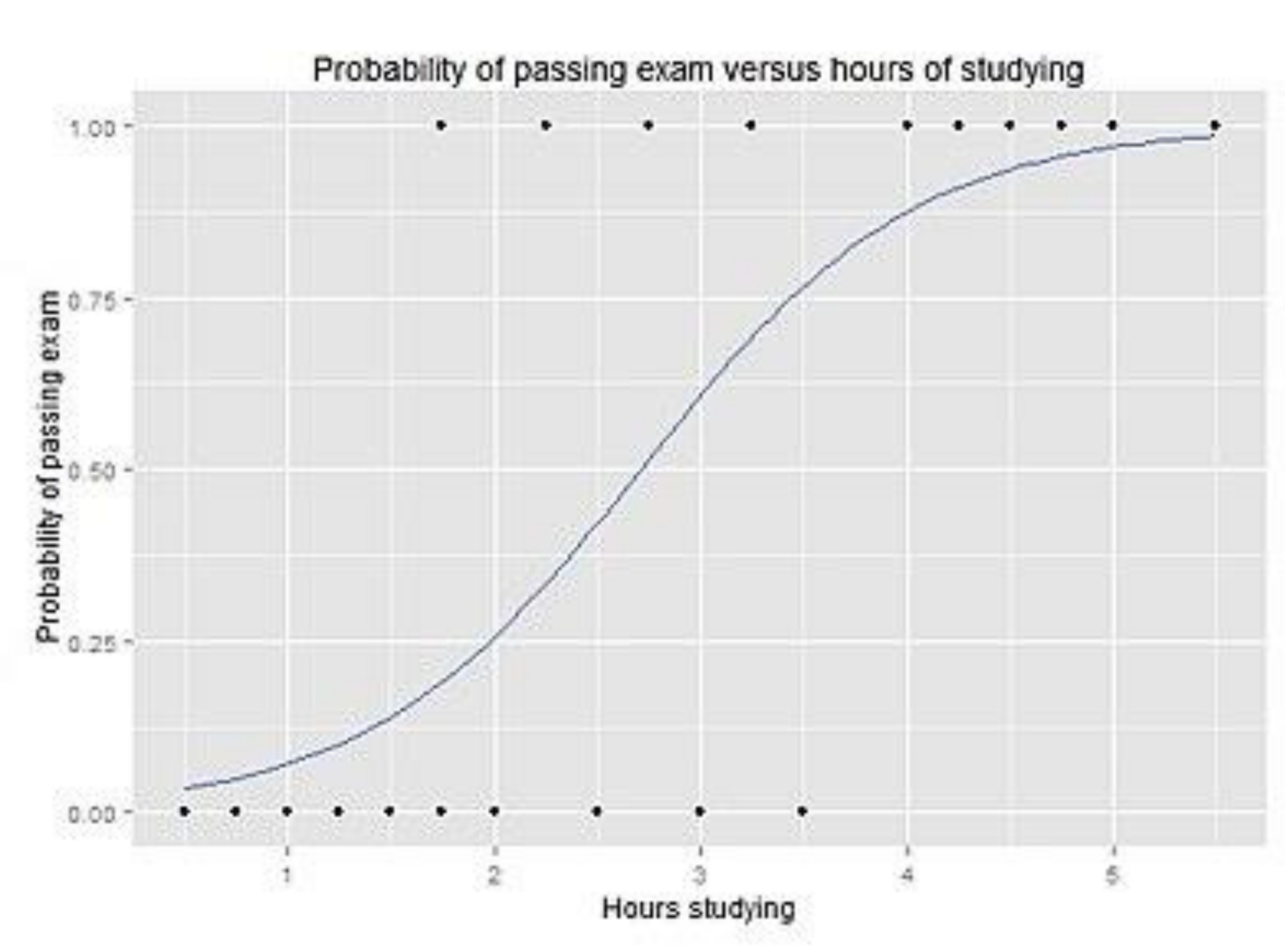
	Pizza Rolls	Chips & Dip	Cookies	Total
Poker	10	3	12	**25**
Trivial Pursuit	8	14	7	**29**
Monopoly	14	17	7	**38**
Wii Bowling	12	7	4	**23**
Total	**44**	**41**	**30**	**115**

- Source: scipy.stats

Logistic regression

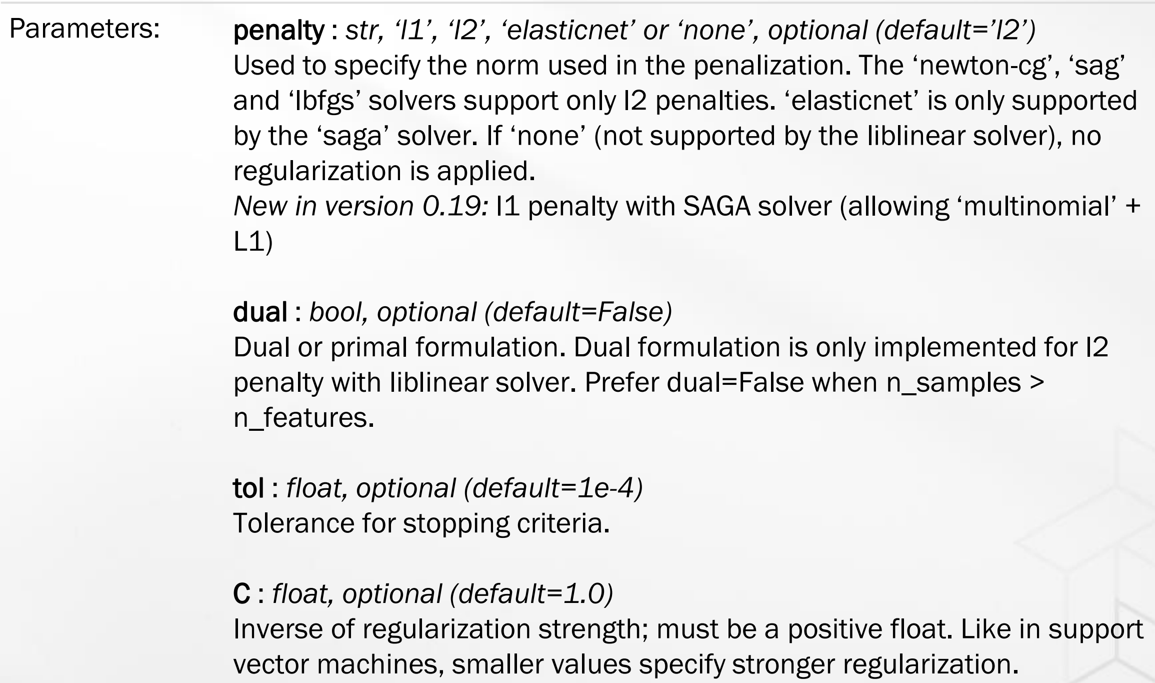
Logistic regression

- Output is a probability a given input belongs to a certain class
- A type of classification algorithm
  - *Binary labels: logistic regression*
  - *More than 2 labels: multinomial logistic regression*
- Applications:
  - *Profile behaviour*
  - *Which factors contribute to a certain health condition (yes vs. no)?*



How to use sklearn.linear_model?

sklearn.linear_model.**LogisticRegression**(*penalty='l2', dual=False, tol=0.0001, C=1.0, fit_intercept=True, intercept_scaling=1, class_weight=None, random_state=None, solver='warn', max_iter=100, multi_class='warn', verbose=0, warm_start=False, n_jobs=None, l1_ratio=None*)



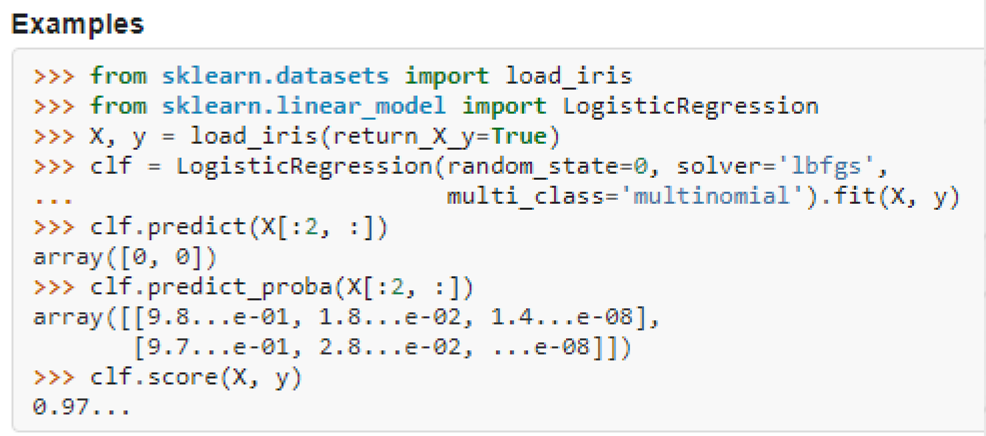
Parameters:

penalty : *str, 'l1', 'l2', 'elasticnet' or 'none', optional (default='l2')*
Used to specify the norm used in the penalization. The 'newton-cg', 'sag' and 'lbfgs' solvers support only l2 penalties. 'elasticnet' is only supported by the 'saga' solver. If 'none' (not supported by the liblinear solver), no regularization is applied.
New in version 0.19: l1 penalty with SAGA solver (allowing 'multinomial' + L1)

dual : *bool, optional (default=False)*
Dual or primal formulation. Dual formulation is only implemented for l2 penalty with liblinear solver. Prefer dual=False when n_samples > n_features.

tol : *float, optional (default=1e-4)*
Tolerance for stopping criteria.

C : *float, optional (default=1.0)*
Inverse of regularization strength; must be a positive float. Like in support vector machines, smaller values specify stronger regularization.



Examples

```
>>> from sklearn.datasets import load_iris
>>> from sklearn.linear_model import LogisticRegression
>>> X, y = load_iris(return_X_y=True)
>>> clf = LogisticRegression(random_state=0, solver='lbfgs',
...                          multi_class='multinomial').fit(X, y)
>>> clf.predict(X[:2, :])
array([0, 0])
>>> clf.predict_proba(X[:2, :])
array([[9.8...e-01, 1.8...e-02, 1.4...e-08],
       [9.7...e-01, 2.8...e-02, ...e-08]])
>>> clf.score(X, y)
0.97...
```

- Source: sklearn.linear_model.LogisticRegression

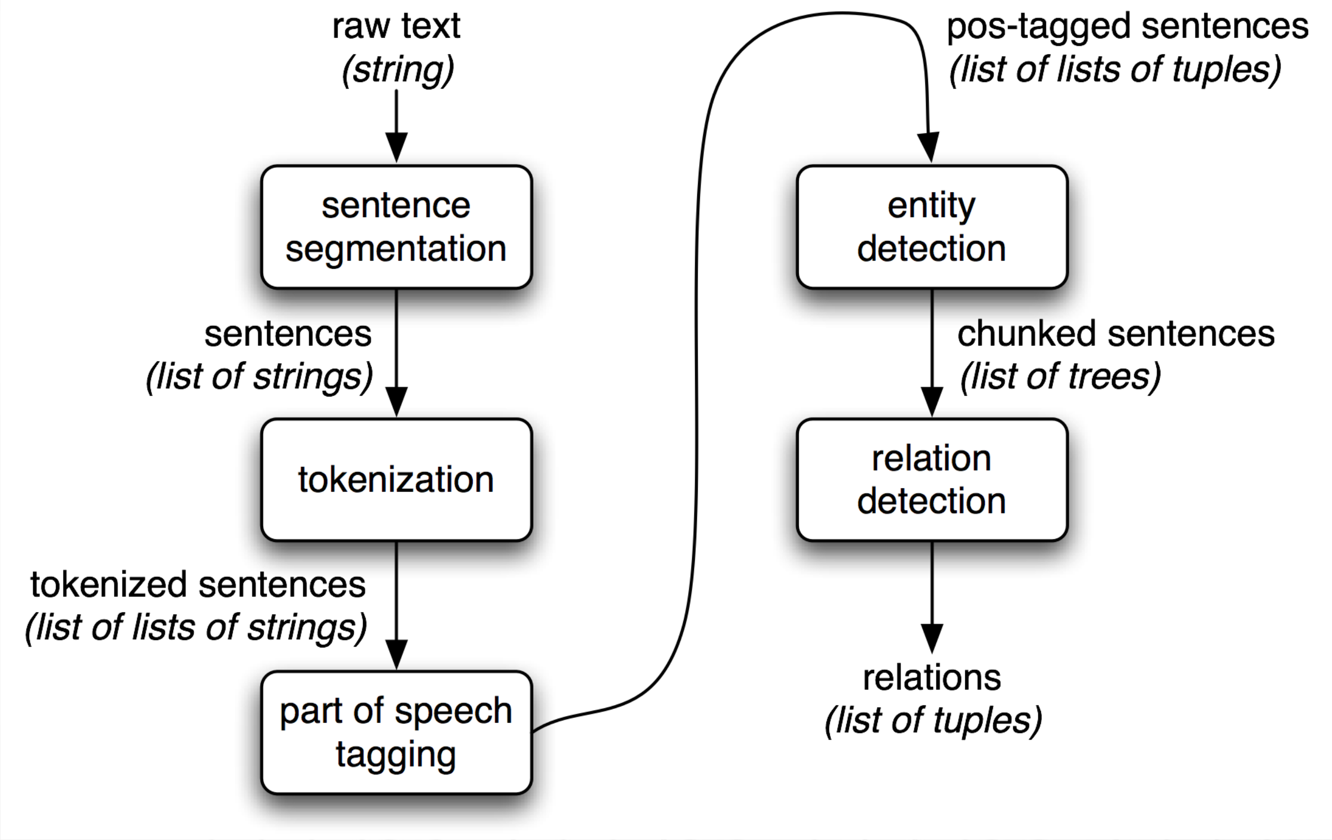
Natural Language Processing

Star
MEDIA GROUP

Natural Language Processing (NLP)

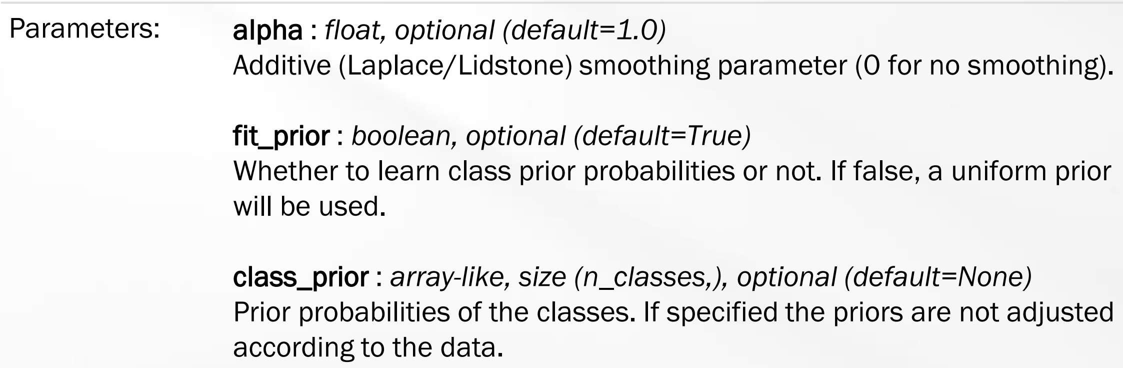
www.sli.do: #T458

- How to programme computers to process and analyse large amounts of unstructured text
- Applications:
  - *Text classification*
  - *Behaviour profile of users*
  - *Taxonomy construction*
  - *Named Entity Recognition*
  - *Natural Language Generation (WIP)*
- Advanced applications:
  - *TalkToTransformer*
  - *BusUncle*
  - *OpenAI GPT-2*



How to use sklearn.naive_bayes?

sklearn.naive_bayes. **MultinomialNB(alpha=1.0, fit_prior=True, class_prior=None)**

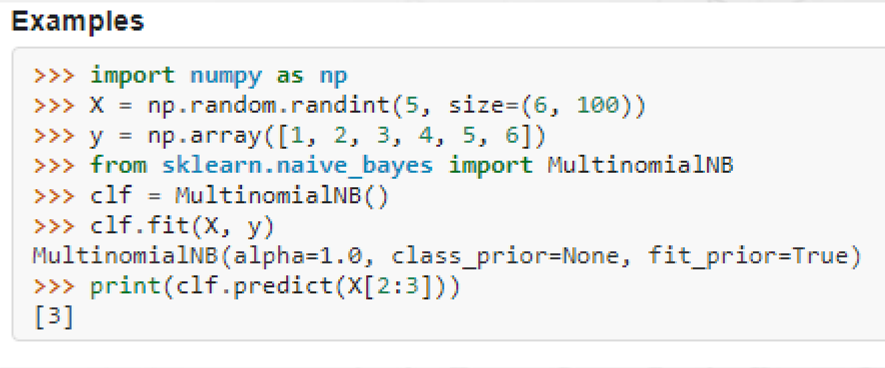


Parameters:

alpha : *float, optional (default=1.0)*
Additive (Laplace/Lidstone) smoothing parameter (0 for no smoothing).

fit_prior : *boolean, optional (default=True)*
Whether to learn class prior probabilities or not. If false, a uniform prior will be used.

class_prior : *array-like, size (n_classes,), optional (default=None)*
Prior probabilities of the classes. If specified the priors are not adjusted according to the data.



Examples

```
>>> import numpy as np
>>> X = np.random.randint(5, size=(6, 100))
>>> y = np.array([1, 2, 3, 4, 5, 6])
>>> from sklearn.naive_bayes import MultinomialNB
>>> clf = MultinomialNB()
>>> clf.fit(X, y)
MultinomialNB(alpha=1.0, class_prior=None, fit_prior=True)
>>> print(clf.predict(X[2:3]))
[3]
```

- Source: sklearn.naive_bayes.MultinomialNB

Google Cloud Platform’s AutoML

Star
MEDIA GROUP

Recommendations and Feedback

- Need to continuously learn independently
- Meet up with others to look for ideas and inspiration
- Facebook:
  - *TensorFlow & Deep Learning Malaysia*
  - *Malaysia R User Group (MYRUG)*
- Meetup:
  - *Kuala Lumpur Artificial Intelligence Meetup*
- Workshop feedback:
  - *https://www.surveymonkey.com/r/X6PT6GT*

Thank you!

Star MEDIA GROUP