

Do bots have a soul?: Investigating the role of psychological characteristics in detecting different types of Twitter bots



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Abstract

Behaviours on OSN accounts can be quantified using psychological profile models in order to paint a picture of a person's behaviour. By breaking down someone's psychological profile with the help of the Big Five model and Attachment Orientation model we can make distinctions and group people in order to identify consistent psychological characteristics on bot users. Using this information and machine learning (ML) models, we show that psychological profiles are a valid method of bot-human identification. Furthermore, we perform statistical analysis to rationalize and explain some of the results extracted by the data. We also compare the results of these features to state-of-the-art machine learning features. Additionally, we also use the same methodology to show differences in personality patterns between types of bots and how they differentiate themselves from each other.

Bot vs Human Analysis

Some key insights found when comparing human users to bots when it comes to their psychological characteristics were:

- Humans and bots display similar levels of neuroticism, meaning that bots display negative emotions in a lot of the same ways that human can. This is very noticeable when humans are compared to political bots.
- Humans in general, seem to show a lot of similarity to political bots, probably due to how human like they are constructed.
- Unsurprisingly, humans are very similar to cyborgs, account that receive direct human input.
- Bots and humans are diametrically opposed when it comes to their openness, chalked up to the inability of bots to display varied behaviours or have a larger purpose.
- Bots display a lot more anxiety than humans when it comes to their attachment orientations, due to the fact that bots require approval and need to seek attention by design.
- Humans also show a huge gap between them and social bots on their profiles.

A model to identify bots psychologically

Using an experimental setup of 4 different models of features to identify bots with the help of machine learning, the following methods were tried:

1. Psychological profiles: A set of features based on the Big Five and Attachment Orientations model.
2. Conventional Features: Features based on Profile Statistics, Content, Sentiment, Network graphs and Temporal Synchronicity.
3. IBM and Emotional: A model using our own psychological profiles along with IBM's personality insights service.
4. All the previous models together.

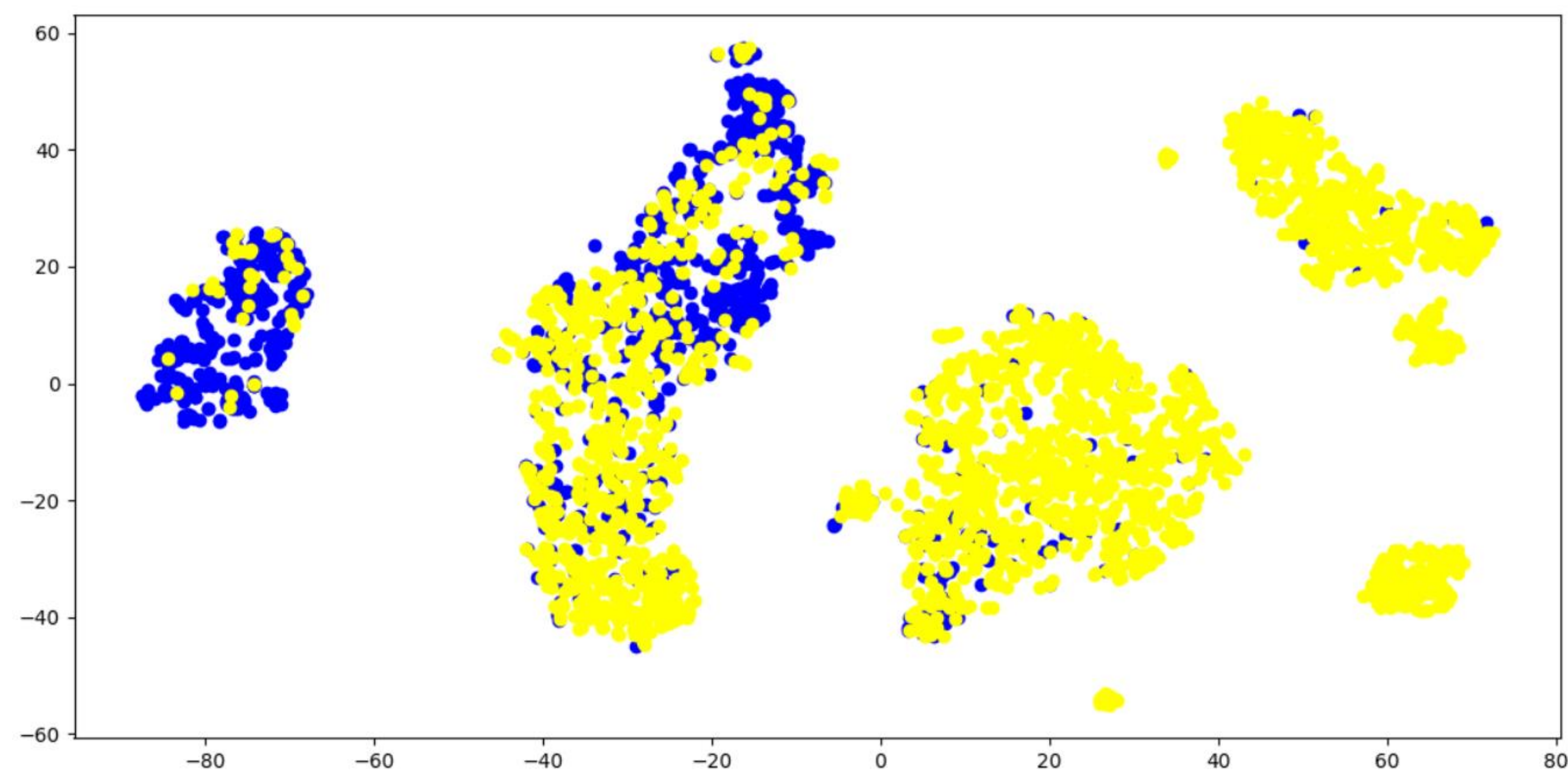


Figure 1. TSNE of Bot users (Blue) and Humans (Yellow) based on their psychological profiles

Accuracy Metrics

Table 1. Accuracy of bot identification.

Accuracy	Emotional Features	Conventional Features	IBM+Emotional	All
Logistic Regression	0.75	0.93	0.85	0.94
Decision Tree	0.79	0.91	0.86	0.91
Random Forest	0.87	0.95	0.93	0.95
Gradient Boosting	0.81	0.93	0.92	0.94

Table 2. False Positive and false negative values in identification

FP, FN	Emotional Features	Conventional Features	IBM+Emotional	All
Logistic Regression	34% FB, 28% FH	7% FB, 6% FH	13% FB, 21% FH	5% FB, 5% FH
Decision Tree	19% FB, 32% FH	8% FB, 9% FH	16% FB, 17% FH	6% FB, 11% FH
Random Forest	9% FB, 19% FH	2% FB, 5% FH	2% FB, 11% FH	5% FB, 4% FH
Gradient Boosting	20% FB, 26% FH	7% FB, 6% FH	4% FB, 10% FH	6% FB, 5% FH

Random Forest was the best performing classifier across the board.

Anxiety, Avoidance and Neuroticism were the best performing psychological features.

Bots had an extremely low misclassification rate.

Conclusions

Conclusions highlight the gap, that being their bigger differences when it comes to their personality profiles, that some bots have to bridge for their behaviours to be psychologically human like but some types of bots are already pretty close. Taking advantage of the existing gap, we can with good accuracy detect bots based on their profiles and improve on this method with better data in the future.

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