

# Machine Learning Operations

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## Resumen

*Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi vulputate tempus molestie.*

## Abstract

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## I. INTRODUCTION

Machine learning models provide valuable insights to the business, but only if those models can continuously access and analyze the organization's data. Machine learning operations (MLOps) is the fundamental process that makes this possible.

MLOps is a cross-functional, collaborative and iterative process that puts data science capabilities to work. To do this, MLOps treat machine learning (ML) and other types of models as reusable software artifacts. The models can then be deployed and continuously monitored through a repeatable process.

MLOps offer continuous integration and rapid, repeatable deployment of models. As such, they help companies discover valuable information and insights from their data faster. MLOps also include continuous monitoring and repeatable training of models in production to ensure they perform optimally as data changes (evolves) over time.

## II. STATE OF ART

### i. Concept

Machine Learning Operations, is an extension of the DevOps methodology that seeks to include the machine learning and data science processes in the development and operations to make ML development more reliable and productive[1].

### ii. Objective

The goal of MLOps is develop, train and deploy ML models with automated procedures that integrate data, developers, security and infrastructure teams[1].

### iii. Importance of MLOps

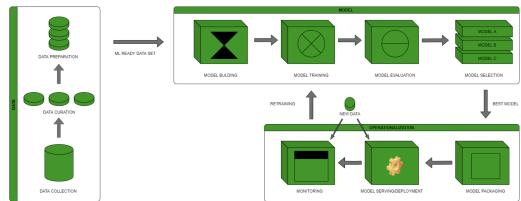
We are in a data-driven world. The importance of the MLOps models is that they are vital to streamline the maturation process of AI and ML projects within an organization.

The use of trained models has changed dramatically in the last decade, and now the policy of managing ML models like 'black boxes' that they held in the traditional operations is

no longer sufficient. Models are updated and maintained. It's therefore vital that the effort and time to deploy and maintain them are reduced as much as possible[1].

#### iv. MLOps pipeline

While there are several attempts to capture and describe MLOps, the one that is best known is the proposal of ToughWorks[5], which automates the life cycle of end-to-end Machine Learning applications. Collection, selection and preparation of data to be used in model training, in finding and selecting the most efficient model after testing and experimenting with different models, in developing and sending the selected model in production[4].

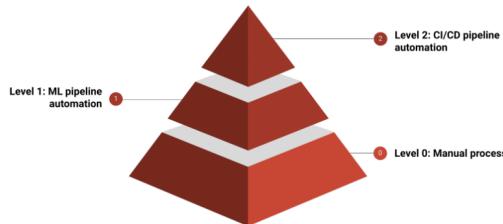


#### v. Maturity Levels

Depending on the level of automation of a MLOps system, it can be classified at a corresponding level. These levels were named by the community maturity levels. Although there is no universal maturity model, the two main ones were created by Google and Microsoft[4].

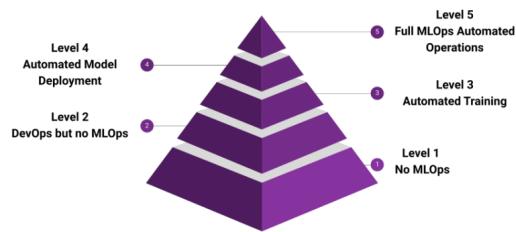
Google model consists of three levels[2].

- MLOps Level 0: Manual process.
- MLOps Level 1: ML pipeline automation.
- MLOps Level 2: CI/CD pipeline automation.



Microsoft model consists of five levels[3].

- MLOps Level 1: No MLOps.
- MLOps Level 2: DevOps but no MLOps.
- MLOps Level 3: Automated Training.
- MLOps Level 4: Automated Model Deployment.
- MLOps Level 5: Full MLOps Automated Operations.



### III. CONCLUSIONS

MLOps supports statistical, data science, machine learning and other types of models to deliver business value quickly. To this end, MLOps ensure that models can be repeatedly deployed and continuously monitored.

As you have seen, the development of analytical models requires many tasks and dependencies that add complexity and delay. The objective of MLOps is none other than to eliminate all these complexities, so that the Data Scientist can work more efficiently, providing real value to the business in a shorter period of time. All this, through process automation and/or simply by organizing processes in a more agile way.

### REFERENCES

- [1] Plain Concepts. Mlops: Qué es, por qué es importante y cómo implementarlo. 2022.
- [2] Google. Mlops: Continuous delivery and automation pipelines in machine learning-google cloud. 2020.
- [3] Microsoft. Machine learning operations maturity modelazure architecture center-microsoft docs. 2020.

- [4] Georgios Symeonidis, Evangelos Nerantzis, Apostolos Kazakis, and George A Papakostas. Mlops-definitions, tools and challenges. In *2022 IEEE 12th Annual Computing and Communication Workshop and Conference (CCWC)*, pages 0453–0460. IEEE, 2022.
- [5] V. Stirbu L. Myllyaho T. Granlund, A. Kopponen and T. Mikkonen. Mlops challenges in multi-organization setup: Experiences from two real-world cases.