Hw5

1.1

- The size of the (miter's) state space (total number of states): 11 (#state-variables)
- The number of frames explored by AVR: 10 (max-frame)
- The frame number at which convergence was established: 7 (frame-conv)
- The total number of SAT calls during AVR's run: 1310 (scalls)
- The size of the inductive invariant that proves equivalence: 31 (sz-invariant)

```
(/afs/umich.edu/class/eecs598a/w24/env27) bash-4.4$
avr --witness -o 'h5p1_1' SeqEqvMiter.v
AVR
Copyright (c) 2016 - Present  Aman Goel and Karem Sakallah, University of Michigan
       (output dir: h5p1_1/work_test)
       (frontend: yosys)
       (found yosys in /afs/umich.edu/class/eecs598a/w24/bin)
       (property: all (1 assertions))
       (problem size: 11 bits)
       (abstraction: sa+uf)
   0    : 0     : 0 s: 0    0s
   0    : 1     : 0 2 s: 2    0s
   0    : 2     : 0 2 2 s: 4    0s
   0    : 3     : 0 2 2 2 s: 6    0s
   0    : 4     : 0 2 2 2 2 s: 8    0s
   0    : 5     : 0 2 2 2 2 2 s: 10    0s
   0    : 6     : 0 5 7 8 9 10 10 s: 49    0s
   0    : 7     : 0 3 4 3 4 3 2 24 s: 43    0s
   0    : 8     : 0 3 5 3 4 4 3 1 24 s: 47    0s
   0    : 9     : 0 3 4 3 4 4 3 1 1 24 s: 47    0s
   0    : 10    : 0 3 4 3 5 5 4 1 1 1 24 s: 51    0s
   0    : 10    : 0 3 4 3 4 4 3 0 5 1 24 s: 51    0s
      Result        Time        Mem.       #Refs
                     sec          MB
          h        0.05          15          0
```

1.2

The longest counterexample demonstrating non-equivalence is when Z = W[1]. The sequential depth of the mite should be 6.

```
(/afs/umich.edu/class/eecs598a/w24/env27) bash-4.4$
avr --witness -o 'h5p1_2' SeqEqvMiter.v
AVR
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       (output dir: h5p1_2/work_test)
       (frontend: yosys)
       (found yosys in /afs/umich.edu/class/eecs598a/w24/bin)
       (property: all (1 assertions))
       (problem size: 11 bits)
       (abstraction: sa+uf)
   0    : 0     : 0 s: 0    0s
   0    : 1     : 0 2 s: 2    0s
   0    : 2     : 0 2 2 s: 4    0s
   0    : 3     : 0 2 2 2 s: 6    0s
   0    : 4     : 0 2 2 2 2 s: 8    0s
   0    : 5     : 0 3 3 3 3 1 s: 13    0s
      Result        Time        Mem.       #Refs
                     sec          MB
          v        0.02          13          0
```

1.3

Here I choose AVR using a bound of 6 steps. Since after running AVR by default boundary, the log file shows that the abstract mode disabled at step 6. In addition, the result becomes f_err if I change the boundary to 5.

```
(/afs/umich.edu/class/eecs598a/w24/env27) bash-4.4$ avr --bmc --kmax 6  --witness -o 'h5p1_3' SeqEqvMiter.v
AVR
Copyright (c) 2016 - Present  Aman Goel and Karem Sakallah, University of Michigan
       (output dir: h5p1_3/work_test)
       (frontend: yosys)
       (found yosys in /afs/umich.edu/class/eecs598a/w24/bin)
       (property: all (1 assertions))
       (problem size: 11 bits)
       (abstraction: sa+uf)
  0s   (bmc: safe till step 0)
  0s   (bmc: safe till step 5)
       (bmc: abstract mode disabled at step 6)
       (bmc: found cex at step 6)
   0   : 0     : 0 s: 0    0s
     Result        Time        Mem.       #Refs
                    sec          MB
          v        0.01          13          0
```

2

The AVR results of the buggy code with safe operation checking are under file ‘h5p2_v’, while the AVR results after modification are under ‘h5p2_h’. The cause of unsafe operation is in state ELG, where both NLTL and ELTL are green. It can eliminated by changing NLTL from green to red in this state.

```
(/afs/umich.edu/class/eecs598a/w24/env27) bash-4.4$ avr --witness --smt2 -o 'h5p2_v' TLC.v
AVR
Copyright (c) 2016 - Present  Aman Goel and Karem Sakallah, University of Michigan
       (output dir: h5p2_v/work_test)
       (frontend: yosys)
       (found yosys in /afs/umich.edu/class/eecs598a/w24/bin)
       (property: all (1 assertions))
       (problem size: 7 bits)
       (abstraction: sa+uf)
   0   : 0     : 0 s: 0    0s
   0   : 1     : 0 2 s: 2    0s
   0   : 2     : 0 1 2 s: 3    0s
   0   : 3     : 0 1 1 2 s: 4    0s
   0   : 4     : 0 1 1 1 2 s: 5    0s
   0   : 5     : 0 1 1 1 1 2 s: 6    0s
   0   : 6     : 0 1 1 1 2 1 2 s: 8    0s
   0   : 7     : 0 1 1 1 1 1 2 2 s: 9    0s
   0   : 8     : 0 1 1 1 1 1 1 2 2 s: 10    0s
   0   : 9     : 0 1 1 1 1 1 1 1 2 2 s: 11    0s
   0   : 10    : 0 1 1 1 1 1 1 1 1 2 2 s: 12    0s
   0   : 11    : 0 1 1 1 1 1 1 1 1 1 3 0 s: 12    0s
     Result        Time        Mem.       #Refs
                    sec          MB
          v        0.08          15          0
```

```
(/afs/umich.edu/class/eecs598a/w24/env27) bash-4.4$ avr --witness --smt2 -o 'h5p2_h' TLC.v
AVR
Copyright (c) 2016 - Present  Aman Goel and Karem Sakallah, University of Michigan
       (output dir: h5p2_h/work_test)
       (frontend: yosys)
       (found yosys in /afs/umich.edu/class/eecs598a/w24/bin)
       (property: all (1 assertions))
       (problem size: 7 bits)
       (abstraction: sa+uf)
   0   : 0     : 0 s: 0    0s
   0   : 1     : 0 0 s: 0    0s
   0   : 1     : 0 0 s: 0    0s
     Result        Time        Mem.       #Refs
                    sec          MB
          h        0.01          14          0
```