CS536 Homework 7

Proof Rules and Proofs

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Answers: -

Question 1

p_1 ≡ wp(k=k+1,p) ≡ (x = 2^k ∧ k ≤ n)[k / k+1] ≡ x = 2^(k+1) ∧ k+1 ≤ n

{ p_2 } x := x*2 { p_1 }
p1≡ x = 2^(k+1) ∧ k+1 ≤ n
Now, **p2** ≡ x=2^(k+1) ∧ k+1 ≤ n [x*2/x]
≡ x*2 =2^(k+1) ∧ k+1 ≤ n

r_1 ≡ precondition strengthen, 4, 3

r_2 ≡ loop, 5

Question 2

p_1 ≡ p ∧ k < n ≡ x = 2^k ∧ k ≤ n ∧ k < n

p_2 ≡ sp(p_1, x := x*2) ≡ x=2^k ∧ k ≤ n ∧ k < n [x_0 /x] ∧ $x = x*2[x_0/x]$

≡ x_0=2^k ∧ k ≤ n ∧ k < n ∧ $x = x_0 *2$

p3 ≡ sp(p2, k := k+1) ≡ (x_0=2^k ∧ k ≤ n ∧ k < n ∧ $x = x_0 *2$) $[k_0/k] \wedge k = k+1[k_0/k]$
≡ x_0=2^k_0 ∧ k_0 ≤ n ∧ k_0 < n ∧ $x = x_0 *2 \wedge k = k_0+1$

R1 ≡ post conditioning weakening 4,3

R2 ≡ loop 5

Question 3

q1 ≡ wp(x := x/2, r = X*Y - x*y) ≡ r = X*Y - x*y [x / x/2] ≡ r = X*Y – (x/2)*y
R1≡ assignment(backward)

q2 ≡ wp(y=2*y,q1) ≡ r = X*Y – (x/2)*y [y/2*y] ≡ r = X*Y – (x/2)*(2*y)
R2≡ assignment(backward)

q3 ≡(r=X*Y-x*y) ∧ (x%2=0)

q4 ≡ (r = X*Y - x*y) ∧ (x % 2 ≠ 0)

R3 ≡ assignment (forward)

q5 ≡ r0 =X*Y-x*y ∧ x%2 ≠ 0 ∧ x=x0 ∧ r:=r0+y

q6 ≡ r0 =X*Y-x0*y ∧ x0 %2 ≠ 0 ∧ r:=r0+y ∧ x:=x0-1

R4 ≡ assignment (forward)

R5 is conditional 5, 10