Software Specifications
Assignment 4

Cain Susko

Queen's University
School of Computing

March 23, 2022

1. The Precondition for the given statements should be:

   (a) `x == 1`

   (b) `x == 2`

   (c) `0 < 2y + 2z`

   (d) `2(y*z + 3) > y + 2`

   (e) `Exists(y = 0; y < 10) 2y + 1 == 50`

   (f) `Exists(y = 0; y < 15) 2(x+y) == y + t`

   (g) `ForAll(z =1; z < 100) 3y + 1 > z + 2`

   (h) `ForAll(y = 1; y < x) 2x + 2y < 100`

   (i) `Exists(y+z = 0; y+z < 10) z*z + 2(y + z)== 15`

   (j) `Exists(y = 0; y < 100)(2y + z == 15 || 2z*y + y < 100)`

2. These following statements have been verified:

   (a)
   ```
   ASSERT( x >= 5 || ( x <= 0 && y == 2 ) )
   z = x - y;
   ASSERT(y == 2)
   y = y + z;
   ASSERT(y - z == 2 || y > 3)
   x = y - z;
   ASSERT( x == 2 || y > 3 )
   ```

   (b)
   ```
   ASSERT( z >= 0 )
   if ( x < 2 ) { y = z+3; } //end-if
   ASSERT(y > x + 1 || x + z > 1)
   z = x + z;
   ASSERT(y > x + 1|| z > 1)
   ```

3. (a) The Loop Invariant is: `i > 0`

(b) The Complete Proof Tableau is:

```
ASSERT(k >= 0)
i = k;
ASSERT(i > 0)
sum = k;
while( i > 0 )
{
        ASSERT(sum+i-1 == j && i > 0)
        i = i - 1;
        ASSERT(sum+i == j && i > 0)
        sum =sum+i;
}
ASSERT(sum == SUM{j=0->k}(j))
```

4.
```
const int n; /* the program will
                compute the sum of the squares
                of the n smallest positive odd integers*/
int sum;     /* the sum is stored in this variable */

int count = 0;
int i = 0;

ASSERT( n >= 1 )

while(count < n)
        i++
        ASSERT(count < n)
        if (i % 2 != 0){
                ASSERT(count < n && i*i ==
                        (2*count)*(2*count))
                count++;
                ASSERT(count < n && i*i ==
                        (2*count+1)*(2*count+1))
                sum += i*i;
        }
}
ASSERT( sum == SUM{i=0->n-1} (2*i+1)*(2*i+1) )
```

The loop invariant is `count < n` and the agrgument for any sequene of numbers there are a given number of odd numbers. Becuase the program can generate a functionally endless sequence of numbers, there will always be to one point n odd number is a series. this is not always possible for extremely large values of n