**Group 24**

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**Lab 2: g24\_mastermind\_score**

Circuit: g24\_mastermind\_score

Inputs:

* P1, P2, P3, P4: 4 3-bit vectors representing the colors of the pins of the Solution at places 1-4
* G1, G2, G3, G4: 4 3-bit vectors representing the colors of the pins of the Guess at places 1-4

Outputs:

* **exact\_match\_score**: 3-bit vector representing the number of color and place match between the Solution and Guess pins
* **color\_match\_score** : 3-bit vector representing the number of color match between the Solution and Guess pins (colors match but places don’t)
* **score\_code** : 4-bit vector representing the code of the solution

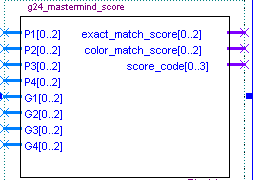
Function:

* P1, P2, P3, P4, the colors of the pins of the Solution at places 1-4 and G1, G2, G3, G4 the colors of the pins of the Guess at places 1-4, can have values from 000 to 101 (6 colors).
* The Circuit takes the 4 Solution pins and 4 Guess pins and check how many of the colors and places match.
* **exact\_match\_score** is the count of the matches at each pair of pins (P1,G1), (P2,G2), (P3,G3) and (P4,G4). **exact\_match\_score** can have values from 000 (none of the pairs match) to 100 (all 4 pairs match)
* **color\_match\_score** is the count of correct colored pins that are placed at incorrect positions. **color\_match\_score** can have values from 000 (none of the incorrectly placed pins are the right color) to 100 (all of the colors are correct but placed in incorrect positions). Thus, if all pins are placed correctly then this value is still 0.
* **score\_code**: a code given to the current score based on the value of **exact\_match\_score**  and **color\_match\_score. score\_code** is 0 when the inputs are invalid. The valid values of score\_code is from 0001 to 1110. The values of **score\_code** have the values in the table on the following page.

Table representing **score\_code** values

|  |  |  |
| --- | --- | --- |
| **exact\_match\_score** | **color\_match\_score** | **score\_code** |
| 4 (100) | 0 (000) | 1 (0001) |
| 3 (011) | 0 (000) | 2 (0010) |
| 2 (010) | 0 (000) | 3 (0011) |
| 2 (010) | 1 (001) | 4 (0100) |
| 2 (010) | 2 (010) | 5 (0101) |
| 1 (001) | 0 (000) | 6 (0110) |
| 1 (001) | 1 (001) | 7 (0111) |
| 1 (001) | 2 (010) | 8 (1000) |
| 1 (001) | 3 (011) | 9 (1001) |
| 0 (000) | 0 (000) | 10 (1010) |
| 0 (000) | 1 (001) | 11 (1011) |
| 0 (000) | 2 (010) | 12 (1100) |
| 0 (000) | 3 (011) | 13 (1101) |
| 0 (000) | 4 (100) | 14 (1110) |
| 3 (011) | 1 (001) | 0 (0000) (invalid) |
| anything else | anything else | 0 (0000) (invalid) |

Circuit diagram:



This circuit was tested with 8 sets of values for P1-P4 and G1-G4. The

Input and Output values tested and obtained are (in base 10):

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Solution Pins P  (Color IDs 0-5) | | | | Guess Pins G  (Color IDs 0-5) | | | | **exact\_match score** | **color\_match score** | **score code**  (check other table) |
| P1 | P2 | P3 | P4 | G1 | G2 | G3 | G4 |
| 1 | 2 | 1 | 1 | 1 | 2 | 3 | 4 | 2 | 0 | 3 |
| 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 4 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 2 | 3 | 4 | 0 | 1 | 11 |
| 4 | 2 | 1 | 3 | 1 | 2 | 3 | 4 | 1 | 3 | 9 |
| 2 | 2 | 1 | 2 | 1 | 2 | 3 | 4 | 1 | 1 | 7 |
| 2 | 2 | 2 | 2 | 1 | 2 | 3 | 4 | 1 | 0 | 6 |
| 2 | 2 | 3 | 2 | 1 | 2 | 2 | 3 | 1 | 2 | 8 |
| 2 | 2 | 3 | 2 | 1 | 2 | 3 | 3 | 2 | 0 | 3 |

The values of **exact\_match\_score**, **color\_match\_score** and **score\_code** are exactly as expected and the value of **score\_code** matches the values in the table on the previous page.

Waveform simulations:

