

Artificial intelligence in neuro-oncology: Advances and challenges in brain tumor diagnosis, prognosis, and precision treatment

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Supplementary Materials

Supplementary Table 1. Key Concepts in AI for Neuro-Oncology: A Glossary of Terms

Artificial Intelligence (AI): A broad field of computer science aiming to create machines that can perform tasks that typically require human intelligence. In neuro-oncology, AI is used to enhance brain tumor diagnosis, prognosis, and treatment.
Machine Learning (ML): A subset of AI that enables machines to learn patterns from data and make decisions without explicit programming. ML techniques are widely applied in neuro-oncology for data analysis.
Deep Learning (DL): A type of ML using neural networks with multiple layers (deep neural networks). Deep learning is crucial in image and data analysis tasks, contributing significantly to neuro-oncology research.
Computer Vision (CV): A field of AI focusing on enabling machines to interpret and understand visual information. In neuro-oncology, computer vision is employed for tasks like medical imaging analysis.
Large Language Models (LLMs): Advanced models, like GPT-3, capable of understanding and generating human-like language. LLMs contribute to textual data analysis and interpretation in neuro-oncology.
Vision Transformers: Deep learning models specifically designed for image analysis tasks, providing an alternative to traditional Convolutional Neural Networks (CNNs).
Convolutional Neural Networks (CNN): A type of deep neural network designed for image recognition and processing. CNNs play a significant role in medical image analysis for brain tumor detection.
Single Cell RNASeq: A molecular biology technique that analyzes gene expression at the single-cell level. In neuro-oncology, it aids in understanding the molecular heterogeneity of brain tumors.
Graph Neural Networks (GNN): Specialized neural networks for analyzing graph-structured data. GNNs are applied in neuro-oncology to model complex relationships in brain tumor data.
Explainable AI (XAI): An approach in AI and ML that emphasizes transparency and the ability to understand and interpret model decisions. In neuro-oncology, XAI is crucial for gaining clinicians' trust in AI-based systems.
Generative Adversarial Networks (GANs): ML models comprising a generator and a discriminator, working in tandem to generate synthetic data. GANs find applications in data augmentation and synthesis for neuro-oncology.
Automated Machine Learning (AutoML): Tools and techniques automating the process of designing, training, and deploying ML models. AutoML facilitates easier adoption of AI in neuro-oncology by reducing the need for extensive expertise.
Graphics Processing Units (GPUs): Hardware accelerators used to enhance the computational power of computers, crucial for training complex neural networks in neuro-oncology.

Field-Programmable Gate Arrays (FPGAs): Reconfigurable integrated circuits used to accelerate specific tasks in AI applications, offering flexibility and efficiency.

Real-time Algorithms: Algorithms designed to provide results or responses within a timeframe that allows immediate action. In neuro-oncology, real-time algorithms facilitate quick decision-making.

Federated Learning: An approach to ML where models are trained across decentralized devices or servers holding local data, ensuring privacy and security in neuro-oncology applications.
