CodeDetective.org Educator's Manual

CodeDetective.org is an educational coding game for kids or anyone wishing to learn basic programming principles.

Features:

No signup or sign-in required

Teaches real coding principles such as variables, loops, if statements, conditionals, and methods as part of an interactive game

Compiles code in Java, Python, or JavaScript

Educators need little to no coding experience to guide the student in the game.

Topics Covered:

Expressions

Arithmetic Operations (e.g., Modulus, Increment)

Variables

Loops (For Loops, While Loops)

Conditional Statements and Boolean Expressions

Methods (e.g., String methods)

Arrays and Two-Dimensional Arrays

Challenge 1 – Convert Milliseconds to Days

Challenge: Convert 432,000,000 milliseconds to days.

Approach:

Have the student break the problem down into smaller pieces. How many milliseconds are in a second? How many seconds are in a minute etc.?

Introduce the concept of VARIABLES as “boxes” that hold values. And have the student create variables to store each piece of information they need to solve the problem.

Challenge 1 Possible Solution (Java)

```
public class Challenge1 {
	public static void main(String[] args) {
		int millis = 432000000;
		int seconds = millis / 1000;
		int minutes = seconds / 60;
		int hours = minutes / 60;
		int days = hours / 24;
		System.out.println(days);
	}
}
```

Challenge 1 Possible Solution (Python)

```
millis = 432000000
seconds = millis / 1000
minutes = seconds / 60
hours = minutes / 60
days = hours / 24
print(days)
```

Challenge 1 Possible Solution (JavaScript)

```
var millis = 432000000;
var seconds = millis / 1000;
var minutes = seconds / 60;
var hours = minutes / 60;
var days = hours / 24;
console.log(days);
```

Challenge 2 – Sum of Even Numbers

Challenge: Find the sum of all even numbers less than 12,368

Approach:

Have the student think about a similar problem (e.g., the sum of all even numbers less than 10) and begin to solve it with a pencil and paper or a calculator. For larger numbers, the student will quickly see that computer programs can be helpful in completing repetitive tasks much more quickly than can be done by hand or even with a calculator.

Again, Introduce the concept of VARIABLES as “boxes” that hold a value.

Ask the student: What numbers do we need to keep track of? Do these numbers change? Store these in VARIABLES.

Ask the student: What ACTION are you taking over and over again? Put these in a LOOP.

Ask the student: What CONDITION has to be met for the loop to stop? Create a CONDITIONAL STATEMENT to tell the LOOP when to stop.

Have the student think about how he or she recognizes an even number. Introduce the concept of the MODULUS to test if a number is even or odd.

Challenge 2 Possible Solution (Java)

```
public class Challenge2 {
      public static void main(String[] args) {
            int num = 12386;
            int sum = 0;
```

```
            int count = 0;
            while (count < num) {
                  if (count % 2 == 0) {
                        sum += count;
                  }
                  count++;
            }
            System.out.println(sum);
      }
}
```

Challenge 2 Possible Solution (Python)

```
num = 12386;
sum = 0;
count = 0;
while (count < num):
      if (count % 2 == 0):
            sum += count;
      count+=1;
print(sum);
```

Challenge 2 Possible Solution (JavaScript)

```
var num = 12386;
var sum = 0;
var count = 0;
while (count < num) {
      if (count % 2 === 0) {
            sum += count;
      }
      count++;
}
console.log(sum);
```

Challenge 3 – Find Every 5th Letter of a String

Challenge: Crack the code by taking every fifth letter of a String. The letter 'X' is code for a space.

Approach:

Introduce the concept of ZERO-BASED INDEXES in STRINGS, and have the student start to solve the problem with a pencil and paper.

Introduce the concept of built-in METHODS or FUNCTIONS (e.g., the String length or length() methods).

Show the student how to find the length of the input String.

Introduce the concept of a FOR LOOP, and note the starting value and incrementing value.

Introduce the concept of a CONDITIONAL STATEMENT and an IF-ELSE STATEMENT.

Challenge 3 Possible Solution (Java)

```
public class Challenge3 {
	public static void main(String[] args) {
		int num = 5;
		String input =
"GIWTWVQMBEPDQUXCZWUHJWZKAKBSIVFZKDEZRFTXIPEZOCNFYUSJXTRHQFNXKMDMCUIAMOTPUWNG
LSUTTQNRAZVOYCPCGMTCPMQSYOMAXBBIJSBWFAETBOCTIPVUXASJZUCOTIPZXCUXBRSMAQOLOTXGJ
TXBVUMTIQAZHFYZKEPKBCXYYSBCXYXFHBQLZIUMOICQXTUABRGLGFQFRODAYQXTWLUBONCPOITHFA
WWRERPCZWDJTQRXTIODOKGRHFAZOOXQQBPTWTNXRDKVZAMFLADHTQUE";
		StringBuilder builder = new StringBuilder();
		for (int i = num - 1; i < input.length(); i += num) {
			if (input.charAt(i) == 'X') {
				builder.append(' ');
			} else {
				builder.append(input.charAt(i));
			}
		}
		System.out.println( builder.toString() );
	}
}
```

Challenge 3 Possible Solution (Python)

```
num = 5;
input =
"GIWTWVQMBEPDQUXCZWUHJWZKAKBSIVFZKDEZRFTXIPEZOCNFYUSJXTRHQFNXKMDMCUIAMOTPUWNG
LSUTTQNRAZVOYCPCGMTCPMQSYOMAXBBIJSBWFAETBOCTIPVUXASJZUCOTIPZXCUXBRSMAQOLOTXGJ
TXBVUMTIQAZHFYZKEPKBCXYYSBCXYXFHBQLZIUMOICQXTUABRGLGFQFRODAYQXTWLUBONCPOITHFA
WWRERPCZWDJTQRXTIODOKGRHFAZOOXQQBPTWTNXRDKVZAMFLADHTQUE";
output = ""
for i in range(num - 1, len(input), num):
	if input[i] is 'X':
		output += ' '
```

```
      else:
            output += input[i]
print output
```

Challenge 3 Possible Solution (JavaScript)

```
var num = 5;
var input =
"GIWTWVQMBEPDQUXCZWUHJWZKAKBSIVFZKDEZRFTXIPEZOCNFYUSJXTRHQFNXKMDMCUIAMOTPUWNG
LSUTTQNRAZVOYCPCGMTCPMQSYOMAXBBIJSBWFAETBOCTIPVUXASJZUCOTIPZXCUXBRSMAQOLOTXGJ
TXBVUMTIQAZHFYZKEPKBCXYYSBCXYXFHBQLZIUMOICQXTUABRGLGFQFRODAYQXTWLUBONCPOITHFA
WWRERPCZWDJTQRXTIODOKGRHFAZOOXQQBPTWTNXRDKVZAMFLADHTQUE";
var output = "";
for (var i = num - 1; i < input.length; i += num) {
      if (input[i] == 'X') {
            output += " ";
      } else {
            output += input[i];
      }
}
console.log(output);
```

Challenge 4 – Arrays, 2-D Arrays, Rail Cipher

Challenge: Put the provided code (left to right, top to bottom) into a Two-Dimensional Array with 5 Rows and 8 Columns. Then, read the deciphered code top to bottom, left to right.

Approach:

Introduce the concept of an ARRAY and a TWO-DIMENSIONAL ARRAY (an array of arrays).

A visual representation of a two-dimensional array will likely be useful for the student.

For example, the following code illustrates the same sort of codebreaking needed to complete the challenge:

CODE: TICCHSROISEDSETE entered into a 4 x 4 two-dimensional array:

T	I	C	C
H	S	R	O
I	S	E	D
S	E	T	E

DECIPHERED CODE: THISISSECRETCODE

The index positions of a 5-row x 8-column two-dimensional array:

[0][0]	[0][1]	[0][2]	[0][3]	[0][4]	[0][5]	[0][6]	[0][7]
[1][0]	[1][1]	[1][2]	[1][3]	[1][4]	[1][5]	[1][6]	[1][7]
[2][0]	[2][1]	[2][2]	[2][3]	[2][4]	[2][5]	[2][6]	[2][7]
[3][0]	[3][1]	[3][2]	[3][3]	[3][4]	[3][5]	[3][6]	[3][7]
[4][0]	[4][1]	[4][2]	[4][3]	[4][4]	[4][5]	[4][6]	[4][7]

Challenge 4 Possible Solution (Java):

```
public class Challenge4 {
	public static void main(String[] args) {
		String cipherText = "TLSHTIIIHA_AHNAMENTCEALE__OK_N_SPI__FCT.";
		int rows = 5;
		int columns = cipherText.length() / rows;
		char[][] matrix = new char[rows][columns];
```

```
            int textIdx = 0;

            for (int row = 0; row < matrix.length; row++) {
                  for ( int col = 0; col < matrix[row].length; col++) {
                        if (textIdx < cipherText.length()) {
                              matrix[row][col] = cipherText.charAt(textIdx);
                        } else {
                              matrix[row][col] = '-';
                        }
                        textIdx++;
                  }
            }

            StringBuilder builder = new StringBuilder();
            for (int col = 0; col < matrix[0].length; col++) {
                  for (int row = 0; row < matrix.length; row++) {
                        builder.append(matrix[row][col]);
                  }
            }

            System.out.println( builder.toString() );
      }
}
```

Challenge 4 Possible Solution (Python):

```
cipherText = "TLSHTIIIHA_AHNAMENTCEALE__OK_N_SPI__FCT."
rows = 5
columns = len(cipherText) / rows
matrix = [[0 for x in range(columns)] for y in range(rows)]
textIdx = 0

for row in range(0,len(matrix)):
      for col in range(0, len(matrix[0])):
            if textIdx < len(cipherText):
                  matrix[row][col] = cipherText[textIdx]
            else:
                  matrix[row][col] = '-'
            textIdx += 1

output = ""

for col in range(0, len(matrix[0])):
      for row in range(0, len(matrix)):
            output += matrix[row][col]

print output
```

Challenge 4 Possible Solution (JavaScript):

```
var cipherText = "TLSHTIIIHA_AHNAMENTCEALE__OK_N_SPI__FCT.";
var rows = 5;
var columns = cipherText.length / rows;
var matrix = [];
for (var i = 0; i < rows; i++) {
      matrix[i] = [];
}
var textIdx = 0;
var output = "";

for (var row = 0; row < rows; row++) {
      for ( var col = 0; col < columns; col++) {
            if (textIdx < cipherText.length) {
                  matrix[row][col] = cipherText[textIdx];
            } else {
                  matrix[row][col] = '-';
            }
            textIdx++;
      }
}

for (var col = 0; col < matrix[0].length; col++) {
      for (var row = 0; row < matrix.length; row++) {
            output += matrix[row][col];
      }
}

console.log(output);
```

Challenge 5 – Exclude Repeating Letters

Challenge: Exclude repeating letters from the code to reveal the message.

Approach:

Introduce the students to the built in String methods (.indexOf() and .lastIndexOf() for Java and JavaScript and .find() and .rfind() in Python) to allow the student to check how many times a letter appears in the String.

Challenge 5 Possible Solution (Java):

```
public class Challenge5 {
	public static void main(String[] args) {
		String code =
"FJPSCYWJQXHGOUYIFVGHTXCJUYZQMPKEOFRLBXGJVANQOHMKBPXUDC";
		StringBuilder builder = new StringBuilder();

		for (int i = 0; i < code.length(); i++){
			if( code.indexOf(code.charAt(i)) ==
code.lastIndexOf(code.charAt(i))) {
				builder.append( code.charAt(i) );
			}
		}

		System.out.println( builder.toString() );
	}
}
```

Challenge 5 Possible Solution (Python):

```
code = "FJPSCYWJQXHGOUYIFVGHTXCJUYZQMPKEOFRLBXGJVANQOHMKBPXUDC"
output = ""

for i in range(0, len(code)):
	if code.find(code[i]) == code.rfind(code[i]):
		output += code[i]

print output
```

Challenge 5 Possible Solution (JavaScript):

```
var code = "FJPSCYWJQXHGOUYIFVGHTXCJUYZQMPKEOFRLBXGJVANQOHMKBPXUDC";
var output = "";

for (var i = 0; i < code.length; i++){
	if( code.indexOf(code[i]) == code.lastIndexOf(code[i]) ) {
		output += code[i];
	}
}
console.log(output);
```