MACHINE LEARNING APPLIED TO BUILDING INFORMATION MODELS

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Abstract

Digitalisation is among prominent concepts in the AEC industry within the scope of Construction 4.0. Effective data management is essential to enable the digitalisation of construction. Converting raw data into knowledge requires the ability to convert data into information by making sense of it in a particular context. Only then information can be converted into knowledge by both humans and machines. As such, this work adopts a learning perspective for machines to learn from data stored in Building Information Modelling (BIM) Models, the modern information management repositories in the sector.

This study suggests that BIM Models represent an opportunity to explore large data sets which can improve the industry's knowledge management and performance. Machine Learning (ML) is a scientific domain including several computational techniques which open new horizons in the learning process, to the extent of finding patterns that are sometimes difficult to be discovered by the human eye and that could insightfully challenge the current construct of AEC.

The methodology of the dissertation included a literature review and a case study. A literature review of state-of-the-art applications of ML on BIM or ML to spatial design was performed. It has been observed a lack of extensive works on application ML to spatial design through BIM models. This gap was considered a research opportunity, leading to the development of a case study that intended to test a proposed framework of ML application to BIM models. The steps of implementation of the case study included: (i) extracting data from BIM models; (ii) modifying, filtering and merging the data; (iii) training and testing ML model. Convolutional Neural Network and Graph Neural Network algorithms were used for this case study. As a final output of the application, the automatic labelling of the spaces was idealised.

The study concludes that the application of ML from BIM models requires meeting specific criteria, which are yet proven to be a challenge in the context of the sector. Firstly, Machine Learning needs a large amount of input data to operate. Secondly, the data also needs to be appropriately collected, filtered and stored. Thirdly, the data shall be converted into information to facilitate the learning process. In the case study presented, the Space Syntax technique was identified as a linking tool to convert BIM models data into information to be processed by ML algorithms.

Notwithstanding the expected hurdles to be overcome in AEC, this study suggests that BIM models, along with the introduction of adequate interoperability measures, can change the paradigm of the industry. The ability to manipulate large amounts of information can facilitate insight and challenge the current mechanisms of information and knowledge management in the industry.

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Presentation video:
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