Classifying Olympic Athletes By Sport and Event

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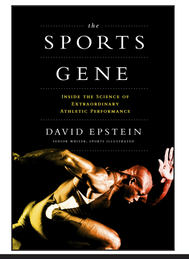


Motivation

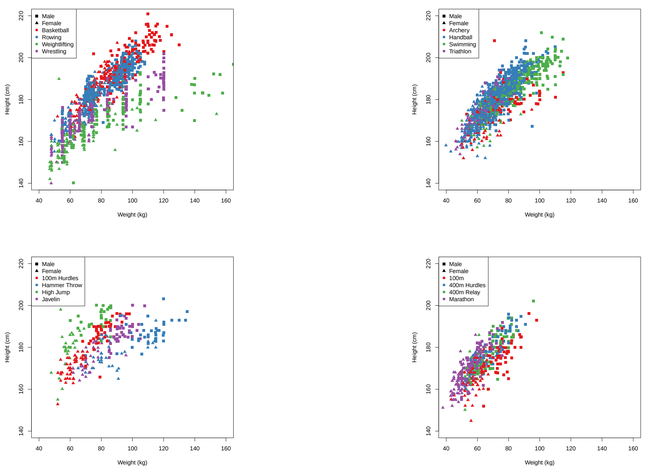
To what extent do biological traits determine sporting success? At the highest level of amateur sports–the Olympic games–we see differences in the physical characteristics of participants across sports. Can these differences be exploited to classify individuals by sport or event given their physical attributes?

This project was inspired by a claim made by David Epstein, author of *The Sports Gene*. This claim is expressed in an interview with Russ Roberts:

> **Roberts**: [You argue that] if you simply had the height and weight of an Olympic roster, you could do a pretty good job of guessing what their events are. Is that correct?
> **Epstein**: That's definitely correct. I don't think you would get every person accurately, but... *I think you would get the vast majority of them correctly.* And frankly, you could definitely do it easily if you had them charted on a height-and-weight graph, and I think you could do it for most positions in something like football as well.

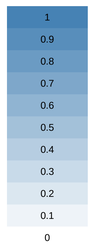
Data

Data was obtained for 10,383 participants in the 2012 London Olympics from *The Guardian*. The processed data consists of 8,856 complete cases. Of these, 6,956 participants were split into training (n=3,520) and test (n=3,436) sets for classification by sports ($k = 27$). The remaining 1,900 Athletics participants were split into training (n=907) and test (n=993) sets for classification by event ($k = 48$). Participants' height, weight, age, and sex were used as features. Some sports and events exhibit relatively well-clustered features, whereas others are less defined.



Methodology

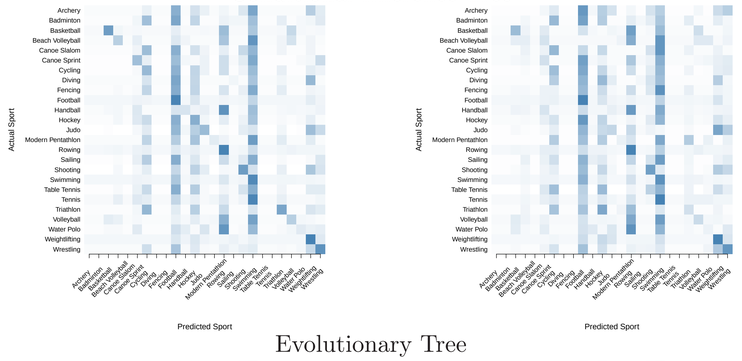
Several machine learning methods were applied to this classification problem. Conditional inference trees were formed by recursive binary partitioning. Evolutionary trees were constructed to be globally optimal by minimizing the misclassification rate. Breiman's Random Forest algorithm was used with 500 trees. Single-hidden-layer neural networks were constructed with 30 units in the hidden layer for sport classification and 50 for event classification.



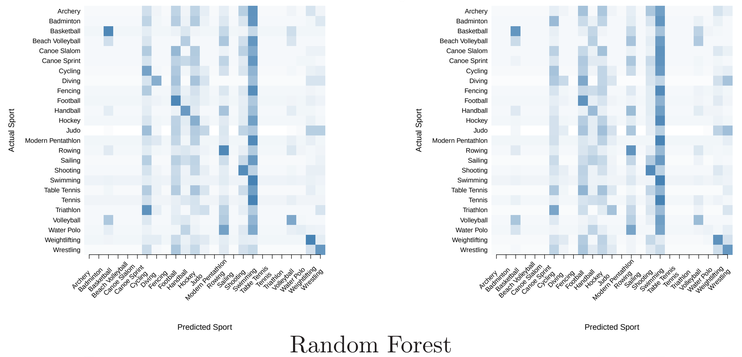
The columns at right present the results visually, with row-normalized observed frequencies. The figure at left serves as a legend for all heatmaps.

Classification by Sport

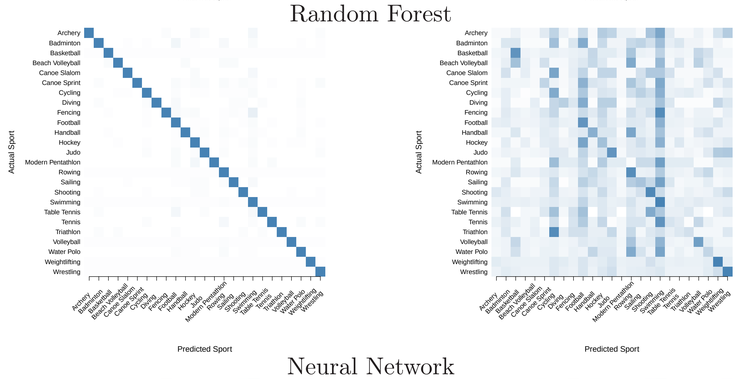
Conditional Inference Tree



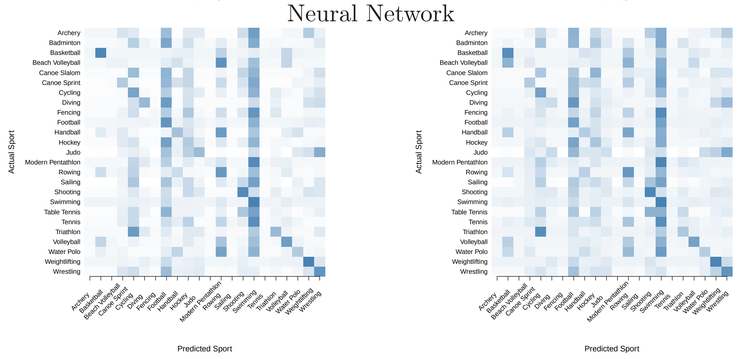
Evolutionary Tree



Random Forest

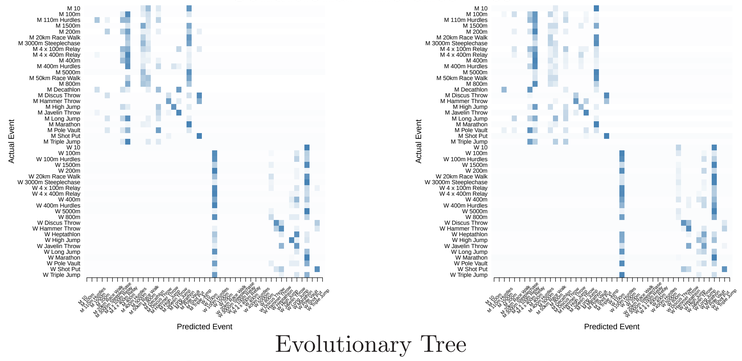


Neural Network

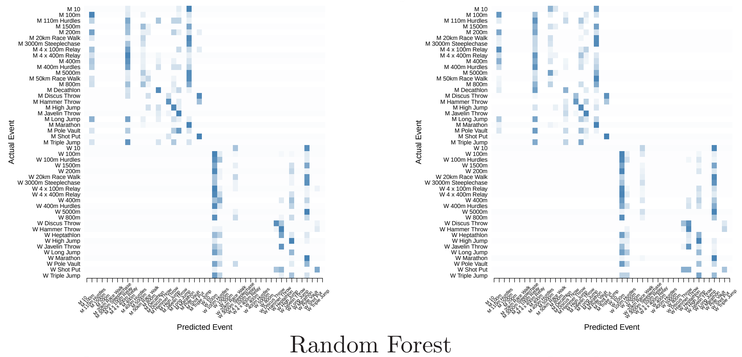


Classification by Event

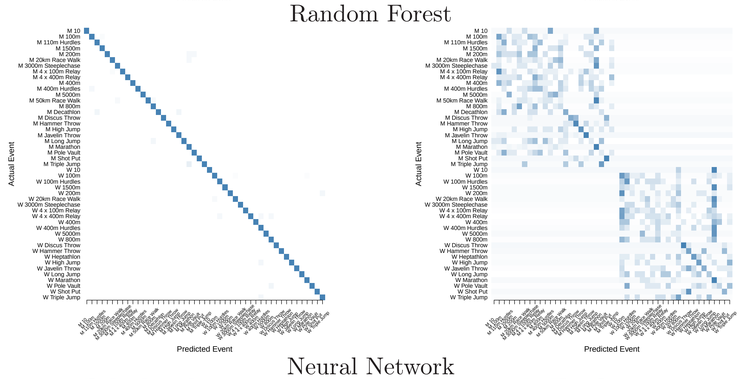
Conditional Inference Tree



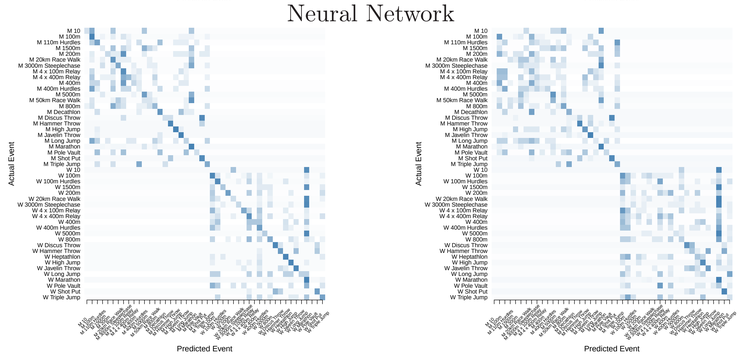
Evolutionary Tree



Random Forest



Neural Network



Accuracy

Evolutionary trees and neural networks both exhibit higher accuracy for events than sports, and maintain acceptable out-of-sample accuracy. Conditional inference trees do slightly less well for both training and test sets. Random forests tend to overfit the training data but still do well on the test set. Overall, this appears to be a difficult classification problem.

	Sports			Events		
	Train	Test	Ratio	Train	Test	Ratio
Conditional Inference Tree	.279	.219	.784	.277	.218	.787
Evolutionary Tree	.292	.236	.807	.303	.230	.757
Random Forest	.923	.244	.265	.976	.228	.233
Neural Network	.280	.265	.949	.397	.249	.623

Discussion

- Classifying athletes by sport can be achieved with moderate accuracy using only a few features
- Additional features such as arm length and torso length could improve predictive accuracy
- Traits of athletes in some sports and events exhibit noticeable clustering, while other categories are less distinct (multi-modal)
- Above a minimum threshold of physicality, success in many sports is dependent on training
- Athletes in some sports and events have a well-defined body type, but Olympians exhibit a wide range of physical features