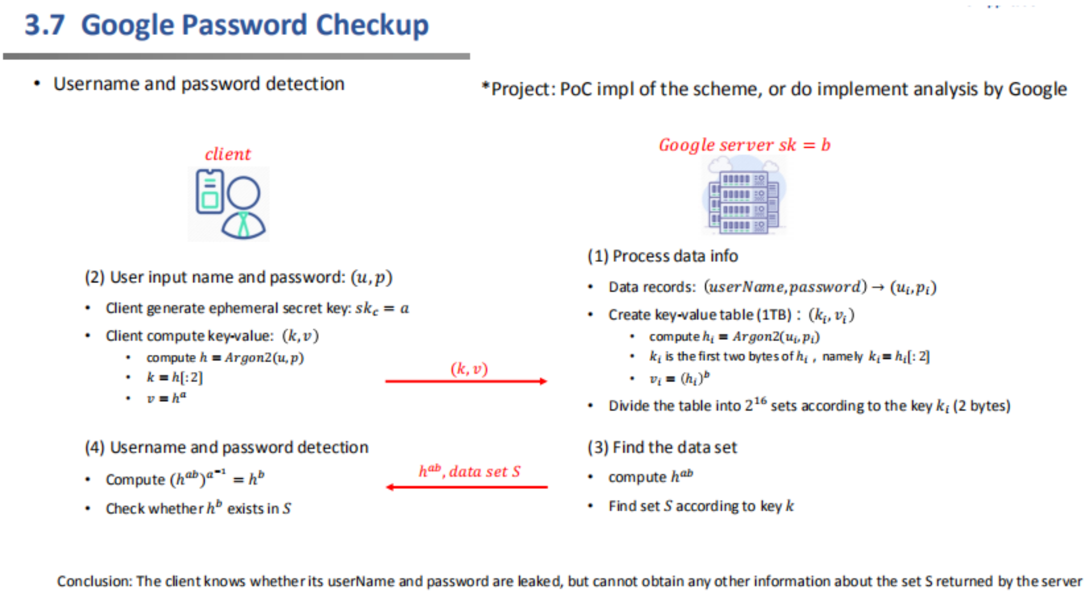
Report

本项目实现了一个简单的PoC scheme，通过网络通信，模拟了server和client的交换，因为只是一个朴素的实现，所以在这里并没有很大的数据量，仅使用了100条数据，每10条数据分成一组，一共10组，并且采用一种最简单的递补法来将hash值映射到椭圆曲线上。在本项目中，使用的hash为sha-256，使用的加密方案为Gmssl库中的sm2。原理如下所示：



3.7 Google Password Checkup

- Username and password detection

*Project: PoC impl of the scheme, or do implement analysis by Google

(1) Process data info

- Data records: $(userName, password) \rightarrow (u_i, p_i)$
- Create key-value table (1TB)： (k_i, v_i)
    - compute $h_i = Argon2(u_i, p_i)$
    - k_i is the first two bytes of h_i , namely $k_i = h_i[:2]$
    - $v_i = (h_i)^b$
- Divide the table into 2^{16} sets according to the key k_i (2 bytes)

(2) User input name and password: (u, p)

- Client generate ephemeral secret key: $sk_c = a$
- Client compute key-value: (k, v)
    - compute $h = Argon2(u, p)$
    - $k = h[:2]$
    - $v = h^a$

(3) Find the data set

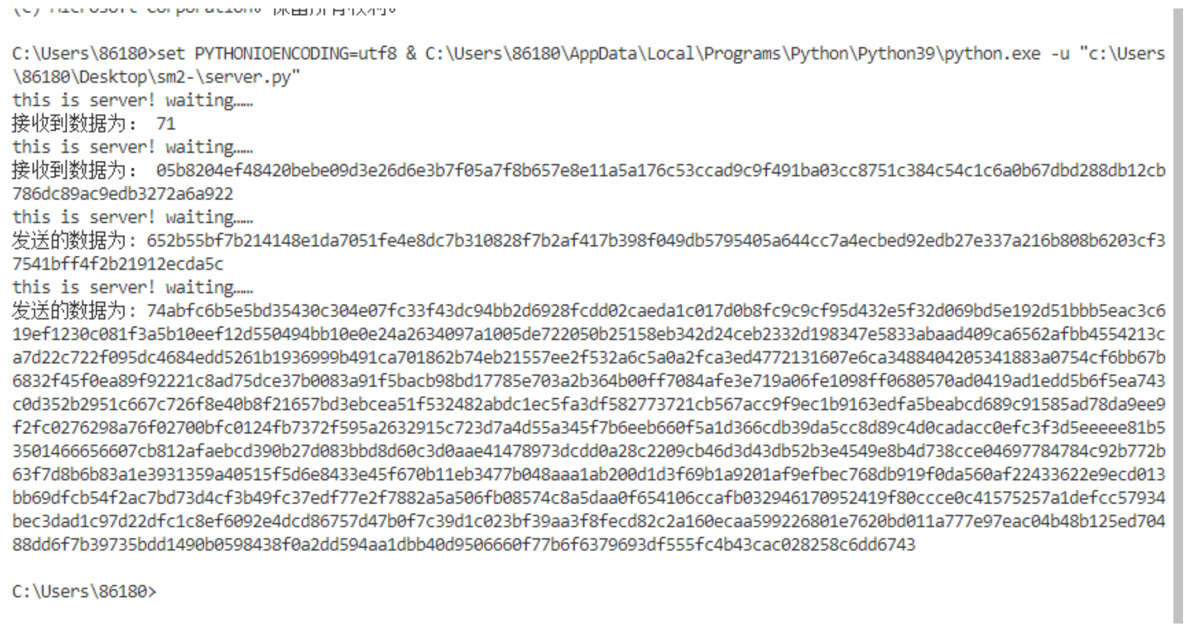
- compute h^{ab}
- Find set S according to key k

(4) Username and password detection

- Compute $(h^{ab})^{a^{-1}} = h^b$
- Check whether h^b exists in S

Conclusion: The client knows whether its userName and password are leaked, but cannot obtain any other information about the set S returned by the server

实验结果如下所示，可以看到，对于客户端输入的”用户名：密码“为”4：4“的组合，因为我们在服务端存储的格式为"str(i)：str(i)"，所以应该会显示泄露，成功完成策略复现。



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C:\Users\86180>set PYTHONIOENCODING=utf8 & C:\Users\86180\AppData\Local\Programs\Python\Python39\python.exe -u "c:\Users
\86180\Desktop\sm2-\server.py"
this is server! waiting.....
接收到数据为：  71
this is server! waiting.....
接收到数据为：  05b8204ef48420bebe09d3e26d6e3b7f05a7f8b657e8e11a5a176c53ccad9c9f491ba03cc8751c384c54c1c6a0b67dbd288db12cb
786dc89ac9edb3272a6a922
this is server! waiting.....
发送的数据为：652b55bf7b214148e1da7051fe4e8dc7b310828f7b2af417b398f049db5795405a644cc7a4ecbed92edb27e337a216b808b6203cf3
7541bff4f2b21912ecda5c
this is server! waiting.....
发送的数据为：74abfc6b5e5bd35430c304e07fc33f43dc94bb2d6928fcdd02caeda1c017d0b8fc9c9cf95d432e5f32d069bd5e192d51bbb5eac3c6
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88dd6f7b39735bdd1490b0598438f0a2dd594aa1dbb40d9506660f77b6f6379693df555fc4b43cac028258c6dd6743

C:\Users\86180>
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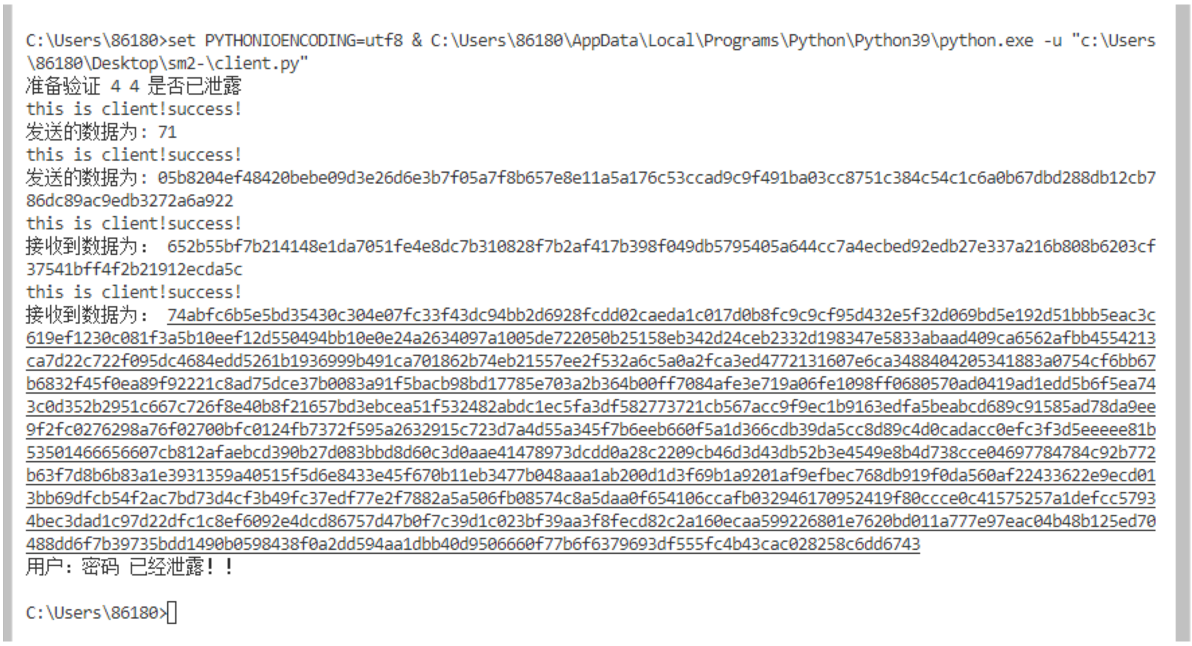

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C:\Users\86180>set PYTHONIOENCODING=utf8 & C:\Users\86180\AppData\Local\Programs\Python\Python39\python.exe -u "c:\Users
\86180\Desktop\sm2-\client.py"
准备验证 4 4 是否已泄露
this is client!success!
发送的数据为: 71
this is client!success!
发送的数据为: 05b8204ef48420bebe09d3e26d6e3b7f05a7f8b657e8e11a5a176c53ccad9c9f491ba03cc8751c384c54c1c6a0b67dbd288db12cb7
86dc89ac9edb3272a6a922
this is client!success!
接收到数据为:  652b55bf7b214148e1da7051fe4e8dc7b310828f7b2af417b398f049db5795405a644cc7a4ecbed92edb27e337a216b808b6203cf
37541bff4f2b21912ecda5c
this is client!success!
接收到数据为:  74abfc6b5e5bd35430c304e07fc33f43dc94bb2d6928fcdd02caeda1c017d0b8fc9c9cf95d432e5f32d069bd5e192d51bbb5eac3c
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488dd6f7b39735bdd1490b0598438f0a2dd594aa1dbb40d9506660f77b6f6379693df555fc4b43cac028258c6dd6743
用户：密码 已经泄露！！

C:\Users\86180>
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