NLP and classification

Empowering insights through classification

5 WEEKS **175** HOURS **10** LESSONS

In this module, we will embark on a journey through the realms of **natural language processing (NLP)** and **classification**. We'll begin by delving into **text preprocessing techniques**, including tokenisation, stemming, lemmatisation, and **feature extraction methods** such as bag-of-words and n-grams. We will explore **various classification algorithms** through practical implementations, understand their operational mechanisms, and learn how to evaluate their performance effectively.

From **logistic regression and classification metrics** to **tree-based methods**, **support vector machines (SVM)**, and **neural networks**, we'll equip ourselves with a diverse toolkit for tackling real-world classification tasks. Using **model-tuning** examples and exercises, we'll gain valuable insights into the iterative process of building and refining classification models.

Module objectives

Natural language processing

Gain a fundamental understanding of **text preprocessing methods** such as **tokenisation**, removing **stopwords**, **stemming**, **lemmatisation**, and **removing punctuation**. Understand feature extraction techniques such as **bag-of-words** and **n-grams** to convert text data into numerical representations.

Classification techniques and methods

Learn how to **implement** and **evaluate various classification techniques** using sklearn, including **logistic regression**, **decision trees**, **random forests**, **SVM**, **naive Bayes**, and **k-nearest neighbours**. Gain insights into model operations, **visualise SVM hyperplanes**, comprehend the **log loss function**, and deploy **neural networks** using **TensorFlow** and **Keras** for optimal classification outcomes.

Model evaluation and metrics

Acquire a foundational understanding of classification techniques, including **performance evaluation**, **class imbalance handling**, and **multiclass challenges**. Apply **feature subset selection** methods and master **hyperparameter tuning** across various models. Develop proficiency in employing metrics such as **accuracy**, **precision**, **recall**, and **F1-score** for effective model evaluation.

Model selection

Learn how to **construct diverse classification models**, conduct **cross-validation** to assess **performance robustness**, and employ visualisation techniques to **interpret results** effectively. Gain skills in **selecting the most suitable model** for a dataset based on performance evaluation metrics and graphical representations, enhancing the ability to **make informed model choices** in practical applications.

Learning activities

Participating in various learning activities will **enhance our understanding** of NLP and classification, by fostering a diverse skill set for **real-world challenges** through **hands-on problem-solving** and **authentic projects**.

We learn by doing. We'll work on practical problem-solving and real-world projects.

Learn Watch animated videos and explore practical examples to learn NLP and classification concepts.

- 12 **Sketch videos**
- 13 **Examples**

Apply Practise NLP and classification modelling and assessment by following detailed step-by-step guides and applying these techniques to real-world scenarios.

- 5 **Exercises**

Assess Test and track your understanding of NLP and classification and their application.

- 12 **KQ assessments**
- 5 **Graded assessments**

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Week 1

Lesson: Natural language processing

In this lesson, we will explore text preprocessing methods such as **tokenisation**, **removing stopwords**, **stemming**, **lemmatisation**, and **removing punctuation**. We will also examine feature extraction techniques such as **bag-of-words** and **n-grams** to convert text data into numerical representations.

- Understand the importance of **text preprocessing** in natural language processing tasks.
- Learn how to **tokenise text data** into words or tokens.
- Implement techniques to **remove stopwords and punctuation from text data**.
- Apply stemming and lemmatisation to **extract the root forms of words**.
- Create a bag-of-words representation to **quantify the occurrence of words** in text data.
- Explore the concept of n-grams to **capture combinations of words** in text data.

Week 2

Lesson: Logistic regression

In this lesson, we'll learn how to **implement logistic regression models** with sklearn, tackle real-world classification problems, **evaluate model performance**, as well as explore the **limitations of logistic regression**.

- Distinguish between **binary classification and regression**, understanding when and why to use each.
- Grasp the concept of logistic regression and its effectiveness in **binary classification scenarios**.
- Implement a logistic regression model using **sklearn** and **evaluate its performance** on real-world data.
- Develop skills in **preprocessing data**, **fitting logistic regression models**, and applying them to **solve classification problems**.

Lesson: Classification metrics

This lesson introduces the fundamental **metrics** used to **assess classification models**, such as accuracy, precision, recall, and the F1 score. We will learn when to use them and the benefits gained in doing so.

- Understand how the issue of **class imbalance** affects model evaluation.
- Know how to **evaluate the performance of a classification model** by interpreting a confusion matrix and a classification report.
- Understand and implement various **binary classification metrics**.

Lesson: Model improvements

In this lesson, we will cover a range of techniques, from **feature subset selection** and **hyperparameter tuning**, to addressing **class imbalance** and introducing **multiclass classification** strategies. We'll refine logistic regression models, utilise **advanced tuning methods**, and effectively manage dataset peculiarities for improved model performance.

- Understand and apply **feature subset selection** techniques such as **variance threshold**, select **KBest**, and **forward/backward stepwise selection**.
- Master **hyperparameter tuning** for various models, including logistic regression, random forests, and neural networks.
- Rebuild and evaluate logistic regression models using **performance metrics** to enhance prediction accuracy.
- Address class imbalance using **threshold adjustments** and **resampling** methods.
- Navigate the complexities of **multiclass classification**.
- Explore various metrics and concepts used for **evaluating classification models**.

Week 3

Lesson: Tree-based classification methods

In this lesson, we **refresh our understanding** of how decision trees and random forests work. We also look at their relevance and application in **classification contexts** and how we can implement them using sklearn to solve classification problems.

- Recall the terms and the process used for **training decision trees**.
- **Compare** the decision tree **training process** in regression and classification settings.
- Build and evaluate **tree-based models for classification**.

Lesson: Support vector classification

In this lesson, we will delve into **support vector machines (SVM)** and the art of **model tuning**. We will gain insights into the working principles of SVMs and the role of kernels. By exploring both **linear** and **non-linear SVM** classifiers using sklearn, we will explore the **significance of hyperplanes** and their **visualisation**. Moreover, we will learn to **fine-tune SVM models** effectively using **GridSearchCV**, thereby **optimising** model performance for real-world applications.

- Understand the **fundamentals of support vector machine (SVM)** models and their operational mechanisms.
- Implement SVM classifier models with **linear and radial basis function kernels** using the sklearn library.
- **Visualise hyperplanes** in SVM classifier models to understand their significance in **decision boundary determination**.
- Learn to **tune SVM models** using the GridSearchCV function, optimising model parameters for improved performance.

Lesson: Nearest neighbours and naive Bayes

In this lesson, we will explore two fundamental algorithms used in classification: **K-nearest neighbours (KNN)** and **naive Bayes classifiers**. By understanding the inner workings of these models and their practical implementations, we will gain valuable insights into how to **effectively classify data**.

- Understand the principles behind **training and implementing naive Bayes classifiers**.
- Gain insight into the **log loss function** and its significance in classification metrics.
- Learn how to **train and implement k-nearest neighbours** for classification tasks.

Week 4

Lesson: Hyperparameter tuning and model validation

In this lesson, we will delve into the intricacies of **hyperparameters and model validation**. We'll explore the significance of tuning hyperparameters and learn how to find optimal settings using a **grid search**. By understanding these concepts, we'll enhance our ability to **fine-tune models for optimal performance**.

- Understand the concept of **hyperparameter tuning** and its importance in **model optimisation**.
- Utilise **grid search** methodology to **find optimal hyperparameters for models** such as KNN and SVMs.
- Apply **model validation techniques** to assess and optimise the performance of machine learning models.

Lesson: Neural network classifiers

In this lesson, we will explore the fundamentals of **artificial neural network (ANN)** classifiers. We will introduce the architecture and components of ANN classifiers, including **layers**, **neurons**, **weights**, and **activation** functions. We will use **TensorFlow** and **Keras** to construct and train neural network models, focusing on classification tasks. Additionally, we will delve into model evaluation techniques, including the use of validation data to guide model training effectively.

- Obtain a basic understanding of the architecture and fundamental elements of an **artificial neural network**.
- Understand how to use **TensorFlow layers** to build a neural network architecture.
- Understand how a model is trained and evaluated using a **validation split**.
- Implement an effective neural network for classification using **Keras**.

Lesson: Classifier model selection

In this lesson, we'll construct several classification models, conduct **cross-validation**, and **visualise** the outcomes. The focus will be on determining the most suitable model for a dataset based on **performance metrics**. This iterative approach exemplifies the machine learning principle of rapid **experimentation** to refine model solutions effectively. Through hands-on exercises, we will gain valuable insights into **model selection and validation processes**.

- Build multiple types of classification models, including **logistic regression**, **k-nearest neighbours (KNN)**, **support vector machines (SVM)**, **decision trees** and **AdaBoost**.
- Perform **cross-validation** to assess the robustness of the models.
- Visualise the **results** of different classifiers.

Week 5

Exam: **NLP and classification**

It is time to review all the work that's been covered up to now and **test our knowledge**. Make sure to **cover each week's section in detail** before attempting this exam! It will be a combination of **theoretical** and **practical questions**, aimed at testing the **general understanding of concepts**, as well as the **application** and **interpretation of our new skills**.

Module summary

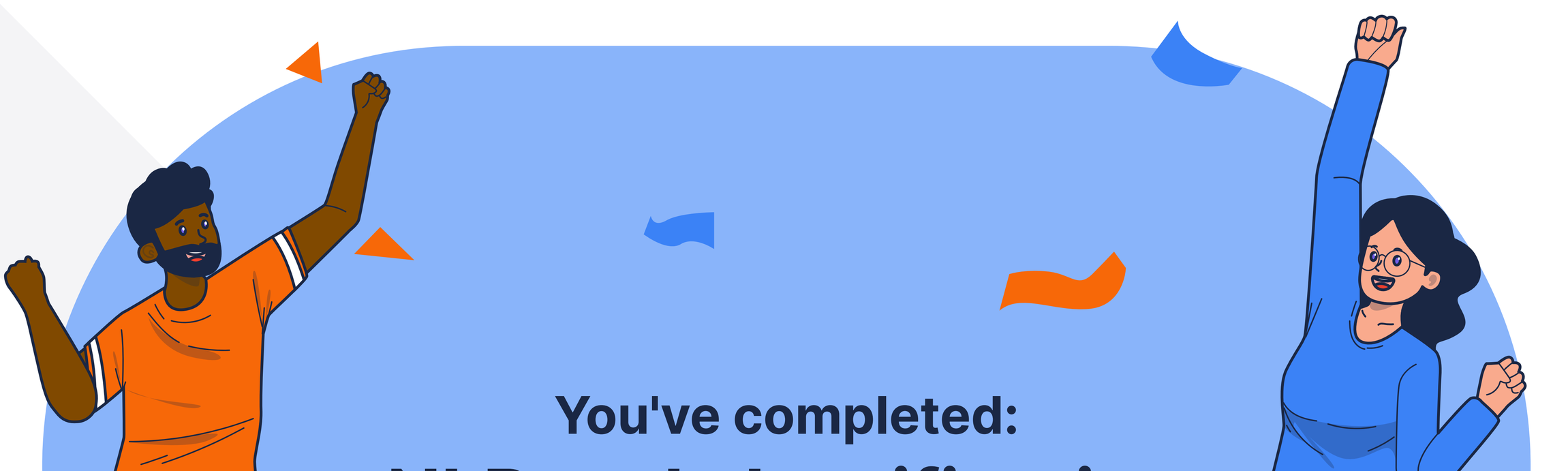
Throughout this module, we've delved into the intricacies of **natural language processing and classification**. We began by understanding the importance of **text preprocessing** and **feature extraction techniques**, laying a good foundation for building classification models. With lessons covering **logistic regression**, **classification metrics**, **model improvements**, **tree-based classification methods**, **support vector machines**, **k-nearest neighbours**, **naive Bayes classifiers**, **hyperparameter tuning**, and **neural network classifiers**, we've explored a wide array of classification algorithms. Using hands-on exercises and practical implementations, we've honed our skills in model construction, evaluation, and refinement.

By mastering these techniques, we're now equipped to tackle **real-world classification challenges** with **confidence** and **precision**.

What's next?

With the knowledge gained so far in **natural language processing (NLP)** and **classification**, we are well-equipped to **tackle a wide range of real-world data analysis tasks**. We can effectively preprocess text data, extract meaningful features, and build robust classification models.

Looking ahead, the next step to enrich our data analysis toolkit is to delve into **unsupervised learning techniques** which will provide powerful tools for uncovering hidden patterns and structures in **unstructured data**. We will continue to refine our analytical abilities and expand our toolkit continuing with our commitment to lifelong learning.



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