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Integrating Deep Learning and Bayesian Network for Personalized Career Guidance

Menaka gandhi M[1] and Dr. S. Chithra Devi[2]
UG Student, Department of Computer Science with Data Analytics [1]
Assistant Professor, Department of Digital and Cyber Forensic Science[2]
Sri Ramakrishna College of Arts & Science, Coimbatore, Tamil Nadu, India

Abstract: *In an era where career choices are increasingly complex due to rapidly evolving industries and skill demands, this project introduces an innovative AI-driven system that merges Deep Learning (DNN) and Bayesian Networks to deliver personalized, data- driven career recommendations. Traditional career counseling often relies on static assessments or generic advice, but this system dynamically adapts to individual profiles and real-time job market trends, offering actionable insights tailored to users' unique strengths and aspirations. At its core, the Deep Neural Network (DNN) analyzes complex datasets, including academic performance, technical skills (e.g., programming languages), extracurricular activities, and personal interests. By identifying hidden patterns, the DNN predicts career paths that align with a user's profile. For instance, a student excelling in mathematics and Python programming, coupled with an interest in robotics, might be matched with careers like data science or AI engineering. The DNN's ability to process nonlinear relationships ensures nuanced recommendations that simpler models might overlook. Complementing this, the Bayesian Network introduces probabilistic reasoning to handle uncertainties inherent in career decisions. It evaluates dependencies between variables—such as how a user's leadership experience might increase the likelihood of managerial roles—and calculates confidence scores for each recommendation. For example, a user passionate about both biology and statistics might receive probabilities like biostatistics (85%) or healthcare analytics (70%), reflecting how their skills intersect with market opportunities. To enhance transparency, Explainable AI (XAI) techniques like SHAP and LIME demystify the AI's decision-making process. SHAP quantifies the contribution of each input feature (e.g., coding skills contributed 40% to recommending software engineering), while LIME generates localized explanations, such as highlighting a user's internship experience as pivotal for a marketing career suggestion. This transparency builds trust and helps users refine their profiles. The system's adaptability is further strengthened by integrating real-time job market data from platforms like LinkedIn and Glassdoor via APIs. For example, during a surge in cybersecurity job postings, the system might prioritize this path for users with foundational IT skills, even if their experience is limited. This ensures recommendations remain relevant to current industry demands.*

Deployed as a web-based platform, the system features an intuitive interface where users input their details and receive interactive dashboards, visual career pathways, and downloadable reports. A case study illustrates its utility: a user with strong analytical skills but unclear interests might receive recommendations spanning financial analysis, data engineering, and supply chain optimization, each accompanied by salary projections, required certifications, and growth trends. Future enhancements aim to incorporate psychometric assessments and voice-based AI advisors, broadening accessibility. Continuous model retraining ensures the system evolves with labor market shifts, while rigorous testing (e.g., accuracy metrics, user feedback loops) maintains reliability. By harmonizing deep learning's predictive power with Bayesian logic's interpretability, this project bridges the gap between individual potential and market realities, offering a scalable, intelligent tool for confident career decision-making in a dynamic world..

Keywords: Deep learning, Bayesian networks, Explainable AI, Personalized career Guidance, Real-Time Job Market analysis, SHAP, LIME, Hybrid AI Models

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