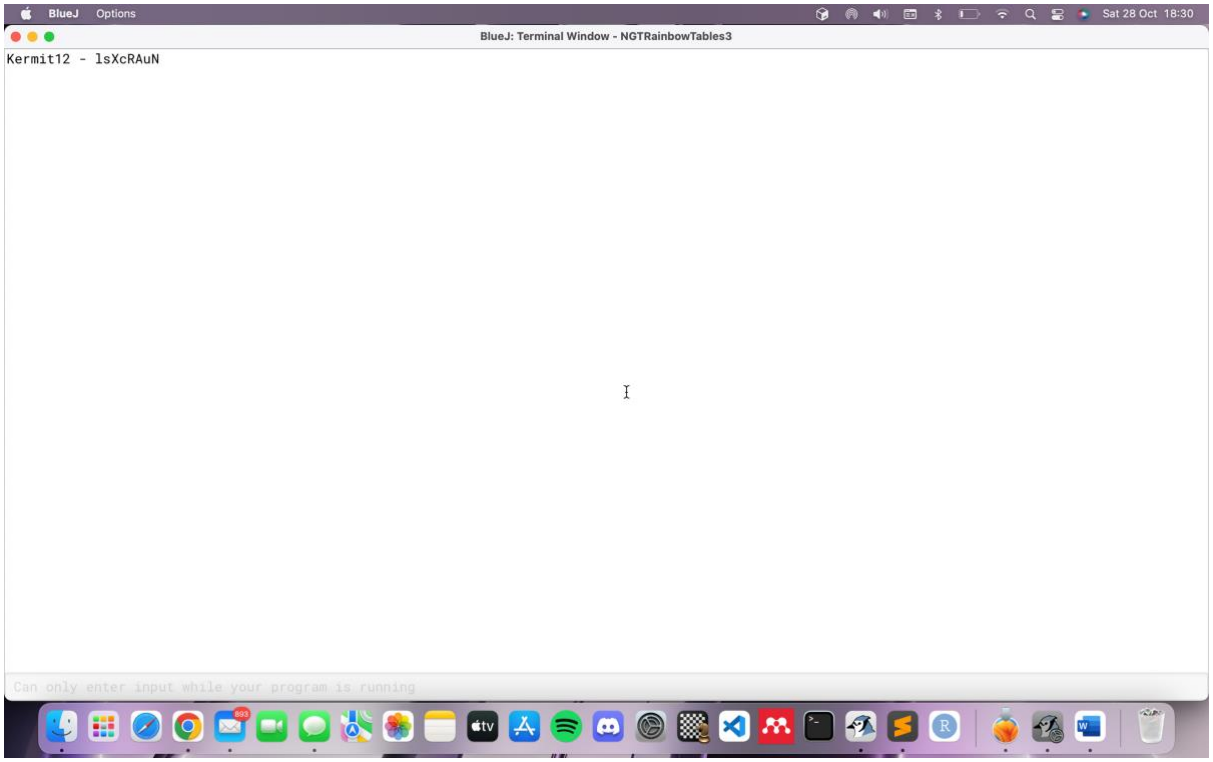
```
/*  CT255 Assignment 2
 *  This class provides functionality to build rainbow tables (with a different reduction function per round) for 8 character long strings, which
   consist of the symbols "a .. z", "A .. Z", "0 .. 9", "!" and "#" (64 symbols in total).
   Properly used, it creates the following value pairs (start value - end value) after 10,000 iterations of hashFunction() and reductionFunction():
        start value  -  end value
        Kermit12       lsXcRAuN
        Modulus!       L2rEsY8h
        Pigtail1       R0NoLf0w
        GalwayNo       9PZjwF5c
        Trumpets       !oeHRZpK
        HelloPat       dkMPG7!U
        pinky##!       eDx58HRq
        01!19!56       vJ90ePjV
        aaaaaaaa       rLtVvpQS
        036abgH#       klQ6IeQJ


 *
 * @author Michael Schukat
 * @version 1.0
 */
public class RainbowTable
{
   /**
    * Constructor, not needed for this assignment
    */
   public RainbowTable() {

   }

   public static void main(String[] args) {
      long res = 0;
      int i;
      //String variables for the starting string, the current string being hashed, current string being reduced, and the endValue
       String start;
       String current;
       String reduction;
       String endValue;
        //variables for the 4 hashes we need to check for a password match
       long hash1 = 895210601874431214L;
       long hash2 = 750105908431234638L;
       long hash3 = 111111111115664932L;
       long hash4 = 977984261343652499L;
```

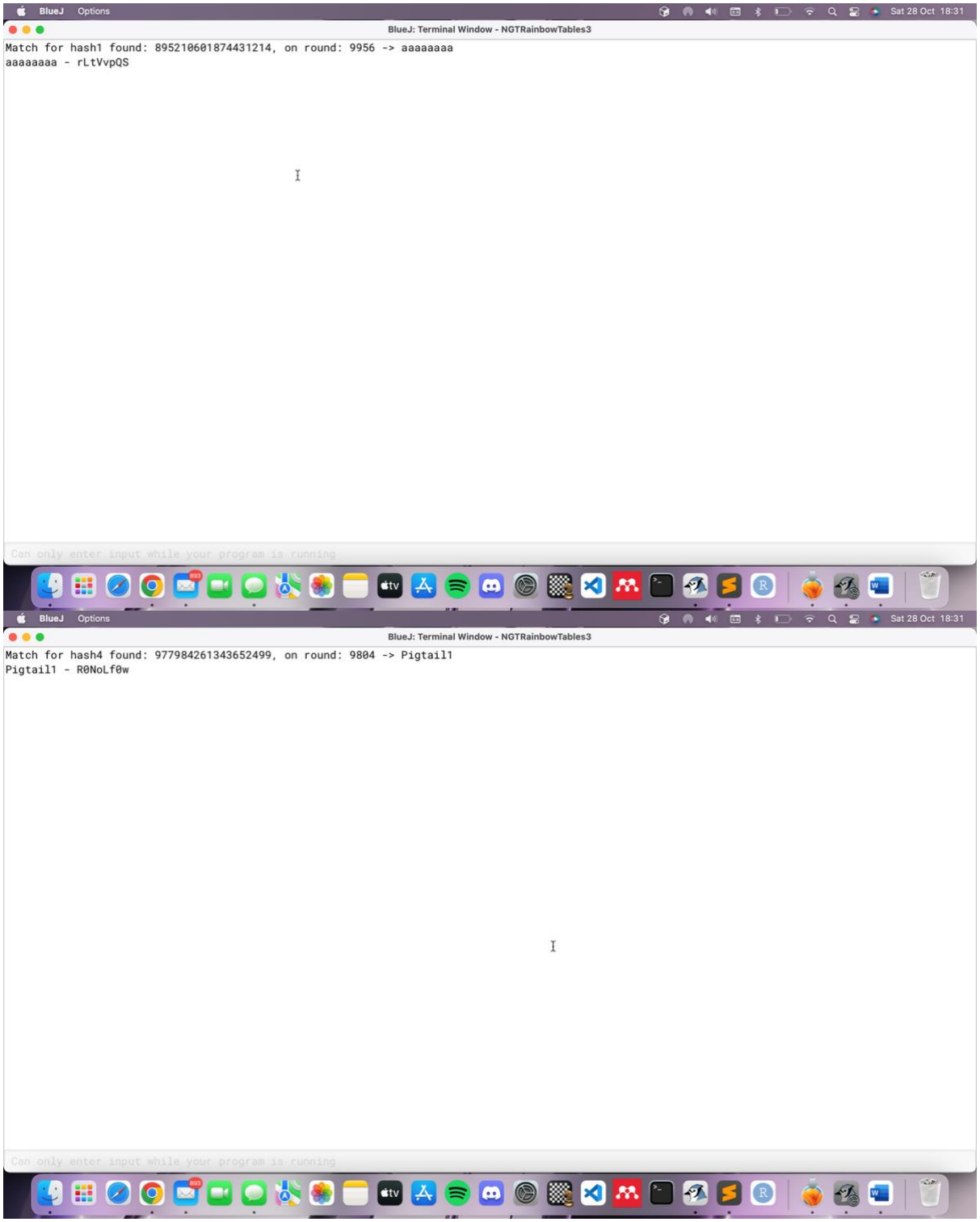
```
    if (args != null && args.length > 0) { // Check for <input> value
      start = args[0];

      if (start.length() != 8) {
        System.out.println("Input " + start + " must be 8 characters long - Exit");
      }
      else {
        current = start;//current being set to the starting input string
        reduction = current;//
        for(i = 0; i < 10000; i++) { //loop that runs 10,000 iterations
          res = hashFunction(current);//res is the current hash value for the string
          reduction = reductionFunction(res, i); //reduction is the hashvalue after being
converted back into a string
          current = reduction;//current updated to the most current string
          if(res == hash1) { //4 if staements checking if any of the 4 hashValues we're
looking for are in the hash chain
            System.out.println("Match for hash1 found: " + res + ", on round: " + i + " -> " +
start);
          }
          if(res == hash2) {
            System.out.println("Match for hash2 found: " + res + ", on round: " + i + " -> " +
start);
          }
          if(res == hash3) {
            System.out.println("Match for hash3 found: " + res + ", on round: " + i + " -> " +
start);
          }
          if(res == hash4) {
            System.out.println("Match for hash4 found: " + res + ", on round: " + i + " -> " +
start);
          }
        }
        System.out.println(start + " - " + reduction);//prints out the start and end value
after the loop is finished
        }
    }
    else { // No <input>
      System.out.println("Use: RainbowTable <Input>");
    }
  }

  private static long hashFunction(String s){
    long ret = 0;
    int i;
    long[] hashA = new long[]{1, 1, 1, 1};
```

```
      String filler, sIn;

      int DIV = 65536;

      filler = new
String("ABCDEFGHABCDEFGHABCDEFGHABCDEFGHABCDEFGHABCDEFGHABCDEFGHABCDEF
GH");

      sIn = s + filler; // Add characters, now have "<input>HABCDEF..."
      sIn = sIn.substring(0, 64); // // Limit string to first 64 characters

      for (i = 0; i < sIn.length(); i++) {
         char byPos = sIn.charAt(i); // get i'th character
         hashA[0] += (byPos * 17111); // Note: A += B means A = A + B
         hashA[1] += (hashA[0] + byPos * 31349);
         hashA[2] += (hashA[1] - byPos * 101302);
         hashA[3] += (byPos * 79001);
      }

      ret = (hashA[0] + hashA[2]) + (hashA[1] * hashA[3]);
      if (ret < 0) ret *= -1;
      return ret;
   }

   private static String reductionFunction(long val, int round) {  // Note that for the first
function call "round" has to be 0,
      String car, out;                              // and has to be incremented by one with every
subsequent call.
      int i;                                     // I.e. "round" created variations of the reduction
function.
      char dat;

      car = new
String("0123456789ABCDEFGHIJKLMNOPQRSTUNVXYZabcdefghijklmnopqrstuvwxyz!#");
      out = new String("");

      for (i = 0; i < 8; i++) {
         val -= round;
         dat = (char) (val % 63);
         val = val / 83;
         out = out + car.charAt(dat);
      }

      return out;
   }
}
```

Problem 1



Problem 2.



The passwords that matched the hash values were aaaaaaaa and Pigtail1