

Project 1

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Highest Accuracy

The use of all four data types gave the highest accuracy of 0.9, with an average recall of 0.9, average precision of approximately 0.904 and an average confusion matrix of $\begin{bmatrix} 5.4 & 0.6 \\ 0.6 & 5.4 \end{bmatrix}$. This was expected because the use of more information is generally associated with a better prediction. In addition to this, the Systolic Blood Pressure alone had an accuracy very similar, of 0.89, with an average recall of 0.883, average precision of 0.905 and an average confusion matrix of $\begin{bmatrix} 5.4 & 0.6 \\ 0.7 & 5.3 \end{bmatrix}$.

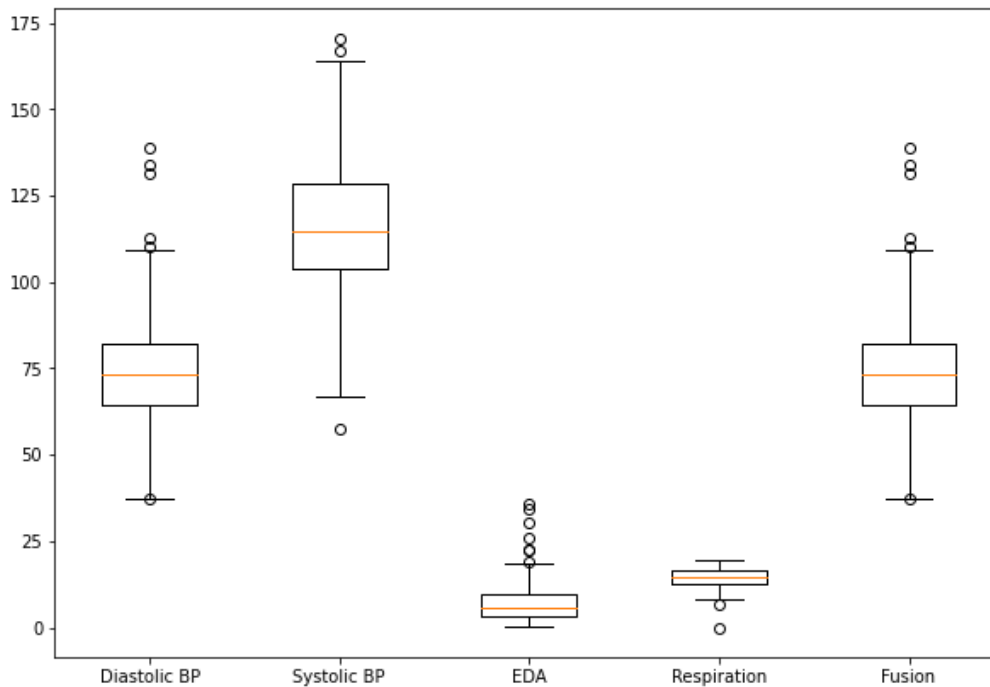
Systolic pressure is the force of the blood against the artery walls when the heart pumps. Pain increases blood pressure by increasing sympathetic activity. Sympathetic system plays the most important role in the regulation of blood pressure. This system is a division of the autonomic nervous system that prepares the body for stress conditions. And it is also activated in stress conditions (Sympathetic Nervous System, 2020). Systolic pressure can spike up substantially if the person has low pain tolerance. People with higher pain tolerance have a higher threshold before their blood pressure shoots up well beyond the healthy point if they are psychologically and emotionally able to hold up well in the presence of pain (Lupilon, 2020).

Fusion Data

The fusion features showed the best performance. Data fusion is a prevalent way to deal with imperfect raw data to capture reliable, valuable and accurate information. Feature fusion discriminates more than singular input features. The combination of the diastolic and systolic blood pressure, the EDA and respiration performed better than any of those features alone. That is because integrating multiple sources to produce an unified data about an entity helps the prediction models predict more accurately. It allows the model to consider relations between features and relations in their changes.

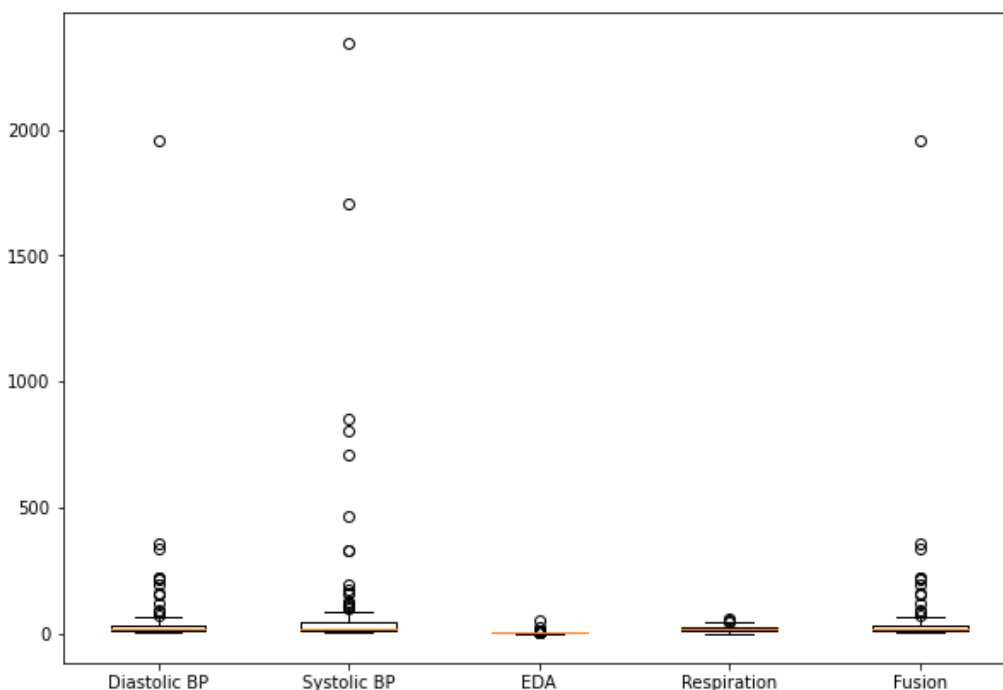
Variability

Mean



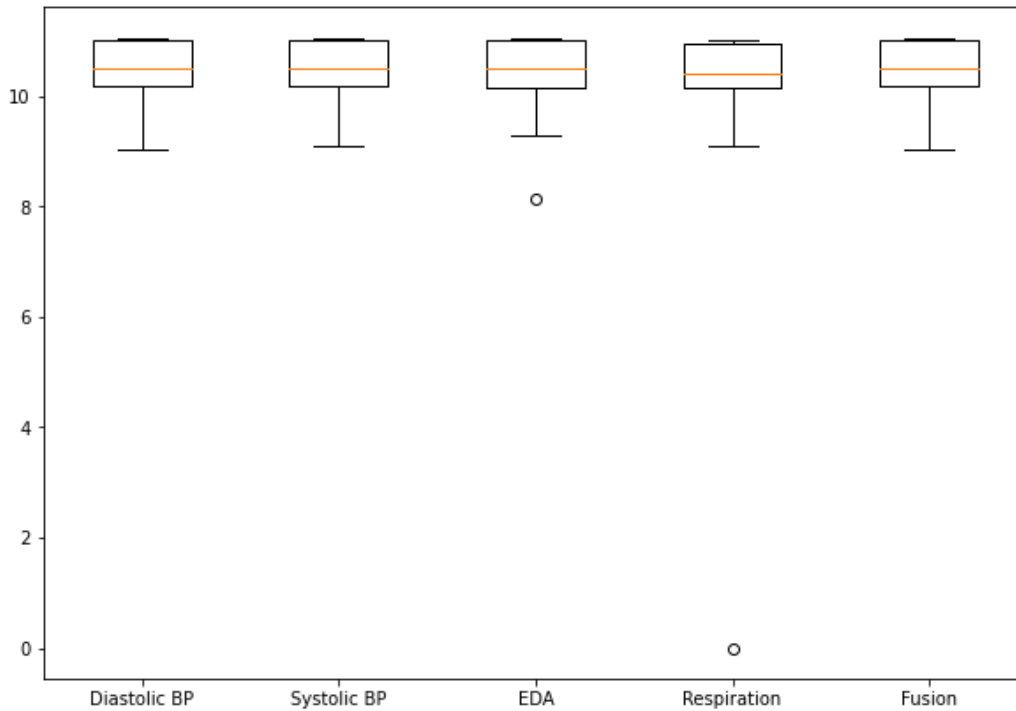
We have a good amount of variability on mean values on Diastolic BP, Systolic BP and Fusion features. There is less variability on the mean values of the EDA and Respiration compared to the others.

Variance



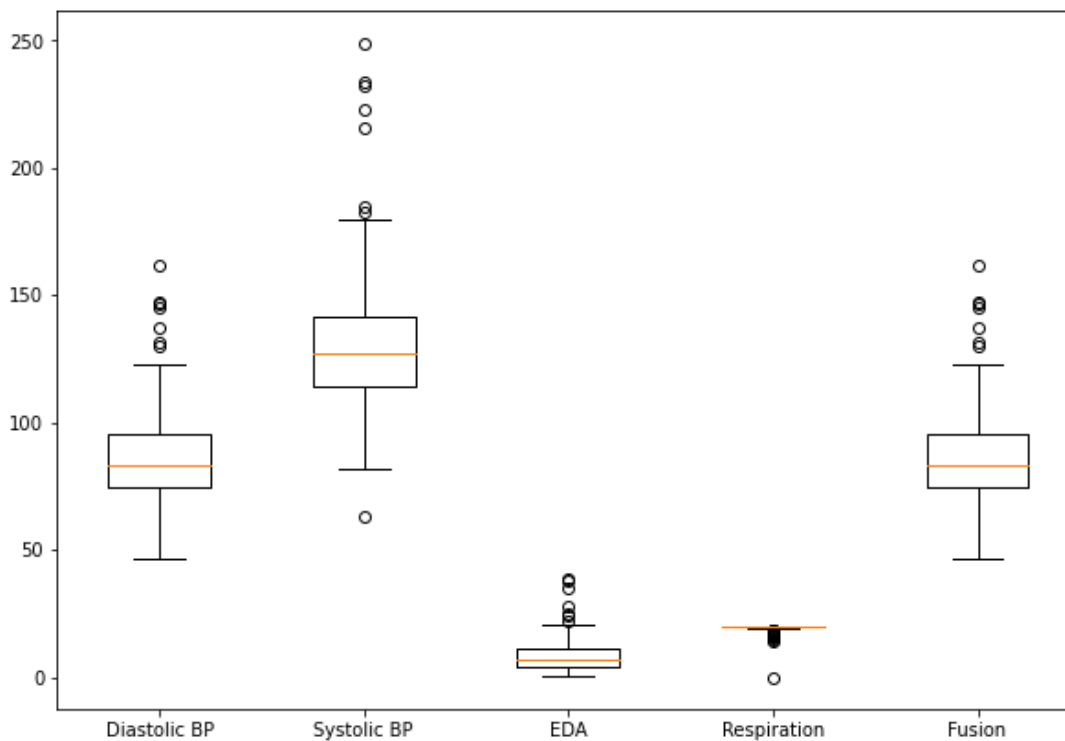
Because there are some outliers, we can not appreciate the variance box plots clearly, but we can see that EDA's variance values have less variability than the other classes.

Entropy

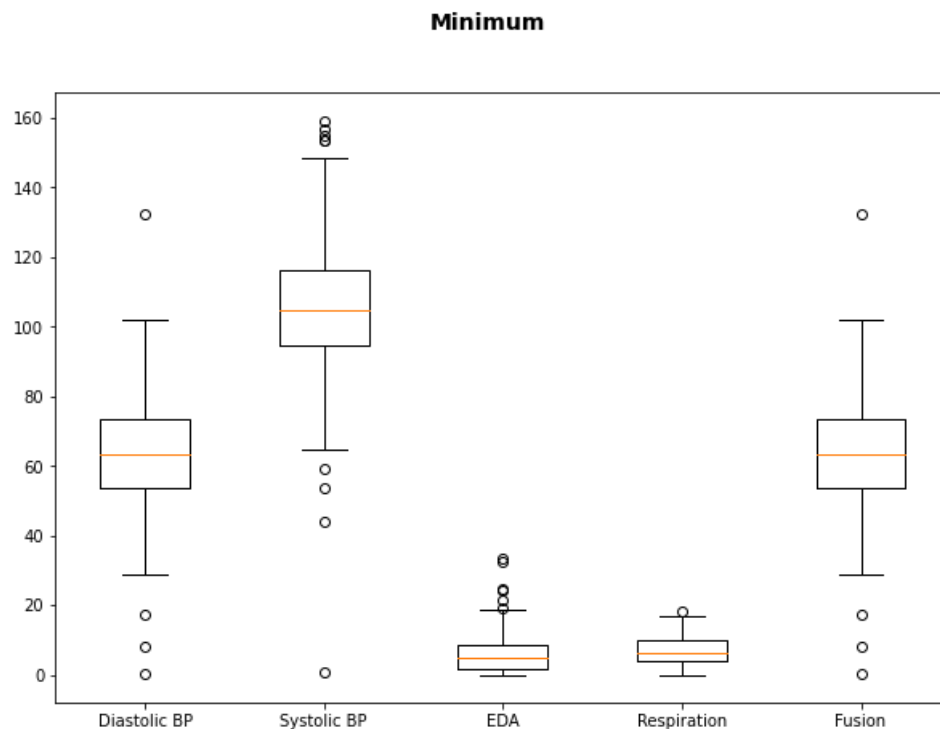


The entropy values have basically the same small variance.

Maximum

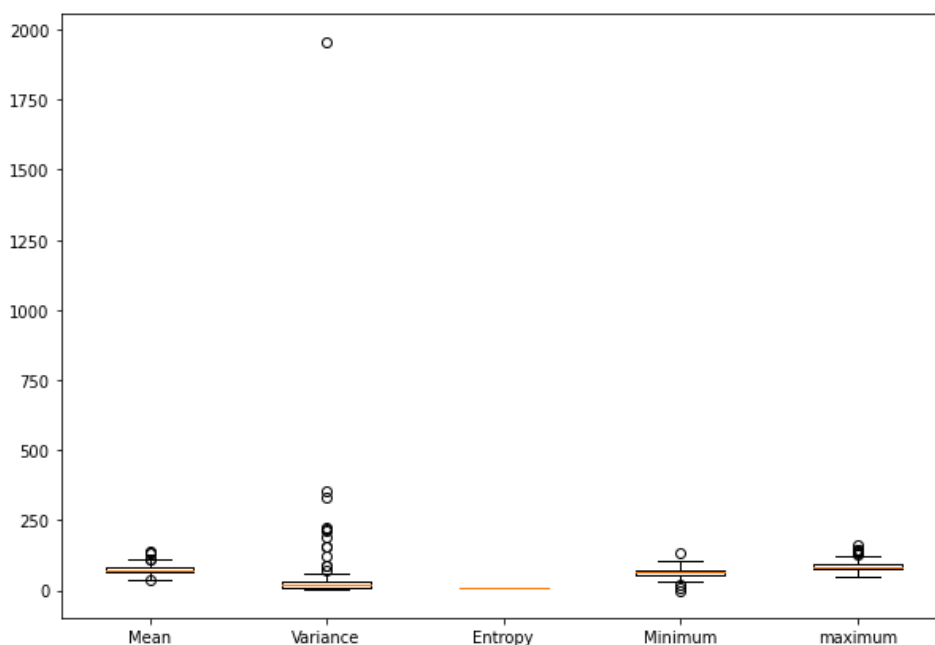


The maximum feature has good variance in the Diastolic BP, Systolic BP and Fusion, but the maximum values of EDA and Respiration present less variance.



The Minimum values have a good variance

This last plot present box plots of all the features together:

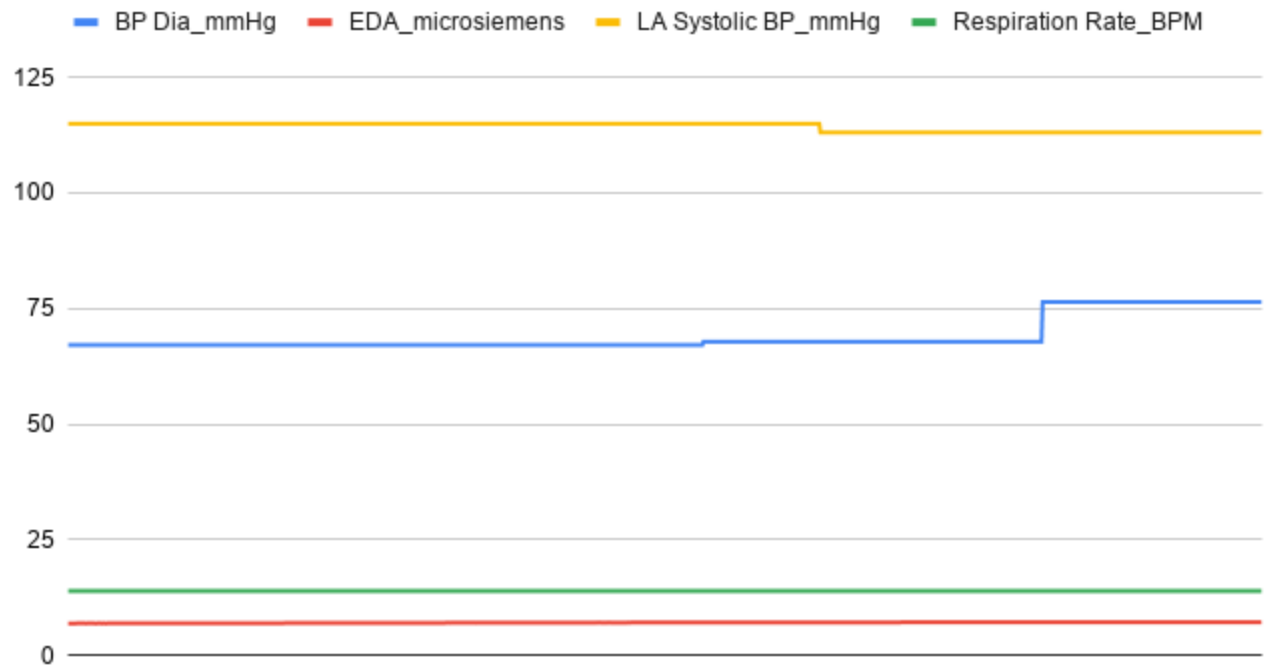


Compared to the others, the entropy feature had little variance. But this is expected because the recorded physical data do not change abruptly.

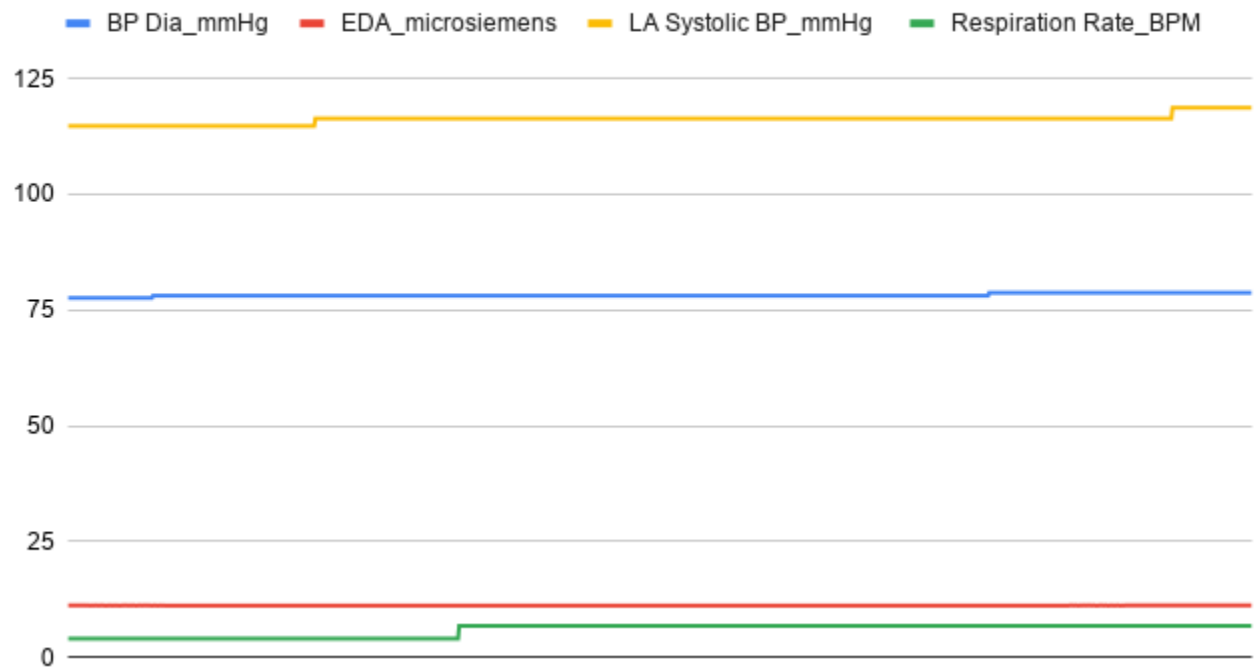
Signal With Most Variability

Based on the signals of subject F013, we can observe that there is more variability in the respiration rate and the diastolic blood pressure. Respiration rate is lower when the subject is in pain. And the diastolic blood pressure was lower when the subject was not in pain. Respiration rate and changes in the blood pressure are both commonly associated with pain. Some studies associate paced slow breathing with pain reduction (Jafari, 2017). And increase in blood pressure is a result of sympathetic activity generated by the pain.

No Pain



Pain



References

“Sympathetic Nervous System”. The Human Memory. 25 November 2020.

<https://human-memory.net/sympathetic-nervous-system/> Accessed 15 February 2021.

Lupilon. “Does Pain Affect Systolic or Diastolic Blood Pressure?”. 14 April 2020.

<https://iupilon.com/does-pain-affect-systolic-or-diastolic-blood-pressure/> Accessed 15 February 2021.

Jafari, Hassan et al. “Pain and respiration: a systematic review.” *Pain* vol. 158,6 (2017): 995-1006.

<https://pubmed.ncbi.nlm.nih.gov/28240995/> Accessed 15 February 2021.