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ALGORITHM CORRECTNESS PROOFS

P.1. Find the precondition of the following piece of code: **y:=2/(2*b+c); x:=1-b*y** if its postcondition is: **{(x+b*y=u) ∧ (c*y-2*x=0)}**.

P.2. Let A and B be the initial values of “a” and “b” respectively. Write a piece of code with the following postcondtion: **{(a=A+B) ∧ (b=A-B)}** and prove its correctness.

P.3. Prove that the assertion: **{sum=j*(j-1)/2}** is the invariant of the following piece of code: sum:=sum+j; j:=j+1.

P.4. Prove the partial correctness of the following piece of code:

```
Sum:=0; j:=1;
While (j<>c) do
        Begin
                Sum:=sum+j; j:=j+1
        End;
{sum=c*(c-1)/2}
```

P.5. Prove the partial correctness of the following piece of code:

```
{n≥0}
i:=1;
while i≤n do
        begin
                a[i]:=b[i];
                i:=i+1
        end;
```

$\{\Lambda_{i=1}^{n} (a[i]=b[i])\}$

P.6. Let A and B be the initial values of “a” and “b” respectively. Prove the partial correctness of the following code that works out the addition of two integer numbers:

```
while a≠0 do
        begin
                a:=a-1;
                b:=b+1
        end;
{(b=A+B) ∧ (a=0)}
```

P.7. Prove the partial correctness of the following code that works out the division of two integer numbers (A and B):

```
q:=0; r:=A;
while r≥B do
        begin
                r:=r-B;
                q:=q+1
        end;
{(q*B+r=A) ∧ (0≤r≤B)}
```

P.8. Let A and B be the initial values of “a” and “b” respectively. Prove the partial correctness of the following code that works out the Maximum Common Divisor (MCD) of two integer numbers:

```
while a≠b do
        if a>b then
                a:=a-b
        else
                b:=b-a
```

For proving the partial correctness, take into account the following features of the MCD:

- if a>b then MCD(a,b)=MCD(a-b,b)
- MCD(a,b)=MCD(b,a)
- MCD(a,a)=a

P.9. Prove the partial correctness of the following code that works out A^N , where A and N are integer numbers:

```
q:=1; z:=A; w:=N;
while w>0 do
        begin
                w:=w-1;
                q:=q*z
        end;
{(q=A^N) ∧ (w=0)}
```

P.10. Prove the partial correctness of the following code that works out $\Sigma_{i=1}^{n}$ i!.

```
i:=1; sum:=0; f:=1;
while i<>n+1 do
        begin
                sum:=sum+f;
                i:=i+1;
                f:=f*i
```

```
end;
```