D0033E - Group 25 - Task 1

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1 Handling Missing Values

The missing values in the train data and the test data was handled by using the ”Replace Missing Values“ operator in RapidMiner. Since filtering by average was fine in this case, we didn't see the need to complicate things and went with that. This can be seen in Figure 1 and 2.

Row No.	Gesture name	-0.479729905	0.726078561	2.403713347	-0.481913435	0.540688661	2.45586452	-0.646273647	0.406351076	2.428460643	-0.312904536	0.43417669	2.469510745	-0.697310385	0.157042201
1	you	0.052	0.647	2.410	0.060	0.452	2.449	-0.107	0.344	2.461	0.184	0.332	2.433	-0.171	0.090
2	thankyou	-0.003	0.625	2.240	0.019	0.436	2.270	-0.153	0.336	2.305	0.164	0.331	2.241	-0.217	0.106
3	name	-0.029	0.664	2.443	-0.023	0.481	2.452	-0.203	0.353	2.506	0.119	0.370	2.411	-0.289	0.114
4	love	0.066	0.639	2.378	0.069	0.447	2.406	-0.093	0.339	2.368	0.231	0.347	2.377	-0.111	0.173
5	welcome	-0.470	0.532	2.414	-0.527	0.352	2.493	-0.669	0.247	2.436	-0.357	0.247	2.541	-0.732	-0.007
6	dance	0.027	0.646	2.303	0.037	0.468	2.336	-0.149	0.390	2.352	0.215	0.404	2.338	-0.337	0.435
7	home	0.056	0.623	2.214	0.060	0.438	2.255	-0.106	0.323	2.261	0.226	0.328	2.244	-0.231	0.218
8	enjoy	-0.421	0.712	2.327	-0.419	0.525	2.390	-0.598	0.411	2.367	-0.247	0.431	2.419	-0.671	0.208
9	study	-0.505	0.565	2.464	-0.529	0.387	2.484	-0.689	0.247	2.431	-0.366	0.238	2.494	-0.673	0.061
10	dance	-0.406	0.522	2.284	-0.425	0.348	2.338	-0.580	0.290	2.321	-0.267	0.284	2.344	-0.676	0.426
11	come	-0.265	0.656	2.405	-0.261	0.474	2.494	-0.429	0.360	2.523	-0.101	0.360	2.488	-0.481	0.098
12	baby	0.204	0.619	2.225	0.226	0.426	2.265	0.051	?	?	?	0.321	2.228	-0.031	0.162
13	strong	-0.148	0.695	2.387	-0.172	0.515	2.449	-0.290	?	?	?	0.461	2.494	-0.194	0.235
14	big	0.172	0.659	2.448	0.187	0.463	2.470	0.016	?	?	?	0.353	2.444	-0.112	0.207
15	cloud	-0.366	0.557	2.435	-0.378	0.373	2.473	-0.543	?	?	?	0.281	2.466	-0.711	0.303
16	child	-0.032	0.687	2.365	-0.036	0.501	2.430	-0.220	0.398	2.447	0.140	0.406	2.435	-0.270	0.130
17	dance	-0.462	0.714	2.322	-0.465	0.540	2.392	-0.639	0.457	2.392	-0.287	0.480	2.423	-0.850	0.463
18	big	-0.007	0.697	2.403	0.006	0.512	2.449	-0.172	0.415	2.443	0.177	0.405	2.433	-0.328	0.304
19	bye	-0.346	0.667	2.407	-0.328	0.479	2.484	-0.500	0.360	2.517	-0.172	0.374	2.496	-0.541	0.096
20	big	-0.420	0.729	2.402	-0.423	0.542	2.447	-0.581	0.416	2.392	-0.257	0.438	2.438	-0.681	0.301
21	name	-0.490	0.726	2.394	-0.483	0.540	2.455	-0.657	0.402	2.451	-0.316	0.451	2.439	-0.701	0.141
22	come	0.137	0.616	2.233	0.146	0.423	2.273	-0.017	0.308	2.279	0.307	0.315	2.241	-0.094	0.052
23	child	-0.338	0.670	2.423	-0.326	0.481	2.505	-0.494	0.361	2.528	-0.164	0.372	2.521	-0.545	0.100

Figure 1: Before replacement of missing values

Row No.	Gesture name	-0.479729905	0.726078561	2.403713347	-0.481913435	0.540688661	2.45586452	-0.646273647	0.406351076	2.428460643	-0.312904536	0.43417669	2.469510745	-0.697310385	0.157042201
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23	child	-0.338	0.670	2.423	-0.326	0.481	2.505	-0.494	0.361	2.528	-0.164	0.372	2.521	-0.545	0.100

Figure 2: After replacement of missing values

2 Preprocessing the Attribute Values

Since none of the columns have any names by default, the first step in the pre-processing involves renaming the columns. We then used the gesture name column as the label that the model will predict. Since none of the other columns had any names, we renamed them so that the name described what the column contained. For example, mp shoulder_center X is the mean X position of the point between the shoulders. We also marked all the points belonging to the legs and the head as 'remove' in the column name. All of the columns containing this flag were then removed using the "Select Attributes" operator using the 'exclude attributes' function. We also removed some highly correlated data that was left, such as the hand and the wrist joints as well as the spine and the middle of shoulders joints. The impact of this is shown in Figure 10 and Figure 11. As you can see, many columns with high correlation have been removed and the training data is now more streamlined.

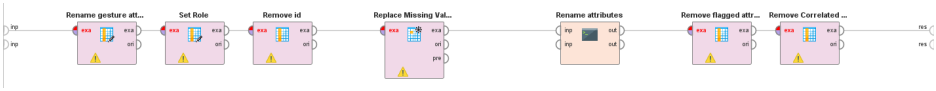

Figure 3: Pre-processing in rapidminer

3 Visualizing the Data

3.1 XYZ Coordinates in a 3D-plain

When visualizing the data three methods were used. The first was using Matlab to map the XYZ coordinates to a 3D-plain. Some examples of this can be seen in Figures 4, 5 and 6.

From these Figures some conclusions can be drawn. The first being that the people that performed the gestures were not always standing in the same place, the second being that the lower part of the body (feet, legs, lower torso) is probably not going to be relevant. This is also something that can be seen in the correlation matrix.

It is also clear that some of the gestures are standing at an angle. This is discussed in [Kumar et al., 2017] where it is described that some of the gestures were captured at 45° and 90° angles. This can be seen in Figure 6.

Figure 4: In this figure one of the poses (you) has been visualized

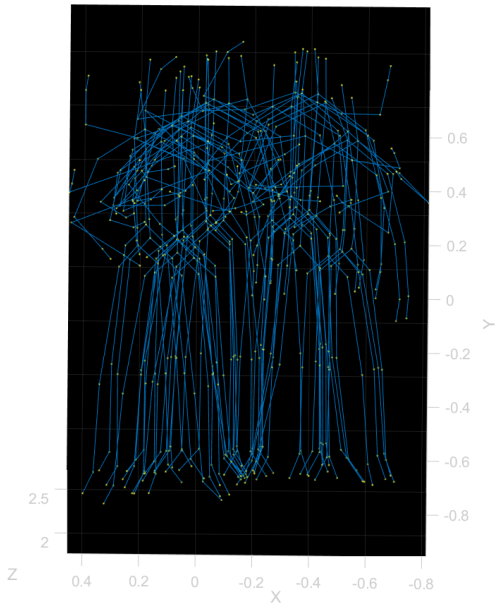

Figure 5: In this figure one example of each of the 30 poses have been visualized

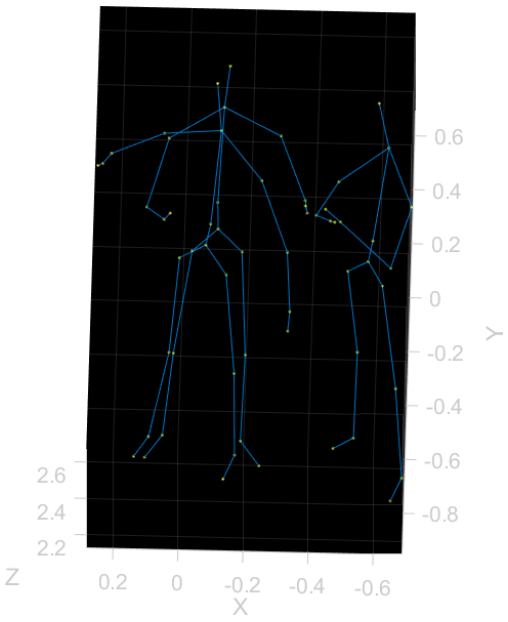

Figure 6: In this figure three poses have been visualized where the one furthest to the right is standing at a 45° angle

3.2 PCA

The second method was using PCA which could reduce the dimensionality of the data and show how the data is related, Figure 7 and 8 shows how data the data can now be represented in 3D. In Figure 7 all of the data has been was included and it is hard to find any specific pattern in the data. In Figure 8 only mean angle and mean position of the hands were included and now two distinct clusters of data can be seen. The cluster on the left contains gestures that only use one hand and the cluster on the right contains gestures that use both hands.

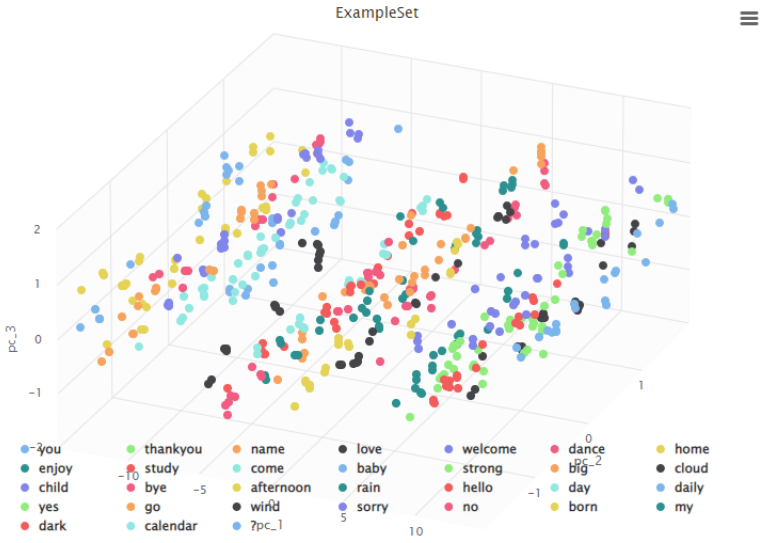

Figure 7: The visualization of the PCA analyses of all training data

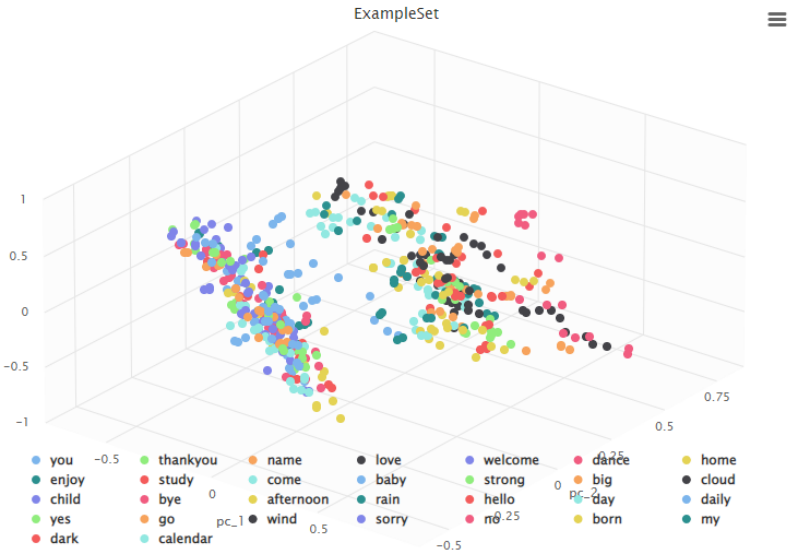

Figure 8: The visualization of the PCA analyses of the position of the hands in each gesture

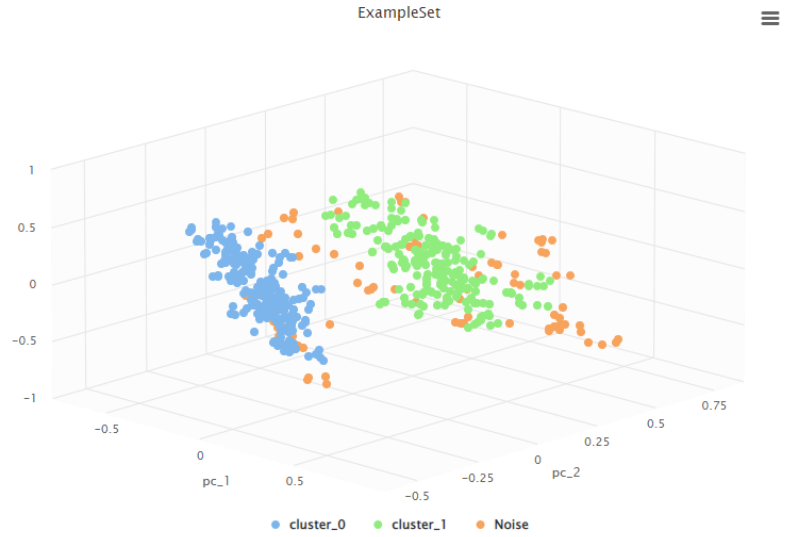

Figure 9: The visualization of running DBSCAN on the result in Figure 8

3.3 Correlation Matrix

The third and final method was a correlation matrix; showing how the different values were related to one another. This can be used as a comparison before and after the pre-processing. This can be seen in Figures 10 and 11. Notice that the second has a fewer attributes as a result of the removal of unnecessary attributes during pre-processing.

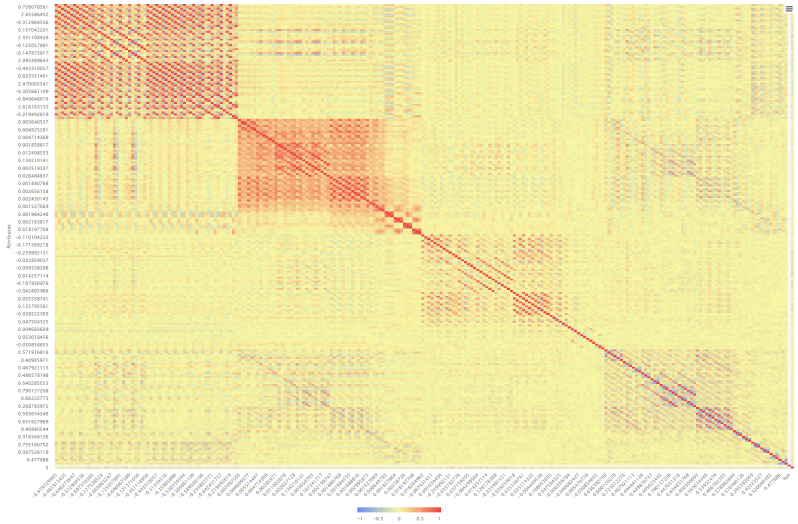

Figure 10: Correlation Matrix before pre-processing

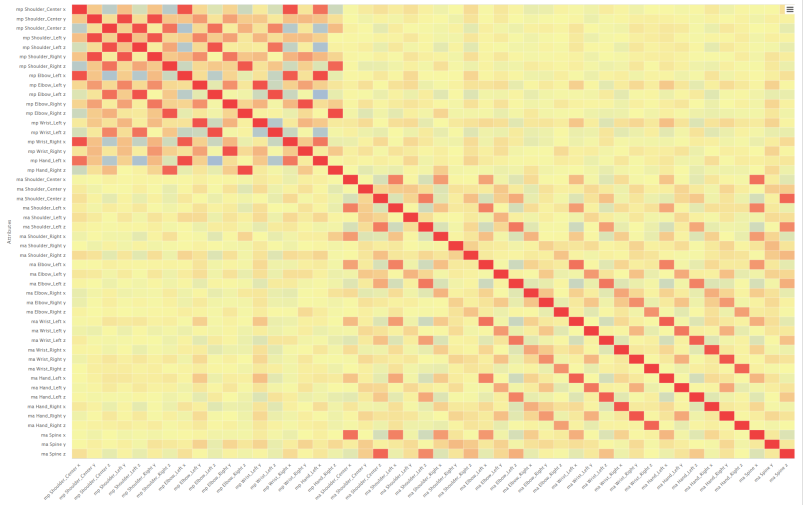

Figure 11: Correlation Matrix after pre-processing

References

[Kumar et al., 2017] Kumar, P., Saini, R., Roy, P. P., and Dogra, D. P. (2017). A position and rotation invariant framework for sign language recognition (SLR) using kinect. *Multimedia Tools and Applications*, 77(7):8823–8846.