Chapter 8
Orchestrating Precision in Alzheimer's Disease Progression Forecasting: A Convergence of XGBoost and Random Forest Ensemble

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ABSTRACT

This study introduces a pioneering approach to forecast Alzheimer's disease progression, blending ensemble learning methods with the harmonious synergy of XGBoost and Random Forest algorithms. Through this fusion, our ensemble model orchestrates a symphony of predictive accuracy and reliability, harnessing the boosting capabilities of XGBoost and the robust tree aggregation of Random Forest. By integrating diverse datasets and employing advanced machine learning methodologies, our research aims to provide clinicians and caregivers with nuanced insights into individualized disease trajectories. This enhanced predictive modeling facilitates personalized care and intervention planning, optimizing patient outcomes and resource allocation.

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INTRODUCTION

In the grand tapestry of human existence, there exists a shadow, a specter that haunts the corridors of memory, slowly eroding the very essence of selfhood. This spectral force is Alzheimer's disease, a relentless adversary that inflicts profound devastation upon the mind and spirit. As we stand on the precipice of the 21st century, this neurological affliction casts a long shadow, touching the lives of millions and leaving an indelible mark on our collective consciousness (De-Paula et al., 2012). Alzheimer's disease, a progressive neurodegenerative disorder, strikes at the core of what it means to be human, robbing individuals of their memories, their identities, and ultimately, their lives. With each passing year, its reach extends further, its grasp tightening around the minds of those afflicted and the hearts of their loved ones. In the ceaseless march of time, Alzheimer's stands as a formidable foe, a silent assailant that strikes without warning, leaving in its wake a trail of shattered lives and broken dreams (Cipriani et al., 2011).

The statistics paint a stark picture of the toll exacted by this insidious disease. According to the World Health Organization, Alzheimer's disease is the most common cause of dementia, accounting for approximately 60-70% of cases globally (Blass, 1985). As of recent estimates, over 50 million people worldwide live with dementia, a number projected to nearly triple by the year 2050 if left unchecked (Terry & Davies, 1980). Behind these staggering figures lie stories of loss and anguish, of families torn asunder by the ravages of cognitive decline. Yet, to truly grasp the gravity of Alzheimer's disease, one must delve into its origins, tracing its lineage through the annals of medical history. The tale begins in the early 20th century, amidst the fog of scientific uncertainty and speculation. In 1906, German psychiatrist Alois Alzheimer made a pivotal discovery that would forever alter our understanding of dementia. While examining the brain tissue of a deceased patient named Auguste Deter, Alzheimer observed peculiar abnormalities, including the presence of tangled fibers and abnormal protein deposits. This seminal finding laid the groundwork for what would later be known as Alzheimer's disease, immortalizing Alzheimer's name in the annals of medical history. Yet, it would take decades of painstaking research and inquiry before the true nature of this enigmatic disease began to emerge from the shadows (Rathmann & Conner, 1984).

In the ensuing years, scientists embarked on a journey of discovery, unraveling the intricate molecular mechanisms that underlie Alzheimer's disease. They uncovered the role of beta-amyloid plaques and tau protein tangles in disrupting neuronal function, paving the way for groundbreaking advances in diagnostics and therapeutics. Yet, despite these strides, Alzheimer's disease remains a formidable adversary, its pathogenesis shrouded in complexity and ambiguity (Yiannopoulou & Papageorgiou, 2020). As the 21st century dawned, the specter of Alzheimer's