Program Reasoning – Assignment – 4

1. Deduce the weakest preconditions for the following programs. Show the step by step working of deduction to get full marks. You need to work the problems out with pen and paper, scan and submit.
   1. Increment a number

|  |  |
| --- | --- |
| P | a != -1 |
| S | a = a + 1 |
| Q | **a < 0 \/ a > 0** |

P=wp(S,Q)= Q<-S => a=-1

* 1. Absolute value

|  |  |
| --- | --- |
| P | X = (any real number) |
| S | if (x < 0)  abs = -1 \* x; else  abs = x; |
| Q | **abs >= 0** |

P=wp(S,Q)

X<0 and abs>=0 or x>=0 and abs >=0

X<0 or x>=0

* 1. Swapping two integers

|  |  |
| --- | --- |
| P | A==20 ^ b==10 |
| S1  S2  S3 | a = a + b b = a – b a = a - b |
| Q | **a == 10 /\ b == 20** |

P=wp(S1,wp(s2,wp(s3,Q)))

P=wp(S1,wp(s2,wp(a=a-b,a==10 ^ b==20)))

P=wp(S1,wp(s2,a==30 ^ b==20))

P=wp(S1,wp(b=a-b,a==30 ^ b==20))

P=wp(S1, a==30 ^ b==10)

P=wp(a=a+b, a==30 ^ b==10)

P= a==20 ^ b==10

* 1. Operations on a stack.

|  |  |
| --- | --- |
| P | Size>1 |
| S1  S2  S3  S4  S5  S6  S7 | Push element to stack; size = size + 1; Push element to stack; size = size + 1; Pop the topmost element; size = size - 1; Pop the topmost element; size = size - 1; Push element to stack; size = size + 1; Pop the topmost element; size = size - 1; Pop the topmost element; size = size - 1; |
| Q | **size >= 0** |

P=wp(S1,wp(S2,wp(S3,wp(S4,wp(S5,wp(S6,wp(S7,Q)))))))

P=wp(S1,wp(S2,wp(S3,wp(S4,wp(S5,wp(S6,wp(S7,size>=0)))))))

P=wp(S1,wp(S2,wp(S3,wp(S4,wp(S5,wp(S6,wp(size=size-1,size>=0)))))))

P=wp(S1,wp(S2,wp(S3,wp(S4,wp(S5,wp(S6, size>=1))))))

P=wp(S1,wp(S2,wp(S3,wp(S4,wp(S5,wp(size=size-1, size>=1))))))

P=wp(S1,wp(S2,wp(S3,wp(S4,wp(S5, size>=2)))))

P=wp(S1,wp(S2,wp(S3,wp(S4,wp(size=size+1, size>=2)))))

P=wp(S1,wp(S2,wp(S3,wp(S4, size>=1))))

P=wp(S1,wp(S2,wp(S3,wp(size=size-1, size>=1))))

P=wp(S1,wp(S2,wp(S3, size>=2)))

P=wp(S1,wp(S2,wp(size=size-1, size>=2)))

P=wp(S1,wp(S2, size>=3))

P=wp(S1,wp(size=size+1, size>=3))

P=wp(size=size+1, size>=2)

P=size>1

1. Fill the following truth table to show that B=>S1 /\ !B=>S2 is equivalent to (B /\ S1) \/ (!B /\ S2).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | S1 | S2 | B=>S1 | !B | !B=>S2 | B=>S1 /\ !B=>S2 |
| T | T | T | T | F | T | T |
| T | T | F | T | F | T | T |
| T | F | T | F | F | T | F |
| T | F | F | F | F | T | F |
| F | T | T | T | T | T | T |
| F | T | F | T | T | F | F |
| F | F | T | T | T | T | T |
| F | F | F | T | T | F | F |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | S1 | S2 | B/\S1 | !B | !B/\S2 | B/\S1 \/ !B/\S2 |
| T | T | T | T | F | F | T |
| T | T | F | T | F | F | T |
| T | F | T | F | F | F | F |
| T | F | F | F | F | F | F |
| F | T | T | F | T | T | T |
| F | T | F | F | T | F | F |
| F | F | T | F | T | T | T |
| F | F | F | F | T | F | F |