**Algorithmics Unit 4 Week 1 – Submission Task**

1. Evaluate:
2. = 3(4n+1)
3. = 4n(n+1)
4. If find in terms of : (k = 10\*f(i))
5. = 4k
6. = k + 50
7. Prove by induction (for all

Let P(n) be the above statement for

Base Case: P(1)

LHS = 1

RHS = 2^1 – 1

= 1

∴ LHS = RHS, ∴ True

Assume that is true.

Induction: P(k+1)

LHS =

=

=

=

= RHS

∴ P(k+1) is true

∴ P(n) is true for any by mathematical induction

Let P(n) be the above statement for

Base Case: P(1)

LHS = 2^1

= 2

RHS = 1

∴ LHS > RHS, ∴ True

Assume that is true.

Induction: P(k+1)

for

P(k+1) is true

∴ P(n) is true for any by mathematical induction

1. Consider the following algorithm, which searches for ‘x’ in array ‘A’ and returns either the index (if A contains x) or -1 if A does not contain x:

def search(A,x):

n = length of array

for i = 1 to n:

if A[i] = x then return i

return -1

(Here indices start at 1, and A[2:4] includes A[2],A[3] and A[4].)

1. Which of the following are loop invariants?
2. At the start of each iteration, if A contains x then the subarray A[i:n] contains x.
3. At the start of each iteration, if A contains x then the subarray A[i+1:n] contains x.
4. At the start of each iteration, A[1:i] does not contain x.
5. At the start of each iteration, A[1:i-1] does not contain x.
6. At the start of each iteration, if A[i:n] does not contain x then x is not in A.
7. At the start of each iteration, if A[i+1:n] does not contain x then x is not in A.
8. At the start of each iteration, if A[i-1:n] does not contain x then x is not in A.

(b) For the first loop invariant you have identified, explain whether or not it remains true after the loop has completed.

This remains true after the loop has completed, because there are two cases where the loop terminates:

1. The loop has found x, meaning that A[i] = x, and ∴ A[i:n] must contain x as well
2. The loop has not found x, in which case the array does not contain x and the statement does not apply.

Therefore, it remains true.