**Homework 2**

Name: Weicheng Zhang JHID: wzhang81

Q1:

(a). Even though Alice and Bob add an L to and change it to , and it looks like that the effort of using brute force is risen to , we can still try times to crack the 16 encryption keys by deducting two ciphertext and , which will let the result be . Just like cracking affine codes, this is the same way as to eliminate the effort of b. As we already know ciphertext and plaintext, we can now use brute force to try to get the keys without being effected by .

(b). The way to eliminate the effort of is the same as the solution in (a), with just changing to , and the equation becomes . Again we have no affection from L and can now try to get the reversed keys. This reversed keys are just in contrary order comparing to original keys, which is comparing to in original order, so we just change the order of reversed keys and can get the 16 original encryption keys.

Q2:

Result:

crackhill(someofplain1,hillciphertext1, 4)

ans =

thisisjustthebeginningofaverylonghillencryptedmessagewouldntyouliketoknowthewholethingfourscoreandsevenyearsagoourfathersbroughtforthonthiscontinentanewnationconceivedinlibertyanddedicatedtothepropositionthatallmenarecreatedequalnowweareengagedinagreatcivilwartestingwhetherthatnationoranynationsoconceivedandsodedicatedcanlongendurewearemetonagreatbattlefieldofthatwarwehavecometodedicateaportionofthatfieldasafinalrestingplaceforthosewhoheregavetheirlivesthatthatnationmightliveitisaltogetherfittingandproperthatweshoulddothisbutinalargersensewecannotdedicatewecannotconsecratewecannothallowthisgroundthebravemenlivinganddeadwhostruggledherehaveconsecrateditfaraboveourpoorpowertoaddordetracttheworldwilllittlenotenorlongrememberwhatwesayherebutitcanneverforgetwhattheydidhereitisforusthelivingrathertobededicatedheretotheunfinishedworkwhichtheywhofoughtherehavethusfarsonoblyadvanceditisratherforustobeherededicatedtothegreattaskremainingbeforeusthatfromthesehonoreddeadwetakeincreaseddevotiontothatcauseforwhichtheygavethelastfullmeasureofdevotionthatweherehighlyresolvethatthesedeadshallnothavediedinvainthatthisnationundergodshallhaveanewbirthoffreedomandthatgovernmentofthepeoplebythepeopleforthepeopleshallnotperishfromtheearthgettysburghaddressabrahamlincolna

crackhill(someofplain2,hillciphertext2, 4)

ans =

canyoudecrypttherestofthefollowingmessagethatimakehiccupandjustalittlenoisetheresaladywhossureallthatglittersisgoldandshesbuyingastairwaytoheavenandwhenshegetstheresheknowsifthestoresareclosedwithawordshecangetwhatshecamefortheresasignonthewallbutshewantstobesureandyouknowsometimeswordshavetwomeaningsinthetreebythebrooktheresasongbirdwhosingssometimesallofourthoughtsaremisgiventheresafeelingigetwhenilooktothewestandmyspiritiscryingforleavinginmythoughtsihaveseenringsofsmokethroughthetreesandthevoicesofthosewhostandlookinganditswhisperedthatsoonifweallcallthetunethenthepiperwillleadustoreasonandanewdaywilldawnforthosewhostandlongandtheforestwillechowithlaughteranditmakesmewonderiftheresabustleinyourhedgerowdontbealarmednowitsjustaspringcleanforthemayqueenyestherearetwopathsyoucangobybutinthelongruntheresstilltimetochangetheroadyoureonyourheadishumminganditwontgobecauseyoudontknowthepiperscallingyoutojoinhimdearladycantyouhearthewindblowanddidyouknowyourstairwayliesonthewhisperingwindandaswewindondowntheroadourshadowstallerthanoursoulstherewalksaladyweallknowwhoshineswhitelightandwantstoshowhoweverythingstillturnstogoldandifyoulistenveryhardthetunewillcometoyouatlastwhenallareoneandoneisalltobearockandnottorollstairwaytoheavenledzeppelina

crackhill(someofplain3,hillciphertext3, 5)

ans =

letstrythisoutforsomemorefunandseeiftherestisreadablejustaliitlemoretwasbrilligandtheslithytovesdidgyreandgimbleinthewabeallmimsyweretheborogovesandthemomerathsoutgrabebewarethejabberwockmysonthejawsthatbitetheclawsthatcatchbewarethejubjubbirdandshunthefrumiousbandersnatchhetookhisvorpalswordinhandlongtimethemanxomefoehesoughtsorestedhebythetumtumtreeandstoodawhileinthoughtandasinuffishthoughthestoodthejabberwockwitheyesofflamecamewhifflingthroughthetulgeywoodandburbledasitcameonetwoonetwoandthroughandthroughthevorpalbladewentsnickersnackheleftitdeadandwithitsheadhewentgalumphingbackandhasthouslainthejabberwockcometomyarmsmybeamishboyofrabjousdaycalloohcallayhechortledinhisjoylewiscarroljabberwockyaaa

crackhill(someofplain4,hillciphertext4, 7)

ans =

thisplaintextwillbeencryptedwithasevenbysevenhillcipherwhichmakesthiswholethingjustalittlemoreinterestingsoiwillwritesomemorethingshereandletmeaddjustafewsentencesthefollowingisbyjimlitkeinjuriesareanoccupationalhazardineverybigtimesportbutsomuchsoinskiingthatkildowwasnttheonlyathleteinwednesdaysracewhocamebackfromahorrificcrashinmondaystrainingsessiontocompeteshewasnteventheonlyathletetakenofftheslopeinahelicopterforemergencymedicaltreatmentwhohealedfastenoughtotakeanothershotfourskiersinallcrashedduringtrainingontheslickwatersoakedartificialsnowandonlycanadianallisonforsythwhotorekneeligamentscalleditanolympicselisabethgoerglofaustriawhomadeitdowntothebottomofthetrainingrununderherownpowercrashedasecondtimewednesdaycarolemontilletcarlesoffrancewhowastakenbyhelicoptertoamedicalclinicinnearbysestriereandshowedupatthestartlinewithafacesobruisedthatshelookedlikeaboxerbravelyskiedtothplacekildowsperformancethoughmayhavebeeneventougherinmondaystrainingrunshewasgoingsofastthathermomentumfirstsplayedherskisandthenlaunchedhertumblingthroughtheairbythetimeshelandedlookingbackwardandbangedtoastopeverybodyonthehillfearedtheworstallirememberisbeinginmytuckandflyingkildowrecalledandlookingbackupatthegateijustwentoverincrediblyforallthepaincausedbysomuchrollingandtumblingabruisedhipwaskildowsmostsevereinjuryandjustaboutthetimeshegotintouchwithalltheotherbatteredpartsofherbodyinahospitalinturinolympicchampionpicabostreetwasatherbedsidestreetwhoknowsathingortwoaboutcrasheshadbeentherolemodelforkildowscareerandshesoonbecameaninspirationaswelltheytalkedthencriedthensettleddownandbeganplottingareturntotheslopestheprotegelikedtheplansomuchthattuesdaymorningwhilethehospitalstaffworkedonherdischargepaperskildowslippedonherclothesgatheredherbagsandmadeabreakforittheyleftmealoneforanhourandahalfandiwasinahurrytogetbackandtrainshesaidibarelymadeitoutoftheroomwhensomeoneranupyellednonoyoumustwaithereandputmebackintheroomkildowsaidbummerbutshedidnthavetowaitmuchlongeradayofrestinsestrierepersuadedhertomakeonefinalpreracetrainingrunwednesdaymorningpainwassomethingiwasgonnatakenomatterwhatkildowsaiditwasjustamatterofifmybodycouldphysicallywithstandtheforcesofthespeedbutasshebarreledoutofthebumpywoodlandzoneabouttwothirdsofthewaydownthehillandintothelongfinalslopethistimeforkeepssherealizedthepainshehadtodealwithitwasntonlyphysicalayearagokildowwasoneofahandfuloftopskierswhotoldofficialsthesansicariocoursewastooboringfortheolympicsthuschallengedthoseofficialsbulldozedthecoursetomakebiggerjumpsslickerplateausandsteeperlandingzonesaa

diary

Code:

function [plaintext]=crackhill(snippetplaintext,ciphertext,blocklength)

dimension=blocklength\*blocklength;

cipherMatrixAll=text2int(block(ciphertext, 1, blocklength));

count=1;

keepLooping = true;

while keepLooping

snippetMatrix=block(snippetplaintext(count:count+dimension-1), 1, blocklength);

cipherMatrix=block(ciphertext(count:count+dimension-1), 1, blocklength);

snippetMatrix=text2int(snippetMatrix);

cipherMatrix=text2int(cipherMatrix);

count = count + blocklength;

dete=round(det(snippetMatrix));

if mod(dete,2)==0

continue;

end

detemodinv=powermod(dete,-1,26);

m2=detemodinv\*dete\*inv(snippetMatrix);

m2=mod(round(m2),26);

Amod26=mod(cipherMatrix\*m2,26);

deteAmod26=round(det(Amod26));

if mod(deteAmod26,2)==0

continue;

end

detemodinvAmod26=powermod(deteAmod26,-1,26);

A2=detemodinvAmod26\*deteAmod26\*inv(Amod26);

A2=mod(round(A2),26);

plaintextMatrix=mod(A2\*cipherMatrixAll,26);

plaintext=int2text(block(plaintextMatrix,-1,blocklength));

break;

end

end

Q3:

|  |  |
| --- | --- |
| a | f |
| b | n |
| c | h |
| d | i |
| e | d |
| f | s |
| g | y |
| h | g |
| i | l |
| j | p |
| k | b |
| l | o |
| m | u |
| n | t |
| o | v |
| p | c |
| q | z |
| r | k |
| s | e |
| t | w |
| u | a |
| v | x |
| w | q |
| x | r |
| y | j |
| z | m |

First, I used the zfrequency.m to get the frequency of each letter in ciphertext. And then copy these values and frequency of letters in English to an excel document. Then I rearrange the order to descending. As mentioned in the homework, the first four most frequent letters can be directly mapped. So I got r->k, t->w, a->f, o->v. Later, I used FindMostFreq.m to find the most frequent bigrams and trigrams and tried to map certain values. After this step, I got 11 mapping pairs, which are r, t, a, o, i, n, s, h, e, d, l in plaintext. Then I used substitute.m to replace certain letters in ciphertext to plaintexts, and try to guess mapping pairs to let the plaintext make sense. As there cannot be too much difference in frequency for each plaintext letter, the chance to guess the mapping correctly was quite good. After several trying, I got all mapping pairs to decrypt the cyphertext, and the pairs are shown above.

Extra Credit:

The cracking method is nearly the same as it in Q3.

wethepeopleoftheunitedstatesinordertoformamoreperfectunionestablishjusticeinsuredomestictranquilityprovideforthecommondefencepromotethegeneralwelfareandsecuretheblessingsoflibertytoourselvesandourposteritydoordainandestablishthisconstitutionfortheunitedstatesofamericaarticleisectionalllegislativepowershereingrantedshallbevestedinacongressoftheunitedstateswhichshallconsistofasenateandhouseofrepresentativessectionthehouseofrepresentativesshallbecomposedofmemberschoseneverysecondyearbythepeopleoftheseveralstatesandtheelectorsineachstateshallhavethequalificationsrequisiteforelectorsofthemostnumerousbranchofthestatelegislaturenopersonshallbearepresentativewhoshallnothaveattainedtotheageoftwentyfiveyearsandbeensevenyearsacitizenoftheunitedstatesandwhoshallnotwhenelectedbeaninhabitantofthatstateinwhichheshallbechosenrepresentativesanddirecttaxesshallbeapportionedamongtheseveralstateswhichmaybeincludedwithinthisunionaccordingtotheirrespectivenumberswhichshallbedeterminedbyaddingtothewholenumberoffreepersonsincludingthoseboundtoserviceforatermofyearsandexcludingindiansnottaxedtheactualenumerationshallbemadewithinthreeyearsafterthefirstmeetingofthecongressoftheunitedstatesandwithineverysubsequenttermoftenyearsinsuchmannerastheyshallbylawdirectthenumberofrepresentativesshallnotexceedoneforeverythirtythousandbuteachstateshallhaveatleastonerepresentativeanduntilsuchenumerationshallbemadethestateofnewhampshireshallbeentitledtochusethreemassachusettseightrhodeislandandprovidenceplantationsoneconnecticutfivenewyorksixnewjerseyfourpennsylvaniaeightdelawareonemarylandsixvirginiatennorthcarolinafivesouthcarolinafiveandgeorgiathreewhenvacancieshappenintherepresentationfromanystatetheexecutiveauthoritythereofshallissuewritsofelectiontofillsuchvacanciesthehouseofrepresentativesshallchusetheirspeakerandotherofficersandshallhavethesolepowerofimpeachmentsectionthesenateoftheunitedstatesshallbecomposedoftwosenatorsfromeachstatechosenbythelegislaturethereofforsixyearsandeachsenatorshallhaveonevoteimmediatelyaftertheyshallbeassembledinconsequenceofthefirstelectiontheyshallbedividedasequallyasmaybeintothreeclassestheseatsofthesenatorsofthefirstclassshallbevacatedattheexpirationofthesecondyearofthesecondclassattheexpirationofthefourthyearandofthethirdclassattheexpirationofthesixthyearsothatonethirdmaybechoseneverysecondyearandifvacancieshappenbyresignationorotherwiseduringtherecessofthelegislatureofanystatetheexecutivethereofmaymaketemporaryappointmentsuntilthenextmeetingofthelegislaturewhichshallthenfillsuchvacanciesnopersonshallbeasenatorwhoshallnothaveattainedtotheageofthirtyyearsandbeennineyearsacitizenoftheunitedstatesandwhoshallnotwhenelectedbeaninhabitantofthatstateforwhichheshallbechosenthevicepresidentoftheunitedstatesshallbepresidentofthesenatebutshallhavenovoteunlesstheybeequallydividedthesenateshallchusetheirotherofficersandalsoapresidentprotemporeintheabsenceofthevicepresidentorwhenheshallexercisetheofficeofpresidentoftheunitedstatesthesenateshallhavethesolepowertotryallimpeachmentswhensittingforthatpurposetheyshallbeonoathoraffirmationwhenthepresidentoftheunitedstatesistriedthechiefjusticeshallpresideandnopersonshallbeconvictedwithouttheconcurrenceoftwothirdsofthememberspresentjudgmentincasesofimpeachmentshallnotextendfurtherthantoremovalfromofficeanddisqualificationtoholdandenjoyanyofficeofhonortrustorprofitundertheunitedstatesbutthepartyconvictedshallneverthelessbeliableandsubjecttoindictmenttrialjudgmentandpunishmentaccordingtolawsectionthetimesplacesandmannerofholdingelectionsforsenatorsandrepresentativesshallbeprescribedineachstatebythelegislaturethereofbutthecongressmayatanytimebylawmakeoraltersuchregulationsexceptastotheplacesofchusingsenatorsthecongressshallassembleatleastonceineveryyearandsuchmeetingshallbeonthefirstmondayindecemberunlesstheyshallbylawappointadifferentdaysectioneachhouseshallbethejudgeoftheelectionsreturnsandqualificationsofitsownmembersandamajorityofeachshallconstituteaquorumtodobusinessbutasmallernumbermayadjournfromdaytodayandmaybeauthorizedtocompeltheattendanceofabsentmembersinsuchmannerandundersuchpenaltiesaseachhousemayprovideeachhousemaydeterminetherulesofitsproceedingspunishitsmembersfordisorderlybehaviourandwiththeconcurrenceoftwothirdsexpelamembereachhouseshallkeepajournalofitsproceedingsandfromtimetotimepublishthesameexceptingsuchpartsasmayintheirjudgmentrequiresecrecyandtheyeasandnaysofthemembersofeitherhouseonanyquestionshallatthedesireofonefifthofthosepresentbeenteredonthejournalneitherhouseduringthesessionofcongressshallwithouttheconsentoftheotheradjournformorethanthreedaysnortoanyotherplacethanthatinwhichthetwohousesshallbesittingsectionthesenatorsandrepresentativesshallreceiveacompensationfortheirservicestobeascertainedbylawandpaidoutofthetreasuryoftheunitedstatestheyshallinallcasesexcepttreasonfelonyandbreachofthepeacebeprivilegedfromarrestduringtheirattendanceatthesessionoftheirrespectivehousesandingoingtoandreturningfromthesameandforanyspeechordebateineitherhousetheyshallnotbequestionedinanyotherplacenosenatororrepresentativeshallduringthetimeforwhichhewaselectedbeappointedtoanycivilofficeundertheauthorityoftheunitedstateswhichshallhavebeencreatedortheemolumentswhereofshallhavebeenencreasedduringsuchtimeandnopersonholdinganyofficeundertheunitedstatesshallbeamemberofeitherhouseduringhiscontinuanceinofficesectionallbillsforraisingrevenueshalloriginateinthehouseofrepresentativesbutthesenatemayproposeorconcurwithamendmentsasonotherbillseverybillwhichshallhavepassedthehouseofrepresentativesandthesenateshallbeforeitbecomealawbepresentedtothepresidentoftheunitedstatesifheapproveheshallsignitbutifnotheshallreturnitwithhisobjectionstothathouseinwhichitshallhaveoriginatedwhoshallentertheobjectionsatlargeontheirjournalandproceedtoreconsideritifaftersuchreconsiderationtwothirdsofthathouseshallagreetopassthebillitshallbesenttogetherwiththeobjectionstotheotherhousebywhichitshalllikewisebereconsideredandifapprovedbytwothirdsofthathouseitshallbecomealawbutinallsuchcasesthevotesofbothhousesshallbedeterminedbyyeasandnaysandthenamesofthepersonsvotingforandagainstthebillshallbeenteredonthejournalofeachhouserespectivelyifanybillshallnotbereturnedbythepresidentwithintendayssundaysexceptedafteritshallhavebeenpresentedtohimthesameshallbealawinlikemannerasifhehadsigneditunlessthecongressbytheiradjournmentpreventitsreturninwhichcaseitshallnotbealaweveryorderresolutionorvotetowhichtheconcurrenceofthesenateandhouseofrepresentativesmaybenecessaryexceptonaquestionofadjournmentshallbepresentedtothepresidentoftheunitedstatesandbeforethesameshalltakeeffectshallbeapprovedbyhimorbeingdisapprovedbyhimshallberepassedbytwothirdsofthesenateandhouseofrepresentativesaccordingtotherulesandlimitationsprescribedinthecaseofabillsectionthecongressshallhavepowertolayandcollecttaxesdutiesimpostsandexcisestopaythedebtsandprovideforthecommondefenceandgeneralwelfareoftheunitedstatesbutalldutiesimpostsandexcisesshallbeuniformthroughouttheunitedstatestoborrowmoneyonthecreditoftheunitedstatestoregulatecommercewithforeignnationsandamongtheseveralstatesandwiththeindiantribestoestablishanuniformruleofnaturalizationanduniformlawsonthesubjectofbankruptciesthroughouttheunitedstatestocoinmoneyregulatethevaluethereofandofforeigncoinandfixthestandardofweightsandmeasurestoprovideforthepunishmentofcounterfeitingthesecuritiesandcurrentcoinoftheunitedstatestoestablishpostofficesandpostroadstopromotetheprogressofscienceandusefulartsbysecuringforlimitedtimestoauthorsandinventorstheexclusiverighttotheirrespectivewritingsanddiscoveriestoconstitutetribunalsinferiortothesupremecourttodefineandpunishpiraciesandfeloniescommittedonthehighseasandoffencesagainstthelawofnationstodeclarewargrantlettersofmarqueandreprisalandmakerulesconcerningcapturesonlandandwatertoraiseandsupportarmiesbutnoappropriationofmoneytothatuseshallbeforalongertermthantwoyearstoprovideandmaintainanavytomakerulesforthegovernmentandregulationofthelandandnavalforcestoprovideforcallingforththemilitiatoexecutethelawsoftheunionsuppressinsurrectionsandrepelinvasionstoprovidefororganizingarminganddiscipliningthemilitiaandforgoverningsuchpartofthemasmaybeemployedintheserviceoftheunitedstatesreservingtothestatesrespectivelytheappointmentoftheofficersandtheauthorityoftrainingthemilitiaaccordingtothedisciplineprescribedbycongresstoexerciseexclusivelegislationinallcaseswhatsoeveroversuchdistrictnotexceedingtenmilessquareasmaybycessionofparticularstatesandtheacceptanceofcongressbecometheseatofthegovernmentoftheunitedstatesandtoexerciselikeauthorityoverallplacespurchasedbytheconsentofthelegislatureofthestateinwhichthesameshallbefortheerectionoffortsmagazinesarsenalsdockyardsandotherneedfulbuildingsandtomakealllawswhichshallbenecessaryandproperforcarryingintoexecutiontheforegoingpowersandallotherpowersvestedbythisconstitutioninthegovernmentoftheunitedstatesorinanydepartmentorofficerthereofsectionthemigrationorimportationofsuchpersonsasanyofthestatesnowexistingshallthinkpropertoadmitshallnotbeprohibitedbythecongresspriortotheyearonethousandeighthundredandeightbutataxordutymaybeimposedonsuchimportationnotexceedingtendollarsforeachpersontheprivilegeofthewritofhabeascorpusshallnotbesuspendedunlesswhenincasesofrebellionorinvasionthepublicsafetymayrequireitnobillofattainderorexpostfactolawshallbepassednocapitationorotherdirecttaxshallbelaidunlessinproportiontothecensusorenumerationhereinbeforedirectedtobetakennotaxordutyshallbelaidonarticlesexportedfromanystatenopreferenceshallbegivenbyanyregulationofcommerceorrevenuetotheportsofonestateoverthoseofanothernorshallvesselsboundtoorfromonestatebeobligedtoenterclearorpaydutiesinanothernomoneyshallbedrawnfromthetreasurybutinconsequenceofappropriationsmadebylawandaregularstatementandaccountofthereceiptsandexpendituresofallpublicmoneyshallbepublishedfromtimetotimenotitleofnobilityshallbegrantedbytheunitedstatesandnopersonholdinganyofficeofprofitortrustunderthemshallwithouttheconsentofthecongressacceptofanypresentemolumentofficeortitleofanykindwhateverfromanykingprinceorforeignstatesectionnostateshallenterintoanytreatyallianceorconfederationgrantlettersofmarqueandreprisalcoinmoneyemitbillsofcreditmakeanythingbutgoldandsilvercoinatenderinpaymentofdebtspassanybillofattainderexpostfactolaworlawimpairingtheobligationofcontractsorgrantanytitleofnobilitynostateshallwithouttheconsentofthecongresslayanyimpostsordutiesonimportsorexportsexceptwhatmaybeabsolutelynecessaryforexecutingitsinspectionlawsandthenetproduceofalldutiesandimpostslaidbyanystateonimportsorexportsshallbefortheuseofthetreasuryoftheunitedstatesandallsuchlawsshallbesubjecttotherevisionandcontroulofthecongressnostateshallwithouttheconsentofcongresslayanydutyoftonnagekeeptroopsorshipsofwarintimeofpeaceenterintoanyagreementorcompactwithanotherstateorwithaforeignpowerorengageinwarunlessactuallyinvadedorinsuchimminentdangeraswillnotadmitofdelayarticleiisectiontheexecutivepowershallbevestedinapresidentoftheunitedstatesofamericaheshallholdhisofficeduringthetermoffouryearsandtogetherwiththevicepresidentchosenforthesametermbeelectedasfollowseachstateshallappointinsuchmannerasthelegislaturethereofmaydirectanumberofelectorsequaltothewholenumberofsenatorsandrepresentativestowhichthestatemaybeentitledinthecongressbutnosenatororrepresentativeorpersonholdinganofficeoftrustorprofitundertheunitedstatesshallbeappointedanelectortheelectorsshallmeetintheirrespectivestatesandvotebyballotfortwopersonsofwhomoneatleastshallnotbeaninhabitantofthesamestatewiththemselvesandtheyshallmakealistofallthepersonsvotedforandofthenumberofvotesforeachwhichlisttheyshallsignandcertifyandtransmitsealedtotheseatofthegovernmentoftheunitedstatesdirectedtothepresidentofthesenatethepresidentofthesenateshallinthepresenceofthesenateandhouseofrepresentativesopenallthecertificatesandthevotesshallthenbecountedthepersonhavingthegreatestnumberofvotesshallbethepresidentifsuchnumberbeamajorityofthewholenumberofelectorsappointedandiftherebemorethanonewhohavesuchmajorityandhaveanequalnumberofvotesthenthehouseofrepresentativesshallimmediatelychusebyballotoneofthemforpresidentandifnopersonhaveamajoritythenfromthefivehighestonthelistthesaidhouseshallinlikemannerchusethepresidentbutinchusingthepresidentthevotesshallbetakenbystatestherepresentationfromeachstatehavingonevoteaquorumforthispurposeshallconsistofamemberormembersfromtwothirdsofthestatesandamajorityofallthestatesshallbenecessarytoachoiceineverycaseafterthechoiceofthepresidentthepersonhavingthegreatestnumberofvotesoftheelectorsshallbethevicepresidentbutifthereshouldremaintwoormorewhohaveequalvotesthesenateshallchusefromthembyballotthevicepresidentthecongressmaydeterminethetimeofchusingtheelectorsandthedayonwhichtheyshallgivetheirvoteswhichdayshallbethesamethroughouttheunitedstatesnopersonexceptanaturalborncitizenoracitizenoftheunitedstatesatthetimeoftheadoptionofthisconstitutionshallbeeligibletotheofficeofpresidentneithershallanypersonbeeligibletothatofficewhoshallnothaveattainedtotheageofthirtyfiveyearsandbeenfourteenyearsaresidentwithintheunitedstatesincaseoftheremovalofthepresidentfromofficeorofhisdeathresignationorinabilitytodischargethepowersanddutiesofthesaidofficethesameshalldevolveonthevicepresidentandthecongressmaybylawprovideforthecaseofremovaldeathresignationorinabilitybothofthepresidentandvicepresidentdeclaringwhatofficershallthenactaspresidentandsuchofficershallactaccordinglyuntilthedisabilityberemovedorapresidentshallbeelectedthepresidentshallatstatedtimesreceiveforhisservicesacompensationwhichshallneitherbeincreasednordiminishedduringtheperiodforwhichheshallhavebeenelectedandheshallnotreceivewithinthatperiodanyotheremolumentfromtheunitedstatesoranyofthembeforeheenterontheexecutionofhisofficeheshalltakethefollowingoathoraffirmationidosolemnlyswearoraffirmthatiwillfaithfullyexecutetheofficeofpresidentoftheunitedstatesandwilltothebestofmyabilitypreserveprotectanddefendtheconstitutionoftheunitedstatessectionthepresidentshallbecommanderinchiefofthearmyandnavyoftheunitedstatesandofthemilitiaoftheseveralstateswhencalledintotheactualserviceoftheunitedstateshemayrequiretheopinioninwritingoftheprincipalofficerineachoftheexecutivedepartmentsuponanysubjectrelatingtothedutiesoftheirrespectiveofficesandheshallhavepowertograntreprievesandpardonsforoffencesagainsttheunitedstatesexceptincasesofimpeachmentheshallhavepowerbyandwiththeadviceandconsentofthesenatetomaketreatiesprovidedtwothirdsofthesenatorspresentconcurandheshallnominateandbyandwiththeadviceandconsentofthesenateshallappointambassadorsotherpublicministersandconsulsjudgesofthesupremecourtandallotherofficersoftheunitedstateswhoseappointmentsarenothereinotherwiseprovidedforandwhichshallbeestablishedbylawbutthecongressmaybylawvesttheappointmentofsuchinferiorofficersastheythinkproperinthepresidentaloneinthecourtsoflaworintheheadsofdepartmentsthepresidentshallhavepowertofillupallvacanciesthatmayhappenduringtherecessofthesenatebygrantingcommissionswhichshallexpireattheendoftheirnextsessionsectionheshallfromtimetotimegivetothecongressinformationofthestateoftheunionandrecommendtotheirconsiderationsuchmeasuresasheshalljudgenecessaryandexpedienthemayonextraordinaryoccasionsconvenebothhousesoreitherofthemandincaseofdisagreementbetweenthemwithrespecttothetimeofadjournmenthemayadjournthemtosuchtimeasheshallthinkproperheshallreceiveambassadorsandotherpublicministersheshalltakecarethatthelawsbefaithfullyexecutedandshallcommissionalltheofficersoftheunitedstatessectionthepresidentvicepresidentandallcivilofficersoftheunitedstatesshallberemovedfromofficeonimpeachmentforandconvictionoftreasonbriberyorotherhighcrimesandmisdemeanorsarticleiiisectionthejudicialpoweroftheunitedstatesshallbevestedinonesupremecourtandinsuchinferiorcourtsasthecongressmayfromtimetotimeordainandestablishthejudgesbothofthesupremeandinferiorcourtsshallholdtheirofficesduringgoodbehaviourandshallatstatedtimesreceivefortheirservicesacompensationwhichshallnotbediminishedduringtheircontinuanceinofficesectionthejudicialpowershallextendtoallcasesinlawandequityarisingunderthisconstitutionthelawsoftheunitedstatesandtreatiesmadeorwhichshallbemadeundertheirauthoritytoallcasesaffectingambassadorsotherpublicministersandconsulstoallcasesofadmiraltyandmaritimejurisdictiontocontroversiestowhichtheunitedstatesshallbeapartytocontroversiesbetweentwoormorestatesbetweenastateandcitizensofanotherstatebetweencitizensofdifferentstatesbetweencitizensofthesamestateclaiminglandsundergrantsofdifferentstatesandbetweenastateorthecitizensthereofandforeignstatescitizensorsubjectsinallcasesaffectingambassadorsotherpublicministersandconsulsandthoseinwhichastateshallbepartythesupremecourtshallhaveoriginaljurisdictioninalltheothercasesbeforementionedthesupremecourtshallhaveappellatejurisdictionbothastolawandfactwithsuchexceptionsandundersuchregulationsasthecongressshallmakethetrialofallcrimesexceptincasesofimpeachmentshallbebyjuryandsuchtrialshallbeheldinthestatewherethesaidcrimesshallhavebeencommittedbutwhennotcommittedwithinanystatethetrialshallbeatsuchplaceorplacesasthecongressmaybylawhavedirectedsectiontreasonagainsttheunitedstatesshallconsistonlyinlevyingwaragainstthemorinadheringtotheirenemiesgivingthemaidandcomfortnopersonshallbeconvictedoftreasonunlessonthetestimonyoftwowitnessestothesameovertactoronconfessioninopencourtthecongressshallhavepowertodeclarethepunishmentoftreasonbutnoattainderoftreasonshallworkcorruptionofbloodorforfeitureexceptduringthelifeofthepersonattaintedarticleivsectionfullfaithandcreditshallbegivenineachstatetothepublicactsrecordsandjudicialproceedingsofeveryotherstateandthecongressmaybygenerallawsprescribethemannerinwhichsuchactsrecordsandproceedingsshallbeprovedandtheeffectthereofsectionthecitizensofeachstateshallbeentitledtoallprivilegesandimmunitiesofcitizensintheseveralstatesapersonchargedinanystatewithtreasonfelonyorothercrimewhoshallfleefromjusticeandbefoundinanotherstateshallondemandoftheexecutiveauthorityofthestatefromwhichhefledbedelivereduptoberemovedtothestatehavingjurisdictionofthecrimenopersonheldtoserviceorlabourinonestateunderthelawsthereofescapingintoanothershallinconsequenceofanylaworregulationthereinbedischargedfromsuchserviceorlabourbutshallbedelivereduponclaimofthepartytowhomsuchserviceorlabourmaybeduesectionnewstatesmaybeadmittedbythecongressintothisunionbutnonewstateshallbeformedorerectedwithinthejurisdictionofanyotherstatenoranystatebeformedbythejunctionoftwoormorestatesorpartsofstateswithouttheconsentofthelegislaturesofthestatesconcernedaswellasofthecongressthecongressshallhavepowertodisposeofandmakeallneedfulrulesandregulationsrespectingtheterritoryorotherpropertybelongingtotheunitedstatesandnothinginthisconstitutionshallbesoconstruedastoprejudiceanyclaimsoftheunitedstatesorofanyparticularstatesectiontheunitedstatesshallguaranteetoeverystateinthisunionarepublicanformofgovernmentandshallprotecteachofthemagainstinvasionandonapplicationofthelegislatureoroftheexecutivewhenthelegislaturecannotbeconvenedagainstdomesticviolencearticlevthecongresswhenevertwothirdsofbothhousesshalldeemitnecessaryshallproposeamendmentstothisconstitutionorontheapplicationofthelegislaturesoftwothirdsoftheseveralstatesshallcallaconventionforproposingamendmentswhichineithercaseshallbevalidtoallintentsandpurposesaspartofthisconstitutionwhenratifiedbythelegislaturesofthreefourthsoftheseveralstatesorbyconventionsinthreefourthsthereofastheoneortheothermodeofratificationmaybeproposedbythecongressprovidedthatnoamendmentwhichmaybemadepriortotheyearonethousandeighthundredandeightshallinanymanneraffectthefirstandfourthclausesintheninthsectionofthefirstarticleandthatnostatewithoutitsconsentshallbedeprivedofitsequalsuffrageinthesenatearticlevialldebtscontractedandengagementsenteredintobeforetheadoptionofthisconstitutionshallbeasvalidagainsttheunitedstatesunderthisconstitutionasundertheconfederationthisconstitutionandthelawsoftheunitedstateswhichshallbemadeinpursuancethereofandalltreatiesmadeorwhichshallbemadeundertheauthorityoftheunitedstatesshallbethesupremelawofthelandandthejudgesineverystateshallbeboundtherebyanythingintheconstitutionorlawsofanystatetothecontrarynotwithstandingthesenatorsandrepresentativesbeforementionedandthemembersoftheseveralstatelegislaturesandallexecutiveandjudicialofficersbothoftheunitedstatesandoftheseveralstatesshallbeboundbyoathoraffirmationtosupportthisconstitutionbutnoreligioustestshalleverberequiredasaqualificationtoanyofficeorpublictrustundertheunitedstatesarticleviitheratificationoftheconventionsofninestatesshallbesufficientfortheestablishmentofthisconstitutionbetweenthestatessoratifyingthesamethewordthebeinginterlinedbetweentheseventhandeighthlinesofthefirstpagethewordthirtybeingpartlywrittenonanerazureinthefifteenthlineofthefirstpagethewordsistriedbeinginterlinedbetweenthethirtysecondandthirtythirdlinesofthefirstpageandthewordthebeinginterlinedbetweenthefortythirdandfortyfourthlinesofthesecondpageattestwilliamjacksonsecretarydoneinconventionbytheunanimousconsentofthestatespresenttheseventeenthdayofseptemberintheyearofourlordonethousandsevenhundredandeightysevenandoftheindependanceoftheunitedstatesofamericathetwelfthinwitnesswhereofwehavehereuntosubscribedournames