

Slides and notebooks: <https://ml4ns.github.io>

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Lecture 8. Applications of Machine Learning in Neuroscience

In lecture 8, we cover examples of real-world applications of machine learning in neuroscience. We also discuss how concepts from neuroscience have been applied to machine learning. In this lecture, we discuss how neuroscience can inspire new types of algorithms and architectures. We first review the content of previous lectures before expanding further on different sub-fields of machine learning. These include reinforcement learning, deep learning, attention-based learning, and continual learning, with citations to state-of-the-art works for each.

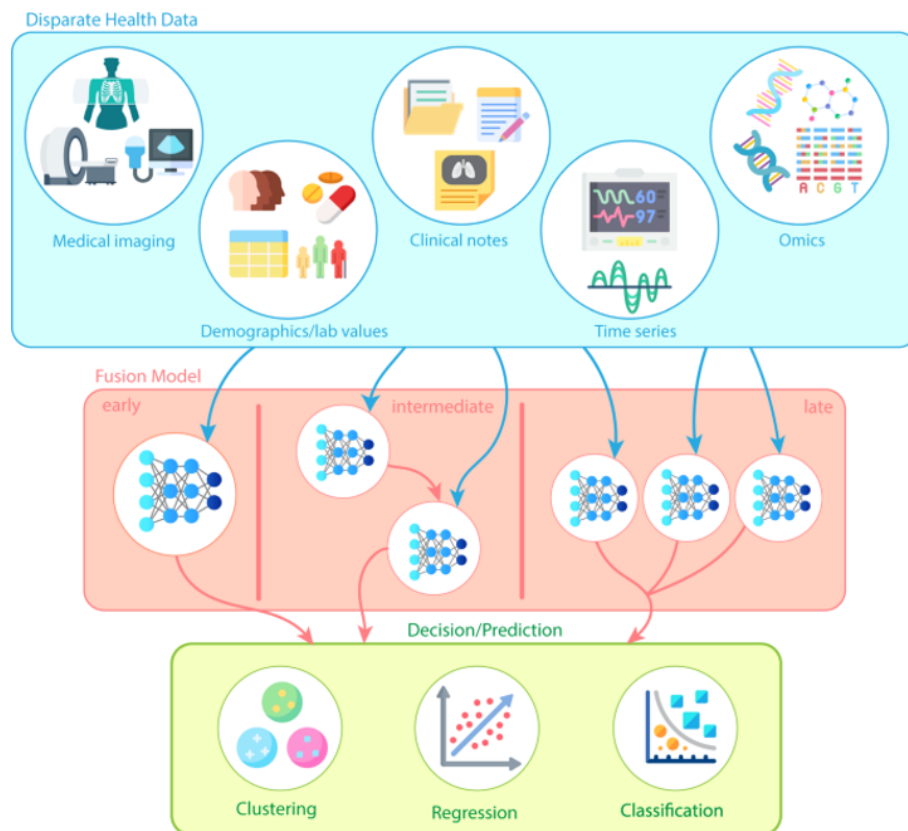


Figure 8.1. Applications of machine learning at different stages of disease

Source: Kline, A., Wang, H., Li, Y. *et al.* Multimodal machine learning in precision health: A scoping review. *npj Digit. Med.* 5, 171 (2022). <https://doi.org/10.1038/s41746-022-00712-8>

We will explore the architecture of Transformer models, a foundational component in many state-of-the-art Large Language Models (LLMs) that power today's advanced AI systems. We will break down the Transformer architecture, explain why it outperforms traditional models, and discuss how it enables machines to understand and generate human language.

We also consider applications of machine learning in precision health care, ranging from neuroimaging to electronic health record analysis to disease diagnosis and treatment to predicting disease progression. Figure 8.1 illustrates how machine learning can be applied in healthcare at different stages of a disease.

Finally, we discuss the practical methodology of machine learning approaches, including dimensionality reduction and imputation of missing values.