

b):

**Attempting to prove the block comparison theorem Status1.
Write down the each of the resulting unprovable sequents.**

Answer:

Status1.1.1 :

```
{-1} Tripped?(f_PressTripS1!1)
[-2] Transmit!1
    |-----
{1}  Pressure!1 < 2400
```

Postponing Status1.1.1.

Status1.1.2 :

```
[-1] Transmit!1
    |-----
{1}  Pressure!1 < 2400
{2}  Pressure!1 < 2450
```

Postponing Status1.1.2.

Status1.2 :

```
{-1} Tripped?(f_PressTripS1!1)
{-2} floor(Pressure!1) < 2450
    |-----
{1}  Pressure!1 < 2400
{2}  f_PressStatusS1!1
```

c):

For each unprovable sequent, write down the characteristic equation for the unprovable sequents.

Unprovable sequent	Characteristic equation
Status1.1.1 : {-1} Tripped?(f_PressTripS1!1) [-2] Transmit!1 ----- {1} Pressure!1 < 2400	f_PressTripS1= Tripped $\wedge$ Transmit $\rightarrow$ Pressure < 2400
Status1.1.2 : [-1] Transmit!1 ----- {1} Pressure!1 < 2400 {2} Pressure!1 < 2450	Transmit $\rightarrow$ Pressure < 2400 $\vee$ Pressure < 2450
Status1.2 : {-1} Tripped?(f_PressTripS1!1) {-2} floor(Pressure!1) < 2450 ----- {1} Pressure!1 < 2400 {2} f_PressStatusS1!1	f_PressTripS1= Tripped $\wedge$ floor(Pressure) < 2450 $\rightarrow$ Pressure < 2400 $\vee$ f_PressStatusS1

d):

For each characteristic equation, find all the values of the inputs that provide counter examples for the characteristic equations you found in (c).

Status1.1.1 : {-1} Tripped?(f_PressTripS1!1) [-2] Transmit!1 ----- {1} Pressure!1 < 2400	f_PressTripS1= Tripped $\wedge$ Transmit $\rightarrow$ Pressure < 2400
---	--

$$\mathbf{f_PressTripS1= Tripped \wedge Transmit \wedge \neg Pressure < 2400 \quad (1)}$$

Using the fact that : $\neg \text{Pressure} < 2400 \Leftrightarrow \text{Pressure} \geq 2400$

Equation (1) can be rewritten as

$$\mathbf{\underline{f_PressTripS1= Tripped \wedge Transmit \wedge Pressure \geq 2400}}$$

Status1.1.2 : [-1] Transmit!1 ----- {1} Pressure!1 < 2400 {2} Pressure!1 < 2450	Transmit $\rightarrow$ Pressure < 2400 $\vee$ Pressure < 2450
--	--

$$\text{Transmit} \wedge \neg \text{Pressure} < 2400 \wedge \neg \text{Pressure} < 2450 \quad (2)$$

Using the fact that : $\neg \text{Pressure} < 2400 \Leftrightarrow \text{Pressure} \geq 2400$

Using the fact that : $\neg \text{Pressure} < 2450 \Leftrightarrow \text{Pressure} \geq 2450$

Equation (2) can be rewritten as

$$\underline{\text{Transmit} \wedge \text{Pressure} \geq 2450}$$

Status1.2 : {-1} Tripped?(f_PressTripS1!1) {-2} floor(Pressure!1) < 2450 ----- {1} Pressure!1 < 2400 {2} f_PressStatusS1!1	f_PressTripS1= Tripped $\wedge$ floor(Pressure) < 2450 $\rightarrow$ Pressure < 2400 $\vee$ f_PressStatusS1
--	---

$$\text{f_PressTripS1= Tripped} \wedge \text{floor(Pressure)} < 2450 \wedge \neg \text{Pressure} < 2400 \wedge \neg \text{f_PressStatusS1} \quad (3)$$

Using the fact that : $\neg \text{Pressure} < 2400 \Leftrightarrow \text{Pressure} \geq 2400$

Equation (3) can be rewritten as

$$\underline{\text{f_PressTripS1= Tripped} \wedge \text{floor(Pressure)} < 2450 \wedge \text{Pressure} \geq 2400 \wedge \neg \text{f_PressStatusS1}}$$

e):

Pick up the specific values that provide a counter example and confirm that it provides a counter example to theorem by hand and comparing the results.

```

 $\forall$ (Pressure:real,f_PressTripS1:Trip,f_PressStatusS1,Transmit:bool):
  f_PressStatus(f_PressTrip(Pressure,f_PressTripS1),f_PressStatusS1,Transmit)
= IF  $\neg$ Transmit THEN STATUS(real2Atype(Pressure),f_PressStatusS1)
  ELSE FALSE  ENDIF)

```

FOR

(1) **f_PressTripS1= Tripped $\wedge$ Transmit $\wedge$ Pressure $\geq$ 2400**

pick these values

Variable	Value
f_PressTripS1!1	Tripped
Transmit!1	True
Pressure!1	2401

f_PressStatus(f_PressTrip(Pressure!1,f_PressTripS1!1),f_PressStatusS1!1,Transmit!1) =TRUE

**IF $\neg$ Transmit THEN STATUS(real2Atype(Pressure),f_PressStatusS1)
ELSE FALSE = FALSE**

(2) **Transmit $\wedge$ Pressure $\geq$ 2450**

pick these values

Variable	Value
Transmit!1	True
Pressure!1	2451

f_PressStatus(f_PressTrip(Pressure!1,f_PressTripS1!1),f_PressStatusS1!1,Transmit!1) =TRUE

**IF $\neg$ Transmit THEN STATUS(real2Atype(Pressure),f_PressStatusS1)
ELSE FALSE = FALSE**

(3) f PressTripS1= Tripped $\wedge$ floor(Pressure) < 2450 $\wedge$ Pressure $\geq$ 2400 $\wedge$ $\neg$ f PressStatusS1

pick these values

Variable	Value
Pressure!1	2401
f_PressTripS1!1	Tripped
f_PressStatusS1	False

f_PressStatus(f_PressTrip(Pressure!1,f_PressTripS1!1),f_PressStatusS1!1, Transmit!1) =TRUE
IF $\neg$ Transmit THEN STATUS(real2Atype(Pressure),f_PressStatusS1)
ELSE FALSE = IF $\neg$ Transmit THEN FALSE ELSE FALSE= FALSE

From these 3 equations and the counter example , we got the theorem STATUS1 can not stand with these 3 counter examples.

g):

Here I give out the input and output for 100 seconds case.
From the program , we can change to any longer time we need to analyze, and any input we want.

To see the data of the draft, simply open the html file attached, and it will automatically run and display the output.

Please see the chart of the next page.

Compare the specification and implementation, we found that the difference happens especially when it is tripped and transmit is true. Like the time 24,27,30th seconds and so on.

i):

Language used: Javascript , HTML

To run : Open this solution.htm to view the result.

