McMaster University  
SFWR ENG 2MD3 Winter 2020 Assignment 4  
Due: Sunday March 7, 2020 at 23:55

March 2, 2020

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Question1 (2 marks each = 8 marks)

Find out the truth values of the following Hoare Triples. (Show that the triple is valid or invalid)

1. {i = j} i = j + i; {i>j}

**FALSE:** Consider i = j = 0 precondition is satisfied, but the post condition is not.

1. {i > j} j = i+1; i = j+1; {i > j}

**TRUE:** Consider i = 0, j = -3; precondition is satisfied, post condition is also satisfied

1. {x > 0} x = x + 1; {x > 1}

**TRUE:** Consider x = 1; precondition is satisfied, post condition is also satisfied

1. {x = 5 > 0} x = x + 1; {x > 1}

**TRUE:** providing x is an integer, it will be assigned 1 by the pre-condition, and then incremented to 2, thus satisfying the post condition

Question 2 (2marks each = 8 marks marks)

Find the weakest pre-condition for the following Hoare Triples:

1. {??} x = 5; {x = 5}

P = wp(x=5, x=5)

**P = {TRUE}**

1. {??} x = x + 3; {x = y + 3}

P = wp(x = x + 3,x = y + 3)

P = (x + 3 = y + 3)

**P = {x = y}**

1. {??} z = x / y; {z < 1}

P = wp(z = x / y, z < 1)

P = (x / y < 1)

**P {y > x}**

1. {??} x = 3 ∗ y + z; {x ∗ y – z > 0}

P = wp(x = 3 \* y + z, x \* y – z > 0)

P = [(3 \* y + z) \* y – z > 0]

**P = {3 \* y2 + z \* y - z > 0}**

Question 3 (2 marks each = 4 marks)

Find the weakest pre-condition for the following sequence of statements:

1. {??} x = z + 1; y = x + y; {y > 5}

P = wp(x = z + 1, wp(y = x + y, y > 5))

P = wp(x = z + 1, x + y > 5)

P = (z + 1 + y > 5)

**P = {y + z > 4}**

1. {??} x = x + 1; x = x + 2; {x > 5}

P = wp(x = x + 1, wp(x = x + 2, x > 5))

P = wp(x = x + 1, x + 2 > 5)

P = (x + 3 > 5)

**P = {x > 2}**

Question 4 (4 marks)

Find the pre-condition for the following conditional statement corresponding to given post- condition:

{??} if (x != 0){ z = x; } else{ z = x + 1;} {z > 0}

P = wp(if (x != 0) z = x else z = x + 1, z > 0)  
P = [(x != 0) wp(z = x, z > 0) (x = 0) wp(z = x + 1, z > 0)]

P = [(x != 0) (x > 0) (x = 0) (x + 1 > 0)]

P = {x > 0} {x = 0}

**P = {x 0}**

Question 5 (4 marks)

What is the loop invariant inside the while loop in the following program?

Show that it is valid before and after the termination of the loop.

int Sum(InputArray A, int n) {

int i = 0, S = 0;

while(i < n){

S+= A[i];

i++;

}

return S;

}

**Prior to loop execution; i = 0, S = 0;**

**Upon termination of the loop; i = n, S =**

**Thus, the loop invariant is: S =**