CS777 – Assignment 3

Gaurav Tungare

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**Task 1**

Graphical user interface, text, application, email

Description automatically generated

Graphical user interface, application, table

Description automatically generated

Graphical user interface

Description automatically generated

**Output**

PySpark Script: /tmp/job-1dcd8404/mod3\_task1.py

21/09/20 17:30:18 INFO org.sparkproject.jetty.util.log: Logging initialized @3267ms to org.sparkproject.jetty.util.log.Slf4jLog

21/09/20 17:30:18 INFO org.sparkproject.jetty.server.Server: jetty-9.4.40.v20210413; built: 2021-04-13T20:42:42.668Z; git: b881a572662e1943a14ae12e7e1207989f218b74; jvm 1.8.0\_292-b10

21/09/20 17:30:18 INFO org.sparkproject.jetty.server.Server: Started @3377ms

21/09/20 17:30:18 INFO org.sparkproject.jetty.server.AbstractConnector: Started ServerConnector@71ec6db4{HTTP/1.1, (http/1.1)}{0.0.0.0:44889}

21/09/20 17:30:18 INFO org.apache.hadoop.yarn.client.RMProxy: Connecting to ResourceManager at cluster-a480-m/10.128.15.208:8032

21/09/20 17:30:19 INFO org.apache.hadoop.yarn.client.AHSProxy: Connecting to Application History server at cluster-a480-m/10.128.15.208:10200

21/09/20 17:30:20 INFO org.apache.hadoop.conf.Configuration: resource-types.xml not found

21/09/20 17:30:20 INFO org.apache.hadoop.yarn.util.resource.ResourceUtils: Unable to find 'resource-types.xml'.

21/09/20 17:30:20 INFO org.apache.hadoop.yarn.client.api.impl.YarnClientImpl: Submitted application application\_1632158578489\_0002

21/09/20 17:30:21 INFO org.apache.hadoop.yarn.client.RMProxy: Connecting to ResourceManager at cluster-a480-m/10.128.15.208:8030

21/09/20 17:30:23 INFO com.google.cloud.hadoop.repackaged.gcs.com.google.cloud.hadoop.gcsio.GoogleCloudStorageImpl: Ignoring exception of type GoogleJsonResponseException; verified object already exists with desired state.

173177174

n\_sum\_xi\_yi= 29176477443.864437

sum\_xi= 1432466913.1399615

sum\_yi= 2138594357.1099975

um\_xi\_square= 7609859300451240.0

square\_sum\_xi= 2.0519614572407299e+18

**m\_slope= 1.5094520785662808e-06**

**b\_hat= 12.34915748694362**

21/09/20 18:15:12 INFO org.sparkproject.jetty.server.AbstractConnector: Stopped Spark@71ec6db4{HTTP/1.1, (http/1.1)}{0.0.0.0:0}

End

**Task 2**

Graphical user interface, text, application, Word, email

Description automatically generated

Graphical user interface, application, table

Description automatically generated

A picture containing table

Description automatically generated

**Output**

PySpark Script: /tmp/job-e74daf21/mod3\_task2.py

21/09/25 04:09:41 INFO org.sparkproject.jetty.util.log: Logging initialized @7855ms to org.sparkproject.jetty.util.log.Slf4jLog

21/09/25 04:09:41 INFO org.sparkproject.jetty.server.Server: jetty-9.4.40.v20210413; built: 2021-04-13T20:42:42.668Z; git: b881a572662e1943a14ae12e7e1207989f218b74; jvm 1.8.0\_292-b10

21/09/25 04:09:41 INFO org.sparkproject.jetty.server.Server: Started @7988ms

21/09/25 04:09:41 INFO org.sparkproject.jetty.server.AbstractConnector: Started ServerConnector@6659a72f{HTTP/1.1, (http/1.1)}{0.0.0.0:44995}

21/09/25 04:09:42 INFO org.apache.hadoop.yarn.client.RMProxy: Connecting to ResourceManager at cluster-bd80-m/10.128.0.54:8032

21/09/25 04:09:43 INFO org.apache.hadoop.yarn.client.AHSProxy: Connecting to Application History server at cluster-bd80-m/10.128.0.54:10200

21/09/25 04:09:44 INFO org.apache.hadoop.conf.Configuration: resource-types.xml not found

21/09/25 04:09:44 INFO org.apache.hadoop.yarn.util.resource.ResourceUtils: Unable to find 'resource-types.xml'.

21/09/25 04:09:45 INFO org.apache.hadoop.yarn.client.api.impl.YarnClientImpl: Submitted application application\_1632542893530\_0001

21/09/25 04:09:46 INFO org.apache.hadoop.yarn.client.RMProxy: Connecting to ResourceManager at cluster-bd80-m/10.128.0.54:8030

21/09/25 04:09:48 INFO com.google.cloud.hadoop.repackaged.gcs.com.google.cloud.hadoop.gcsio.GoogleCloudStorageImpl: Ignoring exception of type GoogleJsonResponseException; verified object already exists with desired state.

count 173177174

0 m\_gradient= 4394093.840371652 Cost= 76136817221539.75 m\_current 0.09560590615962836

1 m\_gradient= 4201005.830519904 Cost= 69596318079340.805 m\_current 0.09140490032910845

2 m\_gradient= 4016402.6143451785 Cost= 63618002911920.75 m\_current 0.08738849771476327

3 m\_gradient= 3839911.3477252265 Cost= 58153549593328.086 m\_current 0.08354858636703805

4 m\_gradient= 3671175.5703082234 Cost= 53158789492106.82 m\_current 0.07987741079672982

5 m\_gradient= 3509854.4856057633 Cost= 48593350460230.19 m\_current 0.07636755631112405

6 m\_gradient= 3355622.272548666 Cost= 44420330509062.055 m\_current 0.07301193403857538

7 m\_gradient= 3208167.427487604 Cost= 40605999534293.016 m\_current 0.06980376661108778

8 m\_gradient= 3067192.1351025086 Cost= 37119526678700.15 m\_current 0.06673657447598527

9 m\_gradient= 2932411.666901799 Cost= 33932731129775.637 m\_current 0.06380416280908348

10 m\_gradient= 2803553.8060159045 Cost= 31019854336738.19 m\_current 0.06100060900306757

11 m\_gradient= 2680358.297552442 Cost= 28357351806801.844 m\_current 0.05832025070551513

12 m\_gradient= 2562576.3228887673 Cost= 25923702797389.566 m\_current 0.05575767438262636

13 m\_gradient= 2449969.997169765 Cost= 23699236366157.83 m\_current 0.053307704385456595

14 m\_gradient= 2342311.8887808057 Cost= 21665972372574.56 m\_current 0.05096539249667579

15 m\_gradient= 2239384.560090009 Cost= 19807476146486.492 m\_current 0.04872600793658578

16 m\_gradient= 2140980.1282018283 Cost= 18108725648088.51 m\_current 0.04658502780838396

17 m\_gradient= 2046899.8451947311 Cost= 16555990046434.492 m\_current 0.04453812796318923

18 m\_gradient= 1956953.6966144142 Cost= 15136718734480.305 m\_current 0.04258117426657481

19 m\_gradient= 1870960.0177328954 Cost= 13839439883601.38 m\_current 0.040710214248841914

20 m\_gradient= 1788745.1266943829 Cost= 12653667718210.475 m\_current 0.03892146912214753

21 m\_gradient= 1710142.9736287075 Cost= 11569817760006.875 m\_current 0.03721132614851882

22 m\_gradient= 1634994.8053555174 Cost= 10579129357818.78 m\_current 0.0355763313431633

23 m\_gradient= 1563148.844721094 Cost= 9673594876117.348 m\_current 0.03401318249844221

24 m\_gradient= 1494459.9840606453 Cost= 8845894969847.873 m\_current 0.032518722514381565

25 m\_gradient= 1428789.4921201416 Cost= 8089339423190.349 m\_current 0.031089933022261422

26 m\_gradient= 1366004.7338739308 Cost= 7397813073112.353 m\_current 0.02972392828838749

27 m\_gradient= 1305978.9025874354 Cost= 6765726380989.637 m\_current 0.028417949385800056

28 m\_gradient= 1248590.7637850554 Cost= 6187970253099.092 m\_current 0.027169358622015

29 m\_gradient= 1193724.410354603 Cost= 5659874744277.414 m\_current 0.025975634211660395

30 m\_gradient= 1141269.0284117048 Cost= 5177171311140.636 m\_current 0.02483436518324869

31 m\_gradient= 1091118.6735378713 Cost= 4735958309955.485 m\_current 0.02374324650971082

32 m\_gradient= 1043172.0568279321 Cost= 4332669460016.619 m\_current 0.022700074452882888

33 m\_gradient= 997332.3402218454 Cost= 3964045017730.399 m\_current 0.021702742112661044

34 m\_gradient= 953506.941013329 Cost= 3627105428484.2197 m\_current 0.020749235171647715

35 m\_gradient= 911607.3448001563 Cost= 3319127243158.4263 m\_current 0.01983762782684756

36 m\_gradient= 871548.9267614969 Cost= 3037621104756.7456 m\_current 0.018966078900086062

37 m\_gradient= 833250.7806914288 Cost= 2780311627256.2104 m\_current 0.018132828119394633

38 m\_gradient= 796635.5556236167 Cost= 2545119003771.875 m\_current 0.017336192563771016

39 m\_gradient= 761629.2995895093 Cost= 2330142195769.594 m\_current 0.016574563264181507

40 m\_gradient= 728161.3102722438 Cost= 2133643567150.85 m\_current 0.015846401953909264

41 m\_gradient= 696163.9921992979 Cost= 1954034839082.538 m\_current 0.015150237961709966

42 m\_gradient= 665572.7202237301 Cost= 1789864252111.2568 m\_current 0.014484665241486235

43 m\_gradient= 636325.7089780447 Cost= 1639804831744.1064 m\_current 0.01384833953250819

44 m\_gradient= 608363.888127216 Cost= 1502643662654.5159 m\_current 0.013239975644380973

45 m\_gradient= 581630.7830360847 Cost= 1377272084767.1162 m\_current 0.012658344861344888

46 m\_gradient= 556072.4007060723 Cost= 1262676732123.6985 m\_current 0.012102272460638816

47 m\_gradient= 531637.1207432686 Cost= 1157931341912.8982 m\_current 0.011570635339895547

48 m\_gradient= 508275.5910781629 Cost= 1062189267579.998 m\_current 0.011062359748817384

49 m\_gradient= 485940.628308494 Cost= 974676635482.1533 m\_current 0.01057641912050889

50 m\_gradient= 464587.1223889065 Cost= 894686089736.1693 m\_current 0.010111831998119982

51 m\_gradient= 444171.9455358011 Cost= 821571074736.3699 m\_current 0.009667660052584182

52 m\_gradient= 424653.86510731967 Cost= 754740609101.027 m\_current 0.009243006187476862

53 m\_gradient= 405993.4603310271 Cost= 693654508840.0833 m\_current 0.008837012727145835

54 m\_gradient= 388153.04268942383 Cost= 637819021092.1483 m\_current 0.008448859684456411

55 m\_gradient= 371096.57979789225 Cost= 586782833172.4224 m\_current 0.00807776310465852

56 m\_gradient= 354789.6226278287 Cost= 540133424665.66156 m\_current 0.007722973482030691

57 m\_gradient= 339199.2359347288 Cost= 497493733049.247 m\_current 0.007383774246095962

58 m\_gradient= 324293.93172640796 Cost= 458519105946.4562 m\_current 0.007059480314369555

59 m\_gradient= 310043.60568431043 Cost= 422894515331.51733 m\_current 0.006749436708685244

60 m\_gradient= 296419.47635183076 Cost= 390332011188.2166 m\_current 0.006453017232333414

61 m\_gradient= 283394.02699824964 Cost= 360568394041.952 m\_current 0.006169623205335165

62 m\_gradient= 270940.95005649066 Cost= 333363087541.3445 m\_current 0.005898682255278674

63 m\_gradient= 259035.09398528145 Cost= 308496193906.8847 m\_current 0.005639647161293392

64 m\_gradient= 247652.41246026257 Cost= 285766716513.6654 m\_current 0.00539199474883313

65 m\_gradient= 236769.9158205228 Cost= 264990935262.33884 m\_current 0.005155224833012607

66 m\_gradient= 226365.62462847345 Cost= 246000921584.8204 m\_current 0.004928859208384134

67 m\_gradient= 216418.52528408982 Cost= 228643181092.2065 m\_current 0.004712440683100044

68 m\_gradient= 206908.52757911393 Cost= 212777412897.77527 m\_current 0.00450553215552093

69 m\_gradient= 197816.42411926796 Cost= 198275375579.60986 m\_current 0.004307715731401662

70 m\_gradient= 189123.85153517924 Cost= 185019850614.78943 m\_current 0.004118591879866482

71 m\_gradient= 180813.25339217894 Cost= 172903694916.40158 m\_current 0.003937778626474303

72 m\_gradient= 172867.84473267698 Cost= 161828974805.9738 m\_current 0.003764910781741626

73 m\_gradient= 165271.57817218004 Cost= 151706174423.7685 m\_current 0.003599639203569446

74 m\_gradient= 158009.11148910373 Cost= 142453472183.9318 m\_current 0.0034416300920803423

75 m\_gradient= 151065.7766446345 Cost= 133996079416.26945 m\_current 0.0032905643154357077

76 m\_gradient= 144427.5501467674 Cost= 126265635858.07594 m\_current 0.00314613676528894

77 m\_gradient= 138081.0247329753 Cost= 119199657104.60934 m\_current 0.003008055740555965

78 m\_gradient= 132013.38229546766 Cost= 112741029553.88123 m\_current 0.0028760423582604973

79 m\_gradient= 126212.36798281978 Cost= 106837548762.82515 m\_current 0.0027498299902776776

80 m\_gradient= 120666.26545605564 Cost= 101441497484.79701 m\_current 0.002629163724821622

81 m\_gradient= 115363.87322178093 Cost= 96509259975.44807 m\_current 0.002513799851599841

82 m\_gradient= 110294.48201235395 Cost= 92000969450.1979 m\_current 0.002403505369587487

83 m\_gradient= 105447.85315079977 Cost= 87880185846.1232 m\_current 0.0022980575164366873

84 m\_gradient= 100814.19787455566 Cost= 84113601280.32736 m\_current 0.0021972433185621317

85 m\_gradient= 96384.15756519014 Cost= 80670770824.71686 m\_current 0.0021008591609969415

86 m\_gradient= 92148.7848496753 Cost= 77523866424.59709 m\_current 0.002008710376147266

87 m\_gradient= 88099.52552038991 Cost= 74647451964.64346 m\_current 0.0019206108506268761

88 m\_gradient= 84228.20126826697 Cost= 72018277673.80432 m\_current 0.001836382649358609

89 m\_gradient= 80526.99315906914 Cost= 69615092198.2624 m\_current 0.00175585565619954

90 m\_gradient= 76988.42584262836 Cost= 67418470829.29061 m\_current 0.0016788672303569116

91 m\_gradient= 73605.35245687694 Cost= 65410658495.497406 m\_current 0.0016052618779000348

92 m\_gradient= 70370.94018964662 Cost= 63575426249.721794 m\_current 0.0015348909377103882

93 m\_gradient= 67278.6564817654 Cost= 61897940092.73332 m\_current 0.0014676122812286227

94 m\_gradient= 64322.255832163326 Cost= 60364641071.0964 m\_current 0.0014032900253964594

95 m\_gradient= 61495.76718209926 Cost= 58963135681.48092 m\_current 0.0013417942582143602

96 m\_gradient= 58793.481857239174 Cost= 57682095695.84679 m\_current 0.001283000776357121

**97 m\_gradient= 56209.94203884322 Cost= 56511166595.5358 m\_current 0.0012267908343182778**

**98 m\_gradient= 53739.92973668564 Cost= 55440883877.19797 m\_current 0.0011730509045815923**

**99 m\_gradient= 51378.45625476015 Cost= 54462596552.41181 m\_current 0.001121672448326832**

**21/09/25 05:25:39 INFO org.sparkproject.jetty.server.AbstractConnector: Stopped Spark@6659a72f{HTTP/1.1, (http/1.1)}{0.0.0.0:0}**

**end**

Please see the plot below

Graphical user interface

Description automatically generated

**Task 3**

Graphical user interface, text, application, email

Description automatically generated

Graphical user interface, application, table

Description automatically generated

Graphical user interface, application, table

Description automatically generated

**PySpark Script: /tmp/job-b3388391/mod3\_task3df.py**

**21/09/26 18:43:27 INFO org.sparkproject.jetty.util.log: Logging initialized @7591ms to org.sparkproject.jetty.util.log.Slf4jLog**

**21/09/26 18:43:27 INFO org.sparkproject.jetty.server.Server: jetty-9.4.40.v20210413; built: 2021-04-13T20:42:42.668Z; git: b881a572662e1943a14ae12e7e1207989f218b74; jvm 1.8.0\_292-b10**

**21/09/26 18:43:27 INFO org.sparkproject.jetty.server.Server: Started @7722ms**

**21/09/26 18:43:27 INFO org.sparkproject.jetty.server.AbstractConnector: Started ServerConnector@31f4094b{HTTP/1.1, (http/1.1)}{0.0.0.0:35937}**

**21/09/26 18:43:28 INFO org.apache.hadoop.yarn.client.RMProxy: Connecting to ResourceManager at cluster-0bae-m/10.128.15.210:8032**

**21/09/26 18:43:28 INFO org.apache.hadoop.yarn.client.AHSProxy: Connecting to Application History server at cluster-0bae-m/10.128.15.210:10200**

**21/09/26 18:43:29 INFO org.apache.hadoop.conf.Configuration: resource-types.xml not found**

**21/09/26 18:43:29 INFO org.apache.hadoop.yarn.util.resource.ResourceUtils: Unable to find 'resource-types.xml'.**

**21/09/26 18:43:31 INFO org.apache.hadoop.yarn.client.api.impl.YarnClientImpl: Submitted application application\_1632681716433\_0001**

**21/09/26 18:43:32 INFO org.apache.hadoop.yarn.client.RMProxy: Connecting to ResourceManager at cluster-0bae-m/10.128.15.210:8030**

**21/09/26 18:43:34 INFO com.google.cloud.hadoop.repackaged.gcs.com.google.cloud.hadoop.gcsio.GoogleCloudStorageImpl: Ignoring exception of type GoogleJsonResponseException; verified object already exists with desired state.**

**count 8647397**

**[0. 0. 0. 0. 0.]**

**21/09/26 19:07:18 WARN org.apache.spark.sql.execution.CacheManager: Asked to cache already cached data.**

**0 m\_gradient= -1545.8653371795683 Cost= 885714366126.2058 m\_current [1.54586534e-08 1.54586534e-08 1.54586534e-08 1.54586534e-08**

**1.54586534e-08]**

**1 m\_gradient= -1545.8652204676014 Cost= 885714349717.8616 m\_current [3.09173056e-08 3.09173056e-08 3.09173056e-08 3.09173056e-08**

**3.09173056e-08]**

**2 m\_gradient= -1545.8651037556444 Cost= 885714333314.3779 m\_current [4.63759566e-08 4.63759566e-08 4.63759566e-08 4.63759566e-08**

**4.63759566e-08]**

**3 m\_gradient= -1545.864987043695 Cost= 885714316915.7568 m\_current [6.18346065e-08 6.18346065e-08 6.18346065e-08 6.18346065e-08**

**6.18346065e-08]**

**4 m\_gradient= -1545.8648703317551 Cost= 885714300521.9984 m\_current [7.72932552e-08 7.72932552e-08 7.72932552e-08 7.72932552e-08**

**7.72932552e-08]**

**5 m\_gradient= -1545.8647536198232 Cost= 885714284133.1016 m\_current [9.27519027e-08 9.27519027e-08 9.27519027e-08 9.27519027e-08**

**9.27519027e-08]**

**6 m\_gradient= -1545.8646369079015 Cost= 885714267749.0635 m\_current [1.08210549e-07 1.08210549e-07 1.08210549e-07 1.08210549e-07**

**1.08210549e-07]**

**7 m\_gradient= -1545.864520195989 Cost= 885714251369.8895 m\_current [1.23669194e-07 1.23669194e-07 1.23669194e-07 1.23669194e-07**

**1.23669194e-07]**

**8 m\_gradient= -1545.8644034840804 Cost= 885714234995.5762 m\_current [1.39127838e-07 1.39127838e-07 1.39127838e-07 1.39127838e-07**

**1.39127838e-07]**

**9 m\_gradient= -1545.8642867721867 Cost= 885714218626.1248 m\_current [1.54586481e-07 1.54586481e-07 1.54586481e-07 1.54586481e-07**

**1.54586481e-07]**

**10 m\_gradient= -1545.8641700602986 Cost= 885714202261.5369 m\_current [1.70045123e-07 1.70045123e-07 1.70045123e-07 1.70045123e-07**

**1.70045123e-07]**

**11 m\_gradient= -1545.8640533484197 Cost= 885714185901.8097 m\_current [1.85503763e-07 1.85503763e-07 1.85503763e-07 1.85503763e-07**

**1.85503763e-07]**

**12 m\_gradient= -1545.86393663655 Cost= 885714169546.9438 m\_current [2.00962403e-07 2.00962403e-07 2.00962403e-07 2.00962403e-07**

**2.00962403e-07]**

**13 m\_gradient= -1545.863819924691 Cost= 885714153196.9376 m\_current [2.16421041e-07 2.16421041e-07 2.16421041e-07 2.16421041e-07**

**2.16421041e-07]**

**14 m\_gradient= -1545.8637032128381 Cost= 885714136851.7964 m\_current [2.31879678e-07 2.31879678e-07 2.31879678e-07 2.31879678e-07**

**2.31879678e-07]**

**15 m\_gradient= -1545.8635865009949 Cost= 885714120511.5137 m\_current [2.47338314e-07 2.47338314e-07 2.47338314e-07 2.47338314e-07**

**2.47338314e-07]**

**16 m\_gradient= -1545.8634697891607 Cost= 885714104176.0945 m\_current [2.62796949e-07 2.62796949e-07 2.62796949e-07 2.62796949e-07**

**2.62796949e-07]**

**17 m\_gradient= -1545.8633530773357 Cost= 885714087845.538 m\_current [2.78255582e-07 2.78255582e-07 2.78255582e-07 2.78255582e-07**

**2.78255582e-07]**

**18 m\_gradient= -1545.86323636552 Cost= 885714071519.8408 m\_current [2.93714214e-07 2.93714214e-07 2.93714214e-07 2.93714214e-07**

**2.93714214e-07]**

**19 m\_gradient= -1545.8631196537092 Cost= 885714055199.0061 m\_current [3.09172846e-07 3.09172846e-07 3.09172846e-07 3.09172846e-07**

**3.09172846e-07]**

**20 m\_gradient= -1545.863002941912 Cost= 885714038883.034 m\_current [3.24631476e-07 3.24631476e-07 3.24631476e-07 3.24631476e-07**

**3.24631476e-07]**

**21 m\_gradient= -1545.8628862301211 Cost= 885714022571.9226 m\_current [3.40090105e-07 3.40090105e-07 3.40090105e-07 3.40090105e-07**

**3.40090105e-07]**

**22 m\_gradient= -1545.8627695183393 Cost= 885714006265.6735 m\_current [3.55548732e-07 3.55548732e-07 3.55548732e-07 3.55548732e-07**

**3.55548732e-07]**

**23 m\_gradient= -1545.8626528065658 Cost= 885713989964.2858 m\_current [3.71007359e-07 3.71007359e-07 3.71007359e-07 3.71007359e-07**

**3.71007359e-07]**

**24 m\_gradient= -1545.862536094803 Cost= 885713973667.7603 m\_current [3.86465984e-07 3.86465984e-07 3.86465984e-07 3.86465984e-07**

**3.86465984e-07]**

**25 m\_gradient= -1545.8624193830476 Cost= 885713957376.0948 m\_current [4.01924608e-07 4.01924608e-07 4.01924608e-07 4.01924608e-07**

**4.01924608e-07]**

**26 m\_gradient= -1545.8623026713005 Cost= 885713941089.2927 m\_current [4.17383231e-07 4.17383231e-07 4.17383231e-07 4.17383231e-07**

**4.17383231e-07]**

**27 m\_gradient= -1545.862185959564 Cost= 885713924807.3505 m\_current [4.32841853e-07 4.32841853e-07 4.32841853e-07 4.32841853e-07**

**4.32841853e-07]**

**28 m\_gradient= -1545.8620692478346 Cost= 885713908530.2716 m\_current [4.48300474e-07 4.48300474e-07 4.48300474e-07 4.48300474e-07**

**4.48300474e-07]**

**29 m\_gradient= -1545.861952536115 Cost= 885713892258.0533 m\_current [4.63759093e-07 4.63759093e-07 4.63759093e-07 4.63759093e-07**

**4.63759093e-07]**

**30 m\_gradient= -1545.861835824404 Cost= 885713875990.6968 m\_current [4.79217712e-07 4.79217712e-07 4.79217712e-07 4.79217712e-07**

**4.79217712e-07]**

**31 m\_gradient= -1545.861719112703 Cost= 885713859728.2029 m\_current [4.94676329e-07 4.94676329e-07 4.94676329e-07 4.94676329e-07**

**4.94676329e-07]**

**32 m\_gradient= -1545.8616024010087 Cost= 885713843470.5697 m\_current [5.10134945e-07 5.10134945e-07 5.10134945e-07 5.10134945e-07**

**5.10134945e-07]**

**33 m\_gradient= -1545.8614856893257 Cost= 885713827217.799 m\_current [5.2559356e-07 5.2559356e-07 5.2559356e-07 5.2559356e-07 5.2559356e-07]**

**34 m\_gradient= -1545.8613689776491 Cost= 885713810969.8885 m\_current [5.41052174e-07 5.41052174e-07 5.41052174e-07 5.41052174e-07**

**5.41052174e-07]**

**35 m\_gradient= -1545.8612522659812 Cost= 885713794726.8405 m\_current [5.56510786e-07 5.56510786e-07 5.56510786e-07 5.56510786e-07**

**5.56510786e-07]**

**36 m\_gradient= -1545.8611355543237 Cost= 885713778488.6552 m\_current [5.71969397e-07 5.71969397e-07 5.71969397e-07 5.71969397e-07**

**5.71969397e-07]**

**37 m\_gradient= -1545.8610188426735 Cost= 885713762255.3293 m\_current [5.87428008e-07 5.87428008e-07 5.87428008e-07 5.87428008e-07**

**5.87428008e-07]**

**38 m\_gradient= -1545.860902131034 Cost= 885713746026.8656 m\_current [6.02886617e-07 6.02886617e-07 6.02886617e-07 6.02886617e-07**

**6.02886617e-07]**

**39 m\_gradient= -1545.8607854194024 Cost= 885713729803.2645 m\_current [6.18345225e-07 6.18345225e-07 6.18345225e-07 6.18345225e-07**

**6.18345225e-07]**

**40 m\_gradient= -1545.860668707778 Cost= 885713713584.5254 m\_current [6.33803831e-07 6.33803831e-07 6.33803831e-07 6.33803831e-07**

**6.33803831e-07]**

**41 m\_gradient= -1545.8605519961652 Cost= 885713697370.6469 m\_current [6.49262437e-07 6.49262437e-07 6.49262437e-07 6.49262437e-07**

**6.49262437e-07]**

**42 m\_gradient= -1545.8604352845596 Cost= 885713681161.6296 m\_current [6.64721041e-07 6.64721041e-07 6.64721041e-07 6.64721041e-07**

**6.64721041e-07]**

**43 m\_gradient= -1545.8603185729628 Cost= 885713664957.475 m\_current [6.80179644e-07 6.80179644e-07 6.80179644e-07 6.80179644e-07**

**6.80179644e-07]**

**44 m\_gradient= -1545.8602018613751 Cost= 885713648758.1812 m\_current [6.95638246e-07 6.95638246e-07 6.95638246e-07 6.95638246e-07**

**6.95638246e-07]**

**45 m\_gradient= -1545.860085149798 Cost= 885713632563.7501 m\_current [7.11096847e-07 7.11096847e-07 7.11096847e-07 7.11096847e-07**

**7.11096847e-07]**

**46 m\_gradient= -1545.8599684382277 Cost= 885713616374.18 m\_current [7.26555447e-07 7.26555447e-07 7.26555447e-07 7.26555447e-07**

**7.26555447e-07]**

**47 m\_gradient= -1545.8598517266655 Cost= 885713600189.4713 m\_current [7.42014045e-07 7.42014045e-07 7.42014045e-07 7.42014045e-07**

**7.42014045e-07]**

**48 m\_gradient= -1545.859735015113 Cost= 885713584009.625 m\_current [7.57472643e-07 7.57472643e-07 7.57472643e-07 7.57472643e-07**

**7.57472643e-07]**

**49 m\_gradient= -1545.8596183035688 Cost= 885713567834.6395 m\_current [7.72931239e-07 7.72931239e-07 7.72931239e-07 7.72931239e-07**

**7.72931239e-07]**

**50 m\_gradient= -1545.8595015920348 Cost= 885713551664.5159 m\_current [7.88389834e-07 7.88389834e-07 7.88389834e-07 7.88389834e-07**

**7.88389834e-07]**

**51 m\_gradient= -1545.8593848805083 Cost= 885713535499.2544 m\_current [8.03848428e-07 8.03848428e-07 8.03848428e-07 8.03848428e-07**

**8.03848428e-07]**

**52 m\_gradient= -1545.8592681689909 Cost= 885713519338.8535 m\_current [8.1930702e-07 8.1930702e-07 8.1930702e-07 8.1930702e-07 8.1930702e-07]**

**53 m\_gradient= -1545.8591514574837 Cost= 885713503183.3158 m\_current [8.34765612e-07 8.34765612e-07 8.34765612e-07 8.34765612e-07**

**8.34765612e-07]**

**54 m\_gradient= -1545.8590347459842 Cost= 885713487032.6384 m\_current [8.50224202e-07 8.50224202e-07 8.50224202e-07 8.50224202e-07**

**8.50224202e-07]**

**55 m\_gradient= -1545.858918034492 Cost= 885713470886.822 m\_current [8.65682791e-07 8.65682791e-07 8.65682791e-07 8.65682791e-07**

**8.65682791e-07]**

**56 m\_gradient= -1545.8588013230105 Cost= 885713454745.8688 m\_current [8.81141379e-07 8.81141379e-07 8.81141379e-07 8.81141379e-07**

**8.81141379e-07]**

**57 m\_gradient= -1545.858684611539 Cost= 885713438609.7767 m\_current [8.96599966e-07 8.96599966e-07 8.96599966e-07 8.96599966e-07**

**8.96599966e-07]**

**58 m\_gradient= -1545.8585679000726 Cost= 885713422478.5464 m\_current [9.12058552e-07 9.12058552e-07 9.12058552e-07 9.12058552e-07**

**9.12058552e-07]**

**59 m\_gradient= -1545.8584511886193 Cost= 885713406352.1774 m\_current [9.27517137e-07 9.27517137e-07 9.27517137e-07 9.27517137e-07**

**9.27517137e-07]**

**60 m\_gradient= -1545.8583344771696 Cost= 885713390230.6682 m\_current [9.4297572e-07 9.4297572e-07 9.4297572e-07 9.4297572e-07 9.4297572e-07]**

**61 m\_gradient= -1545.8582177657336 Cost= 885713374114.0244 m\_current [9.58434302e-07 9.58434302e-07 9.58434302e-07 9.58434302e-07**

**9.58434302e-07]**

**62 m\_gradient= -1545.8581010543046 Cost= 885713358002.2391 m\_current [9.73892883e-07 9.73892883e-07 9.73892883e-07 9.73892883e-07**

**9.73892883e-07]**

**63 m\_gradient= -1545.857984342885 Cost= 885713341895.3163 m\_current [9.89351463e-07 9.89351463e-07 9.89351463e-07 9.89351463e-07**

**9.89351463e-07]**

**64 m\_gradient= -1545.8578676314728 Cost= 885713325793.2565 m\_current [1.00481004e-06 1.00481004e-06 1.00481004e-06 1.00481004e-06**

**1.00481004e-06]**

**65 m\_gradient= -1545.8577509200704 Cost= 885713309696.0559 m\_current [1.02026862e-06 1.02026862e-06 1.02026862e-06 1.02026862e-06**

**1.02026862e-06]**

**66 m\_gradient= -1545.8576342086765 Cost= 885713293603.7194 m\_current [1.0357272e-06 1.0357272e-06 1.0357272e-06 1.0357272e-06 1.0357272e-06]**

**67 m\_gradient= -1545.8575174972912 Cost= 885713277516.2423 m\_current [1.05118577e-06 1.05118577e-06 1.05118577e-06 1.05118577e-06**

**1.05118577e-06]**

**68 m\_gradient= -1545.8574007859145 Cost= 885713261433.6283 m\_current [1.06664434e-06 1.06664434e-06 1.06664434e-06 1.06664434e-06**

**1.06664434e-06]**

**69 m\_gradient= -1545.8572840745476 Cost= 885713245355.8762 m\_current [1.08210292e-06 1.08210292e-06 1.08210292e-06 1.08210292e-06**

**1.08210292e-06]**

**70 m\_gradient= -1545.8571673631895 Cost= 885713229282.984 m\_current [1.09756149e-06 1.09756149e-06 1.09756149e-06 1.09756149e-06**

**1.09756149e-06]**

**71 m\_gradient= -1545.8570506518404 Cost= 885713213214.954 m\_current [1.11302006e-06 1.11302006e-06 1.11302006e-06 1.11302006e-06**

**1.11302006e-06]**

**72 m\_gradient= -1545.8569339405008 Cost= 885713197151.7853 m\_current [1.12847863e-06 1.12847863e-06 1.12847863e-06 1.12847863e-06**

**1.12847863e-06]**

**73 m\_gradient= -1545.8568172291655 Cost= 885713181093.4801 m\_current [1.1439372e-06 1.1439372e-06 1.1439372e-06 1.1439372e-06 1.1439372e-06]**

**74 m\_gradient= -1545.8567005178438 Cost= 885713165040.0349 m\_current [1.15939576e-06 1.15939576e-06 1.15939576e-06 1.15939576e-06**

**1.15939576e-06]**

**75 m\_gradient= -1545.856583806531 Cost= 885713148991.4508 m\_current [1.17485433e-06 1.17485433e-06 1.17485433e-06 1.17485433e-06**

**1.17485433e-06]**

**76 m\_gradient= -1545.8564670952223 Cost= 885713132947.7295 m\_current [1.19031289e-06 1.19031289e-06 1.19031289e-06 1.19031289e-06**

**1.19031289e-06]**

**77 m\_gradient= -1545.8563503839255 Cost= 885713116908.8695 m\_current [1.20577146e-06 1.20577146e-06 1.20577146e-06 1.20577146e-06**

**1.20577146e-06]**

**78 m\_gradient= -1545.8562336726377 Cost= 885713100874.8712 m\_current [1.22123002e-06 1.22123002e-06 1.22123002e-06 1.22123002e-06**

**1.22123002e-06]**

**79 m\_gradient= -1545.8561169613597 Cost= 885713084845.7341 m\_current [1.23668858e-06 1.23668858e-06 1.23668858e-06 1.23668858e-06**

**1.23668858e-06]**

**80 m\_gradient= -1545.8560002500897 Cost= 885713068821.4579 m\_current [1.25214714e-06 1.25214714e-06 1.25214714e-06 1.25214714e-06**

**1.25214714e-06]**

**81 m\_gradient= -1545.855883538827 Cost= 885713052802.0452 m\_current [1.2676057e-06 1.2676057e-06 1.2676057e-06 1.2676057e-06 1.2676057e-06]**

**82 m\_gradient= -1545.8557668275726 Cost= 885713036787.4927 m\_current [1.28306426e-06 1.28306426e-06 1.28306426e-06 1.28306426e-06**

**1.28306426e-06]**

**83 m\_gradient= -1545.85565011633 Cost= 885713020777.8021 m\_current [1.29852281e-06 1.29852281e-06 1.29852281e-06 1.29852281e-06**

**1.29852281e-06]**

**84 m\_gradient= -1545.8555334050943 Cost= 885713004772.9733 m\_current [1.31398137e-06 1.31398137e-06 1.31398137e-06 1.31398137e-06**

**1.31398137e-06]**

**85 m\_gradient= -1545.8554166938693 Cost= 885712988773.0054 m\_current [1.32943992e-06 1.32943992e-06 1.32943992e-06 1.32943992e-06**

**1.32943992e-06]**

**86 m\_gradient= -1545.855299982651 Cost= 885712972777.8986 m\_current [1.34489848e-06 1.34489848e-06 1.34489848e-06 1.34489848e-06**

**1.34489848e-06]**

**87 m\_gradient= -1545.8551832714418 Cost= 885712956787.6552 m\_current [1.36035703e-06 1.36035703e-06 1.36035703e-06 1.36035703e-06**

**1.36035703e-06]**

**88 m\_gradient= -1545.8550665602418 Cost= 885712940802.2727 m\_current [1.37581558e-06 1.37581558e-06 1.37581558e-06 1.37581558e-06**

**1.37581558e-06]**

**89 m\_gradient= -1545.8549498490518 Cost= 885712924821.7517 m\_current [1.39127413e-06 1.39127413e-06 1.39127413e-06 1.39127413e-06**

**1.39127413e-06]**

**90 m\_gradient= -1545.8548331378674 Cost= 885712908846.0913 m\_current [1.40673268e-06 1.40673268e-06 1.40673268e-06 1.40673268e-06**

**1.40673268e-06]**

**91 m\_gradient= -1545.8547164266959 Cost= 885712892875.2941 m\_current [1.42219122e-06 1.42219122e-06 1.42219122e-06 1.42219122e-06**

**1.42219122e-06]**

**92 m\_gradient= -1545.8545997155315 Cost= 885712876909.3585 m\_current [1.43764977e-06 1.43764977e-06 1.43764977e-06 1.43764977e-06**

**1.43764977e-06]**

**93 m\_gradient= -1545.8544830043725 Cost= 885712860948.2834 m\_current [1.45310832e-06 1.45310832e-06 1.45310832e-06 1.45310832e-06**

**1.45310832e-06]**

**94 m\_gradient= -1545.8543662932284 Cost= 885712844992.0691 m\_current [1.46856686e-06 1.46856686e-06 1.46856686e-06 1.46856686e-06**

**1.46856686e-06]**

**95 m\_gradient= -1545.8542495820893 Cost= 885712829040.7183 m\_current [1.4840254e-06 1.4840254e-06 1.4840254e-06 1.4840254e-06 1.4840254e-06]**

**96 m\_gradient= -1545.8541328709605 Cost= 885712813094.228 m\_current [1.49948394e-06 1.49948394e-06 1.49948394e-06 1.49948394e-06**

**1.49948394e-06]**

**97 m\_gradient= -1545.8540161598378 Cost= 885712797152.5997 m\_current [1.51494248e-06 1.51494248e-06 1.51494248e-06 1.51494248e-06**

**1.51494248e-06]**

**98 m\_gradient= -1545.8538994487276 Cost= 885712781215.8333 m\_current [1.53040102e-06 1.53040102e-06 1.53040102e-06 1.53040102e-06**

**1.53040102e-06]**

**99 m\_gradient= -1545.8537827376238 Cost= 885712765283.9275 m\_current [1.54585956e-06 1.54585956e-06 1.54585956e-06 1.54585956e-06**

**1.54585956e-06]**

**21/09/26 19:09:48 INFO org.sparkproject.jetty.server.AbstractConnector: Stopped Spark@31f4094b{HTTP/1.1, (http/1.1)}{0.0.0.0:0}**

**End**

Chart, line chart

Description automatically generated

**With new learning rate**

learningRate = 0.00000000002

**learningRate = 0.00000000002**

A screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generated

Graphical user interface, text, application, email

Description automatically generated

**PySpark Script: /tmp/job-59884826/mod3\_task3df.py**

**21/09/27 00:30:09 INFO org.sparkproject.jetty.util.log: Logging initialized @3503ms to org.sparkproject.jetty.util.log.Slf4jLog**

**21/09/27 00:30:09 INFO org.sparkproject.jetty.server.Server: jetty-9.4.40.v20210413; built: 2021-04-13T20:42:42.668Z; git: b881a572662e1943a14ae12e7e1207989f218b74; jvm 1.8.0\_292-b10**

**21/09/27 00:30:09 INFO org.sparkproject.jetty.server.Server: Started @3602ms**

**21/09/27 00:30:09 INFO org.sparkproject.jetty.server.AbstractConnector: Started ServerConnector@52a869dc{HTTP/1.1, (http/1.1)}{0.0.0.0:44151}**

**21/09/27 00:30:10 INFO org.apache.hadoop.yarn.client.RMProxy: Connecting to ResourceManager at cluster-0513-m/10.128.15.215:8032**

**21/09/27 00:30:10 INFO org.apache.hadoop.yarn.client.AHSProxy: Connecting to Application History server at cluster-0513-m/10.128.15.215:10200**

**21/09/27 00:30:11 INFO org.apache.hadoop.conf.Configuration: resource-types.xml not found**

**21/09/27 00:30:11 INFO org.apache.hadoop.yarn.util.resource.ResourceUtils: Unable to find 'resource-types.xml'.**

**21/09/27 00:30:12 INFO org.apache.hadoop.yarn.client.api.impl.YarnClientImpl: Submitted application application\_1632696834879\_0004**

**21/09/27 00:30:13 INFO org.apache.hadoop.yarn.client.RMProxy: Connecting to ResourceManager at cluster-0513-m/10.128.15.215:8030**

**21/09/27 00:30:14 INFO com.google.cloud.hadoop.repackaged.gcs.com.google.cloud.hadoop.gcsio.GoogleCloudStorageImpl: Ignoring exception of type GoogleJsonResponseException; verified object already exists with desired state.**

**count 8647397**

**[0. 0. 0. 0. 0.]**

**21/09/27 00:30:24 WARN org.apache.spark.sql.execution.CacheManager: Asked to cache already cached data.**

**0 m\_gradient= -1545.8653371795667 Cost= 885714366126.2052 m\_current [3.09173067e-08 3.09173067e-08 3.09173067e-08 3.09173067e-08**

**3.09173067e-08]**

**1 m\_gradient= -1545.8651037556358 Cost= 885714333314.3777 m\_current [6.18346088e-08 6.18346088e-08 6.18346088e-08 6.18346088e-08**

**6.18346088e-08]**

**2 m\_gradient= -1545.8648703317378 Cost= 885714300521.9954 m\_current [9.27519062e-08 9.27519062e-08 9.27519062e-08 9.27519062e-08**

**9.27519062e-08]**

**3 m\_gradient= -1545.8646369078738 Cost= 885714267749.0604 m\_current [1.23669199e-07 1.23669199e-07 1.23669199e-07 1.23669199e-07**

**1.23669199e-07]**

**4 m\_gradient= -1545.8644034840459 Cost= 885714234995.5714 m\_current [1.54586487e-07 1.54586487e-07 1.54586487e-07 1.54586487e-07**

**1.54586487e-07]**

**5 m\_gradient= -1545.8641700602554 Cost= 885714202261.5306 m\_current [1.8550377e-07 1.8550377e-07 1.8550377e-07 1.8550377e-07 1.8550377e-07]**

**6 m\_gradient= -1545.863936636497 Cost= 885714169546.9355 m\_current [2.16421049e-07 2.16421049e-07 2.16421049e-07 2.16421049e-07**

**2.16421049e-07]**

**7 m\_gradient= -1545.863703212777 Cost= 885714136851.7859 m\_current [2.47338323e-07 2.47338323e-07 2.47338323e-07 2.47338323e-07**

**2.47338323e-07]**

**8 m\_gradient= -1545.8634697890907 Cost= 885714104176.0852 m\_current [2.78255593e-07 2.78255593e-07 2.78255593e-07 2.78255593e-07**

**2.78255593e-07]**

**9 m\_gradient= -1545.8632363654394 Cost= 885714071519.8296 m\_current [3.09172857e-07 3.09172857e-07 3.09172857e-07 3.09172857e-07**

**3.09172857e-07]**

**10 m\_gradient= -1545.8630029418237 Cost= 885714038883.0216 m\_current [3.40090117e-07 3.40090117e-07 3.40090117e-07 3.40090117e-07**

**3.40090117e-07]**

**11 m\_gradient= -1545.8627695182424 Cost= 885714006265.6597 m\_current [3.71007373e-07 3.71007373e-07 3.71007373e-07 3.71007373e-07**

**3.71007373e-07]**

**12 m\_gradient= -1545.8625360946976 Cost= 885713973667.7443 m\_current [4.01924624e-07 4.01924624e-07 4.01924624e-07 4.01924624e-07**

**4.01924624e-07]**

**13 m\_gradient= -1545.8623026711857 Cost= 885713941089.275 m\_current [4.3284187e-07 4.3284187e-07 4.3284187e-07 4.3284187e-07 4.3284187e-07]**

**14 m\_gradient= -1545.8620692477107 Cost= 885713908530.2545 m\_current [4.63759111e-07 4.63759111e-07 4.63759111e-07 4.63759111e-07**

**4.63759111e-07]**

**15 m\_gradient= -1545.8618358242722 Cost= 885713875990.6782 m\_current [4.94676348e-07 4.94676348e-07 4.94676348e-07 4.94676348e-07**

**4.94676348e-07]**

**16 m\_gradient= -1545.8616024008684 Cost= 885713843470.5502 m\_current [5.2559358e-07 5.2559358e-07 5.2559358e-07 5.2559358e-07 5.2559358e-07]**

**17 m\_gradient= -1545.861368977498 Cost= 885713810969.8687 m\_current [5.56510807e-07 5.56510807e-07 5.56510807e-07 5.56510807e-07**

**5.56510807e-07]**

**18 m\_gradient= -1545.861135554164 Cost= 885713778488.6324 m\_current [5.8742803e-07 5.8742803e-07 5.8742803e-07 5.8742803e-07 5.8742803e-07]**

**19 m\_gradient= -1545.8609021308673 Cost= 885713746026.8422 m\_current [6.18345248e-07 6.18345248e-07 6.18345248e-07 6.18345248e-07**

**6.18345248e-07]**

**20 m\_gradient= -1545.860668707603 Cost= 885713713584.5002 m\_current [6.49262461e-07 6.49262461e-07 6.49262461e-07 6.49262461e-07**

**6.49262461e-07]**

**21 m\_gradient= -1545.8604352843738 Cost= 885713681161.6046 m\_current [6.8017967e-07 6.8017967e-07 6.8017967e-07 6.8017967e-07 6.8017967e-07]**

**22 m\_gradient= -1545.86020186118 Cost= 885713648758.1552 m\_current [7.11096874e-07 7.11096874e-07 7.11096874e-07 7.11096874e-07**

**7.11096874e-07]**

**23 m\_gradient= -1545.8599684380265 Cost= 885713616374.1519 m\_current [7.42014073e-07 7.42014073e-07 7.42014073e-07 7.42014073e-07**

**7.42014073e-07]**

**24 m\_gradient= -1545.8597350149018 Cost= 885713584009.5963 m\_current [7.72931268e-07 7.72931268e-07 7.72931268e-07 7.72931268e-07**

**7.72931268e-07]**

**25 m\_gradient= -1545.8595015918131 Cost= 885713551664.485 m\_current [8.03848458e-07 8.03848458e-07 8.03848458e-07 8.03848458e-07**

**8.03848458e-07]**

**26 m\_gradient= -1545.8592681687635 Cost= 885713519338.8225 m\_current [8.34765643e-07 8.34765643e-07 8.34765643e-07 8.34765643e-07**

**8.34765643e-07]**

**27 m\_gradient= -1545.859034745745 Cost= 885713487032.6046 m\_current [8.65682824e-07 8.65682824e-07 8.65682824e-07 8.65682824e-07**

**8.65682824e-07]**

**28 m\_gradient= -1545.8588013227638 Cost= 885713454745.8341 m\_current [8.966e-07 8.966e-07 8.966e-07 8.966e-07 8.966e-07]**

**29 m\_gradient= -1545.8585678998181 Cost= 885713422478.51 m\_current [9.27517172e-07 9.27517172e-07 9.27517172e-07 9.27517172e-07**

**9.27517172e-07]**

**30 m\_gradient= -1545.8583344769072 Cost= 885713390230.632 m\_current [9.58434338e-07 9.58434338e-07 9.58434338e-07 9.58434338e-07**

**9.58434338e-07]**

**31 m\_gradient= -1545.858101054031 Cost= 885713358002.2015 m\_current [9.893515e-07 9.893515e-07 9.893515e-07 9.893515e-07 9.893515e-07]**

**32 m\_gradient= -1545.8578676311909 Cost= 885713325793.218 m\_current [1.02026866e-06 1.02026866e-06 1.02026866e-06 1.02026866e-06**

**1.02026866e-06]**

**33 m\_gradient= -1545.857634208386 Cost= 885713293603.6788 m\_current [1.05118581e-06 1.05118581e-06 1.05118581e-06 1.05118581e-06**

**1.05118581e-06]**

**34 m\_gradient= -1545.8574007856146 Cost= 885713261433.588 m\_current [1.08210296e-06 1.08210296e-06 1.08210296e-06 1.08210296e-06**

**1.08210296e-06]**

**35 m\_gradient= -1545.8571673628812 Cost= 885713229282.9421 m\_current [1.1130201e-06 1.1130201e-06 1.1130201e-06 1.1130201e-06 1.1130201e-06]**

**36 m\_gradient= -1545.8569339401813 Cost= 885713197151.7417 m\_current [1.14393724e-06 1.14393724e-06 1.14393724e-06 1.14393724e-06**

**1.14393724e-06]**

**37 m\_gradient= -1545.8567005175173 Cost= 885713165039.9908 m\_current [1.17485437e-06 1.17485437e-06 1.17485437e-06 1.17485437e-06**

**1.17485437e-06]**

**38 m\_gradient= -1545.856467094888 Cost= 885713132947.6841 m\_current [1.2057715e-06 1.2057715e-06 1.2057715e-06 1.2057715e-06 1.2057715e-06]**

**39 m\_gradient= -1545.8562336722937 Cost= 885713100874.8239 m\_current [1.23668863e-06 1.23668863e-06 1.23668863e-06 1.23668863e-06**

**1.23668863e-06]**

**40 m\_gradient= -1545.8560002497345 Cost= 885713068821.41 m\_current [1.26760575e-06 1.26760575e-06 1.26760575e-06 1.26760575e-06**

**1.26760575e-06]**

**41 m\_gradient= -1545.8557668272128 Cost= 885713036787.4436 m\_current [1.29852286e-06 1.29852286e-06 1.29852286e-06 1.29852286e-06**

**1.29852286e-06]**

**42 m\_gradient= -1545.855533404724 Cost= 885713004772.9221 m\_current [1.32943997e-06 1.32943997e-06 1.32943997e-06 1.32943997e-06**

**1.32943997e-06]**

**43 m\_gradient= -1545.855299982271 Cost= 885712972777.8472 m\_current [1.36035708e-06 1.36035708e-06 1.36035708e-06 1.36035708e-06**

**1.36035708e-06]**

**44 m\_gradient= -1545.8550665598536 Cost= 885712940802.2196 m\_current [1.39127418e-06 1.39127418e-06 1.39127418e-06 1.39127418e-06**

**1.39127418e-06]**

**45 m\_gradient= -1545.8548331374718 Cost= 885712908846.038 m\_current [1.42219128e-06 1.42219128e-06 1.42219128e-06 1.42219128e-06**

**1.42219128e-06]**

**46 m\_gradient= -1545.8545997151252 Cost= 885712876909.3029 m\_current [1.45310837e-06 1.45310837e-06 1.45310837e-06 1.45310837e-06**

**1.45310837e-06]**

**47 m\_gradient= -1545.854366292812 Cost= 885712844992.0134 m\_current [1.48402546e-06 1.48402546e-06 1.48402546e-06 1.48402546e-06**

**1.48402546e-06]**

**48 m\_gradient= -1545.8541328705364 Cost= 885712813094.1699 m\_current [1.51494254e-06 1.51494254e-06 1.51494254e-06 1.51494254e-06**

**1.51494254e-06]**

**49 m\_gradient= -1545.8538994482942 Cost= 885712781215.7743 m\_current [1.54585962e-06 1.54585962e-06 1.54585962e-06 1.54585962e-06**

**1.54585962e-06]**

**50 m\_gradient= -1545.8536660260909 Cost= 885712749356.8231 m\_current [1.57677669e-06 1.57677669e-06 1.57677669e-06 1.57677669e-06**

**1.57677669e-06]**

**51 m\_gradient= -1545.853432603919 Cost= 885712717517.3195 m\_current [1.60769376e-06 1.60769376e-06 1.60769376e-06 1.60769376e-06**

**1.60769376e-06]**

**52 m\_gradient= -1545.853199181784 Cost= 885712685697.262 m\_current [1.63861082e-06 1.63861082e-06 1.63861082e-06 1.63861082e-06**

**1.63861082e-06]**

**53 m\_gradient= -1545.8529657596825 Cost= 885712653896.6497 m\_current [1.66952788e-06 1.66952788e-06 1.66952788e-06 1.66952788e-06**

**1.66952788e-06]**

**54 m\_gradient= -1545.8527323376193 Cost= 885712622115.4845 m\_current [1.70044494e-06 1.70044494e-06 1.70044494e-06 1.70044494e-06**

**1.70044494e-06]**

**55 m\_gradient= -1545.852498915589 Cost= 885712590353.7646 m\_current [1.73136199e-06 1.73136199e-06 1.73136199e-06 1.73136199e-06**

**1.73136199e-06]**

**56 m\_gradient= -1545.852265493593 Cost= 885712558611.494 m\_current [1.76227903e-06 1.76227903e-06 1.76227903e-06 1.76227903e-06**

**1.76227903e-06]**

**57 m\_gradient= -1545.8520320716332 Cost= 885712526888.6672 m\_current [1.79319607e-06 1.79319607e-06 1.79319607e-06 1.79319607e-06**

**1.79319607e-06]**

**58 m\_gradient= -1545.8517986497097 Cost= 885712495185.2861 m\_current [1.82411311e-06 1.82411311e-06 1.82411311e-06 1.82411311e-06**

**1.82411311e-06]**

**59 m\_gradient= -1545.8515652278218 Cost= 885712463501.3518 m\_current [1.85503014e-06 1.85503014e-06 1.85503014e-06 1.85503014e-06**

**1.85503014e-06]**

**60 m\_gradient= -1545.8513318059681 Cost= 885712431836.8634 m\_current [1.88594717e-06 1.88594717e-06 1.88594717e-06 1.88594717e-06**

**1.88594717e-06]**

**61 m\_gradient= -1545.8510983841475 Cost= 885712400191.822 m\_current [1.91686419e-06 1.91686419e-06 1.91686419e-06 1.91686419e-06**

**1.91686419e-06]**

**62 m\_gradient= -1545.8508649623657 Cost= 885712368566.227 m\_current [1.94778121e-06 1.94778121e-06 1.94778121e-06 1.94778121e-06**

**1.94778121e-06]**

**63 m\_gradient= -1545.8506315406178 Cost= 885712336960.0774 m\_current [1.97869822e-06 1.97869822e-06 1.97869822e-06 1.97869822e-06**

**1.97869822e-06]**

**64 m\_gradient= -1545.8503981189044 Cost= 885712305373.3732 m\_current [2.00961523e-06 2.00961523e-06 2.00961523e-06 2.00961523e-06**

**2.00961523e-06]**

**65 m\_gradient= -1545.8501646972277 Cost= 885712273806.1163 m\_current [2.04053223e-06 2.04053223e-06 2.04053223e-06 2.04053223e-06**

**2.04053223e-06]**

**66 m\_gradient= -1545.8499312755878 Cost= 885712242258.3052 m\_current [2.07144923e-06 2.07144923e-06 2.07144923e-06 2.07144923e-06**

**2.07144923e-06]**

**67 m\_gradient= -1545.8496978539802 Cost= 885712210729.9412 m\_current [2.10236622e-06 2.10236622e-06 2.10236622e-06 2.10236622e-06**

**2.10236622e-06]**

**68 m\_gradient= -1545.8494644324082 Cost= 885712179221.022 m\_current [2.13328321e-06 2.13328321e-06 2.13328321e-06 2.13328321e-06**

**2.13328321e-06]**

**69 m\_gradient= -1545.8492310108734 Cost= 885712147731.5498 m\_current [2.1642002e-06 2.1642002e-06 2.1642002e-06 2.1642002e-06 2.1642002e-06]**

**70 m\_gradient= -1545.8489975893713 Cost= 885712116261.5222 m\_current [2.19511718e-06 2.19511718e-06 2.19511718e-06 2.19511718e-06**

**2.19511718e-06]**

**71 m\_gradient= -1545.8487641679044 Cost= 885712084810.9421 m\_current [2.22603415e-06 2.22603415e-06 2.22603415e-06 2.22603415e-06**

**2.22603415e-06]**

**72 m\_gradient= -1545.8485307464744 Cost= 885712053379.808 m\_current [2.25695112e-06 2.25695112e-06 2.25695112e-06 2.25695112e-06**

**2.25695112e-06]**

**73 m\_gradient= -1545.8482973250784 Cost= 885712021968.12 m\_current [2.28786809e-06 2.28786809e-06 2.28786809e-06 2.28786809e-06**

**2.28786809e-06]**

**74 m\_gradient= -1545.8480639037182 Cost= 885711990575.8776 m\_current [2.31878505e-06 2.31878505e-06 2.31878505e-06 2.31878505e-06**

**2.31878505e-06]**

**75 m\_gradient= -1545.8478304823946 Cost= 885711959203.0814 m\_current [2.34970201e-06 2.34970201e-06 2.34970201e-06 2.34970201e-06**

**2.34970201e-06]**

**76 m\_gradient= -1545.8475970611041 Cost= 885711927849.7311 m\_current [2.38061896e-06 2.38061896e-06 2.38061896e-06 2.38061896e-06**

**2.38061896e-06]**

**77 m\_gradient= -1545.847363639849 Cost= 885711896515.8271 m\_current [2.41153591e-06 2.41153591e-06 2.41153591e-06 2.41153591e-06**

**2.41153591e-06]**

**78 m\_gradient= -1545.8471302186304 Cost= 885711865201.3698 m\_current [2.44245285e-06 2.44245285e-06 2.44245285e-06 2.44245285e-06**

**2.44245285e-06]**

**79 m\_gradient= -1545.8468967974459 Cost= 885711833906.3572 m\_current [2.47336979e-06 2.47336979e-06 2.47336979e-06 2.47336979e-06**

**2.47336979e-06]**

**80 m\_gradient= -1545.8466633762996 Cost= 885711802630.7913 m\_current [2.50428672e-06 2.50428672e-06 2.50428672e-06 2.50428672e-06**

**2.50428672e-06]**

**81 m\_gradient= -1545.846429955184 Cost= 885711771374.6711 m\_current [2.53520365e-06 2.53520365e-06 2.53520365e-06 2.53520365e-06**

**2.53520365e-06]**

**82 m\_gradient= -1545.8461965341066 Cost= 885711740137.9982 m\_current [2.56612057e-06 2.56612057e-06 2.56612057e-06 2.56612057e-06**

**2.56612057e-06]**

**83 m\_gradient= -1545.8459631130643 Cost= 885711708920.7694 m\_current [2.59703749e-06 2.59703749e-06 2.59703749e-06 2.59703749e-06**

**2.59703749e-06]**

**84 m\_gradient= -1545.8457296920556 Cost= 885711677722.9874 m\_current [2.62795441e-06 2.62795441e-06 2.62795441e-06 2.62795441e-06**

**2.62795441e-06]**

**85 m\_gradient= -1545.8454962710832 Cost= 885711646544.6516 m\_current [2.65887132e-06 2.65887132e-06 2.65887132e-06 2.65887132e-06**

**2.65887132e-06]**

**86 m\_gradient= -1545.8452628501464 Cost= 885711615385.7612 m\_current [2.68978822e-06 2.68978822e-06 2.68978822e-06 2.68978822e-06**

**2.68978822e-06]**

**87 m\_gradient= -1545.8450294292447 Cost= 885711584246.3167 m\_current [2.72070512e-06 2.72070512e-06 2.72070512e-06 2.72070512e-06**

**2.72070512e-06]**

**88 m\_gradient= -1545.844796008378 Cost= 885711553126.3193 m\_current [2.75162202e-06 2.75162202e-06 2.75162202e-06 2.75162202e-06**

**2.75162202e-06]**

**89 m\_gradient= -1545.8445625875472 Cost= 885711522025.767 m\_current [2.78253891e-06 2.78253891e-06 2.78253891e-06 2.78253891e-06**

**2.78253891e-06]**

**90 m\_gradient= -1545.8443291667513 Cost= 885711490944.6602 m\_current [2.8134558e-06 2.8134558e-06 2.8134558e-06 2.8134558e-06 2.8134558e-06]**

**91 m\_gradient= -1545.8440957459895 Cost= 885711459883.0 m\_current [2.84437268e-06 2.84437268e-06 2.84437268e-06 2.84437268e-06**

**2.84437268e-06]**

**92 m\_gradient= -1545.8438623252641 Cost= 885711428840.7861 m\_current [2.87528956e-06 2.87528956e-06 2.87528956e-06 2.87528956e-06**

**2.87528956e-06]**

**93 m\_gradient= -1545.8436289045715 Cost= 885711397818.0178 m\_current [2.90620643e-06 2.90620643e-06 2.90620643e-06 2.90620643e-06**

**2.90620643e-06]**

**94 m\_gradient= -1545.8433954839168 Cost= 885711366814.6952 m\_current [2.9371233e-06 2.9371233e-06 2.9371233e-06 2.9371233e-06 2.9371233e-06]**

**95 m\_gradient= -1545.8431620632987 Cost= 885711335830.818 m\_current [2.96804016e-06 2.96804016e-06 2.96804016e-06 2.96804016e-06**

**2.96804016e-06]**

**96 m\_gradient= -1545.8429286427136 Cost= 885711304866.3871 m\_current [2.99895702e-06 2.99895702e-06 2.99895702e-06 2.99895702e-06**

**2.99895702e-06]**

**97 m\_gradient= -1545.8426952221623 Cost= 885711273921.4023 m\_current [3.02987387e-06 3.02987387e-06 3.02987387e-06 3.02987387e-06**

**3.02987387e-06]**

**98 m\_gradient= -1545.842461801649 Cost= 885711242995.8628 m\_current [3.06079072e-06 3.06079072e-06 3.06079072e-06 3.06079072e-06**

**3.06079072e-06]**

**99 m\_gradient= -1545.842228381169 Cost= 885711212089.7693 m\_current [3.09170757e-06 3.09170757e-06 3.09170757e-06 3.09170757e-06**

**3.09170757e-06]**

**21/09/27 00:56:33 INFO org.sparkproject.jetty.server.AbstractConnector: Stopped Spark@52a869dc{HTTP/1.1, (http/1.1)}{0.0.0.0:0}**

**end**

Chart, line chart

Description automatically generated