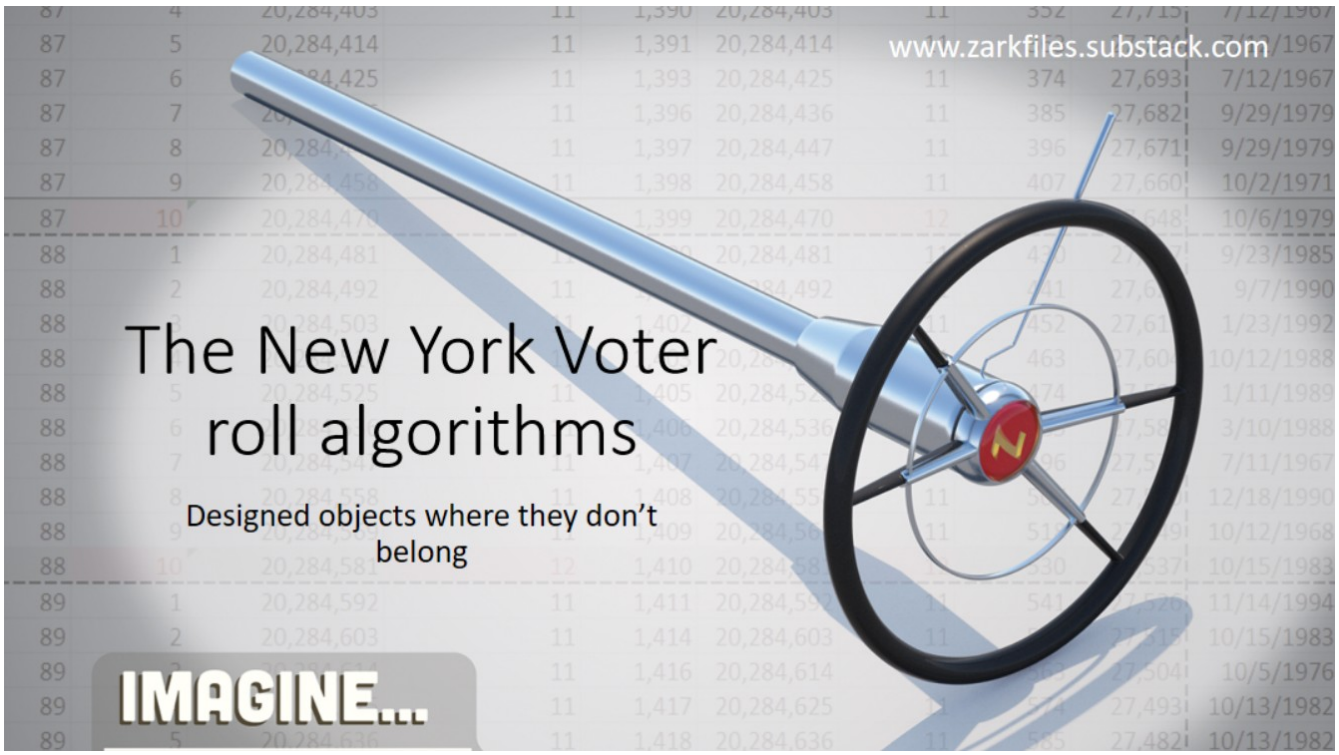


The purpose of voter rolls

- Ensure all voters are eligible to vote ("qualified")
- Fraud prevention
- Election management

- To function, the rolls must be:
  - Accurate
  - Current
  - Transparent (available for public scrutiny)

Voter roll laws (federal)

- National Voter Registration Act (NVRA) of 1993 (52 U.S.C. §§ 20501-20511)
  - Mandates that states maintain accurate and current voter registration rolls.
  - Requires states to follow specific procedures for removing voters from the rolls.
- Help America Vote Act (HAVA) of 2002 (52 U.S.C. §§ 20901-21145)
  - Requires statewide computer voter lists
  - Mandates unique identifier for each voter

Eligibility

- Section 8(a)(3) of the NVRA (52 U.S.C. § 20507(a)(3)) requires:
  - (I) specifies each eligibility requirement (including citizenship)
  - (II) contains an attestation that the applicant meets each such requirement; and
  - (III) requires the signature of the applicant, under penalty of perjury
- In New York, there are about 2,000,000 records that can plausibly be described as in violation of these requirements
- An unknown number, but nearly 100% of the sample so far, have forged signatures

Discrepant voter histories

The Bus problem

Record #	ID	County present	County voted	State present	State voted	Total Under Votes
1	1-Original	1	1	1	0	1
2	2-Original	1	1	1	0	1
3	3-Original	1	1	1	0	1
4	4-Original	1	1	1	0	1
5	5	1	1	1	1	0
6	6	1	1	1	1	0
7	7	1	1	1	1	0
8	1-Clone	0	0	1	1	1
9	2-Clone	0	0	1	1	1
10	3-Clone	0	0	1	1	1
10	7	7	7	10	6	7
	State/County discrepancy			1		
	County votes missing from state			4		
	State votes missing from county			3		
	Total missing votes			7		

Irreconcilable county to state rolls

	Certified	Precincts	State	County	Diff S/C	State only	County onl
Count	788,262	789,973	737,986	739,885	1,899	8	55,063
Matching			737,978	684,822	53,156		
Difference			8	55,063	55,055		

Purged and cloned records

- Over 8,000,000 purged records in the 2022 database
- Almost 2,000,000 lack a purge date
  - Meaning, they can be reactivated/deactivated at will without reference to a deactivation date
- About 2,000,000 clones
- 500,000 deleted, destroying their audit trail
  - But discovered thanks to an algorithm

A clone example

Short ID	Reg Date	County Code	DOB	Enrollment	ount nam	Last Name
52,173,022	01/06/2011	24	06/15/1992	BLK	14	
52,173,023	01/06/2011	24	06/15/1992	BLK	14	
52,173,030	01/06/2011	24	06/15/1992	BLK	14	
52,173,031	01/06/2011	24	06/15/1992	BLK	14	
52,173,032	01/06/2011	24	06/15/1992	BLK	14	
52,173,033	01/06/2011	24	06/15/1992	BLK	14	
52,173,034	01/06/2011	24	06/15/1992	BLK	14	
52,173,035	01/06/2011	24	06/15/1992	BLK	14	
52,173,046	01/06/2011	24	06/15/1992	BLK	14	
52,173,047	01/06/2011	24	06/15/1992	BLK	14	
52,173,048	01/06/2011	24	06/15/1992	BLK	14	
52,173,049	01/06/2011	24	06/15/1992	BLK	14	
52,173,050	01/06/2011	24	06/15/1992	BLK	14	
52,173,051	01/06/2011	24	06/15/1992	BLK	14	

- 14 SBOEID numbers assigned to the same person on the same day
- Many are consecutive
- If registrars followed the law, this would be impossible

Clones by year

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Clones	514	925	4,699	1,896	5,792	6,202	13,185	9,171	11,790	14,705	27,442	16,114	19,605	21,667	56,262	19,059	21,840
Total	206,895	270,123	844,021	312,375	336,611	471,808	797,165	439,670	368,352	375,976	710,394	388,004	419,772	406,860	1,008,143	323,087	373,464
Percent Clones	0.25%	0.34%	0.56%	0.61%	1.72%	1.31%	1.65%	2.09%	3.20%	3.91%	3.86%	4.15%	4.67%	5.33%	5.58%	5.90%	5.85%
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	
Clones	34,893	99,556	33,377	43,487	42,266	101,843	43,941	46,448	45,660	177,523	56,832	86,765	75,090	178,755	59,354	87,626	
Total	391,201	1,150,253	333,032	379,390	350,186	908,300	383,187	380,551	434,755	1,191,531	380,659	687,298	574,203	1,130,608	454,017	504,868	
Percent Clones	8.92%	8.66%	10.02%	11.46%	12.07%	11.21%	11.47%	12.21%	10.50%	14.90%	14.93%	12.62%	13.08%	15.81%	13.07%	17.36%	

- Prior to 1990, between 0-5 clones per year, with a few insignificant deviations
- In 2020, the number of new clones was 178,755 out of 1,130,608 new registrations (15.81%)

Discovery of the algorithms

- The presence of so many erroneous and/or illegal records raises the question:
- If these problems were created intentionally, how would they be accessed?
- To find individual or groups of cloned records in a database of 21 million records is not easy

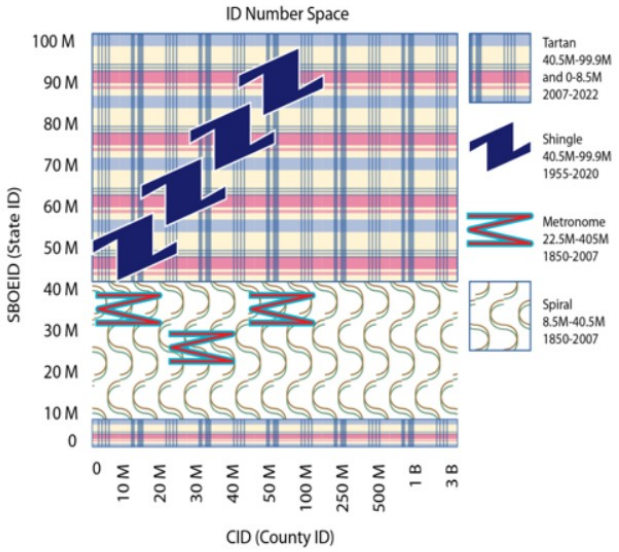
- Possible solutions:
  - Tag the special records
    - With a field for this attribute
    - With special characters in an existing field
  - Assign all records a trackable attribute
    - If all records have it, discovery becomes difficult
    - The attribute can connect to a separate database

Incentive

- It would be very difficult to manipulate a significant volume of fraudulent records without a clandestine means to quickly identify them
- Therefore, if the goal is to commit election fraud through the voter rolls, there is a strong incentive to create this method

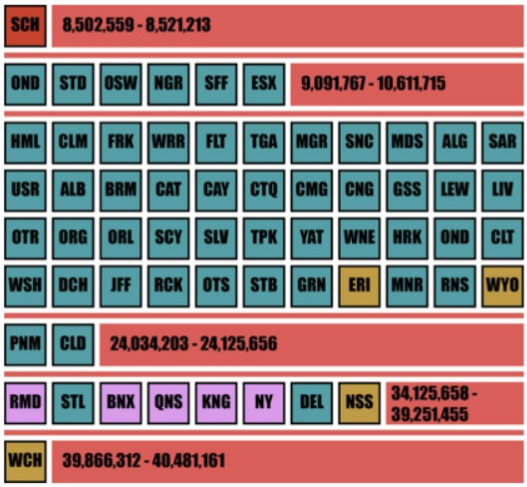
Algorithms

- There are 4 algorithms in NY's voter rolls
  - Spiral
  - Metronome
  - Shingle
  - Tartan
- Their presence is disguised by primary partitions (in-Range a Out of range) and numerous sub-partitions



The Spiral sub-partitions

County	County Code	CRID	MIN SBOEID	MAX SBOEID	Gap to previous	MIN to MAX size	Used Numbers (NYBOE)	Percent used of available	Registered full range (NYBOE)
Out of range		1	0	8,502,558	0		127		
Schoharie	47	1.01	8,502,559	8,521,213	1	18,655	18,447	98.89%	21,134
Buffer 1		2	8,521,214	9,091,766	1		0		
Onondaga	34	2.01	9,091,767	9,382,492	1	290,726	290,015	99.76%	329,306
Schenectady	46	2.02	9,382,494	9,477,662	2	95,169	94,044	98.82%	109,164
Oswego	38	2.03	9,477,664	9,557,731	2	80,068	79,339	99.09%	83,022
Niagara	32	2.04	9,557,733	9,694,852	2	137,120	132,790	96.84%	150,686
Suffolk	52	2.05	9,694,854	10,584,725	2	889,872	882,440	99.16%	1,116,934
Essex	16	2.06	10,584,727	10,611,715	2	26,989	26,685	98.87%	27,222
Buffer 2		3	10,611,716	20,005,105	1		0		
Hamilton	21	3.01	20,005,106	20,010,209	1	5,104	5,054	99.02%	4,677
Columbia	11	3.02	20,010,211	20,054,800	2	44,590	43,484	97.52%	49,665
Franklin	17	3.03	20,054,802	20,082,320	2	27,519	27,314	99.26%	29,083
Warren	57	3.04	20,082,322	20,125,302	2	42,981	42,479	98.83%	48,505
Fulton	18	3.05	20,125,304	20,157,206	2	31,903	31,577	98.98%	35,632
Tioga	54	3.06	20,157,208	20,189,678	2	32,471	32,254	99.33%	35,581
Montgomery	29	3.07	20,189,680	20,221,054	2	31,375	31,080	99.06%	30,712
Seneca	49	3.08	20,221,056	20,241,573	2	20,518	20,309	98.98%	22,052
Madison	27	3.09	20,241,575	20,284,049	2	42,475	42,106	99.13%	45,868
Allegany	2	3.1	20,284,051	20,312,118	2	28,068	27,580	98.26%	27,588



The Spiral (simple view)

Group ID	Row ID	Calc 10	Calc Gap	Short ID	SBOEID G	CID Alpha	CID Num	RegDate RF
87	9	22,202,228	11	22,202,228	11		26,773	10/12/1962
87	10	22,202,239	11	22,202,239	11		26,779	10/13/1962
88	1	22,202,251	12	22,202,251	12		26,798	10/13/1962
88	2	22,202,262	11	22,202,262	11		26,802	10/13/1962
88	3	22,202,273	11	22,202,273	11		26,805	10/13/1966
88	4	22,202,284	11	22,202,284	11		26,861	10/13/1962
88	5	22,202,295	11	22,202,295	11		26,862	10/13/1962
88	6	22,202,306	11	22,202,306	11		26,868	10/13/1962
88	7	22,202,317	11	22,202,317	11		26,902	9/19/1996
88	8	22,202,328	11	22,202,328	11		26,907	10/13/1962
88	9	22,202,339	11	22,202,339	11		26,908	10/13/1962
88	10	22,202,350	11	22,202,350	11		26,937	1/19/1996
89	1	22,202,362	12	22,202,362	12		26,943	10/8/1964
89	2	22,202,373	11	22,202,373	11		26,949	10/9/1964
89	3	22,202,384	11	22,202,384	11		26,967	10/9/1964
89	4	22,202,395	11	22,202,395	11		27,018	11/3/1964
89	5	22,202,406	11	22,202,406	11		27,019	10/10/1964

1	10	100	1,000	10,000	0
213,445	26,271	9,397	7,384	7,038	7,037
228,897	67,103	10,289	7,556	7,203	
C27	67,104	10,296	7,560		
C99,960	78,468	11,969	7,744		
C200205	78,489	11,970	7,793		
C207393	78,575	11,991			
L57527	78,582	12,011	7,834		
L98751	80,627	12,377			
M9638	80,646	12,414	7,124		
M99999	107,917	15,995	8,236		
M200002	107,920	16,023	8,246		
M208901	117,135	17,063	8,276		
N900003	117,172	17,064	8,347		
N933577	169,867	22,026	8,890		
169,869	22,029	8,917	7,205		
213,442	26,230	9,385	7,383		

CID transformations

Row ID	Column	Record ID	Decimal	CID Num	Concatena	CID Decimal	Short ID	RegDate RF
4	0	3,473,699	.	1	.1	0.1000000000	21,942,754	5/1/1995
5	1	3,473,700	.	149,774	.149774	0.1497740000	21,942,755	10/13/1984
6	1	3,473,701	.	149,777	.149777	0.1497770000	21,942,756	10/12/1989
7	1	3,473,702	.	14,978	.14978	0.1497800000	21,942,757	10/15/1997
8	1	3,473,703	.	149,783	.149783	0.1497830000	21,942,758	10/12/1989
9	1	3,473,704	.	149,788	.149788	0.1497880000	21,942,759	8/26/1985
10	1	3,473,705	.	14,979	.14979	0.1497900000	21,942,760	10/15/1997
11	1	3,473,706	.	149,790	.149790	0.1497900000	21,942,761	8/26/1985
1	10	3,473,707	.	1,055	.1055	0.1055000000	21,942,762	12/8/1993
2	1	3,473,708	.	149,794	.149794	0.1497940000	21,942,763	8/27/1985
3	1	3,473,709	.	1,498	.1498	0.1498000000	21,942,764	6/21/1994
4	1	3,473,710	.	14,980	.14980	0.1498000000	21,942,765	10/15/1997
5	1	3,473,711	.	149,807	.149807	0.1498070000	21,942,766	8/19/1988
6	1	3,473,712	.	14,981	.14981	0.1498100000	21,942,767	10/15/1997
7	1	3,473,713	.	149,811	.149811	0.1498110000	21,942,768	8/19/1988
8	1	3,473,714	.	149,812	.149812	0.1498120000	21,942,769	10/9/1984
9	1	3,473,715	.	149,815	.149815	0.1498150000	21,942,770	10/9/1984
10	1	3,473,716	.	149,816	.149816	0.1498160000	21,942,771	10/9/1984
11	1	3,473,717	.	14,982	.14982	0.1498200000	21,942,772	10/15/1997
1	10	3,473,718	.	105,500	.105500	0.1055000000	21,942,773	10/10/1981

Alpha	CID	Short ID	Short ID Gap	Reg Date
N	N1317915	37297200		1/1/1984
N	N1317919	37297211	11	1/1/1984
N	N1317942	37297222	11	1/1/1984
N	N1317944	37297233	11	1/1/1984
N	N1317965	37297244	11	1/1/1984
N	N1317989	37297255	11	1/1/1984
N	N1317991	37297266	11	1/1/1984
C	C0510696	37297275		1/1/1972
N	N1318010	37297289	23	1/1/1984
N	N1318012	37297300	11	1/1/1984
N	N1318020	37297311	11	1/1/1984
N	N1318023	37297322	11	1/1/1984
N	N1318025	37297333	11	1/1/1984
N	N1318040	37297344	11	1/1/1984
N	N1318041	37297355	11	1/1/1984
N	N1318054	37297366	11	1/1/1984
N	N1318055	37297377	11	1/1/1984
C	C0510771	37297386	111	1/1/1972
N	N1318065	37297389	12	1/1/1984
N	N1318075	37297400	11	1/1/1984
N	N1318082	37297411	11	1/1/1984
N	N1318099	37297422	11	1/1/1984
N	N1318104	37297433	11	1/1/1984
N	N1318106	37297444	11	1/1/1984
N	N1318111	37297455	11	1/1/1984
N	N1318113	37297466	11	1/1/1984
N	N1318115	37297477	11	1/1/1984
N	N1318116	37297488	11	1/1/1984
C	C0510775	37297497	111	1/1/1972

Stacking the deck (controlling ID position)

PROJECTED	0	100,000	10,000	1,000	100	10	1
MIN	35,080,636	35,163,969	35,088,969	35,081,469	35,080,719	35,080,644	35,080,637
MAX	36,049,986	36,022,208	36,047,208	36,049,708	36,049,958	36,049,983	36,049,986
Range	969,351	969,350	969,342	969,255	968,383	959,659	872,418
Repunit	NA	111,111	11,111	1,111	111	11	1
Count	1	8	87	872	8,724	87,241	872,418
Adjusted range	969,350	969,342	969,255	968,383	959,659	872,418	0
AID First	1	2	84	834	8,334	83,334	833,334
AID High (CUT)	NA	NA	96	968	9,692	96,933	969,351
AID Low (CUT)			10	97	969	9,693	96,934
AID Last	1	9	83	833	8,333	83,333	833,333
Count First to CUT H	1	8	13	135	1,359	13,600	136,018
Count CUT L to Last	0	0	74	737	7,365	73,641	736,400
Total	1	8	87	872	8,724	87,241	872,418

- The Spiral uses columns as a position control mechanism
- It divides ranges by “repunits”, numbers like 11, 111, 1,111, 11,111, 111,111, and 1,111,111
- Then assigns them to columns based on powers of 10
- Then interlaces the numbers based on column assignment
- Just like shuffling cards

The shift cipher (disguising ID position)

1	ABC	DEFGHIJKLMNOPQRSTUVWXYZ
2		ABCDEFGHIJKLMNOPQRSTUVW XYZ
3	XYZ	ABCDEFGHIJKLMNOPQRSTUVW

	10,000	1,000	100	10	1
MIN SBOEID	MIN SBOEID	MIN SBOEID	MIN SBOEID	MIN SBOEID	MIN SBOEID
	Count down to	Count down to	Count down to	Count down to	Count down to
FIRST GID/RID					
	Next STOP				
	STOP	Next STOP			
		STOP	Next STOP		
			STOP	Next STOP	
				STOP	LAST GID/RID
					STOP
		Count up to	Count up to	Count up to	Count up to
	MAX SBOEID	MAX SBOEID	MAX SBOEID	MAX SBOEID	MAX SBOEID

	10,000	1,000	100	10	1
MIN SBOEID	20	16	12	8	4
	Count down to	Count down to	Count down to	Count down to	Count down to
21					
	17				
	19	13			
		15	9		
			11	5	
				7	1
					3
	Count up to	Count up to	Count up to	Count up to	Count up to
	18	14	10	6	2

Missing ID numbers found with Spiral

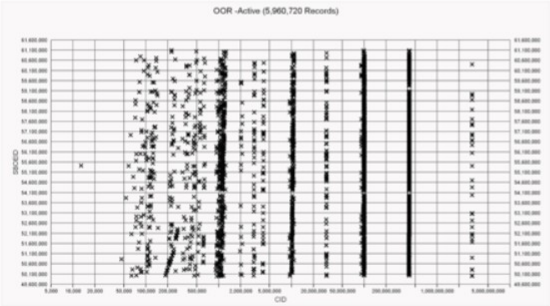
STATE ID Num	State ID Gap	State ID Distance to MIN	State ID Distance to MAX	Power	County ID NUM	CID Decimalized	DOB	Status	VR Source	County Code	Reg Date	Record ID
21,942,837	-50,381	83	50,659	100	1,000,082	0.10000820	5/29/1944	P	CBOE	10	6/1/2007	3,473,759
21,942,948	111	194	50,548	100	1,000,083	0.10000830	12/9/1983	P	CBOE	10	5/25/2007	3,473,870
MISSING				100	1,000,084							
21,943,170	#VALUE!	416	50,326	100	1,000,085	0.10000850	10/5/1988	A	CBOE	10	5/25/2007	3,474,092
21,943,280	110	526	50,216	100	1,000,086	0.10000860	8/22/1977	A	CBOE	10	5/30/2007	3,474,202
MISSING				100	1,000,087							
21,943,502	#VALUE!	748	49,994	100	1,000,088	0.10000880	12/29/1987	A	CBOE	10	5/25/2007	3,474,424
MISSING				100	1,000,089							
21,943,725	#VALUE!	971	49,771	100	100,009	0.10000900	4/6/1947	A	CBOE	10	1/21/1980	3,474,647
MISSING				100	1,000,090							
21,943,947	#VALUE!	1,193	49,549	100	1,000,091	0.10000910	5/20/1949	P	CBOE	10	6/1/2007	3,474,869
21,944,058	111	1,304	49,438	100	1,000,092	0.10000920	8/16/1966	P	CBOE	10	6/4/2007	3,474,980
21,944,169	111	1,415	49,327	100	1,000,093	0.10000930	4/29/1972	P	CBOE	10	6/4/2007	3,475,091
21,944,280	111	1,526	49,216	100	1,000,094	0.10000940	2/26/1985	P	CBOE	10	6/4/2007	3,475,202
21,944,390	110	1,636	49,106	100	1,000,095	0.10000950	8/28/1957	A	CBOE	10	6/4/2007	3,475,312
21,944,501	111	1,747	48,995	100	1,000,096	0.10000960	8/13/1986	P	CBOE	10	6/4/2007	3,475,423
MISSING				100	1,000,097							
21,944,724	#VALUE!	1,970	48,772	100	1,000,098	0.10000980	3/6/1986	P	CBOE	10	6/4/2007	3,475,646
21,944,835	111	2,081	48,661	100	10,001	0.10001000	10/13/1966	A	CBOE	10	9/24/1996	3,475,757
21,944,946	111	2,192	48,550	100	100,010	0.10001000	5/17/1950	P	CBOE	10	1/22/1980	3,475,868
21,945,057	111	2,303	48,439	100	1,000,101	0.10001010	9/27/1983	P	CBOE	10	6/4/2007	3,475,979
MISSING				100	1,000,102							

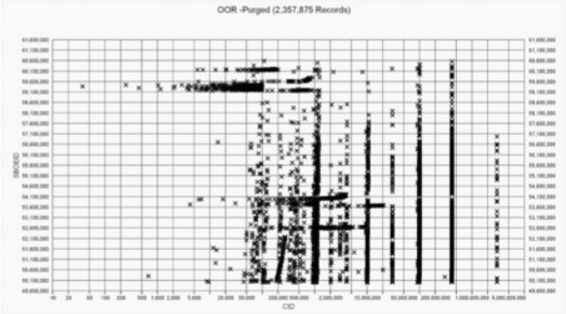
The Algorithm imposed ID number (AID)

- Can be used to clandestinely track records
- Is hard coded into Spiral
- May require an unauthorized copy of the database for use
- The Spiral is proven, the AID is strongly suggested, its purpose is unknown, but it has obvious utility for data tracking

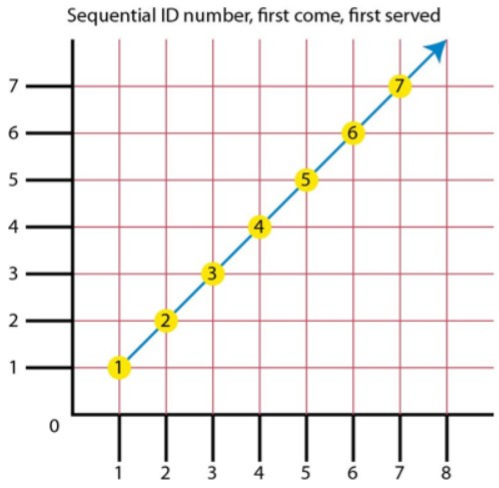
AID	Group ID	AID dist to MAX	Dist to MIN	Dist to MAX	Diff AID Dist to MIN to SBOEID Dist to MIN
1	834	50,741	1	50,741	0
8	835	50,734	9	50,733	1
10	835	50,732	11	50,731	1
75	841	50,667	82	50,660	7
100	844	50,642	111	50,631	11
750	909	49,992	833	49,909	83
1,000	934	49,742	1,111	49,631	111
7,500	1,584	43,242	8,334	42,408	834
10,000	1,834	40,742	11,112	39,630	1,112
42,409	0	8,333	0	50,742	-42,409
43,242	84	7,500	50,739	3	7,497
49,742	734	1,000	49,631	1,111	-111
49,992	759	750	49,908	834	-84
50,642	824	100	50,631	111	-11
50,667	826	75	50,658	84	-9
50,732	833	10	50,731	11	-1
50,734	833	8	50,733	9	-1
50,741	834	1	50,741	1	0

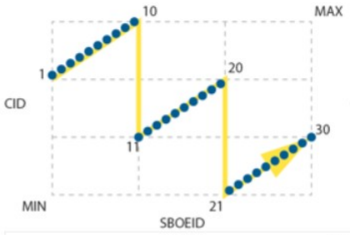
Shingle algorithm: Active vs Purged

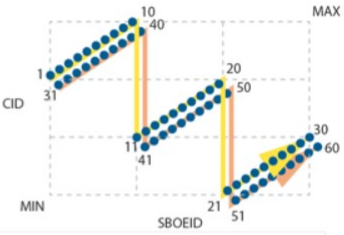


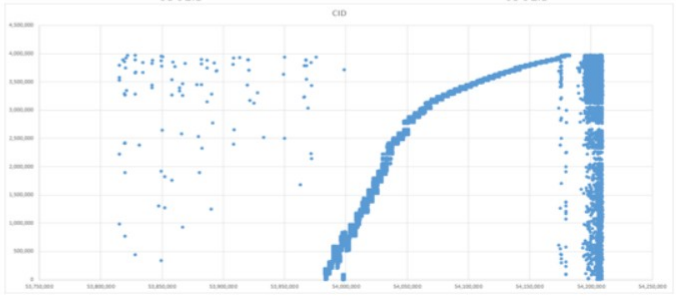


Shingle structure

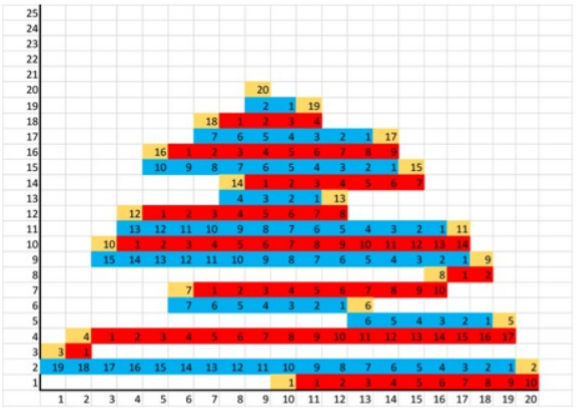


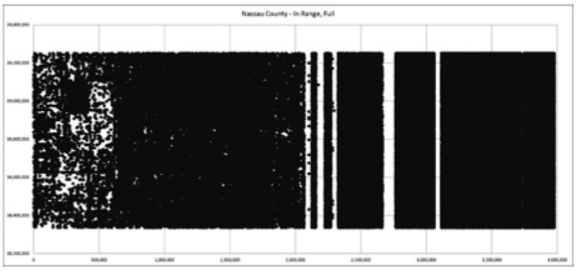






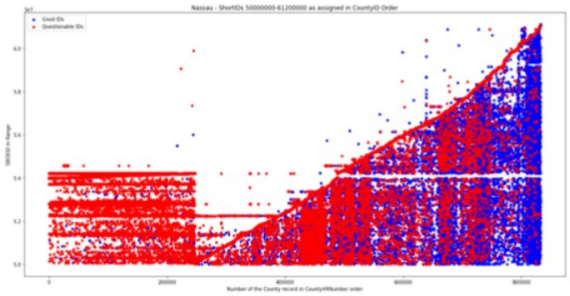
Metronome: Counties 15, 30, 60





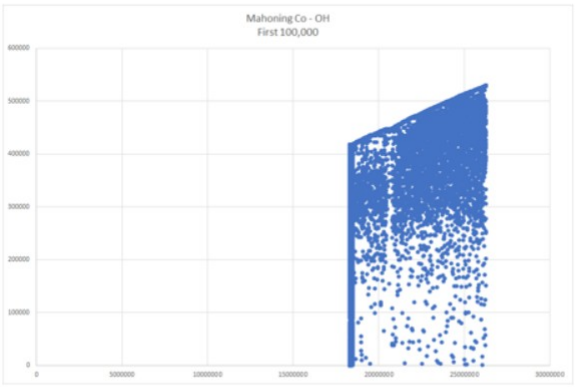
Tartan

- Associated with majority of clones (~1,204,158)
- All generated after 6/15/2007



Other states

- Hawaii
  - Tags records with a 12 digit alphanumeric sequence at the end of a 32 digit UUID
- New Jersey
  - Scrambles positions of ID number elements
- Ohio and North Carolina
  - Scatterplots indicate use of algorithms to assign ID numbers



Why were these algorithms used?

- No privacy concerns
  - All records are public
  - No information is masked by algorithms or withheld from public
- No security impact
  - All records are public
  - No need to use covert methods for access
- No efficiency improvement
  - Retards speed and ease of use

Questions

Example: Forged signature (mechanically duplicated)

Driver's License	[redacted]	SSN4	
Name	RACHEL M	Residential Address	13491-2654
Gender	F	Mailing Address	
Date of Birth	[redacted]	Political Party	BLK
Phone Number		Email Address	
State ID	[redacted]1837	Status	Purged
County ID	[redacted]072	Status Reason	Duplicate
County	Herkimer	Status Effective Date	05/10/2022
Registration Date	02/07/2020	NVRA Registration Source	County Board of Elections
Checksum Value	DF5570FB659AB0946E1837D0C52B4980		

Driver's License	[redacted]	SSN4	
Name	RACHEL M	Residential Address	13491-2654
Gender	F	Mailing Address	
Date of Birth	[redacted]	Political Party	BLK
Phone Number		Email Address	
State ID	[redacted]8056	Status	Active
County ID	[redacted]074	Status Reason	
County	Herkimer	Status Effective Date	
Registration Date	02/08/2020	NVRA Registration Source	County Board of Elections
Checksum Value	808EE522CD1EF02B0C8A340316544E76		

Accuracy

- New York's rolls contain the following known errors:
  - Incorrect name (spelling)
  - Incorrect DOB
  - Incorrect registration date
  - Incorrect address
  - Incorrect voter history
  - Incorrect status
  - Illegal records
- All of these errors, and others not mentioned, would have been prevented if normal data validation tools were used
- About 10% of all records are affected
  - There may be more, undiscovered errors