

**Part 2: Report****I. Observation:****For alpha = 0.1, Epoch Interval = 1:**

epoch	=	1		test_loss	=	6175.078747708176
epoch	=	2		test_loss	=	5194.824840456021
epoch	=	3		test_loss	=	4375.680694149791
epoch	=	4		test_loss	=	3689.8359505111694
epoch	=	5		test_loss	=	3114.609104314474
epoch	=	6		test_loss	=	2631.4225007783207
epoch	=	7		test_loss	=	2225.00020741607
epoch	=	8		test_loss	=	1882.7365071816012
epoch	=	9		test_loss	=	1594.1957391906735
epoch	=	10		test_loss	=	1350.7138404183686
epoch	=	11		test_loss	=	1145.0791033074274
epoch	=	12		test_loss	=	971.2750091809619
epoch	=	13		test_loss	=	824.2720011974835
epoch	=	14		test_loss	=	699.8580720257751
epoch	=	15		test_loss	=	594.5003165366996
epoch	=	16		test_loss	=	505.23132696297415
epoch	=	17		test_loss	=	429.5556259538056
epoch	=	18		test_loss	=	365.37234422754364
epoch	=	19		test_loss	=	310.91112995246806
epoch	=	20		test_loss	=	264.6788828591941
epoch	=	21		test_loss	=	225.41537932024065
epoch	=	22		test_loss	=	192.05622653638406
epoch	=	23		test_loss	=	163.70187803127502
epoch	=	24		test_loss	=	139.59167656638112
epoch	=	25		test_loss	=	119.08207773617215
epoch	=	26		test_loss	=	101.62835807272295
epoch	=	27		test_loss	=	86.7692332682648
epoch	=	28		test_loss	=	74.11391110463379
epoch	=	29		test_loss	=	63.33118449568606
epoch	=	30		test_loss	=	54.14023631166982
epoch	=	31		test_loss	=	46.3028821905919
epoch	=	32		test_loss	=	39.617022579603336
epoch	=	33		test_loss	=	33.91111255715356
epoch	=	34		test_loss	=	29.039488974718942
epoch	=	35		test_loss	=	24.878420257387553
epoch	=	36		test_loss	=	21.32276572900615
epoch	=	37		test_loss	=	18.283149320971788
epoch	=	38		test_loss	=	15.683567587991318
epoch	=	39		test_loss	=	13.459364583575498
epoch	=	40		test_loss	=	11.555516748968955
epoch	=	41		test_loss	=	9.925179876732303
epoch	=	42		test_loss	=	8.528457701557777
epoch	=	43		test_loss	=	7.331357976203393
epoch	=	44		test_loss	=	6.304907201061162
epoch	=	45		test_loss	=	5.424399651406462
epoch	=	46		test_loss	=	4.668760120094509

epoch	=	47		test_loss	=	4.02000297689016
epoch	=	48		test_loss	=	3.4627728321815736
epoch	=	49		test_loss	=	2.9839543609165604
epoch	=	50		test_loss	=	2.572340758045342
epoch	=	51		test_loss	=	2.21835191488207
epoch	=	52		test_loss	=	1.9137947731571674
epoch	=	53		test_loss	=	1.6516594693021667
epoch	=	54		test_loss	=	1.4259458586902154
epoch	=	55		test_loss	=	1.2315158359525527
epoch	=	56		test_loss	=	1.063967566550732
epoch	=	57		test_loss	=	0.9195283362731087
epoch	=	58		test_loss	=	0.7949632259229195
epoch	=	59		test_loss	=	0.6874972422470387
epoch	=	60		test_loss	=	0.5947488950007531
epoch	=	61		test_loss	=	0.5146735139839915
epoch	=	62		test_loss	=	0.44551485738970115
epoch	=	63		test_loss	=	0.3857637810300391
epoch	=	64		test_loss	=	0.33412292299538565
epoch	=	65		test_loss	=	0.2894765151631961
epoch	=	66		test_loss	=	0.2508645660249943
epoch	=	67		test_loss	=	0.2174607721902438
epoch	=	68		test_loss	=	0.18855361174093271
epoch	=	69		test_loss	=	0.16353015396031068
epoch	=	70		test_loss	=	0.1418621890501781
epoch	=	71		test_loss	=	0.12309434015201484
epoch	=	72		test_loss	=	0.10683386987737716
epoch	=	73		test_loss	=	0.09274193597120452
epoch	=	74		test_loss	=	0.08052608681011661
epoch	=	75		test_loss	=	0.06993381813559923
epoch	=	76		test_loss	=	0.06074703855232408
epoch	=	77		test_loss	=	0.05277731357254035
epoch	=	78		test_loss	=	0.045861776942728055
epoch	=	79		test_loss	=	0.03985961414279757
epoch	=	80		test_loss	=	0.03464903672114353
epoch	=	81		test_loss	=	0.030124677876358644
epoch	=	82		test_loss	=	0.02619534972080305
epoch	=	83		test_loss	=	0.02278211121891299
epoch	=	84		test_loss	=	0.019816603101767038
epoch	=	85		test_loss	=	0.01723961230418058
epoch	=	86		test_loss	=	0.014999833808739014
epoch	=	87		test_loss	=	0.013052802346116742
epoch	=	88		test_loss	=	0.011359970306832778
epoch	=	89		test_loss	=	0.00988791156264614

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**alpha = 0.1 | epoch = 89 | train\_loss = 0.0075766280647214445 | test\_loss = 0.0098879115626461**  
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**For alpha = 0.01, Epoch Interval = 10:**

epoch	=	10		test_loss	=	6175.078747708176
epoch	=	20		test_loss	=	5229.578609282139
epoch	=	30		test_loss	=	4433.483239081953
epoch	=	40		test_loss	=	3762.1323534505527
epoch	=	50		test_loss	=	3195.1800190610525
epoch	=	60		test_loss	=	2715.784149653214
epoch	=	70		test_loss	=	2309.9604056791622
epoch	=	80		test_loss	=	1966.064678769652
epoch	=	90		test_loss	=	1674.3766105567881
epoch	=	100		test_loss	=	1426.7628742149595
epoch	=	110		test_loss	=	1216.4037284936412
epoch	=	120		test_loss	=	1037.5700060260888
epoch	=	130		test_loss	=	885.4404962011744
epoch	=	140		test_loss	=	755.9518349575801
epoch	=	150		test_loss	=	645.674675131481
epoch	=	160		test_loss	=	551.7111986070835
epoch	=	170		test_loss	=	471.61003381486364
epoch	=	180		test_loss	=	403.2954258296044
epoch	=	190		test_loss	=	345.00812196866593
epoch	=	200		test_loss	=	295.2559217339456
epoch	=	210		test_loss	=	252.77222537006844
epoch	=	220		test_loss	=	216.48122251125056
epoch	=	230		test_loss	=	185.46860842850418
epoch	=	240		test_loss	=	158.95691338726323
epoch	=	250		test_loss	=	136.28469070682146
epoch	=	260		test_loss	=	116.88893912105546
epoch	=	270		test_loss	=	100.29024107865456
epoch	=	280		test_loss	=	86.08018546212386
epoch	=	290		test_loss	=	73.91071459577789
epoch	=	300		test_loss	=	63.485094311675354
epoch	=	310		test_loss	=	54.55025459478651
epoch	=	320		test_loss	=	46.890288804445944
epoch	=	330		test_loss	=	40.32093316595931
epoch	=	340		test_loss	=	34.68487634948205
epoch	=	350		test_loss	=	29.84777247769539
epoch	=	360		test_loss	=	25.694850621144234
epoch	=	370		test_loss	=	22.128030396346595
epoch	=	380		test_loss	=	19.063467206090543
epoch	=	390		test_loss	=	16.42946238883636
epoch	=	400		test_loss	=	14.164683433946006
epoch	=	410		test_loss	=	12.216647768888729
epoch	=	420		test_loss	=	10.54043068052296
epoch	=	430		test_loss	=	9.097563900650744
epoch	=	440		test_loss	=	7.855096437913154
epoch	=	450		test_loss	=	6.784793517339085
epoch	=	460		test_loss	=	5.862453115857216
epoch	=	470		test_loss	=	5.0673226579127375
epoch	=	480		test_loss	=	4.38160104502931

epoch	=	490		test_loss	=	3.7900134083253225
epoch	=	500		test_loss	=	3.279447854028848
epoch	=	510		test_loss	=	2.8386450699094263
epoch	=	520		test_loss	=	2.45793301833919
epoch	=	530		test_loss	=	2.1290000958364246
epoch	=	540		test_loss	=	1.8447011202636616
epoch	=	550		test_loss	=	1.5988913414535657
epoch	=	560		test_loss	=	1.3862843810478034
epoch	=	570		test_loss	=	1.2023306115012873
epoch	=	580		test_loss	=	1.0431129984383365
epoch	=	590		test_loss	=	0.9052578683404223
epoch	=	600		test_loss	=	0.785858436347758
epoch	=	610		test_loss	=	0.6824092464968917
epoch	=	620		test_loss	=	0.592749947248931
epoch	=	630		test_loss	=	0.5150170557036426
epoch	=	640		test_loss	=	0.4476025604030868
epoch	=	650		test_loss	=	0.3891183801729461
epoch	=	660		test_loss	=	0.33836583933184655
epoch	=	670		test_loss	=	0.29430944148526056
epoch	=	680		test_loss	=	0.2560543281207436
epoch	=	690		test_loss	=	0.22282689698570088
epoch	=	700		test_loss	=	0.19395813101031606
epoch	=	710		test_loss	=	0.1688692532546241
epoch	=	720		test_loss	=	0.1470593786407016
epoch	=	730		test_loss	=	0.12809488046942166
epoch	=	740		test_loss	=	0.11160023009766012
epoch	=	750		test_loss	=	0.09725010267469728
epoch	=	760		test_loss	=	0.08476257136296342
epoch	=	770		test_loss	=	0.07389323773091638
epoch	=	780		test_loss	=	0.06443016762585539
epoch	=	790		test_loss	=	0.056189520344845915
epoch	=	800		test_loss	=	0.04901177477458895
epoch	=	810		test_loss	=	0.042758469752456035
epoch	=	820		test_loss	=	0.037309387540535394
epoch	=	830		test_loss	=	0.03256011928397404
epoch	=	840		test_loss	=	0.028419959883194942
epoch	=	850		test_loss	=	0.024810087052897778
epoch	=	860		test_loss	=	0.021661985642963674
epoch	=	870		test_loss	=	0.01891608370764791
epoch	=	880		test_loss	=	0.016520571457378407
epoch	=	890		test_loss	=	0.014430378221079865
epoch	=	900		test_loss	=	0.012606285980003821
epoch	=	910		test_loss	=	0.011014160985839462
epoch	=	920		test_loss	=	0.009624287515508657

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**alpha = 0.01 | epoch = 920 | train\_loss = 0.007412526696556855 | test\_loss = 0.009624287515508**

**For alpha = 0.001, Epoch Interval = 100:**

epoch	=	100		test_loss	=	6175.078747708176
epoch	=	200		test_loss	=	5232.868297430126
epoch	=	300		test_loss	=	4438.982384283922
epoch	=	400		test_loss	=	3769.0427574609926
epoch	=	500		test_loss	=	3202.915177448222
epoch	=	600		test_loss	=	2723.916692403336
epoch	=	700		test_loss	=	2318.1826775564627
epoch	=	800		test_loss	=	1974.1590678505077
epoch	=	900		test_loss	=	1682.193138678891
epoch	=	1000		test_loss	=	1434.2022207036023
epoch	=	1100		test_loss	=	1223.4043371666112
epoch	=	1200		test_loss	=	1044.0982746912762
epoch	=	1300		test_loss	=	891.4833033793478
epoch	=	1400		test_loss	=	761.510846155779
epoch	=	1500		test_loss	=	650.7620092502036
epoch	=	1600		test_loss	=	556.3461374058274
epoch	=	1700		test_loss	=	475.81653348110746
epoch	=	1800		test_loss	=	407.1002466098989
epoch	=	1900		test_loss	=	348.4394346098179
epoch	=	2000		test_loss	=	298.3422818386544
epoch	=	2100		test_loss	=	255.54183138259148
epoch	=	2200		test_loss	=	218.9613918785118
epoch	=	2300		test_loss	=	187.68542097066708
epoch	=	2400		test_loss	=	160.93498212006836
epoch	=	2500		test_loss	=	138.0470290716744
epoch	=	2600		test_loss	=	118.45690038288978
epoch	=	2700		test_loss	=	101.68351098449247
epoch	=	2800		test_loss	=	87.3168134457094
epoch	=	2900		test_loss	=	75.00717211693166
epoch	=	3000		test_loss	=	64.4563515253137
epoch	=	3100		test_loss	=	55.40986860201958
epoch	=	3200		test_loss	=	47.65049836168413
epoch	=	3300		test_loss	=	40.99275600733284
epoch	=	3400		test_loss	=	35.27820628361812
epoch	=	3500		test_loss	=	30.37147420771165
epoch	=	3600		test_loss	=	26.156850850914452
epoch	=	3700		test_loss	=	22.535404261866642
epoch	=	3800		test_loss	=	19.42251943638532
epoch	=	3900		test_loss	=	16.745802878873512
epoch	=	4000		test_loss	=	14.443297120640436
epoch	=	4100		test_loss	=	12.461958855053084
epoch	=	4200		test_loss	=	10.756361362301828
epoch	=	4300		test_loss	=	9.28758783095491
epoch	=	4400		test_loss	=	8.022287209228464
epoch	=	4500		test_loss	=	6.931868478043402
epoch	=	4600		test_loss	=	5.991812849672187
epoch	=	4700		test_loss	=	5.1810864601829225
epoch	=	4800		test_loss	=	4.481638725197032

epoch	=	4900		test_loss	=	3.8779737376278005
epoch	=	5000		test_loss	=	3.356783962979778
epoch	=	5100		test_loss	=	2.9066370829642643
epoch	=	5200		test_loss	=	2.5177081944069326
epoch	=	5300		test_loss	=	2.1815507238289875
epoch	=	5400		test_loss	=	1.8909003992968008
epoch	=	5500		test_loss	=	1.639507456084646
epoch	=	5600		test_loss	=	1.4219929633903814
epoch	=	5700		test_loss	=	1.2337257644045208
epoch	=	5800		test_loss	=	1.0707170373137063
epoch	=	5900		test_loss	=	0.9295299237266681
epoch	=	6000		test_loss	=	0.8072020449701429
epoch	=	6100		test_loss	=	0.70117904539037
epoch	=	6200		test_loss	=	0.6092575734543859
epoch	=	6300		test_loss	=	0.5295363430651048
epoch	=	6400		test_loss	=	0.4603741150376016
epoch	=	6500		test_loss	=	0.4003536071894454
epoch	=	6600		test_loss	=	0.3482504852732348
epoch	=	6700		test_loss	=	0.3030067096949688
epoch	=	6800		test_loss	=	0.26370761771417994
epoch	=	6900		test_loss	=	0.229562210284455
epoch	=	7000		test_loss	=	0.19988618909991268
epoch	=	7100		test_loss	=	0.17408735469922224
epoch	=	7200		test_loss	=	0.15165303227668372
epoch	=	7300		test_loss	=	0.1321392395484936
epoch	=	7400		test_loss	=	0.11516135181408522
epoch	=	7500		test_loss	=	0.10038605424646944
epoch	=	7600		test_loss	=	0.08752440130324006
epoch	=	7700		test_loss	=	0.07632582870676632
epoch	=	7800		test_loss	=	0.06657298532581654
epoch	=	7900		test_loss	=	0.058077271033414986
epoch	=	8000		test_loss	=	0.050674982676148624
epoch	=	8100		test_loss	=	0.044223984053637685
epoch	=	8200		test_loss	=	0.03860082760926524
epoch	=	8300		test_loss	=	0.03369826565558067
epoch	=	8400		test_loss	=	0.029423097642606342
epoch	=	8500		test_loss	=	0.02569430743191605
epoch	=	8600		test_loss	=	0.02244145094004517
epoch	=	8700		test_loss	=	0.01960326001246384
epoch	=	8800		test_loss	=	0.017126433113616193
epoch	=	8900		test_loss	=	0.01496458747898216
epoch	=	9000		test_loss	=	0.013077350867151935
epoch	=	9100		test_loss	=	0.011429574053628998
epoch	=	9200		test_loss	=	0.00999064779308316

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**alpha = 0.001 | epoch = 9200 | train\_loss = 0.007701935519355699 | test\_loss = 0.00999064779308316**

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**Relation between alpha and Epoch:**

- For the given data set, when       $\alpha = 0.1$ , Epochs = 89  
    $\alpha = 0.01$ , Epochs = 920  
    $\alpha = 0.001$ , Epochs = 9200
- It is evident that for the given data set, as the value of  $\alpha$  decreases, the number of epochs required for reducing the error increases. (It should be noted that the observed epochs for  $\alpha = 0.01$  and  $\alpha = 0.001$  are slightly higher than the actual value as the epoch interval is high.)
- $\alpha$  and epochs are almost inversely proportional.
- However, as the number of epochs increases, the compute time also increases drastically. So, having a large number of epochs is not viable for bigger data sets.