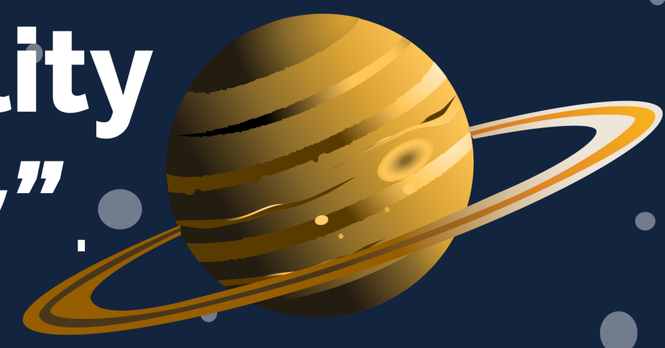
“**Machine learning models** can learn from existing data and **predict habitability** of an exoplanet with ***99% accuracy***”.



Using Machine learning to look to habitable planets

INTRODUCTION

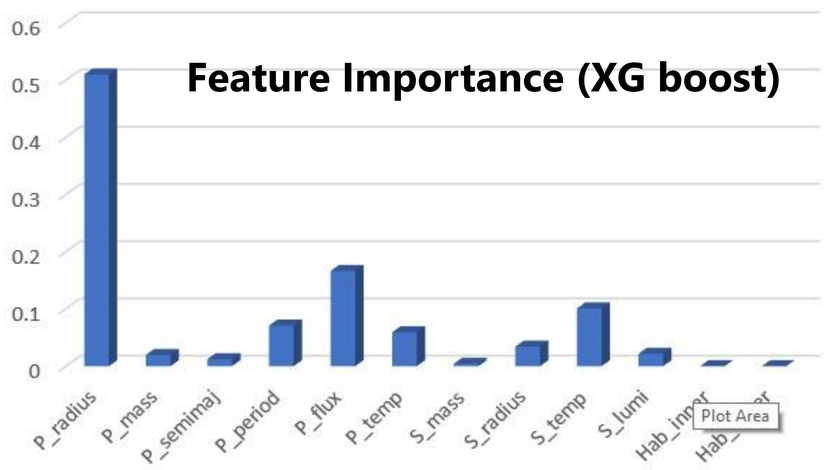
- **Growing need** to manage **terabytes** of astronomical data produced **every night**.[1]
- Machine learning provides **efficient models** to deal with large data sets.[2]
- Will **assess** these models’ **potential** as habitability classifiers.

METHODS

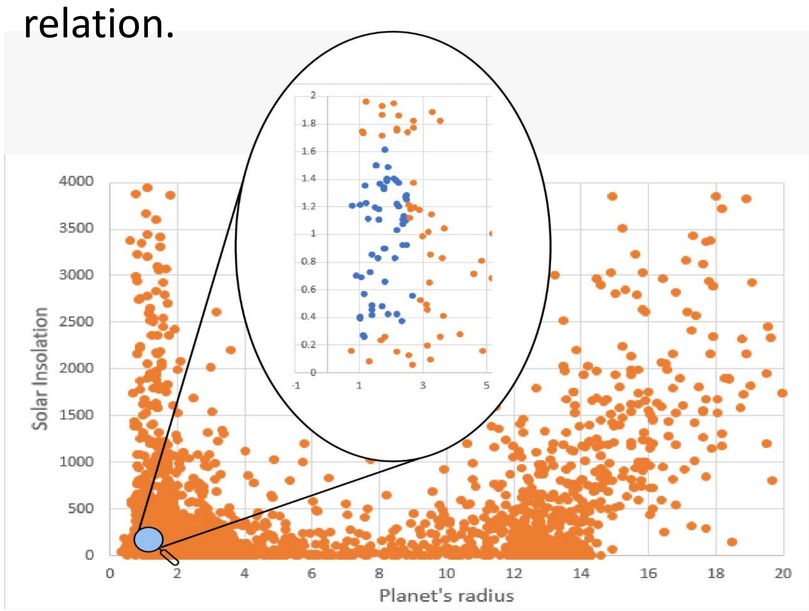
1. Worked on **Habitable Exoplanet Catalog**.[3]
2. Prepared data representing habitability [4], used **70% for training** & reserved **30% for final testing** of the model.
3. **Importance** given to **features** by each predictive model was determined.

RESULTS & DISCUSSION

Model	Accuracy
Neural Network	97.48%
Random forest	99.54%
Ada Boost	99.66%
XG Boost	**99.89%**



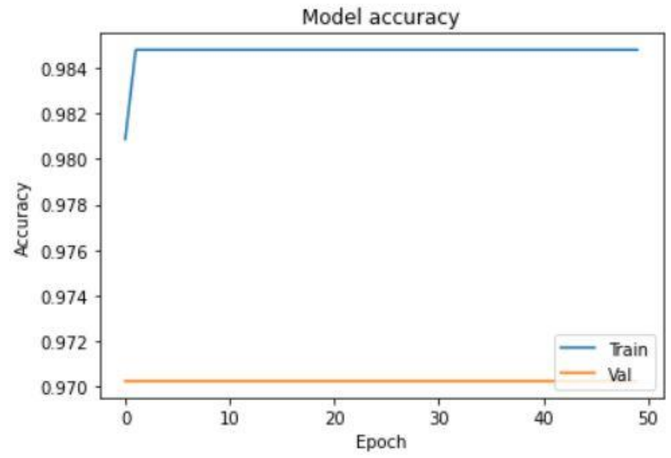
XG boost indicated that **Planet’s radius** and **Solar insolation** are most importance when **determining** habitability of an exoplanet. The graph below highlights this relation.



Features chosen for the data used

Planetary features:	Stellar features:	Habitability features:
Mass (Earth Masses)	Mass (Solar Units)	Hab-zone inner radius (AU)
Radius (Earth Radii)	Radius (Solar Units)	Hab-zone outer radius (AU)
Period (Days)	Effective Temperature (K)	Habitability flag (0 or 1)
Semi-Major Axis (AU)	Star Luminosity (Solar units)	
Equilibrium Temperature (K)		
Solar Insolation(Earth Units)		

Connected Neural Network



XG boost report

```
Confusion Matrix:
[[858   0]
 [  1  15]]
Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00       858
           1       1.00      0.94      0.97        16

    accuracy                           1.00       874
   macro avg       1.00      0.97      0.98       874
weighted avg       1.00      1.00      1.00       874

Accuracy: 99.89%
```

References:

[1] Kremer, J., Stensbo-Smidt, K., Gieseke, F., Pedersen, K. S. & Igel, C. Big Universe, Big Data: Machine Learning and Image Analysis for Astronomy. *IEEE Intell. Syst.* **32**, 16–22 (2017).

[2] Basak, Suryoday, et al. Habitability Classification of Exoplanets: A Machine Learning Insight. arXiv:1805.08810 **[astro-ph.IM]** (2018)

[3] PHL’s catalog: http://phl.upr.edu/projects/habitable-exoplanets-catalog/data/database

[4] Deeg, H. J. *Handbook of exoplanets* (Springer, 2018)

ODTÜ

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