

Predictive Health Analytics

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HAC Realizations

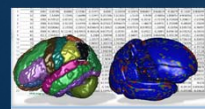
- ❑ The Low-Hanging Fruit may already be Harvested
- ❑ The Era of High-Energy Signals is Over (available data instruments)
- ❑ One-to-One effects are mostly known & understood
 - ❑ GWAS, single gene/SNP \leftrightarrow Phenotype relations
 - ❑ Prediction of univariate clinical outcomes
 - ❑ Simple (linear) causal, moderation, & medication effects
- ❑ Big Data, advanced mathematical models, statistical computing methods, and machine-learning techniques are critical for untangling deeper systems, network, and multivariate clinical phenotypes & complex health traits



Some Recent HAC Findings ... (PD Falls)

- ❑ Investigate falls in PD patients using clinical, demographic and neuroimaging data from two independent initiatives (UMich & Tel Aviv U)
- ❑ Four specific **challenges**
 - ❑ Challenge 1, harmonize & aggregate complex, multisource, multisite PD data
 - ❑ Challenge 2, identify salient predictive features associated with clinical traits,
 - ❑ Challenge 3, forecast patient falls and evaluate the classification performance
 - ❑ Challenge 4, predict tremor dominance (TD) vs. posture instability and gait difficulty (PIGD)
- ❑ **Results:** model-free machine learning based techniques provide a more reliable clinical outcome forecasting, e.g., falls in Parkinson's patients, with classification accuracy of about 70-80%.

Method	acc	sens	spec	ppv	npv	lor	auc
Logistic Regression	0.728	0.537	0.855	0.710	0.736	1.920	0.774
Random Forests	0.796	0.683	0.871	0.778	0.806	2.677	0.821
AdaBoost	0.689	0.610	0.742	0.610	0.742	1.502	0.793
XGBoost	0.699	0.707	0.694	0.604	0.782	1.699	0.787
SVM	0.709	0.561	0.806	0.657	0.735	1.672	0.822
Neural Network	0.699	0.610	0.758	0.625	0.746	1.588	
Super Learner	0.738	0.683	0.774	0.667	0.787	1.999	



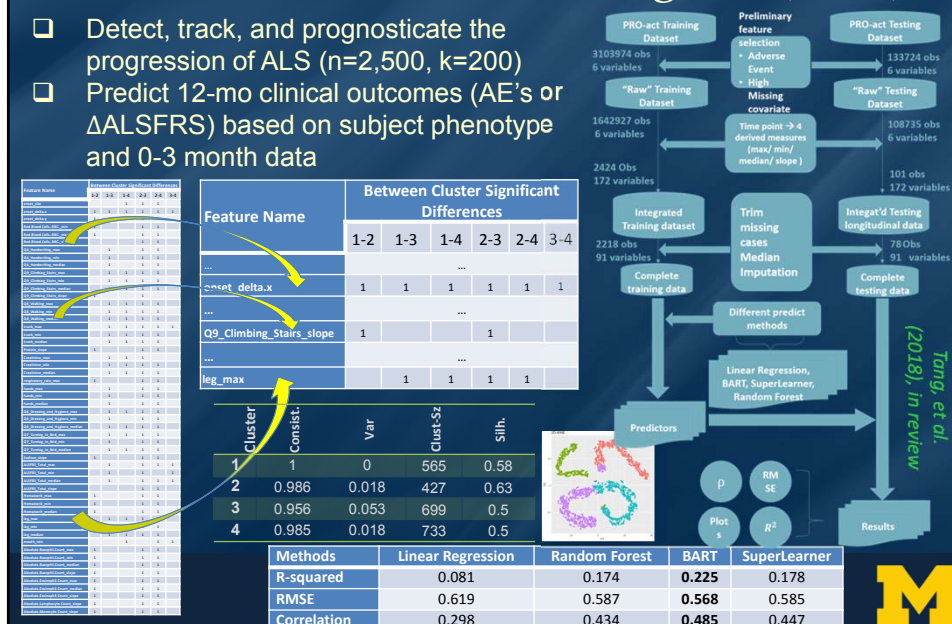
Gao, et al. SREP (2018), in press

<https://github.com/SOCR/PBDA>



Some Recent HAC Findings ... (ALS)

- ❑ Detect, track, and prognosticate the progression of ALS (n=2,500, k=200)
- ❑ Predict 12-mo clinical outcomes (AE's or Δ ALSFRS) based on subject phenotype and 0-3 month data



Some Recent HAC Findings ... (CBDA)

	Reference		
Prediction	AD	MCI	Normal
AD	69	17	1
MCI	12	243	8
Normal	0	9	140
Overall Statistics			
Accuracy	0.9058 [95% CI = (0.8767, 0.93)]		
No Information Rate	0.5391		
P-Value [Acc > NIR]	<2e-16		
Kappa	0.8426		
McNemar's Test P-Value	0.589		
Statistics by Diagnostic Class			
	AD	MCI	Normal
Sensitivity	0.8519	0.9033	0.9396
Specificity	0.9569	0.9130	0.9743
Positive Pred Value	0.7931	0.9240	0.9396
Negative Pred Value	0.9709	0.8898	0.9743
Prevalence	0.1623	0.5391	0.2986
Balanced Accuracy	0.9044	0.9082	0.9569

CBDA multinomial classification results (ADNI)

Marino, et al., 2018 (in review)

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