Homework XI

1. [15 points]
Prove the Hoare while normal form theorem (i.e., provide a construction to replace **if**–**then**– with sequential execution and **while**–**do**–), and justify its correctness.

2 (repeated from Homework X). [25 points]
Provide an axiomatic proof of partial correctness for the Wren program fragment using integer variables:

```
    {true}
  if A=B or A=-B
    then if A>B then C:= A else C:= B-A+1 end if
    else if A*B>0 then C:= A*B else C:= 1-A*B end if
  end if
    {C>0)
```

3. [25 points]
Provide an axiomatic proof of partial correctness for the Wren program fragment with pre/post-conditions below (computing the "square root"), using integer variables:

```
    {N≥1}
  R:= 0;
  while R*R < N do R:= R+1 end while
    {(R-1)^2 < N ≤ R^2)
```

4. [25 points]
Provide an axiomatic proof of partial correctness for the Wren program fragment with pre/post-conditions below (computing the "binary logarithm"), using integer variables:

```
    {N>0}
  P:= 0;  M:= 1;
  while M < N do P:= P+1;  M:= 2*M end while
    {2^(P-1)< N □ 2^P≥N}
```