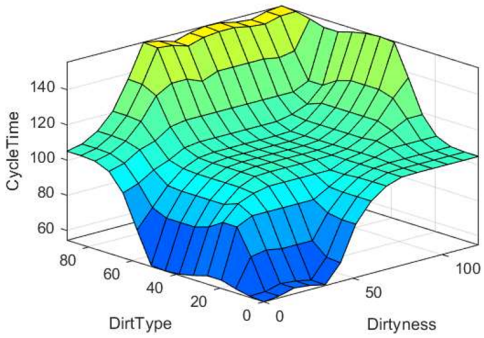
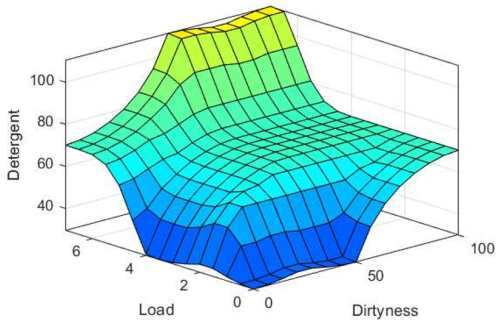
Question 1

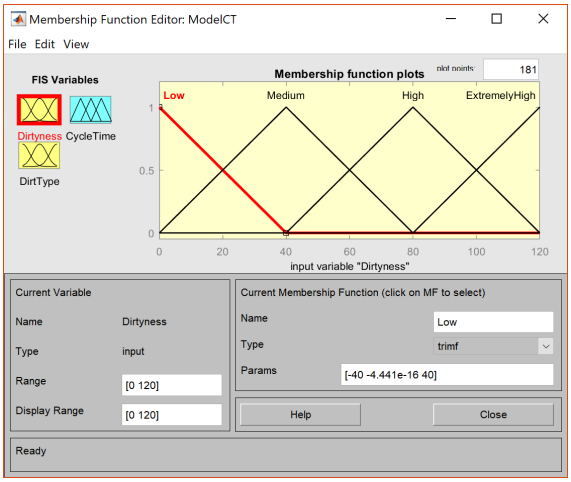
(a) Produce clear images for the surface plots for both Model CT and Model D, and provide screenshots for the input membership functions as well as the output membership functions. State your answers clearly for each model, separately.



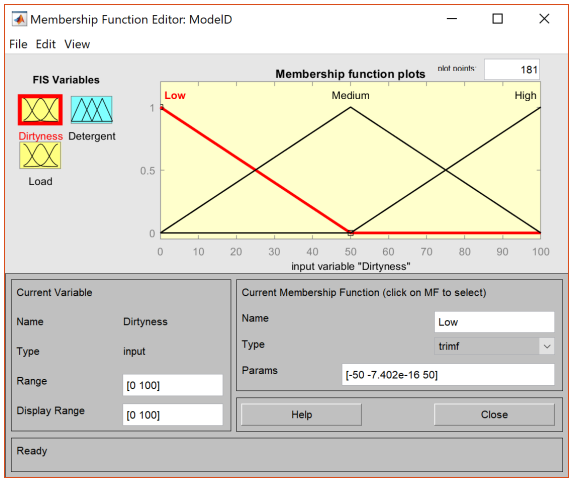
(a) ModelCT



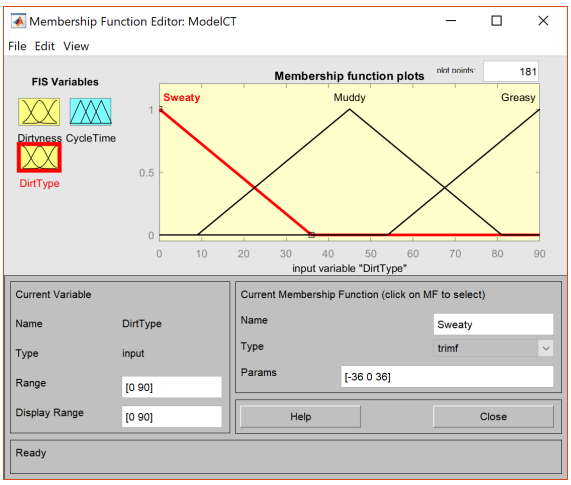
(b) ModelD



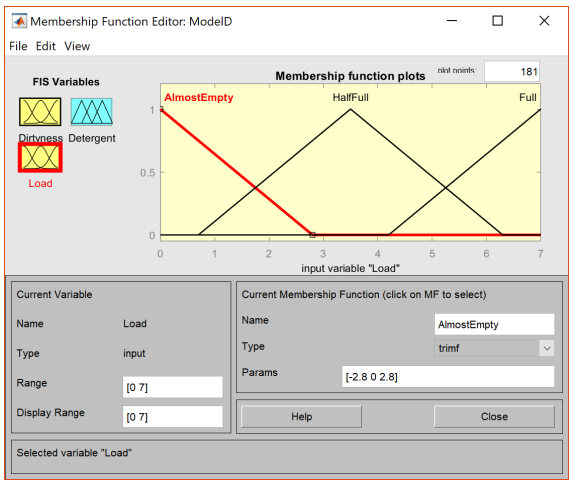
(a) ModelCT - Dirtyness Input



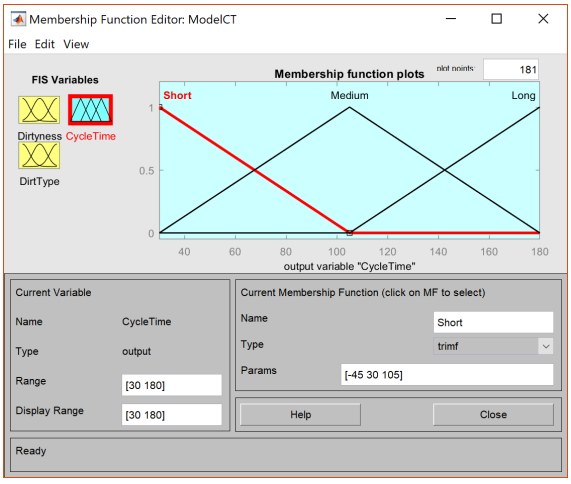
(b) ModelD - Dirtyness Input



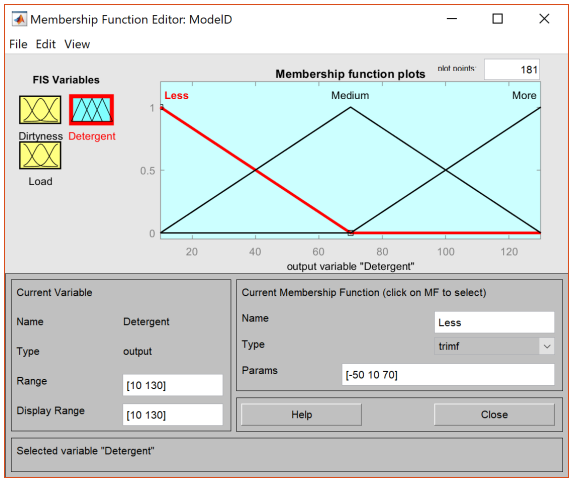
(a) ModelCT - DirtType Input



(b) ModelD - Load Input



(a) ModelCT - CycleTime Output



(b) ModelD - Detergent Output

(b) Modify the rule bases for both Model CT and Model D by reducing as much rules as possible, without changing the behaviour of the system too much. How would you explain the behaviour change while logically maintaining the rule base? If this is possible, give an example of your reasoning. Report the new rule bases, separately, and justify your decisions by briey describing your motivation.

Using the not box, it is possible to avoid make rules seperately for each non-changing variable, reducing the number of rules from 9 to 6 for ModelD, and from 12 to 10 for ModelCT.

ModelD

Before:

(1) If (Dirtyness is Low) and (Load is AlmostEmpty) then (Detergent is Less) (1)
(2) If (Dirtyness is Medium) and (Load is AlmostEmpty) then (Detergent is Less) (1)
(3) If (Dirtyness is High) and (Load is AlmostEmpty) then (Detergent is Medium) (1)
(4) If (Dirtyness is Low) and (Load is HalfFull) then (Detergent is Less) (1)

(5) If (Dirtyness is Medium) and (Load is HalfFull) then (Detergent is Medium) (1)
(6) If (Dirtyness is High) and (Load is HalfFull) then (Detergent is Medium) (1)
(7) If (Dirtyness is Low) and (Load is Full) then (Detergent is Medium) (1)
(8) If (Dirtyness is Medium) and (Load is Full) then (Detergent is More) (1)
(9) If (Dirtyness is High) and (Load is Full) then (Detergent is More) (1)

After:

(1) If (Dirtyness is not High) and (Load is AlmostEmpty) then (Detergent is Less) (1)
(2) If (Dirtyness is High) and (Load is AlmostEmpty) then (Detergent is Medium) (1)
(3) If (Dirtyness is Low) and (Load is HalfFull) then (Detergent is Less) (1)
(4) If (Dirtyness is not Low) and (Load is HalfFull) then (Detergent is Medium) (1)
(5) If (Dirtyness is Low) and (Load is Full) then (Detergent is Medium) (1)
(6) If (Dirtyness is not Low) and (Load is Full) then (Detergent is More) (1)

ModelCT

Before:

(1) If (Dirtyness is Low) and (DirtType is Sweaty) then (CycleTime is Short) (1)
(2) If (Dirtyness is Medium) and (DirtType is Sweaty) then (CycleTime is Short) (1)
(3) If (Dirtyness is High) and (DirtType is Sweaty) then (CycleTime is Medium) (1)
(4) If (Dirtyness is ExtremelyHigh) and (DirtType is Sweaty) then (CycleTime is Medium) (1)
(5) If (Dirtyness is Low) and (DirtType is Muddy) then (CycleTime is Short) (1)
(6) If (Dirtyness is Medium) and (DirtType is Muddy) then (CycleTime is Medium) (1)
(7) If (Dirtyness is High) and (DirtType is Muddy) then (CycleTime is Medium) (1)
(8) If (Dirtyness is ExtremelyHigh) and (DirtType is Muddy) then (CycleTime is Long) (1)
(9) If (Dirtyness is Low) and (DirtType is Greasy) then (CycleTime is Medium) (1)
(10) If (Dirtyness is Medium) and (DirtType is Greasy) then (CycleTime is Long) (1)
(11) If (Dirtyness is High) and (DirtType is Greasy) then (CycleTime is Long) (1)
(12) If (Dirtyness is ExtremelyHigh) and (DirtType is Greasy) then (CycleTime is Long) (1)

After:

(1) If (Dirtyness is Low) and (DirtType is Sweaty) then (CycleTime is Short) (1)
(2) If (Dirtyness is Medium) and (DirtType is Sweaty) then (CycleTime is Short) (1)
(3) If (Dirtyness is High) and (DirtType is Sweaty) then (CycleTime is Medium) (1)
(4) If (Dirtyness is ExtremelyHigh) and (DirtType is Sweaty) then (CycleTime is Medium) (1)
(5) If (Dirtyness is Low) and (DirtType is Muddy) then (CycleTime is Short) (1)
(6) If (Dirtyness is Medium) and (DirtType is Muddy) then (CycleTime is Medium) (1)

(7) If (Dirtyness is High) and (DirtType is Muddy) then (CycleTime is Medium) (1)

(8) If (Dirtyness is ExtremelyHigh) and (DirtType is Muddy) then (CycleTime is Long) (1)

(9) If (Dirtyness is Low) and (DirtType is Greasy) then (CycleTime is Medium) (1)

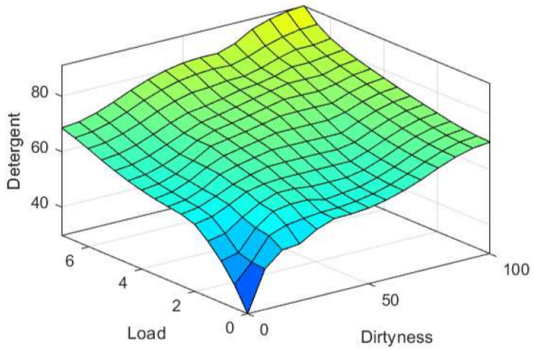
(10) If (Dirtyness is not Low) and (DirtType is Greasy) then (CycleTime is Long) (1)

(c) What kind of inference system did you implement for Model CT? Explain your answer by giving reason.

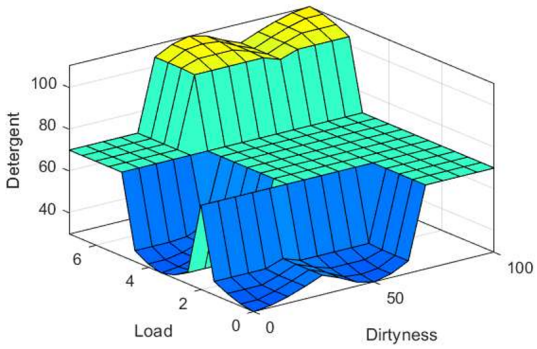
Rule based inference.

(d) Try decreasing and increasing the overlap between both the input and output fuzzy sets for Model D. How does this inuence the behaviour of the system? Explain briey.

Increasing overlap makes the surface of the modal look more flat. Decreasing overlap decreases the complexity of the surface.



(a) ModelD - Increased Overlap



(b) ModelD - Decreased Overlap

(e) five

(f) six

Question 2

(a) one

(b) two

(c) three

(d) four

(e) five

(f) six