Homework 7

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Problem 1

1. a>3
2. a !=0
3. b-c=5
4. a=10

Problem 2

Prove {a = v0 ∧ b = v1}c := a; a := b; b := c{a = v1 ∧ b = v0}

1. {a = v1∧c=v0}b := c{a = v1 ∧ b = v0}
2. {b = v1∧c=v0}a := b{a = v1∧c=v0}
3. {b = v1∧a=v0}c := a{b = v1∧c=v0}
4. {a = v0 ∧ b = v1}c := a; a := b; b := c{a = v1 ∧ b = v0} (1)(2)(3)

Problem 3

Prove {T} if(a == 1) then b := 3 else b := 1 {b = 1 ∨ b = 3}

1. {3=1∨3=3}b:=3{b = 1 ∨ b = 3}
2. {1=1∨1=3}b:=1{b = 1 ∨ b = 3}
3. T∧a==1→3=1∨3=3
4. T∧a!=1→3=1∨3=3
5. {T∧a==1}b:=3{b = 1 ∨ b = 3} (1)(3)
6. {T∧¬(a==1)}b:=1{b = 1 ∨ b = 3} (2)(4)
7. {T} if(a == 1) then b := 3 else b := 1 {b = 1 ∨ b = 3} (5)(6)

Problem 4

Prove {a = 3} while(a! = 10) a := a + 1 {a = 10}. The loop invariant is a ≤ 10

1. {a+1≤10}a := a + 1 {a ≤ 10}
2. a=3 ∧a!=10→ a+1≤10
3. {a=3 ∧a!=10}a := a + 1 {a ≤ 10} (1)(2)
4. {a = 3} while(a! = 10) a := a + 1 {a ≤ 10∧a!=10}
5. a ≤ 10∧a!=10→a=10
6. {a = 3} while(a! = 10) a := a + 1 {a = 10} (4)(5)

Problem 5

Write a weaker precondition and a stronger postcondition for {b = 7}a := b+3{a > 5}

Weakest:b>2

Stronger: a=10

Problem 6

Compute wlp(a := b-1; if(a == 10) then c := a + 1 else c := a + 2,c > 4)

{P}a := b-1; if(a == 10) then c := a + 1 else c := a + 2{c>4}

= wlp( a:=b-1, (a==10)→wlp(c:=a+1,c>4)∧(a!=10)→wlp(c:=a+2,c>4) ) )

=wlp( a:=b-1, a==10 →a>3∧a!=10 →a>2 )

=b==11→b>4∧b!=11 →b>3