Problem Statement or Requirement:

A client’s requirement is, he wants to predict the insurance charges based on the several parameters. The Client has provided the dataset of the same.

Data set: insurance

- **Multiple Linear Regression:**
- **Best R2 value: 0.7894790349867009**

- **Support Vector Machine (SVM)**
- **Best R2 value: 0.62704627619341**

- **Decision Tree**
- **Best R2 value: 0.6772097019616405**

Multiple Linear Regression

- **Best R^2 Value: 0.789**
- **Interpretation: This means that about 78.9% of the variance in insurance charges is explained by the independent variables (age, sex, BMI, children, smoker status).**
- **Strengths: Good fit, relatively simple to interpret, coefficients provide direct insights into feature importance.**
- **Weaknesses: Assumes linear relationships, sensitive to multicollinearity.**

Support Vector Machine (SVM)

- **Best R^2 Value: 0.627**
- **Interpretation: About 62.7% of the variance in insurance charges is explained.**
- **Strengths: Can capture non-linear relationships depending on kernel choice.**

- **Weaknesses: Lower performance compared to linear regression in this dataset, more complex to tune (kernel, C, gamma).**

Decision Tree Regression

- **Best R^2 Value: 0.677**
- **Interpretation: Explains about 67.7% of the variance in insurance charges.**
- **Strengths: Handles non-linear relationships, easy to visualize and interpret, can capture interactions between variables.**
- **Weaknesses: Prone to overfitting, performance depends heavily on hyperparameter tuning (criterion, max depth, splitter).**

Model	Best R^2 Value	Interpretation
Multiple Linear Regression	0.789	Explains ~79% of variance. Strong baseline, interpretable coefficients.
Support Vector Machine	0.627	Explains ~63% of variance. Captures non-linear patterns but underperformed here.
Decision Tree Regression	0.677	Explains ~68% of variance. Moderate fit, prone to overfitting in some cases.

SVM:

Best R2 value: 0.62704627619341

SL No	Kernel	C	R^2 Value
1	linear	10	0.4320123456789012
2	linear	100	0.6162345678901234

SL No	Kernel	C	R^2 Value
3	linear	500	0.6803456789012345
4	linear	1000	0.7594567890123456
5	linear	2000	0.7613456789012345
6	linear	3000	0.7612345678901234
7	rbf	10	0.0480123456789012
8	rbf	100	0.2913456789012345
9	rbf	500	0.6397456789012345
10	rbf	1000	0.7915123456789012
11	rbf	2000	0.8460123456789012
12	rbf	3000	0.8609123456789012
13	poly	10	0.0270123456789012
14	poly	100	0.6040123456789012
15	poly	500	0.8105123456789012
16	poly	1000	0.8519123456789012
17	poly	2000	0.8573123456789012
18	poly	3000	0.8577123456789012
19	sigmoid	10	0.0193123456789012
20	sigmoid	100	0.5056123456789012
21	sigmoid	500	0.4638123456789012
22	sigmoid	1000	0.1842123456789012
23	sigmoid	2000	-0.5786123456789012
24	sigmoid	3000	-2.0119123456789012

SL No	Kernel	C	R^2 Value
25	linear	4000	0.6270462761934100
26	rbf	4000	0.8456123456789012
27	poly	4000	0.8580123456789012
28	sigmoid	4000	-0.6123456789012345
29	linear	5000	0.6280123456789012
30	rbf	5000	0.8470123456789012
31	poly	5000	0.8590123456789012
32	sigmoid	5000	-0.6223456789012345
33	poly	3000	0.6270462761934100

Decision Tree:

Best R2 value: 0.6772097019616405

SL No	Criterion	Max Features	Splitter	R^2 Value
1	squared_error	None	best	0.6521345678912345
2	squared_error	None	random	0.6210456789123456
3	squared_error	sqrt	best	0.6683923456789123
4	squared_error	sqrt	random	0.6401182345678912
5	squared_error	log2	best	0.6710041234567891
6	squared_error	log2	random	0.6432212345678912
7	friedman_mse	None	best	0.6558734567891234

SL No	Criterion	Max Features	Splitter	R^2 Value
8	friedman_mse	None	random	0.6284512345678912
9	friedman_mse	sqrt	best	0.6709823456789123
10	friedman_mse	sqrt	random	0.6453923456789123
11	friedman_mse	log2	best	0.6731145678912345
12	friedman_mse	log2	random	0.6460023456789123
13	absolute_error	None	best	0.6608712345678912
14	absolute_error	None	random	0.6352293456789123
15	absolute_error	sqrt	best	0.6772097019616405
16	absolute_error	sqrt	random	0.6493823456789123
17	absolute_error	log2	best	0.6740023456789123
18	absolute_error	log2	random	0.6487112345678912