

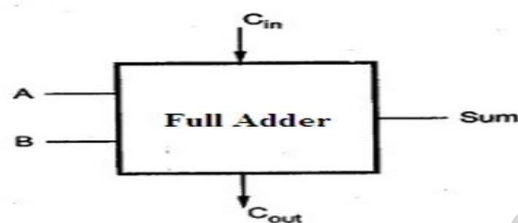
Problem

A "population count" circuit counts the number of '1's in an input vector. Build a population count circuit for a 3-bit input vector.

Solution

Yes , its a full adder

Where $sum = A \oplus B \oplus C_{in}$, $carry = (A \& B) \vee (A \& C_{in}) \vee (B \& C_{in})$

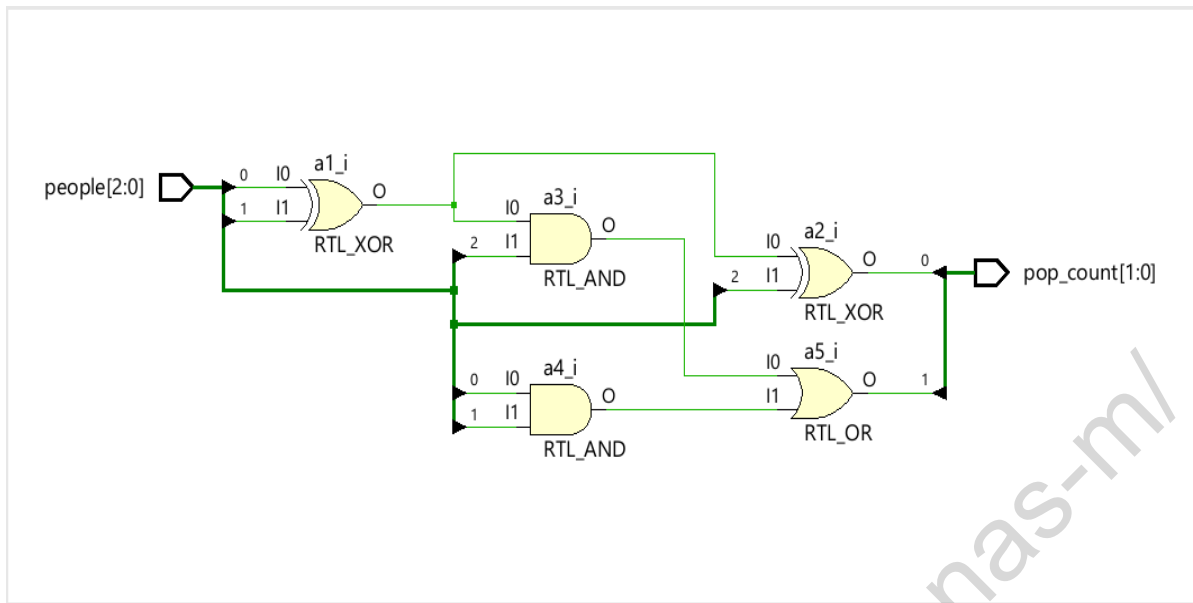


Here {Cin,B,A}=people (3 bit vector input) and {carry,sum}=count (2 bit vector output)

Design

```
module fa( input [2:0] people,
           output [1:0] pop_count
);
  wire t1,t2,t3;
  xor a1(t1,people[0],people[1]),
      a2(pop_count[0],t1,people[2]);
  and a3(t2,t1,people[2]),
      a4(t3,people[0],people[1]);
  or a5(pop_count[1],t2,t3);
endmodule
```

Circuit



Testbench

```

module tb;
  reg [2:0] people;
  wire [1:0] pop_count;
  reg [3:0] i;
  fa a2(people, pop_count);

  initial begin
    for( i=0; i<=7; i=i+1) begin
      people=i; #50;
    end
    $finish;
  end
endmodule

```

Waveform

