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14. ABSTRACT Three areas were investigated. First, new memory models of discrete-time and finitely-valued information sources are introduced and a universal code for the new model class is presented. An algorithm is developed to compute the code, and its practical (polynomial) computational and storage complexities are proved. Second, a statistical method is developed to estimate the memory depth of discrete-time and continuously-valued times series from a sample. (A practical algorithm to compute the estimator is a work in progress.) Third, finitely-valued spatial processes on a d-dimensional integer lattice were considered, which are natural models of images. The open					
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Report Title

Final Report: Statistical Inference on Memory Structure of Processes and Its Applications to Information Theory

ABSTRACT

Three areas were investigated. First, new memory models of discrete-time and finitely-valued information sources are introduced and a universal code for the new model class is presented. An algorithm is developed to compute the code, and its practical (polynomial) computational and storage complexities are proved. Second, a statistical method is developed to estimate the memory depth of discrete-time and continuously-valued times series from a sample. (A practical algorithm to compute the estimator is a work in progress.) Third, finitely-valued spatial processes on a d-dimensional integer lattice were considered, which are natural models of images. The open problem of statistical estimation of the spatial memory structure from a single observation of the process in a finite window has been solved.

Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:

(a) Papers published in peer-reviewed journals (N/A for none)

Received

Paper

TOTAL:

Number of Papers published in peer-reviewed journals:

(b) Papers published in non-peer-reviewed journals (N/A for none)

Received

Paper

TOTAL:

Number of Papers published in non peer-reviewed journals:

(c) Presentations

Number of Presentations: 0.00

Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

Peer-Reviewed Conference Proceeding publications (other than abstracts):

Received Paper

TOTAL:

Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):

(d) Manuscripts

Received Paper

05/11/2016 1.00 Hee Sun Kim, Zsolt Talata. Context Set Weighting Method,
IEEE International Symposium on Information Theory (01 2016)

TOTAL: 1

Number of Manuscripts:

Books

Received Book

TOTAL:

Received Book Chapter

TOTAL:

Patents Submitted

Patents Awarded

Awards

Hee Sun Kim, a doctoral student, inducted in to Mu Sigma Rho, the National Statistics Honorary Society in 2014

Graduate Students

NAME	PERCENT SUPPORTED	Discipline
Hee Sun Kim	0.14	
FTE Equivalent:	0.14	
Total Number:	1	

Names of Post Doctorates

NAME	PERCENT SUPPORTED
FTE Equivalent:	
Total Number:	

Names of Faculty Supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>	National Academy Member
Zsolt Talata	0.78	
FTE Equivalent:	0.78	
Total Number:	1	

Names of Under Graduate students supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>	Discipline
Amy Goodpasture	0.04	Mathematics
Xi Li	0.02	Mathematics
Yiming Tan	0.02	Mathematics
FTE Equivalent:	0.08	
Total Number:	3	

Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: 1.00

The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:..... 0.00

Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):..... 1.00

Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:..... 0.00

The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense 0.00

The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields: 0.00

Names of Personnel receiving masters degrees

<u>NAME</u>
Hee Sun Kim, M.A. in Mathematics v
Total Number: 1

Names of personnel receiving PHDs

<u>NAME</u>
Total Number:

Names of other research staff

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
FTE Equivalent:	
Total Number:	

Sub Contractors (DD882)

Inventions (DD882)

Scientific Progress

Foreword

The research project addressed statistical model selection problems. The nine-month STIR funding provided opportunities for a doctoral and three undergraduate students as well.

1 Studied Problems

1.1 Statistical Estimation of Context Sets

A finitely-valued stationary ergodic process has finite memory if the probability of the next symbol depends only on a finite number k of preceding symbols. Then the process is said to be a Markov chain of order k . The context tree model allows the number k of relevant preceding symbols to vary with the past. The strings of these relevant suffixes of the past are called contexts and their lengths may be substantially shorter than the Markov order. The set of all contexts for a process can be represented by a tree graph, and is called context tree. The research aimed at developing a more powerful model that allows the probability of the next symbol to depend on a not necessarily consecutive sequence of preceding symbols. The collection of these relevant sets of preceding symbols for a process is called context set.

The research concentrated on the problem of statistical estimation of context sets of processes from a sample, a realization of finite length. This is a statistical model selection problem.

1.2 Source Coding for Context Sets

Markov chain and context tree models of time series play a central role in information theory for lossless source coding, because they allow to construct high performance codes for information sources. The two-stage coding approach uses a model selection method to estimate the model, and then a code tailored to the estimated model. A more efficient approach is to use universal codes mixing all possible models. This direct approach can be regarded as a Bayes estimation problem.

The research considered the application of context set models in information theory, and focused on constructing a universal code for this model class.

1.3 Statistical Markov Order Estimation of Real-Valued Markov Chains

The Markov property can be generalized to discrete-time and real-valued processes, but the statistical estimation of the Markov order requires a different approach than in the finitely-valued case. The research investigated this statistical problem.

1.4 Statistical Estimation of Variable Basic Neighborhood of Random Fields

The other direction of research considered random fields. For Markov random fields on the multidimensional integer lattice with finite state space, the basic neighborhood is the smallest region that determines the conditional distribution at a site on the condition that the values at all other sites are given. The variable neighborhood random field model allows the basic neighborhood to depend on the configuration around the sites. Statistical estimation of the system of these neighborhoods from a sample, a single realization of the field on a finite region, was addressed.

2 Summary of Results

2.1 For DNA sequences analyzed before in the statistical literature, statistical estimators of context set models are computed. Using an idea inspired by the PI's recent results for Markov random fields, the set of all possible contexts are estimated with nearly linear computation complexity, and then an optimal context set model is selected. The algorithm is implemented in R.

2.2 Contexts of stationary ergodic sources are considered not necessarily consecutive sequences of symbols of the past. The introduced context set model of a source provides a code that can achieve less parameter redundancy than the code the context tree and generalized context tree models provide. The problem of coding sources with unknown context set is addressed for multialphabet sources. Information on the maximum memory length of the source is not required; it may be even infinite. The Context Set Weighting method is introduced to efficiently calculate a mixture of the Krichevsky-Trofimov distributions over possible context sets. The coding distribution is proved to provide a code whose model redundancy does not exceed the order of the parameter redundancy. An algorithm is provided to compute the Context Set Weighting in a polynomial time.

2.3 Markov chains with real values are considered, and the Markov order is estimated from a sample, an n -length realization of the process. Strong consistency of the estimator is proved under a mild mixing condition, and an algorithm is provided to compute it in polynomial time.

2.4 For random fields on the d -dimensional integer lattice with finite state space, the basic neighborhood is the smallest region that determines the conditional distribution at a site given the values at all other sites. For variable basic neighborhood random fields the basic neighborhood may vary with the values at the surrounding sites, and the sets of the values in these basic neighborhoods are called context blocks. The context blocks may be infinite. Statistical estimation of the context block system of a random field from a sample, a single realization of the random field observed in a finite region, is addressed. The Optimal Likelihood Ratio (OLR) estimator is introduced. Its nearly linear computation complexity is shown and a bound on the probability of the estimation error is proved that implies strong consistency of the estimator. In the special case when all the context blocks lie in a uniform finite basic neighborhood, therefore the random field is a Markov random field, the OLR estimator of the basic neighborhood is proved to have similar bounds on the probability of the estimation error and computation complexity. This provides a solution to the open problem of estimating the basic neighborhood of Markov random fields with feasible computational complexity.

3 Dissemination of Results

3.1 Statistical estimation of context set models for DNA sequences involved three undergraduate students. First Amy Goodpasture worked on the problem (her report is attached) and then the team Xi Li and Yiming Tan continued the work (their report is appended to the previous one). Based on the experience, the theoretical background - i.e., the statistical analysis - of the method will be explored in the summer of 2016.

3.2 Source coding for context sets involved a doctoral student, Hee Sun Kim. She and the PI submitted the results to the 2015 IEEE International Symposium on Information Theory, but the paper was rejected. Incorporating the reviewers' suggestions, the paper was submitted to the 2016 IEEE International Symposium on Information Theory and it has been accepted. The extension of the results (35 pages) will be submitted to IEEE Transactions on Information Theory in June, 2016.

3.3 Statistical Markov order estimation of real-valued Markov chains is well described and its consistency is proved, but the detailed description of its efficient computation is still a work in progress.

3.4 Statistical estimation of variable basic neighborhood of random fields was submitted to The Annals of Statistics, and the PI is working on the requested revision.

4 Broader Impacts

At the PI's department, the PhD students hold a Graduate Teaching Assistant position that waives the tuition and provides 9-month salaries. They get summer support from the department after they have passed the qualifying exams. By the summer of 2014, Hee Sun Kim had not passed the exams yet but she was prepared to give up her scientific career because her family suddenly lost all income. The grant provided a full summer support for her and saved the carrier of a talented and hard-working student who now is expected to have a bright mathematical career. Moreover, in my statistics class I involved the top three undergraduate students in the research project. They gained experience what research means in statistics, and this contributed to their careers. In particular, Amy Goodpasture works as a trade accounting analyst now, Xi Li is in a graduate program in economics and Yiming Tan is graduating with a B.S. in mathematics in Fall 2016.

Technology Transfer

Undergraduate Research Paper

Introduction

My research considered memory models of finite-valued time series, and I specifically applied this to DNA sequences. I explored Markov chain models using a finite memory depth of 3. After applying an estimation criterion, I was able to vary the depth with position, so that it depended on the preceding values. Additionally, I considered a new model, which allowed the relevant histories to not be continuous. I used the statistical software R to implement estimation algorithms.

Problem

My goal for this research was two-fold. First, I wanted to explore the idea of having some method of predicting a value within a given DNA sequence based on perhaps limited information of its preceding values. Second, I was familiar with the programming language R before this research, but I had no prior code writing experience. So I wanted to use this opportunity to learn a new skill, and to challenge my problem solving skills.

Process

DNA sequences are made-up combinations of four letters: a, c, t, and g. I choose a particular DNA sequence from a *Drosophila melanogaster*, or fruit fly, of length 1714¹. The first step in my research was to write a code that would create a table for my output that contained all string combinations, of a,c,t, and g for a depth of 3. Depth of 3 refers to a string within the DNA sequence that includes one value at position n and the 3 values preceding it in positions, $n-1$, $n-2$, and $n-3$. I will use the notation of s to denote the string containing the values in position $n-1$, $n-2$, and $n-3$, and the notion of a to denote the value in position n . So this table would contain 4^4 possible string combinations, or 256. Additionally I wrote a code to look at all string combinations of depth 2, so I could use this in the denominator when calculating the probabilities for obtaining each string combination (detailed below).

In addition to creating a model that considers continuous strings, such as *aact* or *aacg*, I explored a model that would allow for discontinuities, or stringoids. This model would let me look at strings with missing (or irrelevant) values, such as *axct* or *aaxg*. Here the x allows for this position to take on any of the four values: a, c, t, or g. So *axct* is equal to *aact*, *acct*, *atct*, or *agct*. This is to say that to determine the value in position n , it is enough to know what values are in position $n-1$ and $n-3$, and it is not necessary to know what value is in position $n-2$. So it was also necessary to write a code to create a table for my output that contained all stringoid combinations. So this table would contain ${}_5C_3 \times 3! \times 4$, or 240 possible string combinations. Additionally I wrote a code to look at all stringoid combinations of

¹ National Center for Biotechnology Information, *Drosophila melanogaster* sequence scaffold 211000022279206, complete sequence:
<http://www.ncbi.nlm.nih.gov/nuccore/AC246461.1>

depth 2, so I could use this in the denominator when calculating the probabilities for obtaining each string combination (detailed below).

The second step in my research process was to count in occurrences of each string and stringoid within my dataset for depth 2 and 3. After I had counted the occurrences, I could then calculate the probabilities for each value in position n , or a , given the preceding string or stringoid s . The probability is defined as $P(a|s) = \frac{P(sa)}{P(s*)}$, where $P(sa)$ is the number of occurrences within my dataset of the given string or stringoid combination of depth 3. And $P(s*)$ is the number of occurrences within my dataset of the given string or stringoid combination of depth 2, where s does not occur in the last position. For example, $P(c|aaa) = P(aaac)/P(aaa*)$, where $aaa*$ and not in the last position. Which is equal to $[\text{count}(aaac) \div \text{count}(\text{all depth 3})] \div [\text{count}(aaa) \div \text{count}(\text{all depth 2 minus 1})]$. Since $\text{count}(\text{all depth 3})$ is equal to $\text{count}(\text{all depth 2 minus 1})$, this simplifies to $P(c|aaa) = \text{count}(aaac)/\text{count}(aaa)$.

The third step in my research was to use an estimation method to determine whether it is correct to use a stringoid in prediction, or if it was necessary to use a string. If the truth were that I only need to know axc to predict the next value to be t , then I would be underestimating if I said that I needed to know atc to predict t . Conversely, I would be overestimating if I said that I need to know axx in order to predict t as the next value. In order to have a set of string and stringoid probabilities that is both irreducible and contain no coherent or similar contexts, I use the following estimation criteria. Where s represents strings and sz represents stringoids.

$$-\sum_{y=a,c,t,g} N_n(s, y) \log \frac{N_n(s, y)}{N_{n-1}(s)} + \sum_z \sum_{y=a,c,t,g} N_n(sz, y) \log \frac{N_n(sz, y)}{N_{n-1}(sz)} \leq \sqrt{N_n(s)}$$

If the previous inequality holds, then the respective stringoid is deemed not relevant. Conversely if the inequality does not hold, then the respective stringoid is deemed relevant. By deeming the stringoid relevant, I assigned it the value of 1 otherwise 0. Additionally I retroactively assign values of 0 to those stringoid combinations that are coherent, or similar, to those that have have been deemed not relevant. For example, if I assign a value of 0 to xgt , then I need to make sure that xxt and xgx are also assigned a value of 0. Then I go through and assign 0 to those strings who have had at least one respective stringoid assigned a 1, and I assign 1 to all others. Finally I create a results table to display the probabilities of those strings and stringoids that have been assigned a 1; this is achieved by multiplying the probabilities by either 1 or 0, respectively.

Results

My results show that for this data set, the total number of relevant pasts are 172. Notably, only eleven of the 256 string combinations is deemed relevant. Also it would seem that from this data set, in many cases it is enough to only know the

values in positions $n-1$ and $n-2$. Also, the majority of the time, it is enough to know two of the three values in the relevant pasts; however, in no instance is it enough to know just one value. See Table 1 in the appendix for these results. Finally Table 2 in the appendix shows the probabilities of each relevant past, so that a prediction can be made.

Appendix

Output

> x

```
[1] aaacgaattttacattgtacatattagggtag
[32] ttttttccaatgggcggtggcgatatgataaa
[63] ataaaataagtttttaaaaaaattaaagcttt
[94] ttaaattcgtttgttaaaattgcgctcgaat
[125] tagctaccgttaaaacattttatatattatggt
[156] taattctaatttgtctctcatctgacaattt
[187] tttaaaagcgaaatatTTTTTTTgaaacact
[218] gttaatcctaatagtttacatgatattaagtca
[249] aatgactaatatcatgtaccctttatatacct
[280] ttaatgatacccttaatacctttaatgacta
[311] ctaaataattaaaggaagtacaatagaaatt
[342] attatagctcctgtaatttcataaattttcc
[373] aaaaagaagacattacgttgagaaataaata
[404] tttcataaaaataaattttataaaataaataa
[435] acatataactgttcattgcaaaagtcataatc
[466] aaagacactagaattattctagatttacata
[497] gatttggctatttctaattctattttcaaata
[528] ataataacgttaaggcaatgcaaaacaagaa
[559] ttcttcgcatgggtgcccaattgatcaaaaata
[590] atatagattttaaaagtcaaagaacttctaagg
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[652] atgagcatacgtgtgcacacatgcagctgtc
[683] tgctatcactgtatgcgtagaaaagagctgt
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[807] tgcattcttgttattctagtgtctttggtcct
[838] gtcaaccctttaagcacgtgtcaaaaactca
[869] aagaaaaagacgatgactttgaagtctacaa
[900] gtcataatttctgtgaacgagtgaactggcaa
[931] catgtcgaagcccgtaagtaactaggtttttc
[962] ctatagaaattatagcaagtcacagtaaaat
[993] cttgaaccagagaacaacaacaacacagcag
[1024] ctggatcaattgggttcctcggaatcaagggc
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[1210] atgatgattcacgcgcgatacatcaggtcgg
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```
[1241] atcgtggtgtgaatgatatgcaccgaaagta  
[1272] atgagaggagactttgaatcgtgtccgaata  
[1303] tcttctgaaataggaagaacaccctgccagt  
[1334] gggcctcagcgatgtgtgggccaagtcaacg  
[1365] gtgaagatctactgtccacgctgtaaaaact  
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[1427] ttgagcccagcttctcggacatctgccgaac  
[1458] ttgagaccgccccctggacgacccacggtaag  
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[1582] ccacttaaatacgcccaagtcctcaccaaaga  
[1613] atatcgaatcctccctcggccagctagtcct  
[1644] tctcctcgtccagcattccgaagtcaagcg  
[1675] cttcaatgttctaggaatgacgtatttttta  
[1706] actccacac
```

Levels: a c g t

> m

[1] 1714

Table 1

> R4

```
[1,] [1] [2] [3] [4] [5]
[1,] "a" "a" "a" "a" "0"
[2,] "c" "a" "a" "a" "0"
[3,] "t" "a" "a" "a" "0"
[4,] "g" "a" "a" "a" "0"
[5,] "a" "c" "a" "a" "0"
[6,] "c" "c" "a" "a" "0"
[7,] "t" "c" "a" "a" "0"
[8,] "g" "c" "a" "a" "0"
[9,] "a" "t" "a" "a" "0"
[10,] "c" "t" "a" "a" "0"
[11,] "t" "t" "a" "a" "0"
[12,] "g" "t" "a" "a" "0"
[13,] "a" "g" "a" "a" "0"
[14,] "c" "g" "a" "a" "0"
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```
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[46,] "c" "g" "t" "a" "1"
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[82,] "c" "a" "c" "c" "0"
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[474,] "x" "c" "x" "t" "0"
[475,] "x" "t" "x" "t" "0"
[476,] "x" "g" "x" "t" "0"
[477,] "x" "a" "x" "g" "0"
[478,] "x" "c" "x" "g" "0"
[479,] "x" "t" "x" "g" "0"
[480,] "x" "g" "x" "g" "0"
[481,] "a" "x" "x" "a" "0"
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[484,] "g" "x" "x" "a" "0"
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[486,] "c" "x" "x" "c" "0"
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[488,] "g" "x" "x" "c" "0"
[489,] "a" "x" "x" "t" "0"
[490,] "c" "x" "x" "t" "0"
[491,] "t" "x" "x" "t" "0"
[492,] "g" "x" "x" "t" "0"
[493,] "a" "x" "x" "g" "0"
[494,] "c" "x" "x" "g" "0"
[495,] "t" "x" "x" "g" "0"
[496,] "g" "x" "x" "g" "0"

> R4sum
[1] 172

Table 2

> F4

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[16,] "g" "g" "a" "a" "0"
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[218,] "c" "t" "c" "g" "0"	[263,] "x" "t" "c" "a" "0.26605504587156"
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 [339,] "t" "x" "a" "c" "0.137254901960784"
 [340,] "g" "x" "a" "c" "0.230769230769231"
 [341,] "a" "x" "c" "c" "0.185567010309278"
 [342,] "c" "x" "c" "c" "0.233766233766234"
 [343,] "t" "x" "c" "c" "0.198019801980198"
 [344,] "g" "x" "c" "c" "0.256410256410256"
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 [346,] "c" "x" "t" "c" "0"
 [347,] "t" "x" "t" "c" "0.217391304347826"
 [348,] "g" "x" "t" "c" "0.270588235294118"
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 [350,] "c" "x" "g" "c" "0.287878787878788"
 [351,] "t" "x" "g" "c" "0.209302325581395"
 [352,] "g" "x" "g" "c" "0"
 [353,] "a" "x" "a" "t" "0.301587301587302"

[354,] "c" "x" "a" "t" "0.189189189189189"
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[366,] "c" "x" "g" "t" "0.318181818181818"
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[375,] "t" "x" "c" "g" "0.148514851485149"
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[413,] "a" "g" "x" "c" "0.273684210526316"
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[434,] "c" "a" "x" "g" "0.226415094339623"
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"0.197916666666667"
[437,] "a" "c" "x" "g" "0.186813186813187"
[438,] "c" "c" "x" "g" "0.25"
[439,] "t" "c" "x" "g" "0.18348623853211"
[440,] "g" "c" "x" "g" "0"

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[442,] "c" "t" "x" "g" "0.264150943396226"
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[448,] "g" "g" "x" "g" "0"
[449,] "x" "x" "a" "a" "0"
[450,] "x" "x" "c" "a" "0"
[451,] "x" "x" "t" "a" "0"
[452,] "x" "x" "g" "a" "0"
[453,] "x" "x" "a" "c" "0"
[454,] "x" "x" "c" "c" "0"
[455,] "x" "x" "t" "c" "0"
[456,] "x" "x" "g" "c" "0"
[457,] "x" "x" "a" "t" "0"
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[465,] "x" "a" "x" "a" "0"
[466,] "x" "c" "x" "a" "0"
[467,] "x" "t" "x" "a" "0"
[468,] "x" "g" "x" "a" "0"

[469,] "x" "a" "x" "c" "0"
[470,] "x" "c" "x" "c" "0"
[471,] "x" "t" "x" "c" "0"
[472,] "x" "g" "x" "c" "0"
[473,] "x" "a" "x" "t" "0"
[474,] "x" "c" "x" "t" "0"
[475,] "x" "t" "x" "t" "0"
[476,] "x" "g" "x" "t" "0"
[477,] "x" "a" "x" "g" "0"
[478,] "x" "c" "x" "g" "0"
[479,] "x" "t" "x" "g" "0"
[480,] "x" "g" "x" "g" "0"
[481,] "a" "x" "x" "a" "0"
[482,] "c" "x" "x" "a" "0"
[483,] "t" "x" "x" "a" "0"
[484,] "g" "x" "x" "a" "0"
[485,] "a" "x" "x" "c" "0"
[486,] "c" "x" "x" "c" "0"
[487,] "t" "x" "x" "c" "0"
[488,] "g" "x" "x" "c" "0"
[489,] "a" "x" "x" "t" "0"
[490,] "c" "x" "x" "t" "0"
[491,] "t" "x" "x" "t" "0"
[492,] "g" "x" "x" "t" "0"
[493,] "a" "x" "x" "g" "0"
[494,] "c" "x" "x" "g" "0"
[495,] "t" "x" "x" "g" "0"
[496,] "g" "x" "x" "g" "0"

R Code

```
#Undergraduate Research
#-----
#After all code has finished, matrix R4 and F4 will contain the final results for depth 3.
#Matrix R4 and F4 should be interpreted as follows: each row represents a possible
string/stringoid observable for depth of 3, where x is only found in the stringoids and can take on
any value. Columns 1-3 contain the possible relevant past, and column 4 contains the possible
following value.
#Matrix R4 contains the relevant pasts, where it is relevant if column 5 is 1, and it is not relevant if
column 5 is 0.
#R4sum holds to total numbers of relevant pasts.
#Matrix F4 contains the probability of obtaining the following value in column 4, given the
preceding values in columns 1-3, unless the sequence is deemed not relevant, then it will contain
0.

#Additional Description of Variables
#-----
#y is column vector of possible string characters {a,c,t,g}
#n is the length of y, ie=4
#x is vector the entire sequence
#m is the length of x
#Y4 is the matrix of string combinations,
#   ie {a,c,t,g OR aa,ac,at,...,gg OR aaa,aac,aat,...,ggg}
#C4 is a column vector that displays the number of occurrences of the string matching the row in
Y
#P4 is a column vector that displays the probability of obtaining the string matching the row in Y
for the numerator
#PD4 is a column vector that displays the probability of obtaining the string matching the row in Y
for the denominator
#PS4 is a column vector that displays the probability of obtaining the last place in the string, given
the preceding placements. This matches the format  $P(c|a)=P(ac)/P(a^*)$  or  $P(c|aa)=P(aac)/P(aa^*)$ ,
where  $a^*$  and  $aa^*$  are and not in the last position
#E4 is a column matrix containing the estimation for each string/stringoid combination
#MM4 is a column matrix containing either 1 or 0, depending on the relevant past for the
corresponding string/stringoid. This is column 5 for matrix R4.

#Code
#-----
date()

data <- read.table("actg.txt", header=TRUE)
y=data$String
y=matrix(y)
n=length(y)
```

```
dat <- read.table("DNA1714.txt", header=TRUE)
x=dat$String
m=length(x)
```

```
#String Depth 0
```

```
#-----
l=1
a=NULL
col=1
for(i in 1:n)
  {a=matrix(c(a,rep(y[i],n^(l-col)))))}
```

```
Y1=matrix(c(a),(length(a)))
```

```
#String Depth 1
```

```
#-----
l=2
a=NULL
col=1
for(i in 1:n)
  {a=matrix(c(a,rep(y[i],n^(l-col)))))}
```

```
b=NULL
col=2
for(i in 1:n)
  for(j in 1:n)
    {b=matrix(c(b,rep(y[j],n^(l-col)))))}
```

```
Y2=matrix(c(b,a),(length(a)))
```

```
#String Depth 2
```

```
#-----
l=3
a=NULL
col=1
for(i in 1:n)
  {a=matrix(c(a,rep(y[i],n^(l-col)))))}
```

```
b=NULL
col=2
for(i in 1:n)
  for(j in 1:n)
    {b=matrix(c(b,rep(y[j],n^(l-col)))))}
```

```
c=NULL
```

```
col=3
for(i in 1:n)
for(i in 1:n)
for(i in 1:n)
{c=matrix(c(c,rep(y[i],n^(l-col))))}
```

```
Y3=matrix(c(c,b,a),(length(a)))
```

```
#String Depth 3
```

```
#-----
l=4
a=NULL
col=1
for(i in 1:n)
{a=matrix(c(a,rep(y[i],n^(l-col))))}
```

```
b=NULL
col=2
for(i in 1:n)
for(i in 1:n)
{b=matrix(c(b,rep(y[i],n^(l-col))))}
```

```
c=NULL
col=3
for(i in 1:n)
for(i in 1:n)
for(i in 1:n)
{c=matrix(c(c,rep(y[i],n^(l-col))))}
```

```
d=NULL
col=4
for(i in 1:n)
for(i in 1:n)
for(i in 1:n)
for(i in 1:n)
{d=matrix(c(d,rep(y[i],n^(l-col))))}
```

```
Y4=matrix(c(d,c,b,a),(length(a)))
```

```
#Strinoid Depth 2
```

```
#-----
X2=matrix(c(rep("x",3*n^1)),n^1)
X3=matrix(c(rep("x",3*n^2)),n^2)
X4=matrix(c(rep("x",3*n^3)),n^3)
```

```
h=3*(n^2)
S3a=X3
S3a[,2:3]=Y2[,1:2]
S3b=X3
S3b[,1]=Y2[,1]
S3b[,3]=Y2[,2]
S3c=X3
S3c[,1:2]=Y2[,1:2]
```

```
S3a=matrix(rbind(S3a,S3b,S3c),h)
```

```
h=3*n
S3b=X2
S3b[,3]=Y1[,1]
S3c=X2
S3c[,2]=Y1[,1]
S3d=X2
S3d[,1]=Y1[,1]
```

```
S3b=matrix(rbind(S3b,S3c,S3d),h)
```

```
h=3*(n^2)+3*n
a=(n^3)+h
S3=matrix(rbind(S3a,S3b),h)
A3=matrix(rbind(Y3,S3),a)
```

```
CD3=matrix(c(rep(0,a)))
for(j in 1:a)
for(i in 1:(m-l))
if
(((x[i]==A3[j,1])||(A3[j,1]=="x"))&((x[i+1]==A3[j,2])||(A3[j,2]=="x"))&((x[i+2]==A3[j,3])||(A3[j,3]
]=="x"))))
{CD3[j]<-CD3[j]+1}
```

```
CD3a=matrix(cbind(rep(CD3[1:64],n)))
CD3b=matrix(cbind(rep(CD3[65:80],n),rep(CD3[81:96],n),rep(CD3[97:112],n)))
CD3c=matrix(cbind(rep(CD3[113:116],n),rep(CD3[117:120],n),rep(CD3[121:124],n)))
```

```
CD4=matrix(rbind(CD3a,CD3b,CD3c))
```

```
date()
```

```
#Strinoid Depth 3
#-----
X2=matrix(c(rep("x",4*n^1)),n^1)
```

```
X3=matrix(c(rep("x",4*n^2)),n^2)
X4=matrix(c(rep("x",4*n^3)),n^3)
```

```
h=3*(n^3)
S4a=X4
S4a[,2:4]=Y3[,1:3]
S4b=X4
S4b[,1]=Y3[,1]
S4b[,3:4]=Y3[,2:3]
S4c=X4
S4c[,1:2]=Y3[,1:2]
S4c[,4]=Y3[,3]
```

```
S4a=matrix(rbind(S4a,S4b,S4c),h)
```

```
h=3*(n^2)
S4b=X3
S4b[,3:4]=Y2[,1:2]
S4c=X3
S4c[,2]=Y2[,1]
S4c[,4]=Y2[,2]
S4d=X3
S4d[,1]=Y2[,1]
S4d[,4]=Y2[,2]
```

```
S4b=matrix(rbind(S4b,S4c,S4d),h)
```

```
h=3*(n^3)+3*(n^2)
a=(n^4)+h
S4=matrix(rbind(S4a,S4b),h)
A4=matrix(rbind(Y4,S4),a)
```

```
C4=matrix(c(rep(0,a)))
for(j in 1:a)
for(i in 1:(m-l+1))
if
(((x[i]==A4[j,1])||(A4[j,1]=="x"))&((x[i+1]==A4[j,2])||(A4[j,2]=="x"))&((x[i+2]==A4[j,3])||(A4[j,3]
]=="x"))&((x[i+3]==A4[j,4])||(A4[j,4]=="x"))))
{C4[j]<-C4[j]+1}
```

```
date()
```

```
#Probabilities
```

```
#-----
```

```
#Note that for  $P(c|aaa)=P(aaac)/P(aaa^*)$ , where  $aaa^*$  and not in the last position. Which is
```

= $[\text{count}(\text{aaac})/\text{count}(\text{all depth } 3)]/[\text{count}(\text{aaa})/\text{count}(\text{all depth } 3 \text{ minus } 1)]$. And $\text{count}(\text{all depth } 3)=\text{count}(\text{all depth } 2 \text{ minus } 1)$. So this simplifies to $P(c|aaa)=\text{count}(\text{aaac})/\text{count}(\text{aaa})$.

P4=C4/CD4

PL4=matrix(c(A4,P4),length(P4))

#Estimation

#-----

#here 'a' will correspond so the string matrices, and 'x' will correspond with the stringoid matrices

E4=C4*log(P4)

Ea4=matrix(E4[1:256])

Es4=matrix(E4[257:496])

EL4=matrix(cbind(A4,E4),length(E4))

ELa4=matrix(EL4[1:256,1:5],length(Ea4))

ELs4=matrix(EL4[257:496,1:5],length(Es4))

Ea4a=matrix(rep(0,60))

for(i in 1:256)

for(j in 1:60)

if(((ELa4[i,1]==S3[j,1])||(S3[j,1]=="x"))&((ELa4[i,2]==S3[j,2])||(S3[j,2]=="x"))&((ELa4[i,3]==S3[j,3])||(S3[j,3]=="x")))
{Ea4a[j]<-Ea4a[j]+Ea4[i]}

Es4a=matrix(rep(0,60))

for(i in 1:240)

for(j in 1:60)

if(((ELs4[i,1]==S3[j,1])||(S3[j,1]=="x"))&((ELs4[i,2]==S3[j,2])||(S3[j,2]=="x"))&((ELs4[i,3]==S3[j,3])||(S3[j,3]=="x")))
{Es4a[j]<-Es4a[j]+Es4[i]}

E4a=Ea4a-Es4a

ED4a=matrix(CD3[65:124])

ED4a=sqrt(ED4a)

E4b=E4a

for (i in 1:60)

if(is.na(E4a[i]))

{E4b[i]<-9999}

ED4b=ED4a

for (i in 1:60)

if(is.na(ED4a[i]))


```
{ED4b[i]<--9999}

Mx4=matrix(rep(1,60))
for (i in 1:60)
  if(ED4b[i]<E4b[i])
    {Mx4[i]<-0}

Ma4=matrix(rep(1,256))
for(j in 1:60)
  for(i in 1:256)
    if(((ELa4[i,1]==S3[j,1])||(S3[j,1]=="x"))&((ELa4[i,2]==S3[j,2])||(S3[j,2]=="x"))&((ELa4[i,3]==S3[j,3])||(S3[j,3]=="x"))))
      {Ma4[i]<-Ma4[i]-Mx4[j]}

MLx4=matrix(cbind(S3,Mx4),length(Mx4))

MLx4a=MLx4
MLx4b=matrix(rep(1,60))
for (i in 1:60)
  for (j in 1:60)
    if
      (((MLx4a[j,1]==MLx4[i,1])||(MLx4a[j,1]=="x"))&((MLx4a[j,2]==MLx4[i,2])||(MLx4a[j,2]=="x"))&((MLx4a[j,3]==MLx4[i,3])||(MLx4a[j,3]=="x"))))
        {MLx4b[j]=MLx4b[j]*Mx4[i]}
    MLx4a[,4]=MLx4b

MLa4=matrix(cbind(Y3,rep(0,64)),64)
MLa4a=matrix(rep(0,64))
for (i in 1:60)
  for (j in 1:64)
    if
      (((MLa4[j,1]==MLx4[i,1])||(MLx4[i,1]=="x"))&((MLa4[j,2]==MLx4[i,2])||(MLx4[i,2]=="x"))&((MLa4a[j,3]==MLx4[i,3])||(MLx4[i,3]=="x"))))
        {MLa4a[j]=MLa4a[j]+MLx4b[i]}
    MLa4[,4]=MLa4a
MLa4b=matrix(rep(1,64))
for (i in 1:64)
  if(MLa4a[i]>0)
    {MLa4b[i]=0}
MLa4[,4]=MLa4b

aa=matrix(cbind(rep(MLa4b,4)))
bb=matrix(cbind(rep(MLx4b[1:16],4)))
cc=matrix(cbind(rep(MLx4b[17:32],4)))
dd=matrix(cbind(rep(MLx4b[33:48],4)))
```

```
ee=matrix(cbind(rep(MLx4b[49:52],4)))  
ff=matrix(cbind(rep(MLx4b[53:56],4)))  
gg=matrix(cbind(rep(MLx4b[57:60],4)))  
MM4=matrix(rbind(aa,bb,cc,dd,ee,ff,gg),496)  
R4=matrix(c(A4,MM4),length(MM4))  
R4sum=sum(MM4)
```

```
#Final Result Matrix
```

```
#-----
```

```
PP4=P4*MM4
```

```
F4=matrix(c(A4,PP4),length(PP4))
```

```
date()
```

Undergraduate Research Report

Topic

Estimate variable length Markov Chains in given DNA sequence by estimation for stationary ergodic processes.

Approach

In reality, the length of Markov Chains for nth place can be up to n-1. Due to exponential growth on total combinations, we decided to only consider the string depth of 5 in our progress. Combining the 6th term (A, C, T, G), which is being determined, we have a stringoid depth 6. The probability of getting stringoid from the string is $P(a|x) = \frac{N(xa)}{N(x)}$.

By using MLE, we have a condition that

$$\sum_{a \in \{A,C,T,G\}} \sum_{b \in \{A,C,T,G\}} N(bsa) \ln \frac{N(bsa)}{N(bs)} - \sum_{a \in \{A,C,T,G\}} N(xsa) \ln \frac{N(xsa)}{N(xs)} \leq \sqrt{N(s)}$$

Where “b” is the testing part in string depth of 5, “s” is specific combination in depth of 5, “x” is all “A, C, T, G” and “a” is the one that been determined. And note that $\frac{N(bsa)}{N(bs)}$ is just $P(a|bs)$ and $\frac{N(xsa)}{N(xs)}$ is just $P(a|xs)$. If the condition is true, “xs” wins, which indicates that this specific place can be replaced by “x”, in other words, this position does not matter and won’t affect the Markov Chains. Otherwise, this position has the key information of this Markov Chains. However, during this process, we cannot determine which one from “A, C, T, G” has greatest impact on this specific Markov Chains.

Result

From a length of 1714 string sample, we obtain 487 out of 2100, about 23.19% of situations that the positions of “x” does not matter. The result file is attached.

Result Output

Note: The final result is in FF6 as shows below, which contains depth 5 and last column with number “1” or “0”. The “1” means the winner of the two comparisons. For example, we compare “xaaaa” and “aaaaa, caaaa, taaaa, gaaaa”, and the result shows a “1” on “xaaaa” which means that first one of this specific depth 5 does not matter. In other words, it also indicates a “0” on each “aaaaa, caaaa, taaaa, gaaaa”.

> x

```
[1] a a a c g a a t t t a c a t t g t a c a t a t t a g g g t a g t t t t t t
[38] c c a a t g g g c g t g g c g a t a t g a t a a a a t a a a a t a a g t t
[75] t t a a a a a a a t t a a a g c t t t t t a a a t t c g t t t g t t a a a
[112] a t t g c g c t c g a a t t a g c t a c c g t t a a a c a t t t a t a t
[149] t t a t g t t t a a t t c t a a t t t g t c t c t c a t c t g a c a a t t
[186] t t t t a a a a g c g a a a t a t t t t t t t t g a a a c a c t g t t a a
[223] t c t t a a t g t t a c a t g a t a t t a a g t c a a a t g a c t a a t a
[260] t c a t g t a c c t t t a t a t a c c t t t a a t g a t a c c t t t a a t
[297] a c c t t t a a t g a c t a c t a a a t a a t t a a a g g a a g t a c a a
[334] t a g a a a t t a t t a t a g c t c c t g t a a t t t c a t a a a t t t t
[371] c c a a a a a g a a g a c a t t a c g t t g a g a a t a a a t a t t t c
[408] a t a a a a a t a a a t t t a t a a a a t a a a t a a a c a t a t a a c t
[445] g t t c a t t g c a a a a g t c a t a t c a a a g a c a c t a g a a t t a
[482] t t c t a g a t t t a c a t a g a t t t g g c t a t t t c t a a t c t a t
[519] t t t c a a a t a a t a a t a a c g t t a a g g c a a t g c a a a a c a a
[556] g a a t t c t t c g c a t g g t g c c a a t t g a t c a a a a a t a a t a
[593] t a g a t t t a a a g t c a a a g a a c t t c t a a g g t g a a g g g c a
[630] t a t t t t g t c a a a t t t a c a a t g c a t g a g c a t a c g t g t g
[667] c a c a c a t g c a g c t g t c t g c t a t c a c t g t a t g c g t a g a
[704] a a a g a g c t g t t c g c t g t a g c g c t c t c c g c t c t c t c g c
[741] t c t c t a a c a a t t c g a g a g a g c c t g g a g c c a c c t c t a g
[778] a g c c a c g g c g a a a a a a t c g t a t g g c g t t a t g c a t c t t
[815] g t t a t t c t a g t g t c t t t g g t c c t g t c a a c c c t t t a a g
[852] c a c g t g t c a a a a a c t c a a a g a a a a a g a c g a t g a c t t t
[889] g a a g t c t a c a a g t c a t a t t t c t g t g a a c g a g t g a a c t
[926] g g c a a c a t g t c g a g c c c g t a a g t a a c t a g g t t t t t c c
[963] t a t a g a a a t t a t a g c a a g t c a c a g t a a a a t c t t g a a c
[1000] c c a g a a c a a c a c a a c a c a c a g c a g c t g g a t c a a t t g g
[1037] t t c c t c g g a a t c a a g g g c a a c g a g t t c c t c t g c c c c g
[1074] t g c c c a c c a a t t a c t t t c a g g a c a c g t t t a a c c a g a t
[1111] t g g c t t g g a g t a c t c c a g c c a g c a c t g g a c g t g a t c c
[1148] t g a a g c c g g t g t t c g a c a g t t c c t c g g g c t t g t t c t a
[1185] c g a c g a t a a g a a a a a g t g g t c g g c c a t g a t g a t t c a c
```

```
[1222] g c g c g a t a c a t c a g g t c g g a t c g t g g t g t g a a t g a t a
[1259] t g c a c c g a a a g t a a t g a g a g g a g a c t t t g a a t c g t g t
[1296] c c g a a t a t c t t c t g a a a t a g g a a g a a c a c c c t g c c a g
[1333] t g g g c c t c a g c g a t g t g t g g g c c a a g t c a a c g g t g a a
[1370] g a t c t a c t g t c c a c g c t g t a a a a a c t a c t t t c a t c c t
[1407] a a a a c t g a t a c a c a g c c a t g t t g a g c c c a g c t t c t c g
[1444] g a c a t c t g c c g a a c t t g a g a c c g c c c c t g g a c g a c c c
[1481] a c g g t a a g t a a t t c t c c g a a t a t a g t c c t g g t t g t t t
[1518] t c t a a a c a a a g c g c t t g a a c t t g c a g g t c c c t a a t g c
[1555] t t t c g g t t g c a c c a g a a g g c c t t g a t g c c a c t t a a a t
[1592] c g c c c a a g t c c t c a c c a a a g a a t a t c g a a t c c t c c c t
[1629] c g g c c a g c t a g t c c t t c t c c t c g c t c c a g c a t t c c g a
[1666] a g t c a a g c g c t t c a a t g t t c t a g g a a t g a c g t a t t t t
[1703] t t a a c t c c a c a c
```

Levels: a c g t

> m

[1] 1714

>FF6

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]
[1,]	"x"	"a"	"a"	"a"	"a"	"1"
[2,]	"x"	"c"	"a"	"a"	"a"	"0"
[3,]	"x"	"t"	"a"	"a"	"a"	"0"
[4,]	"x"	"g"	"a"	"a"	"a"	"0"
[5,]	"x"	"a"	"c"	"a"	"a"	"0"
[6,]	"x"	"c"	"c"	"a"	"a"	"0"
[7,]	"x"	"t"	"c"	"a"	"a"	"0"
[8,]	"x"	"g"	"c"	"a"	"a"	"0"
[9,]	"x"	"a"	"t"	"a"	"a"	"0"
[10,]	"x"	"c"	"t"	"a"	"a"	"1"
[11,]	"x"	"t"	"t"	"a"	"a"	"1"
[12,]	"x"	"g"	"t"	"a"	"a"	"0"
[13,]	"x"	"a"	"g"	"a"	"a"	"0"
[14,]	"x"	"c"	"g"	"a"	"a"	"0"
[15,]	"x"	"t"	"g"	"a"	"a"	"1"
[16,]	"x"	"g"	"g"	"a"	"a"	"1"
[17,]	"x"	"a"	"a"	"c"	"a"	"0"
[18,]	"x"	"c"	"a"	"c"	"a"	"0"
[19,]	"x"	"t"	"a"	"c"	"a"	"0"
[20,]	"x"	"g"	"a"	"c"	"a"	"0"
[21,]	"x"	"a"	"c"	"c"	"a"	"1"
[22,]	"x"	"c"	"c"	"c"	"a"	"1"
[23,]	"x"	"t"	"c"	"c"	"a"	"0"

[24,]	"x"	"g"	"c"	"c"	"a"	"1"
[25,]	"x"	"a"	"t"	"c"	"a"	"0"
[26,]	"x"	"c"	"t"	"c"	"a"	"0"
[27,]	"x"	"t"	"t"	"c"	"a"	"0"
[28,]	"x"	"g"	"t"	"c"	"a"	"1"
[29,]	"x"	"a"	"g"	"c"	"a"	"0"
[30,]	"x"	"c"	"g"	"c"	"a"	"1"
[31,]	"x"	"t"	"g"	"c"	"a"	"1"
[32,]	"x"	"g"	"g"	"c"	"a"	"1"
[33,]	"x"	"a"	"a"	"t"	"a"	"0"
[34,]	"x"	"c"	"a"	"t"	"a"	"0"
[35,]	"x"	"t"	"a"	"t"	"a"	"1"
[36,]	"x"	"g"	"a"	"t"	"a"	"1"
[37,]	"x"	"a"	"c"	"t"	"a"	"0"
[38,]	"x"	"c"	"c"	"t"	"a"	"1"
[39,]	"x"	"t"	"c"	"t"	"a"	"0"
[40,]	"x"	"g"	"c"	"t"	"a"	"0"
[41,]	"x"	"a"	"t"	"t"	"a"	"1"
[42,]	"x"	"c"	"t"	"t"	"a"	"1"
[43,]	"x"	"t"	"t"	"t"	"a"	"0"
[44,]	"x"	"g"	"t"	"t"	"a"	"1"
[45,]	"x"	"a"	"g"	"t"	"a"	"1"
[46,]	"x"	"c"	"g"	"t"	"a"	"0"
[47,]	"x"	"t"	"g"	"t"	"a"	"0"
[48,]	"x"	"g"	"g"	"t"	"a"	"1"

[49,]	"x"	"a"	"a"	"g"	"a"	"1"	[92,]	"x"	"g"	"t"	"c"	"c"	"0"
[50,]	"x"	"c"	"a"	"g"	"a"	"1"	[93,]	"x"	"a"	"g"	"c"	"c"	"0"
[51,]	"x"	"t"	"a"	"g"	"a"	"1"	[94,]	"x"	"c"	"g"	"c"	"c"	"1"
[52,]	"x"	"g"	"a"	"g"	"a"	"0"	[95,]	"x"	"t"	"g"	"c"	"c"	"1"
[53,]	"x"	"a"	"c"	"g"	"a"	"0"	[96,]	"x"	"g"	"g"	"c"	"c"	"1"
[54,]	"x"	"c"	"c"	"g"	"a"	"1"	[97,]	"x"	"a"	"a"	"t"	"c"	"0"
[55,]	"x"	"t"	"c"	"g"	"a"	"0"	[98,]	"x"	"c"	"a"	"t"	"c"	"1"
[56,]	"x"	"g"	"c"	"g"	"a"	"1"	[99,]	"x"	"t"	"a"	"t"	"c"	"1"
[57,]	"x"	"a"	"t"	"g"	"a"	"1"	[100,]	"x"	"g"	"a"	"t"	"c"	"0"
[58,]	"x"	"c"	"t"	"g"	"a"	"0"	[101,]	"x"	"a"	"c"	"t"	"c"	"1"
[59,]	"x"	"t"	"t"	"g"	"a"	"0"	[102,]	"x"	"c"	"c"	"t"	"c"	"0"
[60,]	"x"	"g"	"t"	"g"	"a"	"0"	[103,]	"x"	"t"	"c"	"t"	"c"	"0"
[61,]	"x"	"a"	"g"	"g"	"a"	"0"	[104,]	"x"	"g"	"c"	"t"	"c"	"1"
[62,]	"x"	"c"	"g"	"g"	"a"	"1"	[105,]	"x"	"a"	"t"	"t"	"c"	"0"
[63,]	"x"	"t"	"g"	"g"	"a"	"1"	[106,]	"x"	"c"	"t"	"t"	"c"	"1"
[64,]	"x"	"g"	"g"	"g"	"a"	"1"	[107,]	"x"	"t"	"t"	"t"	"c"	"0"
[65,]	"x"	"a"	"a"	"a"	"c"	"1"	[108,]	"x"	"g"	"t"	"t"	"c"	"0"
[66,]	"x"	"c"	"a"	"a"	"c"	"0"	[109,]	"x"	"a"	"g"	"t"	"c"	"1"
[67,]	"x"	"t"	"a"	"a"	"c"	"0"	[110,]	"x"	"c"	"g"	"t"	"c"	"1"
[68,]	"x"	"g"	"a"	"a"	"c"	"0"	[111,]	"x"	"t"	"g"	"t"	"c"	"0"
[69,]	"x"	"a"	"c"	"a"	"c"	"0"	[112,]	"x"	"g"	"g"	"t"	"c"	"1"
[70,]	"x"	"c"	"c"	"a"	"c"	"0"	[113,]	"x"	"a"	"a"	"g"	"c"	"0"
[71,]	"x"	"t"	"c"	"a"	"c"	"0"	[114,]	"x"	"c"	"a"	"g"	"c"	"0"
[72,]	"x"	"g"	"c"	"a"	"c"	"0"	[115,]	"x"	"t"	"a"	"g"	"c"	"0"
[73,]	"x"	"a"	"t"	"a"	"c"	"0"	[116,]	"x"	"g"	"a"	"g"	"c"	"1"
[74,]	"x"	"c"	"t"	"a"	"c"	"0"	[117,]	"x"	"a"	"c"	"g"	"c"	"1"
[75,]	"x"	"t"	"t"	"a"	"c"	"0"	[118,]	"x"	"c"	"c"	"g"	"c"	"1"
[76,]	"x"	"g"	"t"	"a"	"c"	"1"	[119,]	"x"	"t"	"c"	"g"	"c"	"0"
[77,]	"x"	"a"	"g"	"a"	"c"	"0"	[120,]	"x"	"g"	"c"	"g"	"c"	"0"
[78,]	"x"	"c"	"g"	"a"	"c"	"0"	[121,]	"x"	"a"	"t"	"g"	"c"	"0"
[79,]	"x"	"t"	"g"	"a"	"c"	"0"	[122,]	"x"	"c"	"t"	"g"	"c"	"1"
[80,]	"x"	"g"	"g"	"a"	"c"	"0"	[123,]	"x"	"t"	"t"	"g"	"c"	"1"
[81,]	"x"	"a"	"a"	"c"	"c"	"0"	[124,]	"x"	"g"	"t"	"g"	"c"	"0"
[82,]	"x"	"c"	"a"	"c"	"c"	"0"	[125,]	"x"	"a"	"g"	"g"	"c"	"1"
[83,]	"x"	"t"	"a"	"c"	"c"	"0"	[126,]	"x"	"c"	"g"	"g"	"c"	"0"
[84,]	"x"	"g"	"a"	"c"	"c"	"1"	[127,]	"x"	"t"	"g"	"g"	"c"	"0"
[85,]	"x"	"a"	"c"	"c"	"c"	"1"	[128,]	"x"	"g"	"g"	"g"	"c"	"0"
[86,]	"x"	"c"	"c"	"c"	"c"	"1"	[129,]	"x"	"a"	"a"	"a"	"t"	"1"
[87,]	"x"	"t"	"c"	"c"	"c"	"1"	[130,]	"x"	"c"	"a"	"a"	"t"	"1"
[88,]	"x"	"g"	"c"	"c"	"c"	"1"	[131,]	"x"	"t"	"a"	"a"	"t"	"0"
[89,]	"x"	"a"	"t"	"c"	"c"	"1"	[132,]	"x"	"g"	"a"	"a"	"t"	"0"
[90,]	"x"	"c"	"t"	"c"	"c"	"0"	[133,]	"x"	"a"	"c"	"a"	"t"	"0"
[91,]	"x"	"t"	"t"	"c"	"c"	"0"	[134,]	"x"	"c"	"c"	"a"	"t"	"1"

[135,] "x" "t" "c" "a" "t" "0"
[136,] "x" "g" "c" "a" "t" "0"
[137,] "x" "a" "t" "a" "t" "0"
[138,] "x" "c" "t" "a" "t" "0"
[139,] "x" "t" "t" "a" "t" "0"
[140,] "x" "g" "t" "a" "t" "1"
[141,] "x" "a" "g" "a" "t" "0"
[142,] "x" "c" "g" "a" "t" "1"
[143,] "x" "t" "g" "a" "t" "0"
[144,] "x" "g" "g" "a" "t" "1"
[145,] "x" "a" "a" "c" "t" "0"
[146,] "x" "c" "a" "c" "t" "0"
[147,] "x" "t" "a" "c" "t" "0"
[148,] "x" "g" "a" "c" "t" "1"
[149,] "x" "a" "c" "c" "t" "0"
[150,] "x" "c" "c" "c" "t" "0"
[151,] "x" "t" "c" "c" "t" "0"
[152,] "x" "g" "c" "c" "t" "0"
[153,] "x" "a" "t" "c" "t" "0"
[154,] "x" "c" "t" "c" "t" "0"
[155,] "x" "t" "t" "c" "t" "0"
[156,] "x" "g" "t" "c" "t" "0"
[157,] "x" "a" "g" "c" "t" "0"
[158,] "x" "c" "g" "c" "t" "0"
[159,] "x" "t" "g" "c" "t" "1"
[160,] "x" "g" "g" "c" "t" "1"
[161,] "x" "a" "a" "t" "t" "1"
[162,] "x" "c" "a" "t" "t" "0"
[163,] "x" "t" "a" "t" "t" "0"
[164,] "x" "g" "a" "t" "t" "0"
[165,] "x" "a" "c" "t" "t" "0"
[166,] "x" "c" "c" "t" "t" "0"
[167,] "x" "t" "c" "t" "t" "0"
[168,] "x" "g" "c" "t" "t" "0"
[169,] "x" "a" "t" "t" "t" "0"
[170,] "x" "c" "t" "t" "t" "0"
[171,] "x" "t" "t" "t" "t" "1"
[172,] "x" "g" "t" "t" "t" "0"
[173,] "x" "a" "g" "t" "t" "0"
[174,] "x" "c" "g" "t" "t" "0"
[175,] "x" "t" "g" "t" "t" "1"
[176,] "x" "g" "g" "t" "t" "0"
[177,] "x" "a" "a" "g" "t" "0"

[178,] "x" "c" "a" "g" "t" "0"
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[518,] "c" "c" "x" "a" "a" "0"
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[520,] "g" "c" "x" "a" "a" "0"
[521,] "a" "t" "x" "a" "a" "1"

[522,] "c" "t" "x" "a" "a" "0"
[523,] "t" "t" "x" "a" "a" "1"
[524,] "g" "t" "x" "a" "a" "0"
[525,] "a" "g" "x" "a" "a" "0"
[526,] "c" "g" "x" "a" "a" "1"
[527,] "t" "g" "x" "a" "a" "0"
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[565,]	"a"	"c"	"x"	"g"	"a"	"1"	[608,]	"g"	"g"	"x"	"c"	"c"	"1"
[566,]	"c"	"c"	"x"	"g"	"a"	"1"	[609,]	"a"	"a"	"x"	"t"	"c"	"0"
[567,]	"t"	"c"	"x"	"g"	"a"	"1"	[610,]	"c"	"a"	"x"	"t"	"c"	"1"
[568,]	"g"	"c"	"x"	"g"	"a"	"1"	[611,]	"t"	"a"	"x"	"t"	"c"	"0"
[569,]	"a"	"t"	"x"	"g"	"a"	"1"	[612,]	"g"	"a"	"x"	"t"	"c"	"1"
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[571,]	"t"	"t"	"x"	"g"	"a"	"0"	[614,]	"c"	"c"	"x"	"t"	"c"	"1"
[572,]	"g"	"t"	"x"	"g"	"a"	"0"	[615,]	"t"	"c"	"x"	"t"	"c"	"1"
[573,]	"a"	"g"	"x"	"g"	"a"	"0"	[616,]	"g"	"c"	"x"	"t"	"c"	"1"
[574,]	"c"	"g"	"x"	"g"	"a"	"0"	[617,]	"a"	"t"	"x"	"t"	"c"	"1"
[575,]	"t"	"g"	"x"	"g"	"a"	"1"	[618,]	"c"	"t"	"x"	"t"	"c"	"0"
[576,]	"g"	"g"	"x"	"g"	"a"	"0"	[619,]	"t"	"t"	"x"	"t"	"c"	"0"
[577,]	"a"	"a"	"x"	"a"	"c"	"0"	[620,]	"g"	"t"	"x"	"t"	"c"	"1"
[578,]	"c"	"a"	"x"	"a"	"c"	"1"	[621,]	"a"	"g"	"x"	"t"	"c"	"0"
[579,]	"t"	"a"	"x"	"a"	"c"	"0"	[622,]	"c"	"g"	"x"	"t"	"c"	"1"
[580,]	"g"	"a"	"x"	"a"	"c"	"0"	[623,]	"t"	"g"	"x"	"t"	"c"	"0"
[581,]	"a"	"c"	"x"	"a"	"c"	"0"	[624,]	"g"	"g"	"x"	"t"	"c"	"0"
[582,]	"c"	"c"	"x"	"a"	"c"	"1"	[625,]	"a"	"a"	"x"	"g"	"c"	"0"
[583,]	"t"	"c"	"x"	"a"	"c"	"0"	[626,]	"c"	"a"	"x"	"g"	"c"	"0"
[584,]	"g"	"c"	"x"	"a"	"c"	"0"	[627,]	"t"	"a"	"x"	"g"	"c"	"1"
[585,]	"a"	"t"	"x"	"a"	"c"	"1"	[628,]	"g"	"a"	"x"	"g"	"c"	"1"
[586,]	"c"	"t"	"x"	"a"	"c"	"0"	[629,]	"a"	"c"	"x"	"g"	"c"	"0"
[587,]	"t"	"t"	"x"	"a"	"c"	"0"	[630,]	"c"	"c"	"x"	"g"	"c"	"1"
[588,]	"g"	"t"	"x"	"a"	"c"	"0"	[631,]	"t"	"c"	"x"	"g"	"c"	"0"
[589,]	"a"	"g"	"x"	"a"	"c"	"0"	[632,]	"g"	"c"	"x"	"g"	"c"	"1"
[590,]	"c"	"g"	"x"	"a"	"c"	"1"	[633,]	"a"	"t"	"x"	"g"	"c"	"0"
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[592,]	"g"	"g"	"x"	"a"	"c"	"1"	[635,]	"t"	"t"	"x"	"g"	"c"	"1"
[593,]	"a"	"a"	"x"	"c"	"c"	"0"	[636,]	"g"	"t"	"x"	"g"	"c"	"0"
[594,]	"c"	"a"	"x"	"c"	"c"	"0"	[637,]	"a"	"g"	"x"	"g"	"c"	"0"
[595,]	"t"	"a"	"x"	"c"	"c"	"1"	[638,]	"c"	"g"	"x"	"g"	"c"	"0"
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[604,]	"g"	"t"	"x"	"c"	"c"	"0"	[647,]	"t"	"c"	"x"	"a"	"t"	"1"
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[606,]	"c"	"g"	"x"	"c"	"c"	"1"	[649,]	"a"	"t"	"x"	"a"	"t"	"1"
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[835,] "t" "a" "a" "x" "c" "0"
[836,] "g" "a" "a" "x" "c" "0"
[837,] "a" "c" "a" "x" "c" "0"
[838,] "c" "c" "a" "x" "c" "1"
[839,] "t" "c" "a" "x" "c" "0"
[840,] "g" "c" "a" "x" "c" "0"
[841,] "a" "t" "a" "x" "c" "0"
[842,] "c" "t" "a" "x" "c" "0"
[843,] "t" "t" "a" "x" "c" "1"
[844,] "g" "t" "a" "x" "c" "0"
[845,] "a" "g" "a" "x" "c" "0"
[846,] "c" "g" "a" "x" "c" "0"
[847,] "t" "g" "a" "x" "c" "0"
[848,] "g" "g" "a" "x" "c" "0"
[849,] "a" "a" "c" "x" "c" "1"
[850,] "c" "a" "c" "x" "c" "0"
[851,] "t" "a" "c" "x" "c" "1"
[852,] "g" "a" "c" "x" "c" "0"
[853,] "a" "c" "c" "x" "c" "1"
[854,] "c" "c" "c" "x" "c" "1"
[855,] "t" "c" "c" "x" "c" "1"
[856,] "g" "c" "c" "x" "c" "0"
[857,] "a" "t" "c" "x" "c" "1"
[858,] "c" "t" "c" "x" "c" "0"
[859,] "t" "t" "c" "x" "c" "0"
[860,] "g" "t" "c" "x" "c" "0"
[861,] "a" "g" "c" "x" "c" "0"
[862,] "c" "g" "c" "x" "c" "0"
[863,] "t" "g" "c" "x" "c" "0"
[864,] "g" "g" "c" "x" "c" "1"
[865,] "a" "a" "t" "x" "c" "0"

[866,] "c" "a" "t" "x" "c" "0"
[867,] "t" "a" "t" "x" "c" "0"
[868,] "g" "a" "t" "x" "c" "0"
[869,] "a" "c" "t" "x" "c" "0"
[870,] "c" "c" "t" "x" "c" "0"
[871,] "t" "c" "t" "x" "c" "0"
[872,] "g" "c" "t" "x" "c" "0"
[873,] "a" "t" "t" "x" "c" "0"
[874,] "c" "t" "t" "x" "c" "1"
[875,] "t" "t" "t" "x" "c" "0"
[876,] "g" "t" "t" "x" "c" "0"
[877,] "a" "g" "t" "x" "c" "0"
[878,] "c" "g" "t" "x" "c" "1"
[879,] "t" "g" "t" "x" "c" "0"
[880,] "g" "g" "t" "x" "c" "1"
[881,] "a" "a" "g" "x" "c" "0"
[882,] "c" "a" "g" "x" "c" "1"
[883,] "t" "a" "g" "x" "c" "1"
[884,] "g" "a" "g" "x" "c" "1"
[885,] "a" "c" "g" "x" "c" "1"
[886,] "c" "c" "g" "x" "c" "1"
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[892,] "g" "t" "g" "x" "c" "0"
[893,] "a" "g" "g" "x" "c" "0"
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[895,] "t" "g" "g" "x" "c" "1"
[896,] "g" "g" "g" "x" "c" "1"
[897,] "a" "a" "a" "x" "t" "1"
[898,] "c" "a" "a" "x" "t" "0"
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[900,] "g" "a" "a" "x" "t" "0"
[901,] "a" "c" "a" "x" "t" "1"
[902,] "c" "c" "a" "x" "t" "1"
[903,] "t" "c" "a" "x" "t" "1"
[904,] "g" "c" "a" "x" "t" "0"
[905,] "a" "t" "a" "x" "t" "0"
[906,] "c" "t" "a" "x" "t" "0"
[907,] "t" "t" "a" "x" "t" "0"
[908,] "g" "t" "a" "x" "t" "0"

[909,] "a" "g" "a" "x" "t" "1"
[910,] "c" "g" "a" "x" "t" "1"
[911,] "t" "g" "a" "x" "t" "0"
[912,] "g" "g" "a" "x" "t" "0"
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[916,] "g" "a" "c" "x" "t" "0"
[917,] "a" "c" "c" "x" "t" "1"
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[920,] "g" "c" "c" "x" "t" "1"
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[928,] "g" "g" "c" "x" "t" "0"
[929,] "a" "a" "t" "x" "t" "0"
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[932,] "g" "a" "t" "x" "t" "0"
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[936,] "g" "c" "t" "x" "t" "0"
[937,] "a" "t" "t" "x" "t" "0"
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[940,] "g" "t" "t" "x" "t" "0"
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[945,] "a" "a" "g" "x" "t" "0"
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[948,] "g" "a" "g" "x" "t" "1"
[949,] "a" "c" "g" "x" "t" "1"
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[952,] "g" "c" "g" "x" "t" "0"
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[972,] "g" "t" "a" "x" "g" "0"
[973,] "a" "g" "a" "x" "g" "1"
[974,] "c" "g" "a" "x" "g" "1"
[975,] "t" "g" "a" "x" "g" "1"
[976,] "g" "g" "a" "x" "g" "1"
[977,] "a" "a" "c" "x" "g" "0"
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[979,] "t" "a" "c" "x" "g" "1"
[980,] "g" "a" "c" "x" "g" "1"
[981,] "a" "c" "c" "x" "g" "1"
[982,] "c" "c" "c" "x" "g" "0"
[983,] "t" "c" "c" "x" "g" "0"
[984,] "g" "c" "c" "x" "g" "0"
[985,] "a" "t" "c" "x" "g" "0"
[986,] "c" "t" "c" "x" "g" "1"
[987,] "t" "t" "c" "x" "g" "0"
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[989,] "a" "g" "c" "x" "g" "0"
[990,] "c" "g" "c" "x" "g" "1"
[991,] "t" "g" "c" "x" "g" "0"
[992,] "g" "g" "c" "x" "g" "1"
[993,] "a" "a" "t" "x" "g" "0"
[994,] "c" "a" "t" "x" "g" "0"

[995,]	"t"	"a"	"t"	"x"	"g"	"1"	[1038,]	"c"	"g"	"a"	"a"	"x"	"1"
[996,]	"g"	"a"	"t"	"x"	"g"	"1"	[1039,]	"t"	"g"	"a"	"a"	"x"	"1"
[997,]	"a"	"c"	"t"	"x"	"g"	"1"	[1040,]	"g"	"g"	"a"	"a"	"x"	"0"
[998,]	"c"	"c"	"t"	"x"	"g"	"0"	[1041,]	"a"	"a"	"c"	"a"	"x"	"0"
[999,]	"t"	"c"	"t"	"x"	"g"	"0"	[1042,]	"c"	"a"	"c"	"a"	"x"	"0"
[1000,]	"g"	"c"	"t"	"x"	"g"	"0"	[1043,]	"t"	"a"	"c"	"a"	"x"	"0"
[1001,]	"a"	"t"	"t"	"x"	"g"	"0"	[1044,]	"g"	"a"	"c"	"a"	"x"	"1"
[1002,]	"c"	"t"	"t"	"x"	"g"	"0"	[1045,]	"a"	"c"	"c"	"a"	"x"	"1"
[1003,]	"t"	"t"	"t"	"x"	"g"	"0"	[1046,]	"c"	"c"	"c"	"a"	"x"	"0"
[1004,]	"g"	"t"	"t"	"x"	"g"	"0"	[1047,]	"t"	"c"	"c"	"a"	"x"	"0"
[1005,]	"a"	"g"	"t"	"x"	"g"	"1"	[1048,]	"g"	"c"	"c"	"a"	"x"	"0"
[1006,]	"c"	"g"	"t"	"x"	"g"	"0"	[1049,]	"a"	"t"	"c"	"a"	"x"	"0"
[1007,]	"t"	"g"	"t"	"x"	"g"	"0"	[1050,]	"c"	"t"	"c"	"a"	"x"	"0"
[1008,]	"g"	"g"	"t"	"x"	"g"	"0"	[1051,]	"t"	"t"	"c"	"a"	"x"	"0"
[1009,]	"a"	"a"	"g"	"x"	"g"	"0"	[1052,]	"g"	"t"	"c"	"a"	"x"	"1"
[1010,]	"c"	"a"	"g"	"x"	"g"	"1"	[1053,]	"a"	"g"	"c"	"a"	"x"	"0"
[1011,]	"t"	"a"	"g"	"x"	"g"	"0"	[1054,]	"c"	"g"	"c"	"a"	"x"	"1"
[1012,]	"g"	"a"	"g"	"x"	"g"	"1"	[1055,]	"t"	"g"	"c"	"a"	"x"	"0"
[1013,]	"a"	"c"	"g"	"x"	"g"	"0"	[1056,]	"g"	"g"	"c"	"a"	"x"	"0"
[1014,]	"c"	"c"	"g"	"x"	"g"	"1"	[1057,]	"a"	"a"	"t"	"a"	"x"	"0"
[1015,]	"t"	"c"	"g"	"x"	"g"	"0"	[1058,]	"c"	"a"	"t"	"a"	"x"	"0"
[1016,]	"g"	"c"	"g"	"x"	"g"	"1"	[1059,]	"t"	"a"	"t"	"a"	"x"	"1"
[1017,]	"a"	"t"	"g"	"x"	"g"	"0"	[1060,]	"g"	"a"	"t"	"a"	"x"	"0"
[1018,]	"c"	"t"	"g"	"x"	"g"	"1"	[1061,]	"a"	"c"	"t"	"a"	"x"	"0"
[1019,]	"t"	"t"	"g"	"x"	"g"	"1"	[1062,]	"c"	"c"	"t"	"a"	"x"	"1"
[1020,]	"g"	"t"	"g"	"x"	"g"	"1"	[1063,]	"t"	"c"	"t"	"a"	"x"	"1"
[1021,]	"a"	"g"	"g"	"x"	"g"	"1"	[1064,]	"g"	"c"	"t"	"a"	"x"	"1"
[1022,]	"c"	"g"	"g"	"x"	"g"	"1"	[1065,]	"a"	"t"	"t"	"a"	"x"	"0"
[1023,]	"t"	"g"	"g"	"x"	"g"	"1"	[1066,]	"c"	"t"	"t"	"a"	"x"	"1"
[1024,]	"g"	"g"	"g"	"x"	"g"	"1"	[1067,]	"t"	"t"	"t"	"a"	"x"	"0"
[1025,]	"a"	"a"	"a"	"a"	"x"	"1"	[1068,]	"g"	"t"	"t"	"a"	"x"	"1"
[1026,]	"c"	"a"	"a"	"a"	"x"	"1"	[1069,]	"a"	"g"	"t"	"a"	"x"	"1"
[1027,]	"t"	"a"	"a"	"a"	"x"	"0"	[1070,]	"c"	"g"	"t"	"a"	"x"	"0"
[1028,]	"g"	"a"	"a"	"a"	"x"	"0"	[1071,]	"t"	"g"	"t"	"a"	"x"	"0"
[1029,]	"a"	"c"	"a"	"a"	"x"	"0"	[1072,]	"g"	"g"	"t"	"a"	"x"	"1"
[1030,]	"c"	"c"	"a"	"a"	"x"	"0"	[1073,]	"a"	"a"	"g"	"a"	"x"	"0"
[1031,]	"t"	"c"	"a"	"a"	"x"	"0"	[1074,]	"c"	"a"	"g"	"a"	"x"	"0"
[1032,]	"g"	"c"	"a"	"a"	"x"	"0"	[1075,]	"t"	"a"	"g"	"a"	"x"	"0"
[1033,]	"a"	"t"	"a"	"a"	"x"	"0"	[1076,]	"g"	"a"	"g"	"a"	"x"	"0"
[1034,]	"c"	"t"	"a"	"a"	"x"	"0"	[1077,]	"a"	"c"	"g"	"a"	"x"	"0"
[1035,]	"t"	"t"	"a"	"a"	"x"	"0"	[1078,]	"c"	"c"	"g"	"a"	"x"	"1"
[1036,]	"g"	"t"	"a"	"a"	"x"	"0"	[1079,]	"t"	"c"	"g"	"a"	"x"	"0"
[1037,]	"a"	"g"	"a"	"a"	"x"	"1"	[1080,]	"g"	"c"	"g"	"a"	"x"	"1"

[1081,]	"a"	"t"	"g"	"a"	"x"	"0"	[1124,]	"g"	"a"	"t"	"c"	"x"	"0"
[1082,]	"c"	"t"	"g"	"a"	"x"	"1"	[1125,]	"a"	"c"	"t"	"c"	"x"	"1"
[1083,]	"t"	"t"	"g"	"a"	"x"	"1"	[1126,]	"c"	"c"	"t"	"c"	"x"	"0"
[1084,]	"g"	"t"	"g"	"a"	"x"	"1"	[1127,]	"t"	"c"	"t"	"c"	"x"	"0"
[1085,]	"a"	"g"	"g"	"a"	"x"	"0"	[1128,]	"g"	"c"	"t"	"c"	"x"	"0"
[1086,]	"c"	"g"	"g"	"a"	"x"	"0"	[1129,]	"a"	"t"	"t"	"c"	"x"	"0"
[1087,]	"t"	"g"	"g"	"a"	"x"	"0"	[1130,]	"c"	"t"	"t"	"c"	"x"	"1"
[1088,]	"g"	"g"	"g"	"a"	"x"	"1"	[1131,]	"t"	"t"	"t"	"c"	"x"	"0"
[1089,]	"a"	"a"	"a"	"c"	"x"	"1"	[1132,]	"g"	"t"	"t"	"c"	"x"	"0"
[1090,]	"c"	"a"	"a"	"c"	"x"	"0"	[1133,]	"a"	"g"	"t"	"c"	"x"	"0"
[1091,]	"t"	"a"	"a"	"c"	"x"	"0"	[1134,]	"c"	"g"	"t"	"c"	"x"	"1"
[1092,]	"g"	"a"	"a"	"c"	"x"	"0"	[1135,]	"t"	"g"	"t"	"c"	"x"	"0"
[1093,]	"a"	"c"	"a"	"c"	"x"	"0"	[1136,]	"g"	"g"	"t"	"c"	"x"	"0"
[1094,]	"c"	"c"	"a"	"c"	"x"	"0"	[1137,]	"a"	"a"	"g"	"c"	"x"	"0"
[1095,]	"t"	"c"	"a"	"c"	"x"	"0"	[1138,]	"c"	"a"	"g"	"c"	"x"	"0"
[1096,]	"g"	"c"	"a"	"c"	"x"	"0"	[1139,]	"t"	"a"	"g"	"c"	"x"	"1"
[1097,]	"a"	"t"	"a"	"c"	"x"	"1"	[1140,]	"g"	"a"	"g"	"c"	"x"	"0"
[1098,]	"c"	"t"	"a"	"c"	"x"	"0"	[1141,]	"a"	"c"	"g"	"c"	"x"	"1"
[1099,]	"t"	"t"	"a"	"c"	"x"	"1"	[1142,]	"c"	"c"	"g"	"c"	"x"	"1"
[1100,]	"g"	"t"	"a"	"c"	"x"	"0"	[1143,]	"t"	"c"	"g"	"c"	"x"	"0"
[1101,]	"a"	"g"	"a"	"c"	"x"	"0"	[1144,]	"g"	"c"	"g"	"c"	"x"	"0"
[1102,]	"c"	"g"	"a"	"c"	"x"	"0"	[1145,]	"a"	"t"	"g"	"c"	"x"	"0"
[1103,]	"t"	"g"	"a"	"c"	"x"	"1"	[1146,]	"c"	"t"	"g"	"c"	"x"	"1"
[1104,]	"g"	"g"	"a"	"c"	"x"	"1"	[1147,]	"t"	"t"	"g"	"c"	"x"	"1"
[1105,]	"a"	"a"	"c"	"c"	"x"	"0"	[1148,]	"g"	"t"	"g"	"c"	"x"	"1"
[1106,]	"c"	"a"	"c"	"c"	"x"	"0"	[1149,]	"a"	"g"	"g"	"c"	"x"	"1"
[1107,]	"t"	"a"	"c"	"c"	"x"	"1"	[1150,]	"c"	"g"	"g"	"c"	"x"	"1"
[1108,]	"g"	"a"	"c"	"c"	"x"	"1"	[1151,]	"t"	"g"	"g"	"c"	"x"	"1"
[1109,]	"a"	"c"	"c"	"c"	"x"	"1"	[1152,]	"g"	"g"	"g"	"c"	"x"	"1"
[1110,]	"c"	"c"	"c"	"c"	"x"	"1"	[1153,]	"a"	"a"	"a"	"t"	"x"	"0"
[1111,]	"t"	"c"	"c"	"c"	"x"	"1"	[1154,]	"c"	"a"	"a"	"t"	"x"	"1"
[1112,]	"g"	"c"	"c"	"c"	"x"	"0"	[1155,]	"t"	"a"	"a"	"t"	"x"	"1"
[1113,]	"a"	"t"	"c"	"c"	"x"	"1"	[1156,]	"g"	"a"	"a"	"t"	"x"	"0"
[1114,]	"c"	"t"	"c"	"c"	"x"	"0"	[1157,]	"a"	"c"	"a"	"t"	"x"	"0"
[1115,]	"t"	"t"	"c"	"c"	"x"	"1"	[1158,]	"c"	"c"	"a"	"t"	"x"	"1"
[1116,]	"g"	"t"	"c"	"c"	"x"	"0"	[1159,]	"t"	"c"	"a"	"t"	"x"	"0"
[1117,]	"a"	"g"	"c"	"c"	"x"	"0"	[1160,]	"g"	"c"	"a"	"t"	"x"	"0"
[1118,]	"c"	"g"	"c"	"c"	"x"	"1"	[1161,]	"a"	"t"	"a"	"t"	"x"	"0"
[1119,]	"t"	"g"	"c"	"c"	"x"	"1"	[1162,]	"c"	"t"	"a"	"t"	"x"	"0"
[1120,]	"g"	"g"	"c"	"c"	"x"	"1"	[1163,]	"t"	"t"	"a"	"t"	"x"	"0"
[1121,]	"a"	"a"	"t"	"c"	"x"	"0"	[1164,]	"g"	"t"	"a"	"t"	"x"	"0"
[1122,]	"c"	"a"	"t"	"c"	"x"	"1"	[1165,]	"a"	"g"	"a"	"t"	"x"	"1"
[1123,]	"t"	"a"	"t"	"c"	"x"	"1"	[1166,]	"c"	"g"	"a"	"t"	"x"	"1"

[1167,]	"t"	"g"	"a"	"t"	"x"	"1"	[1210,]	"c"	"t"	"g"	"t"	"x"	"0"
[1168,]	"g"	"g"	"a"	"t"	"x"	"1"	[1211,]	"t"	"t"	"g"	"t"	"x"	"1"
[1169,]	"a"	"a"	"c"	"t"	"x"	"0"	[1212,]	"g"	"t"	"g"	"t"	"x"	"1"
[1170,]	"c"	"a"	"c"	"t"	"x"	"0"	[1213,]	"a"	"g"	"g"	"t"	"x"	"0"
[1171,]	"t"	"a"	"c"	"t"	"x"	"0"	[1214,]	"c"	"g"	"g"	"t"	"x"	"0"
[1172,]	"g"	"a"	"c"	"t"	"x"	"0"	[1215,]	"t"	"g"	"g"	"t"	"x"	"1"
[1173,]	"a"	"c"	"c"	"t"	"x"	"1"	[1216,]	"g"	"g"	"g"	"t"	"x"	"1"
[1174,]	"c"	"c"	"c"	"t"	"x"	"0"	[1217,]	"a"	"a"	"a"	"g"	"x"	"0"
[1175,]	"t"	"c"	"c"	"t"	"x"	"0"	[1218,]	"c"	"a"	"a"	"g"	"x"	"0"
[1176,]	"g"	"c"	"c"	"t"	"x"	"0"	[1219,]	"t"	"a"	"a"	"g"	"x"	"1"
[1177,]	"a"	"t"	"c"	"t"	"x"	"0"	[1220,]	"g"	"a"	"a"	"g"	"x"	"0"
[1178,]	"c"	"t"	"c"	"t"	"x"	"0"	[1221,]	"a"	"c"	"a"	"g"	"x"	"1"
[1179,]	"t"	"t"	"c"	"t"	"x"	"0"	[1222,]	"c"	"c"	"a"	"g"	"x"	"0"
[1180,]	"g"	"t"	"c"	"t"	"x"	"0"	[1223,]	"t"	"c"	"a"	"g"	"x"	"0"
[1181,]	"a"	"g"	"c"	"t"	"x"	"0"	[1224,]	"g"	"c"	"a"	"g"	"x"	"1"
[1182,]	"c"	"g"	"c"	"t"	"x"	"1"	[1225,]	"a"	"t"	"a"	"g"	"x"	"0"
[1183,]	"t"	"g"	"c"	"t"	"x"	"1"	[1226,]	"c"	"t"	"a"	"g"	"x"	"0"
[1184,]	"g"	"g"	"c"	"t"	"x"	"0"	[1227,]	"t"	"t"	"a"	"g"	"x"	"1"
[1185,]	"a"	"a"	"t"	"t"	"x"	"0"	[1228,]	"g"	"t"	"a"	"g"	"x"	"0"
[1186,]	"c"	"a"	"t"	"t"	"x"	"0"	[1229,]	"a"	"g"	"a"	"g"	"x"	"0"
[1187,]	"t"	"a"	"t"	"t"	"x"	"0"	[1230,]	"c"	"g"	"a"	"g"	"x"	"0"
[1188,]	"g"	"a"	"t"	"t"	"x"	"1"	[1231,]	"t"	"g"	"a"	"g"	"x"	"1"
[1189,]	"a"	"c"	"t"	"t"	"x"	"0"	[1232,]	"g"	"g"	"a"	"g"	"x"	"0"
[1190,]	"c"	"c"	"t"	"t"	"x"	"0"	[1233,]	"a"	"a"	"c"	"g"	"x"	"0"
[1191,]	"t"	"c"	"t"	"t"	"x"	"0"	[1234,]	"c"	"a"	"c"	"g"	"x"	"1"
[1192,]	"g"	"c"	"t"	"t"	"x"	"0"	[1235,]	"t"	"a"	"c"	"g"	"x"	"0"
[1193,]	"a"	"t"	"t"	"t"	"x"	"0"	[1236,]	"g"	"a"	"c"	"g"	"x"	"0"
[1194,]	"c"	"t"	"t"	"t"	"x"	"0"	[1237,]	"a"	"c"	"c"	"g"	"x"	"0"
[1195,]	"t"	"t"	"t"	"t"	"x"	"0"	[1238,]	"c"	"c"	"c"	"g"	"x"	"1"
[1196,]	"g"	"t"	"t"	"t"	"x"	"0"	[1239,]	"t"	"c"	"c"	"g"	"x"	"0"
[1197,]	"a"	"g"	"t"	"t"	"x"	"0"	[1240,]	"g"	"c"	"c"	"g"	"x"	"1"
[1198,]	"c"	"g"	"t"	"t"	"x"	"1"	[1241,]	"a"	"t"	"c"	"g"	"x"	"0"
[1199,]	"t"	"g"	"t"	"t"	"x"	"0"	[1242,]	"c"	"t"	"c"	"g"	"x"	"0"
[1200,]	"g"	"g"	"t"	"t"	"x"	"1"	[1243,]	"t"	"t"	"c"	"g"	"x"	"0"
[1201,]	"a"	"a"	"g"	"t"	"x"	"0"	[1244,]	"g"	"t"	"c"	"g"	"x"	"0"
[1202,]	"c"	"a"	"g"	"t"	"x"	"0"	[1245,]	"a"	"g"	"c"	"g"	"x"	"1"
[1203,]	"t"	"a"	"g"	"t"	"x"	"0"	[1246,]	"c"	"g"	"c"	"g"	"x"	"1"
[1204,]	"g"	"a"	"g"	"t"	"x"	"0"	[1247,]	"t"	"g"	"c"	"g"	"x"	"1"
[1205,]	"a"	"c"	"g"	"t"	"x"	"1"	[1248,]	"g"	"g"	"c"	"g"	"x"	"1"
[1206,]	"c"	"c"	"g"	"t"	"x"	"0"	[1249,]	"a"	"a"	"t"	"g"	"x"	"0"
[1207,]	"t"	"c"	"g"	"t"	"x"	"1"	[1250,]	"c"	"a"	"t"	"g"	"x"	"0"
[1208,]	"g"	"c"	"g"	"t"	"x"	"0"	[1251,]	"t"	"a"	"t"	"g"	"x"	"0"
[1209,]	"a"	"t"	"g"	"t"	"x"	"0"	[1252,]	"g"	"a"	"t"	"g"	"x"	"0"

[1253,]	"a"	"c"	"t"	"g"	"x"	"1"	[1296,]	"x"	"x"	"g"	"g"	"a"	"0"
[1254,]	"c"	"c"	"t"	"g"	"x"	"0"	[1297,]	"x"	"x"	"a"	"a"	"c"	"0"
[1255,]	"t"	"c"	"t"	"g"	"x"	"0"	[1298,]	"x"	"x"	"c"	"a"	"c"	"0"
[1256,]	"g"	"c"	"t"	"g"	"x"	"1"	[1299,]	"x"	"x"	"t"	"a"	"c"	"0"
[1257,]	"a"	"t"	"t"	"g"	"x"	"0"	[1300,]	"x"	"x"	"g"	"a"	"c"	"0"
[1258,]	"c"	"t"	"t"	"g"	"x"	"0"	[1301,]	"x"	"x"	"a"	"c"	"c"	"0"
[1259,]	"t"	"t"	"t"	"g"	"x"	"0"	[1302,]	"x"	"x"	"c"	"c"	"c"	"0"
[1260,]	"g"	"t"	"t"	"g"	"x"	"0"	[1303,]	"x"	"x"	"t"	"c"	"c"	"0"
[1261,]	"a"	"g"	"t"	"g"	"x"	"0"	[1304,]	"x"	"x"	"g"	"c"	"c"	"0"
[1262,]	"c"	"g"	"t"	"g"	"x"	"0"	[1305,]	"x"	"x"	"a"	"t"	"c"	"0"
[1263,]	"t"	"g"	"t"	"g"	"x"	"0"	[1306,]	"x"	"x"	"c"	"t"	"c"	"0"
[1264,]	"g"	"g"	"t"	"g"	"x"	"0"	[1307,]	"x"	"x"	"t"	"t"	"c"	"0"
[1265,]	"a"	"a"	"g"	"g"	"x"	"0"	[1308,]	"x"	"x"	"g"	"t"	"c"	"0"
[1266,]	"c"	"a"	"g"	"g"	"x"	"1"	[1309,]	"x"	"x"	"a"	"g"	"c"	"0"
[1267,]	"t"	"a"	"g"	"g"	"x"	"0"	[1310,]	"x"	"x"	"c"	"g"	"c"	"0"
[1268,]	"g"	"a"	"g"	"g"	"x"	"1"	[1311,]	"x"	"x"	"t"	"g"	"c"	"0"
[1269,]	"a"	"c"	"g"	"g"	"x"	"1"	[1312,]	"x"	"x"	"g"	"g"	"c"	"0"
[1270,]	"c"	"c"	"g"	"g"	"x"	"1"	[1313,]	"x"	"x"	"a"	"a"	"t"	"0"
[1271,]	"t"	"c"	"g"	"g"	"x"	"0"	[1314,]	"x"	"x"	"c"	"a"	"t"	"0"
[1272,]	"g"	"c"	"g"	"g"	"x"	"1"	[1315,]	"x"	"x"	"t"	"a"	"t"	"0"
[1273,]	"a"	"t"	"g"	"g"	"x"	"0"	[1316,]	"x"	"x"	"g"	"a"	"t"	"0"
[1274,]	"c"	"t"	"g"	"g"	"x"	"0"	[1317,]	"x"	"x"	"a"	"c"	"t"	"0"
[1275,]	"t"	"t"	"g"	"g"	"x"	"0"	[1318,]	"x"	"x"	"c"	"c"	"t"	"0"
[1276,]	"g"	"t"	"g"	"g"	"x"	"1"	[1319,]	"x"	"x"	"t"	"c"	"t"	"0"
[1277,]	"a"	"g"	"g"	"g"	"x"	"1"	[1320,]	"x"	"x"	"g"	"c"	"t"	"0"
[1278,]	"c"	"g"	"g"	"g"	"x"	"1"	[1321,]	"x"	"x"	"a"	"t"	"t"	"0"
[1279,]	"t"	"g"	"g"	"g"	"x"	"1"	[1322,]	"x"	"x"	"c"	"t"	"t"	"0"
[1280,]	"g"	"g"	"g"	"g"	"x"	"1"	[1323,]	"x"	"x"	"t"	"t"	"t"	"0"
[1281,]	"x"	"x"	"a"	"a"	"a"	"0"	[1324,]	"x"	"x"	"g"	"t"	"t"	"0"
[1282,]	"x"	"x"	"c"	"a"	"a"	"0"	[1325,]	"x"	"x"	"a"	"g"	"t"	"0"
[1283,]	"x"	"x"	"t"	"a"	"a"	"0"	[1326,]	"x"	"x"	"c"	"g"	"t"	"0"
[1284,]	"x"	"x"	"g"	"a"	"a"	"0"	[1327,]	"x"	"x"	"t"	"g"	"t"	"0"
[1285,]	"x"	"x"	"a"	"c"	"a"	"0"	[1328,]	"x"	"x"	"g"	"g"	"t"	"0"
[1286,]	"x"	"x"	"c"	"c"	"a"	"0"	[1329,]	"x"	"x"	"a"	"a"	"g"	"0"
[1287,]	"x"	"x"	"t"	"c"	"a"	"0"	[1330,]	"x"	"x"	"c"	"a"	"g"	"0"
[1288,]	"x"	"x"	"g"	"c"	"a"	"0"	[1331,]	"x"	"x"	"t"	"a"	"g"	"0"
[1289,]	"x"	"x"	"a"	"t"	"a"	"0"	[1332,]	"x"	"x"	"g"	"a"	"g"	"0"
[1290,]	"x"	"x"	"c"	"t"	"a"	"0"	[1333,]	"x"	"x"	"a"	"c"	"g"	"0"
[1291,]	"x"	"x"	"t"	"t"	"a"	"0"	[1334,]	"x"	"x"	"c"	"c"	"g"	"0"
[1292,]	"x"	"x"	"g"	"t"	"a"	"0"	[1335,]	"x"	"x"	"t"	"c"	"g"	"0"
[1293,]	"x"	"x"	"a"	"g"	"a"	"0"	[1336,]	"x"	"x"	"g"	"c"	"g"	"0"
[1294,]	"x"	"x"	"c"	"g"	"a"	"0"	[1337,]	"x"	"x"	"a"	"t"	"g"	"0"
[1295,]	"x"	"x"	"t"	"g"	"a"	"0"	[1338,]	"x"	"x"	"c"	"t"	"g"	"0"

[1339,]	"x"	"x"	"t"	"t"	"g"	"0"	[1382,]	"x"	"c"	"x"	"c"	"t"	"0"
[1340,]	"x"	"x"	"g"	"t"	"g"	"0"	[1383,]	"x"	"t"	"x"	"c"	"t"	"0"
[1341,]	"x"	"x"	"a"	"g"	"g"	"0"	[1384,]	"x"	"g"	"x"	"c"	"t"	"0"
[1342,]	"x"	"x"	"c"	"g"	"g"	"0"	[1385,]	"x"	"a"	"x"	"t"	"t"	"0"
[1343,]	"x"	"x"	"t"	"g"	"g"	"0"	[1386,]	"x"	"c"	"x"	"t"	"t"	"0"
[1344,]	"x"	"x"	"g"	"g"	"g"	"0"	[1387,]	"x"	"t"	"x"	"t"	"t"	"0"
[1345,]	"x"	"a"	"x"	"a"	"a"	"0"	[1388,]	"x"	"g"	"x"	"t"	"t"	"0"
[1346,]	"x"	"c"	"x"	"a"	"a"	"0"	[1389,]	"x"	"a"	"x"	"g"	"t"	"0"
[1347,]	"x"	"t"	"x"	"a"	"a"	"0"	[1390,]	"x"	"c"	"x"	"g"	"t"	"0"
[1348,]	"x"	"g"	"x"	"a"	"a"	"0"	[1391,]	"x"	"t"	"x"	"g"	"t"	"0"
[1349,]	"x"	"a"	"x"	"c"	"a"	"0"	[1392,]	"x"	"g"	"x"	"g"	"t"	"0"
[1350,]	"x"	"c"	"x"	"c"	"a"	"0"	[1393,]	"x"	"a"	"x"	"a"	"g"	"0"
[1351,]	"x"	"t"	"x"	"c"	"a"	"0"	[1394,]	"x"	"c"	"x"	"a"	"g"	"0"
[1352,]	"x"	"g"	"x"	"c"	"a"	"0"	[1395,]	"x"	"t"	"x"	"a"	"g"	"0"
[1353,]	"x"	"a"	"x"	"t"	"a"	"0"	[1396,]	"x"	"g"	"x"	"a"	"g"	"0"
[1354,]	"x"	"c"	"x"	"t"	"a"	"0"	[1397,]	"x"	"a"	"x"	"c"	"g"	"0"
[1355,]	"x"	"t"	"x"	"t"	"a"	"0"	[1398,]	"x"	"c"	"x"	"c"	"g"	"0"
[1356,]	"x"	"g"	"x"	"t"	"a"	"0"	[1399,]	"x"	"t"	"x"	"c"	"g"	"0"
[1357,]	"x"	"a"	"x"	"g"	"a"	"0"	[1400,]	"x"	"g"	"x"	"c"	"g"	"0"
[1358,]	"x"	"c"	"x"	"g"	"a"	"0"	[1401,]	"x"	"a"	"x"	"t"	"g"	"0"
[1359,]	"x"	"t"	"x"	"g"	"a"	"0"	[1402,]	"x"	"c"	"x"	"t"	"g"	"0"
[1360,]	"x"	"g"	"x"	"g"	"a"	"0"	[1403,]	"x"	"t"	"x"	"t"	"g"	"0"
[1361,]	"x"	"a"	"x"	"a"	"c"	"0"	[1404,]	"x"	"g"	"x"	"t"	"g"	"0"
[1362,]	"x"	"c"	"x"	"a"	"c"	"0"	[1405,]	"x"	"a"	"x"	"g"	"g"	"0"
[1363,]	"x"	"t"	"x"	"a"	"c"	"0"	[1406,]	"x"	"c"	"x"	"g"	"g"	"0"
[1364,]	"x"	"g"	"x"	"a"	"c"	"0"	[1407,]	"x"	"t"	"x"	"g"	"g"	"0"
[1365,]	"x"	"a"	"x"	"c"	"c"	"0"	[1408,]	"x"	"g"	"x"	"g"	"g"	"0"
[1366,]	"x"	"c"	"x"	"c"	"c"	"0"	[1409,]	"x"	"a"	"a"	"x"	"a"	"0"
[1367,]	"x"	"t"	"x"	"c"	"c"	"0"	[1410,]	"x"	"c"	"a"	"x"	"a"	"0"
[1368,]	"x"	"g"	"x"	"c"	"c"	"0"	[1411,]	"x"	"t"	"a"	"x"	"a"	"0"
[1369,]	"x"	"a"	"x"	"t"	"c"	"0"	[1412,]	"x"	"g"	"a"	"x"	"a"	"0"
[1370,]	"x"	"c"	"x"	"t"	"c"	"0"	[1413,]	"x"	"a"	"c"	"x"	"a"	"0"
[1371,]	"x"	"t"	"x"	"t"	"c"	"0"	[1414,]	"x"	"c"	"c"	"x"	"a"	"0"
[1372,]	"x"	"g"	"x"	"t"	"c"	"0"	[1415,]	"x"	"t"	"c"	"x"	"a"	"0"
[1373,]	"x"	"a"	"x"	"g"	"c"	"0"	[1416,]	"x"	"g"	"c"	"x"	"a"	"0"
[1374,]	"x"	"c"	"x"	"g"	"c"	"0"	[1417,]	"x"	"a"	"t"	"x"	"a"	"0"
[1375,]	"x"	"t"	"x"	"g"	"c"	"0"	[1418,]	"x"	"c"	"t"	"x"	"a"	"0"
[1376,]	"x"	"g"	"x"	"g"	"c"	"0"	[1419,]	"x"	"t"	"t"	"x"	"a"	"0"
[1377,]	"x"	"a"	"x"	"a"	"t"	"0"	[1420,]	"x"	"g"	"t"	"x"	"a"	"0"
[1378,]	"x"	"c"	"x"	"a"	"t"	"0"	[1421,]	"x"	"a"	"g"	"x"	"a"	"0"
[1379,]	"x"	"t"	"x"	"a"	"t"	"0"	[1422,]	"x"	"c"	"g"	"x"	"a"	"0"
[1380,]	"x"	"g"	"x"	"a"	"t"	"0"	[1423,]	"x"	"t"	"g"	"x"	"a"	"0"
[1381,]	"x"	"a"	"x"	"c"	"t"	"0"	[1424,]	"x"	"g"	"g"	"x"	"a"	"0"

[1425,]	"x"	"a"	"a"	"x"	"c"	"0"	[1468,]	"x"	"g"	"t"	"x"	"g"	"0"
[1426,]	"x"	"c"	"a"	"x"	"c"	"0"	[1469,]	"x"	"a"	"g"	"x"	"g"	"0"
[1427,]	"x"	"t"	"a"	"x"	"c"	"0"	[1470,]	"x"	"c"	"g"	"x"	"g"	"0"
[1428,]	"x"	"g"	"a"	"x"	"c"	"0"	[1471,]	"x"	"t"	"g"	"x"	"g"	"0"
[1429,]	"x"	"a"	"c"	"x"	"c"	"0"	[1472,]	"x"	"g"	"g"	"x"	"g"	"0"
[1430,]	"x"	"c"	"c"	"x"	"c"	"0"	[1473,]	"x"	"a"	"a"	"a"	"x"	"0"
[1431,]	"x"	"t"	"c"	"x"	"c"	"0"	[1474,]	"x"	"c"	"a"	"a"	"x"	"0"
[1432,]	"x"	"g"	"c"	"x"	"c"	"0"	[1475,]	"x"	"t"	"a"	"a"	"x"	"0"
[1433,]	"x"	"a"	"t"	"x"	"c"	"0"	[1476,]	"x"	"g"	"a"	"a"	"x"	"0"
[1434,]	"x"	"c"	"t"	"x"	"c"	"0"	[1477,]	"x"	"a"	"c"	"a"	"x"	"0"
[1435,]	"x"	"t"	"t"	"x"	"c"	"0"	[1478,]	"x"	"c"	"c"	"a"	"x"	"0"
[1436,]	"x"	"g"	"t"	"x"	"c"	"0"	[1479,]	"x"	"t"	"c"	"a"	"x"	"0"
[1437,]	"x"	"a"	"g"	"x"	"c"	"0"	[1480,]	"x"	"g"	"c"	"a"	"x"	"0"
[1438,]	"x"	"c"	"g"	"x"	"c"	"0"	[1481,]	"x"	"a"	"t"	"a"	"x"	"0"
[1439,]	"x"	"t"	"g"	"x"	"c"	"0"	[1482,]	"x"	"c"	"t"	"a"	"x"	"0"
[1440,]	"x"	"g"	"g"	"x"	"c"	"0"	[1483,]	"x"	"t"	"t"	"a"	"x"	"0"
[1441,]	"x"	"a"	"a"	"x"	"t"	"0"	[1484,]	"x"	"g"	"t"	"a"	"x"	"0"
[1442,]	"x"	"c"	"a"	"x"	"t"	"0"	[1485,]	"x"	"a"	"g"	"a"	"x"	"0"
[1443,]	"x"	"t"	"a"	"x"	"t"	"0"	[1486,]	"x"	"c"	"g"	"a"	"x"	"0"
[1444,]	"x"	"g"	"a"	"x"	"t"	"0"	[1487,]	"x"	"t"	"g"	"a"	"x"	"0"
[1445,]	"x"	"a"	"c"	"x"	"t"	"0"	[1488,]	"x"	"g"	"g"	"a"	"x"	"0"
[1446,]	"x"	"c"	"c"	"x"	"t"	"0"	[1489,]	"x"	"a"	"a"	"c"	"x"	"0"
[1447,]	"x"	"t"	"c"	"x"	"t"	"0"	[1490,]	"x"	"c"	"a"	"c"	"x"	"0"
[1448,]	"x"	"g"	"c"	"x"	"t"	"0"	[1491,]	"x"	"t"	"a"	"c"	"x"	"0"
[1449,]	"x"	"a"	"t"	"x"	"t"	"0"	[1492,]	"x"	"g"	"a"	"c"	"x"	"0"
[1450,]	"x"	"c"	"t"	"x"	"t"	"0"	[1493,]	"x"	"a"	"c"	"c"	"x"	"0"
[1451,]	"x"	"t"	"t"	"x"	"t"	"0"	[1494,]	"x"	"c"	"c"	"c"	"x"	"0"
[1452,]	"x"	"g"	"t"	"x"	"t"	"0"	[1495,]	"x"	"t"	"c"	"c"	"x"	"0"
[1453,]	"x"	"a"	"g"	"x"	"t"	"0"	[1496,]	"x"	"g"	"c"	"c"	"x"	"0"
[1454,]	"x"	"c"	"g"	"x"	"t"	"0"	[1497,]	"x"	"a"	"t"	"c"	"x"	"0"
[1455,]	"x"	"t"	"g"	"x"	"t"	"0"	[1498,]	"x"	"c"	"t"	"c"	"x"	"0"
[1456,]	"x"	"g"	"g"	"x"	"t"	"0"	[1499,]	"x"	"t"	"t"	"c"	"x"	"0"
[1457,]	"x"	"a"	"a"	"x"	"g"	"0"	[1500,]	"x"	"g"	"t"	"c"	"x"	"0"
[1458,]	"x"	"c"	"a"	"x"	"g"	"0"	[1501,]	"x"	"a"	"g"	"c"	"x"	"0"
[1459,]	"x"	"t"	"a"	"x"	"g"	"0"	[1502,]	"x"	"c"	"g"	"c"	"x"	"0"
[1460,]	"x"	"g"	"a"	"x"	"g"	"0"	[1503,]	"x"	"t"	"g"	"c"	"x"	"0"
[1461,]	"x"	"a"	"c"	"x"	"g"	"0"	[1504,]	"x"	"g"	"g"	"c"	"x"	"0"
[1462,]	"x"	"c"	"c"	"x"	"g"	"0"	[1505,]	"x"	"a"	"a"	"t"	"x"	"0"
[1463,]	"x"	"t"	"c"	"x"	"g"	"0"	[1506,]	"x"	"c"	"a"	"t"	"x"	"0"
[1464,]	"x"	"g"	"c"	"x"	"g"	"0"	[1507,]	"x"	"t"	"a"	"t"	"x"	"0"
[1465,]	"x"	"a"	"t"	"x"	"g"	"0"	[1508,]	"x"	"g"	"a"	"t"	"x"	"0"
[1466,]	"x"	"c"	"t"	"x"	"g"	"0"	[1509,]	"x"	"a"	"c"	"t"	"x"	"0"
[1467,]	"x"	"t"	"t"	"x"	"g"	"0"	[1510,]	"x"	"c"	"c"	"t"	"x"	"0"

[1511,]	"x"	"t"	"c"	"t"	"x"	"0"	[1554,]	"c"	"x"	"x"	"a"	"c"	"0"
[1512,]	"x"	"g"	"c"	"t"	"x"	"0"	[1555,]	"t"	"x"	"x"	"a"	"c"	"0"
[1513,]	"x"	"a"	"t"	"t"	"x"	"0"	[1556,]	"g"	"x"	"x"	"a"	"c"	"0"
[1514,]	"x"	"c"	"t"	"t"	"x"	"0"	[1557,]	"a"	"x"	"x"	"c"	"c"	"0"
[1515,]	"x"	"t"	"t"	"t"	"x"	"0"	[1558,]	"c"	"x"	"x"	"c"	"c"	"0"
[1516,]	"x"	"g"	"t"	"t"	"x"	"0"	[1559,]	"t"	"x"	"x"	"c"	"c"	"0"
[1517,]	"x"	"a"	"g"	"t"	"x"	"0"	[1560,]	"g"	"x"	"x"	"c"	"c"	"0"
[1518,]	"x"	"c"	"g"	"t"	"x"	"0"	[1561,]	"a"	"x"	"x"	"t"	"c"	"0"
[1519,]	"x"	"t"	"g"	"t"	"x"	"0"	[1562,]	"c"	"x"	"x"	"t"	"c"	"0"
[1520,]	"x"	"g"	"g"	"t"	"x"	"0"	[1563,]	"t"	"x"	"x"	"t"	"c"	"0"
[1521,]	"x"	"a"	"a"	"g"	"x"	"0"	[1564,]	"g"	"x"	"x"	"t"	"c"	"0"
[1522,]	"x"	"c"	"a"	"g"	"x"	"0"	[1565,]	"a"	"x"	"x"	"g"	"c"	"0"
[1523,]	"x"	"t"	"a"	"g"	"x"	"0"	[1566,]	"c"	"x"	"x"	"g"	"c"	"0"
[1524,]	"x"	"g"	"a"	"g"	"x"	"0"	[1567,]	"t"	"x"	"x"	"g"	"c"	"0"
[1525,]	"x"	"a"	"c"	"g"	"x"	"0"	[1568,]	"g"	"x"	"x"	"g"	"c"	"0"
[1526,]	"x"	"c"	"c"	"g"	"x"	"0"	[1569,]	"a"	"x"	"x"	"a"	"t"	"0"
[1527,]	"x"	"t"	"c"	"g"	"x"	"0"	[1570,]	"c"	"x"	"x"	"a"	"t"	"0"
[1528,]	"x"	"g"	"c"	"g"	"x"	"0"	[1571,]	"t"	"x"	"x"	"a"	"t"	"0"
[1529,]	"x"	"a"	"t"	"g"	"x"	"0"	[1572,]	"g"	"x"	"x"	"a"	"t"	"0"
[1530,]	"x"	"c"	"t"	"g"	"x"	"0"	[1573,]	"a"	"x"	"x"	"c"	"t"	"0"
[1531,]	"x"	"t"	"t"	"g"	"x"	"0"	[1574,]	"c"	"x"	"x"	"c"	"t"	"0"
[1532,]	"x"	"g"	"t"	"g"	"x"	"0"	[1575,]	"t"	"x"	"x"	"c"	"t"	"0"
[1533,]	"x"	"a"	"g"	"g"	"x"	"0"	[1576,]	"g"	"x"	"x"	"c"	"t"	"0"
[1534,]	"x"	"c"	"g"	"g"	"x"	"0"	[1577,]	"a"	"x"	"x"	"t"	"t"	"0"
[1535,]	"x"	"t"	"g"	"g"	"x"	"0"	[1578,]	"c"	"x"	"x"	"t"	"t"	"0"
[1536,]	"x"	"g"	"g"	"g"	"x"	"0"	[1579,]	"t"	"x"	"x"	"t"	"t"	"0"
[1537,]	"a"	"x"	"x"	"a"	"a"	"0"	[1580,]	"g"	"x"	"x"	"t"	"t"	"0"
[1538,]	"c"	"x"	"x"	"a"	"a"	"0"	[1581,]	"a"	"x"	"x"	"g"	"t"	"0"
[1539,]	"t"	"x"	"x"	"a"	"a"	"0"	[1582,]	"c"	"x"	"x"	"g"	"t"	"0"
[1540,]	"g"	"x"	"x"	"a"	"a"	"0"	[1583,]	"t"	"x"	"x"	"g"	"t"	"0"
[1541,]	"a"	"x"	"x"	"c"	"a"	"0"	[1584,]	"g"	"x"	"x"	"g"	"t"	"0"
[1542,]	"c"	"x"	"x"	"c"	"a"	"0"	[1585,]	"a"	"x"	"x"	"a"	"g"	"0"
[1543,]	"t"	"x"	"x"	"c"	"a"	"0"	[1586,]	"c"	"x"	"x"	"a"	"g"	"0"
[1544,]	"g"	"x"	"x"	"c"	"a"	"0"	[1587,]	"t"	"x"	"x"	"a"	"g"	"0"
[1545,]	"a"	"x"	"x"	"t"	"a"	"0"	[1588,]	"g"	"x"	"x"	"a"	"g"	"0"
[1546,]	"c"	"x"	"x"	"t"	"a"	"0"	[1589,]	"a"	"x"	"x"	"c"	"g"	"0"
[1547,]	"t"	"x"	"x"	"t"	"a"	"0"	[1590,]	"c"	"x"	"x"	"c"	"g"	"0"
[1548,]	"g"	"x"	"x"	"t"	"a"	"0"	[1591,]	"t"	"x"	"x"	"c"	"g"	"0"
[1549,]	"a"	"x"	"x"	"g"	"a"	"0"	[1592,]	"g"	"x"	"x"	"c"	"g"	"0"
[1550,]	"c"	"x"	"x"	"g"	"a"	"0"	[1593,]	"a"	"x"	"x"	"t"	"g"	"0"
[1551,]	"t"	"x"	"x"	"g"	"a"	"0"	[1594,]	"c"	"x"	"x"	"t"	"g"	"0"
[1552,]	"g"	"x"	"x"	"g"	"a"	"0"	[1595,]	"t"	"x"	"x"	"t"	"g"	"0"
[1553,]	"a"	"x"	"x"	"a"	"c"	"0"	[1596,]	"g"	"x"	"x"	"t"	"g"	"0"

[1597,]	"a"	"x"	"x"	"g"	"g"	"0"	[1640,]	"g"	"x"	"c"	"x"	"t"	"0"
[1598,]	"c"	"x"	"x"	"g"	"g"	"0"	[1641,]	"a"	"x"	"t"	"x"	"t"	"0"
[1599,]	"t"	"x"	"x"	"g"	"g"	"0"	[1642,]	"c"	"x"	"t"	"x"	"t"	"0"
[1600,]	"g"	"x"	"x"	"g"	"g"	"0"	[1643,]	"t"	"x"	"t"	"x"	"t"	"0"
[1601,]	"a"	"x"	"a"	"x"	"a"	"0"	[1644,]	"g"	"x"	"t"	"x"	"t"	"0"
[1602,]	"c"	"x"	"a"	"x"	"a"	"0"	[1645,]	"a"	"x"	"g"	"x"	"t"	"0"
[1603,]	"t"	"x"	"a"	"x"	"a"	"0"	[1646,]	"c"	"x"	"g"	"x"	"t"	"0"
[1604,]	"g"	"x"	"a"	"x"	"a"	"0"	[1647,]	"t"	"x"	"g"	"x"	"t"	"0"
[1605,]	"a"	"x"	"c"	"x"	"a"	"0"	[1648,]	"g"	"x"	"g"	"x"	"t"	"0"
[1606,]	"c"	"x"	"c"	"x"	"a"	"0"	[1649,]	"a"	"x"	"a"	"x"	"g"	"0"
[1607,]	"t"	"x"	"c"	"x"	"a"	"0"	[1650,]	"c"	"x"	"a"	"x"	"g"	"0"
[1608,]	"g"	"x"	"c"	"x"	"a"	"0"	[1651,]	"t"	"x"	"a"	"x"	"g"	"0"
[1609,]	"a"	"x"	"t"	"x"	"a"	"0"	[1652,]	"g"	"x"	"a"	"x"	"g"	"0"
[1610,]	"c"	"x"	"t"	"x"	"a"	"0"	[1653,]	"a"	"x"	"c"	"x"	"g"	"0"
[1611,]	"t"	"x"	"t"	"x"	"a"	"0"	[1654,]	"c"	"x"	"c"	"x"	"g"	"0"
[1612,]	"g"	"x"	"t"	"x"	"a"	"0"	[1655,]	"t"	"x"	"c"	"x"	"g"	"0"
[1613,]	"a"	"x"	"g"	"x"	"a"	"0"	[1656,]	"g"	"x"	"c"	"x"	"g"	"0"
[1614,]	"c"	"x"	"g"	"x"	"a"	"0"	[1657,]	"a"	"x"	"t"	"x"	"g"	"0"
[1615,]	"t"	"x"	"g"	"x"	"a"	"0"	[1658,]	"c"	"x"	"t"	"x"	"g"	"0"
[1616,]	"g"	"x"	"g"	"x"	"a"	"0"	[1659,]	"t"	"x"	"t"	"x"	"g"	"0"
[1617,]	"a"	"x"	"a"	"x"	"c"	"0"	[1660,]	"g"	"x"	"t"	"x"	"g"	"0"
[1618,]	"c"	"x"	"a"	"x"	"c"	"0"	[1661,]	"a"	"x"	"g"	"x"	"g"	"0"
[1619,]	"t"	"x"	"a"	"x"	"c"	"0"	[1662,]	"c"	"x"	"g"	"x"	"g"	"0"
[1620,]	"g"	"x"	"a"	"x"	"c"	"0"	[1663,]	"t"	"x"	"g"	"x"	"g"	"0"
[1621,]	"a"	"x"	"c"	"x"	"c"	"0"	[1664,]	"g"	"x"	"g"	"x"	"g"	"0"
[1622,]	"c"	"x"	"c"	"x"	"c"	"0"	[1665,]	"a"	"x"	"a"	"a"	"x"	"0"
[1623,]	"t"	"x"	"c"	"x"	"c"	"0"	[1666,]	"c"	"x"	"a"	"a"	"x"	"0"
[1624,]	"g"	"x"	"c"	"x"	"c"	"0"	[1667,]	"t"	"x"	"a"	"a"	"x"	"0"
[1625,]	"a"	"x"	"t"	"x"	"c"	"0"	[1668,]	"g"	"x"	"a"	"a"	"x"	"0"
[1626,]	"c"	"x"	"t"	"x"	"c"	"0"	[1669,]	"a"	"x"	"c"	"a"	"x"	"0"
[1627,]	"t"	"x"	"t"	"x"	"c"	"0"	[1670,]	"c"	"x"	"c"	"a"	"x"	"0"
[1628,]	"g"	"x"	"t"	"x"	"c"	"0"	[1671,]	"t"	"x"	"c"	"a"	"x"	"0"
[1629,]	"a"	"x"	"g"	"x"	"c"	"0"	[1672,]	"g"	"x"	"c"	"a"	"x"	"0"
[1630,]	"c"	"x"	"g"	"x"	"c"	"0"	[1673,]	"a"	"x"	"t"	"a"	"x"	"0"
[1631,]	"t"	"x"	"g"	"x"	"c"	"0"	[1674,]	"c"	"x"	"t"	"a"	"x"	"0"
[1632,]	"g"	"x"	"g"	"x"	"c"	"0"	[1675,]	"t"	"x"	"t"	"a"	"x"	"0"
[1633,]	"a"	"x"	"a"	"x"	"t"	"0"	[1676,]	"g"	"x"	"t"	"a"	"x"	"0"
[1634,]	"c"	"x"	"a"	"x"	"t"	"0"	[1677,]	"a"	"x"	"g"	"a"	"x"	"0"
[1635,]	"t"	"x"	"a"	"x"	"t"	"0"	[1678,]	"c"	"x"	"g"	"a"	"x"	"0"
[1636,]	"g"	"x"	"a"	"x"	"t"	"0"	[1679,]	"t"	"x"	"g"	"a"	"x"	"0"
[1637,]	"a"	"x"	"c"	"x"	"t"	"0"	[1680,]	"g"	"x"	"g"	"a"	"x"	"0"
[1638,]	"c"	"x"	"c"	"x"	"t"	"0"	[1681,]	"a"	"x"	"a"	"c"	"x"	"0"
[1639,]	"t"	"x"	"c"	"x"	"t"	"0"	[1682,]	"c"	"x"	"a"	"c"	"x"	"0"

[1683,]	"t"	"x"	"a"	"c"	"x"	"0"	[1726,]	"c"	"x"	"g"	"g"	"x"	"0"
[1684,]	"g"	"x"	"a"	"c"	"x"	"0"	[1727,]	"t"	"x"	"g"	"g"	"x"	"0"
[1685,]	"a"	"x"	"c"	"c"	"x"	"0"	[1728,]	"g"	"x"	"g"	"g"	"x"	"0"
[1686,]	"c"	"x"	"c"	"c"	"x"	"0"	[1729,]	"a"	"a"	"x"	"x"	"a"	"0"
[1687,]	"t"	"x"	"c"	"c"	"x"	"0"	[1730,]	"c"	"a"	"x"	"x"	"a"	"0"
[1688,]	"g"	"x"	"c"	"c"	"x"	"0"	[1731,]	"t"	"a"	"x"	"x"	"a"	"0"
[1689,]	"a"	"x"	"t"	"c"	"x"	"0"	[1732,]	"g"	"a"	"x"	"x"	"a"	"0"
[1690,]	"c"	"x"	"t"	"c"	"x"	"0"	[1733,]	"a"	"c"	"x"	"x"	"a"	"0"
[1691,]	"t"	"x"	"t"	"c"	"x"	"0"	[1734,]	"c"	"c"	"x"	"x"	"a"	"0"
[1692,]	"g"	"x"	"t"	"c"	"x"	"0"	[1735,]	"t"	"c"	"x"	"x"	"a"	"0"
[1693,]	"a"	"x"	"g"	"c"	"x"	"0"	[1736,]	"g"	"c"	"x"	"x"	"a"	"0"
[1694,]	"c"	"x"	"g"	"c"	"x"	"0"	[1737,]	"a"	"t"	"x"	"x"	"a"	"0"
[1695,]	"t"	"x"	"g"	"c"	"x"	"0"	[1738,]	"c"	"t"	"x"	"x"	"a"	"0"
[1696,]	"g"	"x"	"g"	"c"	"x"	"0"	[1739,]	"t"	"t"	"x"	"x"	"a"	"0"
[1697,]	"a"	"x"	"a"	"t"	"x"	"0"	[1740,]	"g"	"t"	"x"	"x"	"a"	"0"
[1698,]	"c"	"x"	"a"	"t"	"x"	"0"	[1741,]	"a"	"g"	"x"	"x"	"a"	"0"
[1699,]	"t"	"x"	"a"	"t"	"x"	"0"	[1742,]	"c"	"g"	"x"	"x"	"a"	"0"
[1700,]	"g"	"x"	"a"	"t"	"x"	"0"	[1743,]	"t"	"g"	"x"	"x"	"a"	"0"
[1701,]	"a"	"x"	"c"	"t"	"x"	"0"	[1744,]	"g"	"g"	"x"	"x"	"a"	"0"
[1702,]	"c"	"x"	"c"	"t"	"x"	"0"	[1745,]	"a"	"a"	"x"	"x"	"c"	"0"
[1703,]	"t"	"x"	"c"	"t"	"x"	"0"	[1746,]	"c"	"a"	"x"	"x"	"c"	"0"
[1704,]	"g"	"x"	"c"	"t"	"x"	"0"	[1747,]	"t"	"a"	"x"	"x"	"c"	"0"
[1705,]	"a"	"x"	"t"	"t"	"x"	"0"	[1748,]	"g"	"a"	"x"	"x"	"c"	"0"
[1706,]	"c"	"x"	"t"	"t"	"x"	"0"	[1749,]	"a"	"c"	"x"	"x"	"c"	"0"
[1707,]	"t"	"x"	"t"	"t"	"x"	"0"	[1750,]	"c"	"c"	"x"	"x"	"c"	"0"
[1708,]	"g"	"x"	"t"	"t"	"x"	"0"	[1751,]	"t"	"c"	"x"	"x"	"c"	"0"
[1709,]	"a"	"x"	"g"	"t"	"x"	"0"	[1752,]	"g"	"c"	"x"	"x"	"c"	"0"
[1710,]	"c"	"x"	"g"	"t"	"x"	"0"	[1753,]	"a"	"t"	"x"	"x"	"c"	"0"
[1711,]	"t"	"x"	"g"	"t"	"x"	"0"	[1754,]	"c"	"t"	"x"	"x"	"c"	"0"
[1712,]	"g"	"x"	"g"	"t"	"x"	"0"	[1755,]	"t"	"t"	"x"	"x"	"c"	"0"
[1713,]	"a"	"x"	"a"	"g"	"x"	"0"	[1756,]	"g"	"t"	"x"	"x"	"c"	"0"
[1714,]	"c"	"x"	"a"	"g"	"x"	"0"	[1757,]	"a"	"g"	"x"	"x"	"c"	"0"
[1715,]	"t"	"x"	"a"	"g"	"x"	"0"	[1758,]	"c"	"g"	"x"	"x"	"c"	"0"
[1716,]	"g"	"x"	"a"	"g"	"x"	"0"	[1759,]	"t"	"g"	"x"	"x"	"c"	"0"
[1717,]	"a"	"x"	"c"	"g"	"x"	"0"	[1760,]	"g"	"g"	"x"	"x"	"c"	"0"
[1718,]	"c"	"x"	"c"	"g"	"x"	"0"	[1761,]	"a"	"a"	"x"	"x"	"t"	"0"
[1719,]	"t"	"x"	"c"	"g"	"x"	"0"	[1762,]	"c"	"a"	"x"	"x"	"t"	"0"
[1720,]	"g"	"x"	"c"	"g"	"x"	"0"	[1763,]	"t"	"a"	"x"	"x"	"t"	"0"
[1721,]	"a"	"x"	"t"	"g"	"x"	"0"	[1764,]	"g"	"a"	"x"	"x"	"t"	"0"
[1722,]	"c"	"x"	"t"	"g"	"x"	"0"	[1765,]	"a"	"c"	"x"	"x"	"t"	"0"
[1723,]	"t"	"x"	"t"	"g"	"x"	"0"	[1766,]	"c"	"c"	"x"	"x"	"t"	"0"
[1724,]	"g"	"x"	"t"	"g"	"x"	"0"	[1767,]	"t"	"c"	"x"	"x"	"t"	"0"
[1725,]	"a"	"x"	"g"	"g"	"x"	"0"	[1768,]	"g"	"c"	"x"	"x"	"t"	"0"

[1769,]	"a"	"t"	"x"	"x"	"t"	"0"	[1812,]	"g"	"a"	"x"	"c"	"x"	"0"
[1770,]	"c"	"t"	"x"	"x"	"t"	"0"	[1813,]	"a"	"c"	"x"	"c"	"x"	"0"
[1771,]	"t"	"t"	"x"	"x"	"t"	"0"	[1814,]	"c"	"c"	"x"	"c"	"x"	"0"
[1772,]	"g"	"t"	"x"	"x"	"t"	"0"	[1815,]	"t"	"c"	"x"	"c"	"x"	"0"
[1773,]	"a"	"g"	"x"	"x"	"t"	"0"	[1816,]	"g"	"c"	"x"	"c"	"x"	"0"
[1774,]	"c"	"g"	"x"	"x"	"t"	"0"	[1817,]	"a"	"t"	"x"	"c"	"x"	"0"
[1775,]	"t"	"g"	"x"	"x"	"t"	"0"	[1818,]	"c"	"t"	"x"	"c"	"x"	"0"
[1776,]	"g"	"g"	"x"	"x"	"t"	"0"	[1819,]	"t"	"t"	"x"	"c"	"x"	"0"
[1777,]	"a"	"a"	"x"	"x"	"g"	"0"	[1820,]	"g"	"t"	"x"	"c"	"x"	"0"
[1778,]	"c"	"a"	"x"	"x"	"g"	"0"	[1821,]	"a"	"g"	"x"	"c"	"x"	"0"
[1779,]	"t"	"a"	"x"	"x"	"g"	"0"	[1822,]	"c"	"g"	"x"	"c"	"x"	"0"
[1780,]	"g"	"a"	"x"	"x"	"g"	"0"	[1823,]	"t"	"g"	"x"	"c"	"x"	"0"
[1781,]	"a"	"c"	"x"	"x"	"g"	"0"	[1824,]	"g"	"g"	"x"	"c"	"x"	"0"
[1782,]	"c"	"c"	"x"	"x"	"g"	"0"	[1825,]	"a"	"a"	"x"	"t"	"x"	"0"
[1783,]	"t"	"c"	"x"	"x"	"g"	"0"	[1826,]	"c"	"a"	"x"	"t"	"x"	"0"
[1784,]	"g"	"c"	"x"	"x"	"g"	"0"	[1827,]	"t"	"a"	"x"	"t"	"x"	"0"
[1785,]	"a"	"t"	"x"	"x"	"g"	"0"	[1828,]	"g"	"a"	"x"	"t"	"x"	"0"
[1786,]	"c"	"t"	"x"	"x"	"g"	"0"	[1829,]	"a"	"c"	"x"	"t"	"x"	"0"
[1787,]	"t"	"t"	"x"	"x"	"g"	"0"	[1830,]	"c"	"c"	"x"	"t"	"x"	"0"
[1788,]	"g"	"t"	"x"	"x"	"g"	"0"	[1831,]	"t"	"c"	"x"	"t"	"x"	"0"
[1789,]	"a"	"g"	"x"	"x"	"g"	"0"	[1832,]	"g"	"c"	"x"	"t"	"x"	"0"
[1790,]	"c"	"g"	"x"	"x"	"g"	"0"	[1833,]	"a"	"t"	"x"	"t"	"x"	"0"
[1791,]	"t"	"g"	"x"	"x"	"g"	"0"	[1834,]	"c"	"t"	"x"	"t"	"x"	"0"
[1792,]	"g"	"g"	"x"	"x"	"g"	"0"	[1835,]	"t"	"t"	"x"	"t"	"x"	"0"
[1793,]	"a"	"a"	"x"	"a"	"x"	"0"	[1836,]	"g"	"t"	"x"	"t"	"x"	"0"
[1794,]	"c"	"a"	"x"	"a"	"x"	"0"	[1837,]	"a"	"g"	"x"	"t"	"x"	"0"
[1795,]	"t"	"a"	"x"	"a"	"x"	"0"	[1838,]	"c"	"g"	"x"	"t"	"x"	"0"
[1796,]	"g"	"a"	"x"	"a"	"x"	"0"	[1839,]	"t"	"g"	"x"	"t"	"x"	"0"
[1797,]	"a"	"c"	"x"	"a"	"x"	"0"	[1840,]	"g"	"g"	"x"	"t"	"x"	"0"
[1798,]	"c"	"c"	"x"	"a"	"x"	"0"	[1841,]	"a"	"a"	"x"	"g"	"x"	"0"
[1799,]	"t"	"c"	"x"	"a"	"x"	"0"	[1842,]	"c"	"a"	"x"	"g"	"x"	"0"
[1800,]	"g"	"c"	"x"	"a"	"x"	"0"	[1843,]	"t"	"a"	"x"	"g"	"x"	"0"
[1801,]	"a"	"t"	"x"	"a"	"x"	"0"	[1844,]	"g"	"a"	"x"	"g"	"x"	"0"
[1802,]	"c"	"t"	"x"	"a"	"x"	"0"	[1845,]	"a"	"c"	"x"	"g"	"x"	"0"
[1803,]	"t"	"t"	"x"	"a"	"x"	"0"	[1846,]	"c"	"c"	"x"	"g"	"x"	"0"
[1804,]	"g"	"t"	"x"	"a"	"x"	"0"	[1847,]	"t"	"c"	"x"	"g"	"x"	"0"
[1805,]	"a"	"g"	"x"	"a"	"x"	"0"	[1848,]	"g"	"c"	"x"	"g"	"x"	"0"
[1806,]	"c"	"g"	"x"	"a"	"x"	"0"	[1849,]	"a"	"t"	"x"	"g"	"x"	"0"
[1807,]	"t"	"g"	"x"	"a"	"x"	"0"	[1850,]	"c"	"t"	"x"	"g"	"x"	"0"
[1808,]	"g"	"g"	"x"	"a"	"x"	"0"	[1851,]	"t"	"t"	"x"	"g"	"x"	"0"
[1809,]	"a"	"a"	"x"	"c"	"x"	"0"	[1852,]	"g"	"t"	"x"	"g"	"x"	"0"
[1810,]	"c"	"a"	"x"	"c"	"x"	"0"	[1853,]	"a"	"g"	"x"	"g"	"x"	"0"
[1811,]	"t"	"a"	"x"	"c"	"x"	"0"	[1854,]	"c"	"g"	"x"	"g"	"x"	"0"

[1855,]	"t"	"g"	"x"	"g"	"x"	"0"	[1898,]	"c"	"t"	"t"	"x"	"x"	"0"
[1856,]	"g"	"g"	"x"	"g"	"x"	"0"	[1899,]	"t"	"t"	"t"	"x"	"x"	"0"
[1857,]	"a"	"a"	"a"	"x"	"x"	"0"	[1900,]	"g"	"t"	"t"	"x"	"x"	"0"
[1858,]	"c"	"a"	"a"	"x"	"x"	"0"	[1901,]	"a"	"g"	"t"	"x"	"x"	"0"
[1859,]	"t"	"a"	"a"	"x"	"x"	"0"	[1902,]	"c"	"g"	"t"	"x"	"x"	"0"
[1860,]	"g"	"a"	"a"	"x"	"x"	"0"	[1903,]	"t"	"g"	"t"	"x"	"x"	"0"
[1861,]	"a"	"c"	"a"	"x"	"x"	"0"	[1904,]	"g"	"g"	"t"	"x"	"x"	"0"
[1862,]	"c"	"c"	"a"	"x"	"x"	"0"	[1905,]	"a"	"a"	"g"	"x"	"x"	"0"
[1863,]	"t"	"c"	"a"	"x"	"x"	"0"	[1906,]	"c"	"a"	"g"	"x"	"x"	"0"
[1864,]	"g"	"c"	"a"	"x"	"x"	"0"	[1907,]	"t"	"a"	"g"	"x"	"x"	"0"
[1865,]	"a"	"t"	"a"	"x"	"x"	"0"	[1908,]	"g"	"a"	"g"	"x"	"x"	"0"
[1866,]	"c"	"t"	"a"	"x"	"x"	"0"	[1909,]	"a"	"c"	"g"	"x"	"x"	"0"
[1867,]	"t"	"t"	"a"	"x"	"x"	"0"	[1910,]	"c"	"c"	"g"	"x"	"x"	"0"
[1868,]	"g"	"t"	"a"	"x"	"x"	"0"	[1911,]	"t"	"c"	"g"	"x"	"x"	"0"
[1869,]	"a"	"g"	"a"	"x"	"x"	"0"	[1912,]	"g"	"c"	"g"	"x"	"x"	"0"
[1870,]	"c"	"g"	"a"	"x"	"x"	"0"	[1913,]	"a"	"t"	"g"	"x"	"x"	"0"
[1871,]	"t"	"g"	"a"	"x"	"x"	"0"	[1914,]	"c"	"t"	"g"	"x"	"x"	"0"
[1872,]	"g"	"g"	"a"	"x"	"x"	"0"	[1915,]	"t"	"t"	"g"	"x"	"x"	"0"
[1873,]	"a"	"a"	"c"	"x"	"x"	"0"	[1916,]	"g"	"t"	"g"	"x"	"x"	"0"
[1874,]	"c"	"a"	"c"	"x"	"x"	"0"	[1917,]	"a"	"g"	"g"	"x"	"x"	"0"
[1875,]	"t"	"a"	"c"	"x"	"x"	"0"	[1918,]	"c"	"g"	"g"	"x"	"x"	"0"
[1876,]	"g"	"a"	"c"	"x"	"x"	"0"	[1919,]	"t"	"g"	"g"	"x"	"x"	"0"
[1877,]	"a"	"c"	"c"	"x"	"x"	"0"	[1920,]	"g"	"g"	"g"	"x"	"x"	"0"
[1878,]	"c"	"c"	"c"	"x"	"x"	"0"	[1921,]	"x"	"x"	"x"	"a"	"a"	"0"
[1879,]	"t"	"c"	"c"	"x"	"x"	"0"	[1922,]	"x"	"x"	"x"	"c"	"a"	"0"
[1880,]	"g"	"c"	"c"	"x"	"x"	"0"	[1923,]	"x"	"x"	"x"	"t"	"a"	"0"
[1881,]	"a"	"t"	"c"	"x"	"x"	"0"	[1924,]	"x"	"x"	"x"	"g"	"a"	"0"
[1882,]	"c"	"t"	"c"	"x"	"x"	"0"	[1925,]	"x"	"x"	"x"	"a"	"c"	"0"
[1883,]	"t"	"t"	"c"	"x"	"x"	"0"	[1926,]	"x"	"x"	"x"	"c"	"c"	"0"
[1884,]	"g"	"t"	"c"	"x"	"x"	"0"	[1927,]	"x"	"x"	"x"	"t"	"c"	"0"
[1885,]	"a"	"g"	"c"	"x"	"x"	"0"	[1928,]	"x"	"x"	"x"	"g"	"c"	"0"
[1886,]	"c"	"g"	"c"	"x"	"x"	"0"	[1929,]	"x"	"x"	"x"	"a"	"t"	"0"
[1887,]	"t"	"g"	"c"	"x"	"x"	"0"	[1930,]	"x"	"x"	"x"	"c"	"t"	"0"
[1888,]	"g"	"g"	"c"	"x"	"x"	"0"	[1931,]	"x"	"x"	"x"	"t"	"t"	"0"
[1889,]	"a"	"a"	"t"	"x"	"x"	"0"	[1932,]	"x"	"x"	"x"	"g"	"t"	"0"
[1890,]	"c"	"a"	"t"	"x"	"x"	"0"	[1933,]	"x"	"x"	"x"	"a"	"g"	"0"
[1891,]	"t"	"a"	"t"	"x"	"x"	"0"	[1934,]	"x"	"x"	"x"	"c"	"g"	"0"
[1892,]	"g"	"a"	"t"	"x"	"x"	"0"	[1935,]	"x"	"x"	"x"	"t"	"g"	"0"
[1893,]	"a"	"c"	"t"	"x"	"x"	"0"	[1936,]	"x"	"x"	"x"	"g"	"g"	"0"
[1894,]	"c"	"c"	"t"	"x"	"x"	"0"	[1937,]	"x"	"x"	"a"	"x"	"a"	"0"
[1895,]	"t"	"c"	"t"	"x"	"x"	"0"	[1938,]	"x"	"x"	"c"	"x"	"a"	"0"
[1896,]	"g"	"c"	"t"	"x"	"x"	"0"	[1939,]	"x"	"x"	"t"	"x"	"a"	"0"
[1897,]	"a"	"t"	"t"	"x"	"x"	"0"	[1940,]	"x"	"x"	"g"	"x"	"a"	"0"

[1941,]	"x"	"x"	"a"	"x"	"c"	"0"	[1984,]	"x"	"g"	"x"	"x"	"g"	"0"
[1942,]	"x"	"x"	"c"	"x"	"c"	"0"	[1985,]	"x"	"a"	"x"	"a"	"x"	"0"
[1943,]	"x"	"x"	"t"	"x"	"c"	"0"	[1986,]	"x"	"c"	"x"	"a"	"x"	"0"
[1944,]	"x"	"x"	"g"	"x"	"c"	"0"	[1987,]	"x"	"t"	"x"	"a"	"x"	"0"
[1945,]	"x"	"x"	"a"	"x"	"t"	"0"	[1988,]	"x"	"g"	"x"	"a"	"x"	"0"
[1946,]	"x"	"x"	"c"	"x"	"t"	"0"	[1989,]	"x"	"a"	"x"	"c"	"x"	"0"
[1947,]	"x"	"x"	"t"	"x"	"t"	"0"	[1990,]	"x"	"c"	"x"	"c"	"x"	"0"
[1948,]	"x"	"x"	"g"	"x"	"t"	"0"	[1991,]	"x"	"t"	"x"	"c"	"x"	"0"
[1949,]	"x"	"x"	"a"	"x"	"g"	"0"	[1992,]	"x"	"g"	"x"	"c"	"x"	"0"
[1950,]	"x"	"x"	"c"	"x"	"g"	"0"	[1993,]	"x"	"a"	"x"	"t"	"x"	"0"
[1951,]	"x"	"x"	"t"	"x"	"g"	"0"	[1994,]	"x"	"c"	"x"	"t"	"x"	"0"
[1952,]	"x"	"x"	"g"	"x"	"g"	"0"	[1995,]	"x"	"t"	"x"	"t"	"x"	"0"
[1953,]	"x"	"x"	"a"	"a"	"x"	"0"	[1996,]	"x"	"g"	"x"	"t"	"x"	"0"
[1954,]	"x"	"x"	"c"	"a"	"x"	"0"	[1997,]	"x"	"a"	"x"	"g"	"x"	"0"
[1955,]	"x"	"x"	"t"	"a"	"x"	"0"	[1998,]	"x"	"c"	"x"	"g"	"x"	"0"
[1956,]	"x"	"x"	"g"	"a"	"x"	"0"	[1999,]	"x"	"t"	"x"	"g"	"x"	"0"
[1957,]	"x"	"x"	"a"	"c"	"x"	"0"	[2000,]	"x"	"g"	"x"	"g"	"x"	"0"
[1958,]	"x"	"x"	"c"	"c"	"x"	"0"	[2001,]	"x"	"a"	"a"	"x"	"x"	"0"
[1959,]	"x"	"x"	"t"	"c"	"x"	"0"	[2002,]	"x"	"c"	"a"	"x"	"x"	"0"
[1960,]	"x"	"x"	"g"	"c"	"x"	"0"	[2003,]	"x"	"t"	"a"	"x"	"x"	"0"
[1961,]	"x"	"x"	"a"	"t"	"x"	"0"	[2004,]	"x"	"g"	"a"	"x"	"x"	"0"
[1962,]	"x"	"x"	"c"	"t"	"x"	"0"	[2005,]	"x"	"a"	"c"	"x"	"x"	"0"
[1963,]	"x"	"x"	"t"	"t"	"x"	"0"	[2006,]	"x"	"c"	"c"	"x"	"x"	"0"
[1964,]	"x"	"x"	"g"	"t"	"x"	"0"	[2007,]	"x"	"t"	"c"	"x"	"x"	"0"
[1965,]	"x"	"x"	"a"	"g"	"x"	"0"	[2008,]	"x"	"g"	"c"	"x"	"x"	"0"
[1966,]	"x"	"x"	"c"	"g"	"x"	"0"	[2009,]	"x"	"a"	"t"	"x"	"x"	"0"
[1967,]	"x"	"x"	"t"	"g"	"x"	"0"	[2010,]	"x"	"c"	"t"	"x"	"x"	"0"
[1968,]	"x"	"x"	"g"	"g"	"x"	"0"	[2011,]	"x"	"t"	"t"	"x"	"x"	"0"
[1969,]	"x"	"a"	"x"	"x"	"a"	"0"	[2012,]	"x"	"g"	"t"	"x"	"x"	"0"
[1970,]	"x"	"c"	"x"	"x"	"a"	"0"	[2013,]	"x"	"a"	"g"	"x"	"x"	"0"
[1971,]	"x"	"t"	"x"	"x"	"a"	"0"	[2014,]	"x"	"c"	"g"	"x"	"x"	"0"
[1972,]	"x"	"g"	"x"	"x"	"a"	"0"	[2015,]	"x"	"t"	"g"	"x"	"x"	"0"
[1973,]	"x"	"a"	"x"	"x"	"c"	"0"	[2016,]	"x"	"g"	"g"	"x"	"x"	"0"
[1974,]	"x"	"c"	"x"	"x"	"c"	"0"	[2017,]	"a"	"x"	"x"	"x"	"a"	"0"
[1975,]	"x"	"t"	"x"	"x"	"c"	"0"	[2018,]	"c"	"x"	"x"	"x"	"a"	"0"
[1976,]	"x"	"g"	"x"	"x"	"c"	"0"	[2019,]	"t"	"x"	"x"	"x"	"a"	"0"
[1977,]	"x"	"a"	"x"	"x"	"t"	"0"	[2020,]	"g"	"x"	"x"	"x"	"a"	"0"
[1978,]	"x"	"c"	"x"	"x"	"t"	"0"	[2021,]	"a"	"x"	"x"	"x"	"c"	"0"
[1979,]	"x"	"t"	"x"	"x"	"t"	"0"	[2022,]	"c"	"x"	"x"	"x"	"c"	"0"
[1980,]	"x"	"g"	"x"	"x"	"t"	"0"	[2023,]	"t"	"x"	"x"	"x"	"c"	"0"
[1981,]	"x"	"a"	"x"	"x"	"g"	"0"	[2024,]	"g"	"x"	"x"	"x"	"c"	"0"
[1982,]	"x"	"c"	"x"	"x"	"g"	"0"	[2025,]	"a"	"x"	"x"	"x"	"t"	"0"
[1983,]	"x"	"t"	"x"	"x"	"g"	"0"	[2026,]	"c"	"x"	"x"	"x"	"t"	"0"

[2027,]	"t"	"x"	"x"	"x"	"t"	"0"	[2070,]	"c"	"c"	"x"	"x"	"x"	"0"
[2028,]	"g"	"x"	"x"	"x"	"t"	"0"	[2071,]	"t"	"c"	"x"	"x"	"x"	"0"
[2029,]	"a"	"x"	"x"	"x"	"g"	"0"	[2072,]	"g"	"c"	"x"	"x"	"x"	"0"
[2030,]	"c"	"x"	"x"	"x"	"g"	"0"	[2073,]	"a"	"t"	"x"	"x"	"x"	"0"
[2031,]	"t"	"x"	"x"	"x"	"g"	"0"	[2074,]	"c"	"t"	"x"	"x"	"x"	"0"
[2032,]	"g"	"x"	"x"	"x"	"g"	"0"	[2075,]	"t"	"t"	"x"	"x"	"x"	"0"
[2033,]	"a"	"x"	"x"	"a"	"x"	"0"	[2076,]	"g"	"t"	"x"	"x"	"x"	"0"
[2034,]	"c"	"x"	"x"	"a"	"x"	"0"	[2077,]	"a"	"g"	"x"	"x"	"x"	"0"
[2035,]	"t"	"x"	"x"	"a"	"x"	"0"	[2078,]	"c"	"g"	"x"	"x"	"x"	"0"
[2036,]	"g"	"x"	"x"	"a"	"x"	"0"	[2079,]	"t"	"g"	"x"	"x"	"x"	"0"
[2037,]	"a"	"x"	"x"	"c"	"x"	"0"	[2080,]	"g"	"g"	"x"	"x"	"x"	"0"
[2038,]	"c"	"x"	"x"	"c"	"x"	"0"	[2081,]	"a"	"x"	"x"	"x"	"x"	"0"
[2039,]	"t"	"x"	"x"	"c"	"x"	"0"	[2082,]	"c"	"x"	"x"	"x"	"x"	"0"
[2040,]	"g"	"x"	"x"	"c"	"x"	"0"	[2083,]	"t"	"x"	"x"	"x"	"x"	"0"
[2041,]	"a"	"x"	"x"	"t"	"x"	"0"	[2084,]	"g"	"x"	"x"	"x"	"x"	"0"
[2042,]	"c"	"x"	"x"	"t"	"x"	"0"	[2085,]	"x"	"a"	"x"	"x"	"x"	"0"
[2043,]	"t"	"x"	"x"	"t"	"x"	"0"	[2086,]	"x"	"c"	"x"	"x"	"x"	"0"
[2044,]	"g"	"x"	"x"	"t"	"x"	"0"	[2087,]	"x"	"t"	"x"	"x"	"x"	"0"
[2045,]	"a"	"x"	"x"	"g"	"x"	"0"	[2088,]	"x"	"g"	"x"	"x"	"x"	"0"
[2046,]	"c"	"x"	"x"	"g"	"x"	"0"	[2089,]	"x"	"x"	"a"	"x"	"x"	"0"
[2047,]	"t"	"x"	"x"	"g"	"x"	"0"	[2090,]	"x"	"x"	"c"	"x"	"x"	"0"
[2048,]	"g"	"x"	"x"	"g"	"x"	"0"	[2091,]	"x"	"x"	"t"	"x"	"x"	"0"
[2049,]	"a"	"x"	"a"	"x"	"x"	"0"	[2092,]	"x"	"x"	"g"	"x"	"x"	"0"
[2050,]	"c"	"x"	"a"	"x"	"x"	"0"	[2093,]	"x"	"x"	"x"	"a"	"x"	"0"
[2051,]	"t"	"x"	"a"	"x"	"x"	"0"	[2094,]	"x"	"x"	"x"	"c"	"x"	"0"
[2052,]	"g"	"x"	"a"	"x"	"x"	"0"	[2095,]	"x"	"x"	"x"	"t"	"x"	"0"
[2053,]	"a"	"x"	"c"	"x"	"x"	"0"	[2096,]	"x"	"x"	"x"	"g"	"x"	"0"
[2054,]	"c"	"x"	"c"	"x"	"x"	"0"	[2097,]	"x"	"x"	"x"	"x"	"a"	"0"
[2055,]	"t"	"x"	"c"	"x"	"x"	"0"	[2098,]	"x"	"x"	"x"	"x"	"c"	"0"
[2056,]	"g"	"x"	"c"	"x"	"x"	"0"	[2099,]	"x"	"x"	"x"	"x"	"t"	"0"
[2057,]	"a"	"x"	"t"	"x"	"x"	"0"	[2100,]	"x"	"x"	"x"	"x"	"g"	"0"
[2058,]	"c"	"x"	"t"	"x"	"x"	"0"							
[2059,]	"t"	"x"	"t"	"x"	"x"	"0"							
[2060,]	"g"	"x"	"t"	"x"	"x"	"0"							
[2061,]	"a"	"x"	"g"	"x"	"x"	"0"							
[2062,]	"c"	"x"	"g"	"x"	"x"	"0"							
[2063,]	"t"	"x"	"g"	"x"	"x"	"0"							
[2064,]	"g"	"x"	"g"	"x"	"x"	"0"							
[2065,]	"a"	"a"	"x"	"x"	"x"	"0"							
[2066,]	"c"	"a"	"x"	"x"	"x"	"0"							
[2067,]	"t"	"a"	"x"	"x"	"x"	"0"							
[2068,]	"g"	"a"	"x"	"x"	"x"	"0"							
[2069,]	"a"	"c"	"x"	"x"	"x"	"0"							

> sum(F6)
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