

## Master Keys - Alan Yan

Let  $M = \phi(N)$ . Assuming the two primes in the prime factorization of  $N$  are sufficiently large, we must have that  $M < N < 2M$ . So, we have that  $M = d_2 - d_1$ . Since  $N$  is the product of two primes,  $N = pq$  and  $M = pq - p - q + 1$ . Then, our answer is just  $N - M + 1$  giving us the flag. My code is given below.

```
N =
0x74bf4fc2d66d08c0ac7d66d90e21b16b4c0d01b1e04c40fcc2ee8ee622dff02a03f9ac980
27bfff7c119894e581af56ff997e4ee2123e8137e5b7771d02f208f0f47165c76150308fd7a
1d47bb91e67a608a56b12f786d04cb59a15515af5d414f809c4f3564f35ed6b28e35aaf9dc3
d88dda2609ece39edfc9d081e816a7c86173b26dfe4f48835c69a55a8c5a6f851fc617eee2c
3b1f81bf7c0fed7c24adb345d2cfe8fa6e00b7f0cdbb5647004c806b81d4aa6507307700a9e
46dc33b3d3d15c7aa79fcdaef7848344b637c2c173de0b3f085f97a88c18e9aa755d2989f4b
e01d55e234c39dfe834e193b65976e4d82bd8039df8515a50833683db2289e67
d1 =
0x2c93e020c53f5cd83504ad00b424a95a0eefe875c2ef5ae1288d6e82f14e10a5fa5e9b486
faa695270a90f849a9fb097d0f5eeb3fe737769fa1572c64277bc36e3de80eb4d2b38bd760b
eaa2393cbc847dd854c1d31e68822c234d36efd0c60aea10719ecd047ee8f791b63b47cda00
adef7c1c8a2da9bc40370f268b381b589f993af73230aec51d030308a574b340586dc6ee46f
db152bc906aa52812cf25910b8864f6e29eb7e4a42b0cbd1998d1707d5a3f1789793a88f066
7146cd0e098d29f5ab120c5adb3a5be2287ebbf69f34d934bb8cbba25f9e0e417d56ad1e11b
4dec4036b69d74050d5c7d9cac5a44038d92ff9adff8cdd54e660a703b012601
d2 =
0xa1532fe39bac6598e18213d9c2465ac55afcea27a33b9bddeb7bfd69142e00cffe5847e07
226694a31c298d2f2baa607ca8dd3a21f975f7d7870ea3812a6dcc5f3259747c3403bc67386
07e9f4cea2fede62ab730296d586f77cee8c0580234c39910dee02697247ce444470f2c77c4
867d5642941a8d5b2000dfa8734ec320eb671677fc41635f188303272d9ce43e802f3e60ff6
b9be2979aa3800741348d57ee5483131dc44f2ba3ac883d2a30805912161e35be060973c5ac
30442a3d68c40898e9595386793c3b70479a9b1e2f098efdf28fea9a240a8e404c7b1eecf3c
85a6fe718b9becd7e3cd377c5db12f5e15fd3324b10854da2d9d4ad475c7dea9
M = d2 - d1
print((N - M + 1) % (10**9 + 7))
```