11. Write a C program for possible keys does the Playfair cipher have? Ignore the fact that some keys might produce identical encryption results. Express your answer as an approximate power of 2.

a. Now take into account the fact that some Playfair keys produce the same encryption results. How many effectively unique keys does the Playfair cipher have?

**Code:**

```
def generate_matrix(keyword):
   keyword = keyword.lower().replace("j", "i")
   matrix = []
   used = set()
    for ch in keyword:
      if ch not in used and ch.isalpha():
         used.add(ch)
         matrix.append(ch)
 for ch in "abcdefghiklmnopqrstuvwxyz":  # j removed
      if ch not in used:
         used.add(ch)
         matrix.append(ch)
 return [matrix[i:i+5] for i in range(0, 25, 5)]
def find_position(matrix, ch):
   for i in range(5):
      for j in range(5):
         if matrix[i][j] == ch:
            return i, j
   return None
def playfair_encrypt(plaintext, keyword):
   matrix = generate_matrix(keyword)
   plaintext = plaintext.lower().replace("j", "i")
   new_text = ""
```

```
    # Prepare digraphs
    i = 0
    while i < len(plaintext):
        a = plaintext[i]
        b = plaintext[i+1] if i+1 < len(plaintext) else 'x'
        if a == b:
            b = 'x'
            i += 1
        else:
            i += 2
        new_text += a + b
cipher = ""
    for i in range(0, len(new_text), 2):
        a, b = new_text[i], new_text[i+1]
        r1, c1 = find_position(matrix, a)
        r2, c2 = find_position(matrix, b)
if r1 == r2:  # same row
            cipher += matrix[r1][(c1 + 1) % 5]
            cipher += matrix[r2][(c2 + 1) % 5]
        elif c1 == c2:  # same column
            cipher += matrix[(r1 + 1) % 5][c1]
            cipher += matrix[(r2 + 1) % 5][c2]
        else:  # rectangle
            cipher += matrix[r1][c2]
            cipher += matrix[r2][c1]

    return cipher
```

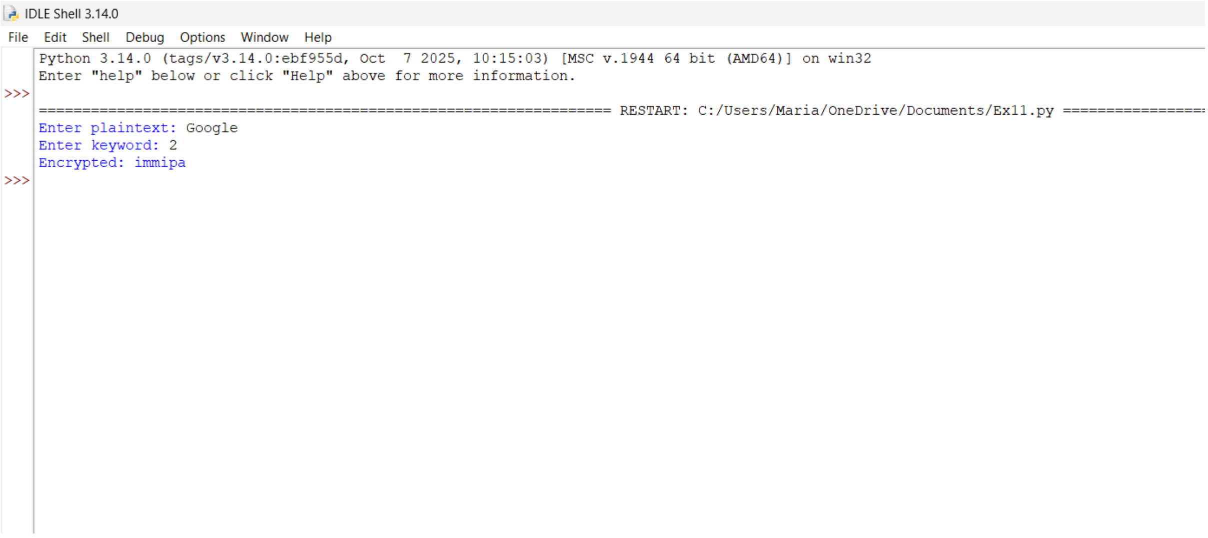
```
# ---- MAIN ----

plaintext = input("Enter plaintext: ")

keyword = input("Enter keyword: ")

cipher = playfair_encrypt(plaintext, keyword)

print("Encrypted:", cipher)
```



```
Python 3.14.0 (tags/v3.14.0:ebf955d, Oct  7 2025, 10:15:03) [MSC v.1944 64 bit (AMD64)] on win32
Enter "help" below or click "Help" above for more information.
>>> 
================================================================== RESTART: C:/Users/Maria/OneDrive/Documents/Ex11.py ================
Enter plaintext: Google
Enter keyword: 2
Encrypted: immipa
>>> 
```