

Measuring the angular distribution fo the cosmological parameters.

Martín de los Rios & Mariano Domínguez

March 30, 2017

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 - Supervised learning.
 - Machine Learning in physics.

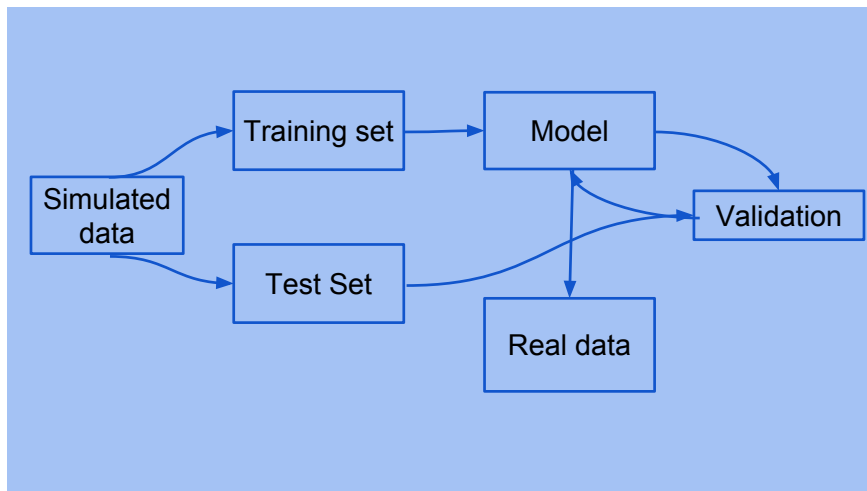
- 2 Basic Concepts of Cosmology.
 - What are the cosmological parameters?
 - How can we measure the cosmological parameters?

- 3 Measuring the Cosmological Parameters.
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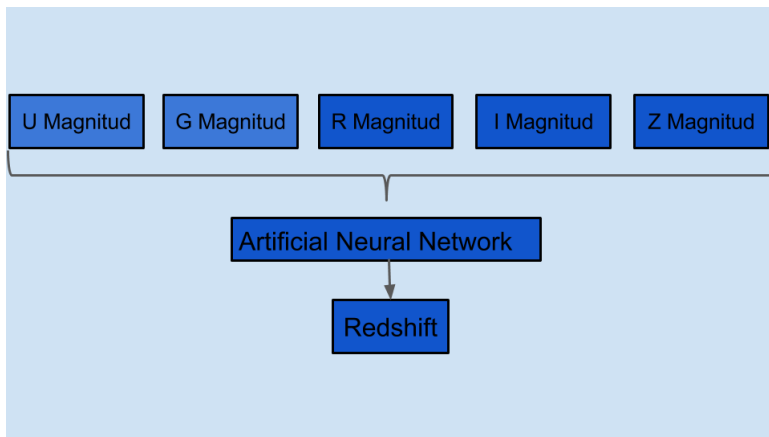
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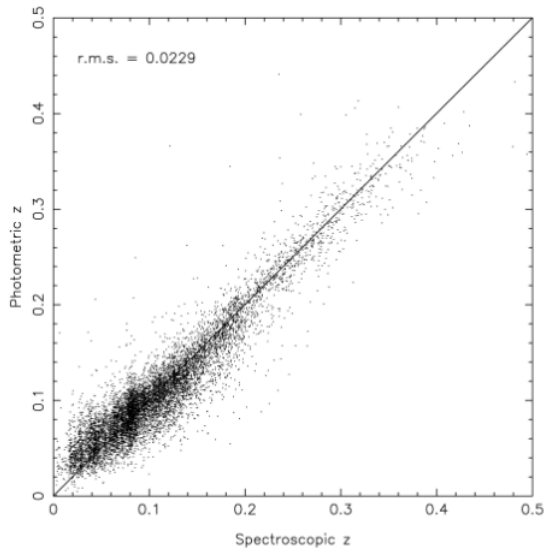
Supervised Learning.



Simple Example:ANN-z

ANNz: Estimating photometric redshift using artificial neural network. Collister & Lahav 2003 (0311058)





1. [arXiv:1703.06236 \[pdf, other\]](#)**Discovering the Building Blocks of Atomic Systems using Machine Learning**

Conrad W. Rosenbrock, Eric R. Homer, Gábor Csányi, Gus L. W. Hart

Comments: 8 pages, 4 figures, 1 table

Subjects: **Materials Science (cond-mat.mtrl-sci)**; Computational Physics (physics.comp-ph)2. [arXiv:1703.05402 \[pdf, other\]](#)**Experimental Quantum Hamiltonian Learning**

Jianwei Wang, Stefano Paesani, Raffaele Santagati, Sebastian Knauer, Antonio A. Gentile, Nathan Wiebe, Maurangelo Petruzzella, Jerem Mark G. Thompson

Subjects: **Quantum Physics (quant-ph)**3. [arXiv:1703.05334 \[pdf, other\]](#)**Many-body quantum state tomography with neural networks**

Giacomo Torlai, Guglielmo Mazzola, Juan Carrasquilla, Matthias Troyer, Roger Melko, Giuseppe Carleo

Subjects: **Disordered Systems and Neural Networks (cond-mat.dis-nn)**; Quantum Gases (cond-mat.quant-gas); Computational Physics (physics.comp-ph); Quantum P4. [arXiv:1703.05210 \[pdf, other\]](#)**Neural Networks retrieving Boolean patterns in a sea of Gaussian ones**

Elena Agliari, Adriano Barra, Chiara Longo, Daniele Tantari

Comments: 16 pages, 1 figure

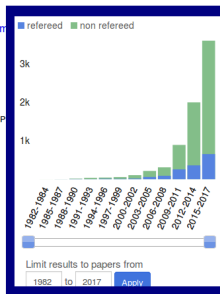
Subjects: **Mathematical Physics (math-ph)**; Disordered Systems and Neural Networks (cond-mat.dis-nn)5. [arXiv:1703.05084 \[pdf, ps, other\]](#)**Astrophysics and Big Data: Challenges, Methods, and Tools**

Mauro Garofalo, Alessio Botta, Giorgio Ventre

Comments: 4 pages, 1 figures, proceedings of the IAU-325 symposium on Astroinformatics, Cambridge University press

Subjects: **Instrumentation and Methods for Astrophysics (astro-ph.IM)**6. [arXiv:1703.04351 \[pdf, other\]](#)**Model-independent search for neutrino sources with the ANTARES neutrino telescope**

A. Albert. M. André. M. Anohinolfi. G. Anton. M. Ardid. J.-J. Aubert. T. Avila. B. Baret. J. Barrios-Marti. S. Basa. V. Bertin. S. Bica. R. Bormuth. S. Bourret. M.C. Bouwhuis. R. Bruijn. J.



Limit results to papers from

1982

to

2017

Apply

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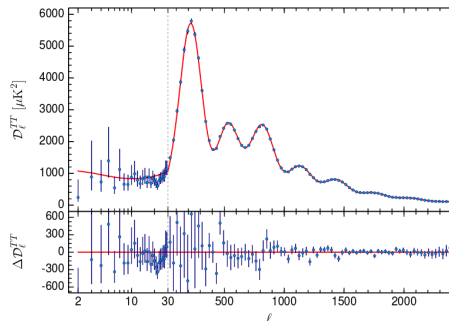
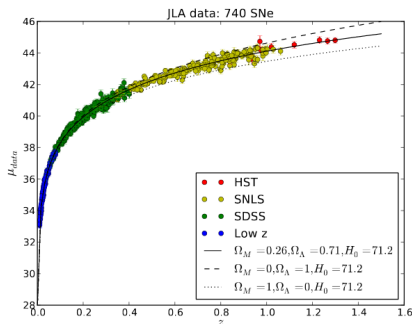
What are the cosmological parameters?

Homogeneous and isotropic Universe \rightarrow FRW metric

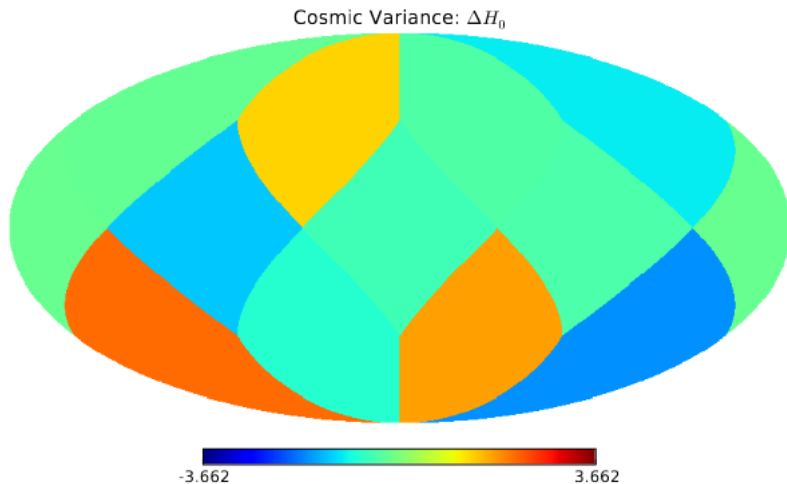
$$ds^2 = dt^2 - a^2(t) \left[\frac{dr^2}{1-kr^2} + r^2(d\theta^2 + \sin^2\theta d\phi^2) \right]$$

$$\left(\frac{H}{H_0}\right)^2 = \Omega_{rad}a^{-4} + \Omega_m a^{-3} + \Omega_\Lambda - Kc^2a^{-2}$$

How can we measure the cosmological parameters?



Carvalho & Marques 2015 (1512.07869) Planck Collaboration 2015 (1502.01589)

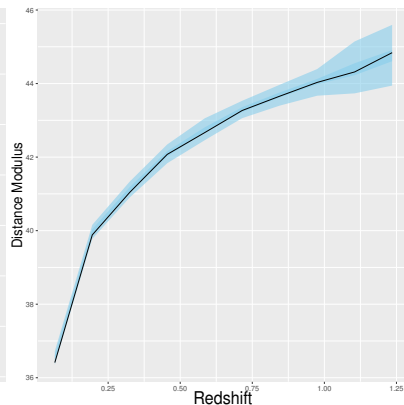
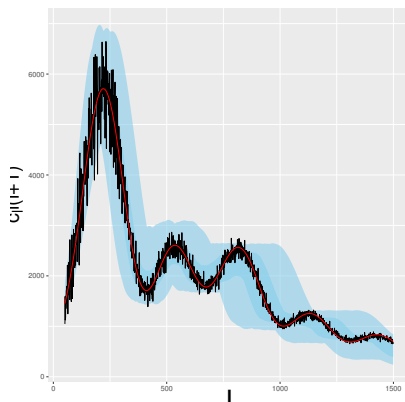


Carvalho & Marques (1512.07869)

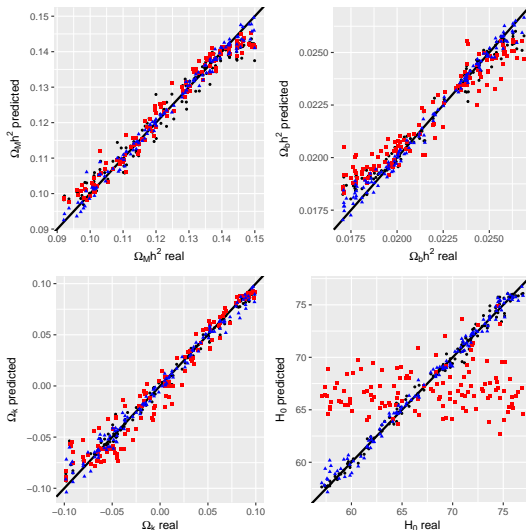
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The training sample.

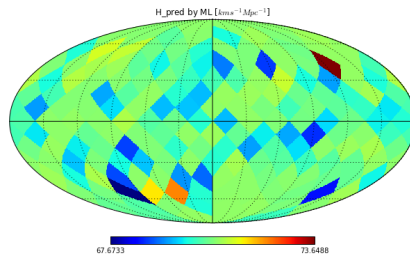
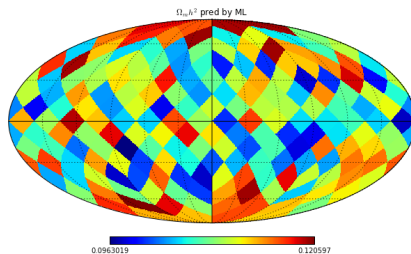
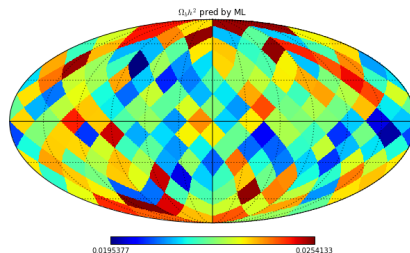
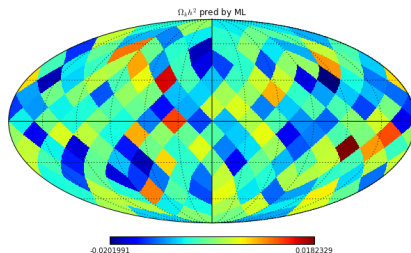
CAMB: Code for Anisotropies in the Cosmic Background
(REFERENCIA)

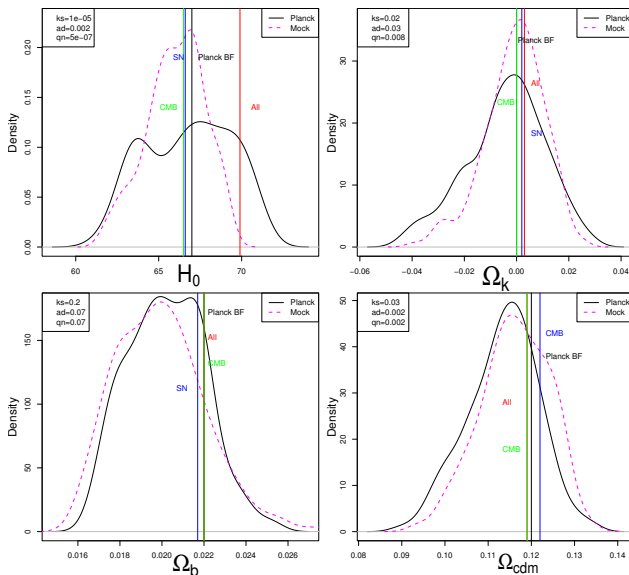


Studying different Machine Learning algorithms.



First Results.





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Final Remarks

- We developed a machine learning technique that estimate the cosmological parameters in a more efficient way, and allow us to measure the angular distribution of this parameters.
- This technique can be easily extended to use more cosmological information as features (BAO, correlation function, SZ emission).
- We do not found statistically significant departures from what is expected in an homogeneous and isotropic universe, with the possible exception of a bi-modal H_0 distribution.
- We will extend the parameters space and add polarization information in a forthcoming work.
- We will analyze the correlations between the angular distribution of the cosmological parameters and the large scale structure (voids, filaments, etc.)