

Appendix: Predicting crude oil viscosity using the models developed in this paper

In this study three models were created using k-nearest neighbour (KNN), genetic programming (GP) and linear discriminant analysis (LDA). The input of all of them is API gravity and temperature. For estimating the viscosity of an oil type using the mentioned models, the following steps should be performed:

- 1) Put the content of the “Attached” folder in the MATLAB path.
- 2) Run the following code:

```
Visc=Viscosity1(Model, API, Temperature)
```

In which:

Visc is the estimated viscosity.

Model is the algorithm in which the resulted model is developed and it can get “KNN” for k-nearest neighbour, “GP” for genetic programming and “LDA” for linear discriminant analysis.

API is the API gravity of the oil sample.

Temperature is the temperature of the sample.

Example:

The viscosity of an oil with 37.7 API gravity at 294.26 K is calculated using the three developed models of this study as follows:

Calculation using k-nearest neighbor is performed as follows:

```
>> Vis=Viscosity('KNN',37.7,294.2611)
```

```
Vis =
```

```
5.2430
```

Calculation using genetic programming is performed as follows:

```
>> Vis=Viscosity('GP',37.7,294.2611)
```

```
Vis =
```

```
5.8214
```

Calculation using linear discriminant analysis is performed as follows:

```
>> Vis=Viscosity('LDA',37.7,294.2611)
```

```
Vis =
```

```
4.9410
```