```
module hamming (input [21:0] data,  output [1:0] error_code);
    wire [4:0] parity;
    wire [4:0] syndrome;
    wire [4:0] old_parity;
    reg [1:0] ecode;
    assign error_code = ecode;
    assign parity[0] = data[20] ^ data[18] ^ data[16] ^ data[14] ^ data[12] ^
data[10] ^ data[8] ^ data[6] ^ data[4] ^ data[2];
    assign parity[1] = data[18] ^ data[17] ^ data[14] ^ data[13] ^ data[10] ^ data[9]
^ data[6] ^ data[5] ^ data[2];
    assign parity[2] = data[20] ^ data[19] ^ data[14] ^ data[13] ^ data[12] ^
data[11] ^ data[6] ^ data[5] ^ data[4];
    assign parity[3] = data[14] ^ data[13] ^ data[12] ^ data[11] ^ data[10] ^ data[9]
^ data[8];
    assign parity[4] = data[20] ^ data[19] ^ data[18] ^ data[17] ^ data[16];

    assign old_parity[0] = data[0];
    assign old_parity[1] = data[1];
    assign old_parity[2] = data[3];
    assign old_parity[3] = data[7];
    assign old_parity[4] = data[15];

    assign syndrome = old_parity ^ parity;


    /*
    Error detection table
    +----------+-------------+--------------
+-----------------------------------------------+
    | syndrome |   overall   |  error type  |
notes                                  |
    |          | Parity (P5) |
|                                               |
    +----------+-------------+--------------
+-----------------------------------------------+
    |    0     |      0      |   no error
|                                               |
    +----------+-------------+--------------
+-----------------------------------------------+
    |   /=0    |      1      | single error | correctable.syndrome holds incorrect
bit      |
    |          |             |              |
position.                                     |
    +----------+-------------+--------------
+-----------------------------------------------+
    |   /=0    |      0      | double error | not
correctable.                              |
    +----------+-------------+--------------
+-----------------------------------------------+
    |    0     |      1      | parity error | overall parity. P5 is in error and can
be     |
    |          |             |              |
corrected.                                    |
    +----------+-------------+--------------
+-----------------------------------------------+
    */

    always @(*) begin
        if (syndrome == 5'b0) begin
            if (data[21] == 1'b0) begin
                ecode <= 2'b00; // no error
            end else begin
```

```
                ecode <= 2'b01; // parity error
            end
        end else begin
            if (data[21] == 1'b0) begin
                ecode <= 2'b10; // double error
            end else begin
                ecode <= 2'b11; // single error
            end
        end
    end
endmodule
```