SYSC 4101: Lab 7
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Exercise 1

1. All-States $TS_S$:
   X -> Y -> Z

| | Steps in test path | | |
|---|---|---|---|
| | T1 | T2 | T6 |
| Source State | Ø | X | Y |
| Input | A | B | B |
| Output | 0 | 1 | 1 |
| Destination state | X | Y | Z |

2. All Transitions $TS_T$

| | Steps in test path | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 | T6 | T8 | T9 | T7 | T6 | T10 |
| Source State | Ø | X | Y | X | Y | Y | Z | X | Z | Y | Z |
| Input | A | B | A | A | C | B | B | C | C | B | A |
| Output | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| Destination state | X | Y | X | Y | Y | Z | X | Z | Y | Z | Z |

3. Transition Tree $TS_{TT}$

| | Steps in test path 1 | |
|---|---|---|
| | T1 | T2 |
| Source State | Ø | X |
| Input | A | B |
| Output | 0 | 1 |
| Destination state | X | Y |

| | Steps in test path 2 | | |
|---|---|---|---|
| | T1 | T4 | T6 |
| Source State | Ø | X | Y |
| Input | A | A | B |
| Output | 0 | 0 | 1 |
| Destination state | X | Y | Z |

| | Steps in test path 3 | | |
|---|---|---|---|
| | T1 | T4 | T3 |
| Source State | Ø | X | Y |
| Input | A | A | A |
| Output | 0 | 0 | 1 |
| Destination state | X | Y | X |

| | Steps in test path 4 | | |
|---|---|---|---|
| | T1 | T4 | T5 |
| Source State | Ø | X | Y |
| Input | A | A | C |
| Output | 0 | 0 | 1 |
| Destination state | X | Y | Y |

| | Steps in test path 5 | | |
|---|---|---|---|
| | T1 | T9 | T10 |
| Source State | Ø | X | Z |
| Input | A | C | A |
| Output | 0 | 0 | 1 |
| Destination state | X | Z | Z |

| | Steps in test path 6 | | |
|---|---|---|---|
| | T1 | T9 | T8 |
| Source State | Ø | X | Z |
| Input | A | C | B |
| Output | 0 | 0 | 0 |
| Destination state | X | Z | X |

| | Steps in test path 7 | | |
|---|---|---|---|
| | T1 | T9 | T7 |
| Source State | Ø | X | Z |
| Input | A | C | C |
| Output | 0 | 0 | 0 |
| Destination state | X | Z | Y |

Exercise 2

1. No because my $TS_S$ never transitions from Z to Y, only from Y to Z. My test suite $TS_S$ only generates the outputs: 0 -> 1 -> 1. This would not cause my test paths to fail because these still exist in this implementation. This is because if you were to be in state Ø and use the input a then 0 would still be the output, and then if you were to give the input b you would still transition to Y and get the output 1 and then if you give the input b you would be in state Z and still have the output 1. Therefore, not fault is revealed here.

| | Steps in test path | | |
|---|---|---|---|
| | T1 | T2 | T6 |
| Source State | Ø | X | Y |
| Input | A | B | B |
| Output | 0 | 1 | 1 |
| Destination state | X | Y | Z |

Same^

2. No it doesn't because my test suite $TS_T$ the transition from state Z to Y but only when the input 0 is given so it does not test the other input that the implementation shows to have in this question. Since my test suite paths would pass because the transitions in my test path $TS_T$ still exist in this implementation, not fault would be revealed.

| | Steps in test path | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 | T6 | T8 | T9 | T7 | T6 | T10 |
| Source State | Ø | X | Y | X | Y | Y | Z | X | Z | Y | Z |
| Input | A | B | A | A | C | B | B | C | C | B | A |
| Output | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |

| Destination state | X | Y | X | Y | Y | Z | X | Z | Y | Z | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|

Same^

3. No because my test paths would still pass since all of the test paths in my test suite exist in this implementation there would be no errors here, revealing no faults. The only test path that would be missing in my $TS_{TT}$ is:

| | Steps in test path 7 | | |
|---|---|---|---|
| | T1 | T9 | T7 |
| Source State | Ø | X | Z |
| Input | A | C | A |
| Output | 0 | 0 | 1 |
| Destination state | X | Z | Y |

Exercise 3

1. No because my test suite $TS_S$ would still pass. A correct $TS_S$ for this implementation would be:

| | Steps in test path | | | |
|---|---|---|---|---|
| | Null to X | X to Y | Y to Z | Z to T |
| Source State | Ø | X | Y | Z |
| Input | A | B | B | B |
| Output | 0 | 1 | 1 | 0 |
| Destination state | X | Y | Z | Z |

2. No because my test suite $TS_T$ would still pass. A correct $TS_T$ for this implementation would be:

| | Steps in test path | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Null to X | X to Y | Y to X | X to Y | Y to Y | Y to Z | Z to Y | Y to Z | Z to Z | Z to T | T to T | T to T | T to Z |
| Source State | Ø | X | Y | X | Y | Y | Z | Y | Z | Z | T | T | T |
| Input | A | B | A | A | C | B | C | B | A | B | A | B | C |
| Output | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
| Destination state | X | Y | X | Y | Y | Z | Y | Z | Z | T | T | T | Z |

3. No because my test suite $TS_{TT}$ would still pass. A correct $TS_T$ for this implementation would be:

| | Steps in test path 1 | |
|---|---|---|
| | Null to X | X to Y |
| Source State | Ø | X |
| Input | A | B |
| Output | 0 | 1 |
| Destination state | X | Y |

| | Steps in test path 2 | | |
|---|---|---|---|
| | Null to X | X to Y | Y to Z |
| Source State | Ø | X | Y |
| Input | A | A | B |
| Output | 0 | 0 | 1 |
| Destination state | X | Y | Z |

| | Steps in test path 3 | | |
|---|---|---|---|
| | Null to X | X to Y | Y to X |
| Source State | Ø | X | Y |
| Input | A | A | A |
| Output | 0 | 0 | 1 |
| Destination state | X | Y | X |

| | Steps in test path 4 | | |
|---|---|---|---|
| | Null to X | X to Y | Y to Y |
| Source State | Ø | X | Y |
| Input | A | A | C |
| Output | 0 | 0 | 1 |
| Destination state | X | Y | Y |

| | Steps in test path 5 | | |
|---|---|---|---|
| | Null to X | X to Z | Z to Z |
| Source State | Ø | X | Z |
| Input | A | C | A |
| Output | 0 | 0 | 1 |
| Destination state | X | Z | Z |

| | Steps in test path 6 | | | |
|---|---|---|---|---|
| | Null to X | X to Z | Z to T | T to Z |
| Source State | Ø | X | Z | T |
| Input | A | C | B | c |
| Output | 0 | 0 | 0 | 0 |
| Destination state | X | Z | T | Z |

| | Steps in test path 7 | | | |
|---|---|---|---|---|
| | Null to X | X to Z | Z to T | T to T |
| Source State | Ø | X | Z | T |
| Input | A | C | B | B |
| Output | 0 | 0 | 0 | 1 |
| Destination state | X | Z | T | T |

| | Steps in test path 8 | | | |
|---|---|---|---|---|
| | Null to X | X to Z | Z to T | T to T |
| Source State | Ø | X | Z | T |
| Input | A | C | B | A |
| Output | 0 | 0 | 0 | 0 |
| Destination state | X | Z | T | T |

Exercise 4

It is correct that {a}, {b}, and {b, a} are not characterization sequences because in states X and Y {a} produce 0 so {a} is indistinguishable. In states X and Y, {b} produces 1 so {b} is indistinguishable. In states X and Y the inputs {b, a} both produce outputs 1, 1 so {b, a} is

indistinguishable. Since the sequence {a, b} produce unique ouputs for each state, it is considered a characterization sequence
Expected outputs:

| | a | b | b, a | a, b |
|---|---|---|---|---|
| X | 0 | 1 | 1, 1 | 0, 1 |
| Y | 0 | 1 | 1, 1 | 1, 1 |
| Z | 1 | 0 | 0, 0 | 1, 0 |

Exercise 5

1. Appending the characterization sequence to $TS_S$: from graph of exercise 1

| | Steps in test path | | | | |
|---|---|---|---|---|---|
| | T1 | T2 | T6 | T10 | T8 |
| Source State | Ø | X | Y | Z | Z |
| Input | A | B | B | A | B |
| Output | 0 | 1 | 1 | 1 | 0 |
| Destination state | X | Y | Z | Z | X |

Appending the characterization sequence to $TS_S$: from graph of exercise 2

| | Steps in test path | | | | |
|---|---|---|---|---|---|
| | T1 | T2 | T6 | Z to Y | Y to Z |
| Source State | Ø | X | Y | Z | Y |
| Input | A | B | B | A | B |
| Output | 0 | 1 | 1 | 1 | 1 |
| Destination state | X | Y | Z | Y | Z |

Since these outputs are different (0, 1, 1, 1, 0) and (0, 1, 1, 1, 1) the fault is revealed.

2. Appending the characterization sequence to $TS_T$: from graph of exercise 1

| | Steps in test path | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 | T6 | T8 | T9 | T7 | T6 | T10 | T10 | T8 |
| Source State | Ø | X | Y | X | Y | Y | Z | X | Z | Y | Z | Z | Z |
| Input | A | B | A | A | C | B | B | C | C | B | A | A | B |
| Output | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| Destination state | X | Y | X | Y | Y | Z | X | Z | Y | Z | Z | Z | X |

Appending the characterization sequence to $TS_T$: from graph of exercise 2

| | Steps in test path | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | T1 | T2 | T3 | T4 | T5 | T6 | T8 | T9 | T7 | T6 | T10 | Z to Y | Y to X |
| Source State | Ø | X | Y | X | Y | Y | Z | X | Z | Y | Z | Z | Y |
| Input | A | B | A | A | C | B | B | C | C | B | A | A | B |
| Output | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Destination state | X | Y | X | Y | Y | Z | X | Z | Y | Z | Z | Y | Z |

Since these outputs are different (0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1, 0) and (0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1, 1) the fault is revealed.

3. Appending the characterization sequence to $TS_{TT}$: from graph of exercise 1

| | Steps in test path 1 | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T2 |
| Source State | Ø | X | Y | X |
| Input | A | B | A | B |
| Output | 0 | 1 | 1 | 1 |
| Destination state | X | Y | X | Y |

| | Steps in test path 2 | | | | |
|---|---|---|---|---|---|
| | T1 | T4 | T6 | T10 | T8 |
| Source State | Ø | X | Y | Z | Z |
| Input | A | A | B | A | B |
| Output | 0 | 0 | 1 | 1 | 0 |
| Destination state | X | Y | Z | Z | X |

| | Steps in test path 3 | | | | |
|---|---|---|---|---|---|
| | T1 | T4 | T3 | T4 | T6 |
| Source State | Ø | X | Y | X | Y |
| Input | A | A | A | A | B |
| Output | 0 | 0 | 1 | 0 | 1 |
| Destination state | X | Y | X | Y | Z |

| | Steps in test path 4 | | | | |
|---|---|---|---|---|---|
| | T1 | T4 | T5 | T3 | T2 |
| Source State | Ø | X | Y | Y | X |
| Input | A | A | C | A | B |
| Output | 0 | 0 | 1 | 1 | 1 |
| Destination state | X | Y | Y | X | Y |

| | Steps in test path 5 | | | | |
|---|---|---|---|---|---|
| | T1 | T9 | T10 | T10 | T8 |
| Source State | Ø | X | Z | Z | Z |
| Input | A | C | A | A | B |
| Output | 0 | 0 | 1 | 1 | 0 |

| Destination state | X | Z | Z | Z | X |
|---|---|---|---|---|---|

| | Steps in test path 6 | | | | |
|---|---|---|---|---|---|
| | T1 | T9 | T8 | T4 | T6 |
| Source State | Ø | X | Z | X | Y |
| Input | A | C | B | A | B |
| Output | 0 | 0 | 0 | 0 | 1 |
| Destination state | X | Z | X | Y | Z |

| | Steps in test path 7 | | | | |
|---|---|---|---|---|---|
| | T1 | T9 | T7 | T3 | T2 |
| Source State | Ø | X | Z | Y | X |
| Input | A | C | C | A | B |
| Output | 0 | 0 | 0 | 1 | 1 |
| Destination state | X | Z | Y | X | Y |

Appending the characterization sequence to $TS_{TT}$: from graph of exercise 2

| same | Steps in test path 1 | | | |
|---|---|---|---|---|
| | T1 | T2 | T3 | T2 |
| Source State | Ø | X | Y | X |
| Input | A | B | A | B |
| Output | 0 | 1 | 1 | 1 |
| Destination state | X | Y | X | Y |

| different | Steps in test path 2 | | | | |
|---|---|---|---|---|---|
| | T1 | T4 | T6 | T10 | T8 |
| Source State | Ø | X | Y | Z | Y |
| Input | A | A | B | A | B |
| Output | 0 | 0 | 1 | 1 | 1 |
| Destination state | X | Y | Z | Y | Z |

| same | Steps in test path 3 | | | | |
|---|---|---|---|---|---|
| | T1 | T4 | T3 | T4 | T6 |
| Source State | Ø | X | Y | X | Y |
| Input | A | A | A | A | B |
| Output | 0 | 0 | 1 | 0 | 1 |
| Destination state | X | Y | X | Y | Z |

| same | Steps in test path 4 | | | | |
|---|---|---|---|---|---|
| | T1 | T4 | T5 | T3 | T2 |
| Source State | Ø | X | Y | Y | X |
| Input | A | A | C | A | B |
| Output | 0 | 0 | 1 | 1 | 1 |
| Destination state | X | Y | Y | X | Y |

| different | Steps in test path 5 | | | | |
|---|---|---|---|---|---|
| | T1 | T9 | T10 | T10 | T8 |
| Source State | Ø | X | Z | Z | Y |
| Input | A | C | A | A | B |
| Output | 0 | 0 | 1 | 1 | 1 |
| Destination state | X | Z | Z | Y | Z |

| Same | Steps in test path 6 | | | | |
|---|---|---|---|---|---|
| | T1 | T9 | T8 | T4 | T6 |
| Source State | Ø | X | Z | X | Y |
| Input | A | C | B | A | B |
| Output | 0 | 0 | 0 | 0 | 1 |
| Destination state | X | Z | X | Y | Z |

| same | Steps in test path 7 | | | | |
|---|---|---|---|---|---|
| | T1 | T9 | T7 | T3 | T2 |
| Source State | Ø | X | Z | Y | X |
| Input | A | C | C | A | B |
| Output | 0 | 0 | 0 | 1 | 1 |
| Destination state | X | Z | Y | X | Y |

Some of the outputs are different which means the fault will be revealed (I labelled in the table which ones are different and which ones are the same).

Exercise 6
Refer to first part of exercise 5 to view the oututs of the appended characterization sequence from exercise 4.

1. Appending the characterization sequence to $TS_S$: from graph of exercise 3:

| | Steps in test path | | | | | |
|---|---|---|---|---|---|---|
| | Null to X | X to Y | Y to Z | Z to T | | |
| Source State | Ø | X | Y | Z | Z | Z |
| Input | A | B | B | B | A | B |
| Output | 0 | 1 | 1 | 0 | 1 | 0 |
| Destination state | X | Y | Z | Z | Z | T |

These outputs are different from the ones using the $TS_S$ (0, 1, 1, 1, 0) so the fault would be revealed.

2. Appending the characterization sequence to $TS_T$: from graph of exercise 3:

| | Steps in test path | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Null to X | X to Y | Y to X | X to Y | Y to Y | Y to Z | Z to Y | Y to Z | Z to Z | Z to T | T to T | T to T | T to Z | | |
| Source State | Ø | X | Y | X | Y | Y | Z | Y | Z | Z | T | T | T | Z | Z |
| Input | A | B | A | A | C | B | C | B | A | B | A | B | C | A | B |
| Output | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| Destination state | X | Y | X | Y | Y | Z | Y | Z | Z | T | T | T | Z | Z | T |

The above outputs are different from the ones from exercise 1: so the fault is revealed

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |

3. Appending the characterization sequence to $TS_T$: from graph of exercise 3:

| different | Steps in test path 2 | | | | |
|---|---|---|---|---|---|
| | Null to X | X to Y | Y to Z | | |
| Source State | Ø | X | Y | Z | Z |
| Input | A | A | B | A | B |
| Output | 0 | 0 | 1 | 1 | 0 |
| Destination state | X | Y | Z | Z | T |

| | Steps in test path 1 | | | |
|---|---|---|---|---|
| | Null to X | X to Y | | |
| Source State | Ø | X | Y | X |
| Input | A | B | A | B |
| Output | 0 | 1 | 1 | 1 |
| Destination state | X | Y | X | Y |

| | Steps in test path 3 | | | | |
|---|---|---|---|---|---|
| | Null to X | X to Y | Y to X | | |
| Source State | Ø | X | Y | X | Y |
| Input | A | A | A | A | b |
| Output | 0 | 0 | 1 | 0 | 1 |
| Destination state | X | Y | X | Y | Z |

| | Steps in test path 4 | | | | |
|---|---|---|---|---|---|
| | Null to X | X to Y | Y to Y | | |
| Source State | Ø | X | Y | Y | X |
| Input | A | A | C | A | b |
| Output | 0 | 0 | 1 | 1 | 1 |
| Destination state | X | Y | Y | X | Y |

| different | Steps in test path 5 | | | | |
|---|---|---|---|---|---|
| | Null to X | X to Z | Z to Z | | |
| Source State | Ø | X | Z | Z | Z |

| Input | A | C | A | A | b |
|---|---|---|---|---|---|
| Output | 0 | 0 | 1 | 1 | 0 |
| Destination state | X | Z | Z | Z | T |

| different | Steps in test path 6 | | | | | |
|---|---|---|---|---|---|---|
| | Null to X | X to Z | Z to T | T to Z | | |
| Source State | Ø | X | Z | T | Z | Z |
| Input | A | C | B | c | A | b |
| Output | 0 | 0 | 0 | 0 | 1 | 0 |
| Destination state | X | Z | T | Z | Z | T |

| different | Steps in test path 7 | | | | | |
|---|---|---|---|---|---|---|
| | Null to X | X to Z | Z to T | T to T | | |
| Source State | Ø | X | Z | T | T | T |
| Input | A | C | B | B | A | B |
| Output | 0 | 0 | 0 | 1 | 0 | 1 |
| Destination state | X | Z | T | T | T | T |

| different | Steps in test path 8 | | | | | |
|---|---|---|---|---|---|---|
| | Null to X | X to Z | Z to T | T to T | | |
| Source State | Ø | X | Z | T | T | T |
| Input | A | C | B | A | A | B |
| Output | 0 | 0 | 0 | 0 | 0 | 1 |
| Destination state | X | Z | T | T | T | T |

Some of the test paths are different between exercise 1 and exercise 3 using the appending sequence form exercise 4, which means the fault is now revealed.