TRADITIONAL CRYPTOGRAPHY

BREAKING THE CODE

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BREAKING THE CODE

1. Introduction to Ciphers
2. Substitution Cipher
3. Permutation Cipher
4. Substitution & Permutation Cipher
5. Polyalphabetic Cipher
6. Periodic Polyalphabetic Cipher
7. Running-Key Ciph
8. Conclusion

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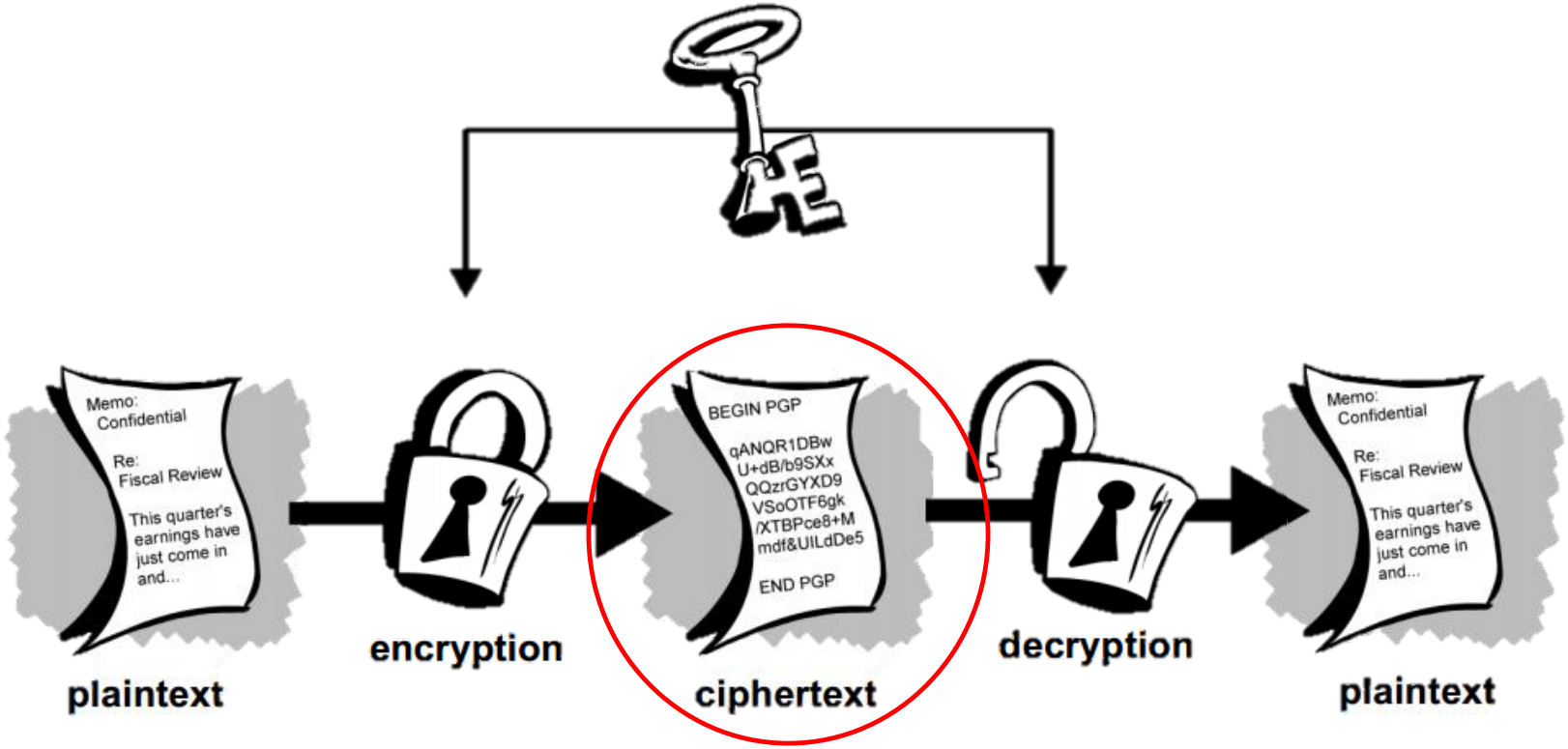
SYMMETRIC CIPHER



SYMMETRIC CIPHER

Formalized

Given a plaintext P, a key K and ciphertext C.

Encryption:

$$E(K,P) = C$$

Decryption

$$D(K,C) = P$$

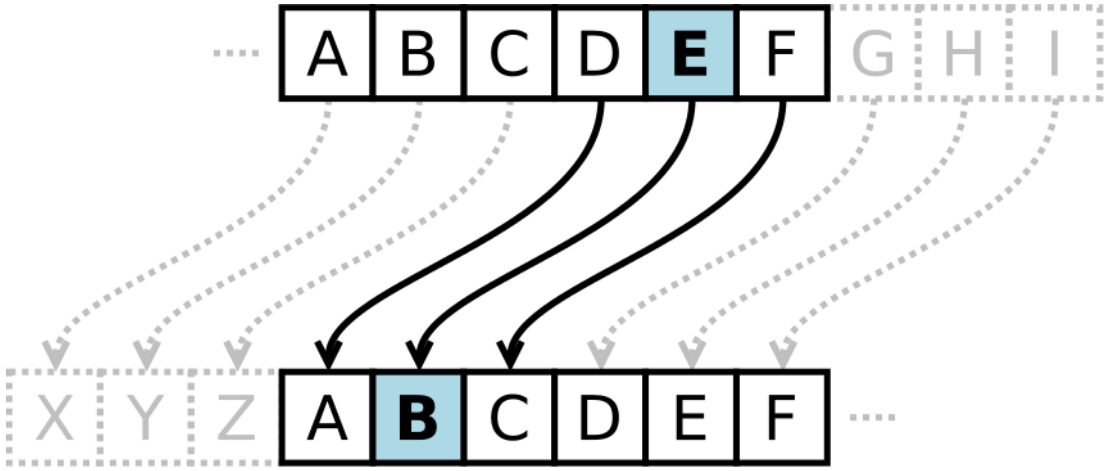
Thus reversible:

$$D(K, E(K,P)) = P$$

CAESAR'S CIPHER

Shifts alphabet by K letters and substitutes each letter in P by it's shifted counterpart.

Example of a left shift 3 Ceasar's cipher (K = −3):



Wikimedia commons - http://en.wikipedia.org/wiki/File:Caesar3.png

CAESAR'S CIPHER

Shifts alphabet by K letters and substitutes each letter in P by it's shifted counterpart.

Each letter is charactarized by it's place in the alphabet thus:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

For $c_i \in C$ and $p_i \in P$

$$c_i = (p_i + K) \; mod \; 26$$

and

$$p_i = (c_i - K) \; mod \; 26$$

EXAMPLE – ENCODE!

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

$K = -5$

Plaintext	V	E	N	I
Ciphertext	..	..	..	..

EXAMPLE – ENCODE!

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

$K = -5$

Plaintext	V	E	N	I
Ciphertext	Q	Z	I	D

EXAMPLE – DECODE!

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

K = 3

Ciphertext	Y	L	G	L
Plaintext	..	..	..	..

EXAMPLE – DECODE!

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

K = 3

Ciphertext	Y	L	G	L
Plaintext	V	I	D	I

EXAMPLE – BREAK?

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

K = ?

Ciphertext	B	O	I	O
Plaintext	..	..	..	..

EXAMPLE – BREAK?

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

K = ?

Ciphertext	B	O	I	O
Plaintext	V	I	C	I

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SUBSTITUTION CIPHER

The encoding function substitutes each character of a plaintext, P, according to the substitution alphabet, a.k.a. the key, K.

Example – Alphabet Shuffled:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Z	T	J	M	V	G	L	N	U	S	R	K	Y	H	A	E	D	P	W	B	C	F	I	O	X	Q

Plaintext: ZIGZAG
Ciphertext: QULQZL

SUBSTITUTION CIPHER

The encoding function substitutes each character of a plaintext, P, according to the substitution alphabet, a.k.a. the key, K.

Example – Alphabet based on other characters:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
!	,	\	(	{	?	$	;	*	[	<	|	'	~	\	-	"	^	>	_	@	.	}	%	&	+

Plaintext: ZIGZAG
Ciphertext: +*$+!$

MATHIAS' SUBSTITUTION CIPHER

```
RVRZF19;:-P:8OP-8RHP8:PL1P19RP-LYY8 DP19RZRP;HPLPZL;YOLFPH RRWP;:P19RPH1;ZZ;:-
P8EP19RPS;:WCP:81PYRHHP19L:P;:P19RPS8VRSR:1P8EP19RP78W;RHP8EPSR:DP19RPH8N;LYPL:WP 8Y;1;NLYP
LHH;8:HP9LVRPLNMI;ZRWPHIN9P;:1R:H;1FCPL:WP7RR:PH8PO;WRYFPW;EEIHRWCP19L1P19R;ZP;:RV;1L7YRPZRHIY1HPLZRPLYS8H1P;SSRW;L1RYFP Z8WINRWDP19RP
RZ;8WP8EPHRRWA1;SRPL:WP9LZVRH1P9LHP7RN8SRPLHPH98Z1P;:P 8Y;1;NLYPLHP;1P;HP;:PL-Z;NIY1IZLYPYL78IZDPLPH;:-YRPFRLZP7Z;:-HP;1HPL  Z8
Z;L1RPEZI;1HP18PSL1IZ;1FP;:P19RPS8ZLYPLHP;:P19RP 9FH;NLYPO8ZYWDPR;-91FPFRLZHPRYL HRWP;:PZ8SRPEZ8SP19RP1;SRPO9R:P19RP 8Y;1;NLYP
LHH;8:HPORZRPE;ZH1PH1;ZZRWP7FP1;7RZ;IHP-
ZLNN9IHCP7RE8ZRP;1HPI:ZIYFPN;1;KR:HPORZRPE;:LYYFPHI7WIRWP7FP19RPLZ1CP8ZPWRN;SL1RWP7FP19RPNZIRY1FP8EP8N1LV;IHDPR:-
YL:WPI:WRZOR:1PH;XPFRLZHP8EPN;V;YPOLZPL:WPHIEERZ;:-CP7RE8ZRP19RPLS7;1;8:PL:WPSLW:RHHP8EP19RPY8:-P LZY;LSR:1PORZRPRX RYYRWP7FP19RP IZ-RP8EP
Z;WRCP8ZPNZIH9RWP7FP19RPHO8ZWP8EPNZ8SORYYBP1ORYVRPFRLZHPRYL HRWP7R1ORR:P19RPN8:V8NL1;8:P8EP19RPH1L1RHA-
R:RZLYP;:P,U.GCPL:WP19RPRX1;:N1;8:P8EP19RPY;NR:HRP8EP19RPEZR:N9PZRV8YI1;8:P7FP19RPLZSP8EP:L
8YR8:DP7I1CP8:P19;HP8NNLH;8:CP;:P8:RPFRLZCPLYYCP;:P19RPSRL:1;SRPL1PYRLH1CP9LHP7RR:PLNN8S Y;H9RWDPRZRP19RPYRLVRHCPO9;N9PI:E8YWRWP;:PH Z;:-
PLS;WH1P19RP8VRZ19Z8OP8EP19Z8:RHCPL:WP19RP1ZL:H 8Z1HP8EPZRV8YI1;8:;H1HP8VRZP19RPO8ZYWCP9LWPELYYR:P;:PLI1IS:CP19RP
LHH;8:HPO9;N9P9LWPN8:VIYHRWPSL:T;:WPORZRPNZIH9RWPE8ZP19RP1;SRCPL:WP19RP1Z;IS 9HP8EPWRS8NZLNFPORZRPLZZRH1RWDPLP1RZZ;7YRPZRLN1;8:P9LWPHR1P;:QPRX
RZ;R:NRP8EPHIEERZ;:-P9LWPW8:RP;1HPO8ZTQPL:WPHO;E1PLHP19RPH9LWRHP8EP:;-91P7RE8ZRP19RPZLFHP8EP19RPLHNR:W;:-PHI:CP9LWPW;HL
RLZRWP19RPERZSR:1P8EPZRV8YI1;8:P7RE8ZRP19RPLZ8IHRWP;:W;-:L1;8:P8EP19RPI:N8ZZI 1RWP LZ1P8EPSL:T;:WDP19RPHLSRP LHH;8:HPSLFPL-
L;:PLZ;HRQP19RPHLSRPWRYIH;8:HPL-L;:PH ZRLWCPLHPH;:PH Z;:-HPI PLEZRH9P;:PHINNRHH;VRP-
R:RZL1;8:HP8EPSR:QP7I1PORPT:8OP19RPZRHIY1DP19RFPO;YYCPY;TRP19RPOLFHP8EP19RPI:Z;-91R8IHCP7RPL-L;:PNZIH9RWD
```

BREAKING A SUBSTITUTION CIPHER

Cipher	
Character	Probability
P	0,1686
R	0,1083
1	0,0672
;	0,0630
L	0,0608
H	0,0587
:	0,0576
8	0,0534
Z	0,0534
9	0,0427
W	0,0336
Y	0,0320
E	0,0240
I	0,0240
N	0,0219
S	0,0187
	0,0181
F	0,0144
O	0,0139
-	0,0133
7	0,0133
C	0,0117
V	0,0091
D	0,0064
T	0,0027
Q	0,0021
X	0,0021
A	0,0011
,	0,0005

English	
Character	Probability
	0,1787
e	0,1034
t	0,0692
a	0,0692
i	0,0652
r	0,0602
o	0,0572
s	0,0552
h	0,0532
n	0,0441
d	0,0291
l	0,0271
c	0,0261
p	0,0230
f	0,0200
g	0,0180
w	0,0170
u	0,0160
y	0,0160
b	0,0140
m	0,0110
,	0,0070
v	0,0060
x	0,0040
.	0,0040
k	0,0020
q	0,0010
-	0,0010
j	0,0010

BREAKING A SUBSTITUTION CIPHER

```
eVeZF19;:-_:8O_-8eH_8:_L1_19e_-LYY8 D_19eZe_;H_L_ZL;YOLF_H eeW_;:_19e_H1;ZZ;:-
_8E_19e_S;:WC_:81_YeHH_19L:_;:_19e_S8VeSe:1_8E_19e_78W;eH_8E_Se:D_19e_H8N;LY_L:W_ 8Y;1;NLY_
LHH;8:H_9LVe_LNMI;ZeW_HIN9_;:1e:H;1FC_L:W_7ee:_H8_O;WeYF_W;EEIHeWC_19L1_19e;Z_;:eV;1L7Ye_ZeHIY1H_LZe_LYS8H1_;SSeW;L1eYF_ Z8WINeWD_19e_
eZ;8W_8E_HeeWA1;Se_L:W_9LZVeH1_9LH_7eN8Se_LH_H98Z1_;:_ 8Y;1;NLY_LH_;1_;H_;:_L-Z;NIY1IZLY_YL78IZD_L_H;:-Ye_FeLZ_7Z;:-H_;1H_L  Z8
Z;L1e_EZI;1H_18_SL1IZ;1F_;:_19e_S8ZLY_LH_;:_19e_ 9FH;NLY_O8ZYWD_e;-91F_FeLZH_eYL HeW_;:_Z8Se_EZ8S_19e_1;Se_O9e:_19e_ 8Y;1;NLY_
LHH;8:H_OeZe_E;ZH1_H1;ZZeW_7F_1;7eZ;IH_-
ZLNN9IHC_7eE8Ze_;1H_I:ZIYF_N;1;Ke:H_OeZe_E;:LYYF_HI7WIeW_7F_19e_LZ1C_8Z_WeN;SL1eW_7F_19e_NZIeY1F_8E_8N1LV;IHD_e:-
YL:W_I:WeZOe:1_H;X_FeLZH_8E_N;V;Y_OLZ_L:W_HIEEeZ;:-C_7eE8Ze_19e_LS7;1;8:_L:W_SLW:eHH_8E_19e_Y8:-_ LZY;LSe:1_OeZe_eX eYYeW_7F_19e_ IZ-e_8E_
Z;WeC_8Z_NZIH9eW_7F_19e_HO8ZW_8E_NZ8SOeYYB_1OeYVe_FeLZH_eYL HeW_7e1Oee:_19e_N8:V8NL1;8:_8E_19e_H1L1eHA-
e:eZLY_;:_,U.GC_L:W_19e_eX1;:N1;8:_8E_19e_Y;Ne:He_8E_19e_EZe:N9_ZeV8YI1;8:_7F_19e_LZS_8E_:L
8Ye8:D_7I1C_8:_19;H_8NNLH;8:C_;:_8:e_FeLZC_LYYC_;:_19e_SeL:1;Se_L1_YeLH1C_9LH_7ee:_LNN8S Y;H9eWD_eZe_19e_YeLVeHC_O9;N9_I:E8YWeW_;:_H Z;:-
_LS;WH1_19e_8VeZ19Z8O_8E_19Z8:eHC_L:W_19e_1ZL:H 8Z1H_8E_ZeV8YI1;8:;H1H_8VeZ_19e_O8ZYWC_9LW_ELYYe:_;:_LI1IS:C_19e_
LHH;8:H_O9;N9_9LW_N8:VIYHeW_SL:T;:W_OeZe_NZIH9eW_E8Z_19e_1;SeC_L:W_19e_1Z;IS 9H_8E_WeS8NZLNF_OeZe_LZZeH1eWD_L_1eZZ;7Ye_ZeLN1;8:_9LW_He1_;:Q_eX
eZ;e:Ne_8E_HIEEeZ;:-_9LW_W8:e_;1H_O8ZTQ_L:W_HO;E1_LH_19e_H9LWeH_8E_:;-91_7eE8Ze_19e_ZLFH_8E_19e_LHNe:W;:-_HI:C_9LW_W;HL
eLZeW_19e_EeZSe:1_8E_ZeV8YI1;8:_7eE8Ze_19e_LZ8IHeW_;:W;-:L1;8:_8E_19e_I:N8ZZI 1eW_ LZ1_8E_SL:T;:WD_19e_HLSe_ LHH;8:H_SLF_L-
L;:_LZ;HeQ_19e_HLSe_WeYIH;8:H_L-L;:_H ZeLWC_LH_H;:_H Z;:-H_I _LEZeH9_;:_HINNeHH;Ve_-
e:eZL1;8:H_8E_Se:Q_7I1_Oe_T:8O_19e_ZeHIY1D_19eF_O;YYC_Y;Te_19e_OLFH_8E_19e_I:Z;-91e8IHC_7e_L-L;:_NZIH9eWD
```

BREAKING A SUBSTITUTION CIPHER

`eVeZF19;:-_:8O_-8eH_8:_L1_19e_-LYY8 D_19eZe_;H_L_ZL;YOLF_H eeW_;:_19e_H1;ZZ;:-_`

19e is likely supposed to mean "the" which means `1 = t` and `9 = h`.

`eVeZFth;:-_:8O_-8eH_8:_Lt_the_-LYY8 D_theZe_;H_L_ZL;YOLF_H eeW_;:_the_Ht;ZZ;:-_`

Lt is probably 'at' so L = a but theZe coild be both 'r' and 's'.

Ciphertext	Plaintext
P	_
R	e
I	t
9	h
L	a

We need to go deeper!

BREAKING A SUBSTITUTION CIPHER

The nine most frequent bigrams (combinations of two letters) in English:

th, he, in, er, an, re, nd, on, en

The nine most frequent bigrams in the (partial decoded) Cipher:

th, he, ;:, e:, 8E, eW, Ze, 8:, Z;

The five most frequent trigrams (combinations of three letters) in English:

the, and, ing, her, hat

The five most frequent bigrams in the (partial decoded) Cipher:

the, ;8:, 8:H, a:W, 8:e

Cipher		English	
Character	Probability	Character	Probability
P	0,1686		0,1787
R	0,1083	e	0,1034
1	0,0672	t	0,0692
;	0,0630	a	0,0692
L	0,0608	i	0,0652
H	0,0587	r	0,0602
:	0,0576	o	0,0572
8	0,0534	s	0,0552
Z	0,0534	h	0,0532
9	0,0427	n	0,0441
W	0,0336	d	0,0291
Y	0,0320	l	0,0271
E	0,0240	c	0,0261
I	0,0240	p	0,0230
N	0,0219	f	0,0200
S	0,0187	g	0,0180
	0,0181	w	0,0170
F	0,0144	u	0,0160
O	0,0139	y	0,0160
-	0,0133	b	0,0140
7	0,0133	m	0,0110
C	0,0117	,	0,0070
V	0,0091	v	0,0060
D	0,0064	x	0,0040
T	0,0027	.	0,0040
Q	0,0021	k	0,0020
X	0,0021	q	0,0010
A	0,0011	-	0,0010
,	0,0005	j	0,0010

BREAKING A SUBSTITUTION CIPHER

everything now goes on at the gallopD there is a railway speed in the stirring of the mindC not less than in the movement of the bodies of menD the social and political passions have acquired such intensityC and been so widely diffusedC that their inevitable results are almost immediately producedD the period of seedAtime and harvest has become as short in political as it is in agricultural labourD a single year brings its appropriate fruits to maturity in the moral as in the physical worldD eighty years elapsed in rome from the time when the political passions were first stirred by tiberius gracchusC before its unruly citizens were finally subdued by the artC or decimated by the cruelty of octaviusD england underwent six years of civil war and sufferingC before the ambition and madness of the long parliament were expelled by the purge of prideC or crushed by the sword of cromwellB twelve years elapsed between the convocation of the statesAgeneral in ,U.GC

DECIPHERED SUBSTITUTION CIPHER

From: BLACKWOOD'S Edinburgh MAGAZINE. VOL. LXV.

Everything now goes on at the gallop. There is a railway speed in the stirring of the mind, not less than in the movement of the bodies of men. The social and political passions have acquired such intensity, and been so widely diffused, that their inevitable results are almost immediately produced. The period of seed-time and harvest has become as short in political as it is in agricultural labour. A single year brings its appropriate fruits to maturity in the moral as in the physical world. Eighty years elapsed in Rome from the time when the political passions were first stirred by Tiberius Gracchus, before its unruly citizens were finally subdued by the art, or decimated by the cruelty of Octavius. England underwent six years of civil war and suffering, before the ambition and madness of the Long Parliament were expelled by the purge of Pride, or crushed by the sword of Cromwell: twelve years elapsed between the convocation of the States-general in 1789, and the extinction of the license of the French Revolution by the arm of Napoleon. But, on this occasion, in one year, all, in the meantime at least, has been accomplished. Ere the leaves, which unfolded in spring amidst the overthrow of thrones, and the transports of revolutionists over the world, had fallen in autumn, the passions which had convulsed mankind were crushed for the time, and the triumphs of democracy were arrested. A terrible reaction had set in; experience of suffering had done its work; and swift as the shades of night before the rays of the ascending sun, had disappeared the ferment of revolution before the aroused indignation of the uncorrupted part of mankind. The same passions may again arise; the same delusions again spread, as sin springs up afresh in successive generations of men; but we know the result. They will, like the ways of the unrighteous, be again crushed.

WEAKNESS OF A SUBSTITUTION CIPHER

- All frequency properties of the underlying language remain intact.

- Thus are breakable by statistical frequency analysis.

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PERMUTATION CIPHER

Changes the order of plaintext in blocks of size b.

Example

`Plaintext: HELLO_WORLD_`

`Blocksize: 3`

1	2	3
H	E	L
L	O	_
W	O	R
L	D	_

1	3	2
H	L	E
L	_	O
W	R	O
L	_	D

`Key: 132`

`Cipher: HLEL_OWROL_D`

The cipher gets more secure by increasing b because there are more possible permutations

MATHIAS' PERMUTATION CIPHER

INTBUI BRETHMH ESTIFE, RPIEA C ORPRY UNTT, ITASES BA HRTHO EN HLYGOUTERSDUNY, BDOOFN OE M NSEE S ALL OFSTIERPA HATT, GHANCA YF DOE ITY SNAOUT OS QHE TF NTIOSUETND A, E THTHANIS REREFORO HORTWM NNTEO COG FNDIHN TIR ETATSE HHICW, T NOS I BEO TEECTFEFHY TBD SEANME ICHH WN COETHITUTISTEITS ON HAS LFEVIDOPRSTHI D.CNVIO CLN, OTIP IMGON SEDSREHN TOUPOATINE AND N,OERWTIN ASNVEEWER ITTTH I WYVER HEWAMER F OFKORI BRETHIH MSTIV HA,NDM COGINOO CTE IDECINHH TTWIIASSPE C INSONTNT EIDYARTPO IVISI D INSON REEFA TE,AST INSHASCESOPRM TIF OURODPE E THDCEGRANT STND AE SUOUTORYLICO P,ICHH WBR AO FQ A EOV TERRUAEA C OF RY,UNTW NOSHAFEN E BDOWELOLI THN ITOUNCS TBY RYEGOV HE,ENTMRNAD LN AOD TEUDKE SH T BYSIEO WHETHELIB LER PALRATON TYTCON HE NT.EINERIVPDEHF TOD HATCWE ODS RWO EN,MF R PAETHAS HETIECOM VES ASO TO THEUMTOF SE GS.NHICANIGORC SOR OA CHLIAV HAENGMECOBE WHE TE CRY-ARTFAC OFN, INIOOAD ESTGHANCF YF DOE TY.SNAT NAETH ISNIOGLON NONDRE ERID WECHOBLO THRY ABD IS FEMI INGTGHE THRFORD OE RHE WH TS ROEITPBY E, IESTARNIVIRSTTOR FG TMAS HET BEYERHN TEWERTUASE HND AT VEROANEILIMFA BUT S, WAS ITS LETNOOHORTS DLY HUG DEDIIV THE BY OFYCRIE BH"TE TH,LL OLEH WAL, LBIHNOT NDT BUGINIE BH TT" A,LLIE TN OD AN,MEOAT H TEFRE"F ADER-TE CHDANNCOR APNT AA" ER.HOT IALCSO,NGEACHATERL AONS OTICOLIPF EHAV Y,CUS H T TOEOM THE BEOAT EGR CTSEBJDCH IWHTDE IIVINAT HED AN;ONTS IA, E EVS IPHE TR OCY IOLSPPOOF TON IITEEPRRO HT TNSEUONDCE GOF CTERNMEOVEAS NTUNEOORRFIT S,,OWSLOLN A S ARSSAEECEONSCY ,NCEEQUTAT H TNMAI HETFORF EHF TOS YARTPE EPOSP ODO ATD RISTNMIAON IATHYS ALWE BEEAVCSIN N,SHE TE SRESPUP OFNIOB REETH IONLEL5174 INFO ET, WT, CFE INNHETOSIPOP , ANIO NGEACHEGEN INI OPLRAAN, ONIE WH,NDON PIN O, TRWE RRYA CHT CATHNE IGANEEFF TOABY CTEANGH CL POF OH. TYICLLD OE NOF AWIRE UATLTILSS E OPN I.IONTRANTIOC AED RN A IONTACAE MLRU ND;INK INDANF EFETHFS OTORERTIA PAUTUMS TOYLLNPLAPSU ACHET IER HOTROWEPN U FOA, NTIOANDI LAS IAOR FD RNTIEN GHANCE OF POE TY ACLIDATET SDRIOE P AND S,EALT AN,IONTRAE GRS AFAS ATG NIMRODTO HT IN,AYI OPETHANS ONIIPOL NDTOF CYIRUL HETPAR NGHN TIY AMESE ATE ASTEIFFDT IT TNRE . SME

BREAKING A PERMUTATION CIPHER

Method of breaking

Possible blocksizes can be found by:

$$|C| \bmod b_i = 0$$

Then you can shuffle 'columns' for each possible b_i and find the b_i which gives the highest frequency of common ngrams (like "th")

BREAKING A PERMUTATION CIPHER

Length of Cipher: 2128

Possible blocksizes: [1, 2, 4, 7, 8, 14, 16, 19, 28, 38, 56, 76, 112, 133, 152, 266, 304, 532, 1064]

“TH”-Frequency for first 5 possible blocksizes: {1: 24, 2: 24, 4: 24, 7: 59, 8: 27}

Blocksize = 7

Key = 5641230

MATHIAS' PERMUTATION CIPHER

BUT IN THE BRITISH EMPIRE, FOR A CENTURY PAST, IT HAS BEEN THOROUGHLY UNDERSTOOD, BY MEN OF SENSE OF ALL PARTIES, THAT A CHANGE OF DYNASTY IS OUT OF THE QUESTION, AND THAT THERE IS NO REFORM WORTH CONTENDING FOR IN THE STATE, WHICH IS NOT TO BE EFFECTED BY THE MEANS WHICH THE CONSTITUTION ITSELF HAS PROVIDED. THIS CONVICTION, LONG IMPRESSED UPON THE NATION, AND INTERWOVEN AS IT WERE WITH THE VERY FRAMEWORK OF THE BRITISH MIND, HAVING COME TO COINCIDE WITH THE PASSIONS INCIDENT TO PARTY DIVISIONS IN A FREE STATE, HAS IN PROCESS OF TIME PRODUCED THE STRANGE AND TORTUOUS POLICY WHICH, FOR ABOVE A QUARTER OF A CENTURY, HAS NOW BEEN FOLLOWED IN THIS COUNTRY BY THE GOVERNMENT, AND LAUDED TO THE SKIES BY THE WHOLE LIBERAL PARTY ON THE CONTINENT. DEPRIVED OF THE WATCHWORDS OF MEN, THE PARTIES HAVE COME TO ASSUME THOSE OF THINGS. ORGANIC OR SOCIAL CHANGE HAVE BECOME THE WAR-CRY OF FACTION, INSTEAD OF CHANGE OF DYNASTY. THE NATION IS NO LONGER DRENCHED WITH BLOOD BY ARMIES FIGHTING FOR THE RED OR THE WHITE ROSE, BY PARTIES STRIVING FOR THE MASTERY BETWEEN THE STUART AND HANOVER FAMILIES, BUT IT WAS NOT LESS THOROUGHLY DIVIDED BY THE CRY OF "THE BILL, THE WHOLE BILL, AND NOTHING BUT THE BILL," AT ONE TIME, AND THAT OF "FREE-TRADE AND CHEAP CORN" AT ANOTHER. SOCIAL CHANGE, ALTERATIONS OF POLICY, HAVE THUS COME TO BE THE GREAT OBJECTS WHICH DIVIDE THE NATION; AND, AS IT IS EVER THE POLICY OF OPPOSITION TO REPRESENT THE CONDUCT OF GOVERNMENT AS ERRONEOUS, IT FOLLOWS, AS A NECESSARY CONSEQUENCE, THAT THE MAIN EFFORTS OF THE PARTY OPPOSED TO ADMINISTRATION ALWAYS HAVE BEEN, SINCE THE SUPPRESSION OF THE REBELLION IN 1745, TO EFFECT, WHEN IN OPPOSITION, A CHANGE IN GENERAL OPINION, AND, WHEN IN POWER, TO CARRY THAT CHANGE INTO EFFECT BY A CHANGE OF POLICY. THE OLD LAW OF NATURE IS STILL IN OPERATION. ACTION AND REACTION RULE MANKIND; AND IN THE EFFORTS OF PARTIES MUTUALLY TO SUPPLANT EACH OTHER IN POWER, A FOUNDATION IS LAID FOR AN ENTIRE CHANGE OF POLICY AT STATED PERIODS, AND AN ALTERATION, AS GREAT AS FROM NIGHT TO DAY, IN THE OPINIONS AND POLICY OF THE RULING PARTY IN THE SAME STATE AT DIFFERENT TIMES.

WEAKNESS

With enough computer power each possible ‘anagram’ can theoretically be calculated and thus the code can be brute forced.

Though in practice with large blocksizes this is pretty hard, but then one can probably solve anagrams within the blocksize which also reveals the key and blocksize.

BREAKING THE CODE

1. Introduction to Ciphers
2. Substitution Cipher
3. Permutation Cipher
4. Substitution & Permutation Cipher
5. Polyalphabetic Cipher
6. Periodic Polyalphabetic Cipher
7. Running-Key Cipher
8. Conclusion

MATHIAS' SUBSTITUTION AND PERMUTATION CIPHER

```
QUJTZJQG?DIZJUOUZQ?QZS'?.ZJ'-!FI!TJF?"J-QUJTJIUF!.JE?Q"DJU"FO'ZTZU?ZDJJL?FU.JO-FIT!Z!!IISJ-FM'AIT-
ZJ?Z!QJJ"'IZ.J'..TZIJ!TS'QJJWUX'TZIJF?IFAJAUIZJI!ILJJMTIFFULB?SQI?JU?FZ!ZJT"IZJTZ?DJI-ILJ'I!ZJ'IFQUJTJTZI?.JQZ;!?APJ'FIGJI-
!MUO"?JTJ.FI'S"IJQQZ?JTZDJ?ZUITJJQJ'TTDQJZ"?FIJX'JIATZ-IJF'JZ'O'SQ'J.Q;JZZERJ'KJ"DF?JFZITJ-!IT!OFZIJMT"I?DQJI!O!QJ"FIO'-KJJ"JXZX?KJ'ITJMDQ-
DJI'TOJVI!U?"!KJL?FUZJ?"FUZFFOUTAJLZUTDJQUJTJXX?UBJWT-
F'JDQU!.UJFQ"JFIJ'D'ZJI?!IFUQ?LUTAJZF?"JE!.'JMTQ?JA?JFIAL?UJ"UZ'?Z.'JJF"FMUAJIXTJIP"''Q'ZAJI!ZDJ"IXTSUJZW-
JQUUJQ'QVAIXJKU"JI'ZU!KSQTZIJIISFQJTDUJIFJ'TS'Z'JDXV?JPUJFISITJZJ'T'SQ'!'YXTJIWAM-J!FQ'ITDFU"AJQ?JDJUXII!J".IBJAZ'!"JIITQIQ!VJF''UQ?USS"IJF'ZJT-
K"JUQU?!SLQXOJ.I!?LTSDJ?MI?S!JQIQ"QI"FJ?JLF!'SXO?Z?J"KIZBIIJ-KJ'-!FUJJ-JIQTZ''XTS!AQJW?T!JWJQPU!IQ"QUAUJTJI.S.?F'?UZ-
XMIZ"FJ?J"UJ?QJI.TQJZSXIU."F'JZ'FIUTQJ.FF'UJSFIIS'!A.JITJZJQ!ZU.F?"JM"?JTJIB!IFQIV"JI!"U?J.U'JKJIQZJLAFUJII"?I"FUBHJOWZF??UX"FJ?J,U?XI!IIDJQX'?J'AF?JJZZQL.
JUITJZZQ!IKQJ'JDZ'Z!UJIT!V'V?UZ'?KVO'JFUTQJFF'"SJWZJSO!'LILF?"JIZUZXJFJIIXID!J"I"XJIZTILUIK-J"J"AF'OQ!?I'ZJJIJIZIQ!UJITIUF!.F'SJ"'A!JI?A"JI?TVJIJM?-
VTJ'"FJ"QIVJFZ''?TBJ'UTAJIJQZ?JSJTITJ.UIUTZIJF-
J'!U.TOZOVQ'JXWQJZ!JZUOK?DQJZ!?J.J..IU"ZFJI!TZJUDIIF!LDJTMI'FDJ'XIZ.JXXJ?JJIDTZSZTI!IFQ"I.'JJQJISF'UBSF'J"'IZTZIJ.JM?Z."JI"FZSIIZFUJJ"IQX?KZ?ZJ-
UTFS?TZIJLQUL"JIS.?!SJTXOILJ!??JF'ZFF'UJZFJISJ"VF?QUI?!Z!T'D?X"J-ITJJWJ"Z?TFIJP?JQQUTJZ??ITZIJZZR!IJZU-
AIJ.Z'JQJSITX'Y'TA'M'!"FJ?JJQT?DFUL"UQUJTJISJ?.TJUFU?TFJQJE?Q"ZJT"FTLJO''K-
J?J.D'JI"!F'JXQO.U!ZUVF?"JQ!Z'QJFJILFMIJB!JQF?DKJ?D'"IJTZZJIFUMQJ!?J"QF?UKFK'X?'JLJW""OTJ?W!QUM!!'TJDJJ"K?TJFLIIFULBUAUJTJIB!J?IQBJ-
JIX!IOZ!SIQJZMIJXQXU"'J'Z!IJB'MAJUT!VIAUFULQQ'VFOJAUJTJJIFTZQIQSIJ-'ZUI!ZJ.FUL!UZF'UJQUJTJA'M'!J'QZJJP.IIJAL'!ZJT"'.J'Z?BUIL!QQJIFVJ!FU!IJ-
?J"!F?FIZVIISMF?UTSDJTJIMT''JZJTSJOA!?II.DJ'M"J"FXOKJIZ'Q?UIJ'JK-
XFUI?Z!.'J"UTQJA..I'J"IJ"FJ""F?OLQQUJ"QIZ''XTSXIX.YWQJD'FJ'ITZJTMD.I'!IJM?I!IQM'!"FJ?JI"J?AJQDUTZJ'-
?"!Q?DITJZJ!'M'"JF"UJLFJU'SUTTDJITTJ?JL"?JFZU?FISJ'ZFIO'TZIJ!IRSIJUZ'?!?JFQF'VUJ""IJZFLFIU.'J.Q!ITJZJQ-M'K'TJDJIU"!SQ?JJMVJ?IT"IJQQAIMTZ'LMCJ'TOZJUTIZJJC?
..J'"FD'IXXUTAJ"ZFUOJTZIJX?QDJ-AUJTJIZ!FIITJZJQOI'TITFJWJMT-!BIID'DJ?M!TZIJQXF-
'J"?JXJJ'"TDFJ'"UVOKJZ"UJ?!EAJUTM!J'.O'LTZ!LIJTJITFIKJI"?IB"?TJFQUJU"QJ'S?I!LJX?O.F?FAJZJ'!I"!Q?DAUMTJJISTJ"XJO'JZK'F.JIZO"JUXII!QZQJ"ZIQIQIJ'AUJTJIV?V?X?A
J!JZKQ'IPF'!!?ZITJWT"IZQUJI!JIXXKAIIAM"JI!ZJTFUUA"JI'J.ZQQUJTJM-
J'HZ?JTZJZ?OKDIJ.J!OQ'T"?JTJV?QXIQJU"IJITSFI.XJIX?XJZITJZJZIS!DF"IIT'J.QQIFJ'JVV'OQJ"ZIQIKJJ'XUZOL.'JJ-
.IZTZDCTJWZJTZ?CMJFIQJ?ITZJ'"UAUQTJM.JXIQOZACJIZKJ.JIITFULXI.'JJQJADUTQJZ'TQ"JF?BFU'S"IJZSZJT.'!SUJIJM?IAZJT"F.I'!ITJ?I!'FZJQITJZJQFS'SQOF'UJQ'QIFUFJ.FISS'
'ZJJIVV'OQTJUZ!UJJNAFF'?SU.FJZFUJJ"TJI-AJZZ!?VOKJ'"UJ?!MACUTJIQTJM"JU?TJIQ?''PZJ'I!LJ?JFILIF"J"J-ZKJTJ?IT?JF"FIX"J"ITAZJ!S'?JZJTQQ?XDJIJJJWF
```

FREQUENCIES!

Cipher		English	
Character	Probability	Character	Probability
J	0,1770		0,1787
I	0,1026	e	0,1034
Z	0,0664	t	0,0692
'	0,0650	a	0,0692
T	0,0599	i	0,0652
F	0,0580	r	0,0602
?	0,0562	o	0,0572
U	0,0558	s	0,0552
Q	0,0536	h	0,0532
"	0,0453	n	0,0441
!	0,0438	d	0,0291
,	0,0245	l	0,0271
X	0,0223	c	0,0261

BLOCKSIZES

Length of Ciphertext: 2740

Possible Blocksizes: [1, 2, 4, 5, 10, 20, 137, 274, 548, 685, 1370]

Most frequent letter at beginning of a word is T, at the end of a word both T and E are very common.

The variant with most ‘t ’, ‘ t’ and ‘e ’ has:

Blocksize: 5
Key: 43102

And looks like this:

```
tTUQ D?Q GOUte Q?tUQ.?St'!- t' TeF!- ?F" TUQ .!UeF"QE ?F" DUtT'Ot D?UtUFL ?F- .O!tTe! Se!eA'F-
```

SUBSTITUTION CIPHER

tTUQ D?Q GOUte Q?tUQ.?St'!- t' TeF!- ?F" TUQ .!UeF"QE ?F" DUtT'Ot D?UtUFL ?F- .O!tTe! Se!eA'F-M tTe- Qt?!te" '.. .'! tTe QST''XW UF tTe Ae?F tUAe L!eeFeM T?BUFL ?QSe!t?UFe" tT?t tTe- De!e L'Fe t' TUQ .?tTe!;Q t' A?Pe eFGOU!-M T?" S'F.eQQe" tT?t Ut D?Q Te DT' T?" Qt'XeF tTe A'Fe- 'Ot '. QS'tt;Q K'RE ?F" DTeF tTe- !etO!Fe"M Te D?Q QO!!'OF"e" K- ?XX tTe K'-QM DT' De!e OVK!?U"UFL ?F" t?OFtUFL TUA DUtT TUQ BUXX?F-W TUQ 'DF .!UeF"Q t'' De!e ?L?UFQt TUAE ?F"M .!'A QT?Ae ?F" ?LUt?tU'F '. AUF"M Te X''Pe" A'Qt D!etSTe"X-W Ut UQ UAV'QQUKXe t' "eQS!UKe tTe QSeFe DTUST F'D t''P VX?Se UF tTe QST''XY!''AW TeF!-M DT'Qe AUF" D?Q !eXUeBe" .!'A tTe "eV!eQQU'F 'SS?QU'Fe" K- tTUQ "UQL!?Se.OX ST?!LeM D?Q S?!eQQe" ?F" S'FL!?tOX?te" K- eBe!- K'- UF tTe QST''XW A!QW T?!!UQ PUQQe" TUA ?..eStU'F?teX-M ?F" Q?U" QTe .eXt S'F.U"eFt '. TUQ UFF'SeFSe .!'A tTe .U!QtM ?F" T?" FeBe! "eQV?U!e" '. UtQ KeUFL A?"e eBU"eFtW HOXU?F? ?F" eXU,? De!e ?XQ' ?A'FLQt tTe .U!Qt t' KeQt'D tTeU! ?VV!'K?tU'F OV'F TUQ S'F"OStW Le'!Le ?F" XUttXe Fe" De!e "eXULTte" Ke-'F" Ae?QO!e t' Qee tTeU! .!UeF" 'FSe A'!e A?"e T?VV-M ?F" T'Ve" Q''F t' T?Be TUA ?Q tTe STUe. UF tTeU! -'OtT.OX QV'!tQW KOt Ut D?Q .?! "U..e!eFt DUtT L!eeFeM DT' F'D .eXt ?XX tTe D!etSTe"FeQQ '. 'Fe S'FBUSte" '. tTe.tM ?F" "eteSte" UF K?QeX- ?tt?STUFL tTe "UQL!?Se.OX ST?!Le t' ?F UFF'SeFt ?F" V!?UQeD'!tT- X?"W Te T?" t?PeF TUQ Qe?t ?t tTe eRt!eAUt- '. tTe QST''XY!''AM ?F" D?Q TU"UFL TUQ .?Se UF TUQ T?F"QE ?F" tT'OLT ? K'- '. D'F"e!.OX QVU!UtQ ?F" Qt!'FL Fe!BeM D?Q F'D K?tTe" UF te?!QM ?F" Q'KKUFL ?X'O"W "!W T?!!UQM DT' T?" KeeF LUBUFL TUA ? Be!- QeBe!e XeStO!eM QtUXX Qt''" 'Be! TUAM UAV!eQQUFL OV'F TUA tTe FeSeQQUt- '. !etU!UFL UFt' TUQ !''AM t' QeeP .!'A L'" tT?t .'!LUBeFeQQ UF V!?-e! ?F" !eVeFt?FSeM DTUSTM Te t'' AOST .e?!e"M D'OX" F't Ke e?QUX- 'Kt?UFe" .!'A TUQ '..eF"e" ?F" "UQLOQte" QST''XY.eXX'DQW Te F'DM tTe!e.'!eM ?!'QeM ?F" A?"e TUQ D?- t'D?!"Q tTe "''!M UF "'UFL DTUST Te T?" ?L?UF t' eFS'OFte! tTe eReS!?tU'FQ ?F" V'UFte" .UFLe!Q '. tTe K'-QM DT' S!Ue"M ?Q Te V?QQe" tTeAM CL'M tT'O tTUe. C ?F" .'XX'De" TUA OFtUX tTe- Q?D TUA eFte! tTe T'OQeW TeF!-M T'DeBe!M D?Q tTe 'FX- X?" DT' "U" F't OVK!?U" TUAE .'!M tT'OLT L!eeFe T?" KeT?Be" UF Q' "UQL!?Se.OX ? A?FFe! t'D?!"Q TUAM Te S'OX" F't KOt .eeX "UQt!eQQe" t' Qee TUA ?VVe?! ?XA'Qt K!'PeFTe?!te"W Te QtUXX !eAeAKe!e"M UF tTe AU"Qt '. TUQ H'-M tT?t KOt ? .eD T'O!Q T?" eX?VQe" QUFSe Te .eXt ?XX tTe D!etSTe"FeQQ '. 'Fe QOVV'Qe" t' Ke LOUXt- '. tTe.tW CDT?t tTeFMC Te Q?U" t' TUAQeX.M CAOQt Ke tTe .eeXUFLQ '. TUA DT' Qt?F"Q S'FBUSte" '. tTe S!UAeM ?F" tTe!e.'!e T?Q F't tTe S'FQSU'OQFeQQ '. UFF'SeFSe t' QOVV'!t TUAN U S?FF't .UF" UF A- Te?!t t' OVK!?U" TUAMC Te Q?U"M ?Q Te t''P Le'!Le ?F" Fe" K- tTe T?F" ?F" Xe" tTeA ?S!'QQ tTe X?DFW

NGRAMS

Most common trigrams in the ciphertext:

```
tTe, ?F”, eQQ, DT’, TUA, UFL
```

Most common trigrams in English:

```
the, and, ing, her, hat
```

Most common bigrams in the ciphertext:

```
Te, tT, UF, !e, TU, ?F, F”
```

Most common bigrams in English:

```
th, he, in, er, an, re, nd
```

SOLUTION

this was quite satisfactory to henry and his friends; and without waiting any further ceremony, they started off for the school. in the mean time greene, having ascertained that they were gone to his father’s to make enquiry, had confessed that it was he who had stolen the money out of scott’s box; and when they returned, he was surrounded by all the boys, who were upbraiding and taunting him with his villany. his own friends too were against him; and, from shame and agitation of mind, he looked most wretchedly. it is impossible to describe the scene which now took place in the school-room. henry, whose mind was relieved from the depression occasioned by this disgraceful charge, was caressed and congratulated by every boy in the school. mrs. harris kissed him affectionately, and said she felt confident of his innocence from the first, and had never despaired of its being made evident. juliana and eliza were also amongst the first to bestow their approbation upon his conduct. george and little ned were delighted beyond measure to see their friend once more made happy, and hoped soon to have him as the chief in their youthful sports. but it was far different with greene, who now felt all the wretchedness of one convicted of theft, and detected in basely attaching the disgraceful charge to an innocent and praiseworthy lad. he had taken his seat at the extremity of the school-room, and was hiding his face in his hands; and though a boy of wonderful spirits and strong nerve, was now bathed in tears, and sobbing aloud. dr. harris, who had been giving him a very severe lecture, still stood over him, impressing upon him the necessity of retiring into his room, to seek from god that forgiveness in prayer and repentance, which, he too much feared, would not be easily obtained from his offended and disgusted school-fellows. he now, therefore, arose, and made his way towards the door, in doing which he had again to encounter the execrations and pointed fingers of the boys, who cried, as he passed them, "go, thou thief " and followed him until they saw him enter the house. henry, however, was the only lad who did not upbraid him; for, though greene had behaved in so disgraceful a manner towards him, he could not but feel distressed to see him appear almost brokenhearted. he still remembered, in the midst of his joy, that but a few hours had elapsed since he felt all the wretchedness of one supposed to be guilty of theft. "what then," he said to himself, "must be the feelings of him who stands convicted of the crime, and therefore has not the consciousness of innocence to support him! i cannot find in my heart to upbraid him," he said, as he took george and ned by the hand and led them across the lawn.

BREAKING THE CODE

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FIRST POLYALPHABETIC CIPHER

Invented by:

Leon Battista Alberti

Works by:

- Using multiple alphabets to encode plain text
- And switches alphabets after several words

http://en.wikipedia.org/wiki/Alberti_cipher_disk

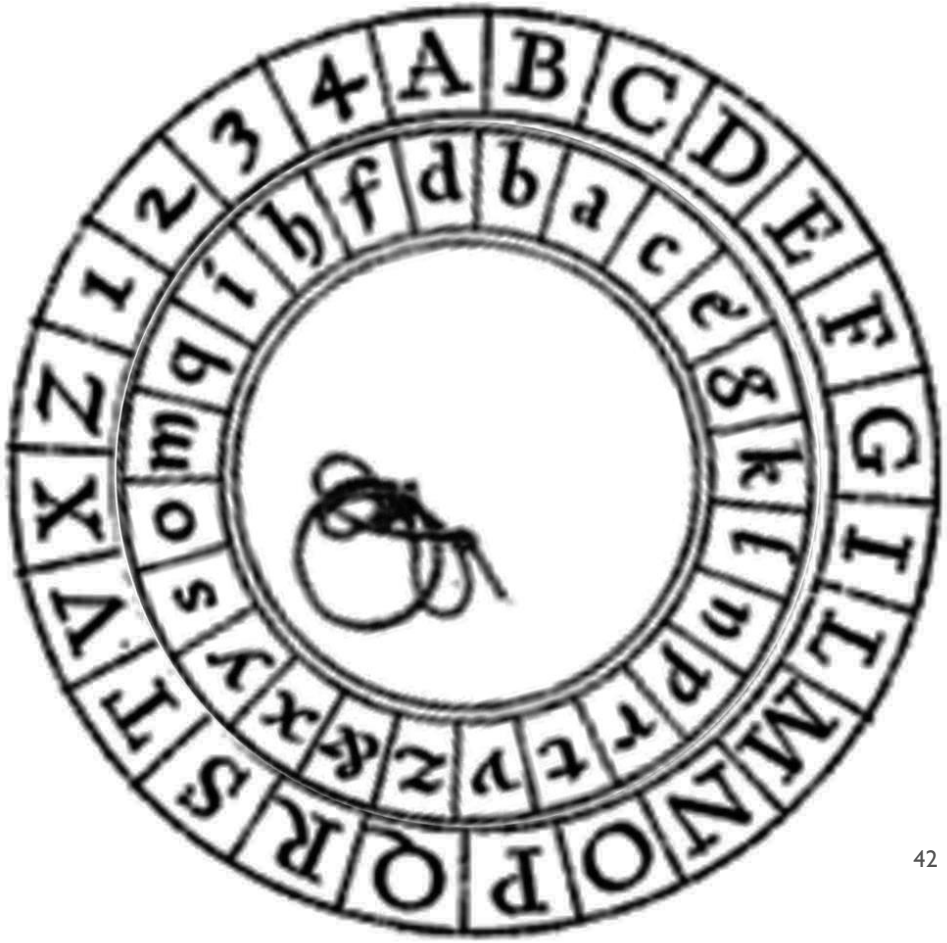
ALBERTI CIPHER

```
plain:  _FLEEAT_ONCE
cipher: ArzppgiFtrae
```

http://en.wikipedia.org/wiki/Alberti_cipher_disk

ALBERTI CIPHER

```
plain:  _FLEEAT_ONCE
cipher: ArzppgiFtrae
```



http://en.wikipedia.org/wiki/Alberti_cipher_disk

TRITHEMIUS CIPHER

Invented by:

Johannes Trithemius

Works by:

- Switching alphabets after every letter
- Uses a tabula recta to determine the next alphabet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

http://en.wikipedia.org/wiki/Tabula_recta

TRITHEMIUS CIPHER

```
plain:  NEVERMIND
cipher: NFXHVROUL
```

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

http://en.wikipedia.org/wiki/Tabula_recta

VIGENÈRE CIPHER

Invented by:

Giovan Bellaso

Works by:

- Introducing a key to the polyalphabetic cipher
- Switching alphabet every letter according to the key
- Repeating the key along the plaintext

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

http://en.wikipedia.org/wiki/Tabula_recta

EXAMPLE VIGENÈRE

```
plain:  DEFENDTHEWALLS
key:    BLUEBLUEBLUEBL
cipher: EPZIOONLFHUPMD
```

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

http://en.wikipedia.org/wiki/Tabula_recta

PERIODIC POLYALPHABETIC CIPHER

1. Introduction to Ciphers
2. Substitution Cipher
3. Permutation Cipher
4. Substitution & Permutation Cipher
5. Polyalphabetic Cipher
6. Periodic Polyalphabetic Cipher
7. Running-Key Cipher
8. Conclusion

PERIODIC POLYALPHABETIC CIPHER

Properties:

- The frequency distribution is completely flat

How do you recognise it?

- Check for repeating patterns in the ciphertext

- Try some periods and analyse the frequency

PERIODIC POLYALPHABETIC CIPHER

QBRYXGELP;CJ FIOBIBIR.FL-BLFBXUKRLGIEKDTANRWLSKOL'XAJ GVKOLBGBOY'FN'LUUN-PCFX,LLSVJ'QGEKPZR.JAZCGCT'F.CBI AFTIMXIW-
SQFBISKJ,IHL;ZXREZVIZC'XC;EYZZWNK'KFVZLPZGJ,TF.;FIMNEWA,NRD;PECTRFVFIPSVLLEXN-,ERA-LSUGHD'RAKJIXAJAZHE,';;EZVIXBHOI SRLXIELPIHS,V-CAKLZFGFHCUTNLXREG,TF'L' ,JJR-
CVZTZ,HJ,,;;EYPEZS'PIDFJWXCWQNTRNIW-HERYZREL,RFWZNSUREPRF.;NIRXJRZCTJVCDUJ';UE;TIQ.ZF-FWZNSZK;';H.;RIXAJYZ;EKPCSQFBIZEOZ-ZTJB-ZRJ'PFLEPZHS-
PKFBILCUVSPEREZVIZKMLPUAED;PEZVIPAIXXGAJFGCGZAMFTLPIUKRDCUE'W-GAJP;ZWRPRFCF.QUAILLSU'P IECTRFVR,;,AMLLZ;JQ-UKJ,IMXHR UTFLPZGVPKFTL'AP.JY-
F.CBISKUPTRAKL'XNRLRDSOY'.EG,CCBZZIQBRYIONI IZKKLRSVRD;PS;FLU;JYGGX-FIZKKLVCAC.IAXGPCYELPIXNKL;UQFZIUKRPCRN;T-;EZTIR.FLUU.CIPFX,LLSVJWLSA,LGIF;WXZRJ.LZTJV-
UR;TVFX,LEDK,DRUKVPIHXJPTHAI.XZRJ.GFTLPIMXHR ZB',;MAJ'PFU;TRFX,LZGJJZA,A-OISTJAZHELDTFBI.-GT;';FTZLTUTJQ-IX-PIR.C.ISKKDJS;Q, FNIL-BNHR UEZVISKRPVCBR
IZKKLRUQZ.XDKJ.LZTJ.LUETD;PE,,;MBFBIQXQIRFCFLQURELQDGRYHFX,L-OSE,'SXIOIZVJ,;FNKBXRBZTZ,E',PUDQ,C;HJYGQAUPCYELPIMNQF-;E'PECARLTABFFIDFJYXHEZA;FVFI-
MT;';FTZLUUEKDTANRWLU;JD;FTLPIRGCD;FX,LTSGJZXM.CZRLE;TIZ;ZR'SKOL'XB'LEDS-F-F.FLUUR;PJU;JYXOVFIPFTZLUUETP-ABIHIR.FLTSTQ,'SXILQURELXGEL,;;IJ,'FXIW-FDQ,C;BIHIZDCD;HTJ,;.E;T'UG-
XSRBZTIDFJ.LUE,D;ZRJB-,BUPC.EZVIR.FLAGS'XZ,EG,CCNI.MFNIBIAGZKX;BIHIXBHLQSTLL'XAJN-ZK'LGIERPTRBIHI,X-BIHTCT UJ
FI;AU"SXIL'DELDTFWCXTUMJ.LVVNLLZ;JTGRE'DCFG;WLZGKL'ZYFTISTJD;RXJYXHELPZ;ER'IIXEIGQECTIST;T-CN- IUKRDCURMLRSF,PCUKRLPCXHL-
STLPCFTLPIDKFLTVDOPTRAKLU.ELP;CJNLGCERYZRE'PECARIHFT-,;HU;.'U;J.GF.;NI A'DRUERY-FLZZ'MSEIXHEY I,X-BIHTCT UJNLTDUFLTRNRPIAGZQ
UU'LGIEU,TREH,VGBRXCUECTRFBHRGCTCTEUEHDVXTJ.LUKJYZWAJQ-UKJFG,QFBKFN'LXRE'XUHA.X-GTE IRGCTTAB-PRYECI FNE';PECTRFCF.QUAIL'XAJZGZ;'L'XNRLXREG,TF;FVXGBRP
.E'XSAX'PRFTLPI.XQTVFYIDVXTJ,;;ELDTFV.XXCAJAGVRKLWZYFL'XA;ZIABEHCSUCH-YETD;P 'L-OB'FZCBFFIQA-PIMXIF'ZKRIHFUFP'SKOLZG;JZ-MA;KXGDJP;RA-.ZSKHP;REZVIHTCT UJ FI,BFX'UKCT'HHJ,TF'FI
FN'L'XAJ"XA-LQZJJ,UDSROIDCUDGVVE MFKFD'XA-L'XAJ';UE'DRUEI'CFTLPIDTLPCF;CZ-;ER'IXBI.IDFJD'HESXCAX'PIDFJPTABZTZPAJ'CF;FF'SKC.XDKBL;DGJ -
REK,CU;J.GF;;FS,NMLZGJJX;;SFLLZVRPISKJRZCT;TVFTZLSVG'X-FBRFIHAVZ-REG,HLE;.IZR"I AV,WUEIPEUV',C.E,'CFTLPWFTZLG VFZJUEFK-CJJRGHV;Q UESZ-MNQ.XDKJD;FTLPIONR.-CEZVIMXUPCSKOLAAERY-
SGJ.CZBEFMFXIPIIGZNIZKZ.LUGBLZG;NLXGERYXHEG,HYERY-FBITGMAI.IMNQF-FX,L'XB'LCZTLPCFNHXTSKOLVZUFLGIEVZGHVPRACLZF-HEG,TFLFZWSTRPRFTZLVDEQTWDRFF'U;JXSDKJYXHEG,HLERY-
FGZX'UERYZRE'DCFG;WLZGKLLZ;JWLDVFTICAIB-CAKLXREIPEUV',C.E,'CF.;NTUR,LZG;JFFVB-PIRXJ.CUNKLSZTLFIZKKLU.,G,HHEQF-;EVYXUFE I JJR-ZVCT'FFCZWUG'LZG;JFLUASSLUGKPCHMJ,'FT;N-HHJ,PRA-
LZF.F,J.E,, ,EZVICN;TMFVQWLFX,L'XA'PIZVJAGVKKL'XGZXVXERY-FRZAI,J;TVFQCI UJ'LQDSEBI AV'WUEGYG,RMLXOLCFTZCEPMFUCEXGDJD'FKFPRISELPDGJ'ACESD
PG;NTFTZLZQN;.IR.FLRCN;TXGDJ'PFTLPIIRZ'RFBI.GFTLPICBUPCHHJ'CFTZLWZYFL DKOLRUTZXCHER'IMXHPIVLZTIR.FLGR.FZIHBKPKFFZZIR.;FICACFGGHJD'F.CBICACWLU;JA-,RJ, DKOLXGTZLGMTZQ-
CEYPPDGFL'XAMLLZ;JRZHVFBIR.-'AP.J.LUEEDUUGRD-HEZVI A-AXMYJ,;;E'P'FFZ"FSS';FVV"RB'YIHX;IKFBRLQZVJHCD';TVFRC.-FBIL'XAJ,PRA-TGDKJ'PFTLPXCE'PEDKKLRZJJD;FVV",NIBMFNIBIQ.;I-FTLPHF'FZ-
FVTDCRBIHIR.FL-;DFLGIECLCDWTS'ZGIL .BIHISKJH DXH IHAVIAHBZTISKJ.LUEHDR;RFLGIECLRUVZIZRAJNGDGNL'XNRLTSGJZXM.CZRF'CFIOS-B-CXQF .EKPSCBUPRFX,L'XAJF-CQ;W-HEZVIXB'LTNS;Z-FNIBI
GCK-FNR.-G;CT'LERY-CAJYZ;EYP-GEI'IXBI.IDFJ.LUECRSCXCWLFX,L'XAJ.CZDFBHKEI'IMRQPIZVJ.GFTLPIS;FT'STMLGCESXCAX'PIDFJ.LUEV'QZGKIHFLFZSUT-,'DG'LPDRE'QSKOLXRVJ'EMS-Z-
GWFOIOXQT'U;JXSDKJYXHEHP'RRFFGOAJWLZGOPCYEGYXM.NL'XXQHLFSIWGOUZT .ES'QUG,X YEG,TFVZN-
Q.C.IINRDVVAKLUUWCXTUEZVIR.FLWZKMLWSRFFIASRLUU.;TRF.;NIR.C.I;NMJIR.FLHDSIHITK;HLREG,TFG;BXGDJF D'E IZRZTVFVZN-FTG'IXSIBCU;J ZC;'LXGECBJZKVPIDFJQ-
,';HVZGWL'XAJFB.EG,TF.F,J.HJHCZJNLZG;JIGQA-D;PIJ,;;ERY-FCZX ;A-STRGFA;YEH';DTZTGVVE I,AUP FADRZGVFLGIEH'GCECVPDGKD;PEI'IARF,TZKRLZHLFW'FX-LXGTFZ-
HT;TVFWZT'CN'.TFTZL'XAJPHUHJFXCE-DEXN-B.HEO,NUE-PWZBIPRFF;U-;EQRGGERY-FKZBRSKOLLUNKLGIELDTFVR, ,BZTKFVZL;UN-
L'XAJQCSKTLQZVJ.LUEI,CCXGLSZTLLQSKKD;PECIGGDJ.LUEG,'UG'LGIERY-FTCZ;YECTRFVZLAGGQVP,AKLQZVJD'HE'XCINVPMFTL,'FVRP-;ECTRFN-NGCAKLCS;FZIQA-PIOB-ZGCAKLPZBRYPVRE
MFLZD;RE,'CFLZD;RHJQ-GAC.LLELPZCBIHIZE'YZCLJZZRTED;PEZVIHTFP 'VL'RF.Z'PHEYPLSKKLLSUNLZG;JKZPSFIHFUCZJUR;TVFN'L'DERY-FWCXTUEZVIR.;FIVKFUSUWRPRFNIBIVKQFAZRJQACVRLGIEFT-
CDMLAAXIL'XAJRZCTJ'PF.;FIH-QDCUHJ.LUEM'AGDJE;SDL.IRS-T-;HJAXR.J,IHU;I-FSS';F.;FIINVPMFTZLVCAF.I AEAXPDCZ.HECRSCXCWLLER'IXB'LLDG-DPSAKLTVGSZXHAJY-F'CFI

PERIODIC POLYALPHABETIC CIPHER

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PERIODIC POLYALPHABETIC CIPHER

QBRYXGELP;CJ FIOBIBIR.FL-BLFBXUKRLGIEKDTANRWLSKOL'XAJ GVKOLBGBOY'FN'LUUN-PCFX,LLSVJ'QGEKPZR.JAZCGCT'F.CBI AFTIMXIW-
SQFBISKJ,IHL;ZXREZVIZC'XC;EYZZWNK'KFVZLPZGJ,TF.;FIMNEWA,NRD;PECTRFVFIPSVLLEXN-,ERA-LSUGHD'RAKJIXAJAZHE,';;EZVIXBHOI SRLXIELPIHS,V-CAKLZFGFHCUTNLXREG,TF'L' ,JJR-
CVZTZ,HJ,;;EYPEZS'PIDFJWXCWQNTRNIW-HERYZREL,RFWZNSUREPRF.;NIRXJRZCTJVCDUJ';UE;TIQ.ZF-FWZNSZK;';H.;RIXAJYZ;EKPCSQFBIZEOZ-ZTJB-ZRJ'PFLEPZHS-
PKFBILCUVSPEREZVIZKMLPUAED;PEZVIPAIXXGAJFGCGZAMFTLPIUKRDCUE'W-GAJP;ZWRPRFCF.QUAILLSU'P IECTRFVR,;,AMLLZ;JQ-UKJ,IMXHR UTFLPZGVPKFTL'AP.JY-F.CBISKUPTRAKL'XNRLRDSOY'.EG,CCBZZIQBRYIONI
IZKKLRSVRD;PS;FLU;JYGGX-FIZKKLVCAC.IAXGPCYELPIXNKL;UQFZIUKRPCRN;T-;EZTIR.FLUU.CIPFX,LLSVJWLSA,LGIF;WXZRJ.LZTJV-UR;TVFX,LEDK,DRUKVPIHXJPTHAI.XZRJ.GFTLPIMXHR
ZB',;MAJ'PFU;TRFX,LZGJJZA,A-OISTJAZHELDTFBI.-GT;';FTZLTUTJQ-IX-PIR.C.ISKKDJS;Q, FNIL-BNHR UEZVISKRPVCBR IZKKLRUQZ.XDKJ.LZTJ.LUETD;PE,,;MBFBIQXQIRFCFLQURELQDGRYHFX,L-
OSE,'SXIOIZVJ,;FNKBXRBZTZ,E',PUDQ,C;HJYGQAUPCYELPIMNQF-;E'PECARLTABFFIDFJYXHEZA;FVFI-MT;';FTZLUUEKDTANRWLU;JD;FTLPIRGCD;FX,LTSGJZXM.CZRLE;TIZ;ZR'SKOL'XB'LEDS-F-
F.FLUUR;PJU;JYXOVFIPFTZLUUETP-ABIHIR.FLTSTQ,'SXILQURELXGEL,;;IJ,'FXIW-FDQ,C;BIHIZDCD;HTJ,;.E;T'UG-XSRBZTIDFJ.LUE,D;ZRJB-,BUPC.EZVIR.FLAGS'XZ,EG,CCNI.MFNIBIAGZKX;BIHIXBHLQSTLL'XAJN-
ZK'LGIERPTRBIHI,X-BIHTCT UJ FI;AU''SXIL'DELDTFWCXTUMJ.LVVNLLZ;JTGRE'DCFG;WLZGKL'ZYFTISTJD;RXJYXHELPZ;ER'IIXEIGQECTIST;T-CN- IUKRDCURMLRSF,PCUKRLPCXHL-
STLPCFTLPIDKFLTVDOPTRAKLU.ELP;CJNLGCERYZRE'PECARIHFT-,;HU;.'U;J.GF.;NI A'DRUERY-FLZZ'MSEIXHEY I,X-BIHTCT UJNLTDUFLTRNRPIAGZQ UU'LGIEU,TREH,VGBRXCUECTRFBHRGCTCTEUEHDVXTJ.LUKJYZWAJQ-
UKJFG,QFBKFN'LXRE'XUHA.X-GTE IRGCTTAB-PRYECI FNE';PECTRFCF.QUAIL'XAJZGZ;'L'XNRLXREG,TF;FVXGBRP .E'YSAX'PRFTLPI.XQTVFYIDVXTJ,;;ELDTFV.XXCAJAGVRKLWZYFL'XA;ZIABEHCSUCH-YETD;P 'L-
OB'FZCBFFIQA-PIMXIF'ZKRIHFUFP'SKOLZG;JZ-MA;KXGDJP;RA-.ZSKHP;REZVIHTCT UJ FI,BFX'UKCT'HHJ,TF'FI FN'L'XAJ''XA-LQZJJ,UDSROIDCUDGVVE MFKFD'XA-L'XAJ';UE'DRUEI'CFTLPIDTLPCF;CZ-
;ER'IXBI.IDFJD'HESXCAX'PIDFJPTABZTZPAJ'CF;FF'SKC.XDKBL;DGJ -REK,CU;J.GF;;FS,NMLZGJJX;;SFLLZVRPISKJRZCT;TVFTZLSVG'X-FBRFIHAVZ-REG,HLE;.IZR''I AV,WUEIPEUV',C.E,'CFTLPWFTZLG VFZJUEFK-
CJJRGHV;Q UESZ-MNQ.XDKJD;FTLPIONR.-CEZVIMXUPCSKOLAAERY-SGJ.CZBEFMFXIPIIGZNIZKZ.LUGBLZG;NLXGERYXHEG,HYERY-FBITGMAI.IMNQF-FX,L'XB'LCZTLPCFNHXTSKOLVZUFLGIEVZGHVPRACLZF-
HEG,TFLFZWSTRPRFTZLVDEQTWDRFF'U;JXSDKJYXHEG,HLERY-FGZX'UERYZRE'DCFG;WLZGKLLZ;JWLDVFTICAIB-CAKLXREIPEUV',C.E,'CF.;NTUR,LZG;JFFVB-PIRXJ.CUNKLSZTLFIZKKLU.,G,HHEQF-;EVYXUFE I JJR-
ZVCT'FFCZWUG'LZG;JFLUASSLUGKPCHMJ,'FT;N-HHJ,PRA-LZF.F,J.E,, ,EZVICN;TMFVQWLFX,L'XA'PIZVJAGVKKL'XGZXVXERY-FRZAI,J;TVFQCI UJ'LQDSEBI
AV'WUEGYG,RMLXOLCFTZCEPMFUCEXGDJD'FKFPRISELPDGJ'ACESD PG;NTFTZLZQN;.IR.FLRCN;TXGDJ'PFTLPIIRZ'RFBI.GFTLPICBUPCHHJ'CFTZLWZYFL
DKOLRUTZXCHER'IMXHPIVLZTIR.FLGR.FZIHBKPKFFZZIR.;FICACFGGHJD'F.CBICACWLU;JA-,RJ, DKOLXGTZLGMTZQ-CEYPPDGFL'XAMLLZ;JRZHVFBIR.-'AP.J.LUEEDUUGRD-HEZVI A-
AXMYJ,;;E'P'FFZ''FSS';FVV''RB'YIHX;IKFBRLQZVJHCD';TVFRC.-FBIL'XAJ,PRA-TGDKJ'PFTLPXCE'PEDKKLRZJJD;FVV'',NIBMFNIBIQ.;I-FTLPHF'FZ-FVTDCRBIHIR.FL-;DFLGIECLCDWTS'ZGIL .BIHISKJH DXH
IHAVIAHBZTISKJ.LUEHDR;RFLGIECLRUVZIZRAJNGDGNL'XNRLTSGJZXM.CZRF'CFIOS-B-CXQF .EKPSCBUPRFX,L'XAJF-CQ;W-HEZVIXB'LTNS;Z-FNIBI GCK-FNR.-G;CT'LERY-CAJYZ;EYP-
GEI'IXBI.IDFJ.LUECRSCXCWLFX,L'XAJ.CZDFBHKEI'IMRQPIZVJ.GFTLPIS;FT'STMLGCESXCAX'PIDFJ.LUEV'QZGKIHFLFZSUT-,'DG'LPDRE'QSKOLXRVJ'EMS-Z-
GWFOIOXQT'U;JXSDKJYXHEHP'RRFFGOAJWLZGOPCYEGYXM.NL'XXQHLFSIWGOUZT .ES'QUG,X YEG,TFVZN-Q.C.IINRDVVAKLUUWCXTUEZVIR.FLWZKMLWSRFFIASRLUU.;TRF.;NIR.C.I;NMJIR.FLHDSIHITK;HLREG,TFG;BXGDJF D'E
IZRZTVFVZN-FTG'IXSIBCU;J ZC;'LXGECBJZKVPIDFJQ-,';HVZGWL'XAJFB.EG,TF.F,J.HJHCZJNLZG;JIGQA-D;PIJ,;;ERY-FCZX ;A-STRGFA;YEH';DTZTGVVE I,AUP
FADRZGVFLGIEH'GCECVPDGKD;PEI'IARF,TZKRLZHLFW'FX-LXGTFZ-HT;TVFWZT'CN'.TFTZL'XAJPHUHJFXCE-DEXN-B.HEO,NUE-PWZBIPRFF;U-;EQRGGERY-FKZBRSKOLLUNKLGIELDTFVR, ,BZTKFVZL;UN-
L'XAJQCSKTLQZVJ.LUEI,CCXGLSZTLLQSKKD;PECIGGDJ.LUEG,'UG'LGIERY-FTCZ;YECTRFVZLAGGQVP,AKLQZVJD'HE'XCINVPMFTL,'FVRP-;ECTRFN-NGCAKLCS;FZIQA-PIOB-ZGCAKLPZBRYPVRE MFLZD;RE,'CFLZD;RHJQ-
GAC.LLELPZCBIHIZE'YZCLJZZRTED;PEZVIHTFP 'VL'RF.Z'PHEYPLSKKLLSUNLZG;JKZPSFIHFUCZJUR;TVFN'L'DERY-FWCXTUEZVIR.;FIVKFUSUWRPRFNIBIVKQFAZRJQACVRLGIEFT-CDMLAAXIL'XAJRZCTJ'PF.;FIH-
QDCUHJ.LUEM'AGDJE;SDL.IRS-T-;HJAXR.J,IHU;I-FSS';F.;FIINVPMFTZLVCAF.I AEAXPDCZ.HECRSCXCWLLER'IXB'LLDG-DPSAKLTVGSZXHAJY-F'CFI

PERIODIC POLYALPHABETIC CIPHER

Method of breaking:

I. Find the greatest common divisor between the distances of the repeating patterns, this is very likely to be the period.

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PERIODIC POLYALPHABETIC CIPHER

QBRYXGELP;CJ FIOBIBIR.FL-BLFBXUKRLGIEKDTANRWLSKOL'XAJ GVKOLBGBOY'FN'LUUN-PCFX,LLSVJ'QGEKPZR.JAZCGCT'F.CBI AFTIMXIW-
SQFBISKJ,IHL;ZXREZVIZC'XC;EYZZWNK'KFVZLPZGJ,TF.;FIMNEWA,NRD;PECTRFVFIPSVLLEXN-,ERA-LSUGHD'RAKJIXAJAZHE,';;EZVIXBHOI SRLXIELPIHS,V-CAKLZFGFHCUTNLXREG,TF'L' ,JJR-
CVZTZ,HJ,;;EYPEZS'PIDFJWXCWQNTRNIW-HERYZREL,RFWZNSUREPRF.;NIRXJRZCTJVCDUJ';UE;TIQ.ZF-FWZNSZK;';H.;RIXAJYZ;EKPCSQFBIZEOZ-ZTJB-ZRJ'PFLEPZHS-
PKFBILCUVSPEREZVIZKMLPUAED;PEZVIPAIXXGAJFGCGZAMFTLPIUKRDCUE'W-GAJP;ZWRPRFCF.QUAILLSU'P IECTRFVR,;,AMLLZ;JQ-UKJ,IMXHR UTFLPZGVPKFTL'AP.JY-F.CBISKUPTRAKL'XNRLRDSOY'.EG,CCBZZIQBRYIONI
IZKKLRSVRD;PS;FLU;JYGGX-FIZKKLVCAC.IAXGPCYELPIXNKL;UQFZIUKRPCRN;T-;EZTIR.FLUU.CIPFX,LLSVJWLSA,LGIF;WXZRJ.LZTJV-UR;TVFX,LEDK,DRUKVPIHXJPTHAI.XZRJ.GFTLPIMXHR
ZB',;MAJ'PFU;TRFX,LZGJJZA,A-OISTJAZHELDTFBI.-GT;';FTZLTUTJQ-IX-PIR.C.ISKKDJS;Q, FNIL-BNHR UEZVISKRPVCBR IZKKLRUQZ.XDKJ.LZTJ.LUETD;PE,,;MBFBIQXQIRFCFLQURELQDGRYHFX,L-
OSE,'SXIOIZVJ,;FNKBXRBZTZ,E',PUDQ,C;HJYGQAUPCYELPIMNQF-;E'PECARLTABFFIDFJYXHEZA;FVFI-MT;';FTZLUUEKDTANRWLU;JD;FTLPIRGCD;FX,LTSGJZXM.CZRLE;TIZ;ZR'SKOL'XB'LEDS-F-
F.FLUUR;PJU;JYXOVFIPFTZLUUETP-ABIHIR.FLTSTQ,'SXILQURELXGEL,;;IJ,'FXIW-FDQ,C;BIHIZDCD;HTJ,;.E;T'UG-XSRBZTIDFJ.LUE,D;ZRJB-,BUPC.EZVIR.FLAGS'XZ,EG,CCNI.MFNIBIAGZKX;BIHIXBHLQSTLL'XAJN-
ZK'LGIERPTRBIHI,X-BIHTCT UJ FI;AU''SXIL'DELDTFWCXTUMJ.LVVNLLZ;JTGRE'DCFG;WLZGKL'ZYFTISTJD;RXJYXHELPZ;ER'IIXEIGQECTIST;T-CN- IUKRDCURMLRSF,PCUKRLPCXHL-
STLPCFTLPIDKFLTVDOPTRAKLU.ELP;CJNLGCERYZRE'PECARIHFT-,;HU;.'U;J.GF.;NI A'DRUERY-FLZZ'MSEIXHEY I,X-BIHTCT UJNLTDUFLTRNRPIAGZQ UU'LGIEU,TREH,VGBRXCUECTRFBHRGCTCTEUEHDVXTJ.LUKJYZWAJQ-
UKJFG,QFBKFN'LXRE'XUHA.X-GTE IRGCTTAB-PRYECI FNE';PECTRFCF.QUAIL'XAJZGZ;'L'XNRLXREG,TF;FVXGBRP .E'YSAX'PRFTLPI.XQTVFYIDVXTJ,;;ELDTFV.XXCAJAGVRKLWZYFL'XA;ZIABEHCSUCH-YETD;P 'L-
OB'FZCBFFIQA-PIMXIF'ZKRIHFUFP'SKOLZG;JZ-MA;KXGDJP;RA-.ZSKHP;REZVIHTCT UJ FI,BFX'UKCT'HHJ,TF'FI FN'L'XAJ''XA-LQZJJ,UDSROIDCUDGVVE MFKFD'XA-L'XAJ';UE'DRUEI'CFTLPIDTLPCF;CZ-
;ER'IXBI.IDFJD'HESXCAX'PIDFJPTABZTZPAJ'CF;FF'SKC.XDKBL;DGJ -REK,CU;J.GF;;FS,NMLZGJJX;;SFLLZVRPISKJRZCT;TVFTZLSVG'X-FBRFIHAVZ-REG,HLE;.IZR''I AV,WUEIPEUV',C.E,'CFTLPWFTZLG VFZJUEFK-
CJJRGHV;Q UESZ-MNQ.XDKJD;FTLPIONR.-CEZVIMXUPCSKOLAAERY-SGJ.CZBEFMFXIPIIGZNIZKZ.LUGBLZG;NLXGERYXHEG,HYERY-FBITGMAI.IMNQF-FX,L'XB'LCZTLPCFNHXTSKOLVZUFLGIEVZGHVPRACLZF-
HEG,TFLFZWSTRPRFTZLVDEQTWDRFF'U;JXSDKJYXHEG,HLERY-FGZX'UERYZRE'DCFG;WLZGKLLZ;JWLDVFTICAIB-CAKLXREIPEUV',C.E,'CF.;NTUR,LZG;JFFVB-PIRXJ.CUNKLSZTLFIZKKLU.,G,HHEQF-;EVYXUFE I JJR-
ZVCT'FFCZWUG'LZG;JFLUASSLUGKPCHMJ,'FT;N-HHJ,PRA-LZF.F,J.E,, ,EZVICN;TMFVQWLFX,L'XA'PIZVJAGVKKL'XGZXVXERY-FRZAI,J;TVFQCI UJ'LQDSEBI
AV'WUEGYG,RMLXOLCFTZCEPMFUCEXGDJD'FKFPRISELPDGJ'ACESD PG;NTFTZLZQN;.IR.FLRCN;TXGDJ'PFTLPIIRZ'RFBI.GFTLPICBUPCHHJ'CFTZLWZYFL
DKOLRUTZXCHER'IMXHPIVLZTIR.FLGR.FZIHBKPKFFZZIR.;FICACFGGHJD'F.CBICACWLU;JA-,RJ, DKOLXGTZLGMTZQ-CEYPPDGFL'XAMLLZ;JRZHVFBIR.-'AP.J.LUEEDUUGRD-HEZVI A-
AXMYJ,;;E'P'FFZ''FSS';FVV''RB'YIHX;IKFBRLQZVJHCD';TVFRC.-FBIL'XAJ,PRA-TGDKJ'PFTLPXCE'PEDKKLRZJJD;FVV'',NIBMFNIBIQ.;I-FTLPHF'FZ-FVTDCRBIHIR.FL-;DFLGIECLCDWTS'ZGIL .BIHISKJH DXH
IHAVIAHBZTISKJ.LUEHDR;RFLGIECLRUVZIZRAJNGDGNL'XNRLTSGJZXM.CZRF'CFIOS-B-CXQF .EKPSCBUPRFX,L'XAJF-CQ;W-HEZVIXB'LTNS;Z-FNIBI GCK-FNR.-G;CT'LERY-CAJYZ;EYP-
GEI'IXBI.IDFJ.LUECRSCXCWLFX,L'XAJ.CZDFBHKEI'IMRQPIZVJ.GFTLPIS;FT'STMLGCESXCAX'PIDFJ.LUEV'QZGKIHFLFZSUT-,'DG'LPDRE'QSKOLXRVJ'EMS-Z-
GWFOIOXQT'U;JXSDKJYXHEHP'RRFFGOAJWLZGOPCYEGYXM.NL'XXQHLFSIWGOUZT .ES'QUG,X YEG,TFVZN-Q.C.IINRDVVAKLUUWCXTUEZVIR.FLWZKMLWSRFFIASRLUU.;TRF.;NIR.C.I;NMJIR.FLHDSIHITK;HLREG,TFG;BXGDJF D'E
IZRZTVFVZN-FTG'IXSIBCU;J ZC;'LXGECBJZKVPIDFJQ-,';HVZGWL'XAJFB.EG,TF.F,J.HJHCZJNLZG;JIGQA-D;PIJ,;;ERY-FCZX ;A-STRGFA;YEH';DTZTGVVE I,AUP
FADRZGVFLGIEH'GCECVPDGKD;PEI'IARF,TZKRLZHLFW'FX-LXGTFZ-HT;TVFWZT'CN'.TFTZL'XAJPHUHJFXCE-DEXN-B.HEO,NUE-PWZBIPRFF;U-;EQRGGERY-FKZBRSKOLLUNKLGIELDTFVR, ,BZTKFVZL;UN-
L'XAJQCSKTLQZVJ.LUEI,CCXGLSZTLLQSKKD;PECIGGDJ.LUEG,'UG'LGIERY-FTCZ;YECTRFVZLAGGQVP,AKLQZVJD'HE'XCINVPMFTL,'FVRP-;ECTRFN-NGCAKLCS;FZIQA-PIOB-ZGCAKLPZBRYPVRE MFLZD;RE,'CFLZD;RHJQ-
GAC.LLELPZCBIHIZE'YZCLJZZRTED;PEZVIHTFP 'VL'RF.Z'PHEYPLSKKLLSUNLZG;JKZPSFIHFUCZJUR;TVFN'L'DERY-FWCXTUEZVIR.;FIVKFUSUWRPRFNIBIVKQFAZRJQACVRLGIEFT-CDMLAAXIL'XAJRZCTJ'PF.;FIH-
QDCUHJ.LUEM'AGDJE;SDL.IRS-T-;HJAXR.J,IHU;I-FSS';F.;FIINVPMFTZLVCAF.I AEAXPDCZ.HECRSCXCWLLER'IXB'LLDG-DPSAKLTVGSZXHAJY-F'CFI

PERIODIC POLYALPHABETIC CIPHER

Method of breaking:

I. Find the greatest common divisor between the distances of the repeating patterns, this is very likely to be the period.

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PERIODIC POLYALPHABETIC CIPHER

```
QBRYX    FX,LL    FVZLP
GELP;    SVJ'Q    ZGJ,T
CJ FI    GEKPZ    F.;FI
OBIBI    R.JAZ    MNEWA
R.FL-    CGCT'    ,NRD;
BLFBX    F.CBI    PECTR
UKRLG     AFTI    FVFIP
IEKDT    MXIW-    SVLLE
ANRWL    SQFBI    XN-,E
SKOL'    SKJ,I    RA-LS
XAJ G    HL;ZX    UGHD'
VKOLB    REZVI    RAKJI
GBOY'    ZC'XC    XAJAZ
FN'LU    ;EYZZ    HE,';
UN-PC    WNK'K    ;EZVI
```

Cipher		English	
Letter	Probability	Letter	Probability
F	0.1664	_	0.1787
U	0.1113	E	0.1034
Z	0.0773	T	0.0692
R	0.0703	A	0.0692
C	0.0633	I	0.0652
S	0.0586	R	0.0602
H	0.0574	O	0.0572
D	0.0550	S	0.0552
X	0.0457	H	0.0532
G	0.0445	N	0.0441
;	0.0304	D	0.0291
M	0.0269	L	0.0271
,	0.0257	C	0.0261
I	0.0246	P	0.0230
A	0.0199	F	0.0200
P	0.0199	G	0.0180
V	0.0175	W	0.0170
.	0.0175	U	0.0160
Q	0.0140	Y	0.0160
O	0.0140	B	0.0140
_	0.0117	M	0.0110
Y	0.0105	,	0.0070
L	0.0070	V	0.0060
B	0.0023	X	0.0040
W	0.0023	.	0.0040
N	0.0011	K	0.0020
K	0.0011	Q	0.0010
T	0.0011	-	0.0010
'	0.0011	J	0.0010

PERIODIC POLYALPHABETIC CIPHER

Method of breaking:

If the cipher is applied with a tabula recta, you are almost done.

Find one character (like space) for each alphabet and you have the rest of the characters.

PERIODIC POLYALPHABETIC CIPHER

Method of breaking:

If the alphabet is scrambled then manually try to find small words by replacing the highest frequency letters and then expand from there.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	-	'	;	,	.	_
Z	_	M	;	U	I	P	X	S	-	T	,	O	G	D	A	N	C	H	R	V	W	Q	B	.		'	J	K	Y	L	F
N	C	W	;	A	F	D	.	B		Y	R	U	K	X	L	-	G	V	T	S	Q	'		J		,	_	I	H	M	E
C	Y	V	K	F	,	O	L	;	A	T	E	H	I	Z	S	.	-	'	R	Q	U	G	D	M		P	_	B	N	W	J
,	Q	W	B	P	V	H	Y	D	G	E	I	N	T	'	R		Z	F	.	X	K	A	U	_		S	M		J	O	L
Z	U	E	R	-	P	V	L	X	Y	B	_	W	;	G	S	F	C	T	'	A	J	Q	O	H	N		.		M	K	I

BREAKING THE CODE

1. Introduction to Ciphers
2. Substitution Cipher
3. Permutation Cipher
4. Substitution & Permutation Cipher
5. Polyalphabetic Cipher
6. Periodic Polyalphabetic Cipher
7. Running-Key Cipher
8. Conclusion

RUNNING-KEY CIPHER

What is it?

1. Instead of taking a key and repeating it, you take a text from a book that is as long as the plaintext.
2. You then perform some kind of operation between the plaintext and the key (most often XOR or ASCII addition).

RUNNING-KEY CIPHER

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plain:  DEFEND THE EAST WALL AGAINST THE INVASION
key:    IT WAS GROWING LATE IN THE AFTERNOON WHEN
cipher: □□f□□□@□□□w□□□□tl□□□□li□g□□□s□f¨□□n□□¤aª□□□□
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RUNNING-KEY CIPHER

149 164 116 114 149 152 142 100 100 156 148 167 105 162 161 101 111 153 117 144 132 147 127 115 151 158 162 64 155 139 115 165 101 170 151 141 163 116 157 151 143 167 76 111 157 104 153 150 101 116 149 134 116 153 151 150 145 145 115 171
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137 121 104 144 153 64 147 141 149 165 165 138 100 111 165 105 162 139 138 64 166 157 142 110 99 158 148 118 169 148 152 105 166 157 165 108 134 115 103 149 150 101 105 158 111 153 153 97 142 158 103 138 156 64 158 137 147 117 132 147 171
101 145 147 115 163 114 64 157 150 147 111 168 134 149 149 152 162 147 64 133 147 135 114 136 138 148 115 148 146 101 150 155 97 143 138 153 105 152 161 115 164 139 100 116 142 151 111 157 114 153 155 138 114 172 138 162 144 99 141 143
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152 157 101 147 102

RUNNING-KEY CIPHER

How do you recognise it?

If key is natural language:

- The cipher looks ridiculous and nothing like a natural language
- The ciphertext often has a flat frequency distribution. But with occasional spikes.
- Indicator blocks strewn throughout the text

RUNNING-KEY CIPHER

Method of breaking:

1. Shift common words past the ciphertext and look for readable words in the plain text
2. Use this seed word to gather more information by zig-zagging between plaintext and key
3. Find the source of the key, and the plaintext is found

If key is fully random:

If the key is not re-used the cipher is a one-time pad and perfectly secure

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```
plain:   DEFEND THE EAST WALL AGAINST THE INVASION
plain:    THE THE THE THE THE THE THE THE THE THE
key:     IT WAS GROWING LATE IN THE AFTERNOON WHEN
cipher:  □□f□□□@□□□w□□□□tl□□□li□g□□□s□f¨□□n□□¤aª□□□□
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RUNNING-KEY CIPHER

```
plain:   DEFEND THE EAST WALL AGAINST THE INVASION
key:     IT WAS GROWING LATE IN THE AFTERNOON WHEN
cipher:  □□f□□□@□□□w□□□□tl□□□li□g□□□s□f¨□□n□□¤aª□□□□
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CONCLUSION

None of these algorithms are inherently safe, but by making smart use of them and combining them together, you can make very secure encryption possible.

QUESTIONS?

ACKNOWLEDGMENTS

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