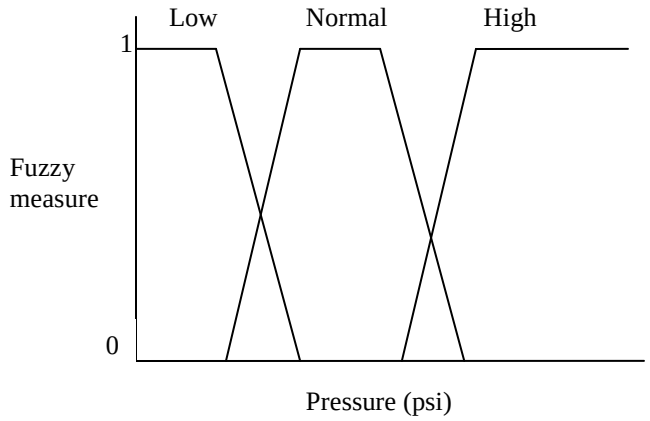
CSCU9T6 Spring 2019
Tutorial on Fuzzy Logic and Case-Based Reasoning (Solutions)

1 **Solution sketch**

You need to draw 3 sets of graphs. For comparison, see the graphs on slide 8 of the lecture notes on fuzzy logic.

One set shows the graphs for the fuzzy sets Pressure Low, Pressure Normal, and Pressure High. These should be drawn on the same axes. The x-axis should be labelled Pressure, with some appropriate unit (such as Pa, psi, atmosphere, bar, etc.). The y-axis represents the fuzzy measure, and ranges from 0 to 1.



The picture above shows possible shapes for the graphs of Pressure Low, Pressure Normal, and Pressure High. I have made the assumption that there is a range of pressure values that are considered to be completely "normal", rather than just a single point value. This is why the graph for Pressure Normal has a flat top, rather than a pointed peak. If, on the contrary, you decide to assume that "normal" refers to a single, specific pressure, then your graph would not be flat on top but would be pointed. Since the question does not specify what pressure is considered "normal", either assumption is ok, but it is important to state what assumptions are being made.

Similarly, you need to draw a second set of 3 graphs on the same axes for Temperature Low, Temperature Normal, and Temperature High, and a third set of 4 graphs on the same axes for Coolant Flow Zero, Coolant Flow Low, Coolant Flow Medium, and Coolant Flow High.

2 You must show how to apply the rules for reasoning with fuzzy logic, and then sketch how to carry out the final "defuzzification" step. See slides 17-20 of the lecture notes on fuzzy logic.

The first rule does not apply, since the fuzzy measures for Pressure High and Temperature High are 0.

The second rule gives us the conclusion Coolant Flow Medium, with fuzzy measure min (0.2, max(1.0, 0)) = 0.2

The third rule gives us the conclusion Coolant Flow Low, with fuzzy measure min (0.2, 1.0) = 0.2

The fourth rule does not apply, since the fuzzy measures for Pressure Low and Temperature Low are 0.

We now have two answers: the coolant flow should be medium, with fuzzy measure 0.2, and it should be low, with fuzzy measure 0.2. The final "defuzzyification" step is now performed in order to convert these two fuzzy values into a single, "crisp" numerical value for the coolant flow. This step should be illustrated by shading in the appropriate portions of the graphs for coolant flow (drawn in question 1) and indicating the approximate position of the centroid of the shaded area. You should explain what you are doing and indicate where the final value of the coolant flow is located on the x-axis of your graph.

Note that you are not expected to give the exact value of the coolant flow. (The question does not provide enough information to allow you to do this.)

3 See the lecture notes on case-based reasoning systems.