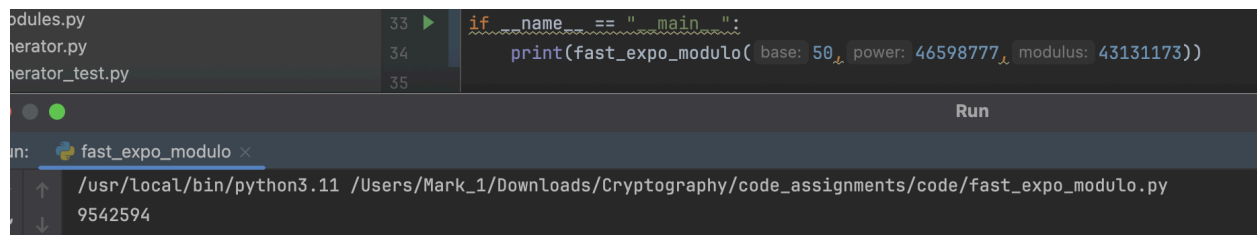
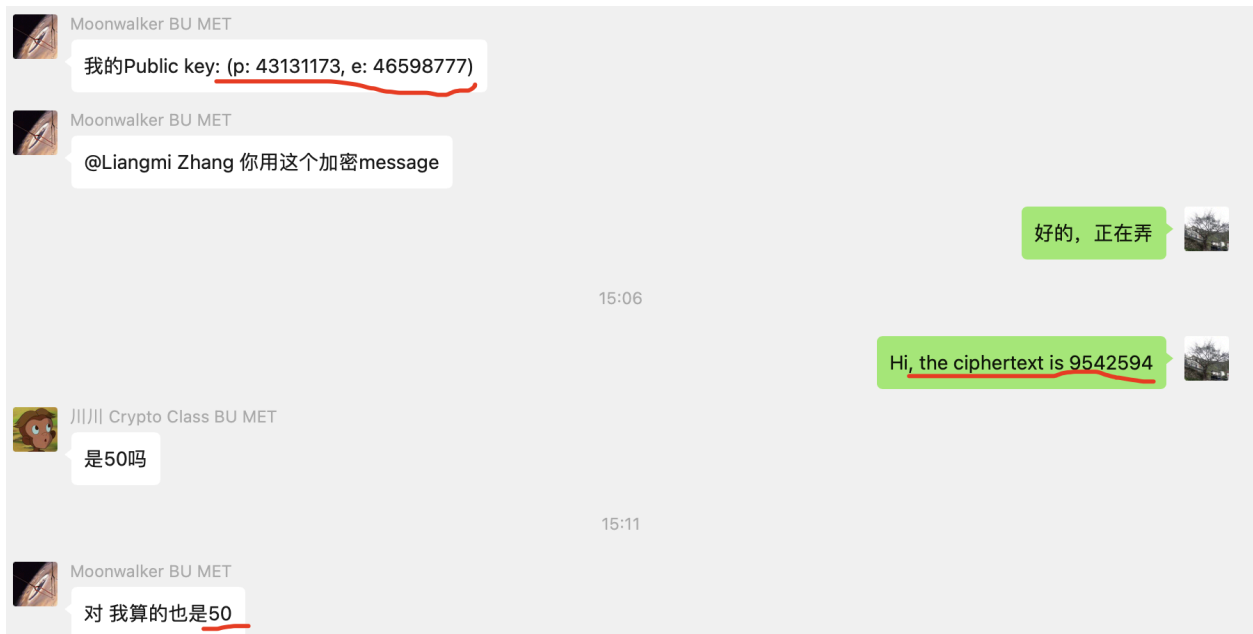


## Exchange and Computation History (I'm the guy on the right in the screenshots)

### RSA

I'm Alice



I'm Bob

Public key generation

```

nts [cryptography] sources root, ~/Downloads/Cr 13
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class MyTestCase(unittest.TestCase):
    def test1(self):
        self: <break_rsa_test.MyTestCase testMethod=test1>
        n = p * q  n: 113549
        phi_of_n = (p - 1)*(q - 1)  phi_of_n: 112860
        e = 2  e: 17939
        while phi_of_n % e == 0: # that is, gcd(e, phi_of_n) = 1
            e = sympy.randprime(a=2, phi_of_n - 1)
        public_key = (n, e)  public_key: (113549, 17939)
        # receiver generates private key
        private_key = rsa_private_key_generator(public_key, p, q)  private_key: (113549, 30299)
        # sender generates the message
        message = random.randint(a=2, n - 1) # 1<x<n
        while euclidean(message, n) != 1:
            message = random.randint(a=2, n - 1)
        # sender encrypt the message

```

Debug

Python tests in break\_rsa\_test.py

Debugger Console

Mal...read Evaluate expression (⌘) or add a watch (⌘⌘)

test1, break\_rsa e = (int) 17939

\_callTestMethod n = (int) 113549

run, case.py:62 p = (int) 419

\_call\_\_ case.p phi\_of\_n = (int) 112860

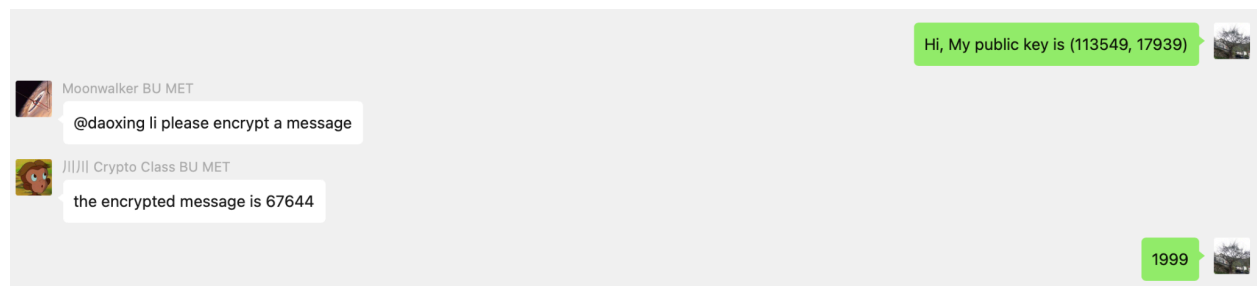
run, suite.py:12 private\_key = (tuple: 2) (113549, 30299)

\_call\_\_ suite.p public\_key = (tuple: 2) (113549, 17939)

run, suite.py:12 q = (int) 271

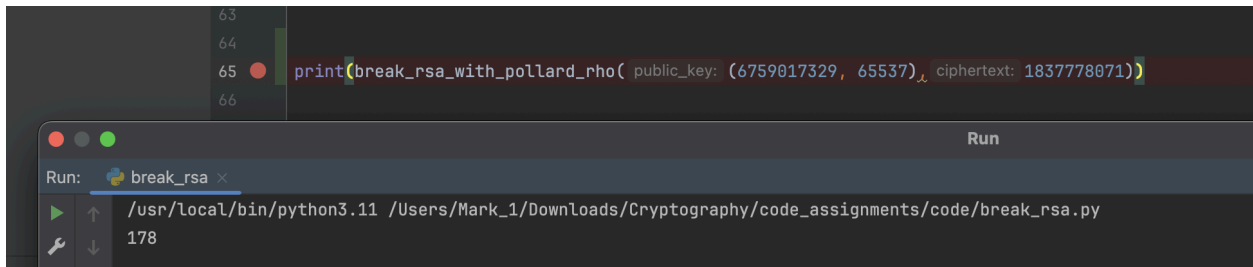
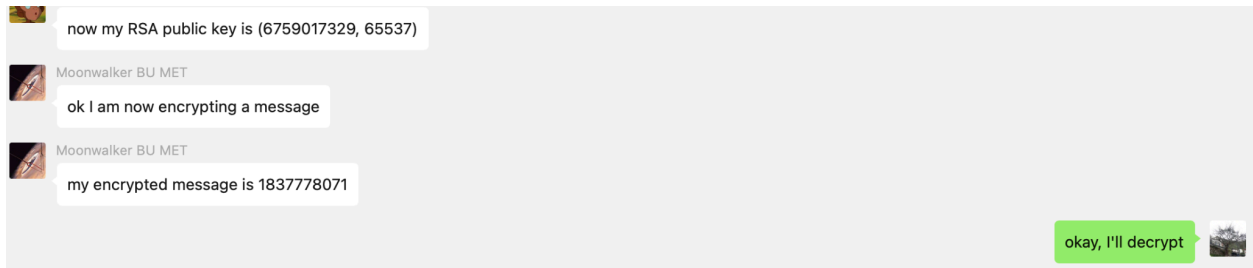
\_call\_\_ suite.p self = (MyTestCase) <break\_rsa\_test.MyTestCase testMethod=test1>

## Message Decryption:



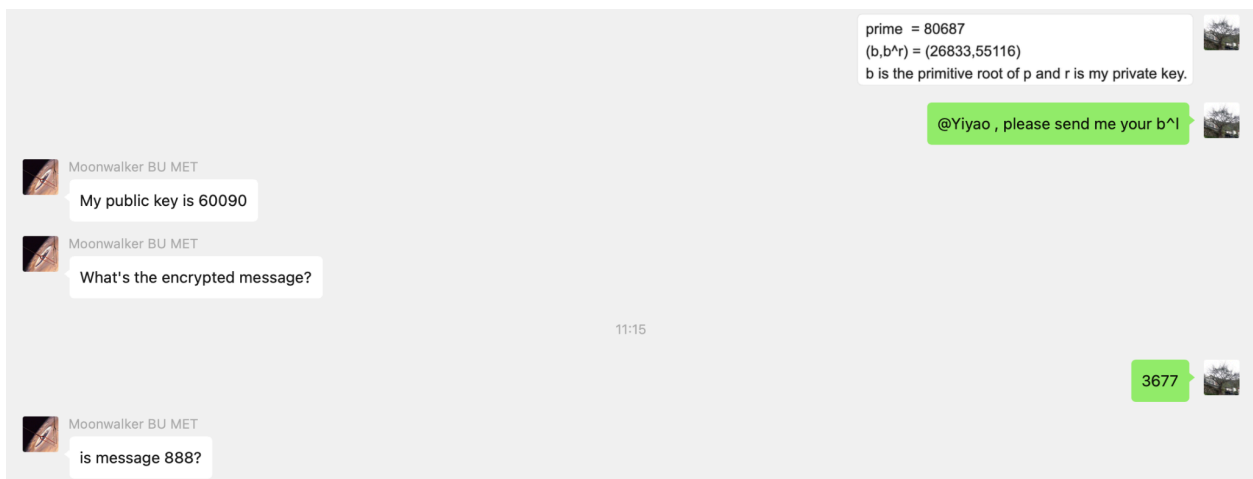
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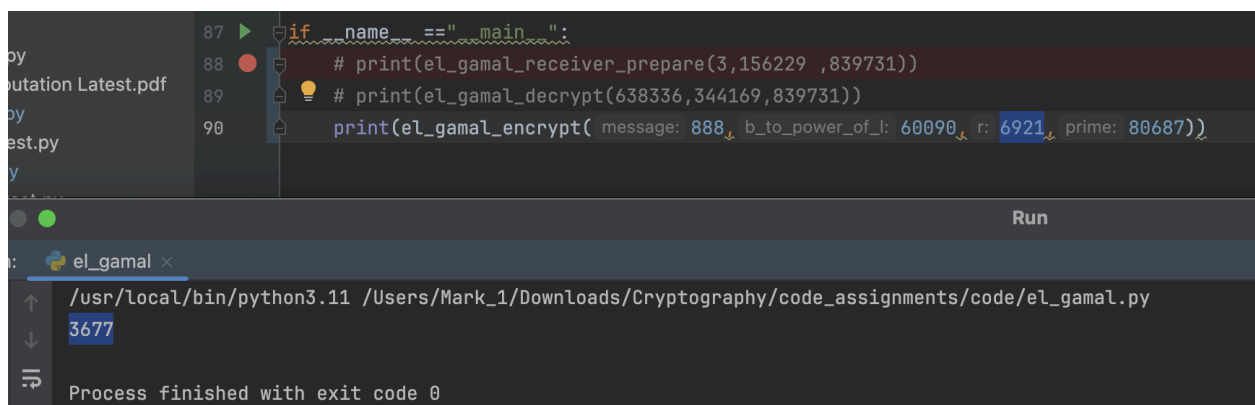
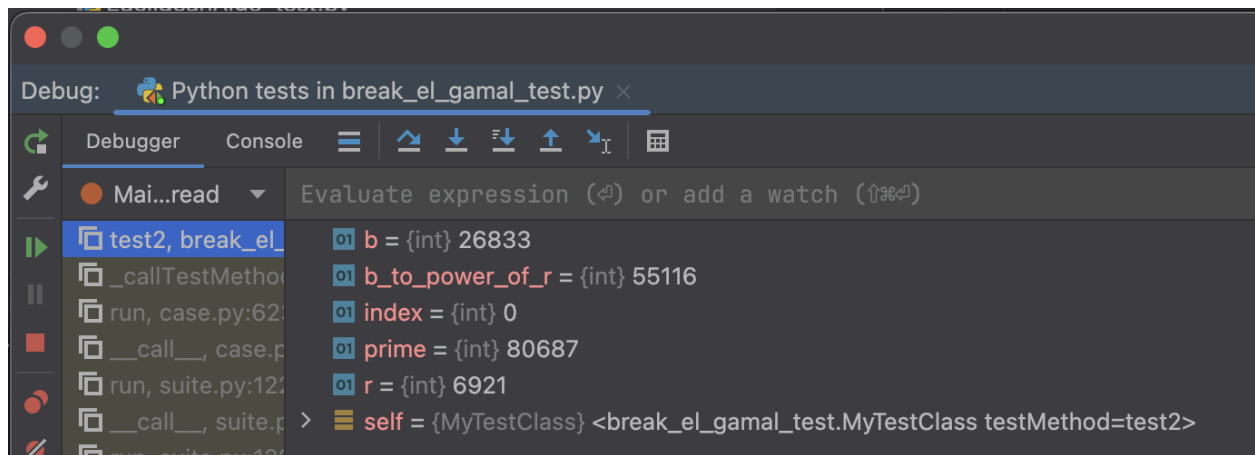
pollard_p_1_factorization_test_factorial_version_test.py 60
pollard_rho_factorization.py 61
pollard_rho_factorization_test.py 62
primitive_root_search.py 63
project_user_manual.pdf 64
random_number_generator.py 65
random_number_generator_test.py 66
random_prime_generator.py 67
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## EL GAMAL

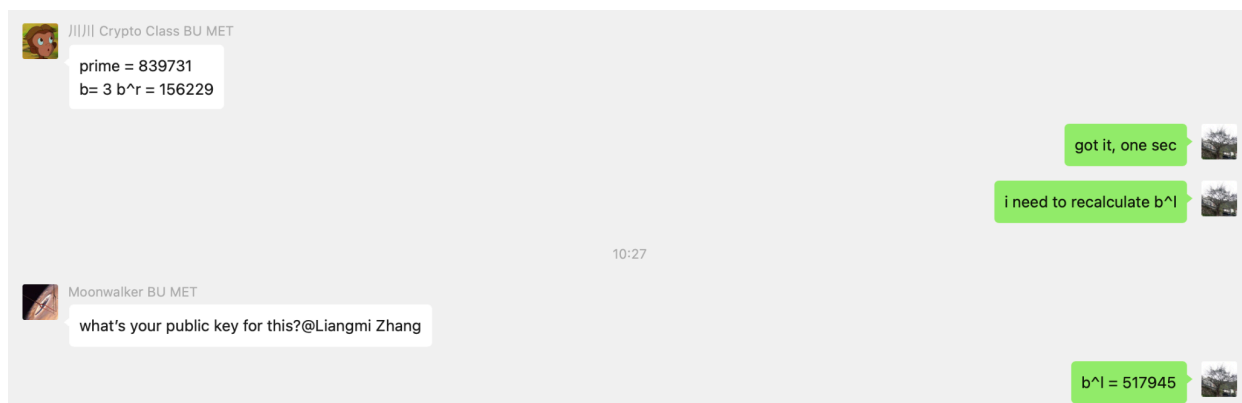
I'm Alice





I'm Bob

Private Key Calculation:



```

def el_gamal_receiver_prepare(b, b_to_power_of_r, prime):
    """
    for receiver to do precomputations
    :param b: integer, which is the primitive root of the group
    :param b_to_power_of_r: which is  $b^r \bmod p$ , shared by the sender.
    :param prime: a prime number
    :return:
    brl, an integer, which is  $(b^r)^l \bmod \text{prime}$  ;
    b_to_power_of_l, an integer, which is  $(b^l) \bmod \text{prime}$  ;
    brl_inverse, and integer, which is the inverse of brl in group  $U(\text{prime})$ 
    """
    # check the primality of the argument prime
    if not is_prime(prime):
        raise Exception(f"{prime} is not prime. Argument should be prime.")

    # l = random_number_generator(0, prime - 2)
    l = 839    l: 839
    # generate a private key
    b_to_power_of_l = fast_expo_modulo(b, l, prime)    b_to_power_of_l: 517945
    # computes  $(b^r)^l$ 
    brl = fast_expo_modulo(b_to_power_of_r, l, prime)    brl: 730095
    # computes inverse of  $(b^r)^l$  in G
    brl_inverse = extended_euclidean_2(brl, prime)[0]    brl_inverse: 344169
    return brl, b_to_power_of_l, brl_inverse

```

Decryption:

plaintext is 178

daoxing li: the encrypted message is 638336

t.py

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est.py

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test.py

```

87
88 if __name__ == "__main__":
89     # print(el_gamal_receiver_prepare(3,156229 ,839731))
90     print(el_gamal_decrypt( cipher_text: 638336, brl_inverse: 344169, prime: 839731))
91     # print(el_gamal_encrypt(888,41404,55116,80687))

```

Run

el\_gamal x

/usr/local/bin/python3.11 /Users/Mark\_1/Downloads/Cryptography/code\_assignments/code/el\_gamal.py

178

Process finished with exit code 0

I'm Eve



Moonwalker BU MET

Public key (p, b, x): (205823, 94379, 27883)



川川川 Crypto Class BU MET

$b^x \equiv 27883$



Moonwalker BU MET

Encrypted message: 25774002

is plaintext 951?

Yiyao: Encrypted message: 25774002



Moonwalker BU MET

That's right

Liangmi Zhang: is plaintext 951?

```
23 if __name__ == "__main__":
24     print(break_el_gamal(cipher_text: 25774002, p: 205823, b: 94379, b_to_power_of_r: 27883, b_to_power_of_l: 27883))
25
26
Run
break_el_gamal x
/usr/local/bin/python3.11 /Users/Mark_1/Downloads/Cryptography/code_assignments/code/break_el_gamal.py
951
Process finished with exit code 0
```