The following project was done in Pycharm using the coding language Python. The project utilizes RSA encryption and a Caesar cipher to encrypt a message the user enters.

The code prints out the public and private keys once they are created. This was to ensure that it was working and was displayed. For the Caesar cipher, I had it pick a random number that it would be shifted by. -- This is also printed out to see what number it picked.

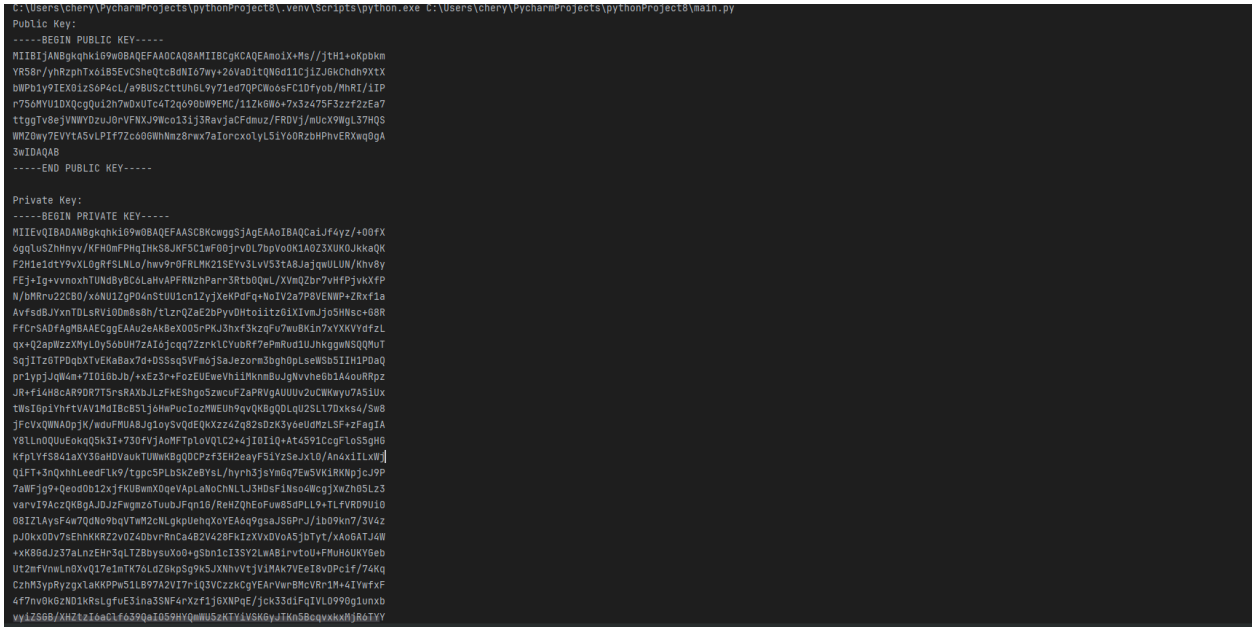
-After the RSA keys are created and the Caesar cipher number is picked it asks for the user's message.
-Once the user enters the message, it will be encrypted first by the Caesar cipher and then by the public key.
-To decrypt the message the private key is used then the Caesar shift is reversed to get the original message.

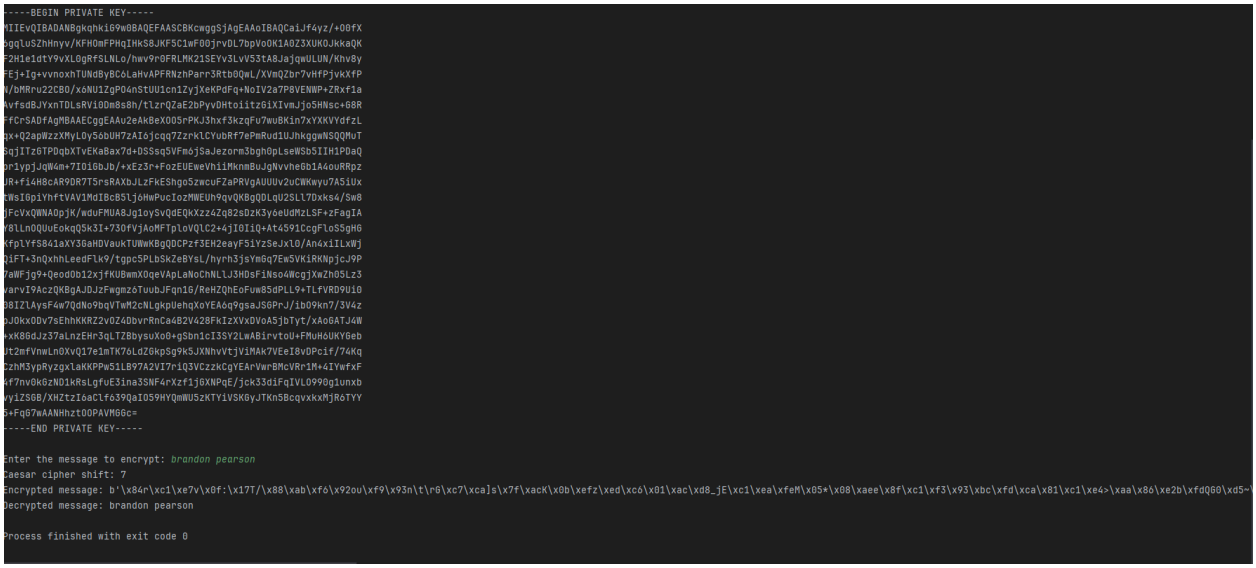
Ecyption = 1st Caesar cipher, 2nd public key
Decryption = 1st private key, 2nd reversed Caesar cipher

```
from cryptography.hazmat.primitives import serialization
from cryptography.hazmat.primitives.asymmetric import rsa
from cryptography.hazmat.primitives import hashes
from cryptography.hazmat.primitives import padding
from cryptography.hazmat.primitives.asymmetric import padding
import random


# RSA key pairs
private_key = rsa.generate_private_key(
    public_exponent=65537,
    key_size=2048, )
public_key = private_key.public_key()

# Serialize and print public key
public_key_pem = public_key.public_bytes(
    encoding=serialization.Encoding.PEM,
    format=serialization.PublicFormat.SubjectPublicKeyInfo
)
print(f"Public Key:\n{public_key_pem.decode()}")
```

```
# Serialize and print private key
private_key_pem = private_key.private_bytes(
   encoding=serialization.Encoding.PEM,
   format=serialization.PrivateFormat.PKCS8,
   encryption_algorithm=serialization.NoEncryption()
)
print(f"Private Key:\n{private_key_pem.decode()}")


# Caesar cipher
def caesar_cipher(text, shift):
   result = ""
   for char in text:
       if char.isalpha():
           ascii_offset = 65 if char.isupper() else 97
           shifted_char = chr((ord(char) - ascii_offset + shift) % 26 +
ascii_offset)
           result += shifted_char
       else:
           result += char
   return result


# Encrypt a message
def encrypt_message(message, public_key, caesar_shift):
   caesar_encrypted_message = caesar_cipher(message, caesar_shift)
   cipher_text = public_key.encrypt(
       caesar_encrypted_message.encode(),
       padding.OAEP(
           mgf=padding.MGF1(algorithm=hashes.SHA256()),
           algorithm=hashes.SHA256(),
           label=None
       )
   )
   return cipher_text, caesar_shift

# Decrypt the message
def decrypt_message(cipher_text, private_key, caesar_shift):
   plain_text = private_key.decrypt(
       cipher_text,
       padding.OAEP(
           mgf=padding.MGF1(algorithm=hashes.SHA256()),
           algorithm=hashes.SHA256(),
           label=None
       )
   )
   decrypted_message = caesar_cipher(plain_text.decode(), -caesar_shift)
   return decrypted_message
```

```
# User input / message
message = input("Enter the message to encrypt: ")

# Encrypt the message
cipher_text, caesar_shift = encrypt_message(message, public_key,
random.randint(1, 25))
print(f"Caesar cipher shift: {caesar_shift}")
print(f"Encrypted message: {cipher_text}")

# Decrypt the message
decrypted_message = decrypt_message(cipher_text, private_key, caesar_shift)
print(f"Decrypted message: {decrypted_message}")
```






**FROM IMAGE ABOVE**

**Public Key**:

-----BEGIN PUBLIC KEY-----
MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAmoiX+Ms//jtH1+oKpbkm
YR58r/yhRzphTx6iB5EvCSheQtcBdNI67wy+26VaDitQNGd11CjiZJGkChdh9XtX
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WMZ0wy7EVYtA5vLPlf7Zc60GWhNmz8rwx7aIorcxolyL5iY6ORzbHPhvERXwq0gA
3wIDAQAB
-----END PUBLIC KEY-----

**Private Key:**

-----BEGIN PRIVATE KEY-----
MIIEvQIBADANBgkqhkiG9w0BAQEFAASCBKcwggSjAgEAAoIBAQCaiJf4yz/+O0fX
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5+FqG7wAANHhztOOPAVMGGc=
-----END PRIVATE KEY-----

**Enter the message to encrypt: brandon pearson**
**Caesar cipher shift: 7**
**Encrypted message:**
b'\x84r\xc1\xe7v\x0f:\x17T/\x88\xab\xf6\x92ou\xf9\x93n\t\rG\xc7\xca]s\x7f\xacK\x0b\xefz\xed\xc6\x01\xac\
xd8_jE\xc1\xea\xfeM\x05*\x08\xaee\x8f\xc1\xf3\x93\xbc\xfd\xca\x81\xc1\xe4>\xaa\x86\xe2b\xfdQG0\xd5~
\xda\x01\x8b\x90\x91\xf4\xe6\xfb\x14\xf9\xc0\xaf\xa3%\xa4b\x11\xa0iYf\x8e\xe5\xe8\x0f\x02\xff2\x03\xde
O+\xa9\xec\x04\xfa\xfe\xcc\x1cKt\xb8B\xc8Z\x0fg[W\x86\x12\xe7R\x83K=CF\xb6)\xc7\xf9\xe0\x1e\xeeX9
}\xf4\x85\xa2\x9du\xa5\x90\x87\xfe\xad\xab\x03{l\x87]]l_3a\x1a\x0c\x02\rd\x8d\x8d==J\x16\n\xeb\xfe/\xe3
\n\x9c(\x9f\xcds\xd7\x8f\xa9+.\xc2l\x1b\xf8\xfb@\xa5\x18ax^T\xf5\xb8\x07\xfa\xce\xaa\xbe\xc0\x1a\x9b\x
84V\xef\x99\x0e\x8ft\xf8\xcb\xd9s\xff\xb7\xe2\xb7\xce\xbfL\xd0V\x13\xd9\x821e\x01\xfd\x892\x83\x1e\xb
3\xc4\xe5\xe7\x91\xc9z\xb9\xdb\tF\x08\r\xc4\x19\x19\x0b'
**Decrypted message: brandon pearson**