CHEN E4580 Artificial Intelligence in Chemical Engineering

Fall 2019

Final Project Due Date: Dec 09th, 2019

Instructions

1. This is an individual project, and all students are expected to work independently. No collaboration or copying is allowed.
2. Since it is an open problem, you can be creative with your solution. However, solution methodology and reason for said methodology should be clearly indicated.
3. The final submission will be graded based on the report and code (should be well documented).
4. The report should be in the form of a professional manuscript, (11 point font and single line spacing). Report should include introduction, methodology, results and discussion.

This project is an exercise to understand faults in a continuous stirred tank reactor (CSTR), and diagnose the cause of these faults.

A CSTR is a useful modeling tool for chemical process units. These serve as surrogates to the actual process unit. In this problem you are given data (`cstr_fault_time_series.mat`) for an exothermic CSTR, as seen in Table 1. Since the CSTR is exothermic, in order to control the temperature of the reactor, a coolant is fed to the reactor.

Table 1 CSTR data format

Inlet Concentration (C_i)	Inlet Temperature (T_i)	Concentration in reactor (C)	Temperature in reactor (T)	Coolant Flow Rate (Q_c)	Coolant Inlet Temperature ($T_{c,\text{in}}$)	Coolant Outlet Temperature (T_c)

The data corresponds to different fault conditions (`fault_labels`) of the system during the time of operation. You are required to create a fault model which takes operation data as input and classifies it into one of the fault conditions. Note that simple classification with all the variables may result in spurious inferences, so there is a need to find appropriate descriptors of the system, based on your knowledge of a CSTR. Based on this knowledge of a CSTR, you will need to address questions such as, but not limited to,

1. What variables/combinations of variables should be monitored to infer different faults in the system?
2. How do we monitor the state of the process?
3. What could be the likely causes of these faults based on the variables that you are monitoring?
4. Is there a model-based strategy which you can adopt to obtain the above conclusions?

Provide reasons for your recommendations in the form of the choice of classifiers, descriptors of the process variables, etc. Note that you have learned a lot of supervised and unsupervised techniques during the course of study. Do not overload the final submission with all these strategies, and use only those which you may deem suitable for this system.