Preparation Guide

Edition 202503

Content

1. Overview

EXIN BCS Machine Learning Award (AIMLA.EN)

Scope

EXIN BCS Machine Learning Award confirms that the professional understands the principles of machine learning and the process through which it can be developed.

This certification includes the following topics:

- What is machine learning?
- Coding for machine learning
- Algorithms used in machine learning
- Machine learning in practice

Summary

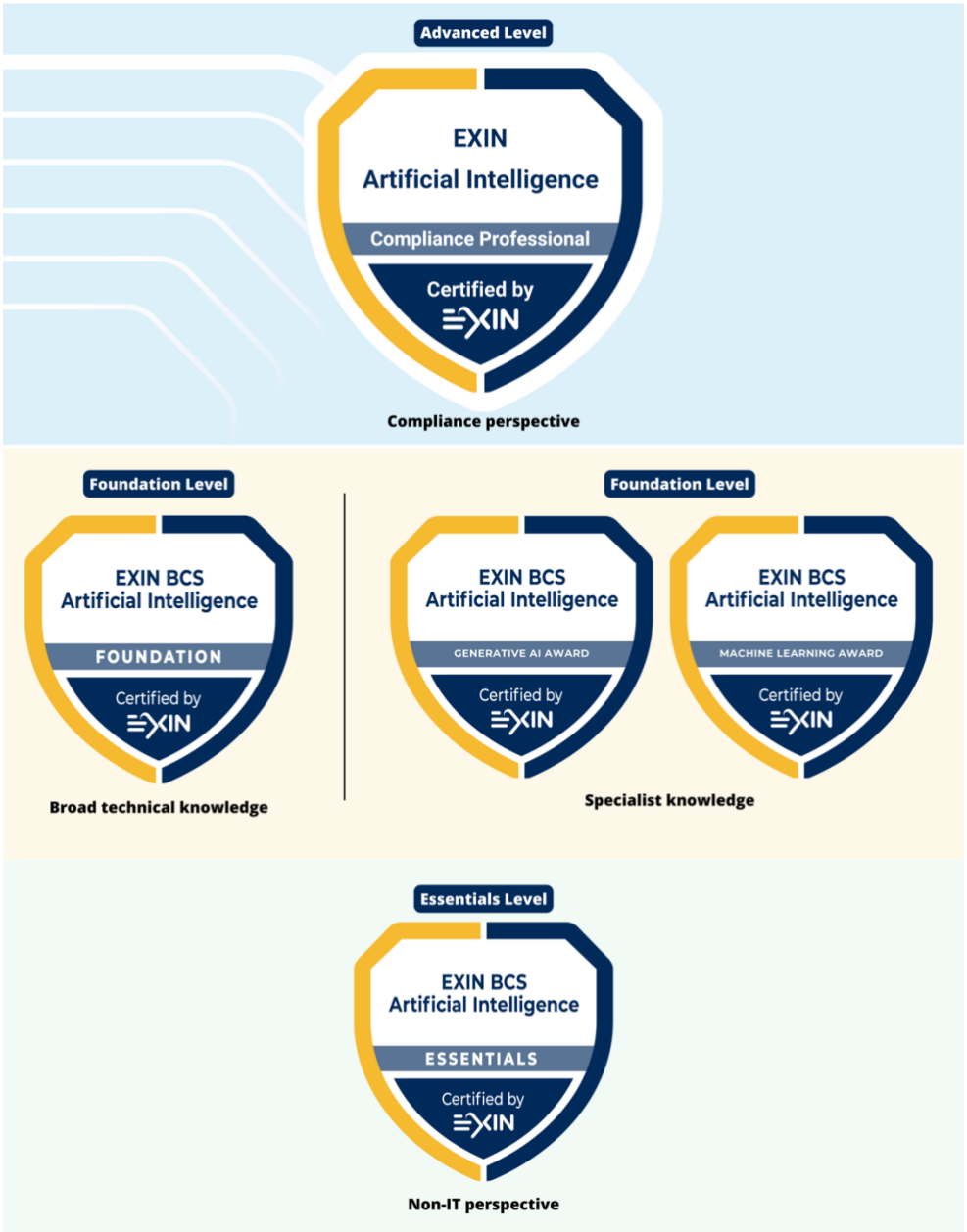
The EXIN BCS Machine Learning Award is designed for individuals wishing to gain an understanding of the principles of machine learning and the process through which it can be developed.

The term ‘machine learning’ has increased in popularity in the last decade and is a technology which is becoming more commonly used within many organizations. With its ability to help solve business problems and develop new customer experiences, there is now a greater demand for individuals with the knowledge and skills to support organizations to successfully implement the technology to deliver improvements.

This award explores what machine learning is and how it is used in practice. It provides an introduction into the different types of machine learning and the tools and techniques required to develop it, including a basic introduction to algorithms. This award will enable candidates to understand these concepts at a foundation level, enabling them to be better informed and equipping them with knowledge which they can build upon through further study and application.

Context

The EXIN BCS Machine Learning Award certification is part of the EXIN Artificial Intelligence qualification program.



Target group

The EXIN BCS Machine Learning Award has been designed for individuals interested in furthering their understanding of the more technical aspects of artificial intelligence (AI). This certification is ideal for candidates who wish to gain an insight into this type of AI technology. Machine learning is becoming much more commonly used. Therefore, it is useful for anyone, regardless of being in IT or in a technical position, to understand what machine learning is, its potential uses and its limitations.

This certification has been created alongside a selection of other awards in the AI space which offer candidates a clear pathway of progression into other disciplines of IT along with a broader knowledge of AI in the workplace. This makes it ideally suited for those looking for a change in career or upskilling their workforce. It is for employers and individuals with a background in science, engineering, knowledge engineering, finance, education or IT services.

Requirements for certification

- Successful completion of the EXIN BCS Machine Learning Award exam.

Examination details

Examination type:	Multiple-choice questions
Number of questions:	18, of which 2 scenario-based questions worth 2 points each
Pass mark:	65% (13/20 points)
Open book:	No
Notes:	No
Electronic equipment/aides permitted:	No
Exam duration:	30 minutes

The Rules and Regulations for EXIN's examinations apply to this exam.

Bloom level

The EXIN BCS Machine Learning Award certification tests candidates at Bloom levels 1 and 2 according to Bloom's revised taxonomy:

- Bloom level 1: Remembering – relies on recall of information. Candidates will need to absorb, remember, recognize and recall.
- Bloom level 2: Understanding – a step beyond remembering. Understanding shows that candidates comprehend what is presented and can evaluate how the learning material may be applied in their own environment. This type of questions aims to demonstrate that the candidate is able to organize, compare, interpret and choose the correct description of facts and ideas.

Training

Contact hours

The recommended number of contact hours for this training course is 8. This includes group assignments, exam preparation and short breaks. This number of hours does not include lunch breaks, homework and the exam.

Indication study effort

28 hours (1 ECTS), depending on existing knowledge.

Training organization

You can find a list of our Accredited Training Organizations at www.exin.com.

2. Exam requirements

The exam requirements are specified in the exam specifications. The following table lists the topics of the module (exam requirements) and the subtopics (exam specifications).

Exam requirements	Exam specifications	Weight
1. What is machine learning?		**20%**
	1.1 Define machine learning	5%
	1.2 Explain different applications of machine learning	2.5%
	1.3 Describe the role of a learning agent	2.5%
	1.4 Explain the concept of deep learning	2.5%
	1.5 Describe the purpose of a neural network	2.5%
	1.6 Illustrate how machine learning compliments knowledge-based systems	2.5%
	1.7 Explain the process through which machine learning works with data	2.5%
2. Coding for machine learning		**20%**
	2.1 Explain the use of at least one coding language used in machine learning	10%
	2.2 Identify common open source and proprietary software used in coding for machine learning	10%
3. Algorithms used in machine learning		**30%**
	3.1 Explain the use of mathematics in enabling a machine to solve numerical problems	8.8%
	3.2 List and describe typical algorithms used in machine learning	8.8%
	3.3 Describe supervised, unsupervised and semi-supervised learning	13.3%
4. Machine learning in practice		**30%**
	4.1 Describe a particular problem that can be addressed through the use of machine learning	7%
	4.2 Outline typical tasks required in the preparation of data for developing a particular application of machine learning	7%
	4.3 Explain the process of training a machine learning model	4.5%
	4.4 Explain the process of testing a machine learning model	4.5%
	4.5 Discuss how to evaluate the results of testing in order to identify the information to be shared with key stakeholders	7%
	Total	**100%**

Exam specifications

1 What is machine learning?

The candidate can…

1.1 define machine learning.

Indicative content

a. Machine learning is a subset of artificial intelligence (AI)
b. "Learning from experience"
c. Tom Mitchell – definition (Academic) iterative, continuous learning (Machine Learning 1997, first publication, 2013)
d. Requirement for talent for learning/mathematics (i.e. data scientist)
e. Application of algorithms to given data to derive insight

Guidance

It is important for candidates to understand that machine learning is a subset of AI. AI itself is not a new concept; machine learning is another step in the evolution of AI. Machine learning is used within data science and is the application of algorithms to derive insight from data and big data.

1.2 explain different applications of machine learning.

Indicative content

a. Prediction
b. Object recognition
c. Classification
d. Clustering
e. Recommendations (e.g. Netflix, Spotify)
f. Generative AI (e.g. ChatGPT, Copilot)

Guidance

Machine learning can be used in a number of contexts to complete different types of tasks. Candidates should be encouraged to explore different examples and applications of machine learning.

1.3 describe the role of a learning agent.

Indicative content

a. Data
b. Single task
c. Learning from experience

Guidance

Learning agents are commonly used in machine learning. Each agent is designed to undertake a specific task using a given amount of data, which they undertake autonomously. Through the repetition of undertaking this task they learn to improve each time. Examples include chatbots, driverless cars, facial recognition.

1.4 explain the concept of deep learning.

Indicative content

a. Universal technique to solve a larger set of problems
b. Neural networks combined with large data sets

Guidance

The application of deep learning (a subset of machine learning) involves the training of large neural networks to process and analyze vast amounts of data to derive greater insight and to solve more complex problems.

1.5 describe the purpose of a neural network.

Indicative content

a. Input > identify patterns in data > output

b. Decision making

Guidance

Neural networks are commonly used in machine learning, particularly in the analysis of unstructured or unlabeled data (e.g. images, handwritten documents), whereby the input data is analyzed to determine any recognizable or similar patterns against other learned bits of data in order to determine the output. Candidates may wish to explore the concept of a neural network by considering technologies that use machine learning such as voice recognition software where the input (captured user's voice) is analyzed and compared against stored patterns (data) to identify the output (a specific action, acceptance of voice command, text-to-speech).

1.6 illustrate how machine learning compliments knowledge-based systems.

Indicative content

a. Knowledge-based systems

b. Complimentary AI technologies

Guidance

A knowledge-based system is a form of AI designed to capture human expertise/knowledge (within a knowledge base) and apply a set of rules to identify an outcome (through an inference engine). Machine learning is data-based and can derive outcomes through the use of algorithms e.g. a neural network. Technologies such as driverless cars may use a combination of different AI applications to perform different tasks. It may include a knowledge-based system to make informed decisions or identity the probable cause of a fault, and it may use a neural network for image recognition for navigation using the car's camera.

1.7 explain the process through which machine learning works with data.

Indicative content

a. The machine learning process

b. Analyze the problem

c. Data selection

d. Data pre-processing

- Cleaning
- Integration
- Transformation
- Reduction
- Wrangling

e. Data visualization

f. Select a machine learning model (algorithm)

- Train the model
- Test the model
- Repeat (learning from experience to improve results)

g. Review

- Peer review
- Learning from multiple algorithms
- Identify best machine learning model

Guidance

The machine learning process allows us to define the solution based on the problem that has been identified through the process of data selection, pre-processing, visualization and testing of data with specific algorithms. Once we are happy that both the data and the algorithms we use, are performing well we can deploy our model. The machine learning process is explored in detail by Google director Aurélien Géron; recognize the problem, define data, check algorithms, improve results, present results.

There is no de facto method within machine learning, learning through experience is vitally important. Testing involves creating the correct test data, creating bins to learn from and bins for what you wish to test.

2 Coding for machine learning

The candidate can…

2.1 explain the use of at least one coding language used in machine learning.

Indicative content

a. Object-oriented programming languages
- Python
- R
- C++
- Java

b. Libraries/templates

Guidance

Candidates should be familiar with common programming languages and their use, although it is not expected that they are fluent in using them. Python is a very popular language used in machine learning and data science. Libraries are used to bundle functions into templates that include the use of different programming languages e.g. Python.

2.2 identify common open source and proprietary software used in coding for machine learning.

Indicative content

a. TensorFlow
b. R Studio
c. Cuda
d. Scikit-Learn
e. MATLAB

Guidance

Candidates should be encouraged to explore some of the known software and programming environments used in programming machine learning. It is not expected that they are proficient in their use however they should be familiar with at least one software.

3 Algorithms used in machine learning

The candidate can…

3.1 explain the use of mathematics in enabling a machine to solve numerical problems.

Indicative content

a. Probability (Bayes' theorem)
b. Statistics
- Descriptive statistics
- Inferential statistics

c. Linear algebra

Guidance

It is important for candidates to have a basic understanding of the mathematics used within machine learning, regardless of whether the software they go on to use handles this automatically. Bayes' theorem is a method which can be used to calculate probability where other probabilities are known. Understanding the basic principles of linear algebra will provide them with the foundation on which to better understand machine learning and in implementing algorithms.

3.2 list and describe typical algorithms used in machine learning.

Indicative content

a. Regression algorithms, e.g.:
- Linear regression
- Polynomial regression

b. Classification algorithms, e.g.:
- K-nearest neighbors
- Decision trees
- Logistic regression

c. Clustering algorithms, e.g.:
- K-means
- Hierarchical

Guidance

Candidates should have a basic understanding of some of the common algorithms used in machine learning and where they may be used in supervised or unsupervised learning. It is not essential at this level for them to understand the specific formulas used within each algorithm, however it is certainly advantageous to have a basic understanding of the mathematics involved in order to make it easier to program machine learning. You may wish to further challenge candidates by looking into the use of boosting, decision forests, and ensembles.

3.3 describe supervised, unsupervised and semi-supervised learning.

Indicative content

a. Supervised learning
b. Unsupervised learning
c. Semi-supervised learning

Guidance

It is useful for candidates to have a basic understanding of the different types of approaches to machine learning to understand how it can be used to work with different types of data and where different algorithms are best used. Supervised learning involves the application of an algorithm to labeled data to solve a problem, for example classification, where we know what the output will be.

Unsupervised learning involves the application of an algorithm to unlabeled data to solve a problem, for example clustering (grouping data based on similarities).

Semi-supervised learning involves the application of an algorithm where during the training of the algorithm we begin with a small amount of labeled data and then introduce a larger amount of unlabeled data.

Candidates may be encouraged to also consider reinforcement learning which is commonly used in gaming.

4 Machine learning in practice

The candidate can…

4.1 describe a particular problem that can be addressed through the use of machine learning.

Indicative content

a. Problem identification
b. Requirements for data collection
c. Proposing the machine learning solution

Guidance

Candidates should be encouraged to identify a specific problem which could be solved through implementing machine learning.

4.2 outline typical tasks required in the preparation of data for developing a particular application of machine learning.

Indicative content

a. Data pre-processing
b. Data transformation
c. Importing/loading data

Guidance

Candidates should be able to outline the tasks they would need to undertake to prepare the data for use within an application of machine learning. This may include steps such as cleaning the data, data validation, and data transformation to ensure it is in a suitable format for using within a chosen software.

4.3 explain the process of training a machine learning model.

Indicative content

a. Requirements for training
b. Setting up training bins for data
c. Selecting an algorithm
d. Rules
e. Supervised, unsupervised, semi-supervised

Guidance

Candidates should be able explain the process of training a particular algorithm using their prepared data

4.4 explain the process of testing a machine learning model.

Indicative content

a. Testing
b. Tuning
c. Ensembles
d. Statistical testing
e. Review

Guidance

Candidates should be able to explain the process through which they tested a particular algorithm using their prepared data and how they identified whether it was performing well. They may use a number of methods to test their algorithm, and they may wish to test and compare multiple algorithms.

4.5 discuss how to evaluate the results of testing in order to identify the information to be shared with key stakeholders.

Indicative content

a. Evaluating findings
b. Identifying relevant information for your stakeholders/context
- What have we learned?
- Have we been able to address the problem?
- What next?
- Learning from experience

c. Drawing conclusions
d. Communication techniques/methods

Guidance

Candidates should be able to explain how they would go about identifying the key pieces of information to share with their stakeholders. They should also explain key considerations for sharing information with stakeholders e.g. type of information, presentation, language and use of technical terms, being prepared to answer questions.

3. Levels of Knowledge / SFIA Levels

This certification provides candidates with the level of knowledge highlighted within the table, enabling them to develop the skills to operate at the levels of responsibility indicated.

Level	Levels of Knowledge	Levels of Skills and Responsibility (SFIA)
K7		Set strategy, inspire and mobilize
K6	Evaluate	Initiate and influence
K5	Synthesize	Ensure and advise
K4	Analyze	Enable
K3	Apply	Apply
K2	Understand	Assist
K1	Remember	Follow

SFIA Plus

This syllabus has been linked to the SFIA knowledge, skills and behaviors required by an individual at level 3.

KSB01	Acquiring a proper understanding of a problem or situation by breaking it down systematically into its component parts and identifying the relationships between these parts. Selecting the appropriate method/tool to resolve the problem and reflecting critically on the result, so that what is learnt is identified and assimilated.
KSB03	Understanding the metrics associated with a problem or situation, their significance and relationship, and being able to manipulate these as necessary to identify solutions.
KSC16	A set of codes and syntax (supported by software tools) which enable the unambiguous translation of specified functionality into “source code” for the creation of computer programs. Examples, but not limited to: Scripting languages - Perl and other languages - C++. Methods and techniques for ensuring valid results are obtained by means of sampling.

Further detail around the SFIA Levels can be found at www.bcs.org/levels.

4. e-CF mapping

All e-Competence Framework competences related to the EXIN BCS Machine Learning Award certification can be found below. Also indicated is the level of the competence and whether the competence is covered entirely, partially or superficially. For more information about the e-CF, please visit https://itprofessionalism.org/ or contact EXIN.

Competence is covered Partial coverage Superficial coverage

e-Competence Level		1	2	3	4	5
A.10.	User Experience					
D.7.	Data Science & Analytics					

5. Literature

Exam literature

The knowledge required for the exam is covered in the following literature:

A. Aurélien Géron
Hands-On Machine Learning with Scikit-Learn, Keras, and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems
O'Reilly (2022)
ISBN: 978-1098125974

B. Oliver Theobald
Machine Learning for Absolute Beginners: A Plain English Introduction
Independently published (3rd edition, 2021)
ISBN: 979-8558098426

C. Gilbert Strang
Linear Algebra and Learning from Data
Wellesley-Cambridge Press (1st edition, 2019)
ISBN: 978-0692196380

D. Andrew Lowe, Steve Lawless
Artificial Intelligence and Machine Learning Foundations: Learning From Experience
BCS (2024)
ISBN: 978-1780176734

E. Sarah Burnett
AI in Business: Towards the Autonomous Enterprise
BCS (2024)
ISBN: 978-1780176673

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