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IDEAS Emerging Technology Skills Scholarship Program

RECAP OF FUNDAMENTALS OF MACHINE LEARNING

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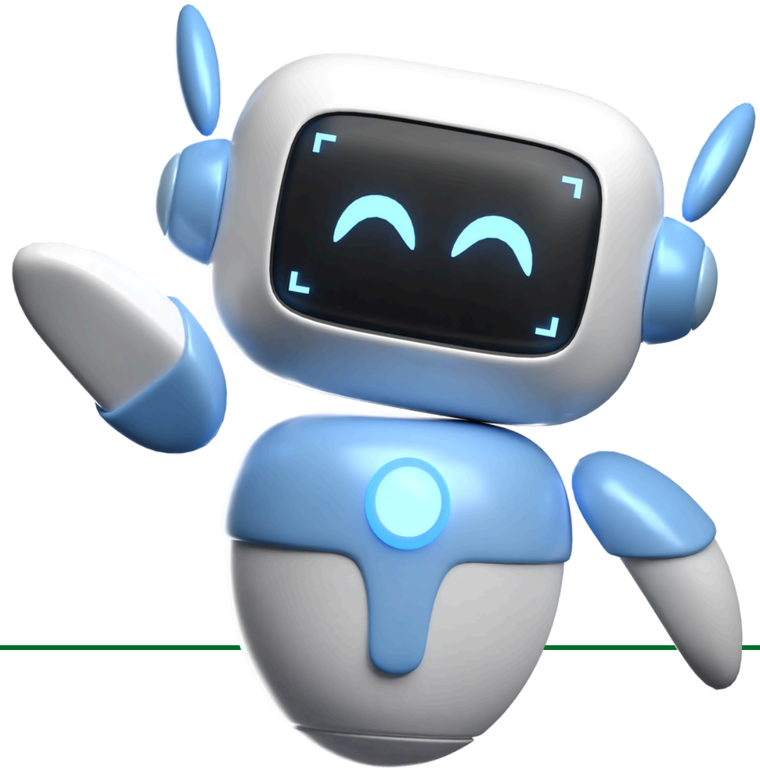

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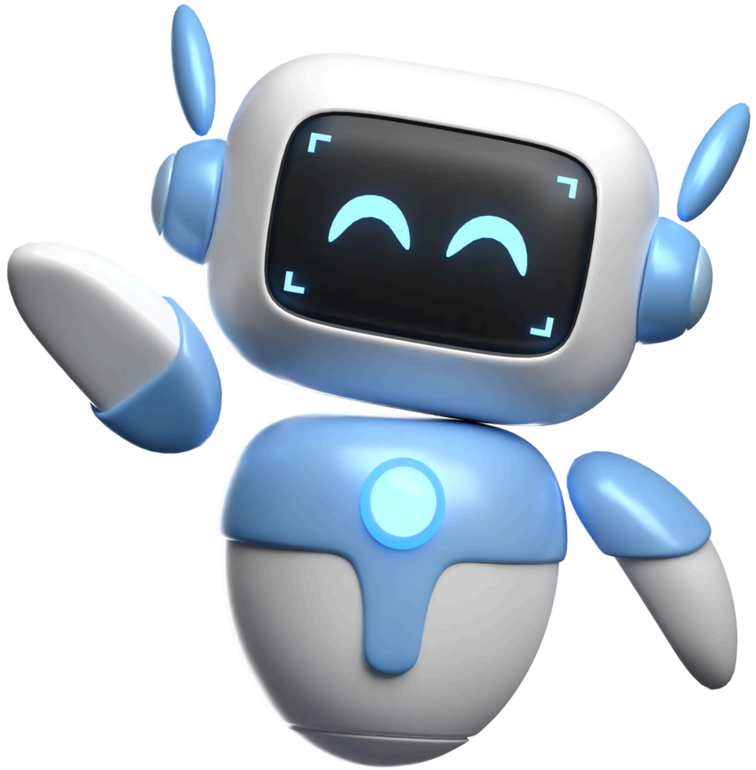
Content

- Recap
- Additional Code



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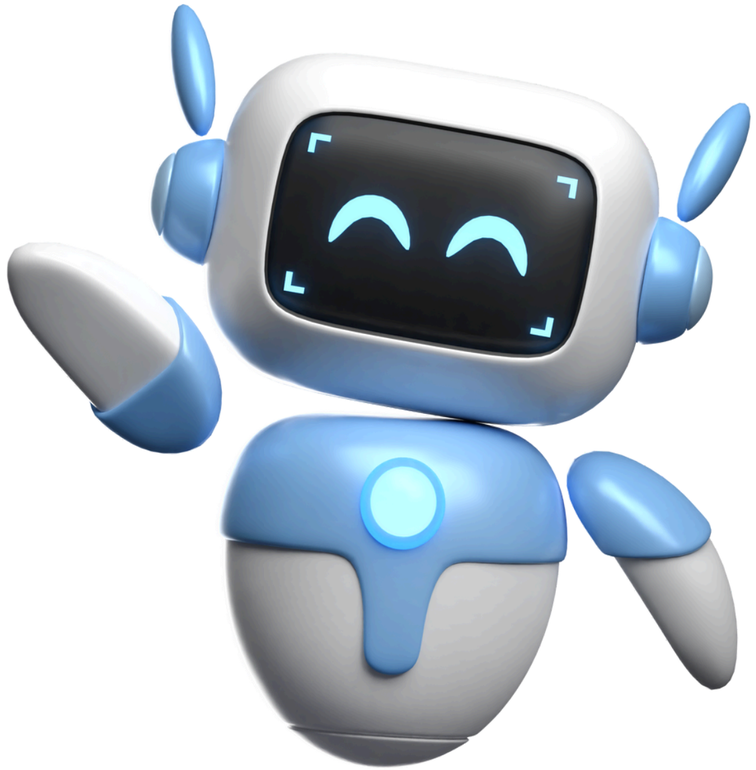
Recap

We'll review the key concepts and techniques we've covered in this module, ensuring you have a solid foundation in machine learning.

- Introduction
- Types of Machine Learning
- Common Algorithms
- Preparing Data and Engineering Features
- Evaluating Model Performance



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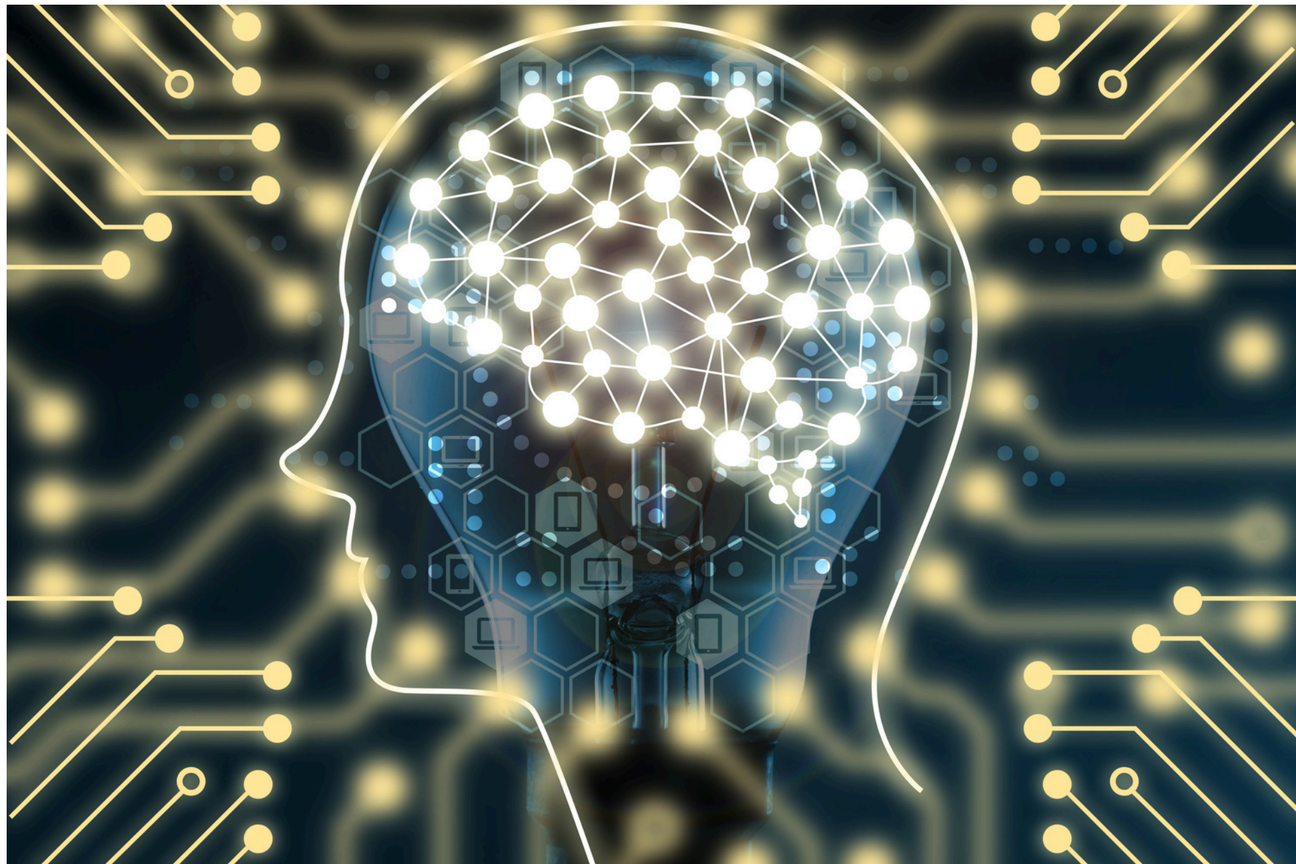
Machine Learning

Machine learning is a subset of artificial intelligence that involves training algorithms to predict outcomes, identify patterns, and make decisions based on data.



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Types of Machine Learning

- **Supervised Learning**: Where the model learns from labeled data.
- **Unsupervised Learning**: Where the model identifies patterns in unlabeled data.
- **Reinforcement Learning**: Where an agent learns to make decisions by performing actions and receiving rewards.

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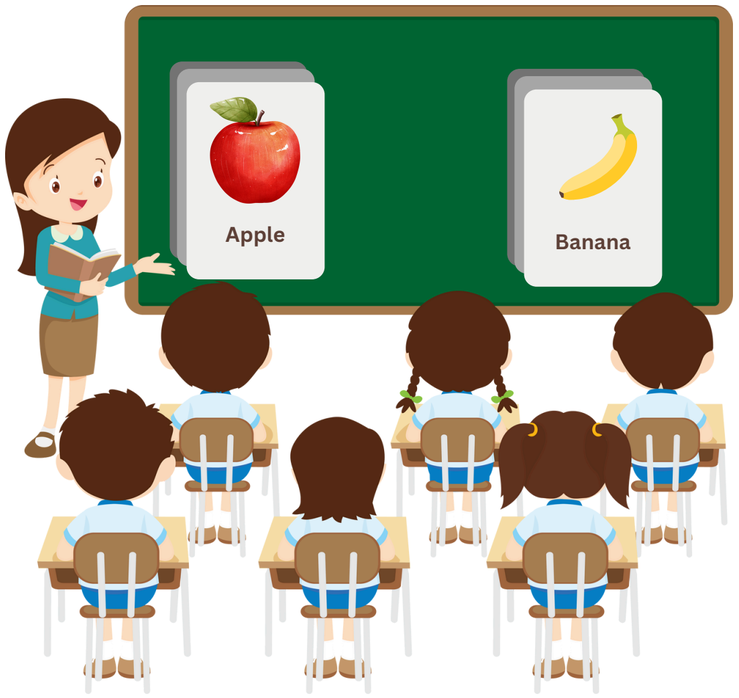
Types of Machine Learning

Supervised Learning

- Where the model learns from labeled data.

In supervised learning, the model uses input-output pairs to learn a function that can predict outcomes for new data.

- **Classification**: Predicting categorical labels (e.g., spam or not spam).
- **Regression**: Predicting continuous values (e.g., price of a house).
  - .



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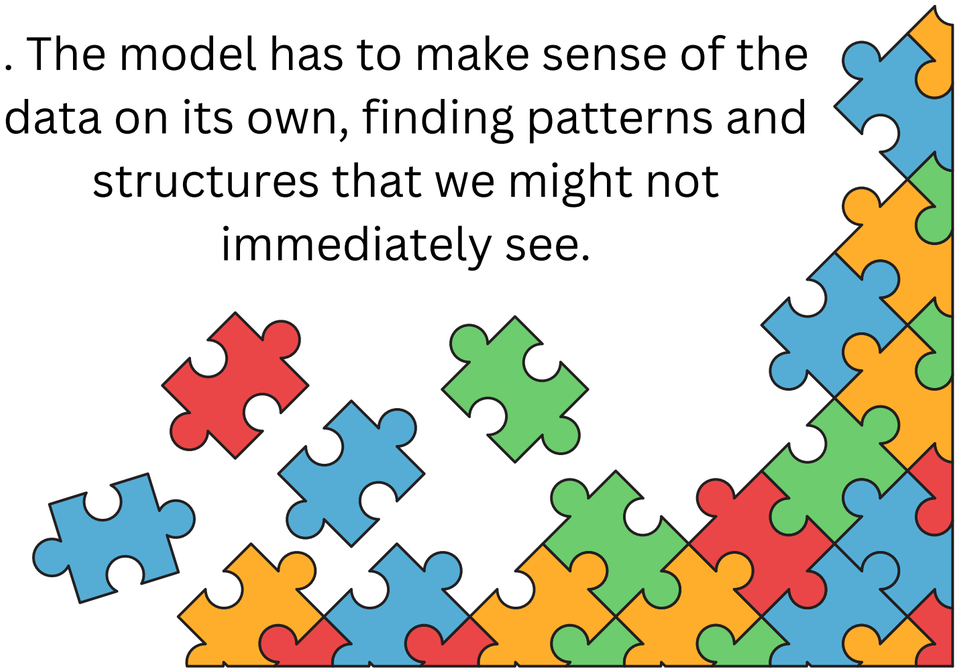
Types of Machine Learning

Unsupervised Learning

Unsupervised learning involves models that infer patterns from unlabeled data without reference to known or labeled outcomes.

- **Clustering**: Grouping a set of objects in such a way that objects in the same group are more similar to each other than to those in other groups.
- **Association**: Discovering rules that describe portions of your data, such as people that buy X also tend to buy Y.

. The model has to make sense of the data on its own, finding patterns and structures that we might not immediately see.



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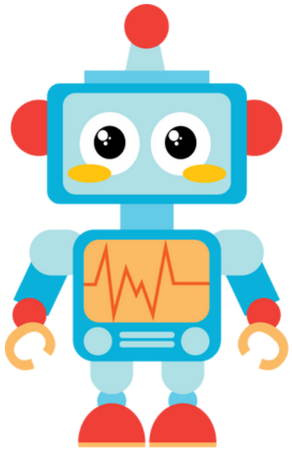
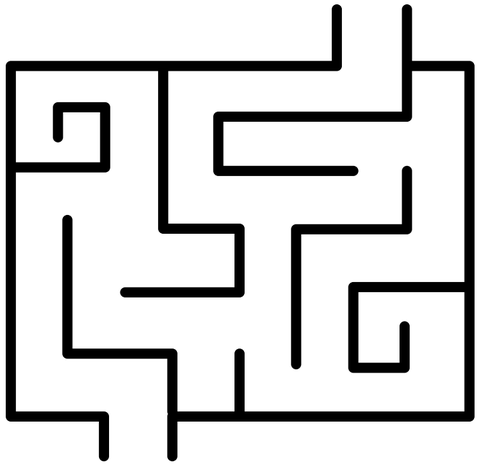
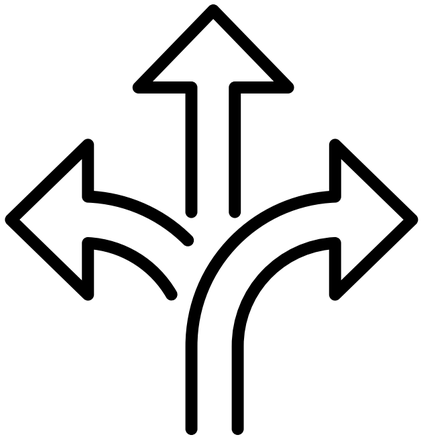
Types of Machine Learning

Reinforcement Learning

- :Where an agent learns to make decisions by performing actions and receiving rewards.







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Preparing Data and Engineering Features

Data Pre-processing

- **Cleaning**: Removing errors and inconsistencies from the data.
- **Transformation**: Scaling or normalizing features to ensure uniformity.
- **Encoding:** Converting categorical variables into numerical representations.
- **Feature Engineering:** Creating new features or transforming existing ones to improve model performance.

Model Evaluation

Why Evaluate a Model?

After training a model, you need to know how well it predi
new data

Basic Metrics

For Classifying Data (e.g., spam or not spam): Look at Accuracy (how many predictions were correct).

For Predicting Values (e.g., house prices): Use MSE (Mean Squared Error), which tells you how far off your predictions are on average.

		Actual Values: Positive (1)	Actual Values: Negative (0)
Predicted Values	Positive (1)	TP	FP
	Negative (0)	FN	TN

In classification, the data is split into training sets for learning and testing sets for evaluating model performance

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Model Evaluation

Evaluating a model's accuracy and performance is crucial for verifying its effectiveness.

- **Key Metrics**
  - For Classification: Accuracy, Precision, Recall, and F1 Score.
  - For Regression: Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and Mean Absolute Error (MAE).
- **Validation Techniques**
  - Train/Test Split
  - Cross-Validation: Using parts of the data to train and validate the model to ensure reliability.

Overfitting and Underfitting

What are These?

- **Overfitting**: Imagine memorizing answers for a test without understanding the concepts. You might fail on different questions. Overfitting is similar; the model performs well on training data but poorly on unseen data.
- **Underfitting:** This is like not studying enough. Underfitting means the model is too simple to learn the underlying pattern of the data.

Overfitting and Underfitting

- Overfitting: Occurs when a model learns the training data too well, including the noise, which hampers its performance on new data.
- Underfitting: Occurs when a model is too simple to capture the underlying data patterns, resulting in poor performance on both training and new data.

- **Solutions**:
  - Regularization: Techniques like L1 (Lasso) and L2 (Ridge) that help reduce overfitting by penalizing large coefficients.
  - Pruning: Used in decision trees to reduce the size of the tree and improve model simplicity.

Regularization Techniques

What is Regularization?

- Think of regularization as a way to prevent your model from studying "too hard" and just memorizing data. It gently nudges the model to be more general.

Best Practices in Machine Learning

- **Data Quality:** High-quality data is critical for building robust models.
- **Algorithm Selection**: There is no one-size-fits-all algorithm. Testing different algorithms based on the problem context is essential.

MORE CODING

The next slides contain snippets of more coding examples.

```
from sklearn.linear_model import LogisticRegression
model = LogisticRegression()
model.fit(X_train, y_train)


predictions = model.predict(X_test)
from sklearn.metrics import accuracy_score
print("Accuracy:", accuracy_score(y_test, predictions))
```

More Data Processing

```
# Create a new column 'is_child' to indicate whether the passenger is a child
df['is_child'] = (df['Age'] < 18).astype(int)


# Fill missing values
df['Age'].fillna(df['Age'].median(), inplace=True)
df['Embarked'].fillna(df['Embarked'].mode()[0], inplace=True)
# Extract title from the Name column
df['Title'] = df['Name'].str.extract(' ([A-Za-z]+)\.', expand=False)


# Convert categorical variables using one-hot encoding
df = pd.get_dummies(df, columns=['Sex', 'Embarked', 'Title'], drop_first=True)


# Drop columns that are not needed
df.drop(['PassengerId', 'Name', 'Ticket', 'Cabin'], axis=1, inplace=True)
# Creating a new feature 'FamilySize'
titanic['FamilySize'] = titanic['SibSp'] + titanic['Parch'] + 1
```

Other Algorithms

```
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
```

Accuracy with other Algorithms

```
# Logistic Regression
log_reg = LogisticRegression()
log_reg.fit(X_train, y_train)
log_reg_preds = log_reg.predict(X_test)
print("Logistic Regression Accuracy:", accuracy_score(y_test, log_reg_preds))

# Random Forest Classifier
rf_clf = RandomForestClassifier()
rf_clf.fit(X_train, y_train)  # no need to scale data for tree-based models
rf_preds = rf_clf.predict(X_test)
print("Random Forest Accuracy:", accuracy_score(y_test, rf_preds))

# Support Vector Machine
svm = SVC()
svm.fit(X_train, y_train)
svm_preds = svm.predict(X_test)
print("SVM Accuracy:", accuracy_score(y_test, svm_preds))
```

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THANK YOU

Q&A