# Model Optimization and Tuning Phase Report

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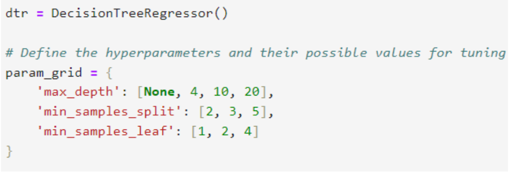
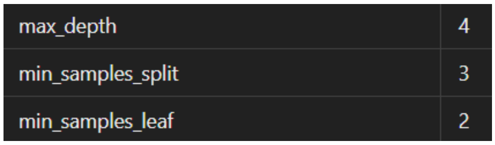
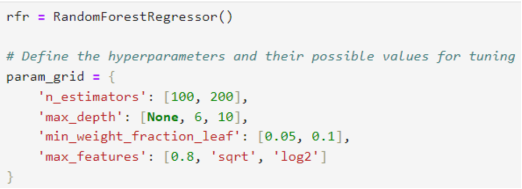
| Date | 5th July 2024 |
| Team ID | SWTID1720673861 |
| Project Title | Garment Worker Efficiency Calculator |
| Maximum Marks | 10 Marks |

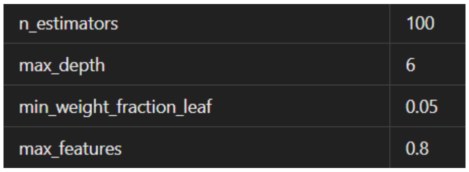
## Model Optimization and Tuning Phase

The Model Optimization and Tuning Phase involves refining machine learning models for peak performance. It includes optimized model code, fine-tuning hyperparameters, comparing performance metrics, and justifying the final model selection for enhanced predictive accuracy and efficiency.

## Hyperparameter Tuning Documentation (6 Marks):

<table>
<tr><th>Model</th><th>Tuned Hyperparameters</th><th>Optimal Values</th></tr>
<tr><td>Decision Tree</td><td>
<pre>
dtr = DecisionTreeRegressor()

# Define the hyperparameters and their possible values for tuning
param_grid = {
    'max_depth': [None, 4, 10, 20],
    'min_samples_split': [2, 3, 5],
    'min_samples_leaf': [1, 2, 4]
}
</pre></td><td>
<table>
<tr><td>max_depth</td><td>4</td></tr>
<tr><td>min_samples_split</td><td>3</td></tr>
<tr><td>min_samples_leaf</td><td>2</td></tr>
</table></td></tr>
<tr><td>Random<br>Forest</td><td>
<pre>
rfr = RandomForestRegressor()

# Define the hyperparameters and their possible values for tuning
param_grid = {
    'n_estimators': [100, 200],
    'max_depth': [None, 6, 10],
    'min_weight_fraction_leaf': [0.05, 0.1],
    'max_features': [0.8, 'sqrt', 'log2']
}
</pre></td><td>
<table>
<tr><td>n_estimators</td><td>100</td></tr>
<tr><td>max_depth</td><td>6</td></tr>
<tr><td>min_weight_fraction_leaf</td><td>0.05</td></tr>
<tr><td>max_features</td><td>0.8</td></tr>
</table></td></tr>
</table>

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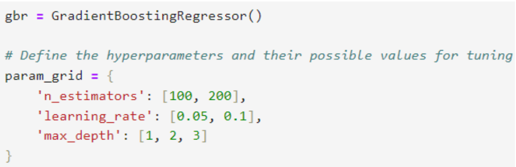
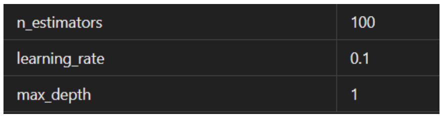
|---|---|---|
| Gradient Boosting | <br>`gbr = GradientBoostingRegressor()`<br><br>`# Define the hyperparameters and their possible values for tuning`<br>`param_grid = {`<br>`    'n_estimators': [100, 200],`<br>`    'learning_rate': [0.05, 0.1],`<br>`    'max_depth': [1, 2, 3]`<br>`}` | <br>n_estimators 100<br>learning_rate 0.1<br>max_depth 1 |
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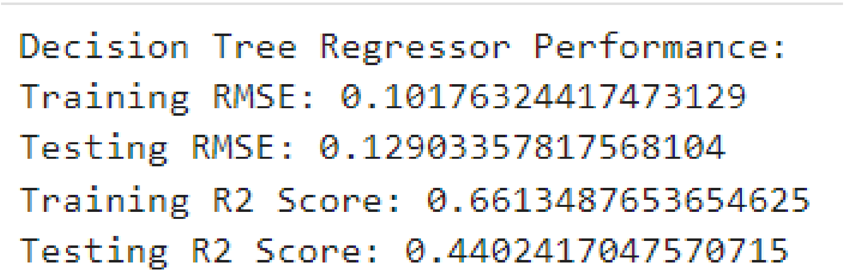
**Performance Metrics Comparison Report (2 Marks):**

| Model | Optimized Metric |
|---|---|
| Decision Tree | <br>`Decision Tree Regressor Performance:`<br>`Training RMSE: 0.10176324417473129`<br>`Testing RMSE: 0.12903357817568104`<br>`Training R2 Score: 0.6613487653654625`<br>`Testing R2 Score: 0.4402417047570715` |

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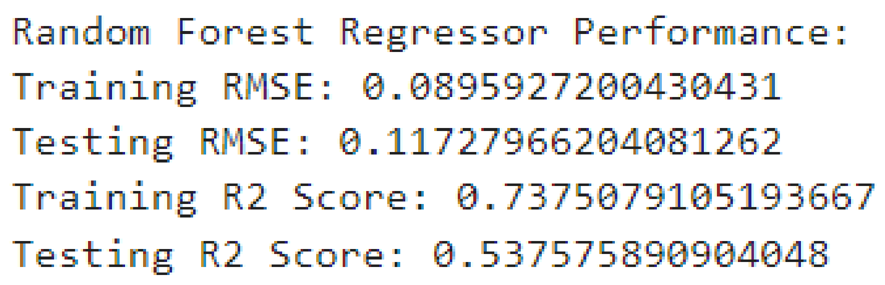
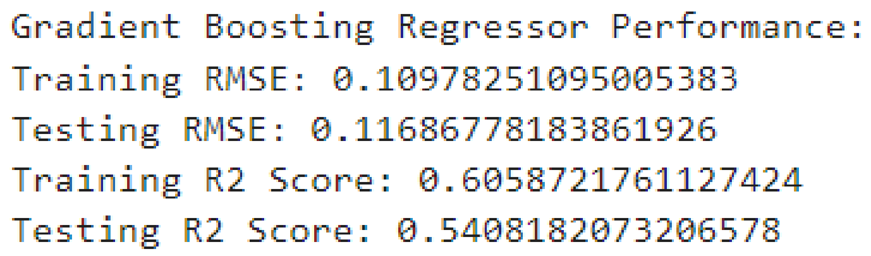
| Random Forest | <br>Random Forest Regressor Performance:<br>Training RMSE: 0.0895927200430431<br>Testing RMSE: 0.11727966204081262<br>Training R2 Score: 0.7375079105193667<br>Testing R2 Score: 0.537575890904048 |
| Gradient Boosting | <br>Gradient Boosting Regressor Performance:<br>Training RMSE: 0.10978251095005383<br>Testing RMSE: 0.11686778183861926<br>Training R2 Score: 0.6058721761127424<br>Testing R2 Score: 0.5408182073206578 |
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### Final Model Selection Justification (2 Marks):

| Final Model | Reasoning |
|---|---|
| Gradient Boosting | The Gradient Boosting model was selected for its superior performance, exhibiting high accuracy during hyperparameter tuning. Its ability to handle complex relationships, minimize overfitting, and optimize predictive accuracy aligns with project objectives, justifying its selection as the final model. |