Early Identification of Autism Spectrum Disorder Using XGBoost and Convolutional Neural Network with Magnetic Resonance Imaging Data

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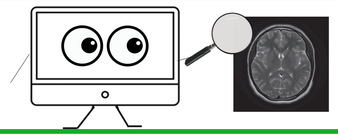
Bloorview RESEARCH INSTITUTE autism RESEARCH CENTRE

BACKGROUND

- Autism spectrum disorder (ASD) is a heterogeneous, neurodevelopmental condition that impact communication, social abilities and behaviours
- **One in 50 children** live with autism spectrum disorder (ASD) yet wait-times for diagnosis is **over 1-3 years**
- **Magnetic resonance imaging (MRI)** can detect differences in brain structure, connections and activity in children with ASD ages 2-5 compared to typically developing (TD) children
- **Machine learning models** (i.e. **XGBoost**) can analyze images (i.e. MRI) and identify patterns from complex data to make informed predictions
- Few studies have developed models to predict ASD in children ages 2-5 using MRI

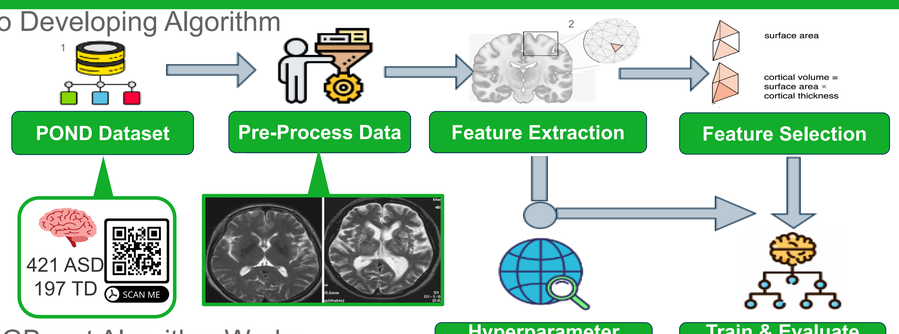
RESEARCH QUESTION

How effectively can machine learning models (i.e. **XGBoost**) **classify** ASD in children ages 2-5 using MRI brain scans?

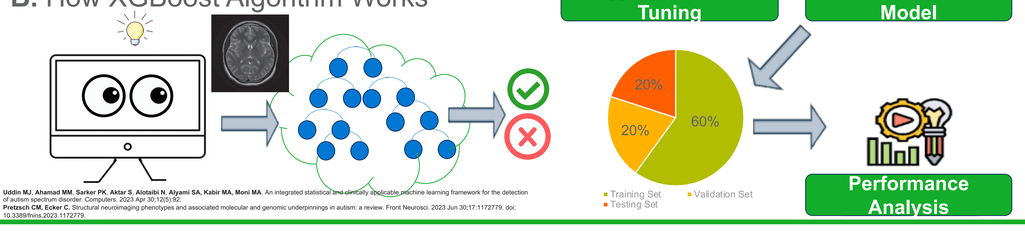


METHODOLOGY: Training an XGBoost Algorithm to Classify MRI Brain Scans

A. Steps to Developing Algorithm



B. How XGBoost Algorithm Works



1. **Uddin MJ, Ahamad MM, Sarker PK, Aktar S, Alotaibi N, Alyami SA, Kabir MA, Moni MA.** An integrated statistical and clinically applicable machine learning framework for the detection of autism spectrum disorder. Computers. 2023 Apr 30;12(5):92.
2. **Pretzsch CM, Ecker C.** Structural neuroimaging phenotypes and associated molecular and genomic underpinnings in autism: a review. Front Neurosci. 2023 Jun 30;17:1172779. doi: 10.3389/fnins.2023.1172779.

Early differences in brain structure in ASD may be informative markers for guiding diagnosis but alone are not sufficient

SCAN ME

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XGBOOST RESULTS

75.2% accuracy
in predicting ASD among children ages 2-5

96% sensitivity
in classifying ASD using 340 brain features (i.e. volume, thickness, area)

Fig 1. Area Under the Curve (AUC)

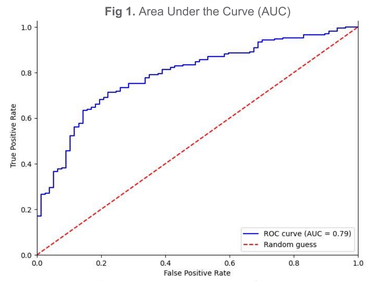


Fig 2. Confusion Matrix

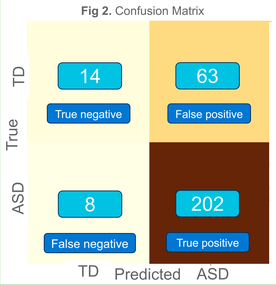
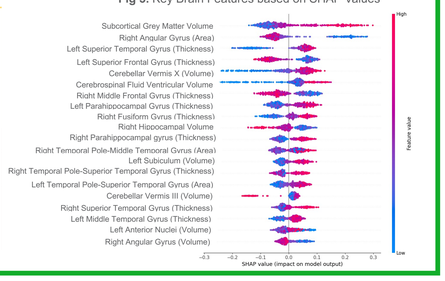


Fig 3. Key Brain Features based on SHAP Values



DISCUSSION

Potential: Highlights utility of developing age-specific machine learning models for ASD on children ages 2-5. Early MRI scans may overcome the complexity heterogeneity in ASD.

Relevance: Guide diagnosis, reduce wait-times for assessment and access to services for young children with ASD

Limitations: Few subjects, need to assess generalizability

Next Steps: (A) Evaluate model performance in distinguishing anxiety, OCD and ADHD. (B) Compare performance with **convolutional neural network**