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On the Notion of Percentage Nucleotide Concentration of Genome Sequences in Terms of Cellular Automata Evolutions of Adjoints Sequences

By Prashanthi Govindarajan, Sathya Govindarajan & Ethirajan Govindarajan *Abstract*- This paper proposes a novel concept called "Percentage Nucleotide Concentration of genomes" in terms of cellular automata evolutions of adjoints of Adenine, Thymine, Guanine, and Cytosine. The adjoints of the given a genome sequenceare the characteristic binary string sequences. For example, the adjoint of Adenine of a given genome sequence is a binary string consisting of 0's and 1's where 1's corresponds to the presence of Adenine, and Cytosine corresponding to a given genome sequence. So, one can have four adjoint sequences of Adenine, Thymine, Guanine, and Cytosine corresponding to a given genome sequence. One-dimensional three neighborhood binary value cellular automata rules could be applied to an adjoint sequence and the desired number of evolutions obtained. These rules aredefined by linear Boolean functions and one can have 256 such linear Boolean functions. Nucleotide concentration is computed for an adjoint sequence and its variation evaluated for its successive evolutions based on a cellular automaton rule.

Keywords: cellular automata, evolutions of adjoints, linear boolean functions, nucleotide concentration in a genome.

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On the Notion of Percentage Nucleotide Concentration of Genome Sequences in Terms of Cellular Automata Evolutions of Adjoints Sequences

Prashanthi Govindarajan[°], Sathya Govindarajan[°] & Ethirajan Govindarajan[°]

Abstract- This paper proposes a novel concept called "Percentage Nucleotide Concentration of genomes" in terms of cellular automata evolutions of adjoints of Adenine, Thymine, Guanine, and Cytosine. The adjoints of the given a genome sequenceare the characteristic binary string sequences. For example, the adjoint of Adenine of a given genome sequence is a binary string consisting of 0's and 1's where 1's corresponds to the presence of Adenine in the genome sequence. So, one can have four adjoint sequences of Adenine, Thymine, Guanine, and Cytosine corresponding to given genome sequence. One-dimensional three a neighborhood binary value cellular automata rules could be applied to an adjoint sequence and the desired number of evolutions obtained. These rules are defined by linear Boolean functions and one can have 256 such linear Boolean functions.Nucleotide concentration is computed for an adjoint sequence and its variation evaluated for its successive evolutions based on a cellular automaton rule.

Keywords: cellular automata, evolutions of adjoints, linear boolean functions, nucleotide concentration in a genome.

I. INTRODUCTION

he purpose of the research carried out and reported in this paper is whether it is possible to categorize a set of genomes like the human genome repository. The concept of "%nucleotide concentration" introduced in this paper seems to show a way to accomplish this task. The genesis of the formulation of this concept originates from chemistry, wherein the quantificational notion of percentage ionic concentration of hydrogen (pH value) is used to categorize solutions into three (i) water, whose pH value is 7, (ii) acidic solutions whose pH values are less than 7 and (iii) alkaline solutions whose pH values are greater than 7. On the same lines, an effort was made to categorize genome sets based on four values (i) % nucleotide concentration of Adenine (pA), (ii) % nucleotide concentration of Thymine (pT), (iii) % nucleotide concentration of Guanine (pG) and (iv) %

nucleotide concentration of Cytosine (pC). It is reasonable to surmise that these values, possibly their compositions would categorize a given set of genomes. The formulation of the concept is briefly explained below. Section 2 of this paper describes the concept formulation.

Section 3 of this paper describes the fundamental notions of adjoints of a genome and their evolution using one dimensional cellular automata rules defined by linear Boolean functions. Section 4 provides experimental results of a case study pertaining to evaluation of Concentration of Nucleotides in terms of Adjoints of BrucellaSuis 1330 Genome Sequence.

II. CONCEPT FORMULATION

Analogous to the notion of pH value of a solution, the values of pA, pT, pG and pC of a genome sequence and possibly composition of these values like the proportion pA:pT:pG:pC seems to pave a way to classify and characterize genome sets. The definition of "Percentage Nucleotide Concentration" of a genome sequence is given below.

Definition

Given a genome sequence, the number of a particular nucleotide, say A, present in that genome sequence is counted and the sum is divided by the total number of nucleotides in that genome sequence. The fraction when multiplied by 100 yields the "Percentage Concentration of Adenine pA". Similarly, one can evaluate pT, pG and pC.

III. One-Dimensional Three Neighborhood Cellular Automata Evolutions of Adjointsof a Genome Sequence

Adjoint of a particular nucleotide in a genome sequence is the binary sequence obtained by substituting the particular nucleotides in the genome sequence by 1's and the others by 0's. For example, let us consider a sample sequence of BrucellaSuis 1330 for a case study. The actual length of the genome sequence of BrucellaSuis 1330 is 5806. A cellular Year 2 020

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automaton is an idealized parallel processing system consisting of an array of numbers (1-D, 2-D and more) realized using updating rules based on certain neighborhood. For example, a one-dimensional cellular automaton would consist of a finite-length array as shown below.

1					1
 	 1-l	1	1+1	 	

Consider an ith cell in the array. This cell has a neighbor i-1 on its left and another i+1 on its right. All three put together is called a three neighborhood. One can assign a site (cell) variable ξ_{i-1} , ξ_{i} , and ξ_{i+1} to the three neighborhood cells. At a particular instant of time, these variables take on numerical values, say either a 0 or a 1. In such a case, the variables are denoted as ξ ti-1, ξ ti, and ξ ti+1. The value of the ith cell at the next instant of time is evaluated using an updating rule that involves the present values of the ith, (i-1)th and (i+1)th cells. This updating rule is essentially a linear Boolean function of three variables. One can construct 256 linear Boolean functions as updating rules of one-dimensional threeneighborhood binary- valued cellular automata. Each rule defines an automaton by itself. So, one dimensional binary valued three neighborhood cellular automata (123CA) rules could be used to model adjoints of a genome sequence. The first twenty linear Boolean functions of cellular automata 123CA are listed below with their decimal equivalents.

Linear Boolean Function	Decimal Equivalent
0	. 0
$(\bar{\xi}_{i-1}\bar{\xi}_i\bar{\xi}_{i+1})$	1
$(\bar{\xi}_{i-1}\bar{\xi}_i\xi_{i+1})$	2
$(\bar{\xi}_{i-1}\bar{\xi}_i)$	3
$(\bar{\xi}_{i-1}\xi_i\bar{\xi}_{i+1})$	4
$(\bar{\xi}_{i-1}\bar{\xi}_{i+1})$	5
$(\overline{\xi}_{i-1}\xi_i\overline{\xi}_{i+1})+(\overline{\xi}_{i-1}\overline{\xi}_i\xi_{i+1})$	6
$(ar{\xi}_{i-1}ar{\xi}_{i+1})_+(ar{\xi}_{i-1}ar{\xi}_i)$	7
$(\bar{\xi}_{i-1}\xi_i\xi_{i+1})$	8
$(\bar{\xi}_{i-1}\bar{\xi}_i\bar{\xi}_{i+1}) + (\bar{\xi}_{i-1}\xi_i\xi_{i+1})$	9
$(\overline{\xi}_{i-1}\xi_{i+1})$	10
$(\bar{\xi}_{i-1}\bar{\xi}_i) + (\bar{\xi}_{i-1}\xi_{i+1})$	11
$(\bar{\xi}_{i-1}\xi_i)$	12
$(\bar{\xi}_{i-1}\bar{\xi}_{i+1}) + (\bar{\xi}_{i-1}\xi_i)$	13
$(\bar{\xi}_{i-1}\xi_i) + (\bar{\xi}_{i-1}\xi_{i+1})$	14
$(\bar{\xi}_{i-1})$	15
$(\xi_{i-1}\bar{\xi}_i\bar{\xi}_{i+1})$	16
$(\overline{\xi}_i \overline{\xi}_{i+1})$	17
$(\xi_{i-1}\bar{\xi}_i\bar{\xi}_{i+1}) + (\bar{\xi}_{i-1}\bar{\xi}_i\xi_{i+1})$	18
$\overline{(\xi_i \overline{\xi_{i+1}})} + (\overline{\xi_{i-1}} \overline{\xi_i})$	19
$(\xi_{i-1}\bar{\xi}_i\bar{\xi}_{i+1}) + (\bar{\xi}_{i-1}\xi_i\bar{\xi}_{i+1})$	20

For the case study rule number 90 is applied to the adjoints of BrucellaSuis 1330 genome sequence and 500 evolutions generated. Rule 90 is shown below.

$$(\xi_{i-1}\bar{\xi}_{i+1}) + (\bar{\xi}_{i-1}\xi_{i+1})$$
 90

Since the image of the 500 evolutions of BrucellaSuis 1330 is large, a small portion of the images are presented in this paper.

IV. Concentration of Nucleotidesin Adjoints of Brucellasuis 1330 Genome Sequence

The values of pA, pT, pG and pCof the BrucellaSuis 1330 genome sequence are computed for the adjoints A(n), T(n),G(n) and C(n) and their 500 evolutions using 123CA rules based one linear Boolean functions. Fig. 1 shows the evolutions of the adjoints of A(n), T(n). G(n) and C(n) using the linear Boolean function rule 90 of 123CA. The values are tabulated and the corresponding graphs shown subsequently. Table 1 shows the pA values of A(n) of BrucellaSuis 1330 genome sequence and the 500 generations of A(n) using rule 90 of 123CA. Figs. 2 and 3 shows the graphs of the variations of pA values of all generations. Table 2 shows the pT values of T(n) of BrucellaSuis 1330 genome sequence and the 500 generations of T(n)using rule 90 of 123CA. Figs. 4and 5 shows the graph of the variations of pT values of all generations. Table 3 shows the pG values of G(n) of BrucellaSuis 1330 genome sequence and the 500 generations of G(n) using rule 90 of 123CA. Fig. 4 shows the graph of variations of pA values of all generations. Table 4 shows the pC values of C(n) of BrucellaSuis 1330 genome sequence and 500 generations of C(n) using rule 90 of 123CA. Fig. 5 shows the graph of the variations of pC values of all generations.

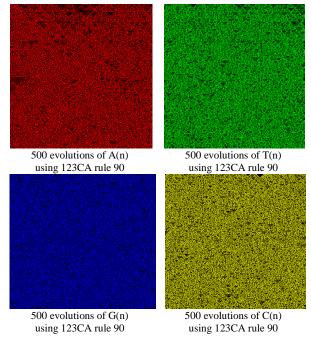


Fig. 1: Evolutions of the adjoints of A(n), T(n). G(n) and C(n).

Table 1: pA values of A(n) and its 500 evolutions

1	19.18705	21	42,7661	41	42.31829	61	50.08612	81	43.1278	101	48.57379	121	49.03548	141	48.96659	161	43.04168	181	50.3272
2	30.50293	22	49.13882	42	48.93214	62	50.24113	82	48.65656	102	49.52108	122	50,68894	142	50.32725	162	48,72546	182	50.1722-
	30.29625	23	48.67379	43	48.35576	63	52.10127	83	49.3455	103	50.82673	123	50,34447	143	50.36169	163	48,60489	183	40.6727
4	40.80252	24	50.55115	44	50.72339	64	48.7599	84	49.85553	104	50.17224	124	50.56452	144	51,13676	164	\$0,55115	184	49,4660
5	30.38236	25	42.95556	45	46.60696	65	30.89907	85	49.31105	105	45,77919	125	50,80951	145	42,19773	165	48,50155	185	48,9493
6	41.62935	26	47.96762	46	49.56941	66	41.54323	86	49.63831	106	50,70617	126	51.8257	146	49.63831	166	49.93111	185	49.7244
7	41.52601	27	48.62212	47	50.22391	67	41.78436	87	50.15501	107	49.60385	127	48.77713	147	49.24216	167	50.13779	197	49.7416
8	48.51877	28	50.51671	48	50.51871	68	47.24423	88	49.88998	108	49.68598	128	48.72546	148	49.37826	168	50.55115	198	51.8945
9	31.01963	29	48.69101	49	42.88667	69	41.93937	89	48.31209	109	48.12263	129	31.45022	149	48.8285	169	48.89769	189	50.3789
10	41.02652	30	50.49948	50	48.19153	70	48.39821	90	49.53496	110	50.17224	130	43.0589	150	49.29383	170	51.18843	19D	50.1377
11	41.14709	31	49.96555	51	49.39718	71	48.50155	91	50.93007	111	49.98278	131	42.85222	151	50.03445	171	49.29383	191	50.1722
12	48.57044	32	49.39718	52	49.56941	72	49.19049	92	50.15501	112	50.99897	132	49.3455	152	49.50052	172	49.93111	192	50.0344
13	41.49156	33	30.83018	53	48.58767	73	42.30107	93	49.17327	113	45.81364	133	42.57654	153	49.22494	173	50.39614	193	42.1532
14	48.19153	34	41.54323	54	50.27558	74	48.32931	94	50.08612	114	48.96659	134	48.01929	154	50.62005	174	49.44885	194	47.8470
15	47.15811	35	41.6638	55	49.65553	75	49.0527	95	50.20668	115	49.86221	135	49.37609	155	51.18843	175	49.94833	195	48.1570
16	50.05889	36	48.536	56	50.44781	76	50.20668	96	50.39614	116	50.13779	136	49.24216	156	49.87944	176	48.81157	195	50,3272
17	31.34688	37	41.92215	57	49.36273	77	47.53703	97	42.42163	117	48.69101	137	43.16225	157	49.98278	177	49.10437	197	48,0537
18	43.1278	38	46.98588	58	50.17224	78	49.1216	98	48.58767	112	50.6545	138	48.74268	158	49.86221	178	49.29383	192	49,4488
19	43.83396	39	47.48536	59	50.20668	79	48.48433	99	49.00103	119	49.94833	139	48.89759	159	50.72339	179	49.06993	199	49.2249
20		-		60	30 93 ANN	ол		100	AR 623134	120	50.36169	140	50.17224	160	52.06583	180	49.37995	200	49.845
201	48.15708	221	50.01722	241	49.10437	261	43,43782	281	48.94936	301	50.01722 50.2928	321	42.33551 48.7599	341	49.44885	362	49.50386	381	51.30899
202	49.51774	222	50.5856	242	50.70617	262	48.19153 49.22191	282	50.82873	302	49.15605	323	48.72546	343	49.98276	363	49.33219	383	49.9483
203	19.89666	223	50.25835	245	49.46329	265	48.65656	283	49.79332	304	49.89566	324	49.81054	344	49.86221	364	51.05064	30.5	49.2938
205	49.25939	225	47.50258	245	51.15398	265	43.04168	285	52.32518	305	48.98381	325	49.29383	345	49.56911	365	49.86221	385	43.1966
206	49.65553	226	50.80951	245	51.30899	266	48,846/02	2.86	49.89666	306	50.51671	326	51.27454	346	50.75784	366	49.63831	386	48.828
207	50.10334	227	50.79228	247	50.63727	267	48.22597	287	49.91388	307	50.79228	327	49.82776	347	50.67172	367	50.44781	387	48.29-18
208	49.51774	228	48.4671	248	50.53393	255	49.7072	2.03	48.55555	308	50.52005	328	49.24216	348	49.89555	368	49.50386	388	50.9473
209	49.36273	229	50.10334	249	49.39718	269	48.32931	289	42.54554	309	50.27558	329	48.1743	349	50.10334	369	18.50189	389	48.6393
210	18.67379	230	49.74165	259	49.93111	270	49.81054	290	49.27561	310	49.55219	330	49.50052	350	50.91285	370	50.79228	390	50.1033-
211	49.68998	231	49.67275	251	49.94833	271	49.84499	291	47.91595	311	49.58598	331	50.53393 49.86221	351	49.51774 50.22391	371	48.38099 49.29383	391	50.3272
212	49.84499	232	50.06889	252	49.63831	272	50.68894	292	49.98278	313	47.76094	333	49.75887	353	48.57044	373	49.74165	393	48.0192
213 214	50.49948	233	49.27661	253	48.89769	273	42.35274	293	49.27661	314	49.50052	334	49,89866	354	49.68998	374	50.86118	394	50.2583
214	50.75784 49.63831	234	50.8784 50.43059	254	49.87944 49.1216	274	48,86324 50,22391	294	S1.29177 S1.20565	315	50.43059	335	50.20568	355	50.41337	375	50.22391	395	49.8622
216	50.22391	236	50.55115	255	48.77713	276	50.37892	296	49.22494	316	50.24113	336	50.37892	356	50.70517	376	50.34447	396	50.8611
217	49,79332	237	49,24216	257	30,96796	277	47.8815	297	49.03548	317	48.536	337	48.58767	357	49.58563	377	49.77609	397	50.6372
218	49.19049	238	50	258	41.99104	278	49,56941	298	49.56941	318	49.52108	338	49.01825	358	51.49845	378	49.7072	398	50.5167
219	49.81054	239	50.18946	259	42.52497	279	49.45607	299	49.63831	319	50.49948	339	50.43059	359	48.62212	379	50.25835	399	51.20565
220	51.58457	240	49.82776	269	49.27661	280	50,60282	300	49.81054	320	49.77609	340	50.39614	360	49.22494	380	49.86221	400	49.62108
401	48.36376	421	49.67275	441	49.91388	461	50.05167	481	48.55322	_									
402	49.67275	422	49.93111	442	51.56734	462	50.72339	482	50.51671	Rul	e nu	ıml	ber §	90	is a	aa	lied	to	A(n
403	51.22287	423	49.22494	443	50.20668	463	48.89769	483	49.87944										``
404	10.37292 49.91388	424	50.44781 49.05993	444	49,85221	465	50.43059	484	51.05786	and	d its	3	500	- 9	jenei	ati	ions.	- 1	t is
406	49.37995	426	49.91388	446	50,5856	466	50.06889	485	49.98278	obr	serve	Ы	tha	at -	the		Aq		alu
407	49.08715	427	49.58653	447	50.36169	467	50.10334	487	49.79332	003		u	uic	at a	116		РΑ	v	au
408	49.56541	428	50.13779	448	50.20668	468	50.10534	483	49.29383	her	come	24	mi	nin	num		at	rea	aula
409	50.68894	429	49.91388	449	48.26012	469	50.18946	489	51.55012									`	<i>J</i>
410	49.63831	430	50.10334	450	49.75887 \$0.05167	470	50.70617	490	49.48329	inte	rvals	0	t 1. 2	. 4	. 8. 1	16.	32, 1	64.	128
411	51.2401	431	49.68998	451	50.05889	471	51.03341	491	49.1216				,	·					
413	50.08612	433	49.89656	453	50.20668	473	49.4144	493	50.89563	and	1 25	б.	This	5 1	ndica	ate	s a	tra	acta
414	50.43059	434	58.516/1	454	49.15605	474	49.60386	494	49.91388	bet	navio	r	of		th a		~		ition
415	49.58278	415	49.1216	455	49.10437	475	49.31106	495	50.53393	Del	avio		01		the	;	ev	olu	ition
416	49.75887	436	50.8784	456	48.63934	476	49.81054	496	50.25835	Mir	i(Δ(n)) =	=30.2	Par	5				and
417	49.72442	437	49.13882	457	51.05064	477	48.98381	497	49.44885			· ·							
418	49.5349E 50.22391	438	58.13779 49.56941	458	50.82678	478	49.96555 50.17224	493	49.00108	Ma	x(A(r	י ((ו	=31 -	450	72 T	he	devi	atio	on is
419	49.51774		49.56942		49.37995	480	50.9478		49.79332	1.1		· <i>m</i>	01.		1		3011	an	511 1

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Fig. 2: pA values of A(n) and of its evolutions

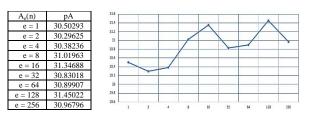
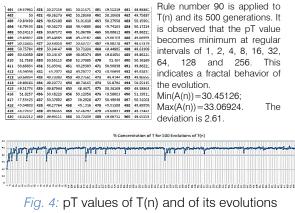


Fig. 3: Minimum pA values of A(n) and of its evolutions

Table 2: pT values of T(n) and its 500 evolutions

1	20.25491	21	43.73062	41	44.09232	61	51.42956	81	43.28281	101	48.4571	121	49.35605	141	48.12263	161	42.4733	181	50.34447
2	30.45126	22	49.22494	42	48.69101	62	49.62108	82	49.06993	102	49.32820	122	49.7072	142	50.51671	162	49.17327	182	50.41337
3	32.15639	23	49.62108	43	48.94935	63	51.53574	83	48./0873	103	49,75887	123	50.89553	143	49.46507	163	48.59101	183	50.82673
4	41.74991	24	49.50052	44	51.10231	64	49.27661	84	50.5856	104	49.24216	124	49.43162	144	50.99897	164	51.1712	184	49.93111
5	31.94971	25	43.38615	45	48.84602	65	31.82914	85	48.65656	105	49.7072	125	51.51567	145	42.97279	165	49.1216	185	49.03548
6	41.68102	26	49.44885	46	49.65553	65	41.83603	86	49.53496	105	53.03445	126	50.82678	145	49.36273	165	49.82776	186	40.68993
7	42.7661	27	48.34654	47	49,58663	67	43.59283	87	50.84395	107	49.93111	127	50.93007	147	49.15615	167	49.89666	187	50.08612
8	48.65655	28	49.81054	48	49.25939	65	47.22701	38	49.74165	108	49.62108	128	50.44781	148	49.25939	168	50.03445	188	49.50052
9	32.3803	29	50.24113	49	43.76507	69	43.52394	89	49.98278	109	49.03549	129	31.82914	149	49.0527	169	48.7599	189	50.18946
10	43.11058	30	50.48226	50	49.75887	70	47.70927	90	49.62108	110	50.08512	130	43.09335	150	49.3455	170	51.10231	190	50.18946
31	43,30003	31	49.48329	51	48.31209	71	48.79435	91	49.46607	111	49.84499	191	43,78225	151	50.91285	171	50.08612	191	49.4144
12	48.94935	32	49.24216	52	51.22287	72	50.18946	92	49.86221	112	49.91389	132	49.69101	152	50.9473	172	48.94936	192	50.44781
13	43.36893	33	32.19084	53	46.8268	73	42.93834	93	50.27558	113	50.55115	133	43.16225	153	48.70823	173	50.25835	193	42.55942
14	47.9504	84	41.97382	54	48.81157	74	48.50155	94	49.51774	114	50.75784	134	48.74268	154	50.77526	174	49.46E07	194	49.3455
15	47.07199	35	42.62832	55	50.08612	75	49,74165	95	49.00103	115	50	195	48.98301	155	48.81157	175	50.55115	195	48.6393
16	51.27454	36	47.67482	56	49,20777	76	45.37878	96	50.77339	116	50.05167	136	51.05054	156	49.19349	176	49.03548	196	49.82776
17	32.65587	37	43.33448	57	48.62212	77	48.8288	97	43.00723	117	51.20565	137	43.40328	157	49.20772	177	48.55322	197	49.00207
18	42.16328	38	48.69101	58	50,74061	78	50.08612	98	47.02032	118	50.18946	158	48.79435	158	50.55115	178	50.15501	198	50.9473
19	42.93001	39	48.69101	59	49,91388	75	50.08612	99	48,79435	119	\$3,43059	139	48.98381	159	49.86ZZ1	179	49.74163	199	49.23635
20	48.55322	40	50.03445	60	51.34344	80	49.58663	100	48.72546	120	49.68999	140	50.15501	160	49.87944	180	50.08612	200	49.79333
201										301	38.91492				49 91384		29.53496		\$1,067
		221	50.99897	241	50.70517	261	43.67895	261	49.01826										
	5D.41837	222	50.40548	242	\$0.17274	262	47.5648	282	49.77609	302	49.13852	322	47,69204	342	49 85553	362	30.03167	302	50.258
203	5D.41837 49.82776	222 223	50.40548 48.88047	242 243	\$0.17774 49.48329	262 263	47.8648 48.63934	282 283	49.77609 49.10437	302 303	49.13852 48.99372	322 323	47.69204 47.6576	342 343	49.85553 50.70617	362	38.03167 49.4560/	302 383	50.258 50.159
203 204	5D.41837 49.82776 49.1216	222 223 224	50.40548 48.88047 49.17327	242 243 244	\$0.17274 49.48329 50.98174	262 263 264	47.8648 48.63934 50	282 263 284	49.77809 49.10437 49.75887	302 303 304	49.13882 48.95372 51.11953	322 323 324	47.69204 47.6576 48.4871	342 343 344	49.85553 50.7061/ 50.15501	362 363 364	50.05167 49.4660/ 50.70617	383 384	50.253 50.155 51.446
203 204 205	5D.41837 49.82776 49.1216	222 223	50.40548 48.88047	242 243	\$0.17774 49.48329 50.98174 49.60385	262 263	47.8648 48.63934	282 283	49.77609 49.10437	302 303	49.13852 48.99372	322 323	47.69204 47.6576 48.4871 49.19349	142 343 344 344	49.85553 50.7061/ 50.15501 49.53831	367 367 367 367	50.03167 49.46607 50.70617 49.37828	102 383 584 385	50.258 50.155 51.445 43.472
202 203 204 205 205 205	5D.41837 49.82776 49.1216 50.27558 49.58668	222 223 224 225 226	\$0.40548 48.88047 49.17327 47.9504 49.39718	242 243 244 245 246	50.17274 49.48329 50.98174 49.60386 49.56941	262 263 264 265 265	47.1648 48.63934 50 43.64451 48.07096	282 263 284 285 286	49.77609 49.10437 49.75887 50.17224 50.68727	302 303 304 305 306	49.13852 48.55373 51.11953 49.46607 49.29383	322 323 324 325 326	47.69204 47.6576 48.4671 49.19049 50.31902	343 343 344 345 346	49.85553 90.7061/ 50.15501 49.53831 49.19049	367 367 367 367 367	50.05167 49.4660/ 50.70617 49.37828 50.01722	302 383 384 385 386	50.258 50.155 51.465 43.477 48.549
203 204 205 205 205 207	50.41837 49.82776 49.1216 50.27558 49.58668 50.53393	222 223 224 225	\$0.40548 48.88047 49.17327 47.9504 49.39718 50.31002	242 243 244 245	\$0.17274 49.48329 50.98174 49.60385 49.56941 49.81054	262 263 264 265	47.1648 48.63934 50 43.64451 48.07096 49.48329	282 283 284 285	49.77609 49.10437 49.75887 50.17224 50.63727 50.93007	302 303 304 305 306 307	49.13852 48.55322 51.11953 49.46607 49.29383 49.29383	322 323 324 325	47.69204 47.6576 48.4671 49.19049 50.31002 48.86324	342 343 344 345 346 346 347	49.85553 50.70617 50.15501 49.53531 49.19049 50.27558	367 367 367 367 367	50.03167 29.4660/ 50.70617 29.37828 50.01722 49.91388	302 383 384 385 386 386	50.258 50.155 51.445 43.477 48.949 49.621
203 204 205 205 205 207 208	5D.41837 49.82776 49.1216 50.27558 49.58668 50.53393 49.24216	2222 223 224 225 226 227	50.40548 48.88047 49.17327 47.9504 49.39718 50.31002 49.01826	242 243 244 245 246 247	50.17274 49.48329 50.98174 49.60386 49.56941 49.81054 50.79228	262 263 264 265 265 265 265 265 265	47.1648 48.63934 50 43.64451 48.07096 49.48329 50.2928	282 283 284 285 286 286 287	49.77609 49.10437 49.75887 50.52724 50.52727 50.93007 49.48329	302 303 304 305 306 307 308	49.13852 48.55372 51.11953 49.46607 49.29383 49.29383 49.24216 50.05157	322 323 324 325 326 327 328	47.69204 47.6576 48.4671 49.19049 50.31002 48.86324 48.8228	142 343 344 345 346 347 348	49.85553 50.7061/ 50.15501 49.83833 49.83833 49.19049 50.27558 49.4144	367 367 367 367 367 367 367	50.03167 49.4660/ 50.70617 49.37828 50.01722 49.91388 49.72442	302 383 384 385 386 387 388	50.258 50.155 51.445 43.477 48.949 49.621 49.445
203 204 205 205 205 205 205 205 209	50.41837 49.82776 49.1216 50.27558 49.58668 50.53393 49.24216 49.00103	222 223 224 225 226 227 228	50.49548 48.88047 49.17327 47.9504 49.39718 50.31002 49.01826 50.74051	242 243 244 245 246 247 248	\$0.17774 49.48329 50.98174 49.60385 49.56941 49.81054 50.79228 50.8784	262 263 264 265 265 265 265	47.8648 48.63934 50 43.66451 48.07096 49.48329 50.2928 49.03548	282 283 284 285 286 286 287 288	49.77809 49.10437 49.75887 50.17224 50.63727 50.93007 49.48329 43.23114	302 303 304 305 306 307	49.13852 48.55372 51.15953 49.46607 49.29383 49.29383 49.24216 50.05157 49.87954	322 323 324 325 326 327 328 329	47,69204 47,6576 48,4571 49,19049 50,31002 48,86524 48,87502	942 343 344 345 346 346 347 348 349	49 85553 50.7061/ 50.15501 49.53531 49.13049 50 27558 49.4144 50.18545	362 363 364 365 366 367 361 365	58.03167 29.46807 50.70817 29.37828 50.01722 49.91358 29.72442 79.63553	902 983 984 985 986 986 986 987 989	50.258 50.155 51.445 43.477 48.549 49.621 49.448 49.242
203 204 205	5D.41837 49.82776 49.1216 50.27558 49.58168 50.53393 49.24216 49.00103 49.91388	222 223 224 225 226 227 228 229	50.40548 48.88047 49.17327 47.9504 49.39718 50.31002 49.01826	242 243 244 245 246 246 247 248 249	50.17274 49.48329 50.98174 49.60386 49.56941 49.81054 50.79228	262 263 264 265 265 265 265 268 269	47.8648 48.63934 50 43.64451 48.07096 49.48329 50.2928 49.03548 49.88499	282 283 284 285 286 286 287 288 289	49.77609 49.10437 49.75887 50.52724 50.52727 50.93007 49.48329	302 303 304 305 306 307 308 309	49.13852 48.55372 51.15953 49.46607 49.29383 49.24216 50.05167 49.87954 50.13779	322 323 324 325 326 327 328	47,69204 47,6576 48,4571 49,19049 50,31002 48,86324 48,86324 48,87502 38,30834	942 343 344 345 346 346 347 348 349	49 55553 50,7061/ 50 15501 49,58351 49,19049 50 27558 49,4144 50 18949 49,82775	367 367 367 367 367 367 367 367 367 367	50.05167 49.4660/ 50.70617 49.37928 50.01722 49.91358 49.72442 /9.63553 51.49948	102 383 384 385 386 387 389 389 390	50,258 50,155 51,445 43,477 48,549 49,621 49,448 49,242 50,051
203 204 205 205 207 208 209 219 211	5D.41837 49.82776 49.1215 50.27558 49.58168 50.53393 49.24216 49.00103 49.91388 49.82776	222 223 224 225 226 227 228 229 230	50.40948 48.88047 49.17327 47.9504 49.39718 50.31002 49.01826 50.74051 49.20437	242 243 244 245 246 247 248 249 250	\$0.17774 49.48329 50.98174 49.60385 49.50941 49.81054 50.79228 50.8784 49.67275	262 263 264 265 265 265 265 265 269 269 270	47.8648 48.63934 50 43.64451 48.07096 49.48329 50.2928 49.03548 49.88499	282 263 284 285 286 287 288 289 290	49.77605 49.10437 49.73887 50.62727 50.63727 50.93007 49.48329 43.23114 48.81157	302 303 304 305 306 307 302 309 310	49.13852 48.55322 51.11953 49.46607 49.29383 49.24216 50.05167 49.87914 50.13779 50.41337	322 323 324 325 326 327 328 329 330	47,69204 47,65,76 48,4671 49,19(149) 50,31002 48,66324 48,86324 48,87502 30,00834 50	142 343 344 345 346 347 348 349 350 351	49,55553 50,70612 50,15501 49,53331 49,53331 49,19049 50,27553 49,4144 50,18945 49,4144 50,18945 49,4245 49,42775	362 364 364 365 366 365 365 365 365 376 371	50.05167 29.4660/ 50.70617 243.37328 50.01722 43.91388 243.72442 25.65553 51.49148 50.62005	992 383 584 385 386 387 389 389 399 390	50,258 50,155 51,445 43,477 48,549 49,621 49,448 49,242 50,051 50,688
203 204 205 205 205 205 205 205 205 205 209 210 211 212	5D.41837 49.82776 49.1215 50.27558 49.58168 50.53393 49.24216 49.00103 49.91388 49.82776 49.67275	222 223 224 225 226 227 228 229 230 231	50.49548 48.88047 49.17327 47.9504 49.39718 50.31002 49.01826 50.74051 49.10437 50.34447	242 243 244 245 246 247 248 249 250 251	\$0.17774 49.48329 50.98174 49.60386 49.50941 49.81054 50.79228 50.8784 49.67275 50.24113	262 263 264 265 265 265 265 265 269 269 270 271	47.8648 48.63934 50 43.64451 48.07096 49.48329 50.2928 49.03548 49.88499 49.1216	282 283 284 285 286 287 288 289 290 291	49.77609 49.10437 49.73887 50.17224 50.58727 50.93007 49.48329 43.23114 48.81157 47.33035	302 303 304 305 306 307 308 309 310 311	49.13832 48.55322 51.11953 49.46607 49.29383 49.24216 50.05167 49.87914 50.13779 50.41397 49.72442	322 323 324 325 326 327 328 329 329 330 331	47,69204 47,65,76 48,4671 49,19(149) 50,31002 48,86324 48,86324 48,87502 38,30834 50 49,87944	342 343 344 345 346 347 348 349 350 351 352	49,55553 50,70612 50,15501 49,55351 49,5535 49,4144 50,18945 49,4144 50,18945 49,4144 50,18945 49,4144 50,18945 50,25835	367 367 367 367 367 367 367 367 377 377	50.03167 29.4660/ 50.70617 24.37878 50.01722 43.01388 29.72442 49.63553 50.62105 50.62105 50.77506	382 383 384 385 386 387 388 387 389 389 390 391 392	50,258 50,155 51,446 43,477 48,549 49,621 49,242 50,658 49,242 50,688 48,723
203 204 205 205 205 207 208 209 219 219 211 212 212 213	5D.41837 49.82276 49.1215 50.27558 49.58663 50.53393 49.24216 49.00103 49.91388 49.82776 49.67275 50.2928	2222 223 224 225 226 227 228 229 230 231 232	50.49548 48.88047 49.17327 47.9504 49.39718 50.31002 49.01826 50.74051 49.20437 50.34447 49.60386	242 243 244 245 246 247 248 249 250 251 252	50.17724 49.48329 50.98174 49.60385 49.56941 49.81054 50.79228 50.8784 49.67275 50.24113 50.72339	262 263 264 265 265 265 265 265 265 269 270 270 271 272	47.8648 48.63934 50 43.66451 48.07096 49.48329 50.2928 49.03548 49.88499 49.1216 49.82776	282 283 284 285 286 287 288 289 290 290 291 292	49.77609 49.10437 49.73887 50.17224 50.53727 50.93007 49.4829 43.2314 48.81157 47.33035 50.32725	302 303 304 305 306 307 308 309 310 311 312	49.13832 48.00372 51.10953 49.46607 49.29383 49.24216 50.05167 49.87914 50.13779 50.40397 49.72442 48.86324	322 323 324 325 326 327 328 329 330 531 332 331 332 333	47,69204 47,6576 48,4571 49,19049 50,31002 48,86324 48,86324 48,87502 50,10834 50 49,87944 50,51671	342 343 344 345 346 347 348 347 348 349 350 350 351 352 353	49, 85953 50, 70517 50, 15501 49, 83853 49, 83853 49, 81849 50, 27558 49, 4144 50, 18945 49, 4144 50, 18945 49, 87775 49, 88660 50, 25835 48, 94214	367 367 367 367 367 367 367 367 371 371 371	50.03167 -38.4660/ 50.70617 -43.37878 50.01722 -43.91388 -43.72442 -9.63553 50.62105 50.62105 50.77506 -50.32725	382 383 384 385 386 387 388 387 389 389 390 391 392	50,258 50,155 51,145 43,477 48,949 49,621 49,448 49,242 50,051 50,688 48,723 49,944
203 204 205 205 205 205 205 205 205 205 205 205	5D.41837 49.82276 49.1215 50.27558 49.58663 50.53393 49.24216 49.00103 49.91388 49.82776 49.67275 50.2928	2222 223 224 225 226 227 228 229 230 231 232 232 233	50.49548 48.88047 49.17327 47.9504 49.39718 50.31002 49.01826 50.74051 49.10437 50.34447 49.60386 50.34447	242 243 244 245 246 247 248 249 250 251 252 253	50.17724 49.48329 50.98174 49.60385 49.50941 49.81054 50.79228 50.8784 49.67275 50.24113 50.72339 50.55115	262 263 264 265 265 265 265 267 268 269 270 271 272 272 273	47.8648 48.63934 50 43.66451 48.07036 49.48329 50.2928 49.03548 49.83499 49.1216 49.82776 43.47227	282 283 284 285 286 287 288 289 290 291 292 292 293	49.77609 49.10437 49.75887 50.17224 50.58727 50.93007 49.4829 43.23114 48.81157 47.38035 50.32725 48.39821	302 303 304 305 306 307 308 309 310 310 311 312 313	49.13832 48.00372 51.10953 49.46607 49.29383 49.24216 50.05167 49.87914 50.13779 50.40397 49.72442 48.86324	322 323 324 325 326 327 328 329 330 531 332 331 332 333	47,69204 47,6576 48,4571 23,19149 50,31002 48,66324 48,8282 48,87602 50,10884 50 49,87944 50,67944 50,51671	342 343 344 345 346 347 348 349 350 351 352 353 354	49 55553 50.7561/ 50.15501 49.85551 49.85551 49.81545 49.4144 50.18545 49.81665 50.25835 48.94214 50.25683	362 363 364 365 366 365 365 376 376 371 371 371 371	38.03167 49.4680/ 50.70617 49.37828 50.01722 49.91388 49.72442 9.65553 50.62205 36.77506 30.32725 49.75887	302 383 384 385 386 387 389 390 390 390 391 392 393 394	50,258 50,155 51,445 43,477 48,949 49,621 49,448 49,242 50,051 50,688 48,723 49,946 49,775
203 204 205 205 207 208 209 210 212 212 212 213 214 215	5D.41837 49.82776 49.1215 50.27558 49.58668 50.53393 49.24216 49.00103 49.91388 49.93388 49.82776 49.67275 50.2928 49.25939	2222 223 224 225 226 227 228 229 230 231 232 232 233 233	\$0.49948 48.88047 49.17327 47.9504 49.39718 50.31002 49.01826 50.74051 49.01826 50.74051 49.0437 50.34447 49.60386 50.34447 49.13882	242 243 244 245 246 247 248 249 210 251 251 252 253 254	50.17724 49.48829 50.98174 49.60385 49.50941 49.81054 50.79228 50.8784 49.67275 50.24113 50.72339 50.55115 50.62005	262 263 264 265 265 265 265 267 268 269 270 271 272 273 274	47.1648 48.63934 50 43.66451 48.07036 49.48329 50.2928 49.03548 49.8459 49.1216 49.82776 43.47227 48.62212	282 263 284 285 286 287 288 289 290 291 292 293 294	49.77609 49.10437 49.73887 50.17224 50.53727 50.93007 49.48329 43.23114 48.81157 47.33035 50.32725 48.39821 51.25732	302 303 304 305 306 307 308 309 310 311 312 313 314	49.43682 48.55372 51.12953 49.46607 49.29383 49.29383 49.29242 50.05157 49.879-4 50.1379-4 50.42387 49.72442 48.86324 49.56653 50.41224	322 323 324 325 326 327 328 329 330 331 332 331 332 333	47,69204 47,6576 48,4571 23,19149 50,31002 48,66324 48,8282 48,87602 50,10884 50 49,87944 50,67944 50,51671	342 343 344 345 346 347 346 347 345 350 351 352 354 354 355	49 85533 50.70617 50.15501 49.8353 49.8043 50.2555 49.4144 50.1545 49.8755 49.8045 49.89656 50.28355 48.94214 50.25666 49.94533	362 363 366 366 367 368 369 371 371 371 371 371 372 375	50,05167 29,4560/ 50,70617 24,37878 50,01722 43,91388 24,72442 49,01388 24,72442 50,62005 50,62005 50,72706 30,32725 49,75867 40,70617	302 383 384 385 386 387 389 390 390 390 391 392 394 394 395	50,258 50,155 51,446 43,477 48,949 49,621 49,448 49,242 50,051 50,688 48,725 49,944 49,776 50,377
203 204 205 205 205 207 208 209 219	50.41837 49.82776 49.1216 50.27558 49.58168 50.53393 49.24216 49.24216 49.24216 49.24216 49.2775 50.2328 49.25339 49.25339 49.25339 49.25339	2222 223 224 225 226 227 228 229 230 231 232 232 233 233 234 235	\$0.49548 48.88047 49.17327 47.9504 49.29718 50.31002 49.01826 50.74061 49.10437 50.34447 49.50386 50.34447 49.13682 49.59656	242 243 244 245 246 247 248 249 250 251 252 253 253 254 255	50.17774 49.48329 50.98174 49.60385 49.50941 49.81054 50.79228 50.8784 49.67275 50.24113 50.72339 50.55115 50.62005 48.77713	262 263 264 265 265 265 267 268 269 270 271 272 273 274 275	47, 1648 48, 63934 50 43, 66451 48, 07096 49, 48329 50, 2928 49, 03548 49, 84499 49, 1216 49, 82776 43, 47227 48, 62212 48, 19153	282 263 284 285 286 287 288 289 290 291 292 293 294 295	49.77609 49.10437 49.73887 50.63727 50.63727 50.93007 49.48329 43.23114 48.81157 47.33035 50.32725 48.39821 50.32725 50.32732 50.72335	302 303 304 305 306 307 308 309 310 311 312 313 314 314 315	49.13682 46.25372 51.12953 49.46677 49.29383 49.24216 50.05167 49.779-4 50.13779 50.4237 49.72442 48.86374 49.56653	322 323 324 325 326 327 328 329 330 531 332 331 332 334 334	47,69204 47,6576 48,4671 49,19149 50,31002 48,69324 48,87602 50,10844 50 9,38734 49,51774 80,51671 49,51774	342 343 344 345 346 347 348 349 350 351 352 351 352 354 354 355 356	49 85533 50.70617 50.15501 49.8353 49.8043 50.2555 49.4144 50.1545 49.8755 49.8045 49.89656 50.28355 48.94214 50.25666 49.94533	362 363 366 366 361 361 361 371 371 371 371 371 371 371 371 371 37	38.03167 29.46407 50.70617 24.37828 30.01722 49.01388 49.01388 49.01388 49.01388 50.6205 30.49148 50.6205 30.77506 30.377506 30.377506 30.377508 30.77508 30.77508 30.77508 30.77508	342 333 384 385 386 387 388 387 388 390 391 392 391 392 393 394 395 396	50,258 50,155 51,446 43,477 48,949 49,621 49,448 49,242 50,051 50,688 48,725 49,944 49,776 50,723
203 204 205 205 207 208 210 210 210 212 213 212 213 214 215 215	\$D.41837 49.82776 49.3216 50.27558 49.58168 50.53303 49.24216 49.50103 49.91388 49.82776 49.67275 50.2328 49.67275 50.2328 49.5933 45.59101 50.6545 50.15501	222 223 224 225 226 227 228 230 231 232 233 234 235 234	50,40547 49,17327 47,9504 49,17327 47,9504 49,01826 50,31002 49,01826 50,74051 49,10685 50,34447 49,10686 50,34447 49,13682 49,50656 49,50651	242 243 244 245 246 247 248 249 250 251 252 253 254 255 256	80.17774 49.48329 50.98174 49.60386 49.50941 49.81054 50.7924 50.7784 49.67275 50.78113 50.71339 50.56105 50.65115 50.65115	262 263 264 265 265 268 269 270 271 272 273 274 275 276	47.1648 48.63934 50 43.64451 48.07096 49.48329 50.2928 49.03548 49.84499 49.1216 49.82776 48.62212 48.62212 48.62212 49.17327	282 283 284 285 286 287 288 289 290 291 292 293 294 295 296	49.77609 49.10437 49.73887 50.57224 50.53207 50.53207 49.48329 43.23114 48.83157 47.33035 50.32725 48.39821 51.25732 50.72335 50.72335 50.7235	302 303 304 305 306 307 308 309 310 311 312 313 314 314 315	49.43682 48.52377 51.12953 49.46677 49.29383 49.29383 49.24216 50.05157 49.67974 50.45377 50.45377 49.72742 48.86324 49.756653 50.17274 51.20565	322 323 324 325 326 327 328 329 330 331 332 331 332 334 334 335 336	47,69204 47,6576 48,4671 43,19149 50,31002 48,69324 48,84502 50,10884 50 49,87344 50 49,5174 49,5174 49,5174 49,5174	942 943 944 945 946 947 948 949 950 951 951 952 951 952 953 954 955 956 957	49 5553 50 70617 50 15501 49 5353 49 5353 49 50 2553 49 50 2553 50 2555 50 25555 50 25555 50 25555 50 25555 50 25555 50 255555 50 255555 50 2555555 50 255555555 50 25555555555	367 367 367 367 367 367 367 367 367 367	58.05167 28.4560/ 58.70617 28.37278 50.70527 24.37278 50.07222 49.01368 25.02422 49.01368 50.62105 50.7042 50.6205 50.6205 50.6205 50.6205 50.6205 50.6205 50.6205 50.6205 50.6205 50.6205 50.6205 50.6205 50.6205 50.6205 50.7506 50.7506 50.7506 50.8205 50.8005 50.8005 50.8005 50.800	902 933 964 935 986 987 989 990 990 991 992 993 992 995 996 997	50,258 50,155 51,445 43,477 48,949 49,621 49,448 49,242 50,151 50,688 48,725 49,244 49,776 50,723 49,224
203 204 205 205 207 208 209 210 212 213 212 213 214 215 215 215 215	3D.411337 49.82776 49.1216 50.27558 49.58169 50.53393 49.24216 49.50103 49.91388 49.82776 49.5775 50.2258 49.25939 48.89101 50.6545 50.515801	222 223 224 225 226 227 228 230 231 232 233 234 234 234 235 234 235 234 235	50,44548 48,88047 49,17227 47,9504 49,39718 50,31002 49,01826 50,74051 49,00386 50,34447 49,60386 50,34447 49,50381 50,34455 9,63831 50,54855	242 243 244 245 246 247 248 249 250 251 251 252 253 254 255 256 257	80.17774 49.48329 50.98174 49.60386 49.50386 49.50941 49.81054 50.79228 50.8784 49.67275 50.87241 50.73239 50.55115 50.65005 48.77713 49.31106 33.06974	262 263 264 265 268 269 270 271 272 273 274 275 276 277	47.8648 48.63934 50 43.66451 48.07096 49.48329 50.2928 49.0548 49.8549 49.82476 49.82476 49.82476 49.82476 49.82476 49.82476 49.82476 49.17327 48.7509	282 263 284 285 286 287 288 289 290 291 292 293 294 295 296 297	49,10437 49,70437 49,70437 50,7224 50,58727 50,93007 49,4829 43,23114 48,81157 47,34035 50,32725 50,32725 50,32725 51,25732 50,72335 50,82673 48,57044	302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317	49.13682 48.20372 51.12953 49.36607 49.29383 49.24216 50.05117 90.8759-4 50.13779 50.42387 49.72442 48.86824 49.56555 80.172555 40.75555	322 323 324 325 326 327 328 329 330 531 332 330 531 332 334 334 335 336 337	47,69204 47,6576 48,4671 43,19149 50,31002 48,69324 48,84502 50,10884 50 49,87344 50 49,5174 49,5174 49,5174 49,5174	942 343 344 345 346 347 348 349 350 351 352 354 355 354 355 354 355	49, 55553 50, 7051, 7 50, 15501 49, 15503 49, 15503 40,	365 366 365 366 365 365 365 365 370 370 371 371 370 377 376 377 377 376	58.05167 28.4560/ 58.70427 58.70427 58.01722 49.91388 49.91388 49.91388 58.62005 58.72566 58.22725 49.73587 58.52587 58.52587 58.55587 59.55587 59.557787 59.55777 59.55777 59.55777 59.557777 59.557777 59.5577777 59.5577777777 59.57777777777	902 933 984 935 986 937 938 939 939 939 939 939 939 939 939 939	50,258 50,154 51,445 48,477 48,549 49,6421 49,448 49,242 50,0511 50,688 48,723 48,723 48,723 49,244 49,776 50,723 50,723 49,224



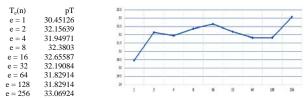


Fig. 5: Minimum pT values of T(n) and of its evolutions

Table 3: pG values of G(n) and its 500 evolutions

1	32,69032	21	48,1743	41	49.15505	61	48.8238	81	49.13882
2	43.00723	21	49.24216	42	51.1712	62	50.24113	82	50.44781
1	43.97175	23	49.75897	43	40.06555	63	49 86221	83	49 89666
4	41.77494	24	\$0.74061	44	49.08715	64	10.68894	84	19 87014
5	43.96841	25	49.28272	45	49.27661	65	43.74785	85	39.3455
6	43.00103	26	49.37995	46	49.57914	66	50.05167	86	50.43059
7	48,50155	27	50,18946	47	49.91388	62	40 77442	87	49.0527
8	59.22391	25	49.36273	47	49.68998	68	50.01722	88	50.36169
8	43,7134	28	49.36273	48	49.05998	69	18.89769	88	50.36169
9	45.7154	30	50.06889	49 50	48.31209	70	48.89709	89	49 \$2775
		30				70			
11	48.2432		48.1054L	51	49.51774		50.48226	91	49.89665
12	50.77506	32	49.22494	52	50.60282	72	51.08508	92	48.88047
13	49.36273	33	42.835	53	49.50152	73	49.00103	93	50.13779
14	49.82776	34	48.86324	54	49.96555	74	50.60282	94	51.36055
15	49.7072	35	50.20668	55	-19.06993	75	51.03341	95	49.44885
16	49,44885	36	51.25732	56	49.37661	76	49.63831	96	50.43059
17	43.79952	37	48.74268	57	49.91388	77	50	97	48.70823
18	48,41543	38	50.12856	58	50,44781	78	49.81054	98	49.19049
19	48.20875	39	50.48226	59	50.68894	79	51.05054	99	49.93111
20	45.55047	40	50.12056	60	50.72339	80	49.53496	160	49.08715
201	50.37892	221	49.91338	241	50.10334	261	49.10437	281	-19.51663
202	50,70617	222	50.41337	242	50.67172	262	49.98278	282	51.01619
21(3	49.84499	223	49.89666	243	50.6545	263	50.13779	283	50.70617
204	49,60386	224	49.93111	244	49.39718	264	49.84499	284	48.89769
216	50.12056	225	511.37892	245	49.67275	265	40.3455	285	50,45948
206	50.37392	226	58.63727	245	50	266	50.84395	286	49.75332
2117	51,05064	227	49.0527	247	50.56838	267	49.65553	287	49.15605
2101	49.44185	228	49.72442	248	50,24113	268	42 68993	238	30.5681
7171	50 51671	229	29 11005	749	51.3401	200	50.44781	739	40 56771
210	50,68194	230	\$0.24113	259	49.62108	270	50,39514	219	51.03341
210	51,20565	230	30.24113	250	49.62108	278	50.39514	290	50.15501
232	49.56221	232	49.51774	252	49.75187	272	50.60282	292	49.55553
213	50.08612	233	50.6545	253	50.86118	273	50,49948	293	50.9473
214	50.25835	234	50	254	49.36273	274	49.15505	294	49,4\$329
215	49.00103	235	49,89666	255	47,9504	275	50.75784	295	49.82776
216	49.08715	236	50.95174	256	50.03415	276	50.05389	296	-19.39666
217	49.63831	237	49.32828	257	44.299	277	50.82673	297	48.65636
218	50.10334	238	50.10234	258	49.39718	278	50.2928	298	50.24648
219	49.22494	239	50.08612	259	48.89769	279	50.39514	299	49.72442
220	49.74165	240	50.91285	269	50.31002	280	49.1216	300	51.76513
401	49.01876	401	2222055	441	\$2.52518	461	58,86118	451	\$0.53303
402	49.84499	422	49.9833	-142	48.93214	462	58.05889	-182	49.6551
403	49.81054	422	59,15501	443	49,48329	463	49.65553	483	51 20563
405	49.31106	425	51 1712	445	49,48329	463	49,600003	483	45 8382
405	49,4144	424	51.012	444	49.73657	464	38,83543	404	40.0200
406	30,20668	425	49,17327	445	49.07215	465	58.32725	485	50.83673
105	49.27661	410	49.17527	440	49,10437	410	58.25835	480	50.43055
105	49.75987	415	49,77609	447	59,67172	463	49,87944	407	50,1961/
109	49,75887 50,6545	418	49,77609	448	51.18843	463	49.87944	483	49.2077
			51.18843				49,72452		
410	49.87944	430		450	49.1216	470		490	49.67273
	50.56838	431	53,51671	451	49.77609	471	58(83951	491	50.2928
412	49.96555	432	53,36169	452	49.37995	472	49,4144	-192	48.7595
413	-19.62108	433	49.93111	453	49.67275	473	49.63831	493	49.39713
414	50.53393	434	53.36159	454	51.13676	474	58.23668	494	49.5800.
415	50.00951	435	52,10334	455	49.24216	475	58.55115	495	30.1610.
416	48.79435	436	\$9,91285	456	48.60489	476	58,41337	496	49.63831
417	58.05167	437	49.86221	457	58.24113	477	48.62212	497	49,46607
415	48,94936	438	53,29668	458	58,46504	478	58017224	498	50.27555
119	-19.93111	-139	59.27558	-159	58,48226	-179	49.51774	-159	50.05163
120	50.01722	440	49.68995	460	48.65656	480	58.36159	500	50.18946

102	50.12056	121	50.06889	141	48,79435	161	48.93214	181	50.7578
	49.82776	122	50.53293	142	50.6545	162	50.03445	182	48.914
103	49,56941	123	51,34344	143	49.82776	163	49,1216	183	50.189
194	49.65553	124	50,41337	144	49.15605	164	49.68998	184	50.241
105	50.24113	125	50.22391	145	50.03445	165	49,25939	185	51.188
106	49.96555	126	50.06559	146	50.82673	165	50.01722	186	48.811
107	49.93111	127	50.25835	147	51.37788	167	49.46607	187	50.568
105	49.01826	128	49,39718	148	50.34447	168	48,96659	158	49.827
109	49.65553	129	43.57561	149	50.46504	169	49.32828	189	50.051
110	51.18843	130	49.20772	150	50.39614	170	50.03445		50.9121
111	49.86221	131	49.15605	151	50.01722	171	49.24216		49.6555
112	48,96381	132	30.6545	152	48.51877	172	50		50.843
113	30,44781	132	47,03735	153	50.17224	173	48,70823		49.8449
113	49,91358	134	50.06539	154	50.12056	174	50.65394	195	49.862
114	49.91388 50.74061	134	50.00039	154	30.12030	174	50.65354	194	49.862
									1
116	49.60386	136	49.29383	156	50.15501	176	51.10231	196	49.8449
117	49.03548	137	49.01826	157	50	177	49.84499	197	49,4310
118	30.48226	138	49.25929	158	50.10334	178	49.55219	198	49.190
119	50.08612	139	50.32725	159	50.39614	175	50.10334	199	50.1894
301	50.18946	321	49.29383	341	50.32725	361	50.60282	381	50.8784
302	49.96555	322	50.91285	342	50.84395	362	49.87944	382	49.60386
303	50.18946	323	49.56941	343	49.91318	363	50.2928	383	49.62108
304	49.31106	324	50.80951	344	50.08612	364	48.88047	384	50.60282
305	49.24216	325	50.55115	345	50.46504	365	49.65553	385	50.20668
306	51.05064	326	49.65553	346	49.87944	366	49.89666	386	49.48329
307	49.20772	327	50,49948	347	49.0527	367	50.51671	387	48.96659
308	49.06993	328	49.86221	348	49.79332	368	49.68998	388	51.06786
309	49.84499	3129	51.49845	349	49.44883	369	50.6345	389	48.62212
310	30.55115	330	30,43039	350	58,11946	370	49,84499	390	50.70617
341	50.44781	331	49.27661	351	50.34447	371	49.17327	391	49.44585
312	50.68894	232	50.55115	352	49.91318	372	58.77506	392	50.43059
313	50.51671	333	49,44885	353	50.01722	373	49.79332	393	50.55115
314	50.06889	334	51.22287	354	49.37995	374	49.82776	394	50.03445
315	49.84499	335	49.75887	355	50	375	50.8784	395	50.46504
316	50.01722	336	49.03548	356	49.84499	376	49.63831	396	48.89769
317	49.01826	337	49.87944	357	49.03548	377	49.65553	397	50.44781
318	50.68894	338	50.15501	358	51.32621	378	51.01619	398	49.77609
319	50.13779	.339	49.48329	359	51.27454	319	48.58767	399	50.37892
320	49,89666	340	50.12056	360	49.93111	380	50.9473	400	49.72442

intervals of 1, 2, 4, 8, 16, 32, 64, 128 and 256. This indicates a fractal behavior of the evolution. Min(A(n))=43.00723 and Max(A(n))=44.29900 The deviation is 1.46

		% Concentrat	ion of G for 500 Evolutio	ns of G(n)		
	111111111111111111					
ar a di se di se				a di cana da kanda da ka	l de la constantia	

Fig. 6: pG values of G(n) and of its evolutions

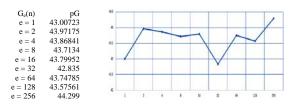


Fig. 7: Minimum pG values of G(n) and of its evolutions

Table 4: pC values of C(n) and its 500 evolutions

1	27.86772	21	46.69305	41	43.65656	61	48.31209	\$1	46.95143	101	49,81054	121	50.46504	141	49,77689	161	46,77919	181	51.01619
2	49,7165	22	49.67275	42	50,86118	62	50.34447	82	50.31002	102	49.94833	122	50.13779	142	49.43162	162	49.58598	182	50.25835
3	41.31932	23	49.08715	43	50.41337	63	50.9473	83	50.67172	102	50.15501	122	49.37995	143	49.45102	162	50.37892	182	49.96555
4	48.55323	24	\$0,48226	44	49,87944	64	49.96555	84	49.53496	105				143	49.29383			184	49/96955
5	39.37306	25	47.22701	45	50	65	40.47537	85	49.03548		50.62005	124	51.11953			164	49.55219		
	48,81157				48.38099				50.32725	105	48.8288	125	49.31106	145	46.02136	165	49.94833	185	49.89666
6		26	49_37995	46		66	47.20978	\$6		106	\$0.05167	126	50	146	49.62108	166	51.22287	186	49.60386
7	48.50155	27	49.74165	47	50.34447	67	47.37816	87	49.29383	107	49.74165	127	48.89769	147	49.98278	167	50.80951	187	49,43162
8	50.15501	28	50.79228	48	50.84395	68	49.10437	88	50.55115	301	49.08715	128	50,43059	148	48.65656	168	50.17224	188	50.05167
9	40.69928	29	49.84499	49	47.57148	69	47.55425	89	50.63727	169	50.32725	129	39.57975	149	49.96535	169	50.32725	189	48.7399
10	47.9504	30	49.94833	50	49.98278	70	50.12056	90	49.46607	110	50.51671	130	48.58767	150	50.06589	170	51.63624	190	49.10437
н	46.98588	31	49.20772	51	50.49348	71	50.08612	91	50.80951	111	50.96452	131	48.77713	151	49.51774	171	51.06786	191	50.0(889
12	48,01929	32	49.3455	52	51.22287	72	50.01722	92	50.20668	112	\$1.20565	132	50.82673	152	50.55115	172	50.12056	192	50.84395
13	47.96762	33	39,88977	53	50.36169	73	45.60439	93	50.6545	113	50,39614	133	45.93524	153	50.75784	173	50,49948	193	48.65656
14	50,03443	34	48.01929	54	49,81034	74	50.36169	94	51.39899	114	49.22494	134	49,44585	154	59.20568	174	50,49948	194	50.74061
15	29 65995	15	48 1741	44	19 94611	75	50 13779	44	50 41337	115	49.29383	135	50.15501	155	59.22391	175	49.74165	195	50.06529
16	49,44885	36	50.09612	56	49.93111	36	42,3455	36	50.27558	116	49.20772	136	49,3455	156	51.08508	176	49,43162	196	50.75784
17	39.32139	37	48 08818	17	49.3455	77	49.98778	97	47 2950	117	49,79332	137	48,81157	157	50.77506	127	49,22494	197	49.311.06
										118	49,29383	138	42.85666	158	50.31002	178	48,03651	198	49.55219
18	47,48536	38	50.20568	58	50,46504	78	48.94936	98	49.24216	118	49.29383	138	49.89000	158	29.81054	178	48,03601	198	49.55219
19	47.12367	39	49.93111	59	50.70517	79	49.79332	99	49.86221										
20	49.51774	40	49,48329	60	50,56\$38	80	50.17224	100	49.39718	120	50.05167	140	50.79228	160	50.24113	180	50.03445	200	49,48329
201	49.39718	221	49.3455	241	48.88047	261	47.82983	281	48.86324	301	49.73494	321	48.63212	341	49 27661	361	40.06278	351	50.56828
202	49.84499	122	51.25732	242	50.93007	262	50.67172	282	49.31106	302	49.56941	322	50.05167	342	49 56941	362	48.65553	382	48.91493
203	49,7072	223	50.06889	243	59.80951	263	49.72442	283	50.9473	303	50.20668	323	50.67172	343	50.77506	363	48.96555	383	40.06555
284	49,50052	224	48.811.57	244	50.20568	264	50.43059	184	51,1712	303	50.20008	324	50.07172	344	50.44781	364	49.90000	384	49.55215
205	50.68894	225	50.27558	245	51,67069	265	48.36376	185	49.82776	304	48 7599	324	49.86721	344	49.56941	363	49.67275	384	49.55215
206	50.44781	126	49.08715	246	50,70517	266	51,2401	186	51.11953										
207	49.00163	227	49.7072	247	50.8784	267	50.36169	287	49.52998	305	49.72442	326	50.24113	346	50.5856	366	49.48329	386	50.01722
207		223		248	2010104	267		287		307	49.86221	327	50,9473	347	50.86118	367	49.53496	387	49.81054
208	48.93214	228	50.10334	248	50.18946	2018	49,48329	288	50.22391	303	51.15398	328	49.82776	348	50.13779	368	48.98381	355	51.05664
										303	49.00103	329	50.24113	349	49.08715	369	50.01722	359	49.36273
210	49.86221	230	20.36169	250	48,77713	270	50.25835	290	50.01722	310	49.37995	330	49,96555	350	50.17224	370	49,44835	390	49.79332
211	50.20568	231	49.7072	251	58,70517	271	49.53496	291	50.80251	311	49.96555	331	50.32725	351	51.20565	371	49.31106	391	50.67173
212	50.6545	232	49.56941	252	49.81054	272	50.39614	292	51.68791	312	49.87944	332	50.9473	352	50.25835	372	49.84499	392	49.74165
213	49.53496	235	49.62108	253	48.58767	273	47.76094	293	48.31209	313	50.13779	333	50.6545	353	50.5856	373	59.37892	393	49.4144
214	49.72442	234	49.15605	254	50	274	49.7072	194	50.03445	314	49.29383	334	50,36169	354	48.79435	374	43.65553	394	50.93893
215	49.43162	235	50.53393	255	50.46504	275	49.68998	295	50.44781	315	49.86221	335	49.31106	355	50.18946	375	49,7072	395	50.75784
216	49.55219	236	50	256	50.18946	276	49.51774	296	49.98278	316	49.63831	336	50.6545	356	50.15501	376	51.87737	396	50
217	50.03445	237	49.65553	257	40.95763	277	49.98278	197	49.46607	317	49.94533	317	48.39821	357	50.03445	377	58.49948	307	49.96155
218	49,51774	235	49.53496	258	48.36376	278	49.72442	298	49,87944	318	51,5329	338	49.68998	358	50.01722	378	49.37995	398	51.37788
219	\$9.75784	230	10.56838	250	48.31209	279	50.82673	199	49 31106	319	50.17234	319	50.05612	159	19 10/37	379	59,80951	100	10 63227
220	49.98278	2.10	49,94833	260	49.32828	280	49.74165	300	50.6545	320	50,74061	340	50.06889	361	50.91785	380	58,25835	400	49.17327
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405	50.53393	425	49.89555	445	50.01722	465	50.03445	485	50.48226					`	· .		-		
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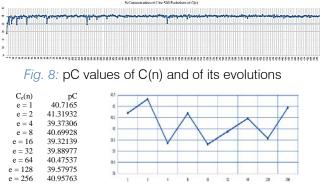


Fig. 9: Minimum pC values of C(n) and of its evolutions

V. Conclusions

This paper proposes a novel concept called "Percentage Nucleotide Concentration of genomes" in terms of cellular automata evolutions of adjoints of Adenine, Thymine, Guanine, and Cytosine. The research carried out and reported in this paper exhibits the possibility to categorize a set of genomes like the human genome repository. In short, the concept of "Percentage Nucleotide Concentration (PNC)" introduced in this paper seems to show a way to accomplish this task.

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