Dataset with electrical impedance measurements in samples of freshly excised tissue from the

106 instances

10 attributes: 9 features+1class attribute

Six classes of freshly excised tissue were studied using electrical impedance measurements:

	•	•
		# of cases
Car	Carcinoma	21
Fad	Fibro-adenoma	15
Mas	Mastopathy	18
Gla	Glandular	16
Con	Connective	14
Adi	Adipose	22
		106

Impedance measurements were made at the frequencies: 15.625, 31.25, 62.5, 125, 250, 500, 1000 K These measurements plotted in the (real, -imaginary) plane constitute the impedance spectrum from where the features below are computed.

9 features:

10	Impedivity (ohm) at zero frequency

PA500 phase angle at 500 KHz

HFS high-frequency slope of phase angle

DA impedance distance between spectral ends

AREA area under spectrum

A/DA area normalized by DA

MAX IP maximum of the spectrum

DR distance between IO and real part of the maximum frequency point

P length of the spectral curve

References: J. Jossinet (1996) Variability of impedivity in normal and pathological breast tissue. Med. & JE Silva, JP Marques de Sá, J Jossinet (2000) Classification of Breast Tissue by Electrical

breast	
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Hz

: Biol. Eng. & Comput, 34: 346-350. Impedance Spectroscopy. Med & Bio Eng & Computing, 38:26-30.

Case # Clases I on PA500 HFS DA Arrea A/DA Max JP DC 1 car 524.79407 0.08729828 0.265292 121.1542 3163.2395 26.109202 69.17361 99.084964 3 car 551.87929 0.2268928 0.260852 126.40044 1188.329 24.894903 77.93297 253.785.3 5 car 362.83127 0.2007129 0.2443461 124.91256 290.0624 26.34127 0.989389 103.89656 7 car 290.45514 0.1441624 0.053058 74.655067 1189.5452 15.93514 35.70331 65.541324 8 car 275.67739 0.153383 0.1877794 15.257383 176.52547 15.851562 79.066351 15.131729 11 car 410 0.2172481 0.06007375 120.9016 427.94647 15.81681 1002.52674 45.516861 10.953930 16.7274041 255.81618 1002.527725 75.604823 12.26263 12.26278 12.2228483 12.222695 12.22464 43.724725									
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26 fad243,293980,0399680,067020668,544778383,928455,60113359,991348367,81665627 fad259,885150,07068580,006981358,243807465,087277,985179717,50683856,34024128 fad2500,0680678-0,015358957,172431652,9013511,41986317,77698155,7912729 fad2000,03769910,117286142,316675220,810915,21805910,67576440,94788230 fad3550,06405360,084473989,5584631033,854211,54390327,56266286,57656131 fad2720,09145530,004886963,78938718,9463111,27062720,08555660,69072932 fad341,620010,09197890,07400285,0430291370,838116,11934729,02896979,93519733 fad160,322450,17697640,163362837,217124341,881469,186133330,88916420,7599134 fad301,30440,10978120,035604764,6162942,7731914,59035329,04567757,7200335 fad1550,17278760,2128930241,54216770,4262393,58445618,1310147,569493137 mas1780,17086770,2012930241,542167489,4405211,78177635,74779521,6239338 mas1950,13910270,205250737,462196328,384058,765744935,02382713,2946539 mas435,093170,0769690,161264 <td< td=""><td></td><td>245</td><td>0,1890192</td><td>0,0816814</td><td>62,902955</td><td>1235,9834</td><td>19,649051</td><td>42,152016</td><td>46,690355</td></td<>		245	0,1890192	0,0816814	62,902955	1235,9834	19,649051	42,152016	46,690355
27 fad 259,88515 0,0766858 0,0669813 58,243807 465,08727 7,9851797 17,506838 56,340241 28 fad 250 0,0680678 -0,0153589 57,172431 652,90135 11,419863 17,776981 55,79127 29 fad 200 0,0376991 0,1172861 42,316675 220,81091 5,218059 10,675764 40,947882 30 fad 355 0,0640536 0,0844739 89,558463 1033,8542 11,543903 27,562662 86,576561 31 fad 272 0,0914553 0,0048869 63,78938 718,94631 11,270627 20,085556 60,690729 32 fad 341,62001 0,0919789 0,074002 85,043029 1370,8381 16,119347 29,028969 79,935197 34 fad 301,3044 0,1097812 0,0356047 64,6162 942,77319 14,590353 29,045677 57,72003 35 fad 155 0,1727876 0,1486824 38,940168 415,1116 10,660242 25,835602 29,134376		352,65645	0,1219985	0,0907571	68,527846	1066,1578	15,558024	43,691925	52,792817
28 fad 250 0,0680678 -0,0153589 57,172431 652,90135 11,419863 17,776981 55,79127 29 fad 200 0,0376991 0,1172861 42,316675 220,81091 5,218059 10,675764 40,947882 30 fad 355 0,0640536 0,0844739 89,558463 1033,8542 11,543903 27,562662 86,576561 31 fad 272 0,0914789 0,074002 85,78938 718,94631 11,270627 20,085556 60,690729 33 fad 160,32245 0,1769764 0,1633628 37,217124 341,861333 30,889164 20,75991 34 fad 301,3044 0,1097812 0,0356047 64,6162 942,77319 14,590353 29,045677 57,72003 35 fad 155 0,1727876 0,1186824 38,940168 415,1116 10,660242 25,836502 29,134376 36 fad 144 0,1206023 0,0460767 19,64767 70,426239 3,5844576 18,131014 7,5694931 37 mas <td< td=""><td>26 fad</td><td>243,29398</td><td>0,039968</td><td>0,0670206</td><td>68,544778</td><td>383,92845</td><td>5,6011335</td><td>9,9913483</td><td>67,816656</td></td<>	26 fad	243,29398	0,039968	0,0670206	68,544778	383,92845	5,6011335	9,9913483	67,816656
29 fad	27 fad	259,88515	0,0706858	0,0069813	58,243807	465,08727	7,9851797	17,506838	56,340241
30 fad 355 0,0640536 0,0844739 89,558463 1033,8542 11,543903 27,562662 86,576561 31 fad 272 0,0914553 0,0048869 63,78938 718,94631 11,270627 20,085556 60,690729 32 fad 341,62001 0,0919789 0,074002 85,043029 1370,8381 16,119347 29,028969 79,935197 33 fad 160,32245 0,1769764 0,1633628 37,217124 341,88146 9,1861333 30,889164 20,75991 34 fad 301,3044 0,1097812 0,0356047 64,6162 942,77319 14,590353 29,045677 57,72003 35 fad 155 0,1727876 0,1186824 38,940168 415,1116 10,660242 25,836502 29,134376 36 fad 144 0,1206023 0,0460767 19,64767 70,426239 3,5844576 18,131014 7,5694931 37 mas 178 0,1708677 0,2129302 41,542167 489,44052 11,781776 35,747795 21,162393 38 mas 195 0,1391027 0,2052507 37,462196 328,36405 8,767449 35,023827 13,29465 39 mas 435,09317 0,0765969 0,1612684 123,59754 1342,2776 10,860068 37,384724 117,80804 40 mas 250 0,0471239 0,0139626 70,90704 224,14579 3,1611218 9,1021757 70,3204 41 mas 339,50855 0,0453786 0,0300197 88,629809 331,08039 3,7355422 19,825581 87,62118 42 mas 236 0,1246165 0,2017601 48,45113 236,88011 4,8890524 36,006622 32,41967 43 mas 481,46715 0,0785398 0,016057 79,059162 1154,3382 14,600942 33,929131 71,408439 44 mas 252 0,106116 0,0314159 38,54421 493,79042 12,811014 25,541145 28,86704 45 mas 172,5158 0,1272345 0,0383972 24,43778 144,46651 5,9117505 22,02108 10,594708 47 mas 196,36486 0,1829105 0,1424189 54,58308 843,26253 5,1198546 19,322081 32,189821 46 mas 370,39572 0,1047198 0 115,92325 1308,1204 11,284366 31,367031 112,7151 49 mas 260,27752 0,0790634 0,0328122 58,817611 277,25903 4,7138778 17,86867 56,037684 50 mas 544,65435 0,0637045 0,0020944 100,78808 1189,2902 11,79991 29,412222 96,58015 51 mas 310 0,1747075 0,1654572 98,50961 2741,032 27,824923 49,327862 85,27001 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008 52,421008 52,4421008 52,4421008 52,4421008 52,4421008 52,4421		250	0,0680678	-0,0153589	57,172431	652,90135	11,419863	17,776981	55,79127
31 fad		200	0,0376991	0,1172861	42,316675	220,81091	5,218059	10,675764	40,947882
32 fad 341,62001 0,0919789 0,074002 85,043029 1370,8381 16,119347 29,028969 79,935197 33 fad 160,32245 0,1769764 0,1633628 37,217124 341,88146 9,1861333 30,889164 20,75991 34 fad 301,3044 0,1097812 0,0356047 64,6162 942,77319 14,590353 29,045677 57,72003 35 fad 155 0,1727876 0,1186824 38,940168 415,1116 10,660242 25,836502 29,134376 36 fad 144 0,1206023 0,0460767 19,64767 70,426239 3,5844576 18,131014 7,5694931 37 mas 178 0,1708677 0,2129302 41,542167 489,44052 11,781776 35,747795 21,162393 38 mas 195 0,1391027 0,2052507 37,462196 328,38405 8,7657449 35,023827 13,29465 39 mas 435,09317 0,076969 0,1612684 123,59754 1342,2776 10,860068 37,384724 117,80804 40 mas 250 0,0471239 0,0139626 70,90704 224,14579 3,1611218 9,1021757 70,3204 41 mas 339,50855 0,0453786 0,0300197 88,629809 331,08039 3,7355422 19,825581 87,62118 42 mas 236 0,1246165 0,2017601 48,45113 236,88011 4,8890524 36,006622 32,41967 43 mas 481,46715 0,0785398 0,016057 79,059162 1154,3382 14,600942 33,929131 71,408439 44 mas 252 0,106116 0,0314159 38,54421 493,79042 12,811014 25,541145 28,86704 45 mas 172,5158 0,1272345 0,0383972 37,543673 192,21815 5,1198546 19,322081 32,189821 46 mas 121 0,1741839 0,0907571 24,43718 144,46651 5,9117505 22,02108 10,594708 47 mas 196,36486 0,1829105 0,1424189 54,88308 843,26253 15,449156 34,149414 42,580865 48 mas 370,39572 0,1047198 0 115,92325 1308,1204 11,284366 31,367031 112,7151 49 mas 260,27752 0,0790634 0,0328122 58,817611 277,25903 4,7138778 17,86867 56,037684 50 mas 544,65435 0,0637045 0,0020944 100,78808 1189,2902 11,79991 29,412222 96,58015 51 mas 310 0,1747075 0,1654572 98,509961 2741,032 27,824923 49,327862 85,27001 52 mas 274,9934 0,1471313 0,1375319 66,45794 1217,4157 18,318588 40,849678 52,421008		355	0,0640536	0,0844739	89,558463	1033,8542	11,543903	27,562662	86,576561
33 fad		272	0,0914553	0,0048869	63,78938	718,94631	11,270627	20,085556	60,690729
34 fad301,30440,10978120,035604764,6162942,7731914,59035329,04567757,7200335 fad1550,17278760,118682438,940168415,111610,66024225,83650229,13437636 fad1440,12060230,046076719,6476770,4262393,584457618,1310147,569493137 mas1780,17086770,212930241,542167489,4405211,78177635,74779521,16239338 mas1950,13910270,205250737,462196328,384058,765744935,02382713,2946539 mas435,093170,0769690,1612684123,597541342,277610,86006837,384724117,8080440 mas2500,04712390,013962670,90704224,145793,16112189,102175770,320441 mas339,508550,04537860,030019788,629809331,080393,735542219,82558187,6211842 mas2360,12461650,201760148,45113236,880114,889052436,00662232,4196743 mas481,467150,07853980,01605779,0591621154,338214,60094233,92913171,40843945 mas172,51580,12723450,038397237,543673192,218155,119854619,32208132,18982146 mas1210,17418390,090757124,43718144,466515,911750522,0210810,59470848 mas370,395720,10471980115,92325 <td></td> <td>341,62001</td> <td>0,0919789</td> <td>0,074002</td> <td>85,043029</td> <td>1370,8381</td> <td>16,119347</td> <td>29,028969</td> <td>79,935197</td>		341,62001	0,0919789	0,074002	85,043029	1370,8381	16,119347	29,028969	79,935197
35 fad 155 0,1727876 0,1186824 38,940168 415,1116 10,660242 25,836502 29,134376 36 fad 144 0,1206023 0,0460767 19,64767 70,426239 3,5844576 18,131014 7,5694931 37 mas 178 0,1708677 0,2129302 41,542167 489,44052 11,781776 35,747795 21,162393 38 mas 195 0,1391027 0,2052507 37,462196 328,38405 8,7657449 35,023827 13,29465 39 mas 435,09317 0,076969 0,1612684 123,59754 1342,2776 10,860068 37,384724 117,80804 40 mas 250 0,0471239 0,0139626 70,90704 224,14579 3,1611218 9,1021757 70,3204 41 mas 339,50855 0,0453786 0,0300197 88,629809 331,08039 3,7355422 19,825581 87,62118 42 mas 236 0,1246165 0,2017601 48,45113 236,88011 4,8890524 36,006622 32,41967 <	33 fad	160,32245	0,1769764	0,1633628	37,217124	341,88146	9,1861333	30,889164	20,75991
36 fad1440,12060230,046076719,6476770,4262393,584457618,1310147,569493137 mas1780,17086770,212930241,542167489,4405211,78177635,74779521,16239338 mas1950,13910270,205250737,462196328,384058,765744935,02382713,2946539 mas435,093170,0769690,1612684123,597541342,277610,86006837,384724117,8080440 mas2500,04712390,013962670,90704224,145793,16112189,102175770,320441 mas339,508550,04537860,030019788,629809331,080393,735542219,82558187,6211842 mas2360,12461650,201760148,45113236,880114,889052436,00662232,4196743 mas481,467150,07853980,01605779,0591621154,338214,60094233,92913171,40843944 mas2520,1061160,031415938,54421493,7904212,81101425,54114528,8670445 mas172,51580,12723450,038397237,543673192,218155,119854619,32208132,18982146 mas1210,17418390,090757124,43718144,466515,911750522,0210810,59470847 mas196,364860,18291050,142418954,58308843,2625315,44915634,14941442,58086548 mas370,395720,007906340,032812258,	34 fad	301,3044	0,1097812	0,0356047	64,6162	942,77319	14,590353	29,045677	57,72003
37 mas1780,17086770,212930241,542167489,4405211,78177635,74779521,16239338 mas1950,13910270,205250737,462196328,384058,765744935,02382713,2946539 mas435,093170,0769690,1612684123,597541342,277610,86006837,384724117,8080440 mas2500,04712390,013962670,90704224,145793,16112189,102175770,320441 mas339,508550,04537860,030019788,629809331,080393,735542219,82558187,6211842 mas2360,12461650,201760148,45113236,880114,889052436,00662232,4196743 mas481,467150,07853980,01605779,0591621154,338214,60094233,92913171,40843944 mas2520,1061160,031415938,54421493,7904212,81101425,54114528,8670445 mas172,51580,12723450,038397237,543673192,218155,119854619,32208132,18982146 mas1210,17418390,090757124,43718144,466515,911750522,0210810,59470847 mas196,364860,18291050,142418954,58308843,2625315,44915634,14941442,58086548 mas370,395720,009796340,032812258,817611277,259034,713877817,8686756,03768450 mas544,654350,06370450,0020944<		155	0,1727876	0,1186824	38,940168	415,1116	10,660242	25,836502	29,134376
38 mas1950,13910270,205250737,462196328,384058,765744935,02382713,2946539 mas435,093170,0769690,1612684123,597541342,277610,86006837,384724117,8080440 mas2500,04712390,013962670,90704224,145793,16112189,102175770,320441 mas339,508550,04537860,030019788,629809331,080393,735542219,82558187,6211842 mas2360,12461650,201760148,45113236,880114,889052436,00662232,4196743 mas481,467150,07853980,01605779,0591621154,338214,60094233,92913171,40843944 mas2520,1061160,031415938,54421493,7904212,81101425,54114528,8670445 mas172,51580,12723450,038397237,543673192,218155,119854619,32208132,18982146 mas1210,17418390,090757124,43718144,466515,911750522,0210810,59470847 mas196,364860,18291050,142418954,58308843,2625315,44915634,14941442,58086548 mas370,395720,10471980115,923251308,120411,28436631,367031112,715149 mas260,277520,07906340,032812258,817611277,259034,713877817,8686756,03768450 mas544,654350,06370450,00209441		144	0,1206023	0,0460767	19,64767	70,426239	3,5844576	18,131014	7,5694931
39 mas435,093170,0769690,1612684123,597541342,277610,86006837,384724117,8080440 mas2500,04712390,013962670,90704224,145793,16112189,102175770,320441 mas339,508550,04537860,030019788,629809331,080393,735542219,82558187,6211842 mas2360,12461650,201760148,45113236,880114,889052436,00662232,4196743 mas481,467150,07853980,01605779,0591621154,338214,60094233,92913171,40843944 mas2520,1061160,031415938,54421493,7904212,81101425,54114528,8670445 mas172,51580,12723450,038397237,543673192,218155,119854619,32208132,18982146 mas1210,17418390,090757124,43718144,466515,911750522,0210810,59470847 mas196,364860,18291050,142418954,58308843,2625315,44915634,14941442,58086548 mas370,395720,10471980115,923251308,120411,28436631,367031112,715149 mas260,277520,07906340,032812258,817611277,259034,713877817,8686756,03768450 mas544,654350,06370450,0020944100,788081189,290211,7999129,41222296,5801551 mas3100,17470750,165457298		178	0,1708677	0,2129302	41,542167	489,44052	11,781776	35,747795	21,162393
40 mas2500,04712390,013962670,90704224,145793,16112189,102175770,320441 mas339,508550,04537860,030019788,629809331,080393,735542219,82558187,6211842 mas2360,12461650,201760148,45113236,880114,889052436,00662232,4196743 mas481,467150,07853980,01605779,0591621154,338214,60094233,92913171,40843944 mas2520,1061160,031415938,54421493,7904212,81101425,54114528,8670445 mas172,51580,12723450,038397237,543673192,218155,119854619,32208132,18982146 mas1210,17418390,090757124,43718144,466515,911750522,0210810,59470847 mas196,364860,18291050,142418954,58308843,2625315,44915634,14941442,58086548 mas370,395720,10471980115,923251308,120411,28436631,367031112,715149 mas260,277520,07906340,032812258,817611277,259034,713877817,8686756,03768450 mas544,654350,06370450,0020944100,788081189,290211,7999129,41222296,5801551 mas3100,17470750,165457298,5099612741,03227,82492349,32786285,2700152 mas274,99340,14713130,137531966,4									
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43 mas 481,46715 0,0785398 0,016057 79,059162 1154,3382 14,600942 33,929131 71,408439 44 mas 252 0,106116 0,0314159 38,54421 493,79042 12,811014 25,541145 28,86704 45 mas 121 0,1741839 0,0907571 24,43718 144,46651 5,9117505 22,02108 10,594708 47 mas 196,36486 0,1829105 0,1424189 54,58308 843,26253 15,449156 34,149414 42,580865 48 mas 370,39572 0,1047198 0 115,92325 1308,1204 11,284366 31,367031 112,7151 49 mas 260,27752 0,0790634 0,0328122 58,817611 277,25903 4,7138778 17,86867 56,037684 50 mas 310 0,1747075 0,1654572 98,509961 2741,032 27,824923 49,327862 85,27001 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008	41 mas								
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45 mas 172,5158 0,1272345 0,0383972 37,543673 192,21815 5,1198546 19,322081 32,189821 46 mas 121 0,1741839 0,0907571 24,43718 144,46651 5,9117505 22,02108 10,594708 47 mas 196,36486 0,1829105 0,1424189 54,58308 843,26253 15,449156 34,149414 42,580865 48 mas 370,39572 0,1047198 0 115,92325 1308,1204 11,284366 31,367031 112,7151 49 mas 260,27752 0,0790634 0,0328122 58,817611 277,25903 4,7138778 17,86867 56,037684 50 mas 544,65435 0,0637045 0,0020944 100,78808 1189,2902 11,79991 29,412222 96,58015 51 mas 310 0,1747075 0,1654572 98,509961 2741,032 27,824923 49,327862 85,27001 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008	43 mas	481,46715	0,0785398	0,016057	79,059162	1154,3382	14,600942	33,929131	71,408439
46 mas 121 0,1741839 0,0907571 24,43718 144,46651 5,9117505 22,02108 10,594708 47 mas 196,36486 0,1829105 0,1424189 54,58308 843,26253 15,449156 34,149414 42,580865 48 mas 370,39572 0,1047198 0 115,92325 1308,1204 11,284366 31,367031 112,7151 49 mas 260,27752 0,0790634 0,0328122 58,817611 277,25903 4,7138778 17,86867 56,037684 50 mas 544,65435 0,0637045 0,0020944 100,78808 1189,2902 11,79991 29,412222 96,58015 51 mas 310 0,1747075 0,1654572 98,509961 2741,032 27,824923 49,327862 85,27001 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008		252	0,106116	0,0314159	38,54421	493,79042	12,811014	25,541145	28,86704
47 mas 196,36486 0,1829105 0,1424189 54,58308 843,26253 15,449156 34,149414 42,580865 48 mas 370,39572 0,1047198 0 115,92325 1308,1204 11,284366 31,367031 112,7151 49 mas 260,27752 0,0790634 0,0328122 58,817611 277,25903 4,7138778 17,86867 56,037684 50 mas 544,65435 0,0637045 0,0020944 100,78808 1189,2902 11,79991 29,412222 96,58015 51 mas 310 0,1747075 0,1654572 98,509961 2741,032 27,824923 49,327862 85,27001 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008		172,5158	0,1272345	0,0383972	37,543673	192,21815	5,1198546	19,322081	32,189821
48 mas 370,39572 0,1047198 0 115,92325 1308,1204 11,284366 31,367031 112,7151 49 mas 260,27752 0,0790634 0,0328122 58,817611 277,25903 4,7138778 17,86867 56,037684 50 mas 544,65435 0,0637045 0,0020944 100,78808 1189,2902 11,79991 29,412222 96,58015 51 mas 310 0,1747075 0,1654572 98,509961 2741,032 27,824923 49,327862 85,27001 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008		121	0,1741839	0,0907571	24,43718	144,46651	5,9117505	22,02108	10,594708
49 mas 260,27752 0,0790634 0,0328122 58,817611 277,25903 4,7138778 17,86867 56,037684 50 mas 544,65435 0,0637045 0,0020944 100,78808 1189,2902 11,79991 29,412222 96,58015 51 mas 310 0,1747075 0,1654572 98,509961 2741,032 27,824923 49,327862 85,27001 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008									
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51 mas 310 0,1747075 0,1654572 98,509961 2741,032 27,824923 49,327862 85,27001 52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008									
52 mas 274,9934 0,1471313 0,1375319 66,457943 1217,4157 18,318588 40,849678 52,421008									
53 mas 281,32326 0,2323033 0,4377286 157,88418 5305,1232 33,60136 46,384335 150,91689									
	53 mas	281,32326	0,2323033	0,4377286	157,88418	5305,1232	33,60136	46,384335	150,91689

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 58 gla
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