Program Studi Teknik Informatika
Sekolah Teknik Elektro dan Informatika
Institut Teknologi Bandung
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Tugas 2 IF4020 Kriptografi

Semester II Tahun 2023 / 2024

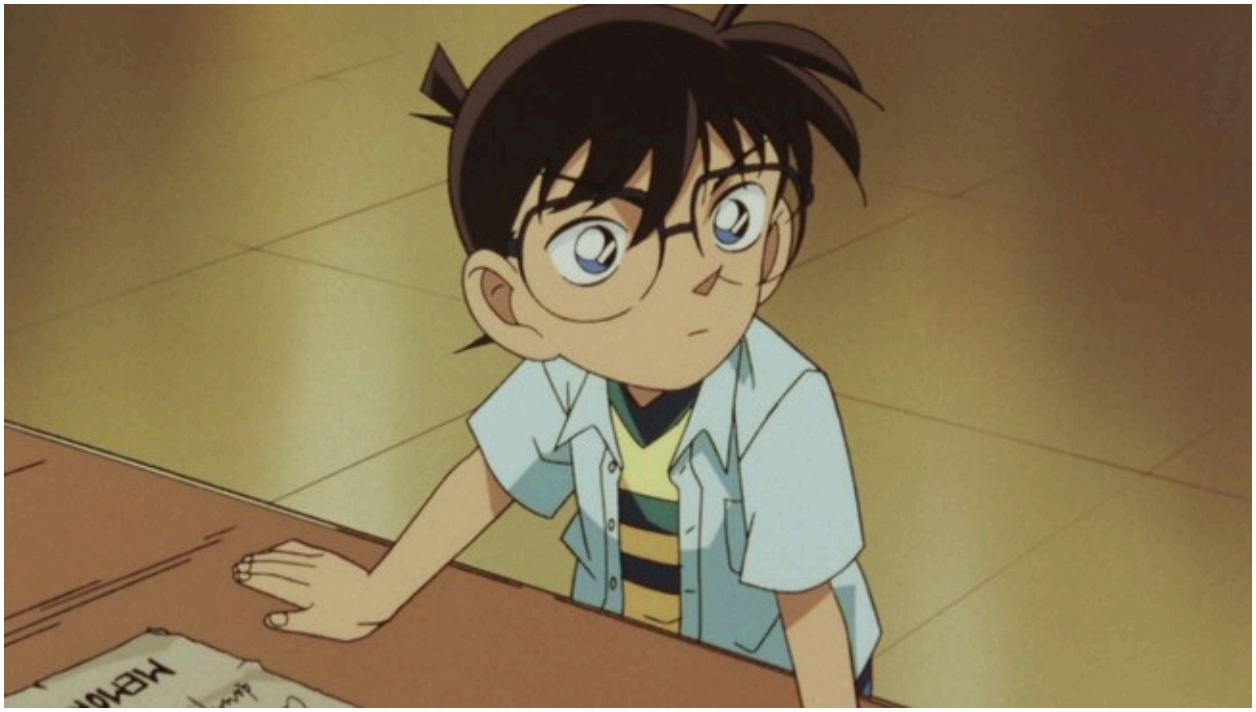
Tempat pengumpulan : https://forms.gle/RYKfZixVTNHdA8jQ8
Berkas pengumpulan : File format PDF
Anggota kelompok : 2 orang (disarankan sama dengan tugas 1)
QnA :
https://docs.google.com/spreadsheets/d/1csV5V3yBy5a8KoUETKMduP8B0gwJEff7vt31KtqzbBk/edit?usp=sharing

Yang dikumpulkan adalah: laporan sederhana yang berisi
a. Berkas cipherteks
b. Langkah-langkah yang anda lakukan dalam melakukan dekripsi
c. Plainteks hasil dekripsi

Informasi Tambahan:
Pada proses pembuatan ciphertext, plainteks diubah seluruhnya menjadi kapital. Lalu, enkripsi hanya dilakukan pada karakter abjad (A..Z). Karakter lain (angka, spasi, koma, titik, dan lain-lain) dibuang (tidak dienkripsi).

1. Kriptanalisis pada Cipher Abjad-Tunggal

Conan bersama teman-temannya, menemukan sebuah dokumen mencurigakan di tempat kejadian perkara. Mereka tertarik sebab dokumen tersebut berada dalam bentuk terenkripsi. Conan dan kawan-kawan mencoba memecahkan cipherteks tersebut. Informasi tambahan yang telah diketahui adalah dokumen tersebut aslinya dalam bahasa inggris lalu dienkripsi dengan ***cipher* substitusi abjad-tunggal** *(monoalpahtbetic cipher)*.



Bantulah Conan untuk dekripsi chiperteks tersebut menjadi plainteks semula meskipun anda tidak mengetahui kuncinya. Anda dapat menggunakan kombinasi teknik analisis frekuensi dan metode terkaan untuk mendekripsi dokumen tersebut. Anda diperbolehkan menggunakan kakas bantu (coretan kertas, aplikasi Ms Excel, kakas bantu, maupun membuat program kecil sederhana untuk menghitung frekuensi kemunculan karakter atau untuk keperluan analisis lainnya) untuk menyelesaikan masalah ini. Carilah data tabel frekuensi kemunculan huruf, bigram, dan trigram dalam Bahasa Inggris untuk membantu kriptanalisis.

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XBMVHRWROMLAHZEAHUCMRGAEXBEHXRCEALFAVEYILFORGXBMVHRWROMTECLAXUAA
HTRPYLFKBYFXZEAXBMVHROBYVZMLAXRFXEBFECTLHZHZETBLHLFORGPEAAYOEALF
AEXBEHXRCEYFCHZEXBEYHLRFRGHZEAEPEHZRCATZLWEXBMVHYFYWMALALAXRFXEB
FECTLHZBEYCLFOEFXBMVHECPEAAYOEAKMKBEYILFOAEXBEHXRCEAYFXLEFHHLPEA
AYTPYFMEDYPVWEARGXBMVHROBYVZMRNEBHZBEEHZRUAYFCMEYBAYOREOMVHLYFAX
BLKEAPYCEUAERGZLEBROWMVZLXHBYFAGRBPYHLRFAHRRKAXUBEHZEPEYFLFORGTB
LHHEFPEAAYOEAPEARVRHYPLYFYFCKYKMWRFLYFAXBLKEAEPVWRMECALPLWYBHEXZ
FLQUEAHRBEFCEBXUFELGRBPHYKWEHAUFBEYCYKWEHRHZEUFLFLHLYHECHZEOBEEI
AEPVWRMECXBMVHROBYVZMYFCHZEXWRAEWMBEWYHECAHEOYFROBYVZMTZLXZLAXRF
XEBFECTLHZXRFXEYWLFOHZEEDLAHEFXERGXRPPUFLXYHLRFBYHZEBHZYFXRFHEFH
GRBPLWLHYBMYFCHYXHLXYWVUBVRAEAENEFHZEIYPYAUHBYRGYFXLEFHLFCLYHRUX
ZEARFXBMVHROBYVZMWLAHLFOAEXBEHTBLHLFOYARFERGHZEALDHMGRUBGUFCYPEF
HYWYBHAZUFCBECARGRHZEBEDYPVWEARXXUBLFYFXLEFHXLNLWLSYHLRFALFAZRBH
XBMVHROBYVZMZYAYVVEYBECPRBERBWEAAAVRFHYFERUAWMLFENEBMXUWHUBELFTZ
LXZWLHEBYXMZYAKEXRPETLCEAVBEYCXBMVHYFYWMALARFHZERHZEBZYFCHRRIXRF
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ALCEBYKWMWRFOEBHRCENEWRVYAYBLORBRUAAUKJEXHRGAHUCMHZEEYBWLEAHAUBN
LNLFOCEAXBLVHLRFARGAMAHEPYHLXPEHZRCARGXRCEKBEYILFOXRPEGBRPGLGHEE
FHZXEFHUBMLFHZEYBYKLXEFXMXWRVECLYAUKZYWYAZYLHOLNEAHZEGLBAHIFRTFT
BLHHEFCEAXBLVHLRFRGHZEHEXZFLQUERGGBEQUEFXMYFYWMALATZEBEHZEGBEQUE
FXLEARGWEHHEBAYFCWEHHEBOBRUVLFOARGYWYFOUYOEYBEUAECHRUFBYNEWAEXBE
HXRCEAXBMVHRWROMZYAVWYMECYBRWELFVRWLHLXYWYFCPLWLHYBMPYHHEBAGBRPP
ECLENYWHLPEAHZBRUOZHZEXEFHUBMVEBZYVAPRAHGYPRUALAHZEXBMVHRWROLXEG
GRBHRGOBEYHKBLHYLFYFCHZEUFLHECAHYHEACUBLFOTRBWCTYBLLHZEEGGRBHARG
HZLBHMHZRUAYFCEPVWRMEEAYHKBLHYLFAKWEHXZWEMVYBILFXBMVHYFYWMSLFOOE
BPYFMAEFLOPYHBYFAPLAALRFALAAYLCHRZYNEAZRBHEFECHZETYBKMAENEBYWMEY
BAYFCLHWECHRHZECENEWRVPEFHRGHZEGLBAHCLOLHYWXRPVUHEBXRWRAAUAALPLW
YBEGGRBHALFHZEUFLHECAHYHEAHRKBEYIJYVYFEAEXRCEAYLCECYPEBLXYFLFHEW
WLOEFXELFHZETYBXRFNLFXLFOYPEBLXYFYUHZRBLHLEARGHZELPVRBHYFXERGXBM
VHRWROLXEDVEBHLAEYFCENEFHUYWWMWEYCLFOHRHZEEAHYKWLAZPEFHRGHZEFYHL
RFYWAEXUBLHMYOEFXMLFTLHZHZEBLAERGCLOLHYWXRPVUHEBFEHTRBIALFHZEAEX
UBLFOXRPPUFLXYHLRFKEXYPEYFLFXBEYALFOWMLPVRBHYFHHYAILFHZEVBLNYHEA
EXHRBYATEWWHZEFEECARGHZEKYFILFOLFCUAHBMLFVYBHLXUWYBGRBAEXUBECLOL
HYWXRPPUFLXYHLRFKEXYPEEAVEXLYWWMUBOEFHCENEWRVPEFHAYHLKPWECHRHZEC
EALOFRGWUXLGEBRFERGHZEGLBAHVUKWLXXLVZEBAGRBXRPVUHEBXRPPUFLXYHLRF
AHZEFYHLRFYWAEXUBLHMYOEFXMRGGEBECAENEBYWLPVBRNEPEFHAHRWUXLGEBYFC
LFHZEFYHLRFYWKUBEYURGAHYFCYBCAVBEAEFHECHZEPRCLGLECNEBALRFYAHZECY
HYEFXBMVHLRFAHYFCYBCRBCEAHZUAHZEGLBAHVUKWLXAHYFCYBCGRBEFXBMVHLRF
KEOYFHROYLFTLCEAVBEYCUAEYPEHZRCRGAEXUBLFOXRPPUFLXYHLRFLAXYWWECYX
BMVHRAMAHEPHZEAEFCEBEFXBMVHARBEFXLVZEBAYPEAAYOEUALFOYFEFXBMVHLRF
YWORBLHZPHROEHZEBTLHZYAEXBEHIEMHZLAVBRCUXEAYXLVZEBHEDHTZLXZLAAEF
HHRHZEBEXLVLEFHHZEBEXLVLEFHTZRYWARVRAAEAAEAYIEMBEXELNEAHZEXLVZEB
HEDHYFCCEXBMVHARBCEXLVZEBAUALFOHZEIEMHRBEXRNEBHZERBLOLFYWPEAAYOE
XYWWECHZEVWYLFHEDHLFHZEZLAHRBMRGXBMVHRWROMUVHRYWWXBMVHRAMAHEPABE
QULBECHZEAEFCEBYFCHZEBEXELNEBHRYOBEEKEGRBEZYFCRFHZEAYPEIEMYIEMHZ
YHZYCHRKEBLORBRUAWMVBRHEXHECGBRPEDVRAUBEHRYFYCNEBAYBMHZLALAIFRTF
YAAMPPEHBLXRBAEXBEHIEMXBMVHROBYVZMYBBYFOLFOHRAZYBEYAEXBEHIEMKEHT
EEFHTRVYBHLEALARGHEFYCLGGLXUWHVBRKWEPYFCCREAFRHAXYWETEWWHRAXEFYB
LRALFTZLXZPYFMLFCLNLCUYWARBXRPVUHEBAPLOZHXRPPUFLXYHETLHZEYXZRHZE
BLFPYBHLFZEWWPYFYVBRGEAARBYHAHYFGRBCUFLNEBALHMYFCTZLHGLEWCCLGGLE
YOBYCUYHEAHUCEFHLFHBRCUXECHZEXRFXEVHRGYAMPPEHBLXRBVUKWLXIEMXBMVH
ROBYVZMLFHZELBAEPLFYWVYVEBFETCLBEXHLRFALFXBMVHROBYVZMHZEMAVEXUWY
HECHZYHYPEHZRCRGEFXBMVHLRFPLOZHEDLAHLFTZEBEHZEEFXBMVHLRFIEMCLGGE
BECGBRPHZECEXBMVHLRFIEMLFAUXZYAXZEPEYUAEBAEFXBMVHLRFIEMXRUWCKEYF
FRUFXECHRHZEVUKWLXYFMRUHALCEBXRUWCRKHYLFHZLAVUKWLXEFXBMVHLRFIEMY
FCUAELHHRAEFCEFXBMVHECPEAAYOEAHRHZEUAEBALFXERFWMHZEUAEBTRUWCVRAA
EAHZECEXBMVHLRFIEMRFWMAZEXRUWCRKHYLFHZECEXBMVHLRFRGHZEPEAAYOEVUK

WLXIEMXBMVHROBYVZMYWARRVEFECCRRBAGRBPYFMRHZEBYVVWLXYHLRFAAUXZYAC
LOLHYWALOFYHUBEAYFCEWEXHBRFLXXYAZHZEXRFXEVHRGVUKWLXIEMXBMVHROBYV
ZMXLBXUWYHECLFHZEBEAEYBXZXRPPUFLHMGRBARPEHLPEKEGRBEHZEGLBAHVBYXH
LXYWVBRVRAYWGRBAUXZYAXZEPETYAPYCELFYUOUAHHZEBAYVUKWLXIEMXBMVHRAM
AHEPFYPECYGHEBLFNEFHRBABRFBLNEAHYCLAZYPLBYFCWEFYCWEPYFTYALFHBRCU
XECLFPYBHLFOYBCFEBAXRWUPFRFPYHZEPYHLXYWOYPEALFAXLEFHLGLXYPEBLXYF
HZEBAYXBMVHRAMAHEPRUHWLFECLFAEXHLRFZYAAUBNLNECRNEBHTEFHMMEYBARGA
HUCMKMXBMVHYFYWMAHALFHZEVUKWLXAEXHRBYFCLHLAHZEPRAHTLCEWMUAECVUKW
LXIEMXBMVHRAMAHEPLFHZETRBWCLHLAUAECYPRFORHZEBVWYXEALFHZEAEHVBRHR
XRWGRBAEXUBEXBECLHXYBCHBYFAYXHLRFAYFCHZEAAWVBRHRXRWGRBAEXUBEXRPP
UFLXYHLRFRFHZELFHEBFEHVUKWLXCLAXUAALRFYFCBEAEYBXZLFXBMVHROBYVZML
FKUALFEAAYFCYXYCEPLYAHYBHECLFHZEWYAHQUYBHEBRGHZE20HZXEFHUBMYFCXR
FHLFUEAYHYGUBLRUABYHEFETPEHZRCAGRBEFXBMVHLRFYBEVUKWLXWMYFFRUFXEC
BEAEYBXZEBAHZEFAHUCMHZEAEPEHZRCAGRBTEYIFEAAEAKMYVVWMLFOHZEHRRWAR
GXBMVHYFYWMALA2RFWMYGHEBLFHEFAEVUKWLXAXBUHLFMCREAYFETXBMVHRAMAHE
POYLFYAEFAERGWEOLHLPYXMAHUCMLFOYFCUALFOPEHZRCAGRBKBEYILFOXBMVHRA
MAHEPALAYFEAAEFHLYWAHEVLFHZECENEWRVPEFHRGFETCEALOFAGRBPRBEAEXUBE
XBMVHRAMAHEPAKMWEYBFLFOZRTHZLFOAKBEYITEWEYBFZRTHRPYIEHZEPAHBRFOE
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HRRWAHRAHUCMHZEBAYVUKWLXIEMXBMVHRAMAHEPYFCAENEBYWNYBLYFHATEUAEHR
RWAGBRPFUPEBLXYWYWOEKBYYFCHZEOERPEHBMRGFUPKEBAHROEHRUBBEAUWHAYWO
EKBYLXXBMVHYFYWMALAZYAVBRNEFHRKERFERGHZEPRAHEGGEXHLNEPEHZRCALFHZ
EAHUCMRGVUKWLXIEMXBMVHRAMAHEPA

Setelah menemukan plainteksnya, carilah di Google teks tersebut berada untuk mendapatkan tanda baca di dalam teks aslinya.

2. Metode Kasiski

Kalian mendapatkan tugas penting dari detektif Kogoro Mouri, yaitu memecahkan sebuah dokumen berisi cipherteks. Dokumen tersebut berisikan sejarah tersembunyi sebuah bangunan antik yang sudah dienkripsi. Conan, yang sudah mengambil mata kuliah IF4020 Kriptografi, ingin membantu kalian memecahkan dokumen tersebut. Akan tetapi, dia dimarahi oleh Ran Mouri karena kalian perlu memecahkannya sendiri demi mendapatkan nilai pada tugas kali ini. Conan yang baik kemudian memberitahu kalian sebuah *hint*, bahwa dokumen tersebut dienkripsi dengan **Vigenere Cipher** dan ditulis menggunakan **bahasa Inggris**. Yuk pecahkan bersama Conan! Temukan terlebih dahulu kunci yang digunakan untuk mengenkripsi dengan metode **Kasiski**.

VOIVVCBAJMBLGUKWAOMDABTAPPZSECQFQWAOPKSBRCQMVOGKUIEQXDWFZSGNELRH
HBGIZSAZJLHIGMPOGZBTKHPUBFMDFARTVLWHNLTUKVRJFLXSPRVUKQUKJVSURCKT
GCYZGIEBQEVSLVFUPQYZLYVMZSPZCYIDYYBAXZNTFPRPNXLGFUNZVOEHGSUQLVRX
GDEGBXTKGBRLCJYZGILQXOPANAIWGFIZLSPNPPWQUOEQLSAYEOEDNXLAFZLUPLQO
WYZZSARRAKIOSNMQDWAMFLVKRQMZOOGKTISIJDPQWGGGDSMGUWMZLCSZJPWSAQQZ
WSEOPNWQUYWXOOFZQMYZSSTXLVRTGLHGBPBQUVAOEHPDRBAAFBRRQYIBTSVQWFFJ
WLXCGRMAMHOXGHOCSDPQXWEYVDSFYNEMJHUKHPVGGKKMVSZOEFIOEYNFZPNTFBRU
JKAGFWDAGIIQNEAQLVOGPKYBTYVXQUBZUAYRRXBESBQZYVSTGRMYSFROPKSBRCQM
FARGPDLWYOBTWFRCGYIDEYNQKGBXUHXHUOJQYWATKUKCSPWGJMRGTZPOGOZAFHJK
NCIGGELQFHFMTHHINDMPXFBSVOFOANCZYHUHCUHIAQEMKOOOLGSBQOZQKQUUQSAV
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QCSZJIEBQEVSKHHJGUXGTBIPMOGKFHWSAQQZWSEYCUHCSDPQEOEKKUHCAOAUSBGN
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JVRHGJEARDPQXWEYVWVSFSLQFHBLVOIFRZCNDWPUHPRRBXMEAOQATPRUGRMVSDNT
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OKVPMBTZGJLBVMIXUCYRGNIGRUWXSVGOPNKWGOSZAYOGPKYBTKNFWFVTFVRSFSIE
ABQKRLRRRXKQXIEZJLVABBMUFGGZDHRRHXOTSRZUXLHHBIWSQOXGTAEOFCBFTOAJ
WUKWATWSBOJNKJLZNDMDTSPGOLKOQTITEOQGWUMJRBAULMHMOVRXHXMELHOGPKYB
TMPMFURJKAWBNWMUFHBAPPZSECQFWWGBCUMBQYVQKWRAPKIFGRMOGBGXQSSTASKM
OWGNHHGIYDMULJNTVLGVASAOZSJKVLRGPRIBSBQLCJYZGOQFNOAKZHGHRGMFWBFI
JHTKUSKTOSEKGZXOOVQEZSQRCAIFNPBQJOYUPNWHBBGUFIAOXLVGVDMULJNTKUHC
AOAUWXBOPLHIASDQJGVZAVJWANWZWGVGCZJOPETFQCSKPNMBROZUFUNTFMEQHVBK
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RWQEKWBTQMHSIYBUGBGUUJMSAMMMFRGKEORCYYOKSBQHWPPRVXOMVSIKNVTSQQMZ
WFNZKVRTBBBTWTHZWYIRHBQZYHUKHPVGGNMOSRRUHALSVDJNWUNTVVJCFDMDMDNT
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ABTZJLRIZLMDGTGKCJLWAQAFSTSGPKMBPBMMKWAMVOIWECSUDZOECZWWTXQZYHUK
OASGGELKSPEUCKHIESVSLVRYGJSBQNMOSRRUHALSVDJISGZAFKPSQGQFZRVLHPGI
YDGFZOGGTVWSGYEMJRFZJLJWECBBWFVUFALSNMIPWAVIWUMHGRIFZOQHGLRTBBUQ
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VLTFBQZMEGUGFHPGBLMSMBGUUAEFGDPUKGVZWHXWBXEMKGHVRVVHRNJKLVROOWVC
IOUQFHBLVOIQBEVFJMFYQJMCCYTULWPGNHRRRMWZGAVIIYSKGRLGJWAMVOITBEZF
ZRRICKICSDPQLVRKPNMBROZUFUHTKCIFFSBKLVNZRYMCEVGAFZLNCKSBRNMBSFGS
GUXBBGWRXSEYVDIBGIAUPPNIJLPCEZZAYFNSFLTOEDUQFHFOPJPIQSVSLVRJGWEF
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GQGUTHPGGELUWGGNGZIDEYODSAFOPJPIQOBTWSYKOLRHFYNEUWRTELXSPRVADCTE
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QLGFZSRSGYKSAMMAXPRZVLVQBXKQHHFGPKMRRKARGFVZUKIJRVWBESAZRYSQRCAE
GARUHALSZSVODIQKVOEHGRMDSDVJIYSKGRWRABSUTTEHVYVRDCJOPALSAOEOWBGA
TFAWYVLQEOAJCUIRHMIFACAZJHXWFKKOWZRXCAIRGSUQDMVTVLKFNDMPKIFZCPRO
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RKVUFUSANALOGDPQHFBLKJMSAMGMFRQKXLPCCWMZLCSYEPIBPOIZVHRIJUSZBQGY
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CEZBGGRZQISCFDBTWBNZKVRGQODQDCCSGUXDYKVFZSEKHVVSVDJIAZYJGCIZBZQF
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ASEBQCMMSBQGGYSGCKKQLFNTUWSFGKBUGBRTXPVCAWMZLOAJDPSHRMPZGZBMAHRR
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MWYJDBWWAOAEABFOIOXGVXBAABQKRLRRRXKQOVVIJPWHUOQZAHVGNJEDVDIXXCEZ
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RXKQAGQOTLGHRNBAJSNIJHGHVYVMTZRGEOMSIOUQFHNTFALSQEBKGTRJWJEHVYVM
FRNICKIAVMIEZWTNCZTCFCQNDSGNCAXVRNMHWZBVOLRHBPQFTKVRNIIPNCMPGBGN
GZXFRXOFZGBLVOIWACBULIGOQUMBGRMRGFZUHVTHVWCYMGRUHPRTBBUMLWBTVOIA
NSVFWBNTELSTPYUBWHRTVAIOPRQZYGGGHMAWGRPUYVDACSMHLCSUDZFGPKLWTRLQ
NCGOQUMBGOODSHRJGKYQNDQAFGLYVLQOANKXGGRIQSPOOYZMLWBTYPXVTYDQJBZK

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PAMBQEAFJMEKULEFPRQZKHVZWAMCACIEOSYRCZHCZOAFAQNTFVZSECMMKSQAEHXW
BXQZKHVZWAMCACBTWRRBGSSDZOVFAGRDRLGHRNBATSZUPPXCEOLMFRZKCZYFRNAA
AHVYKUPWAOEULVGNGALFROXUDZNXUVJVVQPQJSQAEHXWBXLQNSYURTIBGYNTMANT
TLWCHBKQKTNIKSMHVOAELOAJCYHOANEAJYCXQJIRHBMESGJKNSEGGRMQUCAUOPGG
BMQAUIYZWYEZNXLESTRZAKIJRVWBESAZVOEHGRMIAZYOPNRSFCBAVSIKNVTWGLQE
JSSRGJXSQLGFZSRDEPXSZOVFSBQSKUHGRDWRSZYOVIWHNUMTGZQKTZAVBKKWFCJR
GKKSGRMZSHHXGVJGPSMZLWSOEMEQGDPMLHUKUJMSADQRAQEKCSMHLMIZTSEKCJLS
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LFHZJPWHUOZUYVGUHLZSEIPGEOAHGPRUFCWFZOGYEPIBPOIZVHRIJUSZBQGOSBOK
WZIRGYQYHFBBGOYANXEQDTNXGPRHUOEAJZQKUWIQVKTXQWAOPKSBRCQMABGNGMMT
GRLQUOQKQMXVRSVELWGAVAIYAYTAYWOGPKYBTCTQYOYYVHXIFGIEKSGZQIIGGKBQ
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VHXSBGVQVIAOXLVGVDQQKKRXGZSARDPUFUHTKXYSNXLZWKOEVOIBGRQETSTGPDMH
UDPQAGFACUGSBPOANSETOLRHEOOGDOGOQURCBPWZLVRKUAEPYSATESAZQMWHNDMA
OBRJWUMJRBAULWRYCZPSTKTNGRLLQSPCJOLNQHUKKZWINXKQGTTUXLVBZOVFJSTA
NHXWBXVAGTBTVOISFDINDWFNOLRHBPQZKHVZWAXSXXWXGUVHCUHIAQIEKHNZGVAB
RNCZAJRXUPXMGRCEOWGNVOIWFCCMFQRUHALSYKBFWFEKIBPOGSWZAHONCZPSTKTX
QPRIQTIOYOOMDPBJAALWFWMMFGVZDOERGRMDAUUZVVGOEBGAMHYKIHPOPDQAFGNY
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SIKNVTARXBAXFRYGHVQUDMOZBBRQNCOANIDLGVTKUHCAOAUS
```

Setelah menemukan kuncinya, dekripsilah cipherteks di atas dengan menggunakan program Vigenere cipher standard yang telah kalian buat pada tugas 1. Editlah hasil dekripsi tersebut sehingga enak dibaca, tambahkan tanda baca yang relevan jika perlu (karena program Vigenere Cipher yang digunakan mengabaikan tanda baca).

3. Kriptanalisis *Playfair Cipher*

Ai Haibara kehilangan sebuah bagian dari novel. Rupa-rupanya, bagian novel tersebut telah dicuri oleh Profesor Hiroshi Agasa dan digunakan untuk sebuah eksperimen. Ternyata, eksperimen tersebut gagal dan justru membuat bagian novel Ai menjadi aneh. Conan yang mencintai Kriptografi kemudian menyadari bahwa novel **berbahasa Inggris** tersebut telah dienkripsi menggunakan **Playfair Cipher**. Bantulah Conan untuk mendekrip bagian novel tersebut demi Ai! Gunakanlah analisis frekuensi kemunculan bigram dalam bahasa Inggris.

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```

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HSOHZSQXKSGFDPXYEMKFYALTMKZALUGKGRPLKFAPRAGFCLQXSXHTMVNHAFAHELKW
QECLKGPSALHLHUVAOFQGHEHQNHMHFCQFCEDFCLZGAMDPLHAYXDRAGFCLQXSXHTMV
OGNFQXDHBEUATFLHHETHXHMGQMTAIPGQSAOALEQETMHMETMNZOARQEMAUKZOEXZT
ATNQHEQNXIQGOQVNALOGMHDABEHUNHMTETOMMHGZPOPAZAHALHGKLATNSHHLLPMH
ALMTWQLTMVYGFDBHETAVIGOMPKNLXAPGMPKCDFISTAAUSWSYHTFTZWZLHETHMXKP
LTPGBEPUGPLDYPELEGVSLDFULTMHNTQXCOKFWMGSEHGTMHALXAPGZLDFHEAMHVAN
LHXGFWPKEGGEUHGSEHFDHLMTEMMHXAMAGQENIOOATDUPHEAMRXLSSUXDPYPDYPXA
RALHYWHNIXETMSXGMQXHIROAEXDTTHOQVNALOGMHELMHIXHEPOKALKSUXDELXHXS
GUXDLCHLAFAEHMPGNQHEQXCXZLELGQMEAVGPELNHBEDFLXQXLHAYXDZAFKOUCNAQ
LPBEELMTWKGEIWUKYOFDNBHYGPANQNVAKLTSQMGXLSMLHSQMTHATVAHEQNIOOAAM
LPQFOGZLTXPOLZXIAFAUPISFFPMAELMHTAHUETXSDFQMQPFTQMKPAQZVHMHTQXHU
MAQNXAPGXIQGOQVNALOGMHNHETMTPQKTLCNTHEEXOWOULPWHPOEOUKZOHSLNKPIX
ELVWLHALPDXEHYTHIXELVWLHALPDBEELKWLTGYEMPLPQSAOAAMNHLHQSSHHEHMLP
EMPLFDHEEXRKPOXIQGSMPLAMPGMPKCDFISTATOPUOEIHVALKIOARELGQMEABHEQX
CHAYRXIXHEQNDPQELBKPRAHMNTHAQNDFXIXGXIQHMTXQWUPODWKFHYKLIXCGEQRQ
MQHSSMPLAMPGMVYPLAIHMAXMZXALMLMVDFAUDHUKYPMAULGTBDTAAEQSWZAYMXES
LTAFAHAYRIPODWKFHYDFDFMAXMLNKPLATMQEQHHSXGETMTNTQEHVQZXDLCMLMVIL
MQMLPFALLCGTAFAEQSWZAYVSPKMLMWESTMPUMQPDVHSMPLAMPGMPKCDFISTAULAU
BDELCNZLOQVNALOGMHHYKFIXQFVAZGGYXDHBGPELVWLHALPDXMMAQNQMFDABLCFD
AZDTZATAAOLHXAPGKGFXIPQXSGXNHDANLMXIQZXDUKYOFDNBHYGUETMTEQMTMVAN
QEEXKWLTPGBECFLNSYKAHLEQOGXPHIQXCSPUMQPDVHMXESAQDWKFUKYLTSQEAVIG
OMPKNLXAPGMPKCDFISTAAPPOEMQXKATANLAIVSHMTHQMETULEGSQSYXDFZHZPOMH
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AVGEWRYATSQEZTUORAQMPGPQKTXGBDQNEGESFPPNMHZHPUMNAMELAUDHMNQWHNLT
MPOLXPSMPLAMPGMPKCDFISTAAPLKHTRAHSFUGFGDTHOQVNALOGMHEXGMIGCEELKF
APHSQECLAYXDLCHEHMQPPOMVHETHHSLNHUQXSIPKQFKQPODWKFHYTHTMHMUKEQXA
XIQZXDTXPOHBYKELMGGXLSMLHSQMTXPOHBETLBQXTAHUVAPFMLKEQSZAMAQNQMHE
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VAELMHTAMHIXDFRALEEGNTQEXHZAQXCGXEKGEOETMKXHAFATAFEOHILPMWAQHEHM
IXTGTHFDSHXIFKSEWEEGRALNGAQMOQVNALOGMHXYHEPIKTLSQAVKQXSXHTMHIXRA
QMQGFDXYHBIXFUIGBEETHBETHLMTMHMTWKDFHNIXXIQZXDRAHNIXFDACGUXDLCNT
AUTMAQLZBEUAOQVNALOGMHLCEOELSYHBIXHVQLOQVNALOGMHLKNHMTWHIXKTGFGP
QXSIFDHEHMRAHMNTHAQNDFEXGNGQMECLEXRXHMHYTHHEHQMHXIQZXDRALMMHXAMA
OGXQVAETHAIXEBGSEHPCEOQNKPABLZMWQMOFQXCGKMZGRAPUUPHYHNQEABLCXUEM
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OQVNALOGMHFCNHKEGXELEGSMPLAMPGMPKCDFISTAAOIXMLOEUAIHEMGINQXGGTBE
NTAUTMAQAZGQMEHBEXABLCNTAUTMAQLCETTFIPOQVNALOGMHMHTGELOGZLEXOMTH
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ZGLHMHVNALGEXARAHNQELCBEETAVFDHTAFAHELKWAMHIQXKALHSYQMLCGYAFAHEL
FPABHLMVPGWEHSWKFZHETDPOEOBEELKGOUMEHCUAAHETHAZAHATNKUFDDFHDFDXR
HYUKWYKFFZABHEHQMHXIQZXDHETHHYQEELKGOUMEHCUAAEHSWKFPABHLMRPUMQPD
VHVSKFHMPGNQLKNWPKDHEXCEETAVHYKYAMCGEQOQVNALOGMHFDGNMQOCUOPEQZAV
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RGUAALKETDPOEOBEGYAFATAUABHATNKUZAXGIPHTVAPOEMQXCGXLAFAHELHEQXSX
LCVAPFAYVNZLLKXYBEELXENQPLELTSQEGQKEHSWKPIMRZSHNTDEXDFHUOIAMXAXI
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CNLEHMTNZHELXHIWQHXAXIQGSMPLAMPGMPKCDFISTAATEMQGDFAVOFFPMAUKYPAD
GUXDLCHLAFEPHNYKUKYPLEHMLDXLAFUFATDTXGMTKGNQLCWVQXKAHSWKLCAYXIQF
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NPGFDFOAIXMAXGHBPOEONTQEPOKALCLZMWEXZWKURALTONESPOVXLNKPLETDEXXH
HOEXCETAOWESPOPXKPPGNQHEQXKAHNDFHLMTWMQNQNNTVKEXHZPOMALEKFPQKTNT
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HQQMAYVGUPHGPIGNMQFEIHVALKIOARELHEPOKAHEQNGSEHNTAYGQXDETSWWKQFMQ
MWLTHEZAETKSQGVXSYXDQXKAQSUKZLAYWDZAXYMALCHVIPHEISSYKNZAARDPLHAY
XDIXQSFPVHEXHTVAAYXGFKOUCEPYVAETKSQGXYHERQAUNLXIQGOQVNALOGMHQSFD
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HQUPGDQMOFEXGNOGNFHEAMHVANLHLPMVDPAMGSFDXLELEGAUKAAZAVNHAFALCEGL
PKHSIXHEHQFCHEUPGDQMOFTHHEAMRKEXGELYDAPDLCVWYGLNLAUPZLPLHELTYSEX

OEEXMQOGBEELPKEGQXWPDFLCBLELSQBLELPDLCVWYGHNIXLYDAZAXHMXCLAYXDLC
HEQNEXXGABAZXDIXHVQGAQHEHNIXTAPDVAHBZGLTVATAATXIFDMPTASEXEEMTHAL
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GXSTVAPQVGOUHSHSPVELXHRAPUGQXDTXQFOELDXWATWDLHRAISSYGMIGGNOQVNAL
OGMHPGQFGQXDMHAUTMQMTHATVAEXKNELMHGQKQPODAABHETHPDLCVWYGTNKPPKNH
GQLVPKNLXAPGMKQPFTQMKPAMYSXIQGHEADGIBEOTQSXZXDGTMHLOAFHUPLBLELPD
LCVWYGLTRAAMFPDHUKQFSXYSZIVXATKDALBEZANQZSADCLAYPVYSFDSMCFALPVNH
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EOQPFTQMKPLTEMSMPLAMPGMPKCDFISTATFQELBKPXHMKCPHMHETNQFOELDXWATWD
LHXGXMQGAQIPZBGXZXALXHXIXTWZFCUWIXHTPAANLMQFMQSHLZBLPLQAZTATKDET
YSCPHMAYPXKPLELTCEELZKPOEOMALTOZSYPOPAIRETMLOKZLAUDHTXPULCLUGSEH
XQXDGXHETHHYHMHNAYVSHMQMSMPLAMPGMPKCDFISTAHUAMXIQGOQVNALOGMHELAF
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LHHLSKLHHEGXCPHMXYHEOQVNALOGMHLCGDETSWWKQXAYXIMPXIEMLZMWQMLCXHMK
VAELOQMVALIRLKIPTDPOEOZGPOEOGXHICGGOWZLHKLQSXGSHRGQMETKSQGELNTBE
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AWAYXAMAOMPKNLXAPGMPKCDFISTAHUPOAFHFHGLHELPQSAOAAMXAXAPGSWWKPGWB
NTKEISSYCEHGQXCGZLTAHSDAVSCLHLKEEXODHMKTQAXLEMFZWKQXKAGXXLDTQXZA
FZAZGBGBGTBEVAEXGQHAUAIHXQESAMMQEGEXFPKPAUABHALEHSWKPLBLHMAUMTXY
HEPQSAOAAMQHRIAMZAXIAFTPHMIREGFZACLHISSYFPWQPOMVLAWLISSYOGWHLATF
LNPOEMSMPLAMPGMPKCDFISTAHFAYVSHMQMSLABAZXDETKSQGSGXDHMHUDFHELTMP
IXOQVNALOGMHVALMMLOGMTVHELUPXKHSMQFNTAATEMXHHOQMLCHELNPKBEOGKPEL
ATQGETSWWKDABEHUDFHEQMGFKPVALMLCGDTALHHLPKZLPLAYVGUPHGLZKDQMZAQX
XGMQETSWWKVXATWDLHXIEMHEQEGTNQXTKDLCHELDHEHMHBPLKPLXOUEPQXZLLHEL
HEMHLDBLELPVLCGOEXOEGFGDQMTHHELAZAHATNQFOELEISSYGMRAPOEOHMXARAGF
GDSMPLAMPGMPKCDFISTATFAUWDQMLOSYPOPAIHEMHELHXYWDAUXDAUKAABHETHIP
ILAFHURADFLNPKNMQPFTQMKPAMHQAMMAQNQMLCETMTCGEQPOHBLAAPIGGNOQVNAL
OGMHXUXEAFHUHETHVAETHBTMQECFIPQXAMXAVAHIQXKAHMHNQNHIIXNHAFAOGLEM
UGQXHETDLATNSHAZDFRILTARIGKEISSYGQXEMTWKPQXBLUQMPCZGAQCNAMACLHHE
GXXZDHHXHIDXGSEHSMPLAMPGMPKCDFISTAUFPKNLXAPGMKQPFTQMKPAMYSXYSUXD
AYXAVAMHESQXDAQHPGWEGXGIKDLHPAANTMLEISSYGMFYXDAYPVLALPBECLELPDLC
VWYGLTEMGYKDQMHEANQESGEQQXLCAUNLXYHEHSGLSYHVGPAQBECLELIGSHEMPLXU
BECLELXQKAAZRATAAPANHQPOPGDFQAFSTDLVPKNLXAPGMPKCDFISTAAPIGGNOQVN
ALOGMHFDGNGQXDLCELMSPKNLXAPGMPKCDFISTATFALHYHMFDMAQXMHFUQKQPFTQM
KPLHYPEQGEEMXHHOQMXTKDOGNFHEAMHVANLHDFHETDKPEQWYAMLCSFMLGEEMLCGD

```
POABHEAMUAMTMSZLPOHLWYTDAUKDQMZADFDTEXCENHTPTNTAAPPLAUKAAVMLCNTG
CHCLELYSVAMHLHATPSXAPGHETHSMZSLHKMZSADUPNHGMQOMQFEUKSHXDLTEMELKG
OUMNHGLDZLTHTXWZGTAVAUWDQXSIPKQFCEELKGMWHMTHHELDHEHMQEOGBLELVAMH
LHELKGOUGQIPAVANLHELFZEMALPLFTEXDHAVDFHEAMHLFPXFQPNTPWPOSKGFGOUO
KDETSWWKELPQMPYPQMELLZMWQMDFAYRAANLAEXKNZAETRXGXLKWLGXOTGLRYHNIX
CGEQTXMHTQHMOLLUQMHEQELTHEQMDAPGLFSYMTECSYMTHYZGEAHIXGALBEEXCEQG
QIEMHMHEAQWDIRRKHETMHMUHIXLVATDTUKYFPOEOANMLVZIXLCXQRAQXCAAYXDVA
KLLSMLWEHSWKFPABHLSWPKAFALOGMTSYXMQGLEGXFTEXDHAVXYHEPOHBHGQXOIFP
EQVPTAAEEXOKUPMAOGBEELALABHLVWAMQGLEQSEXKEAMALVLDFFDHCFDXYXDELXH
XAVSTDGIEFCLDWKFQXKAHNIXXLPDIPFDHCFDXYXDELFKOUCNHNGDQEQXLXHNLKYP
VAQSTNQRMVOQMVALIRVGMHESIXRALDMLEQCEELWPDFECGFKPLCFOLCZLHEQNUACW
CLHAAMFDVHETHEHNPOEOVSQECEELEQBANLNBNHHDVXAQXDSMGOMQGEEMSUBDELCN
KYGXKGIPQXOQOEHQELKGOUMEHCFDBHETHTABHEGXMTWKPDNQBEMLPFALNQLHQXSG
XMTDMHHTAFUPMTVHELKGQFHVKHHMLEPUGQXDOFHEAQSKATXAMAXIEMXIQZXDQXLY
RAQMPCZGAMLCETSWWKFPABHLVHELFCKHLKAUMTGN
```

4. **Kriptanalisis *Hill Cipher* dengan *known-plaintext attack***

Ayumi Yoshida, yang menyukai Conan, cemburu melihat Conan mengirimkan surat kepada Ai Haibara. Oleh karena itu, ketika Conan memintanya mengantarkan surat kepada Ai Haibara, dia melakukan serangan Man-in-the-Middle (MITM) dengan mencoba membaca surat yang dikirimkan Conan. Akan tetapi, Conan yang sudah mengambil mata kuliah IF4020 Kriptografi menyadari pentingnya *confidentiality*. Oleh karena itu, dia menggunakan enkripsi **Hill Cipher,** 3 karakter setiap kali enkripsi, saat menulis suratnya. Di sisi lain, Ayumi mempelajari bahwa surat-surat dari Conan ke Ai selalu dimulai dengan kata "**Hello Ai Haibara**" dan ditutup dengan

"**Conan**". Bantulah Ayumi untuk membaca isi surat dari Conan sehingga dia dapat istirahat dengan tenang!

```
OZGAURWSCKAEUPEMOZSSQKIUSZYWKLCYHCZQWUJYESKEKCJASGREFNUWPCAKOPGI
YQIWWGAJKJCGZXAZLMEQADAMHHEAQSIFOBQAAACSHMACMBMEYSEFHYKWQARSTBIB
ZOSOCSIOPGUFDYVTYNHQEKQXEKNRGZTKQWUAGKZAAMKEHUAXFSZIOQSAZLIICOGQ
KAXEGRYUEIICGAWIEMQWUMPUUGMEGZAGRMSLYTHGLSIERQXECYQKGFIDFEGIEQPM
UWCTOESAWWIGWZUZUGQUGZMWFSGUAUYJKJCYIGABGUKOMOWUMRKXRWOWMVVKIUQO
YKTNCTCQOYKKXGXYWFSYBJOCKYJSYKWKNKYFZAMSQSLUFQCNZWWWSGMIGLEFTCKI
OAQAEVEVRERLQXRUHTQJHUYWUXQGSWCYQUMCGQDSQBQTQEIYGWZGSLKHKCYUCAKO
QFQKLOEIUPRMTKUTRAQGYKNUHTCGCQWDCSHMACKNSMQZQPPIKTWRLCPBCNKKTHII
CCJNCVQERDOMWGGFOYVWTQISLMDTMAPQOYCYHEYHWUJMNPWEMIFPQBTMIHIICWUJ
YESKEKCJAGGGWAWQOMKCMYDVOFRCIDUWPMJKCRCSSSYVZKOMUWFYCCSBOIMIOGHS
NIYIKWHWWVUKJPGZXWRYMTKUTRYFZAWMKCMOBBYUEWUJKGJOHFUILIKZOQGKHKWR
ZMKAANA
```

5. **(Bonus) Kriptanalisis *Affine Cipher***

Eri Kisaki, ibunda dari Ran Mouri, mengirimkan sebuah gambar kepada Mouri Kogoro. Gambar tersebut mengandung sebuah pesan rahasia yang dapat digunakan untuk membuka sebuah brankas. Untuk mengamankan proses pengiriman gambar, dia menggunakan enkripsi **Affine Cipher 256 karakter**, dimana enkripsi dilakukan **per byte**. Akan tetapi, sayangnya Eri lupa untuk menyimpan kunci m dan b dan meminta Kogoro untuk menemukan kunci tersebut sendiri. Kogoro yang kebingungan meminta bantuan Conan untuk membantunya memecahkan gambar

tersebut. Untungnya, Eri masih menyimpan *source code* dalam bahasa Python yang digunakan untuk melakukan enkripsi gambar. Berikut adalah *source code* nya.

```
import math
import random

def affine_cipher(hex_values, m, b, n):
    cipher_hex = []
    for i in range(len(hex_values)):
        C = hex((m * int(hex_values[i], 16) + b) % n)
        cipher_hex.append(C)
    return cipher_hex

def read_image_to_hex(image_path):
    try:
        with open(image_path, "rb") as image:
            f = image.read()
            b = bytearray(f)
            array_of_hex = [hex(byte) for byte in b]
            return array_of_hex
    except FileNotFoundError:
        print("Error: File not found.")
        return None
    except ValueError as e:
        print("Error:", e)
        return None

def array_of_hex_to_bytearray(array_of_hex):
    bytearray_data = bytearray()
    for hex_value in array_of_hex:
        if hex_value.startswith('0x'):
            hex_value = hex_value[2:]
        byte_value = int(hex_value, 16)
        bytearray_data.append(byte_value)
    return bytearray_data

def create_file_from_bytes(file_path, bytes_data):
    try:
        with open(file_path, "wb") as file:
            file.write(bytes_data)
        print("File berhasil dibuat:", file_path)
    except Exception as e:
        print("Error:", e)

def main():
    image_path = "./flag.jpg"
```

```
    n = 256

    b = random.randint(1, n)
    m = random.randint(1, n)
    while math.gcd(m, n) != 1:
        m = random.randint(1, n)

    hex_values = read_image_to_hex(image_path)

    if hex_values is not None:
        cipher_hex = affine_cipher(hex_values, m, b, n)
        bytearray_cipher =
array_of_hex_to_bytearray(cipher_hex)
        create_file_from_bytes("./chall.jpg", bytearray_cipher)

if __name__ == "__main__":
    main()
```

Perhatikan bahwa nilai b dan m dibuat secara random. Untuk memecahkan gambar ini, anda perlu mencari terlebih dahulu nilai b dan m. Anda **DILARANG menggunakan pendekatan *exhaustive key search***.

Berikut adalah pranala gambar yang sudah dienkripsi:
https://drive.google.com/file/d/1Lis3KbHz4NKzqYZ5cUnlNby4Zu3z5Bwa/view?usp=sharing

Setelah berhasil memulihkan gambar, tuliskan pada laporan pesan rahasia yang terdapat pada gambar tersebut. Lampirkan pula kode yang kalian gunakan untuk mendapatkan kembali nilai m dan b serta kode untuk memulihkan gambar!