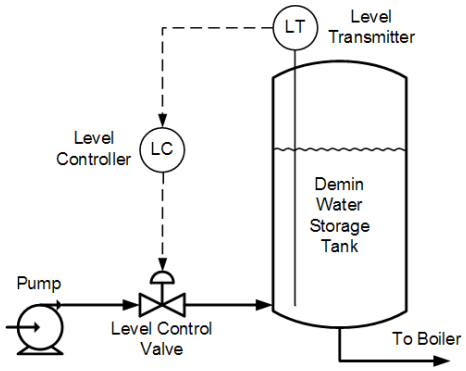
**RAI5 - Exercises - 2024-09-12**

*Artificial intelligence introduction*

(i) What is a rational agent?
(ii) In the context of AI agents, how can an environment be characterized?
(iii) What is a reactive agent and how does it differ from a deliberative agent?
(iv) Which are some of the main topics in AI research?
(v) What is the difference between supervised, unsupervised, and reinforcement learning?

*Fuzzy control*

(i) What is fuzzy control – namely, how does it differ from conventional control, and based on what is a fuzzy control system designed?
(ii) What is a fuzzy set and what is a membership function?
(iii) Draw a membership function (and hence define a fuzzy set) that quantifies the set of all people of medium height.
(iv) Draw a membership function that quantifies the set of all small properties.
(v) Draw a membership function that quantifies the set of all big properties.
(vi) Draw a membership function that quantifies the statement "the number x is near 10."
(vii) Draw a membership function that quantifies the statement "the number x is less than 10."
(viii) Draw a membership function that quantifies the statement "the number x is greater than 10."
(ix) Suppose that X = {a, b, c, d, e} and that $\mu_A(a)=0.5$, $\mu_A(b)=0$, $\mu_A(c)=0.2$, $\mu_A(d)=0$, $\mu_A(e)=1$.
   a. Compute the cardinality of $A$.
   b. Compute the complement of $A$, namely $\overline{A}$.
   c. Compute $A \cup \overline{A}$.
   d. Compute $A \cap \overline{A}$.
(x) What is a linguistic variable?
(xi) What is a linguistic value?
(xii) What is a rule and a rule-base?
(xiii) Specify linguistic variables, linguistic values, and a fuzzy rule-base for the "Level Controller" (LC) in the system shown below. Your input is the water level provided by the "Level Transmitter" (LT). The goal is to maintain the water level in the tank at around 75% of total capacity and you can regulate the influx of water by opening and closing the "Level Control Valve"


LT
Level
Transmitter
Level
Controller
LC
Demin
Water
Storage
Tank
Pump
Level Control
Valve
To Boiler