School of Electrical Engineering and Computer Science

Applied Cryptography – DD2520 2023

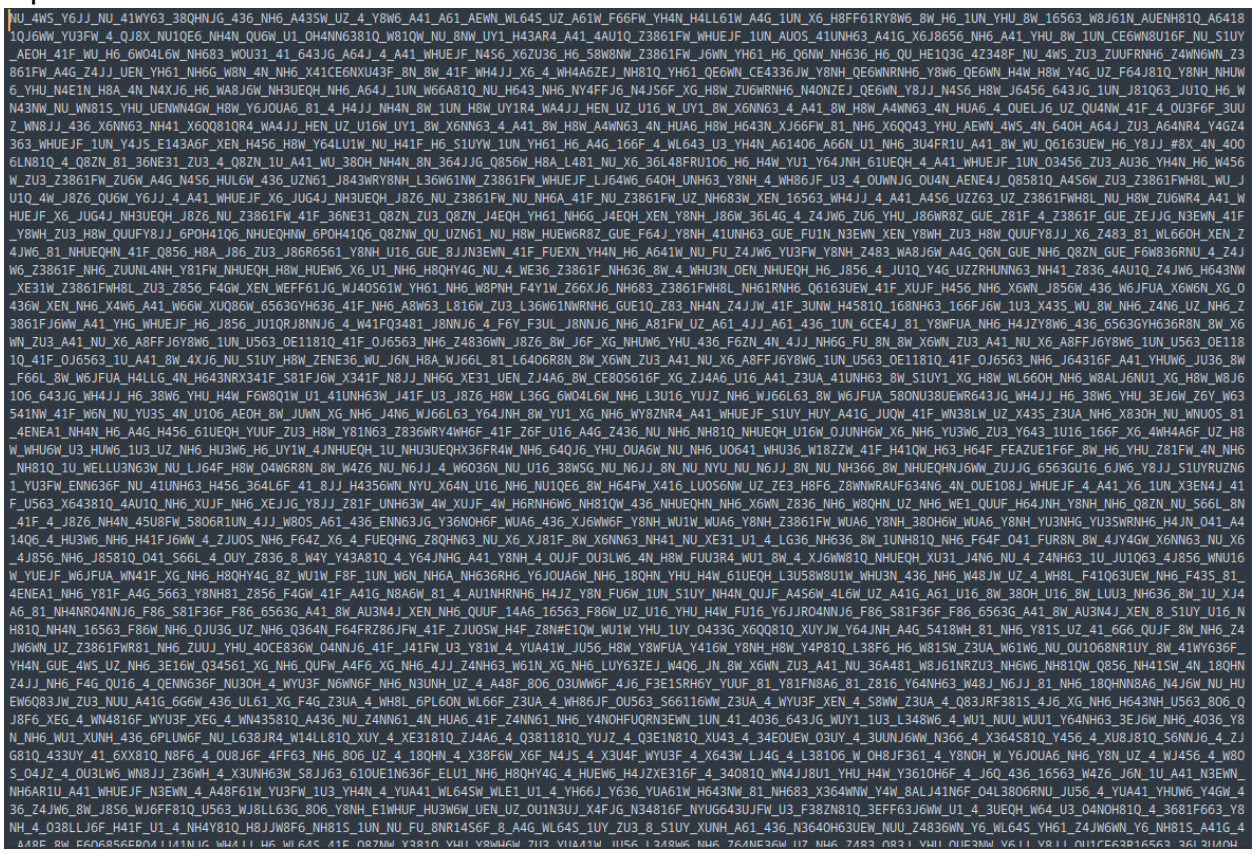
Georgios Akkogiounoglou – gakk@kth.se

January 2022

1. Introduction:

The two ciphertexts that I received was:

Ciphertext #1:



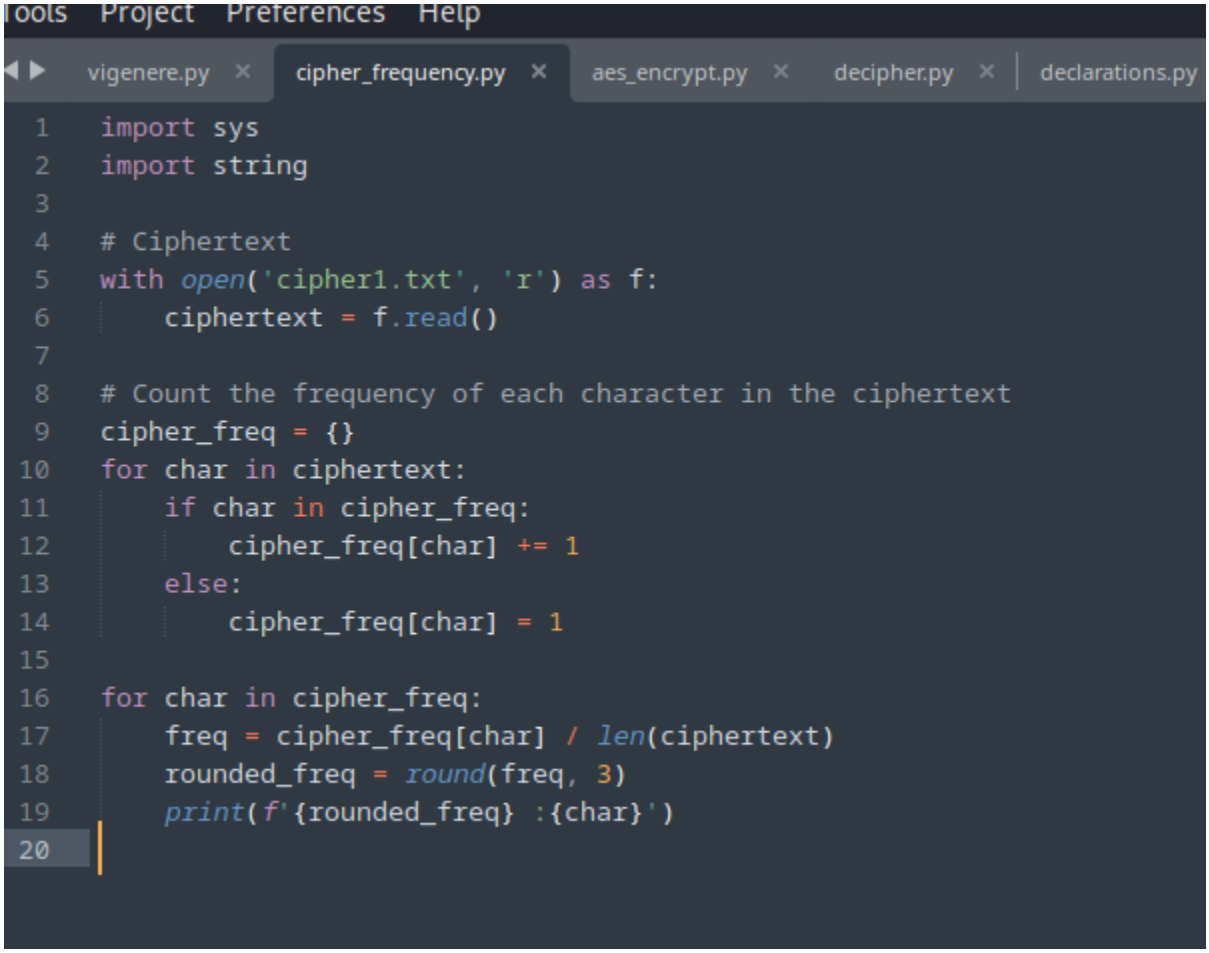
NU_4WS_Y6JJ_NU_41WY63_38QHNJG_436_NH6_A43SW_UZ_4_Y8W6_A41_A61_AEWN_WL64S_UZ_A61W_F66FW_YH4N_H4LL61W_A4G_1UN_X6_H8FF61RY8W6_8W_H6_1UN_YHU_8W_16563_W8J61N_AUENH81Q_A6418
1QJ6WW_YU3FW_4_QJ8X_NU1QE6_NH4N_QU6W_U1_OH4NN6381Q_W81QW_NU_8NW_UY1_H43AR4_A41_4AU1Q_Z3861FW_WHUEJF_1UN_AUOS_41UNH63_A41G_X6J8656_NH6_A41_YHU_8W_1UN_CE6WN8U16F_NU_S1UY
_AEOH_41F_WU_H6_6WO4L6W_NH683_WOU31_41_643JG_A64J_4_A41_WHUEJF_N4S6_X6ZU36_H6_58W8NW_Z3861FW_J6WN_YH61_H6_Q6NW_NH636_H6_QU_HE1Q3G_4Z348F_NU_4WS_ZU3_ZUUFRNH6_Z4WN6WN_Z3
861FW_A4G_Z4JJ_UEN_YH61_NH6G_W8N_4N_NH6_X41CE6NXU43F_8N_8W_41F_WH4JJ_X6_4_WH4A6ZEJ_NH81Q_YH61_QE6WN_CE4336JW_Y8NH_QE6WNRNH6_Y8W6_QE6WN_H4W_H8W_Y4G_UZ_F64J81Q_Y8NH_NHUW
6_YHU_N4E1N_H8A_4N_N4XJ6_H6_WA8J6W_NH3UEQH_NH6_A64J_1UN_W66A81Q_NU_H643_NH6_NY4FFJ6_N4JS6F_XG_H8W_ZU6WRNH6_N4ONZEJ_QE6WN_Y8JJ_N4S6_H8W_J6456_643JG_1UN_J81Q63_JU1Q_H6_W
N43NW_NU_WN81S_YHU_UENWN4GW_H8W_Y6JOUA6_81_4_H4JJ_NH4N_8W_1UN_H8W_UY1R4_WA4JJ_HEN_UZ_U16_W_UY1_8W_X6NN63_4_A41_8W_H8W_A4WN63_4N_HUA6_4_OUELJ6_UZ_QU4NW_41F_4_OU3F6F_3UU
Z_WN8JJ_436_X6NN63_NH41_X6QQ81QR4_WA4JJ_HEN_UZ_U16W_UY1_8W_X6NN63_4_A41_8W_H8W_A4WN63_4N_HUA6_H8W_H643N_XJ66FW_81_NH6_X6QQ43_YHU_AEWN_4WS_4N_64OH_A64J_ZU3_A64NR4_Y4GZ4
363_WHUEJF_1UN_Y4JS_E143A6F_XEN_H456_H8W_Y64LU1W_NU_H41F_H6_S1UYW_1UN_YH61_H6_A4G_166F_4_WL643_U3_YH4N_A614O6_A66N_U1_NH6_3U4FR1U_A41_8W_WU_Q6163UEW_H6_Y8JJ_#8X_4N_4OO
6LN81Q_4_Q8ZN_81_36NE31_ZU3_4_Q8ZN_1U_A41_WU_38OH_NH4N_8N_364JJG_Q856W_H8A_L481_NU_X6_36L48FRU1O6_H6_H4W_YU1_Y64JNH_61UEQH_4_A41_WHUEJF_1UN_O345G_ZU3_AU36_YH4N_H6_W456
W_ZU3_Z3861FW_ZU6W_A4G_N4S6_HUL6W_436_UZN61_J843WRY8NH_L36W61NW_Z3861FW_WHUEJF_LJ64W6_64OH_UNH63_Y8NH_4_WH86JF_U3_4_OUWNJG_OU4N_AENE4J_Q8581Q_A4S6W_ZU3_Z3861FWH8L_WU_J
U1Q_4W_J8Z6_QU6W_Y6JJ_4_A41_WHUEJF_X6_JUG4J_NH3UEQH_J8Z6_NU_Z3861FW_NU_NH6A_41F_NU_Z3861FW_UZ_NH683W_XEN_16563_WH4JJ_4_A41_A4S6_UZZ63_UZ_Z3861FWH8L_NU_H8W_ZU6WR4_A41_W
HUEJF_X6_JUG4J_NH3UEQH_J8Z6_NU_Z3861FW_41F_36NE31_Q8ZN_ZU3_Q8ZN_J4EQH_YH61_NH6G_J4EQH_XEN_Y8NH_J86W_36L4G_4_Z4JW6_ZU6_YHU_J86WR8Z_GUE_Z81F_4_Z3861F_GUE_ZEJJG_N3EWN_41F
_Y8WH_ZU3_H8W_QUUFY8JJ_6POH41Q6_NHUEQHNW_6POH41Q6_Q8ZNW_QU_UZN61_NU_H8W_HUEW6R8Z_GUE_F64J_Y8NH_41UNH63_GUE_FU1N_N3EWN_XEN_Y8WH_ZU3_H8W_QUUFY8JJ_X6_Z483_81_WL66OH_XEN_Z
4JW6_81_NHUEQHN_41F_Q856_H8A_J86_ZU3_J86R6561_Y8NH_U16_GUE_8JJN3EWN_41F_FUEXN_YH4N_H6_A641W_NU_FU_Z4JW6_YU3FW_Y8NH_Z483_WA8J6W_A4G_Q6N_GUE_NH6_Q8ZN_GUE_F6W836RNU_4_Z4J
W6_Z3861F_NH6_ZUUNL4NH_Y81FW_NHUEQH_H8W_HUEW6_X6_U1_NH6_H8QHY4G_NU_4_WE36_Z3861F_NH636_8W_4_WHU3N_OEN_NHUEQH_H6_J856_4_JU1Q_Y4G_UZZRHUNN63_NH41_Z836_4AU1Q_Z4JW6_H643NW
_XE31W_Z3861FWH8L_ZU3_Z856_F4GW_XEN_WEFF61JG_WJ4OS61W_YH61_NH6_W8PNH_F4Y1W_Z66XJ6_NH683_Z3861FWH8L_NH61RNH6_Q6163UEW_41F_XUJF_H456_NH6_X6WN_J856W_436_W6JFUA_X6W6N_XG_O
436W_XEN_NH6_X4W6_A41_W66W_XUQ86W_6563GYH636_41F_NH6_A8W63_L816W_ZU3_L36W61NWRNH6_GUE1Q_Z83_NH4N_Z4JJW_41F_3UNW_H4581Q_168NH63_166FJ6W_1U3_X43S_WU_8W_NH6_Z4N6_UZ_NH6_Z
3861FJ6WW_A41_YHG_WHUEJF_H6_J856_JU1QRJ8NNJ6_4_W41FQ3481_J8NNJ6_4_F6Y_F3UL_J8NNJ6_NH6_A81FW_UZ_A61_4JJ_A61_436_1UN_6CE4J_81_Y8WFUA_NH6_H4JZY8W6_436_6563GYH636R8N_8W_X6
WN_ZU3_A41_NU_X6_A8FFJ6Y8W6_1UN_U563_OE1181Q_41F_OJ6563_NH6_Z4836WN_J8Z6_8W_J6F_XG_NHUW6_YHU_436_F6ZN_4N_4JJ_NH6G_FU_8N_8W_X6WN_ZU3_A41_NU_X6_A8FFJ6Y8W6_1UN_U563_OE118
1Q_41F_OJ6563_1U_A41_8W_4XJ6_NU_S1UY_H8W_ZENE36_WU_J6N_H8A_WJ66L_81_L64O6R8N_8W_X6WN_ZU3_A41_NU_X6_A8FFJ6Y8W6_1UN_U563_OE1181Q_41F_OJ6563_NH6_J64316F_A41_YHUW6_JU36_8W
_F66L_8W_W6JFUA_H4LLG_4N_H643NRX341F_S81FJ6W_X341F_N8JJ_NH6G_XE31_UEN_ZJ4A6_8W_CE8OS616F_XG_ZJ4A6_U16_A41_Z3UA_41UNH63_8W_S1UY1_XG_H8W_WL66OH_NH6_W8ALJ6NU1_XG_H8W_W8J6
1O6_643JG_WH4JJ_H6_38W6_YHU_H4W_F6W8Q1W_U1_41UNH63W_J41F_U3_J8Z6_H8W_L36G_6WO4L6W_NH6_L3U16_YUJZ_NH6_WJ66L63_8W_W6JFUA_58ONU38UEWR643JG_WH4JJ_H6_38W6_YHU_3EJ6W_Z6Y_W63
541NW_41F_W6N_NU_YU3S_4N_U1O6_AEOH_8W_JUWN_XG_NH6_J4N6_WJ66L63_Y64JNH_8W_YU1_XG_NH6_WY8ZNR4_A41_WHUEJF_S1UY_HUY_A41G_JUQW_41F_WN38LW_UZ_X43S_Z3UA_NH6_X83OH_NU_WNUOS_81
_4ENEA1_NH4N_H6_A4G_H456_61UEQH_YUUF_ZU3_H8W_Y81N63_Z836WRY4WH6F_41F_Z6F_U16_A4G_Z436_NU_NH6_NH81Q_NHUEQH_U16W_OJUNH6W_X6_NH6_YU3W6_ZU3_Y643_1U16_166F_X6_4WH4A6F_UZ_H8
W_WHU6W_U3_HUW6_1U3_UZ_NH6_HU3W6_H6_UY1W_4JNHUEQH_1U_NHU3UEQHX36FR4W_NH6_64QJ6_YHU_OUA6W_NU_NH6_UO641_WHU36_W18ZZW_41F_H41QW_H63_H64F_FEAZUE1F6F_8W_H6_YHU_Z81FW_4N_NH6
_NH81Q_1U_WELLU3N63W_NU_LJ64F_H8W_O4W6R8N_8W_W4Z6_NU_N6JJ_4_W6O36N_NU_U16_38WSG_NU_N6JJ_8N_NU_NYU_NU_N6JJ_8N_NU_NH366_8W_NHUEQHNJ6WW_ZUJJG_6563GU16_6JW6_Y8JJ_S1UYRUZN6
1_YU3FW_ENN636F_NU_41UNH63_H456_364L6F_41_8JJ_H4356WN_NYU_X64N_U16_NH6_NU1QE6_8W_H64FW_X416_LUOS6NW_UZ_ZE3_H8F6_Z8WNWRAUF634N6_4N_OUE1O8J_WHUEJF_4_A41_X6_1UN_X3EN4J_41
F_U563_X64381Q_4AU1Q_NH6_XUJF_NH6_XEJJG_Y8JJ_Z81F_UNH63W_4W_XUJF_4W_H6RNH6W6_NH81QW_436_NHUEQHN_NH6_X6WN_Z836_NH6_W8QHN_UZ_NH6_WE1_QUUF_H64JNH_Y8NH_NH6_Q8ZN_NU_S66L_8N
_41F_4_J8Z6_NH4N_45U8FW_58O6R1UN_4JJ_W8OS_A61_436_ENN63JG_Y36NOH6F_WUA6_436_XJ6WW6F_Y8NH_WU1W_WUA6_Y8NH_Z3861FW_WUA6_Y8NH_38OH6W_WUA6_Y8NH_YU3NHG_YU3SWRNH6_H4JN_O41_A4
14Q6_4_HU3W6_NH6_H41FJ6WW_4_ZJUOS_NH6_F64Z_X6_4_FUEQHNG_Z8QHN63_NU_X6_XJ81F_8W_X6NN63_NH41_NU_XE31_U1_4_LG36_NH636_8W_1UNH81Q_NH6_F64F_O41_FUR8N_8W_4JY4GW_X6NN63_NU_X6
_4J856_NH6_J8581Q_O41_S66L_4_OUY_Z836_8_W4Y_Y43A81Q_4_Y64JNHG_A41_Y8NH_4_OUJF_OU3LW6_4N_H8W_FUU3R4_WU1_8W_4_XJ6WW81Q_NHUEQH_XU31_J4N6_NU_4_Z4NH63_1U_JU1Q63_4J856_WNU16
W_YUEJF_W6JFUA_WN41F_XG_NH6_H8QHY4G_8Z_WU1W_F8F_1UN_W6N_NH6A_NH636RH6_Y6JOUA6W_NH6_18QHN_YHU_H4W_61UEQH_L3U58W8U1W_WHU3N_436_NH6_W48JW_UZ_4_WH8L_F41Q63UEW_NH6_F43S_81_
4ENEA1_NH6_Y81F_A4G_5663_Y8NH81_Z856_F4GW_41F_A41G_N8A6W_81_4_AU1NHRNH6_H4JZ_Y8N_FU6W_1UN_S1UY_NH4N_QUJF_A4S6W_4L6W_UZ_A41G_A61_U16_8W_38OH_U16_8W_LUU3_NH636_8W_1U_XJ4
A6_81_NH4NRO4NNJ6_F86_S81F36F_F86_6563G_A41_8W_AU3N4J_XEN_NH6_QUUF_14A6_16563_F86W_UZ_U16_YHU_H4W_FU16_Y6JJRO4NNJ6_F86_S81F36F_F86_6563G_A41_8W_AU3N4J_XEN_8_S1UY_U16_N
H81Q_NH4N_16563_F86W_NH6_QJU3G_UZ_NH6_Q364N_F64FRZ86JFW_41F_ZJUOSW_H4F_Z8N#E1QW_WU1W_YHU_1UY_O433G_X6QQ81Q_XUYJW_Y64JNH_A4G_5418WH_81_NH6_Y81S_UZ_41_6G6_QUJF_8W_NH6_Z4
JW6WN_UZ_Z3861FWR81_NH6_ZUUJ_YHU_4OCE836W_O4NNJ6_41F_J41FW_U3_Y81W_4_YUA41W_JU56_H8W_Y8WFUA_Y416W_Y8NH_H8W_Y4P81Q_L38F6_H6_W81SW_Z3UA_W61W6_NU_OU1O68NR1UY_8W_41WY636F_
YH4N_GUE_4WS_UZ_NH6_3E16W_Q34561_XG_NH6_QUFW_A4F6_XG_NH6_4JJ_Z4NH63_W61N_XG_NH6_LUY63ZEJ_W4Q6_JN_8W_X6WN_ZU3_A41_NU_36A481_W8J61NRZU3_NH6W6_NH81QW_Q856_NH41SW_4N_18QHN
Z4JJ_NH6_F4G_QU16_4_QENN636F_NU3OH_4_WYU3F_N6WN6F_NH6_N3UNH_UZ_4_A48F_8O6_O3UWW6F_4J6_F3E1SRH6Y_YUUF_81_Y81FN8A6_81_Z816_Y64NH63_W48J_N6JJ_81_NH6_18QHNN8A6_N4J6W_NU_HU
EW6Q83JW_ZU3_NUU_A41G_6G6W_436_UL61_XG_F4G_Z3UA_4_WH8L_6PL6ON_WL66F_Z3UA_4_WH86JF_OU563_S66116WW_Z3UA_4_WYU3F_XEN_4_S8WW_Z3UA_4_Q83JRF381S_4J6_XG_NH6_H643NH_U563_806_Q
J8F6_XEG_4_WN4816F_WYU3F_XEG_4_WN43581Q_A436_NU_Z4NN61_4N_HUA6_41F_Z4NN61_NH6_Y4NOHFUQRN3EWN_1UN_41_4O36_643JG_WUY1_1U3_L348W6_4_WU1_NUU_WUU1_Y64NH63_3EJ6W_NH6_4O36_Y8
N_NH6_WU1_XUNH_436_6PLUW6F_NU_L638JR4_W14LL81Q_XUY_4_XE3181Q_ZJ4A6_4_Q381181Q_YUJZ_4_Q3E1N81Q_XU43_4_34EOUEW_O3UY_4_3UNJ6WW_N366_4_X364S81Q_Y456_4_XU8J81Q_S6NNJ6_4_ZJ
G81Q_433UY_41_6XX81Q_N8F6_4_OU8J6F_4FF63_NH6_8O6_UZ_4_18QHN_4_X38F6W_X6F_N4JS_4_X3U4F_WYU3F_4_X643W_LJ4G_4_L381O6_W_OH8JF361_4_Y8NOH_W_Y6JOUA6_NH6_Y8N_UZ_4_WJ456_4_W8O
S_O4JZ_4_OU3LW6_WN8JJ_Z36WH_4_X3UNH63W_S8JJ63_61OUE1N636F_ELU1_NH6_H8QHY4G_4_HUEW6_H4JZXE316F_4_34O81Q_WN4JJ8U1_YHU_H4W_Y361OH6F_4_J6Q_436_16563_W4Z6_J6N_1U_A41_N3EWN_
NH6AR1U_A41_WHUEJF_N3EWN_4_A48F61W_YU3FW_1U3_YH4N_4_YUA41_WL64SW_WLE1_U1_4_YH66J_Y636_YUA61W_H643NW_81_NH683_X364WNW_Y4W_8ALJ41N6F_O4L38O6RNU_JU56_4_YUA41_YHUW6_Y4GW_4
36_Z4JW6_8W_J8S6_WJ6FF81Q_U563_WJ8LL63G_8O6_Y8NH_E1WHUF_HU3W6W_UEN_UZ_OU1N3UJ_X4FJG_N34816F_NYUG643UJFW_U3_F38ZN81Q_3EFF63J6WW_U1_4_3UEQH_W64_U3_O4NOH81Q_4_3681F663_Y8
NH_4_O38LLJ6F_H41F_U1_4_NH4Y81Q_H8JJW8F6_NH81S_1UN_NU_FU_8NR14S6F_8_A4G_WL64S_1UY_ZU3_8_S1UY_XUNH_A61_436_N364OH63UEW_NUU_Z4836WN_Y6_WL64S_YH61_Z4JW6WN_Y6_NH81S_A41G_4

Ciphertext #2:

```
OD3TI7YNC16D_PF3UJ8ZODIPA#RF4VK9_PU#MBIC807QTHU04ABACV7QXSE0YY#40P4EQQWF0MSOTT8UR5WY3MUOO0JXMFC042#HVGQXI2NVM_GO_CDEXGWN0MW2C_E827NQ8AX50OQY296X0AC
2SPQYRKARY1B#ZGQALGI04AMC7GQ6SS9GY1MMCCDT2QAVM3POTG4#296RB8#6CMD2_SUQGAX6ZNQVSJCKHQ#AS07QZ6WPA3#C5J4522PVYOIASPJ623AG9ATDSE8QPDU0Y#QCWPJUHS7_MRBHS0
J22LKT8QOHCCQXI2907UL2CO81ISLQA1#9SQD2V2WC9P#MSVQY2O6UMZPHCVEEFD6O0AX_40872EU01MV950JXELWY3UMG50JXISLG_4M6OTQSL2NOEAP3CJ452KEUFQSOOH52V5AFMYFOOPQQK
JAGYNM2CGD7IJPC4ZN2#VQQ2H6UEUPBCHE52EA0IMTOSP6UR5AT0P#6#07UVSBG0NM2CJ4QVLWC9P#MSVQQQSE0ITP9Z_QRP2IG7QTGCF8T2AWPA3#2#EE8V2CGMTFFCGC2XAKPEAE6R08ERGP0
1QF9CE7QVEAFMMUO5JE6ISPTGXZOUGD8MFA007QFSUIYSFO0AR#BOVK5ISSJ4OIO5JE8K9WDG3#9WVJ#ISIKD3I36NQYRSNGYXJHA0I22GBV0Z#__WIUHSQUMPJ1CKQ1SLW0Z4UO0JQAL2P042#
AOPQ7L2P03Q#1OT462KK0F_#_QEK6ISDK82F9T0CC25ACDAGFWGDT2AWRD_N64GQCSMWKM6J9Z080TJKX0AJO8KB#2FK07_O4STQQWSDCEAFJSTQRI6JO88#5OD8724KPFUOIS0J22JQO4ZBHS0
E126RGD8#DSVJC2NAZY3JC#0MXM4D01_SH6P4EQ2U0#UTDSPIU2AWY4XMOSP920SPJ0AQFSU41XS6P#AU5S0FQWLWU3MM9CD4EJGN08Q#HVGQ3EKP09_#10W172QKWMMS2CT8WLLWOKAC24VQ2J
SBT4QO140JXIJA0I_V9R01U276TMXFG40I8J7AT4ZHOOOE1KKP08MO8WP3EM7WO0Z#OOP3EKG906ZPK40MX0SPJ08#_3GQ6SSBCETJC#G3E25EFMZPHCGC3PGU0FTF63080E8EPY3JC#UQ6SS6U
EUEI0WI#0SEPM1F0ONBYR8WV3Q#ASOE50SKHM#BG50I2VJKYMUOG5G0T2GB0ZQBFWP6EX9AKDAQFSU41XSHQFAX65JQUUM6P4YJHA01U2CEP#AFB0W6X2LK04ZGC3OQ00SIQFTFFCV7QXSE0ETB
9Z007X6JFM3POVGHEFMOK9QTGCVEEX9A0ZQTHCQ5EQQWCZUM65_QQR5WU3MM9CI89ISDGDAU5S04QVDEGE3#6#HE5Q2PKAZ#_PQK72AP04AI_7GQ6I6JO88#_6PJEEF901UO1CV7QXSOJ0AJGCX
450SBCDAGF0OQRIAJIM3I2CF86E8NG0MC9S0FUVKKPM_VFCHHYIF9UMMM9SI4EL6N0F_##S0IXISEUMM#9WX4#0S8J0QS36NQASE6PM6JHV0JXIS7GE3#CT07UEJPUMU#29RBQMFAFM3POVGHEQ
QWOA3I23UQAVGJIEAX65JQ5I86T#AUCCV7QXSLCD3#CT07UVSLQD3JC#0MXM4D03MTOPG412OEV3TF9R055SEWJ01#GVGQ7SD908Q#HVGQ0SLEX02#_#FQ5I2OQ92#CT07UVSKY9ADC#FKSXS6P
#AU5S0JUVEO0AZ#KVK2X2KDGMUTO8KB#MFC0F_#4WX4EYHWV3Q#KVQBU22JFM3PORQQ0SJA0FTBBCY4EL2RGMMT8SFQYRSOJA1UOW02QRFKVM6S65GQVYJPJ01#I1QDEX9EUM2V#XG2722P0B1F
GSPJESFH_MMTG6T4EQQWOA3I230JXELWC7X#KWNBEKGWQ9AX2ZNQQR5WKMTBJS00WEAJ0ANT23X4T2EU0#QBFCHHYIF904Z#HVKIEXJEH7UO4CC5VEAN0FTBHCO86YF9GD2U_#F81KKWC9P#BSI
BUGLWQ_OBGWQDEQGNGMYJGQJ8UJSEPM3I2CYE5P5WV3MOOSX412E6N4OFOOP3E_A8M0PO24UQQXS6N7AFJSPJ62LDGM3XCCN07X6N0Y1FO0HQ#IKO011FE6GD72G8EG1S2#E4E2AJ0A3I230HUW
HAEF2#6CCCEZ6N_M6F9Z0EVJSDGDQ#G0N87Y5A04Z#HVKIEX6NT02UFWCBET2NC#UT2CKIEESCG9UB9CD0#QSPQMYZO_KDT22JFM3I2C_E8R8WUB1JBU02XI6NUM6JHV087WS7QGZU20WIETJKO
42FGCOOES7PG93JASUQ0MKCKHUO4CJ4QVLWGHQSMCVHUISAX01ZOPWIX2AO014M9CQ5EJDKY01TOOP3ESFA08UH550MYW9WJ4YT2ZHQ7V2JU1_SASFQYRLK0YACI5V45JDU0F_#3ZQ07227QG3#
6#0JXMKWQ_QBBCQ5ET6NHGYFOOP3EJAJFMTJGCY72P6WGJUTHSP2U2AJ043#O5J4EXGSPMUUGSN5EMKWF42B43G4QFDA0Z4UO5J412HNMMSC6P3E0GQ01UO1CCDEMFAZB1FG4K1#IS7GY4UMCQ
5ER2PWDQ#HVKIEMF9W_QEO5J4EP2PGMOPI#VQ02LK07MZO0WJEESCCDPFBCQDESFA0AR#HVGQ6PGLK9S#5WNB62ODK_T#5ST4EMFPGD2F0504QG9WQFTFFCY87LSPJ0ANC4VQSL2NO4ZHO7CHYI
LU0YZEOTQH02LDGMYPG50B2Z6H_M5B9ZGO62LDGMSBFRGDEMKWU4YQ9S001HSEVMUTOSCIC2LK0BQS0SKLU26RG9AVD0PQCSMN01USG5041XJ6P_Q#HVCJEX9A0BXBBCY062FKVMPFGWIDUHS7_
MM#GQK41XABK_AH_3F41IJWDG3##A00EQ2J0ITPO8KIXI5WVAAH67GQXMEOG7R#I107UV6WVAAU5S041NGUO0ZUO0HQXMKWQIZ#GSPIYXARGMTF_3VQ0EFU0YAU2OTQXENA04AB93G0T0SOJ0P#
H00JXISIG8_SMCQ5EMLO0#QQ_3V4T2E6UFQSOWPQQ2KQO8QSOVQK6ISSJ4OIOWUQ1SOWT0PV0SFQ7SSNW4ZTOPWJE_2O03UTOTCL2YJEV0AS24QH722JFMZPKCKIEQAJGMU#GVCB#2KKQ9AC2CO
06X6N0AR#HVGQ3P28GM3I2CI05H6JGDAI_401UGGIGMMUHOE7UHSPQMYFO8KJXMFWV3Q#9OUJEJ6S0#MZGCCDT29A0IUM9CNE6ISJQFTJBU0JXIJADKA#AO_QH4SWCM6PBRGHVYDWU01FBWVOEL
2O0FML2#0F2WKAUEUPBCQ5EQQWG93JFS0I2YDWN4WFO5J46ISOY0QUO_QH1MFCUM_GO4RHYR8WY3UD5CKQURBK_M6JHV0CC2ODQ7Q#5SCH72AWC8AB90P4EEF901QF9CV7U24DCDY#CT04BMKPG
9OFOWPQ7LAO0E#PHCY7YG9WYY2#03G07I5WHA1#HVGQRPAOUM_GO4QK#WSHK6Q#AWP4EMS6OM2POVCF30SI_MPF_3055M6JFM2POODI2V3AFMUOO5J4EIPMW42JHS0IURKA0AR#AST4EXJ6PC4J
9CGNYWLAP_Q#HVCJEMSJG2XF050CC2L6N0ZUGCKQ6LGQN#AC2CKDSEH6D7Q#CT035EOEP2ABO4KDWP6WUF1P8S0072LDGM#S24GD72EKO0ZUOOP3E06P04AG2SNQ7L2P04AO27GHE_2O0YAHFSC
JUVS6TFUTHCV7QRSJQIAX5SPQALAHGM3I2CNE9IDU0HMM9S_Q7I6IUM6JHV0LQTGQTMMSC6P3EQ6WC9P#HVGQ0IJEF4MOO4WDEWLNK6QTO5J4EYHLGDATI3H0SISKHM3I2CKC3IFAVDMC9S052P
A6I0AP3COOEXJAGEABBR018XS601QXO4VHQ0SCN0MNGCUJUEDWK93PO5J4EMFJGDAT_#EJ8EJU04AU53QMEQQOG7R#10YDEEEKP2AU5S0JQPDWIDMTGCDOEX9A0F1J0YN81KSOVDQBACCDT22O0
4AM6S02#SKA0F_#HVGQUEJPJMM#HVQK6EF90GZLB0YDETD6PF2#_3GQ1SLEE0P##A0CU2ODG9AJOVG052LDGMNVNB0EV2LDGMXJH5N4E_GNN#ABA0P6EX9A0E3B9YUQQR5WID_XOTCCYPA6TM6J
HV0JXIS8QGZU9SUIEMF9GEOS6PC1#ISBQDYTO0HQ7L6WK92F05UQQR5WH7UFGCV7URSE01QF9CV7U2HNGEQO0S0EV2LDGMMMAWI770SSJAAGC3O4T2MO04Z#5WUQ2_FWK8MH2CCDT2LDGMNS2OV
7ES7WV3MUO6P89IJOC7AMC7GQALA8JMNF_3UQQR5WUG2U_WPIEYKWCEAJHCHB2ELO0Y1PI#FQ8WSEPMMOOSV45RAP_M_GOPN86WS6P#AU5SPQ00SBT4QO1CY7URS9CDWO24UQ2Z6NUB1F_RUQ00
SA_02#_#FQXI2RG9ABBR04QVLD0EQFACVEEHOAN7AJBCOOEWGQNMMO1CC16SJ7043TO1QMUVSHK6Q#HVGQVSJI0AR#_CD4#SNAFMYJG5T46WSPJ0Z#6CQ57IFWV3UO8CY87LSHQ9SJBU0EX2OKW
7P#6CEE8P5WF02DFWD4EX9AU0ADC#E43XAKPEADC6N3EMELT02TO6RE12H6R01#_ZNQ7L2P042#9WX81KSOQMRV9Z001HSSCDY#KWV7YRSIGM3I_50872EEI33##S0JXISIKD1PFCQ5EQQWUA4M
OOUQ00SOQGX#640JXISIKD1PFCQ5EX9A04ZG6#KJU28KFM_#AA055M6JFMACI50872AO0F_PO_W2X27KTMYZO4VHUR8PJMAJO4KD_2MJF01#HVGQAIACJFAP3CV7U2KLN0ZEC6TQ2JSPJ02FO7K
IYSFO0MYBMC3UE2AWM9_XO#QJE_9AV3QSO4QCU25AE0UU36NQ6TANKF2#5OWD72LDKEATD0VQ2VSSJ03I2308723A0FTFO8CH024AN02U6ONQVEF8_MUOO__Q2_FWJ0MSHCY7YG9WOYWFGCGLUV
QPJ4ZHOOTE8R5WO0AT2SOQ#MCA0BMS_RKIU2AJ011PB50EV2LDGMTPI4GQYWS601_VB5C812S601_VB5C812LK0ITJ0V08EEEWDA4O1CDOEES8JY1NOZKAU2EANG2JBO001HSDGDAT64V45WS9G
EOFBRKDW22WI0ZU9S0I#SHA0K_VOQQCU2LK0YZ#_3E7E_9AT0ATC_GQ7_6JVKATHSRIEPGSGDAEC8PQAELATM_GO5J4EGDACDQTHCEHCWL6NMSVGVGIEJJKOM3I2CO05FDA0D_D8CV7U2F6TD_X
O8CB#2ODK_T#2#EB2W6O043#_PQLU2LDGM3B9Z0J5I6O0ITJ0V041GANE7Q#HVGQ6TGP0YZEO5J4EGGKN9QTGCQ5EX9A0BXB0S087W6HHMAFJSTO7LAJIMUNDOTJ622WR7QBGOPJEFMP0E4C9WO
4EMELT02T60PQ1SLWCMPBMCR06W6O0AZ#KVK2X2AWFAAOC50I3IF90YZ#50WHEX9AT0AU5S0O2YFCO8MJ1SPIEGGIGMRSC_0JXISPQIZ#H005UX4D0IMU230QYRFKE0ZUOOP3ER68GE2BFA040T
DK_8QOHCCDT27KT8QS9A0JXISKE_4Q_5KE12GB0FTFORCKWLLATEAP3CM81KKWCEAJO5CAU2EU0DQTHCV7UV6WV3Q#6RG0ES7WV3Q#CZFQ3ELNKY1D5ONQ#M7A042#_8CAUR690Y1PI#FQ0ISE0
EQFO5J402GQTM_M1CCDSIKPQD2#50YQ7L6U01_SASFQ7L6ETMRS6SP36LALUMMO1CEE1XJ6EFQEOONBYEF8GEABHCV7U27KW93B6#0IYH6WC9P#6CH4UPSDQIAGC6PJQMFO0YZEO4VHUEEO0IQS
```

2. Cryptanalysis of Ciphertext #1:

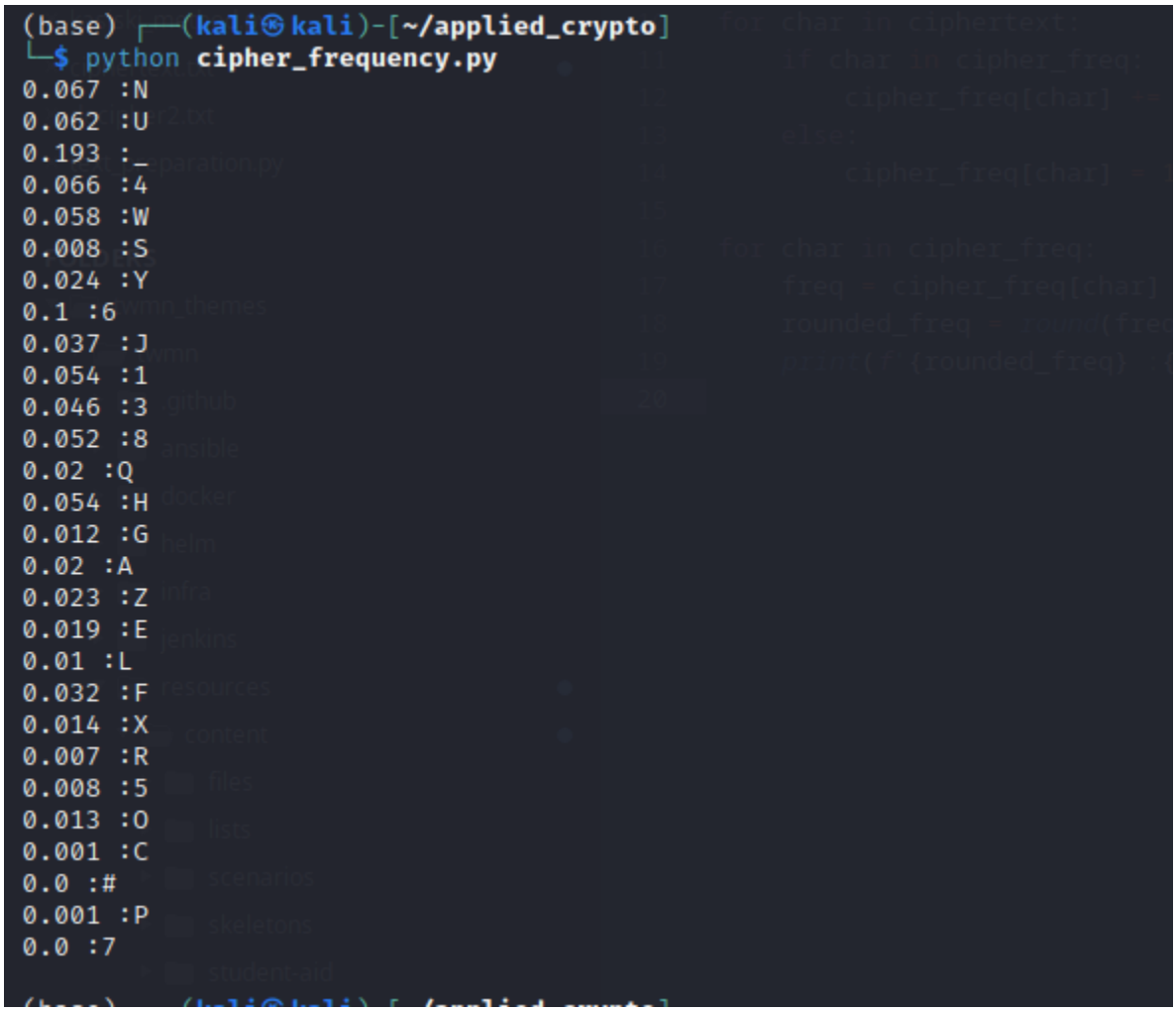
First of all, I had to write a python script to count the frequency of each character in the ciphertext.



This python script reads the contents of the ciphertext file No. 1 and calculates the frequency of each character in the ciphertext.

- First it checks if the current character already exists in the dictionary "cipher_freq".
- If the character exists in the dictionary, its value (the frequency count) is incremented by 1.
- If the character does not exist in the dictionary, a new entry is added with the character as the key and its frequency count set to 1.

The output of it look like this:



According to the frequency of English characters, there are a lot in common.

A	0.072	J	0.001	S	0.056
B	0.013	K	0.007	T	0.080
C	0.024	L	0.035	U	0.024
D	0.037	M	0.021	V	0.009
E	**0.112**	N	0.059	W	0.021
F	0.020	O	0.066	X	0.001
G	0.018	P	0.017	Y	0.017
H	0.054	Q	0.001	Z	0.001
I	0.061	R	0.053	_	**0.120**

For example, the character "_" in the ciphertext, might probably be the space.

So I wrote another Python script that reads the content of the Ciphertext 1, and replaces specific characters in the ciphertext with other characters, and then writes the deciphered text to a file.

And it looks like this:

```python
import sys
import string
import collections

# python cipher_replace.py [CipherText]

# Ciphertext
with open('cipher1.txt', 'r') as f:
    ciphertext = f.read()

ciphertext = ciphertext.replace('_', ' ')
ciphertext = ciphertext.replace('N', 'T')
ciphertext = ciphertext.replace('A', 'M')
ciphertext = ciphertext.replace('S', 'K')
ciphertext = ciphertext.replace('W', 'S')
ciphertext = ciphertext.replace('Y', 'W')
ciphertext = ciphertext.replace('G', 'Y')
ciphertext = ciphertext.replace('Q', 'G')
ciphertext = ciphertext.replace('X', 'B')
ciphertext = ciphertext.replace('P', 'X')
ciphertext = ciphertext.replace('L', 'P')
ciphertext = ciphertext.replace('C', 'Q')
ciphertext = ciphertext.replace('O', 'C')
ciphertext = ciphertext.replace('5', 'V')
ciphertext = ciphertext.replace('4', 'A')
ciphertext = ciphertext.replace('8', 'I')
ciphertext = ciphertext.replace('F', 'D')
ciphertext = ciphertext.replace('1', 'N')
ciphertext = ciphertext.replace('Z', 'F')
ciphertext = ciphertext.replace('3', 'R')
ciphertext = ciphertext.replace('7', 'Z')
ciphertext = ciphertext.replace('U', 'O')
ciphertext = ciphertext.replace('E', 'U')
ciphertext = ciphertext.replace('6', 'E')
ciphertext = ciphertext.replace('J', 'L')
ciphertext = ciphertext.replace('#', 'J')

with open('decipher1.txt', 'w') as f:
    f.write(ciphertext)
```

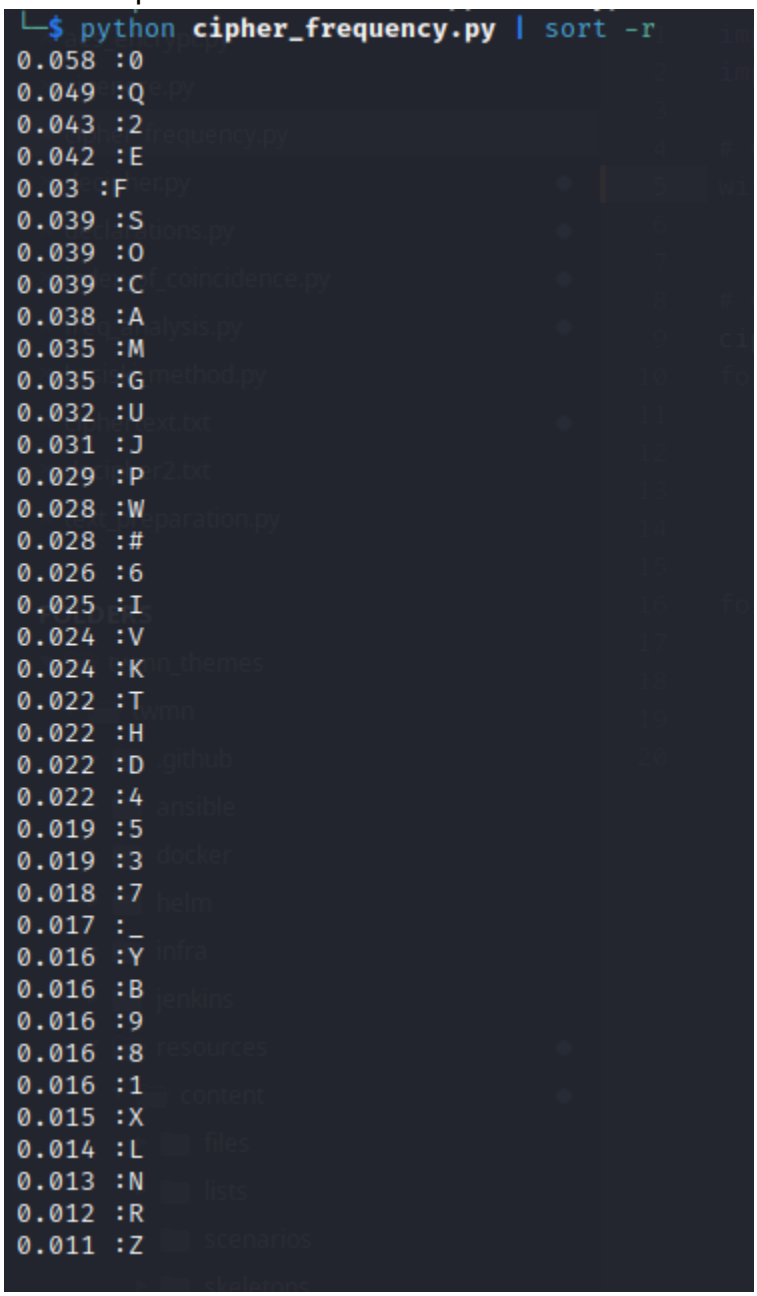
Finally, after executing this Python script we have the deciphered text:

```
TO ASK WELL TO ANSWER RIGHTLY ARE THE MARKS OF A WISE MAN MEN MUST SPEAK OF MENS DEEDS WHAT HAPPENS MAY NOT BE HIDDENRWISE IS HE NOT WHO IS NEVER SILENT MOUTHING
MEANINGLESS WORDS A GLIB TONGUE THAT GOES ON CHATTERING SINGS TO ITS OWN HARMRA MAN AMONG FRIENDS SHOULD NOT MOCK ANOTHER MANY BELIEVE THE MAN WHO IS NOT QUESTIONED
TO KNOW MUCH AND SO HE ESCAPES THEIR SCORN AN EARLY MEAL A MAN SHOULD TAKE BEFORE HE VISITS FRIENDS LEST WHEN HE GETS THERE HE GO HUNGRY AFRAID TO ASK FOR FOODRTHE
FASTEST FRIENDS MAY FALL OUT WHEN THEY SIT AT THE BANQUETBOARD IT IS AND SHALL BE A SHAMEFUL THING WHEN GUEST QUARRELS WITH GUESTRTHE WISE GUEST HAS HIS WAY OF
DEALING WITH THOSE WHO TAUNT HIM AT TABLE HE SMILES THROUGH THE MEAL NOT SEEMING TO HEAR THE TWADDLE TALKED BY HIS FOESRTHE TACTFUL GUEST WILL TAKE HIS LEAVE EARLY
NOT LINGER LONG HE STARTS TO STINK WHO OUTSTAYS HIS WELCOME IN A HALL THAT IS NOT HIS OWNRA SMALL HUT OF ONE S OWN IS BETTER A MAN IS HIS MASTER AT HOME A COUPLE OF
GOATS AND A CORDED ROOF STILL ARE BETTER THAN BEGGINGRA SMALL HUT OF ONES OWN IS BETTER A MAN IS HIS MASTER AT HOME HIS HEART BLEEDS IN THE BEGGAR WHO MUST ASK AT
EACH MEAL FOR MEATRA WAYFARER SHOULD NOT WALK UNARMED BUT HAVE HIS WEAPONS TO HAND HE KNOWS NOT WHEN HE MAY NEED A SPEAR OR WHAT MENACE MEET ON THE ROADRNO MAN IS SO
GENEROUS HE WILL JIB AT ACCEPTING A GIFT IN RETURN FOR A GIFT NO MAN SO RICH THAT IT REALLY GIVES HIM PAIN TO BE REPAIDRONCE HE HAS WON WEALTH ENOUGH A MAN SHOULD NOT
CRAVE FOR MORE WHAT HE SAVES FOR FRIENDS FOES MAY TAKE HOPES ARE OFTEN LIARSRWITH PRESENTS FRIENDS SHOULD PLEASE EACH OTHER WITH A SHIELD OR A COSTLY COAT MUTUAL
GIVING MAKES FOR FRIENDSHIP SO LONG AS LIFE GOES WELL A MAN SHOULD BE LOYAL THROUGH LIFE TO FRIENDS TO THEM AND TO FRIENDS OF THEIRS BUT NEVER SHALL A MAN MAKE OFFER
OF FRIENDSHIP TO HIS FOESRA MAN SHOULD BE LOYAL THROUGH LIFE TO FRIENDS AND RETURN GIFT FOR GIFT LAUGH WHEN THEY LAUGH BUT WITH LIES REPAY A FALSE FOE WHO LIESRIF YOU
FIND A FRIEND YOU FULLY TRUST AND WISH FOR HIS GOODWILL EXCHANGE THOUGHTS EXCHANGE GIFTS GO OFTEN TO HIS HOUSERIF YOU DEAL WITH ANOTHER YOU DONT TRUST BUT WISH FOR
HIS GOODWILL BE FAIR IN SPEECH BUT FALSE IN THOUGHT AND GIVE HIM LIE FOR LIEREVEN WITH ONE YOU ILLTRUST AND DOUBT WHAT HE MEANS TO DO FALSE WORDS WITH FAIR SMILES MAY
GET YOU THE GIFT YOU DESIRERTO A FALSE FRIEND THE FOOTPATH WINDS THOUGH HIS HOUSE BE ON THE HIGHWAY TO A SURE FRIEND THERE IS A SHORT CUT THOUGH HE LIVE A LONG WAY
OFFRHOTTER THAN FIRE AMONG FALSE HEARTS BURNS FRIENDSHIP FOR FIVE DAYS BUT SUDDENLY SLACKENS WHEN THE SIXTH DAWNS FEEBLE THEIR FRIENDSHIP THENRTHE GENEROUS AND BOLD
HAVE THE BEST LIVES ARE SELDOM BESET BY CARES BUT THE BASE MAN SEES BOGIES EVERYWHERE AND THE MISER PINES FOR PRESENTSRTHE YOUNG FIR THAT FALLS AND ROTS HAVING
NEITHER NEEDLES NOR BARK SO IS THE FATE OF THE FRIENDLESS MAN WHY SHOULD HE LIVE LONGRLITTLE A SANDGRAIN LITTLE A DEW DROP LITTLE THE MINDS OF MEN ALL MEN ARE NOT
EQUAL IN WISDOM THE HALFWISE ARE EVERYWHERERIT IS BEST FOR MAN TO BE MIDDLEWISE NOT OVER CUNNING AND CLEVER THE FAIREST LIFE IS LED BY THOSE WHO ARE DEFT AT ALL THEY
DO IT IS BEST FOR MAN TO BE MIDDLEWISE NOT OVER CUNNING AND CLEVER NO MAN IS ABLE TO KNOW HIS FUTURE SO LET HIM SLEEP IN PEACERIT IS BEST FOR MAN TO BE MIDDLEWISE NOT
OVER CUNNING AND CLEVER THE LEARNED MAN WHOSE LORE IS DEEP IS SELDOM HAPPY AT HEARTRBRAND KINDLES BRAND TILL THEY BURN OUT FLAME IS QUICKENED BY FLAME ONE MAN FROM
ANOTHER IS KNOWN BY HIS SPEECH THE SIMPLETON BY HIS SILENCE EARLY SHALL HE RISE WHO HAS DESIGNS ON ANOTHERS LAND OR LIFE HIS PREY ESCAPES THE PRONE WOLF THE SLEEPER
IS SELDOM VICTORIOUSREARLY SHALL HE RISE WHO RULES FEW SERVANTS AND SET TO WORK AT ONCE MUCH IS LOST BY THE LATE SLEEPER WEALTH IS WON BY THE SWIFTRA MAN SHOULD KNOW
HOW MANY LOGS AND STRIPS OF BARK FROM THE BIRCH TO STOCK IN AUTUMN THAT HE MAY HAVE ENOUGH WOOD FOR HIS WINTER FIRESRWASHED AND FED ONE MAY FARE TO THE THING THOUGH
ONES CLOTHES BE THE WORSE FOR WEAR NONE NEED BE ASHAMED OF HIS SHOES OR HOSE NOR OF THE HORSE HE OWNS ALTHOUGH NO THOROUGHBREDRAS THE EAGLE WHO COMES TO THE OCEAN
SHORE SNIFFS AND HANGS HER HEAD DUMFOUNDED IS HE WHO FINDS AT THE THING NO SUPPORTERS TO PLEAD HIS CASERIT IS SAFE TO TELL A SECRET TO ONE RISKY TO TELL IT TO TWO TO
TELL IT TO THREE IS THOUGHTLESS FOLLY EVERYONE ELSE WILL KNOWROFTEN WORDS UTTERED TO ANOTHER HAVE REAPED AN ILL HARVEST TWO BEAT ONE THE TONGUE IS HEADS BANE POCKETS
OF FUR HIDE FISTSRMODERATE AT COUNCIL SHOULD A MAN BE NOT BRUTAL AND OVER BEARING AMONG THE BOLD THE BULLY WILL FIND OTHERS AS BOLD AS HERTHESE THINGS ARE THOUGHT THE
BEST FIRE THE SIGHT OF THE SUN GOOD HEALTH WITH THE GIFT TO KEEP IT AND A LIFE THAT AVOIDS VICERNOT ALL SICK MEN ARE UTTERLY WRETCHED SOME ARE BLESSED WITH SONS SOME
WITH FRIENDS SOME WITH RICHES SOME WITH WORTHY WORKSRTHE HALT CAN MANAGE A HORSE THE HANDLESS A FLOCK THE DEAF BE A DOUGHTY FIGHTER TO BE BLIND IS BETTER THAN TO BURN
ON A PYRE THERE IS NOTHING THE DEAD CAN DORIT IS ALWAYS BETTER TO BE ALIVE THE LIVING CAN KEEP A COW FIRE I SAW WARMING A WEALTHY MAN WITH A COLD CORPSE AT HIS DOORRA
SON IS A BLESSING THOUGH BORN LATE TO A FATHER NO LONGER ALIVE STONES WOULD SELDOM STAND BY THE HIGHWAY IF SONS DID NOT SET THEM THERERHE WELCOMES THE NIGHT WHO HAS
ENOUGH PROVISIONS SHORT ARE THE SAILS OF A SHIP DANGEROUS THE DARK IN AUTUMN THE WIND MAY VEER WITHIN FIVE DAYS AND MANY TIMES IN A MONTHRTHE HALF WIT DOES NOT KNOW
THAT GOLD MAKES APES OF MANY MEN ONE IS RICH ONE IS POOR THERE IS NO BLAME IN THATRCATTLE DIE KINDRED DIE EVERY MAN IS MORTAL BUT THE GOOD NAME NEVER DIES OF ONE WHO
HAS DONE WELLRCATTLE DIE KINDRED DIE EVERY MAN IS MORTAL BUT I KNOW ONE THING THAT NEVER DIES THE GLORY OF THE GREAT DEADRFIELDS AND FLOCKS HAD FITJUNGS SONS WHO NOW
CARRY BEGGING BOWLS WEALTH MAY VANISH IN THE WINK OF AN EYE GOLD IS THE FALSEST OF FRIENDSRIN THE FOOL WHO ACQUIRES CATTLE AND LANDS OR WINS A WOMANS LOVE HIS WISDOM
WANES WITH HIS WAXING PRIDE HE SINKS FROM SENSE TO CONCEITRNOW IS ANSWERED WHAT YOU ASK OF THE RUNES GRAVEN BY THE GODS MADE BY THE ALL FATHER SENT BY THE POWERFUL
SAGE LT IS BEST FOR MAN TO REMAIN SILENTRFOR THESE THINGS GIVE THANKS AT NIGHTFALL THE DAY GONE A GUTTERED TORCH A SWORD TESTED THE TROTH OF A MAID ICE CROSSED ALE
DRUNKRHEW WOOD IN WINDTIME IN FINE WEATHER SAIL TELL IN THE NIGHTTIME TALES TO HOUSEGIRLS FOR TOO MANY EYES ARE OPEN BY DAY FROM A SHIP EXPECT SPEED FROM A SHIELD
COVER KEENNESS FROM A SWORD BUT A KISS FROM A GIRLRDRINK ALE BY THE HEARTH OVER ICE GLIDE BUY A STAINED SWORD BUY A STARVING MARE TO FATTEN AT HOME AND FATTEN THE
WATCHDOGRTRUST NOT AN ACRE EARLY SOWN NOR PRAISE A SON TOO SOON WEATHER RULES THE ACRE WIT THE SON BOTH ARE EXPOSED TO PERILRA SNAPPING BOW A BURNING FLAME A GRINNING
WOLF A GRUNTING BOAR A RAUCOUS CROW A ROOTLESS TREE A BREAKING WAVE A BOILING KETTLE A FLYING ARROW AN EBBING TIDE A COILED ADDER THE ICE OF A NIGHT A BRIDES BED TALK
A BROAD SWORD A BEARS PLAY A PRINCE S CHILDREN A WITCH S WELCOME THE WIT OF A SLAVE A SICK CALF A CORPSE STILL FRESH A BROTHERS KILLER ENCOUNTERED UPON THE HIGHWAY A
HOUSE HALFBURNED A RACING STALLION WHO HAS WRENCHED A LEG ARE NEVER SAFE LET NO MAN TRUST THEMRNO MAN SHOULD TRUST A MAIDENS WORDS NOR WHAT A WOMAN SPEAKS SPUN ON A
WHEEL WERE WOMENS HEARTS IN THEIR BREASTS WAS IMPLANTED CAPRICERTO LOVE A WOMAN WHOSE WAYS ARE FALSE IS LIKE SLEDDING OVER SLIPPERY ICE WITH UNSHOD HORSES OUT OF
CONTROL BADLY TRAINED TWOYEAROLDS OR DRIFTING RUDDERLESS ON A ROUGH SEA OR CATCHING A REINDEER WITH A CRIPPLED HAND ON A THAWING HILLSIDE THINK NOT TO DO ITRNAKED I
MAY SPEAK NOW FOR I KNOW BOTH MEN ARE TREACHEROUS TOO FAIREST WE SPEAK WHEN FALSEST WE THINK MANY A MAID IS DECEIVEDRGALLANTLY SHALL HE SPEAK AND GIFTS BRING WHO
```

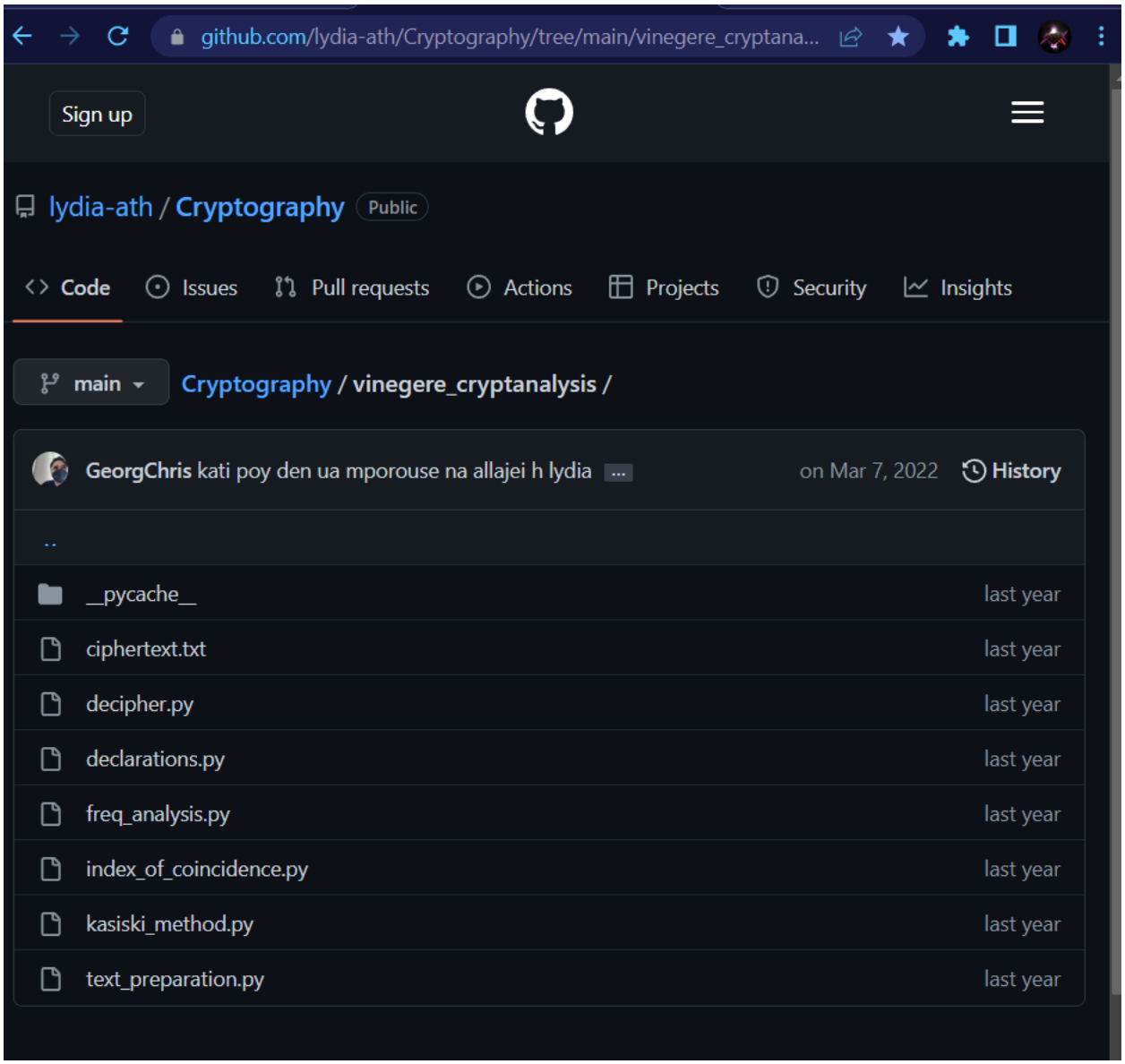
3. Ciphertext #2

Having a first look at the 2nd ciphertext, we notice that all characters are shuffled randomly. In addition, the frequency analysis of the second ciphertext had a lot of characters which frequencies were in common with other characters.

For example:



I searched for decoders on Github, but unfortunately most of them weren't for polyalphabetic ciphertext. Nevertheless, I found an implementation for the Vigenere Cipher, and I adjusted it to run for multiple characters and numbers.
https://github.com/lydia-ath/Cryptography/tree/main/vinegere_cryptanalysis



```python
# Defaults
SEQ_LEN = 7

# Maximum size of the key has to be up to 8
MAX_KEY_LENGTH = 18

EN_INDEX_OF_COINCIDENCE = 0.065
# Map with letters corresponding indexes
# The letters are the keys and the values are the frequencies
# These numbers are the standard frequencies of the letters of the english alphabet
EN_FREQ = {'0':0.00001, '1':0.00001, '2':0.00001, '3':0.00001, '4':0.00001, '5':0.00001, '6':0.00001, '7':0.00001, '8':0.00001,
'9':0.00001, 'A': 0.08167, 'B': 0.01492, 'C': 0.02782, 'D': 0.04253, 'E': 0.12702, 'F': 0.02228, 'G': 0.02015, 'H': 0.06094,
'I': 0.06966, 'J': 0.00153, 'K': 0.00772, 'L': 0.04025, 'M': 0.02406, 'N': 0.06749,'O': 0.07507, 'P': 0.01929, 'Q': 0.00095,
'R': 0.05987, 'S': 0.06327, 'T': 0.09056, 'U': 0.02758,'V': 0.00978, 'W': 0.02360, 'X': 0.00150, 'Y': 0.01974, 'Z': 0.00074,
'_': 0.12000, '#': 0.00010}

```

I changed the declarations and I included the rest of the numbers and characters in the table.

And then I adjust the index_of_coincidence.py file and freq_analysis.py file to run under this “new” alphabet.

```python
import text_preparation

from declarations import EN_FREQ
import string

#This function counts how many times appears each letter of the alphabet in the ciphertext
def getLetterCounts(text):
    #ciphertext
    text_upper = text.upper()
    #letter counter
    letter_counts_array = {}
    alphabet = "0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ_#"
    for index, letter in enumerate(alphabet):
        letter_counts_array[letter] = text_upper.count(letter)

    return letter_counts_array

#This function calculates the frequency of each character found in the ciphertext
def letterFrequencies(text):
    letter_counts = getLetterCounts(text)

    #for each key=letter and value=count compute the frequency of each letter
    frequencies = {letter: count/len(text) for letter, count in letter_counts.items()}

    return frequencies

#Makes right shift of the ciphertext
def shift(text, amount):

    letters = "0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ_#"
    shifted = ''
    for letter in text:
        shifted += letters[(letters.index(letter)-amount) % len(letters)]
    return shifted

# Correlation function
def correlation(text, lf):
    return sum([(lf[letter]*EN_FREQ[letter]) for letter in text])

# This function calculates each letter of the ciphertext's key
def find_letter_key(text, lf):

```

```python
import text_preparation
import freq_analysis as freq

import string
from sys import maxsize
from declarations import EN_INDEX_OF_COINCIDENCE

# Index of concidence method
def index_of_coincidence(letter_counts):
    alphabet = "0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ_#"
    numerator = sum([letter_counts[l]*(letter_counts[l]-1) for l in alphabet])
    text_size = sum(occurrences for occurrences in letter_counts.values())
    denominator = text_size*(text_size-1)
    return numerator/denominator

# this method attempts to find the length of the key
def find_key_length(cyphertext, max_key_len):
    min_diff = maxsize
    key_len = 0
    for candidate_length in range(1, max_key_len + 1):
        groups, last_group = text_preparation.get_blocks(text=cyphertext, size=candidate_length)
        columns, last_column = text_preparation.get_columns(groups, last_group)
        ics = [index_of_coincidence(letter_counts=freq.getLetterCounts(text=column)) for column in columns]
        delta_bar_ic = sum(ics) / len(ics)
        if EN_INDEX_OF_COINCIDENCE-delta_bar_ic < min_diff:
            min_diff = EN_INDEX_OF_COINCIDENCE-delta_bar_ic
            key_len = candidate_length

        #print results
        print('The length of the key is : ' + str(candidate_length) + '\n')
        print('Index of Coincidence by column: '+str(ics))
        print('Index of Coincidence delta bar: '+str(delta_bar_ic)+'\n')

    return key_len
```

After the execution of this programme we had the key of this Vigenere cipher.
Chosen key length: 12
Restored key: OC1QE2SG4UY2

Then, I wrote a script to shift characters, using the key.

```
import string
import random

vals =  {'0': 0, '1': 1, '2': 2, '3': 3, '4': 4, '5': 5, '6': 6, '7': 7, '8': 8, '9': 9, 'A': 10, 'B': 11, 'C': 12, 'D': 13, 'E': 14, 'F': 15, 'G':
nums =  {0: '0', 1: '1', 2: '2', 3: '3', 4: '4', 5: '5', 6: '6', 7: '7', 8: '8', 9: '9', 10: 'A', 11: 'B', 12: 'C', 13: 'D', 14: 'E', 15: 'F', 16: '

def letterToVal(letter):
    letter = letter.upper()
    return vals[letter]

def valToLetter(val):
    return nums[val]

def getKeyLetter(c):
    return valToLetter((min(c, key=lambda k: c[k])))

def decrypt(c, k):
    output = ''
    keyIndex = 0
    for x in c:
        output = output + valToLetter((letterToVal(x)-letterToVal(k[keyIndex]))%38)
        if keyIndex == len(k)-1:
            keyIndex = 0
        else:
            keyIndex = keyIndex+1

    return output


key = input("ENter the key: ")
with open("cipher2.txt", "r") as f:
    ciphertext = f.read()
ciphertext = ciphertext.replace("\t", "")
plaintext = decrypt(ciphertext, key)
plaintext = plaintext.replace("_", " ")
plaintext = plaintext.replace("#", "\n")


with open("decipher2.txt", "w") as f:
    f.write(plaintext)
```

So the script reads the Ciphertext No. 2, and the user is prompted to enter the key for decryption. The decrypted plaintext is then written to a file. The decryption process involves subtracting the value of each letter in the key from the value of each letter in the ciphertext, modulo 38 (the number of valid characters). The result is then mapped back to the corresponding letter using a dictionary named nums. The character '_' in the ciphertext is replaced with a space character and the character ‘#’ replaced with a new line, in the resulting plaintext.

Finally, I had the plaintext of the second ciphertext:

```
0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ
HOW HAPPY I AM THAT I AM GONE MY DEAR FRIEND WHAT A THING IS THE HEART OF MAN TO LEAVE YOU FROM WHOM I HAVE BEEN INSEPARABLE WHOM I LOVE SO DEARLY
AND YET TO FEEL HAPPY I KNOW YOU WILL FORGIVE ME HAVE NOT OTHER ATTACHMENTS BEEN SPECIALLY APPOINTED BY FATE TO TORMENT A HEAD LIKE MINE POOR
LEONORA AND YET I WAS NOT TO BLAME WAS IT MY FAULT THAT WHILST THE PECULIAR CHARMS OF HER SISTER AFFORDED ME AN AGREEABLE ENTERTAINMENT A PASSION
FOR ME WAS ENGENDERED IN HER FEEBLE HEART AND YET AM I WHOLLY BLAMELESS DID I NOT ENCOURAGE HER EMOTIONS DID I NOT FEEL CHARMED AT THOSE TRULY
GENUINE EXPRESSIONS OF NATURE WHICH THOUGH BUT LITTLE MIRTHFUL IN REALITY SO OFTEN AMUSED US DID I NOT  BUT OH WHAT IS MAN THAT HE DARES SO TO
ACCUSE HIMSELF MY DEAR FRIEND I PROMISE YOU I WILL IMPROVE I WILL NO LONGER AS HAS EVER BEEN MY HABIT CONTINUE TO RUMINATE ON EVERY PETTY VEXATION
WHICH FORTUNE MAY DISPENSE I WILL ENJOY THE PRESENT AND THE PAST SHALL BE FOR ME THE PAST NO DOUBT YOU ARE RIGHT MY BEST OF FRIENDS THERE WOULD BE
FAR LESS SUFFERING AMONGST MANKIND IF MEN  AND GOD KNOWS WHY THEY ARE SO FASHIONED  DID NOT EMPLOY THEIR IMAGINATIONS SO ASSIDUOUSLY IN RECALLING
THE MEMORY OF PAST SORROW INSTEAD OF BEARING THEIR PRESENT LOT WITH EQUANIMITY BE KIND ENOUGH TO INFORM MY MOTHER THAT I SHALL ATTEND TO HER
BUSINESS TO THE BEST OF MY ABILITY AND SHALL GIVE HER THE EARLIEST INFORMATION ABOUT IT I HAVE SEEN MY AUNT AND FIND THAT SHE IS VERY FAR FROM
BEING THE DISAGREEABLE PERSON OUR FRIENDS ALLEGE HER TO BE SHE IS A LIVELY CHEERFUL WOMAN WITH THE BEST OF HEARTS I EXPLAINED TO HER MY MOTHERS
WRONGS WITH REGARD TO THAT PART OF HER PORTION WHICH HAS BEEN WITHHELD FROM HER SHE TOLD ME THE MOTIVES AND REASONS OF HER OWN CONDUCT AND THE
TERMS ON WHICH SHE IS WILLING TO GIVE UP THE WHOLE AND TO DO MORE THAN WE HAVE ASKED IN SHORT I CANNOT WRITE FURTHER UPON THIS SUBJECT AT PRESENT
ONLY ASSURE MY MOTHER THAT ALL WILL GO ON WELL AND I HAVE AGAIN OBSERVED MY DEAR FRIEND IN THIS TRIFLING AFFAIR THAT MISUNDERSTANDINGS AND NEGLECT
OCCASION MORE MISCHIEF IN THE WORLD THAN EVEN MALICE AND WICKEDNESS AT ALL EVENTS THE TWO LATTER ARE OF LESS FREQUENT OCCURRENCE  IN OTHER
RESPECTS I AM VERY WELL OFF HERE SOLITUDE IN THIS TERRESTRIAL PARADISE IS A GENIAL BALM TO MY MIND AND THE YOUNG SPRING CHEERS WITH ITS BOUNTEOUS
PROMISES MY OFTENTIMES MISGIVING HEART EVERY TREE EVERY BUSH IS FULL OF FLOWERS AND ONE MIGHT WISH HIMSELF TRANSFORMED INTO A BUTTERFLY TO FLOAT
ABOUT IN THIS OCEAN OF PERFUME AND FIND HIS WHOLE EXISTENCE IN IT  THE TOWN ITSELF IS DISAGREEABLE BUT THEN ALL AROUND YOU FIND AN INEXPRESSIBLE
BEAUTY OF NATURE THIS INDUCED THE LATE COUNT M TO LAY OUT A GARDEN ON ONE OF THE SLOPING HILLS WHICH HERE INTERSECT EACH OTHER WITH THE MOST
CHARMING VARIETY AND FORM THE MOST LOVELY VALLEYS THE GARDEN IS SIMPLE AND IT IS EASY TO PERCEIVE EVEN UPON YOUR FIRST ENTRANCE THAT THE PLAN WAS
NOT DESIGNED BY A SCIENTIFIC GARDENER BUT BY A MAN WHO WISHED TO GIVE HIMSELF UP HERE TO THE ENJOYMENT OF HIS OWN SENSITIVE HEART MANY A TEAR HAVE
I ALREADY SHED TO THE MEMORY OF ITS DEPARTED MASTER IN A SUMMER HOUSE WHICH IS NOW REDUCED TO RUINS BUT WAS HIS FAVOURITE RESORT AND NOW IS MINE I
SHALL SOON BE MASTER OF THE PLACE THE GARDENER HAS BECOME ATTACHED TO ME WITHIN THE LAST FEW DAYS AND HE WILL LOSE NOTHING THEREBY  MAY 10  A
WONDERFUL SERENITY HAS TAKEN POSSESSION OF MY ENTIRE SOUL LIKE THESE SWEET MORNINGS OF SPRING WHICH I ENJOY WITH MY WHOLE HEART I AM ALONE AND
FEEL THE CHARM OF EXISTENCE IN THIS SPOT WHICH WAS CREATED FOR THE BLISS OF SOULS LIKE MINE I AM SO HAPPY MY DEAR FRIEND SO ABSORBED IN THE
EXQUISITE SENSE OF MERE TRANQUIL EXISTENCE THAT I NEGLECT MY TALENTS I SHOULD BE INCAPABLE OF DRAWING A SINGLE STROKE AT THE PRESENT MOMENT AND
YET I FEEL THAT I NEVER WAS A GREATER ARTIST THAN NOW WHEN WHILE THE LOVELY VALLEY TEEMS WITH VAPOUR AROUND ME AND THE MERIDIAN SUN STRIKES THE
UPPER SURFACE OF THE IMPENETRABLE FOLIAGE OF MY TREES AND BUT A FEW STRAY GLEAMS STEAL INTO THE INNER SANCTUARY I THROW MYSELF DOWN AMONG THE TALL
GRASS BY THE TRICKLING STREAM AND AS I LIE CLOSE TO THE EARTH A THOUSAND UNKNOWN PLANTS ARE NOTICED BY ME WHEN I HEAR THE BUZZ OF THE LITTLE WORLD
AMONG THE STALKS AND GROW FAMILIAR WITH THE COUNTLESS INDESCRIBABLE FORMS OF THE INSECTS AND FLIES THEN I FEEL THE PRESENCE OF THE ALMIGHTY WHO
FORMED US IN HIS OWN IMAGE AND THE BREATH OF THAT UNIVERSAL LOVE WHICH BEARS AND SUSTAINS US AS IT FLOATS AROUND US IN AN ETERNITY OF BLISS AND
THEN MY FRIEND WHEN DARKNESS OVERSPREADS MY EYES AND HEAVEN AND EARTH SEEM TO DWELL IN MY SOUL AND ABSORB ITS POWER LIKE THE FORM OF A BELOVED
MISTRESS THEN I OFTEN THINK WITH LONGING OH WOULD I COULD DESCRIBE THESE CONCEPTIONS COULD IMPRESS UPON PAPER ALL THAT IS LIVING SO FULL AND WARM
WITHIN ME THAT IT MIGHT BE THE MIRROR OF MY SOUL AS MY SOUL IS THE MIRROR OF THE INFINITE GOD O MY FRIEND  BUT IT IS TOO MUCH FOR MY STRENGTH  I
SINK UNDER THE WEIGHT OF THE SPLENDOUR OF THESE VISIONS  MAY 12  I KNOW NOT WHETHER SOME DECEITFUL SPIRITS HAUNT THIS SPOT OR WHETHER IT BE THE
WARM CELESTIAL FANCY IN MY OWN HEART WHICH MAKES EVERYTHING AROUND ME SEEM LIKE PARADISE IN FRONT OF THE HOUSE IS A FOUNTAIN  A FOUNTAIN TO WHICH
I AM BOUND BY A CHARM LIKE MELUSINA AND HER SISTERS DESCENDING A GENTLE SLOPE YOU COME TO AN ARCH WHERE SOME TWENTY STEPS LOWER DOWN WATER OF THE
CLEAREST CRYSTAL GUSHES FROM THE MARBLE ROCK THE NARROW WALL WHICH ENCLOSES IT ABOVE THE TALL TREES WHICH ENCIRCLE THE SPOT AND THE COOLNESS OF
THE PLACE ITSELF  EVERYTHING IMPARTS A PLEASANT BUT SUBLIME IMPRESSION NOT A DAY PASSES ON WHICH I DO NOT SPEND AN HOUR THERE THE YOUNG MAIDENS
COME FROM THE TOWN TO FETCH WATER  INNOCENT AND NECESSARY EMPLOYMENT AND FORMERLY THE OCCUPATION OF THE DAUGHTERS OF KINGS AS I TAKE MY REST THERE
THE IDEA OF THE OLD PATRIARCHAL LIFE IS AWAKENED AROUND ME I SEE THEM OUR OLD ANCESTORS HOW THEY FORMED THEIR FRIENDSHIPS AND CONTRACTED ALLIANCES
```