Machine learning exam

This exam is timed and the duration of each question is displayed at the end of each question. A progress bar below each question also indicates the time remaining. **Questions are automatically skipped** as soon as the time runs out, and **there is no turning back.**

It is divided into 2 parts

1- **Oral exam:** you will read the questions on the screen and answer them orally to your examiner.

You will have a two-minute break in between to prepare.

2**- The written exam:** you will read the questions and answers on the screen, and you will have to answer via a google forms form by ticking the right answer(s).

ORAL EXAM 15 min

(2 min)

QUESTION 1

Give a concrete example where you could use a clustering algorithm. (1 min 30)

QUESTION 2

What is the difference between hyperparameters and parameters? (1 min)

QUESTION 3

Explain how the Random Forest algorithm works. (1 min 30)

QUESTION 4

Explain the differences between L1 and L2 regularization. (1 min)

QUESTION 5

The gradient-descent algorithm is used in the implementation of the backpropagation procedure in a neural network. (1 min)

True or False? Explain

QUESTION 6

What is KNN, and in what context is it used? (1 min)

QUESTION 7

What is a feature in machine learning? (30 s)

QUESTION 8

What is a confusion matrix, and what metrics can be derived from it (4 at least)? (1 min 30)

QUESTION 9

Compare SVM with a Gaussian kernel and a multilayer perceptron. When would you use one over the other? (1 min)

QUESTION 10

Normalizing input data is always required for tree-based models.

True or False? Explain why if false. (1 min)

QUESTION 11

Name three types of supervised machine learning algorithms (1 min)

QUESTION 12

How can overfitting be avoided? (1 min)

QUESTION 13

Explain the difference between linear regression and logistic regression. (1 min)

QUESTION 14

Why and how would you use dimensionality reduction (e.g., PCA) in a machine learning project?
(1 min)

WRITTEN EXAM 15 min

(2 min)

QUESTION 1

What is the formula for accuracy? *(1 min)*

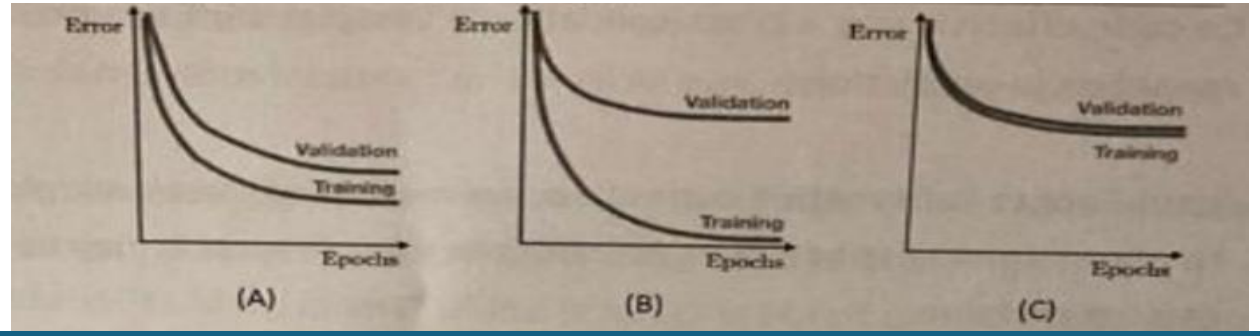
QUESTION 2

What are the main steps of a machine learning project? (Provide only the names of the steps, without explanation.) *(2 min)*

QUESTION 3

Match each curve to the corresponding proposition : (1min30)

- a) (A) Good Fit, (B) Underfit, (C) Overfit
- b) (A) Good Fit, (B) Overfit, (C) Underfit
- c) (A) Underfit, (B) Overfit, (C) Good Fit
- d) (A) Underfit, (B) Good Fit, (C) Overfit



QUESTION 4

What is the difference between label encoding and scaling? (2 min)

QUESTION 5

Among the following scenarios, choose the one(s) that might be considered as a regression problem: (3min)

a) We collect a set of data on the top 500 firms in France. For each firm we record profit, number of employees, industry and the CEO salary. We are interested in understanding which factors affect CEO salary

b) We are considering launching a new product and wish to know whether it will be a success or a failure. We collect data on 20 similar products that were previously launched. For each product we have recorded whether it was a success or failure, price charger for the product, marketing budget, competition price, and ten other variables.

c) We are interested in predicting the % change in the US dollar in relation to the weekly changes in the world stock markets. Hence we collect weekly data for all of 2012. For each week record the % change in the dollar, the % change in the US market, the % change in the British market, and the % change in the German market

d) An emergency room in a hospital measures 10 variables (e.g. blood pressure, age, etc.) of newly admitted patients. Based on these variables, the hospital can determine the life-risk (high/low) of each patient. A decision has to be taken whether to put the patient in an intensive-care unit based on his life-risk level.

QUESTION 6

Which technique can be used to handle missing data in a dataset?

(1 min)

a) Removing columns with missing values.

b) Imputation using the mean or median.

c) Using predictive models to estimate the missing values.

d) All of the above.

QUESTION 7

What is a limitation of Grid Search? (1 min 30)

a) It cannot tune hyperparameters for regression models.
b) It requires large computational resources for high-dimensional grids.
c) It only works for tree-based models.
d) It cannot handle categorical hyperparameters.

QUESTION 8

What does the alpha parameter in the Lasso model do? (1 min)

```
# 1. Load the dataset
data = pd.DataFrame({
    "X1": np.random.rand(100),
    "X2": np.random.rand(100),
    "X3": np.random.rand(100),
    "y": np.random.rand(100) * 10
})
# 2. Define features and target
X = data[["X1", "X2", "X3"]]
y = data["y"]
# 3. Split the dataset
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
# 4. Initialize and train the Lasso model
lasso_model = Lasso(alpha=0.1)
lasso_model.fit(X_train, y_train)
# 5. Make predictions
y_pred = lasso_model.predict(X_test)
# 6. Evaluate the model
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)
# 7. Display results
print("Mean Squared Error:", mse)
print("R2 Score:", r2)
print("Lasso Coefficients:", lasso_model.coef_)
```

QUESTION 9

What does grid_search.best_params_ return? (2 min)

```
# Split the dataset
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
# 3. Define the SVM model
svm_model = SVC()
# Define the parameter grid for Grid Search
param_grid = {
    'C': [0.1, 1, 10, 100],  # Regularization parameter
    'kernel': ['linear', 'rbf', 'poly'],  # Kernel type
    'gamma': ['scale', 'auto']  # Kernel coefficient
}
# Perform Grid Search
grid_search = GridSearchCV(estimator=svm_model, param_grid=param_grid, cv=5, scoring='accuracy')
grid_search.fit(X_train, y_train)

best_params = grid_search.best_params_
best_model = grid_search.best_estimator_
# Make predictions
y_pred = best_model.predict(X_test)
# Evaluate the model
accuracy = accuracy_score(y_test, y_pred)
```

END OF EXAM

(2 min)