

Homework 5CS 541
Fall 1991
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1 Prove the following program specification:

```
var I: 1..N;  
    SQUARE: array [0..N] of INTEGER;  
  
{N ≥ 0}  
begin  
    SQUARE[0] := 0;  
    for I := 1 to N do  
        SQUARE[I] := SQUARE[I-1] + (2*I-1)  
    end  
{∀k[0 ≤ k ≤ N ⇒ SQUARE[k] = k2]}
```

2 (Alagić and Arbib, chapter 5, problem 8) The Fibonacci numbers are defined by:

$$f_n = \begin{cases} 0, & \text{if } n = 0; \\ 1, & \text{if } n = 1; \\ f_{n-1} + f_{n-2}, & \text{if } n > 1. \end{cases}$$

Consider the following function declaration and prove that $n \geq 0 \implies \text{FIB}(n) = f_n$ is a tautology.

```
function FIB (N: INTEGER): INTEGER;  
var I,A,B: INTEGER;  
begin  
    A := 1;  
    B := 0;  
    for I := 1 to N do  
        begin  
            B := A + B;  
            A := B - A  
        end;  
    FIB := B  
end
```

3 (Alagić and Arbib, chapter 5, problem 9) Prove the following program specification:

```
var A: INTEGER;
procedure M (X,Y: INTEGER; var Z: INTEGER);
    var P,Q: INTEGER;
begin
    P := X;
    Q := Y;
    Z := 0;
    while P <> 0 do
        begin
            if ODD(P) then Z := Z + Q;
            Q := Q * 2;
            P := P div 2
        end
    end;

    {true}
begin
    M (5, 7, A);
end
{A = 35}
```