

The MATLAB™ Challenge is an effort to spur interest in programming among USI Engineering students. This challenge is available to all USI Engineering students.



# Bulls and Cows (Mastermind)



## 1 Introduction

Mastermind is a game invented in 1970 by an Israeli telecommunications expert, Mordecai Meirowitz. The object of the game is to break a sequenced color code devised by a programmer. After each attempt to break the code, information as to the accuracy of each attempt is passed from the programmer. Mastermind resembles another game, Bulls and Cows, that is usually played with a pencil and paper using numbers instead of colors.<sup>1</sup>

### 1.1 Mastermind Game Play

Mastermind is a game that requires two players:

- A PROGRAMMER and
- A CODE BREAKER

1. The game starts with THE PROGRAMMER setting the code.

- (a) The PROGRAMMER may choose to set his/her code using between 3-6 colors (an example of 6 shown colors shown below):

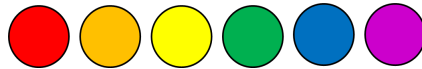


Figure 1: Color Options

**Note:** Usually the code consists of unique colors, but in advanced game play, the PROGRAMMER may choose the code to include repeated colors.

- (b) Next the PROGRAMMER establishes the code by placing each color in a specific order within 3-5 spaces (an example of 4 positions shown below):

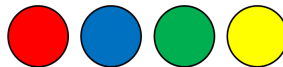


Figure 2: PROGRAMMER CODE

2. The game continues with the CODE BREAKER attempting to “break” the PROGRAMMER’S code by matching the sequence and colors of the PROGRAMMER’S code with an initial attempt.



Figure 3: CODE BREAKER’S 1st Attempt



## 1.2 The Bulls and Cows

“Bulls and cows” are marks given by the PROGRAMMER to indicate to the CODE BREAKER the accuracy of the CODE BREAKER’S attempt. Bulls (or black pegs) indicate that there is a correct color in the correct position in the CODE BREAKER’S attempt. Cows (or white pegs) indicate that there are correct colors in the CODE BREAKER’s attempt, however, they may not be in the correct position. Note that the Bulls and Cows do not *indicate* the correct color or position, only that there is a correct color in the correct position.



Figure 4: PROGRAMMER marks a BULL, for the red circle, and a COW, for the blue circle, for CODE BREAKER’s 1st attempt

The game continues with the CODE BREAKER using the information from the PROGRAMMER to change each attempt to break the PROGRAMMER’S code.

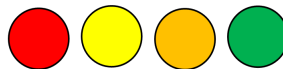


Figure 5: CODE BREAKER: 2nd Attempt

Here the CODE BREAKER guesses correctly by keeping the RED peg in its current location, moves the ORANGE peg, and exchanges the BLUE and PURPLE pegs for GREEN and YELLOW pegs. THE PROGRAMMER indicates that the CODE BREAKER is getting closer.



Figure 6: PROGRAMMER marks BULLS, for the red circle, and COWS, for the yellow and green circles

## 2 The Challenge

Write a MATLAB<sup>TM</sup> script to allow a user to play Mastermind as “THE CODE BREAKER ”  
Your program must

1. allow the user to change the number of input colors; playing the game with at least 3 and at most 5 colors.
2. randomize the PROGRAMMER’S CODE, but only allow for **UNIQUE** colors in the CODE (i.e. No repeated colors in the CODE.)
3. show all of the “CODE BREAKER’S” attempts visually (color and location).
4. show all the CODE previous attempts with bulls and cows adjacent to previous code breaking attempts.
5. allow for at least 15 attempts in the game.
6. show the solution on the first correct CODE BREAKER attempt.
7. allow the CODE BREAKER to quit, and reveal the code.



## 3 Challenge Rules

### 3.1 General Rules

1. Write your own code.
  - (a) Your code must be original; All of your work must be your own!
  - (b) You are encouraged to use subroutines where & when appropriate.
2. Please comment your code.
  - (a) You must include your last and first name as the first commented line in your main code.
  - (b) You must add comments to your code to describe the operation of different sections.
  - (c) If your code is not understandable or easy to follow, you may forfeit your entry.
  - (d) I strongly encourage you to include a flow chart with your submission.
3. Team entries are valid (all names must be included in submitted code), however, only one prize may be awarded.
4. "Elegance of code" will decide tie-breakers.

### 3.2 Submission Instructions

#### 3.2.1 Submission Method

1. Matlab code and required subroutines must be zipped into a single file.
2. Please use the file name structure: "LastName\_FirstName\_Year\_Month\_Day\_MatlabChallenge02.zip"  
For example, my submission would be: "Davis\_Julian\_2015\_01\_16\_MatlabChallenge02.zip"
3. E-mail the zipped file to Dr. Davis (jldavis2@usi.edu).
4. The E-mail subject line must include the text: "Matlab Challenge 02"

#### 3.2.2 Resubmissions

1. There must be at least 15 calendar days between submissions.
2. You may re/submit as a team OR an individual - NOT BOTH.

### 3.3 Matlab Challenge Closing Date!

The closing date for this MATLAB Challenge is:

**April 2, 2015.**

### 3.4 The Prize!

TBD.

## 4 References

[1] "[http://en.wikipedia.org/wiki/Mastermind\\_\(board\\_game\)#Variations](http://en.wikipedia.org/wiki/Mastermind_(board_game)#Variations)"