12 Difficult Python Questions You Might Take Days To Solve

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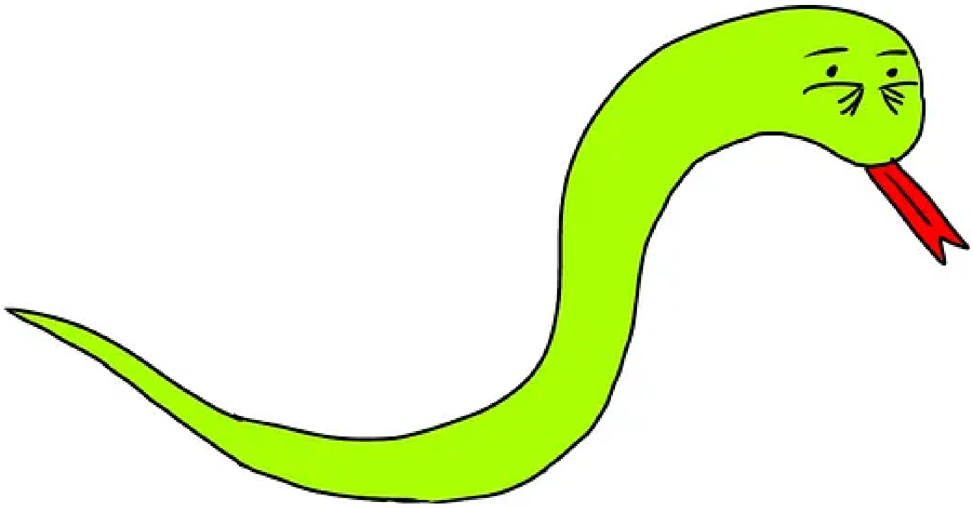
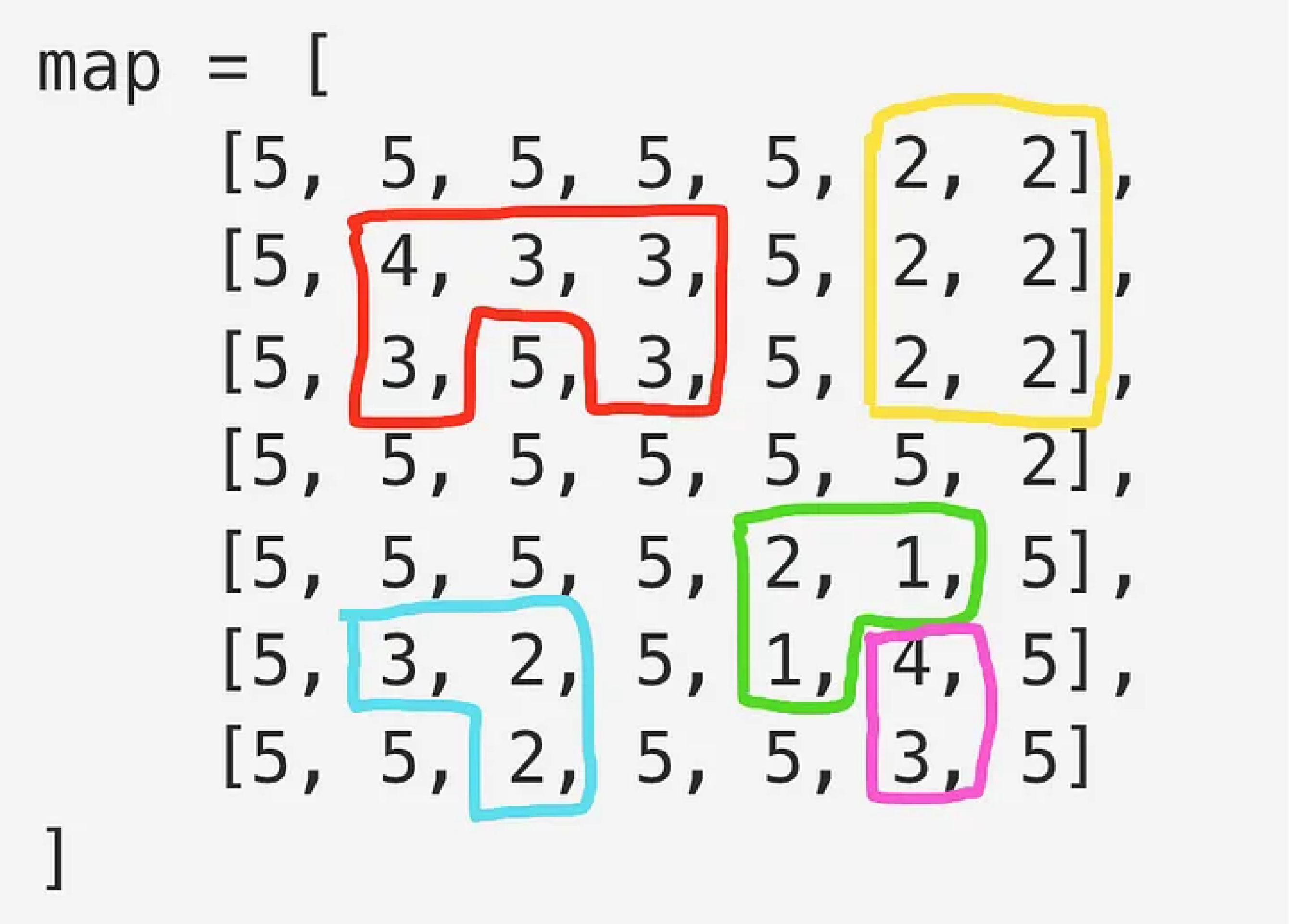


1) Largest Puddle

You are given a 2D list of integers.

```
map = [
    [5, 5, 5, 5, 5, 2, 2],
    [5, 4, 3, 3, 5, 2, 2],
    [5, 3, 5, 3, 5, 2, 2],
    [5, 5, 5, 5, 5, 5, 2],
    [5, 5, 5, 5, 2, 1, 5],
    [5, 3, 2, 5, 1, 4, 5],
    [5, 5, 2, 5, 5, 3, 5]
]
```

Each number represents the height of the land. When it rains, water flows from larger numbers to smaller numbers (horizontally/vertically). Puddles collect when water cannot flow out of the map. Assume that water that flows outside of the map will *not* form a puddle.



```
map = [
    [5, 5, 5, 5, 5, 2, 2],
    [5, 4, 3, 3, 5, 2, 2],
    [5, 3, 5, 3, 5, 2, 2],
    [5, 5, 5, 5, 5, 5, 2],
    [5, 5, 5, 5, 2, 1, 5],
    [5, 3, 2, 5, 1, 4, 5],
    [5, 5, 2, 5, 5, 3, 5]
]
```

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- The blue area is NOT a puddle, as water can flow out
- The green area is a puddle as water cannot flow out
- The yellow area is NOT a puddle as water can flow out
- The pink area is also NOT a puddle as water can flow out

Our task here would be to write a function `largest_puddle(map)` that takes in a 2D list `map` , and returns the coordinates of the largest puddle on the map. For the above map:

```
{(1,1), (2,1), (1,2), (1,3), (2,3)}
```

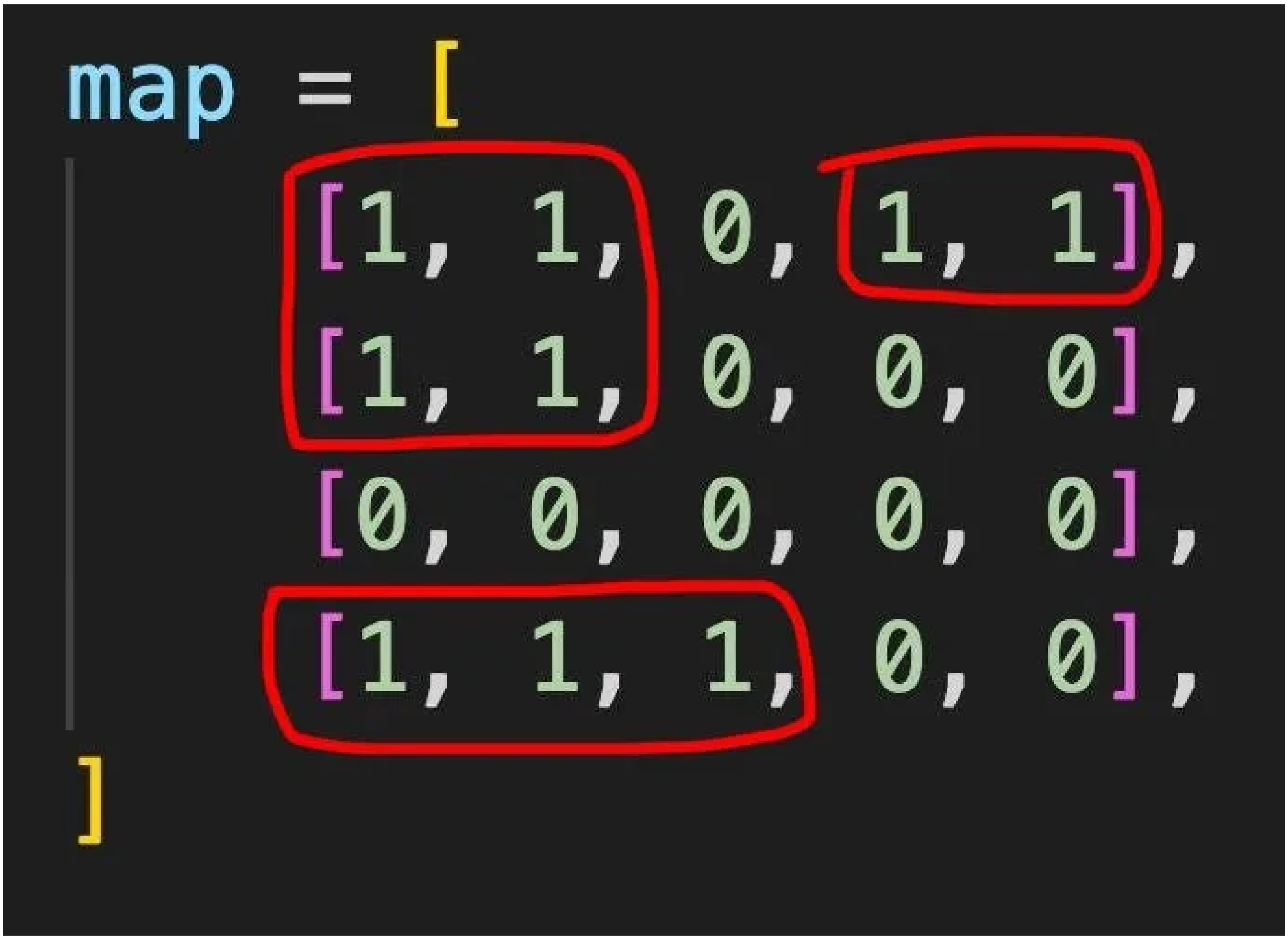
^ the coordinates of the red puddle

2) Finding Island Coordinates

You are given a 2D list of integers (either 0 or 1)

```
map = [
    [1,1,0,1,1],
    [1,1,0,0,0],
    [0,0,0,0,0],
    [1,1,1,0,0],
]
```

1’s are land, while 0’s are sea. 1’s that are next to each other (horizontal + vertical only) make up an island. Here, we have 3 islands:



```
map = [
    [1, 1, 0, 1, 1],
    [1, 1, 0, 0, 0],
    [0, 0, 0, 0, 0],
    [1, 1, 1, 0, 0],
]
```

Write a function `get_islands(map)` that takes in a 2D list `map`, and returns a list of sets, each set representing 1 island.

```
[
    {(0, 1), (1, 0), (0, 0), (1, 1)},  # the top-left island
    {(0, 3), (0, 4)},                  # the top-right island
    {(3, 0), (3, 2), (3, 1)}           # the bottom-right island
]
```

3) Longest Word Chain

You are given a list of English words:

```
words = ["apple", "orange", "tank", "elephant", "kitten"]
```

A word chain is a list of English words where the last letter of each word is equal to the first letter of the next word. For instance:

- `["apple", "elephant"]` is a valid word chain
- `["tank", "kitten"]` is a valid word chain
- `["elephant", "apple"]` is not a valid word chain as `"apple"` does not begin with `"t"`
- `["apple", "kitten"]` is not a valid word chain as `"kitten"` does not begin with `"e"`

Write a function `longest_word_chain(words)` that takes in a list of English words `words`, and returns the longest possible valid word chain. For the example above, the longest possible valid word chain is:

```
["apple", "elephant", "tank", "kitten"]
```

Or:

```
["orange", "elephant", "tank", "kitten"]
```

4) Hollow Diamond

Write a function `hollow_diamond(string)` that takes in a string `string`, and prints the following pattern:

```
hollow_diamond('abcdefgh')

  a
 b h
c   g
 d f
  e
```

If there are insufficient characters to form a perfect hollow diamond shape, append your string with `*` characters.

```
hollow_diamond('abcdefghij')

   a
  b *
 c   *
d     j
 e   i
  f h
   g
```

Another example:

```
hollow_diamond('abcdefghijklmnop')

    a
   b p
  c   o
 d     n
e       m
 f     l
  g   k
   h j
    i
```

Yet another example:

```
hollow_diamond('abcdefghijklmn')

    a
   b *
  c   *
 d     n
e       m
 f     l
  g   k
```

```
      h j
       i
```

5) Upslope Coordinates

```
lis = [1, 3, 4, 6, 2, 3, 5, 3, 3, 8, 9]
```

You are given a list of numbers representing land height. Write a function `upslope(lis)` that takes in this list of numbers, and returns a 2D list containing sections that are upslope (increasing).

```
x = upslope(lis)

# [[1, 3, 4, 6], [2, 3, 5], [3, 8, 9]]
```

6) Contains 1 (No Strings Allowed)

Write a function `contains1(n)` that takes in an integer `n`, and returns True if n contains the digit 1, and False otherwise. You cannot use any strings or string methods. (if you could, it's way too easy)

```
contains1(21)    # True
contains1(201)   # True
contains1(617)   # True

contains1(22)    # False
contains1(202)   # False
contains1(627)   # False
```

7) Minimum number of coins

Write a function `min_coins(coins, value)` that takes in a list `coins` and an integer `value`, and returns a dictionary representing the *minimum* total number of coins we need to make up `value`. For instance:

```
min_coins([1, 2, 5], 101)
```

- We have an infinite number of $1 coins, $2 coins and $5 coins
- We need to find the *minimum* number of coins to make $101
- In this case, the best possible answer is 20 $5 coins and 1 $1 coin
- The function hence returns `{1:1, 5:20}`

```
min_coins([2, 3], 20)
```

- We have an infinite number of $2 and $3 coins
- We need the minimum number of coins to make up $20
- The answer is 6 $3 coins and 1 $2 coin.
- The function hence returns `{2:1, 3:6}`

```
min_coins([2, 4, 6], 5)
```

- We have an infinite number of $2, $4 and $6 coins to make $5
- This is not possible, so we simply return `{}`

8) Dictionary Parsing

```
string = '{"apple":4, "orange":5, "pear":6}'
```

You are given a string representing a Python dictionary. Write a function `parse(string)` that takes in this string, parses it, and returns the actual dictionary.

Assume that keys and values will either be numbers or string, and that there are no nested lists/dicts etc.

Note — You cannot use libraries or the `eval` or `exec` function

```
parse(string)

# {"apple":4, "orange":5, "pear":6}
```

9) Magic Square

A magic square is a 3x3 grid containing numbers 1 to 9 (each number should appear ONCE). Every 3 consecutive numbers (row, column or diagonal) must add up to 15. An example:

```
[  [2, 7, 6],
   [9, 5, 1],
   [4, 3, 8]  ]
```

You are given an *incomplete* magic square.

```
magic_square = [
  [2, 0, 0],
  [0, 0, 0],
  [0, 3, 8]
]
```

Here, 0 means you need to fill it in. Write a function `solve(magic_square)` that takes in the incomplete magic square, fills it in with the correct numbers, and returns the complete magic square.

```
def solve(magic_square):
    # stuff

solve(magic_square)
```

```
# [  [2, 7, 6],
#    [9, 5, 1],
#    [4, 3, 8]  ]
```

10) Square root

Write a function `sqrt(n)` that takes in an integer `n`, and returns its square root. You are not allowed to use any built-in operations or functions to automatically find the square root.

Hint — build the answer using a string

```
def sqrt(n):
    # stuff

sqrt(0) # 0
sqrt(1) # 1.0
sqrt(2) # 1.414213562
sqrt(3) # 1.732050808
sqrt(4) # 2.0
sqrt(5) # 2.236067977
```

11) Letter pyramid

Write a function `pyramid(string)` that takes in a string `string`, and prints the following pattern.

```
pyramid('abcdef')

a
bc
def
```

If there are insufficient letters, add `*` characters to form a perfect triangle

```
pyramid('abcdefg')

a
bc
```

```
def
g***
```

```
pyramid('abcdefgh')

a
bc
def
gh**
```

```
pyramid('abcdefghijk')

a
bc
def
ghij
k****
```

12) Evaluating Math Expressions

You are given a string representing a math expression. For instance:

```
string = '1+2x3/4-5'
```

Without using built-in functions like `eval` or `exec`, write a function `evaluate(string)` that takes in a math expression `string`, solves it, and returns the result.

- Assume that only addition, subtraction, multiplication and division operators will exist in the string
- PEDMAS rule applies — multiplication/division before addition/subtraction

```
def evaluate(string):
    # stuff

evaluate('1+1')       # 2
evaluate('1+2x3')     # 7
evaluate('1-2x3+4x5') # 15
```

Conclusion

Let me know how long you took to solve them all!

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