SecGraph: A Uniform and Open-source Evaluation System for Graph Data Anonymization and De-anonymization

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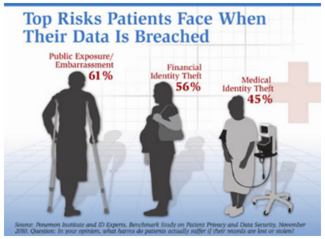
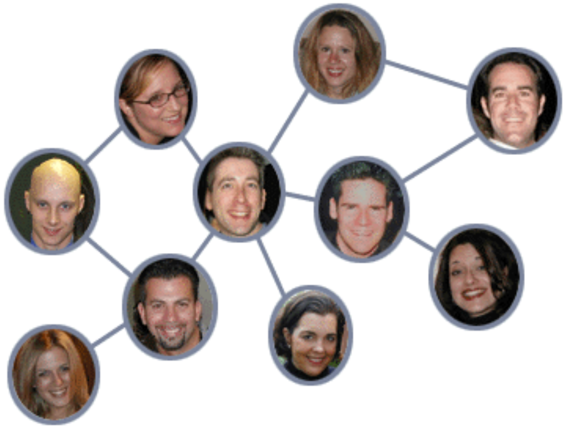
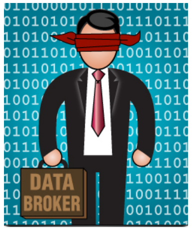
Introduction

- Graph Data
  - Social networks data
  - Mobility traces
  - Medical data
  - ……
- Why data sharing/publishing
  - Academic research
  - Business applications
  - Government applications
  - Healthcare applications
  - ……



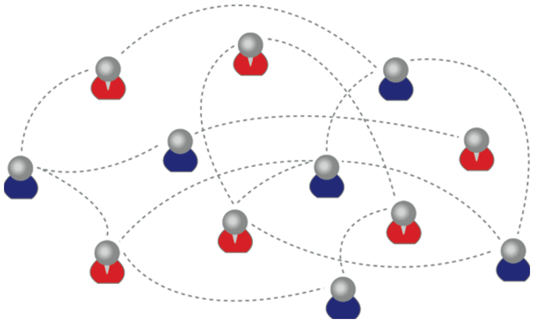
Anonymization and De-anonymization





De-anonymization

Anonymization



Utility

Anonymization vs DA

Contribution

- We studied and analyzed
  - 11 state-of-the-art graph anonymization techniques
  - 15 modern Structure-based De-Anonymization (SDA) attacks

- We developed and evaluated SecGraph
  - 11 anonymization techniques
  - 12 graph utility metrics
  - 7 application utility metrics
  - 15 de-anonymization attacks

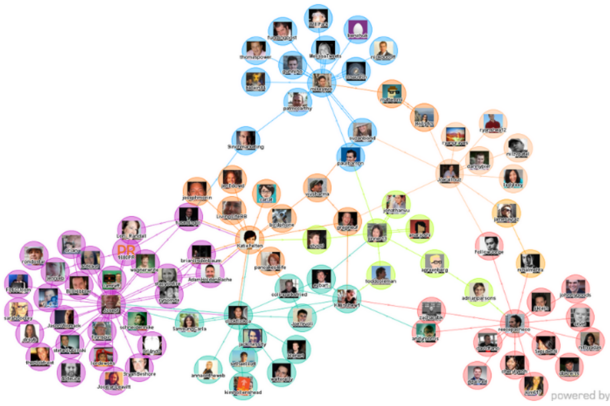
- We released SecGraph
  - Publicly available at http://www.ece.gatech.edu/cap/secgraph/

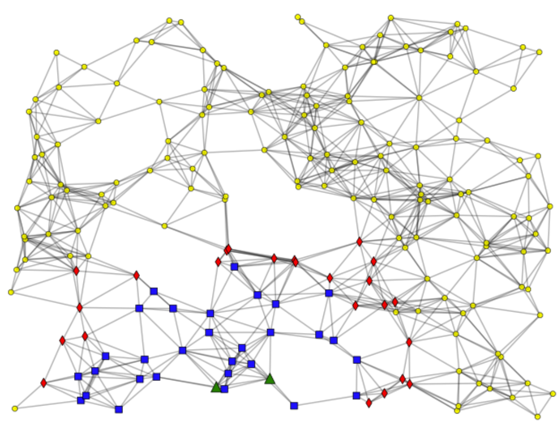
Outline

- Introduction
- Graph Anonymization
- Graph De-anonymization
- Anonymization vs. De-anonymization Analysis
- SecGraph
- Conclusion

Graph Anonymization

- Naïve ID Removal
- Edge Editing (EE) based anonymization
  - Add/Del
  - Switch
- *K*-anonymity
  - K-Neighborhood Anonymization (k-NA)
  - K-Degree Anonymization (k-DA)
  - K-automorphism (k-auto)
  - K-isomorphism (k-iso)
- Aggregation/class/cluster based anonymization
- Differential Privacy (DP) based anonymization
- Random Walk (RW) based anonymization





Utility Metrics

- Graph utility (12)
  - Degree (Deg.)
  - Joint Degree (JD)
  - Effective Diameter (ED)
  - Path Length (PL)
  - Local Clustering Coefficient (LCC)
  - Global Clustering Coefficient (GCC)
  - Closeness Centrality (CC)
  - Betweenness Centraltiy (BC)
  - Eigenvector (EV)
  - Network Constraint (NC)
  - Network Resilience
  - Infectiousness (Infe.)
- Application utility (7)
  - Role eXtraction (RX)
  - Influence Maximization (IM)
  - Minimum-sized Influential Node Set (MINS)
  - Community Detection (CD)
  - Secure Routing (SR)
  - Sybil Detection (SD)

Graph utility captures how the anonymized data preserve fundamental structural properties of the original graph

How useful the anonymized data are for practical graph applications and mining tasks

Anonymization vs Utility

Anonymization Techniques

preserve the utility

Resilient to DA attacks

	graph utility												application utility							
	Deg.	JD	ED	PL	LCC	GCC	CC	BC	EV	NC	NR	Infe	RX	RE	IM	MINS	CD	SR	SD	R2SDA
Naive	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
Add/Del [6]	◐	♦	◐	◐	♦	♦	◐	◐	◐	♦	◐	◐	✗	◐	◐	♦	✗	♦	♦	✗
Switch [6]	✓	♦	♦	◐	♦	♦	◐	◐	◐	◐	♦	◐	♦	◐	◐	♦	♦	◐	◐	✗
k-NA [7]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	n/a
k-DA [8]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	n/a
k-auto [9]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	n/a
k-iso [10]	♦	♦	✗	✗	♦	✗	✗	✗	✗	♦	✗	✗	✗	✗	✗	♦	♦	✗	♦	n/a
Aggregation [12]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	n/a
Cluster [14]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	n/a
DP [15]	♦	♦	♦	◐	♦	♦	◐	♦	♦	♦	♦	◐	✗	◐	♦	♦	✗	♦	♦	n/a
DP [16, 17]	♦	♦	♦	◐	♦	♦	◐	♦	♦	♦	♦	◐	✗	◐	♦	♦	✗	♦	♦	n/a
DP [18]	♦	♦	♦	◐	♦	♦	◐	♦	♦	♦	♦	◐	✗	◐	♦	♦	✗	♦	♦	n/a
DP [19]	♦	♦	♦	◐	♦	♦	◐	♦	♦	♦	♦	◐	✗	◐	♦	♦	✗	♦	♦	n/a
RW [20]	✓	♦	♦	♦	♦	✗	◐	♦	♦	◐	♦	◐	✗	◐	♦	✗	✗	◐	◐	n/a

Conditionally preserve the utility

Not preserve the utility

Partially preserve the utility

Anonymization vs Utility

Anonymization Techniques

Resilient to DA attacks

	graph utility												application utility							
	Deg.	JD	ED	PL	LCC	GCC	CC	BC	EV	NC	NR	Infe.	RX	RE	IM	MINS	CD	SR	SD	R2SDA
Naive	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
Add/Del [6]	◐	♦	◐	◐	♦	♦	◐	◐	◐	♦	◐	◐	✗	◐	◐	♦	✗	♦	♦	✗
Switch [6]	✓	♦	♦	◐	♦	♦	◐	◐	◐	◐	♦	◐	♦	◐	◐	♦	♦	◐	◐	✗
k-NA [7]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	**n/a**
k-DA [8]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	**n/a**
k-auto [9]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	**n/a**
k-iso [10]	♦	♦	✗	✗	♦	✗	✗	✗	✗	♦	✗	✗	✗	✗	✗	♦	♦	✗	♦	**n/a**
Aggregation [12]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	**n/a**
Cluster [14]	♦	♦	♦	♦	♦	♦	◐	♦	♦	◐	◐	◐	✗	◐	♦	♦	♦	♦	♦	**n/a**
DP [15]	♦	♦	♦	◐	♦	♦	◐	♦	♦	♦	♦	◐	✗	◐	♦	♦	✗	♦	♦	**n/a**
DP [16, 17]	♦	♦	♦	◐	♦	♦	◐	♦	♦	♦	♦	◐	✗	◐	♦	♦	✗	♦	♦	**n/a**
DP [18]	♦	♦	♦	◐	♦	♦	◐	♦	♦	♦	♦	◐	✗	◐	♦	♦	✗	♦	♦	**n/a**
DP [19]	♦	♦	♦	◐	♦	♦	◐	♦	♦	♦	♦	◐	✗	◐	♦	♦	✗	♦	♦	**n/a**
RW [20]	✓	♦	♦	♦	♦	✗	◐	♦	♦	◐	♦	◐	✗	◐	♦	✗	✗	◐	◐	**n/a**

Conditionally preserve the utility

Partially preserve the utility

Not preserve the utility

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Graph De-Anonymization (DA)

- Seed-based DA
  - Backstrom et al.'s attack (BDK)
  - Narayanan-Shmatikov's attack (NS)
  - Narayanan et al.'s attack (NSR)
  - Nilizadeh et al.'s attack (NKA)
  - Distance Vector (Srivatsa-Hicks attack) (DV)
  - Randomized Spanning Trees (Srivatsa-Hicks attack) (RST)
  - Recursive Subgraph Matching (Srivatsa-Hicks attack) (RSM)
  - Yartseva-Grossglauser's attack (YG)
  - De-Anonymization attack (Ji et al.'s attack) (DeA)
  - Adaptive De-Anonymization attack (Ji et al.'s attack) (ADA)
  - Korula-Lattanzi's attack (KL)
- Seed-free DA
  - Pedarsani et al.'s attack (PFG)
  - Ji et al.'s attack (JLSB)

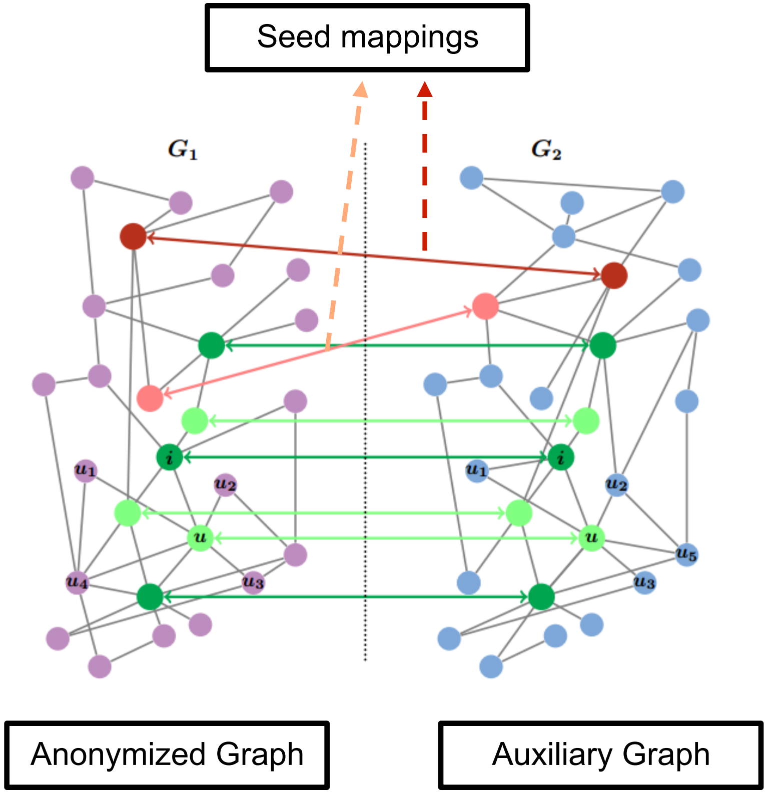

Figure source: E. Kazemi et al., Growing a Graph Matching from a Handful of Seeds, VLDB 2015

DA Attacks

	✓	✓	✓	✓	✓	✓	✓
	SF	AGF	SemF	A/P	Scal.	Prac.	Rob.
BDK [26]	✓	✓	✓	A, P	✗	◐	✗
NS [2]	✗	✗	✓	P	✓	✓	✓
NSR [21]	✗	✗	✓	P	✓	✓	✓
NKA [22]	♦	✗	✓	P	♦	♦	♦
DV [5]	✗	✗	✓	P	♦	♦	✓
RST [5]	✗	✗	✓	P	♦	♦	✓
RSM [5]	✗	✗	✓	P	♦	♦	✓
PFG [23]	✓	✗	✓	P	✓	♦	♦
YG [27]	✗	✗	✓	P	✓	♦	✓
DeA [25]	✗	✗	✓	P	✓	✓	✓
ADA [25]	✗	✗	✓	P	✓	✓	✓
KL [24]	✗	✗	✓	P	✓	♦	✓
JLSB [3]	✓	✗	✓	P	✓	✓	✓

SF: seed-free
AGF: auxiliary graph-free
SemF: semantics-free
A/P: active/passive attack
Scal.: scalable
Prac.: practical
Rob.: robust to noise

✓ = true
◐= partially true
♦ = conditionally true
✗ = false

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Anonymization vs. DA

State-of-the-art Anonymization Techniques

Modern DA Attacks

	Naive	EE	k-anony.	Cluster	DP	RW
BDK [26]	✓	✗	✗	✗	✗	✗
NS [2]	✓	✓	◆	◆	✓	✓
NSR [21]	✓	✓	◆	◆	✓	✓
NKA [22]	✓	◆	◆	◆	✗	✗
DV [5]	✓	✓	◆	◆	✓	✓
RST [5]	✓	✓	◆	◆	✓	✓
RSM [5]	✓	✓	◆	◆	✓	✓
PFG [23]	✓	✓	◆	◆	✓	✓
YG [27]	✓	✓	◆	◆	✓	✓
DeA [25]	✓	✓	◆	◆	✓	✓
ADA [25]	✓	✓	◆	◆	✓	✓
KL [24]	✓	✓	◆	◆	✓	✓
JLSB [3]	✓	✓	◆	◆	✓	✓

✓ : vulnerable
◆ : conditionally vulnerable
✗ : invulnerable

DA attacks!

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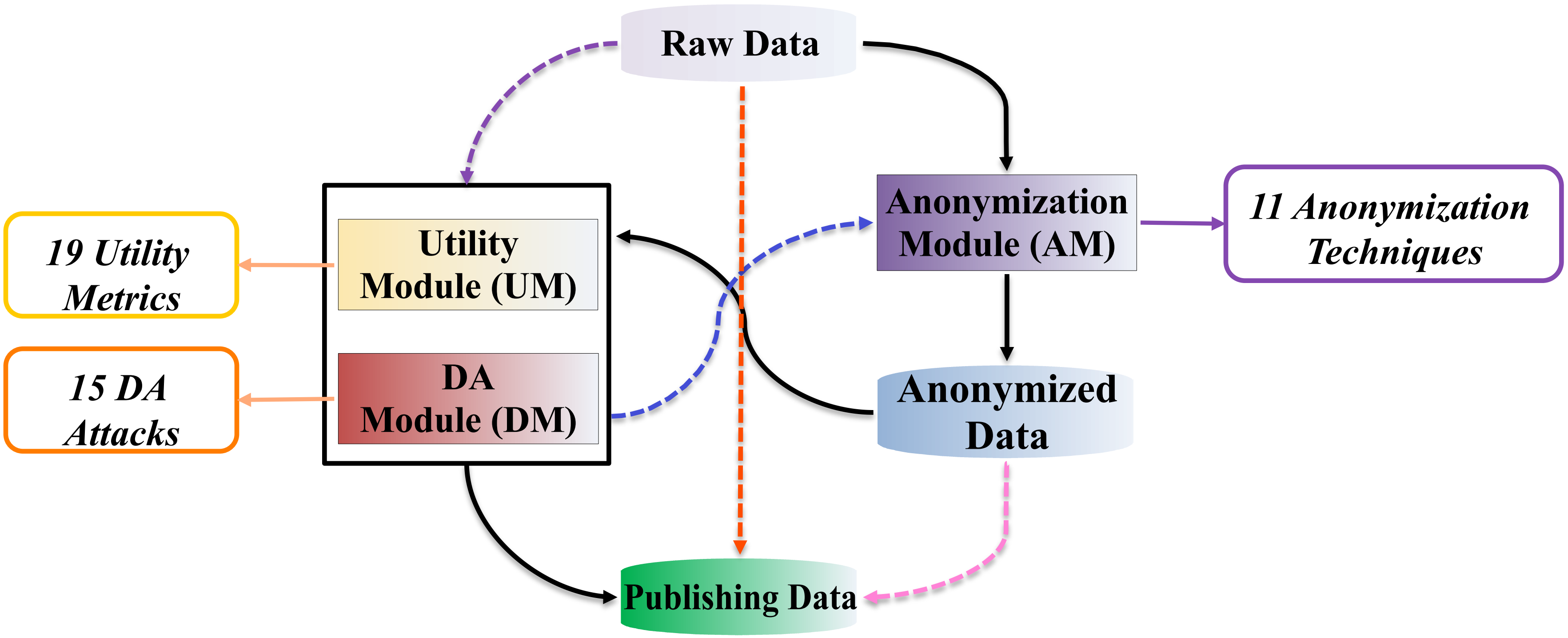
SecGraph: Overview & Implementation



Raw Data -> AM -> Anonymized Data -> UM/DM -> Publishing Data

Raw Data -> Publishing Data

Raw Data -> UM/DM -> AM -> Anonymized Data -> Publishing Data

SecGraph: Evaluation

- Datasets
  - Enron (36.7K users, 0.2M edges): an email network dataset
  - Facebook – New Orleans (63.7K users, 0.82M edges): a Facebook friendship dataset in the New Orleans area
- Evaluation settings
  - Follow the same/similar settings in the original papers
  - See details in the paper and http://www.ece.gatech.edu/cap/secgraph/
- Evaluation scenarios
  - Anonymization vs Utility
  - DA performance
  - Robustness of DA attacks
  - Anonymization vs DA

SecGraph: Anonymity vs Utility

Utility	Enron										Facebook									
	Switch (vs. k)		k-DA (vs. k)		Cluster (vs. k)		DP (vs. ε)		RW (vs. t)		*Switch* (vs. k)		k-DA (vs. k)		Cluster (vs. k)		DP (vs. ε)		RW (vs. t)	
	.05m	.1m	5	50	5	50	300	50	2	D	.05m	.1m	5	50	5	50	300	50	2	D
Deg.	1	1	.9988	.9166	.9990	.9934	.9617	.8616	.9871	.9964	1	1	.9990	.9595	.9998	.9981	.9932	.9716	.9958	.9959
JD	.8725	.8338	.8928	.4183	.8216	.7055	.8496	.7363	.6972	.6438	.9941	.9804	.9947	.7328	.9872	.9024	.9755	.8263	.9678	.9362
ED	.9881	.9617	1.080	.9561	1.04	1.02	1.03	.9627	1.02	.9025	.9161	.8328	.9350	1.015	.9957	.9956	.9414	.9313	.9285	.8376
PL	.9954	.9887	.9891	.8934	.9994	.9905	.9565	.9839	.9963	.9657	.9618	.9159	.9999	.9946	.9999	1	.9960	.9653	.9706	.8965
LCC	.9830	.9631	.9972	.9809	.9966	.9797	.9528	.8328	.6785	.5985	.9204	.8303	.9998	.9983	.9968	.9947	.9793	.9437	.6239	.5543
GCC	.8967	.8013	.9921	.9283	.9774	.9097	.7755	.4609	.3107	.5383	.5180	.2241	.9847	.9986	.9766	.9937	.9522	.8702	.2552	.0334
CC	.9986	.9965	.9985	.9955	.9999	.9947	.9759	.9666	.9885	.9994	1	.9999	1	1	1	1	1	.9998	1	.9998
BC	.9859	.9812	.9691	.9019	.9936	.9733	.8360	.7406	.9613	.9246	.9787	.9494	.9790	.9515	.9983	.9897	.9779	.9518	.9935	.9669
EV	.9991	.9977	.9910	.8998	.9947	.9720	.9232	.8653	.9717	.9204	.9881	.9556	.9981	.9626	.9999	.9996	.9977	.9911	.9891	.9480
NC	.9984	.9962	.9999	.9991	.9996	.9956	.9977	.9596	.9042	.9028	.9995	.9986	1	1	1	1	.9987	.9934	.9928	.9942
NR	.9968	.9917	.9988	.9599	.9998	.9962	.9782	.8591	.9313	.8695	.9990	.9990	.9990	.9990	.9990	.9990	.9990	.9990	.9990	.9990
Infe.	.9627	.9597	.9604	.9411	.9427	.9413	.9662	.9593	.9664	.9446	.9748	.9704	.9758	.9695	.9730	.9719	.9730	.9699	.9788	.9778
PR	.9980	.9962	.9848	.8934	.9997	.9974	.9801	.9000	.8925	.9942	.9866	.9825	.9878	.9610	.9900	.9907	.9875	.9691	.9869	.9810
HS	.9991	.9977	.9910	.8998	.9947	.9720	.9232	.8653	.9717	.9204	.9326	.8780	.9711	.9789	.9648	.9625	.9626	.9322	.9283	.8655
AS	.9991	.9977	.9910	.8998	.9947	.9720	.9232	.8653	.9717	.9204	.9920	.9656	.9946	.9498	.9978	.9986	.9970	.9965	.9943	.9594
RX	.6575	.6009	.4561	.3173	.4512	.3685	.4196	.4116	.2955	.2680	.3494	.2608	.2974	.3139	.3902	.4652	.3483	.3134	.3250	.2772
RE	.9997	.9997	.9999	.9954	.9999	.9996	.9994	.9985	.9994	.9990	.9999	.9997	1	.9999	1	1	1	.9996	.9999	.9997
MINS	.7578	.6486	.9639	.9026	.9898	.9297	.7292	.3272	.1815	.1645	.6085	.4419	.9426	.9251	.9240	.9184	.8483	.7768	.2480	.1893
CD	.6251	.5411	.8454	.5339	.6794	.6692	.5095	.1028	.2531	.0569	.3536	.1986	.5043	.5887	.8558	.8523	.5027	.3213	.2860	.1205

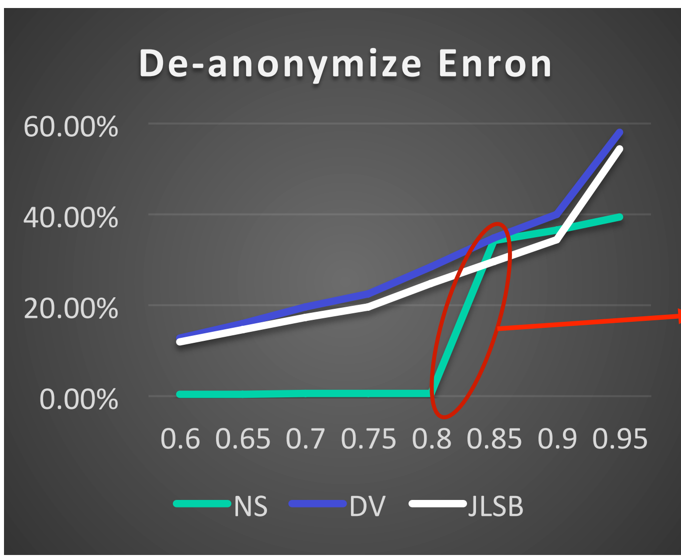
C1: existing anonymization techniques are better at preserving graph utilities

C2: all the anonymization techniques lose one or more application utility

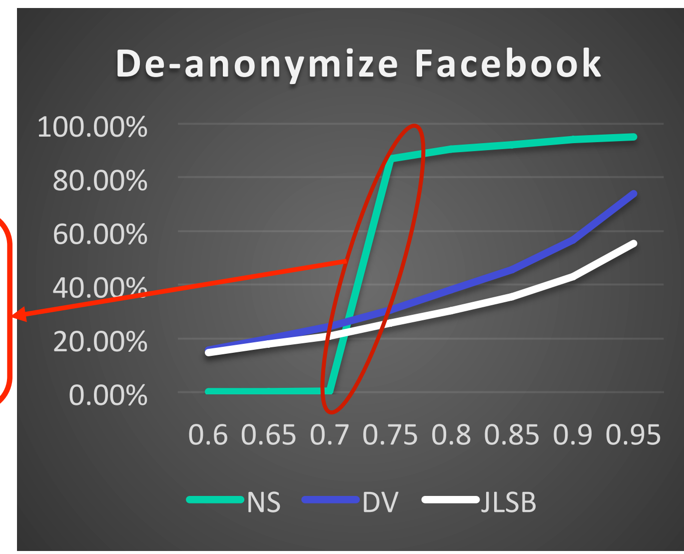
SecGraph: DA Performance

Table 6: Performance of DA attacks. s is the probability of generating the auxiliary and anonyized graphs from the original graph. Each value, e.g., 0.1277, in the table indicates the ratio of successfully de-anonymized users.

s	De-anonymize Enron							De-anonymize Facebook						
	NS	DV	PFG	YG	ADA	KL	JLSB	NS	DV	PFG	YG	ADA	KL	JLSB
.60	.0037	.1277	.0739	.0310	.1305	.1596	.1191	.0018	.1563	.1087	.2832	.1568	.0599	.1473
.65	.0039	.1601	.0937	.0410	.1651	.1814	.1460	.0020	.1998	.1402	.3346	.2005	.0747	.1799
.70	.0054	.1969	.1397	.0725	.2013	.2026	.1723	.0031	.2437	.1523	.4124	.2444	.0841	.2094
.75	.0055	.2244	.1349	.1004	.2307	.2152	.1958	.8712	.3068	.2041	.4554	.3078	.1196	.2574
✓ .80	.0061	.2841	.1837	.1014	.2896	.2519	.2474	.9056	.3802	.2586	.4970	.3805	.1508	.3042
.85	.3420	.3481	.2180	.1531	.3522	.3123	.2971	.9231	.4561	.3073	.5402	.4576	.1817	.3559
.90	.3660	.4004	.2736	.1885	.4043	.3389	.3443	.9414	.5659	.3977	.5737	.5670	.2552	.4289
.95	.3937	.5814	.4370	.2277	.5898	.5209	.5438	.9527	.7407	.5584	.6071	.7422	.3989	.5542



Phase transitional phenomena



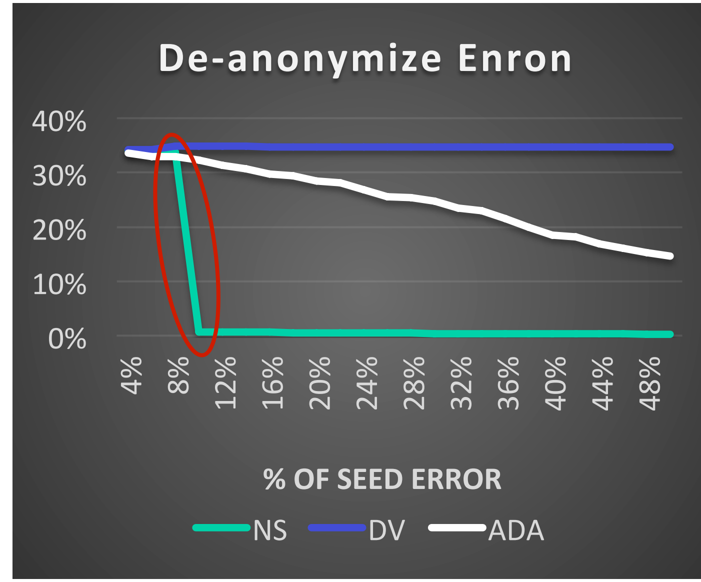
C1: the phase transitional (percolation) phenomena is attack-dependent

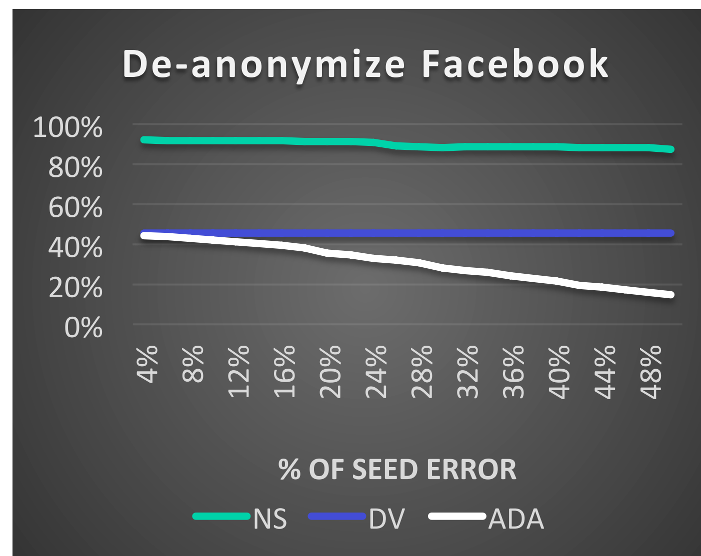
SecGraph: Robustness of DA Attacks

% of error seeds

$\frac{\Lambda_e}{\Lambda}$	De-anonymize Enron					De-anonymize Facebook				
	NS	DV	YG	ADA	KL	NS	DV	YG	ADA	KL
4%	.341	.342	.148	.336	.302	.922	.456	.537	.442	.183
6%	.341	.342	.133	.329	.303	.917	.456	.528	.440	.183
8%	.338	.348	.135	.329	.310	.918	.456	.542	.428	.184
10%	.007	.348	.147	.323	.310	.918	.456	.536	.420	.182
12%	.007	.348	.142	.313	.311	.915	.456	.529	.414	.185
14%	.006	.348	.112	.306	.307	.916	.456	.526	.403	.186
16%	.006	.348	.129	.297	.303	.916	.456	.525	.394	.184
18%	.006	.348	.099	.293	.308	.913	.456	.533	.380	.183
20%	.006	.348	.126	.285	.306	.913	.456	.518	.356	.179
22%	.005	.348	.125	.280	.303	.912	.456	.531	.347	.182
24%	.005	.348	.116	.268	.304	.910	.456	.521	.332	.180
26%	.005	.348	.118	.255	.303	.889	.456	.528	.319	.179
28%	.004	.348	.112	.253	.300	.886	.456	.520	.309	.182
30%	.004	.348	.120	.247	.307	.884	.456	.522	.283	.180
32%	.004	.348	.106	.235	.305	.888	.456	.521	.270	.178
34%	.004	.348	.081	.230	.304	.887	.456	.521	.259	.178
36%	.004	.348	.084	.216	.300	.889	.456	.505	.245	.182
38%	.004	.347	.096	.199	.301	.888	.456	.493	.230	.178
40%	.004	.347	.065	.186	.302	.886	.456	.505	.214	.179
42%	.003	.347	.071	.182	.302	.882	.456	.516	.195	.181
44%	.003	.347	.106	.169	.303	.881	.456	.495	.185	.180
46%	.003	.347	.050	.160	.299	.881	.456	.480	.173	.177
48%	.003	.347	.059	.153	.297	.881	.456	.497	.161	.180
50%	.002	.347	.063	.146	.298	.874	.456	.475	.148	.176

C1: global structure-based DA attacks are more robust to seed errors





SecGraph: Anonymization vs DA

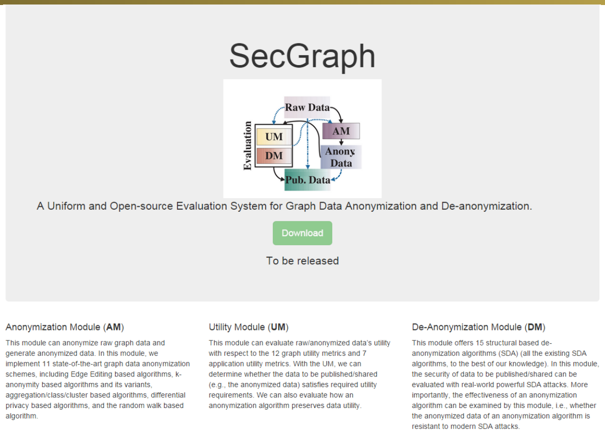
		Enron										Facebook									
	s	Switch (*k*)		*k*-DA (*k*)		Cluster (*k*)		DP (*ε*)		RW (*t*)		Switch (*k*)		*k*-DA (*k*)		Cluster (*k*)		DP (*ε*)		RW (*t*)	
		5	10	5	50	5	50	300	50	2	D	5	10	5	50	5	50	300	50	2	D
NS	.85	.0072	.0052	.3702	.0088	.3722	.3707	.0091	.0055	.0015	.0015	.8973	.8247	.9454	.9402	.9456	.9442	.9317	.8914	.0008	.0006
	.90	.0077	.0054	.3822	.0105	.3900	.3839	.0095	.0060	.0015	.0015	.9063	.8427	.9520	.9495	.9519	.9508	.9393	.8944	.0008	.0007
	.95	.3577	.0064	.4033	.0418	.4049	.4064	.3946	.0064	.0015	.0016	.9162	.8583	.9570	.9559	.9569	.9558	.9453	.9130	.0000	.0007
DV	.85	.1261	.0813	.1433	.0437	.2120	.1408	.1160	.0701	.1923	.2412	.1716	.0926	.2411	.0588	.3340	.3368	.2324	.0736	.1530	.1271
	.90	.1546	.0956	.1765	.0517	.2564	.1637	.1394	.0733	.2129	.2169	.2124	.1147	.2999	.0758	.4113	.4090	.3623	.0802	.1604	.1322
	.95	.2121	.1366	.2548	.0753	.3745	.2215	.1821	.0858	.2072	.2190	.3006	.1586	.4210	.1161	.5767	.5656	.4087	.1016	.1591	.1332
PFG	.85	.0667	.0422	.0692	.0214	.1116	.0683	.0489	.0365	.1578	.2131	.0706	.0395	.0703	.0154	.1191	.1155	.0891	.0206	.1349	.1190
	.90	.0805	.0478	.0810	.0263	.1317	.0789	.0571	.0390	.1711	.2012	.0978	.0497	.0946	.0213	.1480	.1595	.1870	.0223	.1382	.1217
	.95	.1193	.0695	.1123	.0353	.1978	.0952	.0755	.0479	.1714	.2074	.1378	.0725	.1317	.0332	.2034	.2330	.1756	.0295	.1397	.1216
YG	.85	.1373	.0969	.1646	.0289	.1576	.1570	.1549	.0664	.0394	.0323	.5437	.5056	.5816	.5086	.5897	.5805	.5404	.4347	.0356	.0210
	.90	.1716	.1037	.1612	.0253	.1868	.1710	.1577	.0736	.0404	.0342	.5681	.5182	.6089	.5129	.6036	.5980	.5702	.4818	.0372	.0222
	.95	.1730	.1197	.2155	.3785	.1971	.2064	.1884	.0838	.0418	.0348	.5821	.5439	.6208	.5504	.6223	.6190	.5716	.4538	.0346	.0231
ADA	.85	.1262	.0820	.1468	.0445	.2130	.1418	.1160	.0701	.0771	.0731	.1724	.0926	.2425	.0603	.3358	.3379	.2337	.0749	.0985	.0725
	.90	.1543	.0964	.1795	.0534	.2588	.1652	.1394	.0729	.0855	.0704	.2129	.1146	.3026	.0776	.4124	.4103	.3639	.0823	.1008	.0764
	.95	.2139	.1381	.2605	.0768	.3777	.2230	.1823	.0855	.0872	.0733	.3019	.1589	.4245	.1186	.5780	.5667	.4105	.1038	.1041	.0784
KL	.85	.0904	.0811	.0997	.0357	.0965	.0689	.0745	.0331	.0900	.0729	.0799	.0764	.0819	.0683	.0788	.0762	.0769	.0313	.1099	.0737
	.90	.1077	.0970	.1202	.0549	.1134	.0918	.0874	.0319	.0939	.0744	.0979	.0939	.1013	.0848	.0960	.0863	.1249	.0317	.1099	.0715
	.95	.1381	.1150	.1936	.0978	.2052	.1686	.1719	.0376	.0994	.0776	.1350	.1331	.1418	.1265	.1294	.1206	.1450	.0600	.1171	.0754
JLSB	.85	.0692	.0440	.0798	.0234	.1248	.0854	.0886	.0656	.0709	.0720	.1453	.0786	.2025	.0595	.2618	.2673	.1958	.0768	.0901	.0681
	.90	.0886	.0536	.1046	.0296	.1618	.1135	.1070	.0664	.0767	.0728	.1673	.0911	.2335	.0708	.3001	.3094	.3050	.0777	.0911	.0699
	.95	.1846	.1189	.2381	.0746	.3317	.2319	.1449	.0814	.0838	.0740	.2180	.1174	.3111	.1096	.3983	.3924	.3142	.0950	.0940	.0734
		✓		✓		✓		✓		✓		✓		✓		✓		✓		✓	

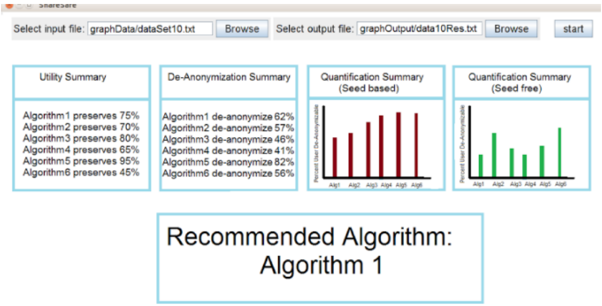
C1: state-of-the-art anonymization techniques are vulnerable to one or several modern DA attacks

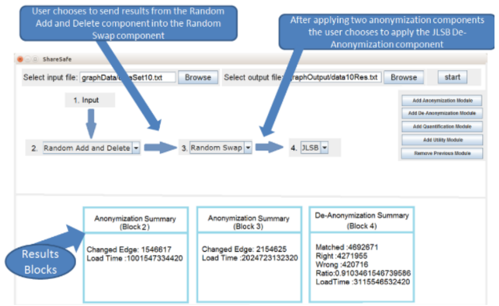
C2: no DA attack is general optimal. The DA performance depends on several factors, e.g., similarity between anonymized and auxiliary graphs, graph density, and DA heuristics

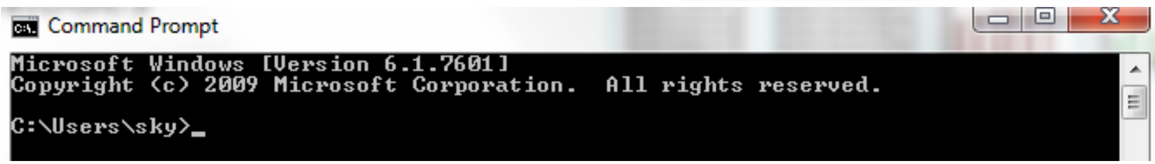
SecGraph: Release & Support

- Website
  - http://www.ece.gatech.edu/cap/secgraph/
  - Software
  - Datasets
  - Documents
  - Demo
  - Q&A
- Modes
  - GUI
  - Command line
- Supporting
  - Windows
  - Linux
  - Mac









Microsoft Windows

Linux

Conclusion

- We analyzed existing graph anonymization techniques and de-anonymization attacks
- We implemented and evaluated SecGraph: a uniform and open-source evaluation system from graph data anonymization and de-anonymization

Acknowledgement

We thank the anonymous reviewers very much for their valuable comments!

We are grateful to the following researchers in developing SecGraph: Ada Fu, Michael Hay, Davide Proserpio, Qian Xiao, Shirin Nilizadeh, Jing S. He, Wei Chen, and Stanford SNAP developers

Thank you!

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