**WAY TO MANY TOKEN, DELETED AT LEAST 300 PAGES.**

Token: [time at] ||| Value: [[{431: [[18], 0.04, 0.24025412638406932], 453: [[97], 0.008849557522123894, 0.05315356778408613]}, 6.0063531596017325]]

Token: [end (] ||| Value: [[{431: [[22], 0.04, 0.2679800136064671]}, 6.699500340161678]]

Token: [side] ||| Value: [[{432: [[9], 0.04, 0.2679800136064671]}, 6.699500340161678]]

Token: [mining )] ||| Value: [[{432: [[16], 0.04, 0.2679800136064671]}, 6.699500340161678]]

Token: [owner owner] ||| Value: [[{432: [[20], 0.04, 0.2679800136064671]}, 6.699500340161678]]

Token: [owner side] ||| Value: [[{432: [[21], 0.04, 0.2679800136064671]}, 6.699500340161678]]

Token: [side (] ||| Value: [[{432: [[22], 0.04, 0.2679800136064671]}, 6.699500340161678]]

Token: [and decrypting] ||| Value: [[{433: [[13], 0.058823529411764705, 0.3940882553036281]}, 6.699500340161678]]

Token: [decrypting )] ||| Value: [[{433: [[14], 0.058823529411764705, 0.3940882553036281]}, 6.699500340161678]]

Token: [) separately] ||| Value: [[{433: [[15], 0.058823529411764705, 0.3940882553036281]}, 6.699500340161678]]

Token: [8] ||| Value: [[{434: [[24], 0.010752688172043012, 0.06022460270423192], 624: [[1], 0.022222222222222223, 0.1244641789220793], 658: [[0], 0.14285714285714285, 0.8001268644990811]}, 5.600888051493568]]

Token: [were] ||| Value: [[{434: [[27], 0.010752688172043012, 0.06022460270423192], 446: [[2], 0.058823529411764705, 0.3294640030290334], 562: [[16], 0.023255813953488372, 0.13025321049985042]}, 5.600888051493568]]

Token: [site] ||| Value: [[{434: [[43], 0.010752688172043012, 0.06458444257636273], 501: [[16], 0.023255813953488372, 0.13968263161864494]}, 6.0063531596017325]]

Token: [Classic frequent] ||| Value: [[{434: [[47], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [as Apriori] ||| Value: [[{434: [[58], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [Apriori [] ||| Value: [[{434: [[59], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [[ 6] ||| Value: [[{434: [[60], 0.010752688172043012, 0.06458444257636273], 613: [[19], 0.02702702702702703, 0.1623338691784252]}, 6.0063531596017325]]

Token: [6 ]] ||| Value: [[{434: [[61], 0.010752688172043012, 0.06458444257636273], 613: [[20], 0.02702702702702703, 0.1623338691784252]}, 6.0063531596017325]]

Token: [FP-growth [] ||| Value: [[{434: [[69], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [[ 8] ||| Value: [[{434: [[70], 0.010752688172043012, 0.06458444257636273], 624: [[23], 0.022222222222222223, 0.1334745146578163]}, 6.0063531596017325]]

Token: [8 ]] ||| Value: [[{434: [[71], 0.010752688172043012, 0.06458444257636273], 624: [[24], 0.022222222222222223, 0.1334745146578163]}, 6.0063531596017325]]

Token: [, were] ||| Value: [[{434: [[73], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [were designed] ||| Value: [[{434: [[74], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [a centralized] ||| Value: [[{434: [[77], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [database setting] ||| Value: [[{434: [[79], 0.010752688172043012, 0.06022460270423192], 539: [[39], 0.024390243902439025, 0.1366070256461846], 541: [[32], 0.01818181818181818, 0.10183432820897395]}, 5.600888051493568]]

Token: [setting where] ||| Value: [[{434: [[80], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [where the] ||| Value: [[{434: [[81], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [data is] ||| Value: [[{434: [[84], 0.010752688172043012, 0.06458444257636273], 454: [[94], 0.008264462809917356, 0.04963928231075812]}, 6.0063531596017325]]

Token: [is stored] ||| Value: [[{434: [[85], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [stored in] ||| Value: [[{434: [[86], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [the central] ||| Value: [[{434: [[88], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [central site] ||| Value: [[{434: [[89], 0.010752688172043012, 0.06458444257636273], 501: [[37], 0.023255813953488372, 0.13968263161864494]}, 6.0063531596017325]]

Token: [site for] ||| Value: [[{434: [[90], 0.010752688172043012, 0.07203763806625461]}, 6.699500340161678]]

Token: [for mining] ||| Value: [[{434: [[91], 0.010752688172043012, 0.06458444257636273], 613: [[30], 0.02702702702702703, 0.1623338691784252]}, 6.0063531596017325]]

Token: [/] ||| Value: [[{435: [[14], 0.024390243902439025, 0.1366070256461846], 457: [[24], 0.017543859649122806, 0.09826119388585207], 795: [[21], 0.0136986301369863, 0.07672449385607627]}, 5.600888051493568]]

Token: [low] ||| Value: [[{435: [[17], 0.024390243902439025, 0.1366070256461846], 437: [[28], 0.01694915254237288, 0.0949303059575181], 801: [[23], 0.02040816326530612, 0.114303837785583]}, 5.600888051493568]]

Token: [As expected] ||| Value: [[{435: [[21], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [expected ,] ||| Value: [[{435: [[22], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [, our] ||| Value: [[{435: [[23], 0.024390243902439025, 0.10491719676495871], 466: [[64], 0.014084507042253521, 0.06058598686427193], 483: [[28], 0.022222222222222223, 0.0955912237191846], 486: [[25], 0.023255813953488372, 0.10003732714798388], 507: [[33], 0.01639344262295082, 0.07051811585841487], 518: [[22], 0.030303030303030304, 0.130351668707979], 547: [[13], 0.05263157894736842, 0.22640026670333194], 560: [[23], 0.02857142857142857, 0.12290300192466592], 561: [[57], 0.011494252873563218, 0.04944373640647479], 795: [[41], 0.0136986301369863, 0.05892609681319599], 802: [[27], 0.02564102564102564, 0.11029756582982839]}, 4.301605067363307]]

Token: [not as] ||| Value: [[{435: [[27], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [as ef.cient] ||| Value: [[{435: [[28], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [ef.cient as] ||| Value: [[{435: [[29], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [ef.cient algorithms] ||| Value: [[{435: [[33], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [algorithms /] ||| Value: [[{435: [[34], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [/ solutions] ||| Value: [[{435: [[35], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [solutions of] ||| Value: [[{435: [[36], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [of low] ||| Value: [[{435: [[37], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [low privacy] ||| Value: [[{435: [[38], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [they achieve] ||| Value: [[{436: [[16], 0.037037037037037035, 0.24812964222821027]}, 6.699500340161678]]

Token: [achieve a] ||| Value: [[{436: [[17], 0.037037037037037035, 0.2224575244296938], 795: [[44], 0.0136986301369863, 0.08227881040550318]}, 6.0063531596017325]]

Token: [a higher] ||| Value: [[{436: [[18], 0.037037037037037035, 0.20744029820346546], 453: [[94], 0.008849557522123894, 0.04956538098666874], 795: [[45], 0.0136986301369863, 0.07672449385607627]}, 5.600888051493568]]

Token: [higher privacy] ||| Value: [[{436: [[19], 0.037037037037037035, 0.2224575244296938], 795: [[46], 0.0136986301369863, 0.08227881040550318]}, 6.0063531596017325]]

Token: [level with] ||| Value: [[{436: [[21], 0.037037037037037035, 0.24812964222821027]}, 6.699500340161678]]

Token: [an acceptable] ||| Value: [[{436: [[23], 0.037037037037037035, 0.24812964222821027]}, 6.699500340161678]]

Token: [acceptable running] ||| Value: [[{436: [[24], 0.037037037037037035, 0.24812964222821027]}, 6.699500340161678]]

Token: [fastest] ||| Value: [[{437: [[3], 0.01694915254237288, 0.11355085322307928]}, 6.699500340161678]]

Token: [Compared with] ||| Value: [[{437: [[30], 0.01694915254237288, 0.0900543386278269], 465: [[10], 0.05263157894736842, 0.27964241994956773], 560: [[18], 0.02857142857142857, 0.15180588511547963], 795: [[37], 0.0136986301369863, 0.07278364354851763]}, 5.313205979041787]]

Token: [the fastest] ||| Value: [[{437: [[32], 0.01694915254237288, 0.11355085322307928]}, 6.699500340161678]]

Token: [fastest algorithms] ||| Value: [[{437: [[33], 0.01694915254237288, 0.11355085322307928]}, 6.699500340161678]]

Token: [algorithms running] ||| Value: [[{437: [[34], 0.01694915254237288, 0.11355085322307928]}, 6.699500340161678]]

Token: [time ,] ||| Value: [[{437: [[36], 0.01694915254237288, 0.0949303059575181], 463: [[48], 0.011494252873563218, 0.06437802358038584], 524: [[57], 0.014492753623188406, 0.08117229060135606]}, 5.600888051493568]]

Token: [clouds running] ||| Value: [[{437: [[39], 0.01694915254237288, 0.0949303059575181], 440: [[63], 0.011494252873563218, 0.06437802358038584], 441: [[21], 0.02564102564102564, 0.1436125141408607]}, 5.600888051493568]]

Token: [time is] ||| Value: [[{437: [[41, 55], 0.03389830508474576, 0.1898606119150362], 453: [[62], 0.008849557522123894, 0.04956538098666874], 461: [[14], 0.047619047619047616, 0.26670895483302703]}, 5.600888051493568]]

Token: [is about] ||| Value: [[{437: [[42], 0.01694915254237288, 0.11355085322307928]}, 6.699500340161678]]

Token: [about one] ||| Value: [[{437: [[43], 0.01694915254237288, 0.11355085322307928]}, 6.699500340161678]]

Token: [one order] ||| Value: [[{437: [[44], 0.01694915254237288, 0.1018025959254531], 778: [[63], 0.013333333333333334, 0.08008470879468978]}, 6.0063531596017325]]

Token: [order higher] ||| Value: [[{437: [[45], 0.01694915254237288, 0.1018025959254531], 778: [[64], 0.013333333333333334, 0.08008470879468978]}, 6.0063531596017325]]

Token: [higher for] ||| Value: [[{437: [[46], 0.01694915254237288, 0.11355085322307928]}, 6.699500340161678]]

Token: [for most] ||| Value: [[{437: [[47], 0.01694915254237288, 0.1018025959254531], 478: [[32], 0.0196078431372549, 0.11777163058042613]}, 6.0063531596017325]]

Token: [most cases] ||| Value: [[{437: [[48], 0.01694915254237288, 0.11355085322307928]}, 6.699500340161678]]

Token: [while data] ||| Value: [[{437: [[51], 0.01694915254237288, 0.11355085322307928]}, 6.699500340161678]]

Token: [owners running] ||| Value: [[{437: [[53], 0.01694915254237288, 0.0900543386278269], 447: [[41], 0.014492753623188406, 0.07700298520350417], 451: [[11], 0.05263157894736842, 0.27964241994956773], 453: [[60, 110], 0.017699115044247787, 0.0940390438768458]}, 5.313205979041787]]

Token: [is very] ||| Value: [[{437: [[56], 0.01694915254237288, 0.0949303059575181], 443: [[26], 0.024390243902439025, 0.1366070256461846], 801: [[46], 0.02040816326530612, 0.114303837785583]}, 5.600888051493568]]

Token: [very low] ||| Value: [[{437: [[57], 0.01694915254237288, 0.1018025959254531], 801: [[47], 0.02040816326530612, 0.12257863591023943]}, 6.0063531596017325]]

Token: [low .] ||| Value: [[{437: [[58], 0.01694915254237288, 0.1018025959254531], 801: [[48], 0.02040816326530612, 0.12257863591023943]}, 6.0063531596017325]]

Token: [the classic] ||| Value: [[{438: [[12], 0.05263157894736842, 0.3526052810611409]}, 6.699500340161678]]

Token: [classic trade-off] ||| Value: [[{438: [[13], 0.05263157894736842, 0.3526052810611409]}, 6.699500340161678]]

Token: [trade-off between] ||| Value: [[{438: [[14], 0.05263157894736842, 0.3526052810611409]}, 6.699500340161678]]

Token: [between privacy-preserving] ||| Value: [[{438: [[15], 0.05263157894736842, 0.3526052810611409]}, 6.699500340161678]]

Token: [privacy-preserving and] ||| Value: [[{438: [[16], 0.05263157894736842, 0.3526052810611409]}, 6.699500340161678]]

Token: [and ef.ciency] ||| Value: [[{438: [[17], 0.05263157894736842, 0.3526052810611409]}, 6.699500340161678]]

Token: [ef.ciency .] ||| Value: [[{438: [[18], 0.05263157894736842, 0.3526052810611409]}, 6.699500340161678]]

Token: [From Figs] ||| Value: [[{439: [[3], 0.2, 1.3399000680323356]}, 6.699500340161678]]

Token: [chang] ||| Value: [[{440: [[10], 0.011494252873563218, 0.05850646468652388], 441: [[14], 0.02564102564102564, 0.13051442122378404], 444: [[7], 0.02857142857142857, 0.14543035507793078], 453: [[21], 0.008849557522123894, 0.04504480024537679], 642: [[11], 0.023255813953488372, 0.1183735448308739]}, 5.090062427727577]]

Token: [t.] ||| Value: [[{440: [[17], 0.011494252873563218, 0.06437802358038584], 474: [[18], 0.013333333333333334, 0.07467850735324758], 475: [[28], 0.011235955056179775, 0.06293132642127604]}, 5.600888051493568]]

Token: [dmax] ||| Value: [[{440: [[27, 34], 0.022988505747126436, 0.11701292937304776], 476: [[6], 0.022222222222222223, 0.11311249839394617], 477: [[2], 0.047619047619047616, 0.24238392512988463], 478: [[0, 17], 0.0392156862745098, 0.1996102912834344], 481: [[20], 0.022222222222222223, 0.11311249839394617]}, 5.090062427727577]]

Token: [larger] ||| Value: [[{440: [[33, 37], 0.022988505747126436, 0.12875604716077169], 475: [[20], 0.011235955056179775, 0.06293132642127604], 478: [[3], 0.0196078431372549, 0.10982133434301114]}, 5.600888051493568]]

Token: [also observe] ||| Value: [[{440: [[49], 0.011494252873563218, 0.06903854206438773], 447: [[37], 0.014492753623188406, 0.08704859651596714]}, 6.0063531596017325]]

Token: [that running] ||| Value: [[{440: [[51], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [time changes] ||| Value: [[{440: [[53], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [changes with] ||| Value: [[{440: [[54], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [with increasing] ||| Value: [[{440: [[55], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [increasing values] ||| Value: [[{440: [[56], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [k and] ||| Value: [[{440: [[59], 0.011494252873563218, 0.06437802358038584], 474: [[54], 0.013333333333333334, 0.07467850735324758], 475: [[71], 0.011235955056179775, 0.06293132642127604]}, 5.600888051493568]]

Token: [and t.] ||| Value: [[{440: [[60], 0.011494252873563218, 0.06437802358038584], 474: [[55], 0.013333333333333334, 0.07467850735324758], 475: [[72], 0.011235955056179775, 0.06293132642127604]}, 5.600888051493568]]

Token: [t. The] ||| Value: [[{440: [[61], 0.011494252873563218, 0.06437802358038584], 474: [[56], 0.013333333333333334, 0.07467850735324758], 475: [[73], 0.011235955056179775, 0.06293132642127604]}, 5.600888051493568]]

Token: [The clouds] ||| Value: [[{440: [[62], 0.011494252873563218, 0.06903854206438773], 441: [[20], 0.02564102564102564, 0.1540090553744034]}, 6.0063531596017325]]

Token: [time increases] ||| Value: [[{440: [[65], 0.011494252873563218, 0.06903854206438773], 441: [[23], 0.02564102564102564, 0.1540090553744034]}, 6.0063531596017325]]

Token: [increases with] ||| Value: [[{440: [[66, 72], 0.022988505747126436, 0.13807708412877545], 441: [[24], 0.02564102564102564, 0.1540090553744034]}, 6.0063531596017325]]

Token: [with t] ||| Value: [[{440: [[67, 73], 0.022988505747126436, 0.15401150207268224]}, 6.699500340161678]]

Token: [t ,] ||| Value: [[{440: [[68], 0.011494252873563218, 0.06903854206438773], 471: [[32], 0.024390243902439025, 0.14649641852687154]}, 6.0063531596017325]]

Token: [as dmax] ||| Value: [[{440: [[70], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [dmax increases] ||| Value: [[{440: [[71], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [t and] ||| Value: [[{440: [[74], 0.011494252873563218, 0.06903854206438773], 453: [[88], 0.008849557522123894, 0.05315356778408613]}, 6.0063531596017325]]

Token: [a larger] ||| Value: [[{440: [[76], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [larger dmax] ||| Value: [[{440: [[77], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [dmax results] ||| Value: [[{440: [[78], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [results in] ||| Value: [[{440: [[79], 0.011494252873563218, 0.06903854206438773], 453: [[92], 0.008849557522123894, 0.05315356778408613]}, 6.0063531596017325]]

Token: [in larger] ||| Value: [[{440: [[80], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [larger ciphertext] ||| Value: [[{440: [[81], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [size and] ||| Value: [[{440: [[83], 0.011494252873563218, 0.06903854206438773], 472: [[38], 0.022222222222222223, 0.1334745146578163]}, 6.0063531596017325]]

Token: [and more] ||| Value: [[{440: [[84], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [more computations] ||| Value: [[{440: [[85], 0.011494252873563218, 0.07700575103634112]}, 6.699500340161678]]

Token: [computations .] ||| Value: [[{440: [[86], 0.011494252873563218, 0.06903854206438773], 509: [[108], 0.009174311926605505, 0.05510415742753883]}, 6.0063531596017325]]

Token: [bare] ||| Value: [[{441: [[13], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [with k] ||| Value: [[{441: [[25], 0.02564102564102564, 0.1436125141408607], 451: [[16], 0.05263157894736842, 0.2947835816575562], 475: [[70], 0.011235955056179775, 0.06293132642127604]}, 5.600888051493568]]

Token: [k for] ||| Value: [[{441: [[26], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [the retail] ||| Value: [[{441: [[28], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [dataset ,] ||| Value: [[{441: [[30], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [but barely] ||| Value: [[{441: [[32], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [barely changes] ||| Value: [[{441: [[33], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [changes for] ||| Value: [[{441: [[34], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [dataset .] ||| Value: [[{441: [[38], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [The increase] ||| Value: [[{442: [[17], 0.030303030303030304, 0.20301516182308116]}, 6.699500340161678]]

Token: [in running] ||| Value: [[{442: [[19], 0.030303030303030304, 0.20301516182308116]}, 6.699500340161678]]

Token: [time for] ||| Value: [[{442: [[21], 0.030303030303030304, 0.20301516182308116]}, 6.699500340161678]]

Token: [for retail] ||| Value: [[{442: [[22], 0.030303030303030304, 0.20301516182308116]}, 6.699500340161678]]

Token: [dataset is] ||| Value: [[{442: [[24], 0.030303030303030304, 0.16972388034828995], 443: [[25], 0.024390243902439025, 0.1366070256461846], 449: [[36], 0.02564102564102564, 0.1436125141408607]}, 5.600888051493568]]

Token: [is due] ||| Value: [[{442: [[25], 0.030303030303030304, 0.20301516182308116]}, 6.699500340161678]]

Token: [the increase] ||| Value: [[{442: [[28], 0.030303030303030304, 0.20301516182308116]}, 6.699500340161678]]

Token: [in .ctitious] ||| Value: [[{442: [[30], 0.030303030303030304, 0.20301516182308116]}, 6.699500340161678]]

Token: [dens] ||| Value: [[{443: [[7], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [very dense] ||| Value: [[{443: [[27], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [dense ,] ||| Value: [[{443: [[28], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [supports are] ||| Value: [[{443: [[32], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [are already] ||| Value: [[{443: [[33], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [already very] ||| Value: [[{443: [[34], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [very high] ||| Value: [[{443: [[35], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [high without] ||| Value: [[{443: [[36], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [without including] ||| Value: [[{443: [[37], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [including .ctitious] ||| Value: [[{443: [[38], 0.024390243902439025, 0.16340244732101655]}, 6.699500340161678]]

Token: [hardli] ||| Value: [[{444: [[6], 0.02857142857142857, 0.16002537289981622], 453: [[18], 0.008849557522123894, 0.04956538098666874], 505: [[4], 0.03225806451612903, 0.18067380811269573]}, 5.600888051493568]]

Token: [, adding] ||| Value: [[{444: [[19], 0.02857142857142857, 0.1914142954331908]}, 6.699500340161678]]

Token: [adding more] ||| Value: [[{444: [[20], 0.02857142857142857, 0.1914142954331908]}, 6.699500340161678]]

Token: [more .ctitious] ||| Value: [[{444: [[21], 0.02857142857142857, 0.1914142954331908]}, 6.699500340161678]]

Token: [data hardly] ||| Value: [[{444: [[23], 0.02857142857142857, 0.1914142954331908]}, 6.699500340161678]]

Token: [hardly changes] ||| Value: [[{444: [[24], 0.02857142857142857, 0.1914142954331908]}, 6.699500340161678]]

Token: [changes the] ||| Value: [[{444: [[25], 0.02857142857142857, 0.1914142954331908]}, 6.699500340161678]]

Token: [the number] ||| Value: [[{444: [[26], 0.02857142857142857, 0.15180588511547963], 460: [[10], 0.06666666666666667, 0.35421373193611916], 471: [[23], 0.024390243902439025, 0.12959038973272652], 484: [[70], 0.013333333333333334, 0.07084274638722383]}, 5.313205979041787]]

Token: [of seemingly] ||| Value: [[{444: [[28], 0.02857142857142857, 0.1914142954331908]}, 6.699500340161678]]

Token: [compromis] ||| Value: [[{445: [[19], 0.02127659574468085, 0.1277947480766326], 561: [[40], 0.011494252873563218, 0.06903854206438773]}, 6.0063531596017325]]

Token: [for outsourced] ||| Value: [[{445: [[28], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [databases that] ||| Value: [[{445: [[30], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [that allow] ||| Value: [[{445: [[31], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [allow multiple] ||| Value: [[{445: [[32], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [multiple data] ||| Value: [[{445: [[33], 0.02127659574468085, 0.1277947480766326], 490: [[28], 0.023255813953488372, 0.13968263161864494]}, 6.0063531596017325]]

Token: [owners to] ||| Value: [[{445: [[35], 0.02127659574468085, 0.1277947480766326], 553: [[22], 0.02857142857142857, 0.17161009027433521]}, 6.0063531596017325]]

Token: [to ef.ciently] ||| Value: [[{445: [[36], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [ef.ciently share] ||| Value: [[{445: [[37], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [share their] ||| Value: [[{445: [[38], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [their data] ||| Value: [[{445: [[39], 0.02127659574468085, 0.1277947480766326], 524: [[43], 0.014492753623188406, 0.08704859651596714]}, 6.0063531596017325]]

Token: [data securely] ||| Value: [[{445: [[40], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [securely without] ||| Value: [[{445: [[41], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [without compromising] ||| Value: [[{445: [[42], 0.02127659574468085, 0.1277947480766326], 561: [[83], 0.011494252873563218, 0.06903854206438773]}, 6.0063531596017325]]

Token: [compromising on] ||| Value: [[{445: [[43], 0.02127659574468085, 0.1277947480766326], 561: [[84], 0.011494252873563218, 0.06903854206438773]}, 6.0063531596017325]]

Token: [on data] ||| Value: [[{445: [[44], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [privacy .] ||| Value: [[{445: [[46], 0.02127659574468085, 0.14254256042897187]}, 6.699500340161678]]

Token: [concern] ||| Value: [[{446: [[1], 0.058823529411764705, 0.3533148917412784], 501: [[20], 0.023255813953488372, 0.13968263161864494]}, 6.0063531596017325]]

Token: [Privacy concerns] ||| Value: [[{446: [[9], 0.058823529411764705, 0.3940882553036281]}, 6.699500340161678]]

Token: [concerns were] ||| Value: [[{446: [[10], 0.058823529411764705, 0.3940882553036281]}, 6.699500340161678]]

Token: [were not] ||| Value: [[{446: [[11], 0.058823529411764705, 0.3940882553036281]}, 6.699500340161678]]

Token: [this setting] ||| Value: [[{446: [[15], 0.058823529411764705, 0.3940882553036281]}, 6.699500340161678]]

Token: [setting .] ||| Value: [[{446: [[16], 0.058823529411764705, 0.3533148917412784], 539: [[40], 0.024390243902439025, 0.14649641852687154]}, 6.0063531596017325]]

Token: [We can] ||| Value: [[{447: [[35], 0.014492753623188406, 0.08704859651596714], 475: [[45], 0.011235955056179775, 0.06748711415282846]}, 6.0063531596017325]]

Token: [that data] ||| Value: [[{447: [[39], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [time decreases] ||| Value: [[{447: [[43], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [decreases TABLE] ||| Value: [[{447: [[44], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [TABLE VI] ||| Value: [[{447: [[45], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [VI TABLE] ||| Value: [[{447: [[46], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [TABLE VII] ||| Value: [[{447: [[47], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [VII ESTIMATED] ||| Value: [[{447: [[48], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [ESTIMATED RUNNING] ||| Value: [[{447: [[49], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [RUNNING TIME] ||| Value: [[{447: [[50], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [TIME OF] ||| Value: [[{447: [[51], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [OF [] ||| Value: [[{447: [[52], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [s SOLUTION] ||| Value: [[{447: [[56], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [SOLUTION TRANSACTION] ||| Value: [[{447: [[57], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [TRANSACTION COUNT] ||| Value: [[{447: [[58], 0.014492753623188406, 0.08704859651596714], 470: [[44], 0.017543859649122806, 0.1053746168351181]}, 6.0063531596017325]]

Token: [COUNT OF] ||| Value: [[{447: [[59], 0.014492753623188406, 0.08704859651596714], 470: [[45], 0.017543859649122806, 0.1053746168351181]}, 6.0063531596017325]]

Token: [OF JOINT] ||| Value: [[{447: [[60], 0.014492753623188406, 0.08704859651596714], 470: [[46], 0.017543859649122806, 0.1053746168351181]}, 6.0063531596017325]]

Token: [DATABASE (] ||| Value: [[{447: [[62], 0.014492753623188406, 0.08704859651596714], 470: [[48], 0.017543859649122806, 0.1053746168351181]}, 6.0063531596017325]]

Token: [( RETAIL] ||| Value: [[{447: [[63], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [RETAIL )] ||| Value: [[{447: [[64], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [) when] ||| Value: [[{447: [[65], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [when t] ||| Value: [[{447: [[66], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [t increases] ||| Value: [[{447: [[67], 0.014492753623188406, 0.09709420782843012]}, 6.699500340161678]]

Token: [increases .] ||| Value: [[{447: [[68], 0.014492753623188406, 0.08704859651596714], 471: [[40], 0.024390243902439025, 0.14649641852687154]}, 6.0063531596017325]]

Token: [simpl] ||| Value: [[{448: [[3], 0.1111111111111111, 0.7443889266846309]}, 6.699500340161678]]

Token: [The reason] ||| Value: [[{448: [[5], 0.1111111111111111, 0.7443889266846309]}, 6.699500340161678]]

Token: [reason is] ||| Value: [[{448: [[6], 0.1111111111111111, 0.7443889266846309]}, 6.699500340161678]]

Token: [is simple] ||| Value: [[{448: [[7], 0.1111111111111111, 0.7443889266846309]}, 6.699500340161678]]

Token: [simple .] ||| Value: [[{448: [[8], 0.1111111111111111, 0.7443889266846309]}, 6.699500340161678]]

Token: [smaller] ||| Value: [[{449: [[18], 0.02564102564102564, 0.1540090553744034], 450: [[2], 0.06666666666666667, 0.4004235439734488]}, 6.0063531596017325]]

Token: [same joint] ||| Value: [[{449: [[22], 0.02564102564102564, 0.1540090553744034], 668: [[26], 0.02857142857142857, 0.17161009027433521]}, 6.0063531596017325]]

Token: [is vertically] ||| Value: [[{449: [[25], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [partitioned to] ||| Value: [[{449: [[27], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [to more] ||| Value: [[{449: [[28], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [owners dataset] ||| Value: [[{449: [[35], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [is smaller] ||| Value: [[{449: [[37], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [smaller .] ||| Value: [[{449: [[38], 0.02564102564102564, 0.1717820600041456]}, 6.699500340161678]]

Token: [outsourced compar-ison] ||| Value: [[{811: [[65], 0.0136986301369863, 0.09177397726248873]}, 6.699500340161678]]

Token: [compar-ison scheme] ||| Value: [[{811: [[66], 0.0136986301369863, 0.09177397726248873]}, 6.699500340161678]]

Token: [for comparing] ||| Value: [[{811: [[68], 0.0136986301369863, 0.09177397726248873]}, 6.699500340161678]]

Token: [comparing supports/con.dences] ||| Value: [[{811: [[69], 0.0136986301369863, 0.09177397726248873]}, 6.699500340161678]]

Token: [supports/con.dences with] ||| Value: [[{811: [[70], 0.0136986301369863, 0.09177397726248873]}, 6.699500340161678]]

**The Max Gap is : 0.23104906019**

Keywords are :

databas

ieee

jun

data

for

rule mining

are two

thi

privacy-preserv

paper ,

we focus

focus on

on privacy-preserving

privacy-preserving mining

mining on

databases .

term

Index Terms

Terms Association

mining ,

mining .

(

)

requir

addit

more

other

association rule

comput

[

]

15

secur

is the

are designed

in this

This paper

paper proposes

a ciphertext

from

16

item

substitut

transact

attack

[ 16

as a

manner

supports ,

privacy-preserving manner

manner .

it

such

aggreg

, it

F

I

F I

I .

fig

Fig .

2

2 .

system

model

outsourc

System model

model of

of outsourced

outsourced data

on joint

database .

A

A .

organ

remaind

Organization The

The remainder

remainder of

of this

paper is

is organized

organized as

as follows

follows .

section

II

consid

system model

considered in

materi

cryptograph

provid

iii

The required

required background

background material

material on

on cryptographic

cryptographic techniques

techniques is

is provided

provided in

in Section

Section III

III .

IV

as the

V

VI

vii

solutions for

the security

relat

work

discuss

viii

Related work

work is

is discussed

discussed in

Section VIII

VIII .

introduct

2016

6

, 2016

6 ,

16 ,

2016 .

We

conclud

IX

We conclude

conclude the

the paper

paper in

Section IX

IX .

II .

see

System Model

Model The

The system

model (

( see

see Fig

2 )

is comprised

comprised of

two or

a cloud

cloud .

each

has a

private database

Data owners

frequent itemsets

honest

curiou

The (

honest but

but curious

) cloud

B

B .

date

may

19

2 ,

19 ,

Security Model

The cloud

is considered

considered honest

curious in

paper .

honestli

cloud honestly

honestly stores

stores and

and mines

mines data

trust

reput

cloud provider

provider with

a trusted

trusted reputation

reputation )

) .

are also

not

.nancial

gain

is not

it is

.nancial gains

paid

advertis

for paid

paid advertisement

advertisement )

analysis attacks

attacks .

For each

each of

the item

1

need

of a

item .

reason

This is

need to

itemsets .

ani

insid

Hence ,

, colluding

colluding attacks

attacks and

and insider

insider attacks

attacks are

not considered

also considered

considered collaborative

collaborative but

major

contribut

dataset

buy

doe

owner (

) as

does not

J.

in part

part by

As

mention

earlier

As mentioned

mentioned earlier

earlier ,

are .nancial

gains in

in doing

doing so

so .

each data

has some

surpris

not surprising

surprising .

size

tid

all

set

set of

: .

privaci

Privacy .

possibl

speci.c

avoid

inform

tabl

alphabet

More speci.cally

speci.cally ,

to avoid

] .

exact

con.denc

solutions should

should also

also protect

protect the

ef.cienc

Ef.ciency .

decreas

therefor

trade-off

latenc

mining algorithms

R.

function

unit

A substitution

to a

substitution alphabet

outsourced association

items in

a transaction

let

L

includ

uniqu

be the

everi

correspond

Every item

item in

in L

L has

a corresponding

corresponding unique

unique ciphertext

ciphertext .

shown

alphabet example

example is

is shown

shown in

in Table

Table I

the database

subject

cipher is

is subject

subject to

to frequency

if the

different .

usa

south

USA ,

an

bread

milk

second

bread and

H

resist

H (

former

one-way

The former

former is

is related

related to

a one-way

one-way function

function .

given

m

=

veri

i.e

i.e .

m1

( m1

m1 )

22

23

[ 22

22 ]

[ 23

23 ]

oper

If

then

+

encryption [

epk

in Paillier

EPK (

denot

homomorphic addition

third

parti

scheme .

IV .

schemes will

then serve

exist

number

number of

onlin

http

paper are

http :

q

>

) The

is a

> q

q .

Z

p.

p. .

mod

, m

small

degre

r

<

a small

below

is given

given below

below .

interest

between

c2

Then ,

and c2

random ingredients

As shown

c1 and

must

must be

ensur

Therefore ,

|q|

|q| >

|r1|+|r2|+2|q|+1

|p|

We only

only need

to ensure

ensure |r1|+|r2|+2|q|+1

|r1|+|r2|+2|q|+1 <

< |p|

|p| .

d2

: As

of c1

3

4

5

3 )

suppos

lower

Suppose c2s

c2s degree

degree d2

d2 is

is lower

lower .

1 .

addition/subtract

Then we

we can

can do

do homomorphic

homomorphic addition/subtraction

addition/subtraction of

c2 .

transaction is

threshold

, both

problem

0

Let m

m be

, where

0 .

i

i be

generated by

i-th data

{

}

} .

. )

owners hold

hold SK

and want

to know

know whether

owners need

with 0

An

supp

Ts

speci.

miner

Z is

Supp (

( Z

Z )

threshold speci.ed

speci.ed by

data miner

miner .

comparison result

result is

The secure

scheme for

above problem

problem is

is as

follows :

u

vi

cloud generates

requirements .

i=1

.1

/2

vi >

( q

q .1

.1 )

) /2

/2 >

i=1 t

t .

> .

note

/2 i=1

Note :

vi .

Q

due

thirdli

Thirdly ,

, each

owner computes

computes .

Zs

de.n

occurr

is de.ned

de.ned as

with (

/2 .

i=if

i=If .

. <

< (

/2 ,

otherwis

Otherwise ,

m <

< 0

i=1 i=1

3 .

Privacy-preserving outsourced

. >

express

X

An association

rule is

is expressed

expressed using

using X

X .

+1

q +1

+1 )

0or

owner can

can detect

detect whether

m 0or

0or not

not by

by comparing

comparing .

Y

disjoint

Y ,

where X

X and

and Y

Y are

two disjoint

disjoint itemsets

main

idea

Main Idea

Idea As

in Fig

own

3 ,

preprocess

preprocessing and

collaborate to

encrypted joint

clouds end

hi

due to

the databases

erv

transactions )

using our

RV

either

1 ,

is .ctitious

sent

All ERVs

ERVs are

are sent

sent to

ERVs .

cloud mines

mines association

candid

rule candidates

candidates from

veri.

solution is

can-did

mines frequent

itemset can-didates

can-didates (

( i.e

the seemingly

itemsets are

are de.ned

de.ned later

later )

) instead

candidates .

solution in

is shared

select

maximum

size .

are shown

Let i

ciphertext generated

, 1

The owner

sends cs

ce along

with Ts

Ts to

veri.c

1 other

other items

same private

agre

ks

to agree

agree on

on ks

ks value

value .

butter

A customer

customer buying

buying bread

and butter

butter will

will also

also buy

buy milk

milk .

transac-t

owner tags

tags his

databases transac-tions

transac-tions with

with 1-degree

1-degree ERVs

If a

.ctitious ,

, its

its RV

RV is

is 0

the RV

is 1

6 )

) Database

Database outsourcing

outsourcing .

join

cloud joins

Then {

{ bread

bread ,

, butter

butter }

7

7 )

) Aggregated

Aggregated veri.cation

veri.cation of

of ERVs

e

Let e

e be

the set

of all

all ERVs

a frequent

itemset located

here may

be real

itemset .

milk is

a possible

possible association

rule .

computes the

support for

( X

the transactions

transactions containing

containing X

in X

X are

of 0

ESVR .

Suppose Z

is such

such an

an itemset

recal

Recall that

Ts with

0 using

our secure

( encrypted

encrypted )

) comparison

the ESVR

As Supp

Ts 0

high

Y is

the con.dence

and X

X Y

If it

frequent ,

decrypt it

it .

of preprocessing

of mining

subsequ

ini-ti

Subsequently ,

, ERV

ERV generation

generation and

and ini-tialization

ini-tialization for

comparison will

be deferred

deferred .

, X

increas

separ

The only

increase in

separately .

( Currently

Currently ,

, ERVs

sent along

The solution

these itemsets

owners do

to decrypt

decrypt frequent

, 0

con

f

Y )

Con f

f (

generates association

rule candidate

candidate X

Y and

are seemingly

ecvr

For any

any association

both X

The encrypted

encrypted comparison

the ECVR

ECVR .

Tc

) Tc

Tc .

of X

VI .

that substitution

We de.ne

de.ne Con

contrast

appli

In contrast

undermin

will not

undermine the

not undermine

security .

items .

crack

Th

, from

from [

, Th

Th .

no

above-ment

joins the

the above-mentioned

above-mentioned databases

con.dence of

( 2

) ERVs

ERVs will

result of

information .

experiment

TABLE V

V EXPERIMENTAL

EXPERIMENTAL SETTINGS

SETTINGS B

via

exact supports

there is

still a

possible attack

attack via

via chosen

ingredients in

solv

systems .

= Supp

known-plaintext

scheme should

be secure

secure under

under known-plaintext

known-plaintext attacks

mi

time .

view

constant

These unknowns

unknowns will

be viewed

viewed as

as constants

constants in

the generated

generated systems

Tc denotes

denotes the

the threshold

to conceal

iv-c

From the

proof in

Section IV-C

IV-C ,

that mi

mi 0

.q

> mi

mi .1

.1 .q

.q .

> (

/2 Fig

4 .

4and

12

Running time

time comparison

comparison (

= 4and

4and k

k =

= 12

12 )

If .

couldbeani

valuein

m couldbeany

couldbeany valuein

valuein [

[ .

. ,

0 ]

more information

VII .

complex

the computational

13

s solutions

level

solutions achieve

contrast ,

, other

other solutions

achieve lower

lower privacy

privacy levels

levels .

supports .

retail

26

retail and

and pumsb

[ 26

26 ]

The retail

88,162

49,046

pumsb datasets

datasets contain

contain 88,162

88,162 and

and 49,046

49,046 transactions

implement

Our solutions

solutions are

single-thread

All implementations

implementations are

are single-threaded

single-threaded implementations

implementations .

Figs .

4 ,

, 5

5 and

and 6

6 .

Most association

are built

on frequent

time of

5 .

.xed

time under

is .xed

.xed to

different k

k (

t is

to 2

of frequent

show

We show

show our

solutions running

time at

end (

side

mining )

owner owner

owner side

side (

and decrypting

decrypting )

) separately

8

were

they achieve

level with

an acceptable

acceptable running

Compared with

time is

owners running

the classic

classic trade-off

trade-off between

between privacy-preserving

privacy-preserving and

and ef.ciency

ef.ciency .

From Figs

dmax

with k

the number

concern

Privacy concerns

concerns were

were not

this setting

setting .

simpl

The reason

reason is

is simple

simple .

smaller

less

Preprocessing a

a smaller

smaller dataset

dataset requires

requires less

less time

doesnt

time doesnt

doesnt increase

increase with

k either

either .

domin

is dominated

dominated by

is one

9

and Clifton

Clifton [

expens

n

F is

This solutions

by these

these expensive

expensive operations

operations .

the result

our solution

impor-t

to an

an increased

increased understanding

understanding of

the impor-tance

impor-tance of

parallel

These keys

parameters can

be sent

in parallel

parallel .

normal

Normally ,

, dmax

dmax can

small constant

constant .

above experiments

averag

the average

average transaction

transaction size

The traf.c

and cost

in classic

are O

2048

rules can

can then

then be

be found

found given

given frequent

31

the master

semi-trust

server

a semi-trusted

The master

master generates

database containing

containing .ctitious

each rule

quali.

The server

server veri.es

veri.es if

the rule

is quali.ed

quali.ed or

third-party is

is utilized

utilized for

unlik

, unlike

unlike our

master )

) does

does the

the majority

majority of

computational work

work .

solutions do

except

server to

expos

expose exact

only exception

exception is

row

If each

has one

more rows

rows (

desir-

The .rst

.rst solution

solution exposes

exposes exact

not desir-able

desir-able .

The second

second solution

solution does

not expose

complic

support .

con.-denc

supports or

or con.-dences

con.-dences to

1556-6013

) 1556-6013

1556-6013 .

giannotti

et

al

Giannotti et

et al

al .

2016 IEEE

IEEE .

person

permit

republication/redistribut

permiss

Personal use

use is

is permitted

permitted ,

but republication/redistribution

republication/redistribution requires

requires IEEE

IEEE permission

permission .

adversari

our adversary

adversary model

model is

is different

beyond

scope

These settings

settings are

are beyond

beyond the

the scope

scope of

data than

than most

//www.ieee.org/publications\_standards/publications/rights/index.html

See http

: //www.ieee.org/publications\_standards/publications/rights/index.html

//www.ieee.org/publications\_standards/publications/rights/index.html for

for more

solutions also

also ensure

the privacy

privacy of

research

is horizontally

partitioned .

1 items

summar

is summarized

summarized as

follows (

( also

also see

sort

owner sorts

sorts items

in decreasing

decreasing order

order of

of support

start

Starting from

.rst of

the sorted

sorted item

item list

list (

nois

The difference

difference is

the noise

noise of

sigkdd

1999

pp

SIGKDD ,

, 1999

1999 ,

, pp

pp .

254c260

254C260 .

P.

med

Med .

Inform .

assoc.

vol

Assoc. ,

, vol

vol .

5 ,

, no

no .

373c381

1998

373C381 ,

, 1998

1998 .

busi

widm

2001

WIDM ,

, 2001

2001 ,

9c15

9C15 .

79c86

2003

79C86 ,

, 2003

2003 .

siam

sdm

SIAM SDM

SDM ,

2003 ,

1c5

1C5 .

These businesses

businesses collaborate

mine customer

buying patterns

patterns from

vldb

1994

VLDB ,

, 1994

1994 ,

1c13

1C13 .

tran

Trans .

knowl

Knowl .

eng.

Data Eng.

Eng. ,

12 ,

372c390

may/jun

372C390 ,

, May/Jun

May/Jun .

2000

2000 .

acm

sigmod

ACM SIGMOD

SIGMOD ,

1c12

1C12 ,

, 2000

2002

, 2002

2002 ,

639c644

639C644 .

the businesses

businesses (

9 ,

1026c1037

sep.

2004

1026C1037 ,

, Sep.

Sep. 2004

2004 .

59

59 ,

378c396

2006

378C396 ,

, 2006

2006 .

dbsec

2005

DBSEC ,

, 2005

2005 ,

153c165

153C165 .

owners )

) will

will own

own some

some transaction

transaction partitions

partitions in

inf

Inf .

sci.

Sci. ,

177

177 ,

490c503

2007

490C503 ,

, 2007

2007 .

] P.

eurocrypt

EUROCRYPT ,

223c238

223C238 .

telecommun.

Telecommun. ,

8 ,

481c490

1997

481C490 ,

, 1997

1997 .

J. ,

7 ,

385c395

2013

385C395 ,

Sep. 2013

2013 .

27th

annu

27th Annu

Annu .

ifip

WG

conf

IFIP WG

WG Conf

Conf .

appl

Data Appl

Appl .

Secur .

newark

NJ

jul

Privacy (

( DBSec

DBSec )

, Newark

Newark ,

, NJ

NJ ,

, USA

, Jul

Jul .

2013 ,

258c265

258C265 .

[ Online

Online ]

int

SIAM Int

Int .

reg-ul

regim

to reg-ulations

reg-ulations in

in existing

existing privacy

privacy regime

regime )

vancouv

BC

canada

apr./may

Mining ,

, Vancouver

Vancouver ,

, BC

BC ,

, Apr./May

Apr./May 2015

2015 ,

244c252

244C252 .

2007 ,

111c122

111C122 .

security and

icdm

dec.

2009

ICDM ,

, Dec.

Dec. 2009

2009 ,

872c877

872C877 .

solution must

be applied

applied .

cpdp

2011

CPDP ,

, 2011

2011 ,

411c426

411C426 .

fip

180-1

standard

nat

] FIPS

FIPS Publication

Publication 180-1

180-1 :

: Secure

Secure Hash

Hash Standard

Standard ,

, Nat

Nat .

inst

Inst .

technol.

gaithersburg

MD

1995

Standards Technol.

Technol. ,

, Gaithersburg

Gaithersburg ,

, MD

MD ,

, 1995

1995 .

180-2

Publication 180-2

180-2 :

2002 .

theori

Theory ,

31 ,

469c472

469C472 ,

1985

1985 .

2000 ,

392c407

392C407 .

fournier-vig

P. Fournier-Viger

Fournier-Viger .

real-lif

spmf

format

access

apr

Real-life Datasets

Datasets in

in SPMF

SPMF Format

Format ,

, accessed

accessed on

on Apr

Apr .

mach.learn.res.

Mach.Learn.Res. ,

15 ,

2014

, 2014

Comput .

secur.

Secur. ,

13 ,

593c622

593C622 ,

2005 .

sedm

SEDM ,

, Jun

Jun .

2010

2010 ,

345c350

345C350 .

network

raipur

chhat-tisgarh

india

springer

Raipur ,

, Chhat-tisgarh

Chhat-tisgarh ,

, India

India :

: Springer

Springer ,

2014 ,

827c836

827C836 .

18th

paci.c-asia

18th Paci.c-Asia

Paci.c-Asia Conf

adv

Adv .

, May

May 2014

606c617

606C617 .

267

267 ,

267c286

267C286 ,

2014 .

5th

5th Int

ideal

IDEAL ,

, 2004

2004 ,

320c325

320C325 .

adma

2008

ADMA ,

, 2008

2008 ,

170c181

170C181 .

curious but

but honest

honest )

cloud in

acsw-aisc

ACSW-AISC ,

15c22

15C22 .

symp

ACM Symp

Symp .

sac

seoul

korea

mar

( SAC

SAC )

, Seoul

Seoul ,

, South

South Korea

Korea ,

, Mar

Mar .

375c379

375C379 .

appl.

Appl. ,

22 ,

351c364

351C364 ,

, 2013

His research

research interests

interests include

include privacy

privacy and

and security

security in

in cloud

and big

big data

shanghai

was a

cryptographi

network security

security ,

and applied

applied cryptography

cryptography .

recipi

governor

gold

metal

He was

a recipient

recipient of

the Canada

Canada Governor

Governor General

General Gold

Gold Metal

Metal .

three-fold

The contributions

contributions of

are three-fold

three-fold :

include network

proposes privacy-preserving

for high

high privacy

privacy requirements

space

designed to

avoid such

such complications

complications .

Our solution

ef.cient due

The introduction

introduction of

semi-trusted third

third party

party Fig

Design space

space of

rule and