The Dependence of Cooling and Heating Functions on Local Radiation Fields

David Robinson
Collaborators: Camille Avestruz, Nick Gnedin
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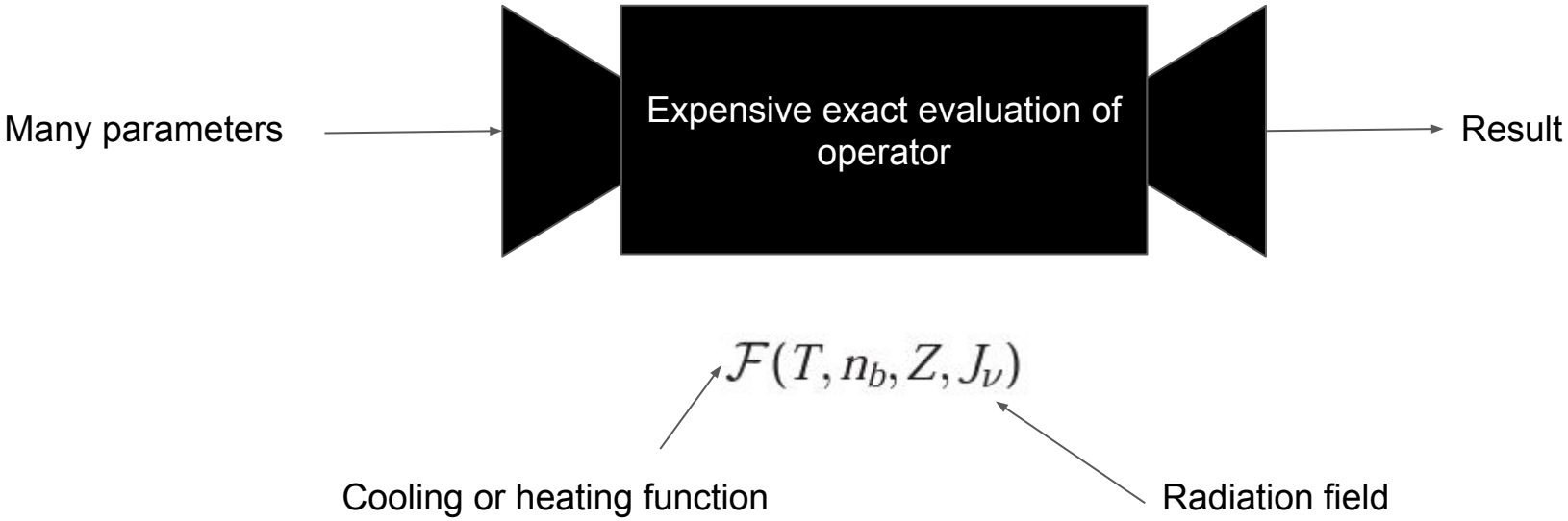
Approximating operators: general problem



If the operator is linear…

Known solution: principal component analysis (PCA)!

But what is the non-linear version of PCA?

No generic solution, but an opportunity to apply machine learning

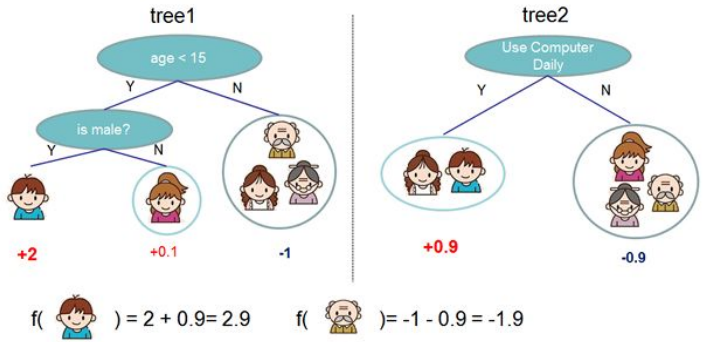
What kind of machine learning approach?

Tabular training data

Λ(Z) or Γ(Z)	T	n_b	J_0	τ_0	f_Q	α

Gas properties | Radiation field

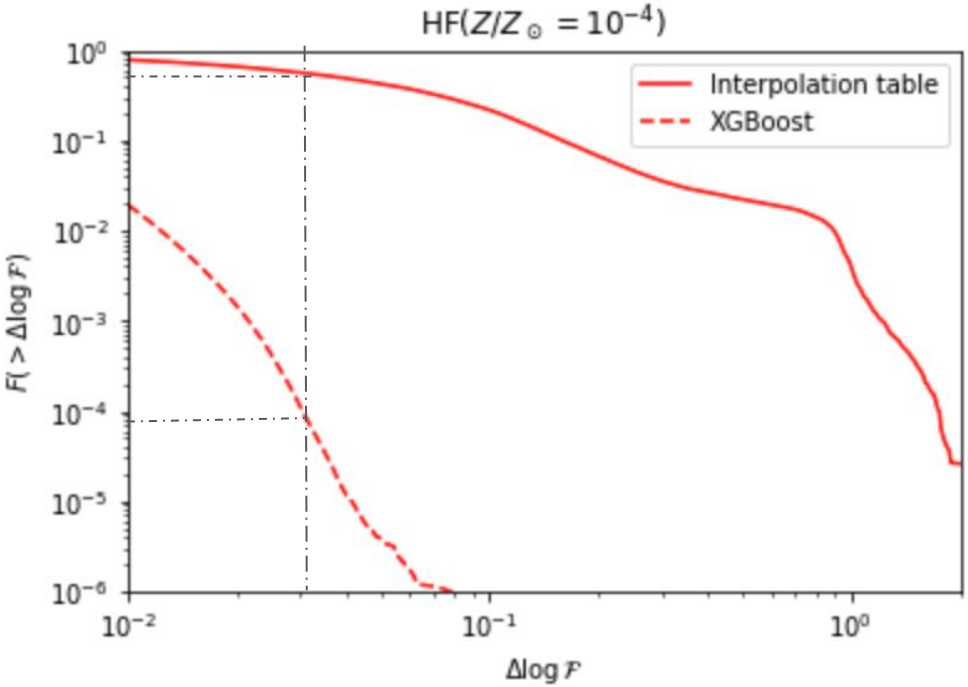
Gradient boosted trees (XGBoost)



Chen and Guestrin 16

XGBoost can outperform an interpolation table

Evaluated on the training data



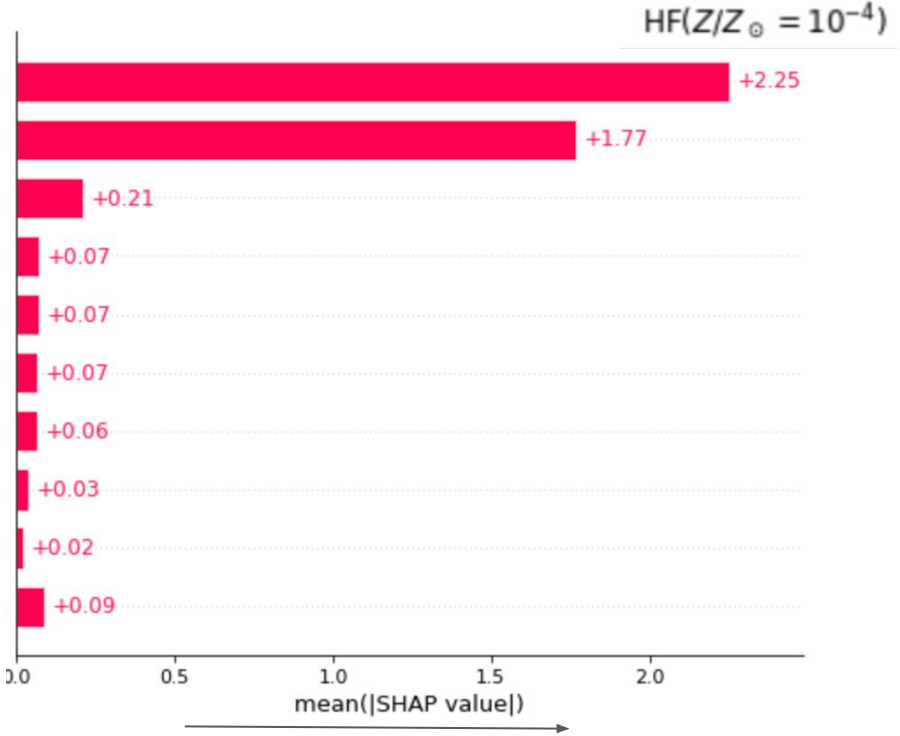
More frequent

Larger errors

But PCA also tells us which variables are most influential

Feature importances with *shap*

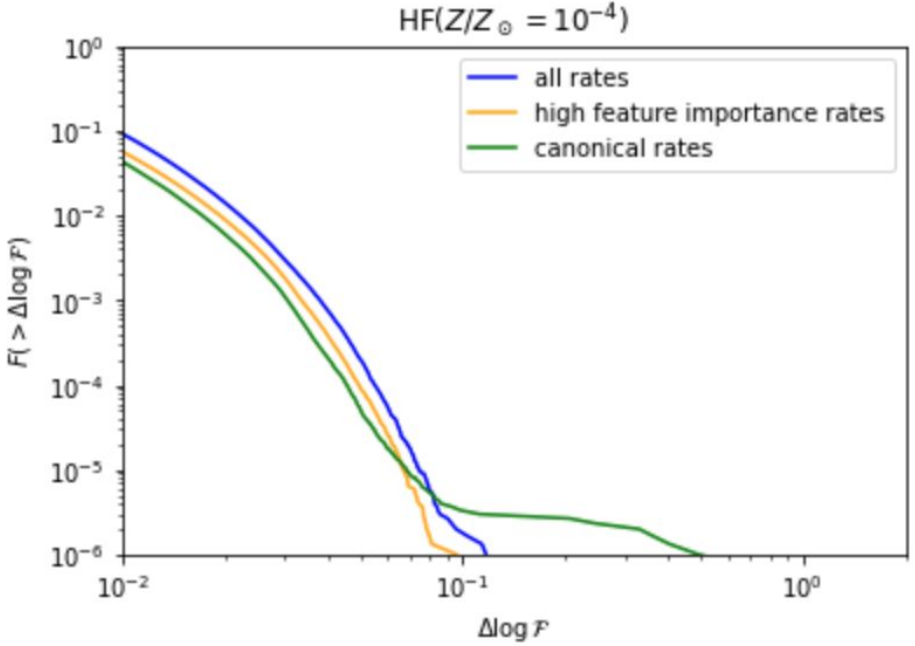
Input features that contribute more to model predictions



"Average contribution to model prediction"

Are the most important rates more predictive?

There are tradeoffs in performance between different rate choices



Evaluated on test data withheld from training