Identifying exoplanets from Kepler light curves: a partial replication of a deep learning study by Shallue and Vanderburg

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Introduction

This study aimed to partially replicated the work of Shallue and Vanderburg [1] on their *AstroNet* deep learning model to identify exoplanet from Kepler light curves data using transit photometry.

Installation

The installation process shed light on

- The software versioning is critical for implementing the model.
- 5 failed test units during the model test builds with Bazel remain unresolved.

Metrics

Analysing the model produced metrics in line with those reported by Shallue and Vanderburg.

- Mean Accuracy = 0.959; Mean AUC = 0.989.
- A similar precision vs recall curve on the test dataset.

Static analysis

Static analysis over the AstroNet source code using Pylint raised a total of 4158 messages. Most of them resulted in style not follwing Pylint's convention. Examination of the messages concluded they could be all flags as False Positive.

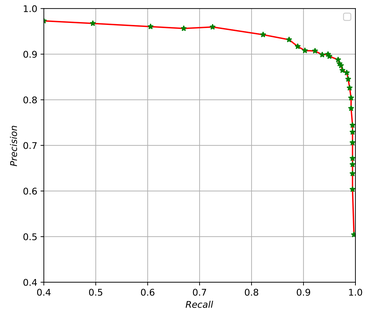
Conclusion

This partial replication support the results of the model analysis undertaken by Shallue and Vanderburg upon their *AstroNet* model.
The source code is clean and the style is consistent, although does not follows Pylint convention.

Replication confirms the **performance** of the Shallue and Vanderburg *AstroNet* model for exoplanet identification.

Take a picture to download the full paper

Precision vs. Recall for the test data set:



Static analysis results

Package	Number of subpackages	Number of modules	Total pylint messages	Number of message: Refactor	Convention	Warning	*Indentation warning*	Error	Fatal
				Pylint					
exoplanet-ml/	**5**	**72**	**4158**	**111**	**370**	**3503**	***3490***	**174**	**0**
exoplanet-ml/astronet/	9	32	1674	25	140	1418	*1415*	91	0
exoplanet/astrowavenet/	2	13	1036	25	60	905	*899*	48	0
exoplanet/light_curve/	2	13	757	14	120	610	*608*	13	0
exoplanet/tf_util/	0	8	358	4	21	315	*315*	18	0
exoplanet/third_party/	2	6	333	45	29	255	*253*	4	0
number of different message			24	9	7	5	*(1)*	3	0

New Candidate

In addition to the model analysis, the best trained model has been applied to investigate 2421 unconfirmed exoplanet candidates from the Kepler Object of Interest table. 63 signals generated prediction probabilities above 0.99.

KIC ID	KOI ID	Period (days)	Epoch (days)	Duration (days)	Prediction
5770074	K01928.01	63.038	169.122	7.370	0.996
5629353	K06132.01	33.320	150.049	6.527	0.996
8480285	K00691.01	29.666	189.369	8.412	0.996
5020319	K00635.01	16.720	171.401	3.317	0.995
10386922	K00289.01	26.629	191.996	7.871	0.995
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References

[1] Shallue, C. J., and Vanderburg, A. Identifying exoplanets with deep learning: A five-planet resonant chain around kepler-80 and an eighth planet around kepler-90. *The Astronomical Journal 155*, 2 (jan 2018), 94.

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