1. **[40 points]** Alice is a student in our class. She also happens to be a movie actor. She wanted to share the plot of one of her movies with her friend, Bob. Although she knew that the substitution cipher wasn't completely secure, she still wanted to use it as she had an urgent need to send this message. She couldn't wait for the end of the course to get to know more secure ciphers. She did some brief research about the tools that can solve substitution cipher. Unfortunately, she discovered that there are many such online tools that can automatically solve substitution ciphers (https://www.guballa.de/substitution-solver and https://www.dcode.fr/frequency-analysis). So, she tried to slightly strengthen the substitution cipher instead of following the textbook approach as it is.

   Instead of substituting just the letters, she also used the "punctuation letters" that were in her text as part of the substitution mapping. To be specific, these are the all the letters that she had a mapping for:

   ```
   abcdefghijklmnopqrstuvwxyz "',-.;
   ```

   Note how she has a mapping for 7 special characters: space (right after z), double quote, single quote, comma, hyphen, period and semi-colon. So, she now has 33 characters that will all be substituted. This change improved the key space size to 33! (roughly equal to 2^{122}) keys and thus strengthened the cipher! More importantly for Alice, most of the online tools didn't seem to work as well anymore after using this version of the cipher. This provided some comfort to her and she went on to send a message to Bob. We were able to get hold of the encrypted text that she sent:

   http://www.phanivadrevu.com/files/teaching/cipher.txt

   Now, break this cipher and find the plain text as well as the correct key used for encryption. The encryption key should be represented as a single line of text where each character denotes the character that it replaces. An example key is the following (but, this is not the correct key).

   ```
   ;q'oc.ikbaugjtf,vn"yl -ehdrxzwmsp
   ```

   You should submit the **plain text, encryption key** as well as **any code** that you wrote as part of the cryptanalysis.

   - It's also OK to do the entire cryptanalysis in a manual manner (without any programming). If that's the case, please submit **a brief write-up** about how you arrived at the answer.

   - You can also use any of the available online tools to find the solution. If that's the case, please **mention the tool** that you used in the write-up and also **how you used it** to arrive at the answer.

Here are some helpful tips about how you can crack a substitution cipher (apart from what we've seen in the textbook):
https://www.simonsingh.net/The_Black_Chamber/hintsandtips.html

2 - 7 **[60 points]**

The Questions 2-7 in the assignment are simply the following questions from the 1st chapter of the textbook: 1.3, 1.4, 1.7, 1.9, 1.13, 1.14. Each of them carries 10 points. For the sake of students who haven't acquired the textbook yet, I am attaching the problems to this PDF document.