Regression Algorithm:

#1 Objective: Predict insurance premium charges using AI based on the following features: Age, Sex, BMI, Number of Children, and Smoking Habit.

#2 Dataset: The dataset has dimensions of 1338 x 6 (1338 rows and 6 columns). Both input features and the output (insurance charges) are present in the dataset.

#3 Preprocessing: Since the dataset includes categorical variables such as sex and smoker, one-hot encoding is applied.

#4 Algorithm Selection: As the output variable is continuous, a supervised regression algorithm is suitable (ML-Supervised-Regression Algorithm). Various regression models were tested with different hyperparameters to identify the best model.

#5 Evaluation: Models were evaluated using R^2 score.

> **Multiple Linear Regression**: R^2 Score = 0.78
>
> **SVM Regression**: Performance varied with kernels and parameters, with R^2 scores ranging from negative values to around 0.75.
>
> **Decision Tree Regression**: R^2 Scores ranged between 0.59 and 0.77 depending on the criterion and splitting method.
>
> **Random Forest Regression:** Achieved the best results. The highest R^2 Score was 0.8931.
>
> Please find All the research values (r2_score of the models) in below tables

#6 Best Model: Random Forest Regressor with the following parameters: n_estimators = 50 criterion = poisson max_depth = 5 min_samples_split = 2 min_samples_leaf = 10 Conclusion: After comparing multiple regression algorithms, the Random Forest Regressor achieved the best performance with an R^2 Score of approximately **0.893.** This model can be reliably used for predicting insurance premium charges

Multiple Linear Regression: R Score - 0.78

SVM Results:

C	Kernel	R Score
0.01	linear	-0.088831334
0.01	rbf	-0.089645537
0.01	poly	-0.089568285
0.01	sigmoid	-0.089565016
0.1	linear	-0.080959968
0.1	rbf	-0.089074515
0.1	poly	-0.088302377

0.1	sigmoid	-0.088269915	
10	linear	0.462468414	
10	rbf	-0.032273294	
10	poly	0.038716223	
10	sigmoid	0.039307144	
100	linear	0.628879286	
100	rbf	0.320031783	
100	poly	0.617956962	
100	sigmoid	0.527610355	
200	linear	0.635611016	
200	rbf	0.479029091	
200	poly	0.75163526	
200	sigmoid	0.545553207	
500	linear	0.763105805	
500	rbf	0.664298465	
500	poly	0.826368354	
500	sigmoid	0.444606103	

Decision Tree:

criterion	splitter	max_features	R Score
squared_error	best	sqrt	0.738535315
squared_error	best	log2	0.734909152
squared_error	best		0.706691175
squared_error	random	sqrt	0.660058289
squared_error	random	log2	0.627973246
squared_error	random		0.697495781
friedman_mse	best	sqrt	0.67890806
friedman_mse	best	log2	0.761270133
friedman_mse	best		0.695738099
friedman_mse	random	sqrt	0.650293723
friedman_mse	random	log2	0.676730997
friedman_mse	random		0.713760761
absolute_error	best	sqrt	0.713356976
absolute_error	best	log2	0.697985412
absolute_error	best		0.672228304
absolute_error	random	sqrt	0.692669894
absolute_error	random	log2	0.69827347
absolute_error	random		0.734970652
poisson	best	sqrt	0.667222403
poisson	best	log2	0.777917208
poisson	best		0.712211016
poisson	random	sqrt	0.656313056
poisson	random	log2	0.593555241
poisson	random		0.723977583

Random Forest:

n_estimators	criterion	max_depth	min_samples_split	min_samples_leaf	r_score
50	squared_error	5	2	1	0.88140136
50	squared_error	5	2	3	0.8913365
50	squared_error	5	2	5	0.89078743
50	squared_error	5	2	10	0.89179811
50	squared_error	5	5	1	0.88210604
50	squared_error	5	5	3	0.89080588
50	squared_error	5	5	5	0.88974485
50	squared_error	5	5	10	0.89011079
50	squared_error	5	10	1	0.88386222
50	squared_error	5	10	3	0.89252696
50	squared_error	5	10	5	0.89145071
50	squared_error	5	10	10	0.89180515
50	squared_error	10	2	1	0.8610395
50	squared_error	10	2	3	0.88018786
50	squared_error	10	2	5	0.88556263
50	squared_error	10	2	10	0.88879801
50	squared_error	10	5	1	0.8713307
50	squared_error	10	5	3	0.88168962
50	squared_error	10	5	5	0.88585811
50	squared_error	10	5	10	0.88803456
50	squared_error	10	10	1	0.8710184
50	squared_error	10	10	3	0.88337816
50	squared_error	10	10	5	0.88513199
50	squared_error	10	10	10	0.88860573
50	squared_error		2	1	0.85217019
50	squared_error		2	3	0.88322973
50	squared_error		2	5	0.88375318
50	squared_error		2	10	0.8893717
50	squared_error		5	1	0.86574696
50	squared_error		5	3	0.88189111
50	squared_error		5	5	0.88731618
50	squared_error		5	10	0.88638667
50	squared_error		10	1	0.87913277
50	squared_error		10	3	0.88505778
50	squared_error		10	5	0.884099
50	squared_error		10	10	0.88696809
50	absolute_error	5	2	1	0.88690603
50	absolute_error	5	2	3	0.89195946
50	absolute_error	5	2	5	0.89202189
50	absolute_error	5	2	10	0.88928261
50	absolute_error	5	5	1	0.88917305
50	absolute_error	5	5	3	0.89163124
50	absolute_error	5	5	5	0.89078708

50	absolute_error	5	5	10	0.88935775
50	absolute_error	5	10	1	0.88638519
50	absolute_error	5	10	3	0.89152622
50	absolute_error	5	10	5	0.89125399
50	absolute_error	5	10	10	0.89005126
50	absolute_error	10	2	1	0.86736744
50	absolute_error	10	2	3	0.88866576
50	absolute_error	10	2	5	0.89300692
50	absolute_error	10	2	10	0.88965445
50	absolute_error	10	5	1	0.87152798
50	absolute_error	10	5	3	0.88856974
50	absolute_error	10	5	5	0.89131694
50	absolute_error	10	5	10	0.89003917
50	absolute_error	10	10	1	0.87714418
50	absolute_error	10	10	3	0.89247244
50	absolute_error	10	10	5	0.89177958
50	absolute_error	10	10	10	0.88980481
50	absolute_error		2	1	0.85227698
50	absolute_error		2	3	0.88825346
50	absolute_error		2	5	0.89138734
50	absolute_error		2	10	0.88973671
50	absolute_error		5	1	0.86992862
50	absolute_error		5	3	0.88856443
50	absolute_error		5	5	0.89255994
50	absolute_error		5	10	0.889557
50	absolute_error		10	1	0.88150808
50	absolute_error		10	3	0.89162654
50	absolute_error		10	5	0.89293323
50	absolute_error		10	10	0.88974083
50	friedman_mse	5	2	1	0.87734159
50	friedman_mse	5	2	3	0.88982577
50	friedman_mse	5	2	5	0.89022826
50	friedman_mse	5	2	10	0.89094794
50	friedman_mse	5	5	1	0.88675687
50	friedman_mse	5	5	3	0.88971388
50	friedman_mse	5	5	5	0.89243908
50	friedman_mse	5	5	10	0.89026517
50	friedman_mse	5	10	1	0.88479973
50	friedman_mse	5	10	3	0.89238109
50	friedman_mse	5	10	5	0.89217681
50	friedman_mse	5	10	10	0.89101524
50	friedman_mse	10	2	1	0.85780203
50	friedman_mse	10	2	3	0.88182562
50	friedman_mse	10	2	5	0.88757744
50	friedman_mse	10	2	10	0.88882291
50	friedman_mse	10	5	1	0.86976119

50	friedman_mse	10	5	3	0.88281883
50	friedman_mse	10	5	5	0.88487604
50	friedman_mse	10	5	10	0.88964985
50	friedman_mse	10	10	1	0.87365035
50	friedman_mse	10	10	3	0.88307878
50	friedman_mse	10	10	5	0.88562977
50	friedman_mse	10	10	10	0.88868026
50	friedman_mse		2	1	0.85578862
50	friedman_mse		2	3	0.88219038
50	friedman_mse		2	5	0.88623211
50	friedman_mse		2	10	0.88969531
50	friedman_mse		5	1	0.86583618
50	friedman_mse		5	3	0.88168383
50	friedman_mse		5	5	0.88686781
50	friedman_mse		5	10	0.88820413
50	friedman_mse		10	1	0.87380533
50	friedman_mse		10	3	0.88312285
50	friedman_mse		10	5	0.8856414
50	friedman_mse		10	10	0.88850746
50	poisson	5	2	1	0.88342235
50	poisson	5	2	3	0.89083034
50	poisson	5	2	5	0.89025196
50	poisson	5	2	10	0.89310303
50	poisson	5	5	1	0.88193223
50	poisson	5	5	3	0.89140603
50	poisson	5	5	5	0.89194856
50	poisson	5	5	10	0.89086082
50	poisson	5	10	1	0.88242894
50	poisson	5	10	3	0.89075761
50	poisson	5	10	5	0.89181861
50	poisson	5	10	10	0.89244683
50	poisson	10	2	1	0.85118021
50	poisson	10	2	3	0.87992826
50	poisson	10	2	5	0.88493521
50	poisson	10	2	10	0.88766653
50	poisson	10	5	1	0.86663051
50	poisson	10	5	3	0.8805221
50	poisson	10	5	5	0.88601808
50	poisson	10	5	10	0.8888751
50	poisson	10	10	1	0.87441531
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50	poisson	10	10	5	0.88422587
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50	poisson		2	1	0.85257765
50	poisson		2	3	0.87942125
50	poisson		2	5	0.88552375

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50	poisson		10	10	0.88854387
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100	squared_error	5	2	3	0.89187421
100	squared_error	5	2	5	0.89231736
100	squared_error	5	2	10	0.89188928
100	squared_error	5	5	1	0.88587076
100	squared_error	5	5	3	0.89100413
100	squared_error	5	5	5	0.89208137
100	squared_error	5	5	10	0.89213033
100	squared_error	5	10	1	0.88674919
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100	squared_error	10	10	1	0.87693454
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100	absolute_error	5	2	5	0.89156493
100	absolute_error	5	2	10	0.8895805
100	absolute_error	5	5	1	0.8888864
100	absolute_error	5	5	3	0.89214439
100	absolute_error	5	5	5	0.89110829
100	absolute_error	5	5	10	0.88975959
100	absolute_error	5	10	1	0.88578599
100	absolute_error	5	10	3	0.89167879
100	absolute_error	5	10	5	0.89129513
100	absolute_error	5	10	10	0.89096971
100	absolute_error	10	2	1	0.87192978
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100	absolute_error	10	5	3	0.88944887
100	absolute_error	10	5	5	0.89211075
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100	absolute_error	10	10	3	0.89195975
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100	absolute_error	10	10	10	0.88929867
100	absolute_error		2	1	0.853811
100	absolute_error		2	3	0.88878435
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100	absolute_error		2	10	0.88948332
100	absolute_error		5	1	0.86939486
100	absolute_error		5	3	0.88805477
100	absolute_error		5	5	0.89166575
100	absolute_error		5	10	0.89012444
100	absolute_error		10	1	0.88370894
100	absolute_error		10	3	0.89202058
100	absolute_error		10	5	0.89354975
100	absolute_error		10	10	0.89059138
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100	friedman_mse	5	2	3	0.89069977
100	friedman_mse	5	2	5	0.8916472
100	friedman_mse	5	2	10	0.89152091
100	friedman_mse	5	5	1	0.88348813
100	friedman_mse	5	5	3	0.88992985
100	friedman_mse	5	5	5	0.89212716
100	friedman_mse	5	5	10	0.89158037
100	friedman_mse	5	10	1	0.88659117
100	friedman_mse	5	10	3	0.89029006
100	friedman_mse	5	10	5	0.89201774

100	friedman_mse	5	10	10	0.89152487
100	friedman_mse	10	2	1	0.86286556
100	friedman_mse	10	2	3	0.88125897
100	friedman_mse	10	2	5	0.88514868
100	friedman_mse	10	2	10	0.88962018
100	friedman_mse	10	5	1	0.86930814
100	friedman_mse	10	5	3	0.88243395
100	friedman_mse	10	5	5	0.88714721
100	friedman_mse	10	5	10	0.88864804
100	friedman_mse	10	10	1	0.87694993
100	friedman_mse	10	10	3	0.88533108
100	friedman_mse	10	10	5	0.88746743
100	friedman_mse	10	10	10	0.88878783
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100	friedman_mse		2	3	0.88460985
100	friedman_mse		2	5	0.88638614
100	friedman_mse		2	10	0.887803
100	friedman_mse		5	1	0.86139514
100	friedman_mse		5	3	0.88243765
100	friedman_mse		5	5	0.88682739
100	friedman_mse		5	10	0.88810941
100	friedman_mse		10	1	0.87726167
100	friedman_mse		10	3	0.88376682
100	friedman_mse		10	5	0.88414372
100	friedman_mse		10	10	0.88810815
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100	poisson	5	2	3	0.89065978
100	poisson	5	2	5	0.89254955
100	poisson	5	2	10	0.89037609
100	poisson	5	5	1	0.88377703
100	poisson	5	5	3	0.89185145
100	poisson	5	5	5	0.89206628
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100	poisson	5	10	1	0.8829927
100	poisson	5	10	3	0.89040744
100	poisson	5	10	5	0.89208632
100	poisson	5	10	10	0.88988124
100	poisson	10	2	1	0.86256645
100	poisson	10	2	3	0.881054
100	poisson	10	2	5	0.88699794
100	poisson	10	2	10	0.88866261
100	poisson	10	5	1	0.86756512
100	poisson	10	5	3	0.88345362
100	poisson	10	5	5	0.88499697
100	poisson	10	5	10	0.88804415
100	poisson	10	10	1	0.87847602

100	poisson	10	10	3	0.88366963
100	poisson	10	10	5	0.88469586
100	poisson	10	10	10	0.88854289
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100	poisson		2	3	0.88150876
100	poisson		2	5	0.88618905
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100	poisson		5	5	0.88553205
100	poisson		5	10	0.8885119
100	poisson		10	1	0.87117449
100	poisson		10	3	0.88489633
100	poisson		10	5	0.88572439
100	poisson		10	10	0.88892121
150	squared_error	5	2	1	0.88295787
150	squared_error	5	2	3	0.89081243
150	squared_error	5	2	5	0.8924616
150	squared_error	5	2	10	0.89204498
150	squared_error	5	5	1	0.88475796
150	squared_error	5	5	3	0.89105769
150	squared_error	5	5	5	0.89174157
150	squared_error	5	5	10	0.89088488
150	squared_error	5	10	1	0.88378944
150	squared_error	5	10	3	0.89202061
150	squared_error	5	10	5	0.89285645
150	squared_error	5	10	10	0.89182429
150	squared_error	10	2	1	0.86227732
150	squared_error	10	2	3	0.88180641
150	squared_error	10	2	5	0.88559608
150	squared_error	10	2	10	0.8886316
150	squared_error	10	5	1	0.87002144
150	squared_error	10	5	3	0.88232834
150	squared_error	10	5	5	0.88626101
150	squared_error	10	5	10	0.88867247
150	squared_error	10	10	1	0.87486393
150	squared_error	10	10	3	0.8849363
150	squared_error	10	10	5	0.88776814
150	squared_error	10	10	10	0.88860337
150	squared_error		2	1	0.85183519
150	squared_error		2	3	0.88179236
150	squared_error		2	5	0.88641628
150	squared_error		2	10	0.88880273
150	squared_error		5	1	0.86893502
150	squared_error		5	3	0.88194749
150	squared_error		5	5	0.88615761

150	squared_error		5	10	0.88819235
150	squared_error		10	1	0.87596766
150	squared_error		10	3	0.8846483
150	squared_error		10	5	0.88589843
150	squared_error		10	10	0.8883077
150	absolute_error	5	2	1	0.88765648
150	absolute_error	5	2	3	0.89135183
150	absolute_error	5	2	5	0.89153475
150	absolute_error	5	2	10	0.8898493
150	absolute_error	5	5	1	0.88752057
150	absolute_error	5	5	3	0.89130962
150	absolute_error	5	5	5	0.89201401
150	absolute_error	5	5	10	0.8906781
150	absolute_error	5	10	1	0.88851893
150	absolute_error	5	10	3	0.89162195
150	absolute_error	5	10	5	0.89157411
150	absolute_error	5	10	10	0.8902644
150	absolute_error	10	2	1	0.87181615
150	absolute_error	10	2	3	0.89109632
150	absolute_error	10	2	5	0.89234594
150	absolute_error	10	2	10	0.88981208
150	absolute_error	10	5	1	0.87494221
150	absolute_error	10	5	3	0.88994092
150	absolute_error	10	5	5	0.8915129
150	absolute_error	10	5	10	0.88959542
150	absolute_error	10	10	1	0.88322065
150	absolute_error	10	10	3	0.89231924
150	absolute_error	10	10	5	0.89237151
150	absolute_error	10	10	10	0.88961292
150	absolute_error		2	1	0.8542068
150	absolute_error		2	3	0.89057997
150	absolute_error		2	5	0.8920126
150	absolute_error		2	10	0.88941411
150	absolute_error		5	1	0.86813202
150	absolute_error		5	3	0.88976654
150	absolute_error		5	5	0.89152272
150	absolute_error		5	10	0.88959336
150	absolute_error		10	1	0.88193915
150	absolute_error		10	3	0.89073838
150	absolute_error		10	5	0.89233883
150	absolute_error		10	10	0.88996182
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150	friedman_mse	5	2	5	0.89227869
150	friedman_mse	5	2	10	0.89191781
150	friedman_mse	5	5	1	0.88390434

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150	friedman_mse	5	5	5	0.89200083
150	friedman_mse	5	5	10	0.89270071
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