

$$1260 = 21 \times 60$$



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Vampire Numbers: Traits and Uniqueness

Vampire numbers are numbers that have unique mathematical characteristics. They are even numbers that can be represented as the product of two numbers (called fangs) with the same number of digits, where the digits of the fangs must be a combination of the digits of the vampire number.

Features of Vampire Numbers

1. **Even number of digits:** A vampire number must have an even number of digits.
2. **Fangs:** They should be paired in such a way that both fangs connect to the vampire number.
3. **Lack of two zeros at the end:** They must not end in „00“ (e.g. 1000).

Examples

1. **1260 = 21 * 60**
2. **1827 = 21 * 87**
3. **2187 = 27 * 81**

Difficulties in Programming

Writing an efficient program to find vampire numbers is a challenging task for several reasons:

The complexity of the Algorithm

1. **Combinations of numbers:** Find all possible pairs of numbers that satisfy the conditions. Checking that the digits of the two canines make up the vampire number requires the analysis of certain permutations.
2. **Mathematical constraints:** The program must skip those numbers that end in „00“, which further complicates the process.

Performance

1. Computing for a large number of permutations can be time consuming. A typical approach is to search through all possible tuples, which can result in large programme execution times.

Example implementation in python and comparison with the implementation in C

```
def is_vampire_number(n):
    # Check if the number ends with "00"
    if str(n).endswith("00"):
        return False

    # Iterate over possible fangs
    for i in range(10, 100): # Fangs must be two digits
        if n % i == 0: # Check if i is a divisor of n
            fang2 = n // i # Calculate the second fang
            # Check if both have the same number of digits and are
            # permutations
            if len(str(i)) == len(str(fang2)) and sorted(str(i)) ==
sorted(str(fang2)):
                return True
    return False

# Searching for vampire numbers in a given range
vampire_numbers = []
for num in range(1000, 10000): # Searching in the four-digit range
    if is_vampire_number(num):
        vampire_numbers.append(num)

print("Vampire numbers:", vampire_numbers)
```

Running the program:

```
$ python3 main.py
Vampire numbers: [1008, 1024, 1089, 1156, 1207, 1225, 1296, 1369, 1444,
1458, 1462, 1521, 1612, 1681, 1729, 1764, 1849, 1855, 1936, 1944, 2025,
2116, 2209, 2268, 2296, 2304, 2401, 2430, 2601, 2668, 2701, 2704, 2809,
2916, 2944, 3025, 3136, 3154, 3249, 3364, 3478, 3481, 3627, 3640, 3721,
3844, 3969, 4032, 4096, 4225, 4275, 4356, 4489, 4606, 4624, 4761, 4930,
5041, 5092, 5184, 5329, 5476, 5605, 5625, 5776, 5848, 5929, 6084, 6241,
6561, 6624, 6724, 6786, 6889, 7056, 7225, 7396, 7569, 7663, 7744, 7921,
8281, 8464, 8649, 8722, 8836, 9025, 9216, 9409, 9604, 9801]
```

Implementation in C

Link: <https://github.com/plerros/helsing>

```
$ time ./helsing -n 4 --progress
Checking interval: [1000, 9999]
1000, 1133 1/66
1134, 1267 2/66
1268, 1401 3/66
1402, 1535 4/66
1536, 1669 5/66
1670, 1803 6/66
1804, 1937 7/66
1938, 2071 8/66
2072, 2205 9/66
2206, 2339 10/66
2340, 2473 11/66
2474, 2607 12/66
2608, 2741 13/66
2742, 2875 14/66
2876, 3009 15/66
3010, 3143 16/66
3144, 3277 17/66
3278, 3411 18/66
3412, 3545 19/66
3546, 3679 20/66
3680, 3813 21/66
3814, 3947 22/66
3948, 4081 23/66
4082, 4215 24/66
4216, 4349 25/66
4350, 4483 26/66
4484, 4617 27/66
4618, 4751 28/66
4752, 4885 29/66
4886, 5019 30/66
5020, 5153 31/66
5154, 5287 32/66
5288, 5421 33/66
5422, 5555 34/66
5556, 5689 35/66
5690, 5823 36/66
5824, 5957 37/66
5958, 6091 38/66
6092, 6225 39/66
6226, 6359 40/66
6360, 6493 41/66
6494, 6627 42/66
6628, 6761 43/66
6762, 6895 44/66
6896, 7029 45/66
7030, 7163 46/66
7164, 7297 47/66
```

```
7298, 7431 48/66
7432, 7565 49/66
7566, 7699 50/66
7700, 7833 51/66
7834, 7967 52/66
7968, 8101 53/66
8102, 8235 54/66
8236, 8369 55/66
8370, 8503 56/66
8504, 8637 57/66
8638, 8771 58/66
8772, 8905 59/66
8906, 9039 60/66
9040, 9173 61/66
9174, 9307 62/66
9308, 9441 63/66
9442, 9575 64/66
9576, 9709 65/66
9710, 9801 66/66
```

```
Found: 7 vampire number(s).
```

```
real    0m0,003s
user    0m0,001s
sys     0m0,004s
```

As can be seen in the range of 4-digit numbers, the execution was thousandths of a second.

Summary

Vampire numbers present an intriguing problem in mathematics and programming. The performance of an algorithm searching for these numbers requires an understanding of digit combinations and appropriate management of execution time. Examples and algorithms from the programming forum show the variety of approaches to the problem, making it an attractive challenge for programmers.