The Netherlands AI Coalition (NL AIC)
AI Fundamentals

The 'AI Brevet'

Artificial Intelligence Brevet

Syllabus

NL AI Coalition

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INTRODUCTION

AI – the driving force of a new industrial era

Self-driving vehicles, voice and image recognition, healthcare analysis, robots and personalised information on social media – Artificial Intelligence (AI) has permeated our world, changing our society, our economy and our lives. AI based applications are central to the business model of some of the most powerful and successful commercial businesses today. AI itself is however not new – it has been with us since the 40's - inspiring the science fiction genre in entertainment.
Many of the algorithms that we use today were invented and scientifically proven in the 1950's. The difference between then and now is the availability of data and low-cost communication and computing power with which we can now apply algorithms to create innovative, smart applications of AI.

With such a powerful tool that AI represents, comes great responsibility. In parallel with the applications which benefit society, we have also witnessed applications of AI which can cause great harm to society, undermine democracy, increase discrimination and raise many ethical questions. Military applications have transformed warfare and sovereign governments view AI capability as a strategic national capability.

Will AI take over humans? Some believe this may happen, but long before then, the humans who use AI will take over from the humans who don't, and the companies which apply AI will take over from those who don't. This raises a new business and societal imperative – to educate leaders, managers, governments, consumer protection organisations, and a broad cross section of our society on what AI is (and is not), what benefits we can enjoy with it, and how to deal with the risks and ethical questions which it raises.

The Netherlands AI Coalition

The Netherlands AI Coalition (NL AIC) is a public-private collaboration which aims to promote the responsible use of AI within the Netherlands. The coalition consists of government, business, educational institutions and communities working together to accelerate AI developments and to share and connect initiatives.

With the Human Capital Agenda (HCA), the NL AIC supports a set of initiatives which aim to raise awareness and capability in the field of AI in The Netherlands. This includes tertiary education at bachelor and masters levels, PhDs and lifelong learning. For more information and activities concerning the AI Coalition refer to the NL AIC website.

The Professional Certification Programme (described in this document) is part of the HCA and is aimed at providing recognised certifications for competency in AI. Whilst this may typically be achieved by participants following short education paths, the focus of this certification is the competence of professionals as demonstrated by successfully passing an exam, based upon a syllabus issued by NL AIC. The Professional Certification Programme

does not accredit training programmes, nor require that participants have followed a training programme.

This programme is therefore complementary to other tertiary education programmes which aim to develop a deeper understanding of AI, how it operates with underlying algorithms, approaches and specialist techniques.

Intended Audience

The AI Brevet, for Business & Government Certification, is aimed at executives, managers and professionals who wish to progress beyond basic awareness to acquire an understanding of what AI is, how it works and where it can be applied – including both benefits and risks.

It is therefore ideal for people for whom the concept of AI is relatively new and who wish to become competent in AI, are considering becoming involved in the application of AI or who must make informed decisions about the application of AI in their business domain.

Level	Objective	Target Groups
AI Brevet, for Business & Government	Able to identify applications for AI. Aware of how models are built and assessed. Able to make informed decisions on the use of AI.	Executives, managers and professionals who are considering becoming involved in AI or who will make decisions in relation to the use of AI in their environment.

The AI Brevet

The AI Brevet, for Business & Government Certification, recognises awareness and understanding of the components of AI and how to foster its adoption and application in a manner which benefits business, government and society at large. This involves considering both benefits and the ethical questions and risks of this powerful new technology.

The AI Brevet Certificate is achieved through an exam which demonstrates that a participant:

- Appreciates what AI is, why it is important now and what benefits it brings
- Is aware of fundamental concepts such as robotics, algorithms and machine learning approaches
- Is aware of how to organise a team for AI, approaches and common tools required
- Understands the dependence AI has upon data and how to manage data for AI
- Is aware of how to assess risks and ethical dilemmas for Trustworthy AI
- Can describe how humans and machines will coexist in an organisation
- Is aware of the future directions of AI

The syllabus outlines the knowledge that the candidate will be tested on during the Exam. It also provides suggestions for preparation (background reading) and highlights the benefits of taking this exam.

Certifying Organisation

The NL AIC has chosen Van Haren Learning Solutions as certifying organisation for the provision of the AI Brevet. Van Haren Learning Solutions is an established and full service provider of certification programs.

The role of Van Haren Learning Solutions is to operate the certification on behalf of NL AIC. This includes, among others, the following activities:

- Offering the exam in a controlled environment which enables candidates to take the exam in accordance with the exam procedure.
- Evaluation and feedback of exam results to candidates.
- Issuing the certificate to the successful candidates.

The AI Brevet can be found via this link: https://www.vhls. global/van-haren/certification/the-nl-aic-ai-for-business/.

THE AI BREVET EXAM

You first need to have successfully completed the AI Brevet, for Business & Government Exam to obtain the AI Brevet. The exam procedure is explained in this section.

Practical information

You must pass a multiple-choice exam in which your knowledge of AI will be tested to obtain an AI Brevet. All exam candidates will get access to the online exam environment and will need to answer 60 multiple-choice questions within 60 minutes.

You must answer 65% of the questions correctly (or at least 39 of the 60 questions) to pass. Each question has precisely four possible answers where only one is the best answer.

You will receive the result immediately after the exam. (Digital) Access to your certificate will be given once you have passed.

Registration for the exam can be done by purchasing a participation certificate via Van Haren.

Number of questions:	60
Time (minutes) for the exam:	60 minutes
% minimal passing grade	65%
Open/closed book:	Closed
Language:	Dutch and English.
Exam format:	Online
Type of questions:	Multiple choice
Are there also negative questions included in the exam? *(for example: "which of the following is NOT a machine learning method")*	Yes. Candidates are advised to read the questions carefully.

Levels

The AI Brevet tests candidates at levels 1, 2 and 3 according to the Bloom Revised Taxonomy. The exam requires delegates to comprehend the theory for 85% at Bloom level 1 & 2 and 15% at Bloom level 3.

Bloom Level 1: Recall & Retention

We test candidates on their ability to memorize factual information, to retain information by collecting, remembering, and recognizing specific knowledge. Knowledge includes facts, terms, answers, or terminology.

Bloom Level 2: Understanding

We test candidates on their ability to construct meaning from oral, written, or graphical pieces of information. This is done by interpreting, summarizing, distracting, comparing, classifying, predicting, or explaining the message.

Bloom Level 3: Applying

Being able to solve problems by applying them in existing and new situations, leveraging acquired knowledge techniques, facts, and rules in various situations. This can include choosing or identifying to correct answer between a range of options or appropriate actions.

Your investment

The AI Exam requires preparation, which means this is an investment in time for personal study and attention for the subject of AI. You are completely free to do this in several ways and can consider self-study, reading the reference materials listed in the syllabus or following a training programme which is designed in line with this syllabus.

Refer to the list of topics in this syllabus. Here you can see which subjects you will be tested on during the exam. The time it takes to prepare for the exam depends on your prior knowledge, experience, and training. Commercially offered training programmes that prepare for the AI Brevet Exam will typically last 2 to 3 days. You should allow sufficient time for self-study to address the subjects listed in this syllabus.

Preparation and recommended literature

During your exam preparation, you will familiarise yourself with the concepts of AI for example by following a course and reading specified literature. There are ongoing publications about AI.

So, it should be straightforward to find books, articles, blogs, vlogs, or videos about the different aspects. We include a recommended reading list in this syllabus.

We also advise you to contact people who work with AI and observe what they do and see the techniques they use - and talk to them.

We have included the following in the syllabus to help you get started:

- Specifications of the examination material - divided into modules.
- How each individual module weighs towards the overall exam.
- A list of key terms and concepts detailing what must be covered.
- Literature suggestions are available for newcomers in field. Note many of the AI concepts are established for some time and widely accepted with online and offline reference materials available.
- A practice exam is available online after purchasing an exam. The practice exam contains questions at the same level as the questions in the actual exam. The number of questions may differ from the actual exam. The actual exam includes 60 questions and you will have 60 minutes to answer them.

Preparation training

We endorse the added value of thoroughly preparing for the AI Brevet Exam and strongly recommend preparatory classroom training, webinars and online eLearning journeys. This can help you to understand the essence of AI and can give you practical examples. That said, it is not mandatory to follow specialised training.

The Netherlands AI Coalition does not accredit trainers, training institutions or training programmes. The composition and duration, organisation, pricing, and execution of the training is the responsibility of the trainer.

TOPICS IN THE AI BREVET EXAM

In this section, you can read about how the AI Brevet Exam is structured and which subjects you will be tested on as a candidate. It is also a tool that you can use to prepare yourself for the test.

In this syllabus we indicate the topics which are covered in the exam and additional topics which are relevant for further study but not covered in the exam. During the exam you will be tested on your general knowledge about:

Section 1: AI Fundamentals

1.   Applications of AI and their benefits

Describes a range of applications of AI, how they impact organisations & society, what value they create and their underlying use of data, algorithms and learning approaches. Describes the role of the NL AIC in promoting the beneficial and ethical use of AI. Includes examples of key domains such as classification systems, forecasting, cluster analysis, voice, image and Natural Language Processing. Addresses Large Language Models such as ChatGPT and the use of Generative AI and Prompt Engineering for generation of text, software, images, videos etc.

2.   Data, Robots and Artificial Intelligence including definitions

This sets out a common vocabulary around data, data science, algorithms, human logical thinking versus intelligent agents and provides definitions for key items. Describes Intelligent Agent types, robotics and agent models.

3.   Predictions, Algorithms, Machine and Deep Learning

Introduces the different levels of predictions, an overview of the key algorithms and the learning approaches. Highlights which types of algorithms address which types of problems.

Section 2: Applying AI in practice

4.   Building and assessing an AI application

Describes a basic approach towards building a simple AI application. The CRISP-DM method is described highlighting the steps involved and raising awareness of the business context and trustworthiness assessment at each step. Highlight pitfalls including overfitting, underfitting and bias. Addresses need for innovation and creativity including team organisation.

5. Managing Data for AI

Raises awareness of the dependence upon data and how to acquire, prepare, manage, provide and scale data for AI applications. Addresses the role of the cloud for managing data and processing capability. Emphasise the risks that arise in data and impact on trustworthiness.

Section 3: Ethics, Risks, Trustworthiness and Human Machine Coexistence

6. Ethics, Risks and Trustworthiness

Identify the risks and ethical dilemmas associated with AI including the need for explainable AI. Introduce EU Ethical Guidelines and the need to maintain the trust of society in the use of AI. You will become familiar with the different risk levels of AI applications as described in the EU AI Act.

7. Human and Machine Coexistence

Covers the combination of human and machine capability in an organisation addressing the question of whether AI will replace humans (singularity). Includes key roles of business management, domain expertise, analytics and data managers, and how these roles work together. Finally, the rise of and dealing with generative AI is also addressed.

Section 4: Future developments of AI

8. The future developments of AI

Highlight future directions and applications of AI.

The exam is not a test of:

- Programming ability or working knowledge of specific toolkits
- Mathematical basis of algorithms

Exam structure

The exam specifications describe the topics in the subject matter of the AI Brevet Exam, and their relative importance. Questions can be asked during the exam about the following subjects.

Module		Sub-module	Bloom -level	% exam question
1.	Applications of AI and their benefits	Describes a range of applications of AI, how these applications affect organizations and society, what value they create and their underlying use of data, generative AI, algorithms and learning approaches. Describes the role of the NL AIC in promoting the beneficial and ethical use of AI. Includes examples of key domains such as classification systems, forecasting, cluster analysis, speech, image and natural language processing.	1	10%
2.	Data, Robots and Artificial Intelligence	This describes a common vocabulary around data, data science, algorithms, human logical thinking versus intelligent agents and provides definitions for key items. .	1	5%
3.	Predictions, Algorithms, Machine and Deep Learning	Introduces the different levels of prediction, an overview of the main algorithms, generative AI modeling incl. Large language models, possibly stable diffusion and learning approaches. Emphasizes which types of algorithms address which types of problems.	1+2	25%
4.	Building and assessing an AI application	Describes a basic approach to building a simple AI application. Describes the CRISP-DM methodology, highlighting the steps involved and increasing awareness of the business context and reliability assessment incl. hallucinations and deep fakes at each step. Highlights pitfalls such as overfitting, underfitting and biases. Addresses the need for innovation and creativity, including team organization.	1	15%
5.	Managing Data for AI	Explains awareness of data dependence and how data can be acquired, prepared, managed, provided and scaled for AI applications Addresses the role of the prompt engineer, and of the cloud in managing data and processing capacity. Emphasizes the risks that arise in data and affect reliability.	1	10%
6.	Ethics, Risks and Trustworthiness	Addresses the risks and ethical dilemmas associated with AI, including the need for explainable AI. Introduces EU ethical guidelines, the EU Act and the need to maintain society's trust in the use of AI.	1+2 +3	20%
7.	Human and Machine Coexistence	Covers the combination of human and machine capabilities in an organization that answers the question of whether AI will replace humans (singularity). Covers key roles of the prompt engineer, business management, domain expertise, analytics and data managers, and how these roles work together and make AI accessible	1+2	10%
8.	The future developments of AI	Highlights future directions and applications of AI.	1	0%

Exam Specifications

TOPIC 1 Applications of AI and their benefits

AI is all around us. AI has overtaken humans in some areas such as playing games but still cannot solve difficult or ambiguous problems. There are many benefits of AI applications such as smart propositions, improved service, increased efficiency, human safety and lower costs.

Not all areas involve learning or cognitive functions and are therefore not AI e.g. data visualisation, robotic process automation or data mining etc.

Examination goal

- Recall of facts and concepts
- Ability to detect applications of AI (and differentiate when not AI)

Elements included in exam

- Importance of data, platform / data driven business models, 4th Industrial Revolution, Singularity
    - Why is AI in an acceleration phase now – availability of data
    - What is "data driven" and how this impacts business models / ways of working

- What is AI
    - How and when AI arose, Founding fathers
        - 1956 conference ° Turing test
        - Already defined many years ago
    - Intelligent Agent concept
        - In Computer Science the general term is 'Agent'

- Definition of Human and Artificial Intelligence (AI)
  - ° Robert Dilt's logical levels versus human thinking and existence
    - Use Dilt's logical levels as reference for cognitive taxonomy
    - Link Artificial Narrow, General, Super Intelligence to the Dilt's levels
    - Test using examples how far AI ascends the Dilt's levels
- Understanding different application areas and benefits of AI:
  - ° Benefit lies in application – to make faster, better decisions
  - ° Text and Speech, Voice Recognition, Chatbots and Turing test
  - ° Expert Systems (classification models)
  - ° Image recognition, Facial Analysis, Image to text, Video Analysis and synthetic human
  - ° Augmented / Virtual reality and learning
  - ° Natural Language Processing (NLP), ChatGPT and Generative AI
    - Exam test – what is and is not AI
    - Difficult problems can't be solved by AI e.g. regional conflicts, your marriage

Additional reference elements (for background reference or further study, not included in exam)

- Milestones in development, IBM's deep Blue etc, Neural Network and Large Language Models etc.
- Blooms cognitive taxonomy vs AI capability
  - ° Dilts is preferred due to reasoning and identity (missing in Blooms)

TOPIC 2 Data, Robots and Artificial Intelligence

Understand difference between data, information and knowledge. Recent acceleration in the availability of data, low cost processing power, high bandwidth networks and many IoT and Edge devices created the conditions for AI to be applied in many areas. Understand different levels of Intelligent Agents and Robotics (Russel/Norvig model).

Examination goal

- Recall of facts and concepts
- Ability to detect application of robotic levels in real world situations

Elements included in exam

- Definitions for data, information, knowledge, intelligence
- Robotic paradigm
  - ° What is a paradigm – robotic paradigms
  - ° Robotics versus intelligent agents
- Definition of Intelligent Agents and characteristics
  - ° Robots and intelligence – Russel / Norvig levels
  - ° Rational agent concept and dependencies (Environment, Sensors, Performance, Actuators)
  - ° Overview of agent types: Simple reflex, Model based, Goal-based, Utility based and Learning
  - ° Relationship between Agents and Machine Learning
  - ° Humans adopting AI wearables

Additional reference elements (for background reference or further study, not included in exam)

- Descriptions and differences in Agent types: Simple reflex, Model based, Goal-based, Utility based and Learning
- Adversarial games with intelligent agents (predict opponent's actions)
- Use of Intelligent Agent in social media, AdWords, recommender engines etc

TOPIC 3 **Predictions, Algorithms, Machine and Deep Learning**

The key techniques that constitute AI centre around the ability to make predictions, apply algorithms, enable machine learning through different techniques and understand the fundamental shift with deep learning. The exam requires that the participant knows of these techniques, the differences between them and when they should be applied.

Examination goal

- Recall of facts and concepts
- Aware of elements and their purpose
- Aware of fundamentals and impact upon models
- Note: the participant is not expected to be able to apply algorithms

Elements included in exam

- Data Analytics
  - ° Descriptive, diagnostic, predictive and prescriptive analytics
  - ° Differences between explaining past and predicting the future
  - ° Generic approach to data analytics including dependence upon data
- Common problem types ° Classification
  - ° Regression
  - ° Time series forecasting
  - ° Cluster analysis
  - ° Anomaly detection
  - ° Association discovery

- Fundamentals – an overview
  - ° Correlation vs causation
  - ° Key metrics of ML: precision and recall, confusion matrix
    - Questions on this

- ° What is Probability Density Function (PDF)
  - Probability instead of absolute values
  - Vector (one dim array), Vector Calculus
  - Hardware developing to support this (no questions on this)
- ° Overfitting, bias variance trade-off
  - Questions on this (including overfitting vs underfitting)

- Types of Machine Learning
  - ° Learning from experience – Tom Mitchell definition
  - ° (Semi-)Supervised learning
  - ° Unsupervised learning
  - ° Reinforcement learning

- Overview of Common algorithms / techniques
  - ° Understanding that different algorithms are relevant for different problem types
  - ° Bayes Network and Inference
  - ° Naive Bayes
  - ° K-Means and KNN (K- Nearest Neighbours)
  - ° SVM (Support Vector Machine)
  - ° Random Forest
  - ° Linear regression
  - ° Logistic regression
  - ° Deep learning
    - Understand neural network basics, nodes, back-propagation and learning
    - Understand that deep learning does feature extraction itself
    - Algorithm no longer chosen by human – derived by network °Need to explain

  how conclusions are derived in a neural network
    - Large Language Models, Stable Diffusion and Generative AI.

Additional reference elements (for background reference or further study, not included in exam)

Fundamentals – in depth review and application
- ° Fundamentals of hypothesis testing
- ° Test/train/validate split and k-fold cross validation
- ° Best fit to data / Boosting / Kolmogorov 3 statistical axioms (1933)
- ° Use of hyper parameters to tune performance

- Common algorithms / techniques in practice
  - ° Choosing best algorithms for different problem types and limitations etc
  - ° Application of algorithms (listed above)
  - ° Mathematical basis of algorithm and how to assess outcome

TOPIC 4 **Building and assessing an AI application**

An AI application is built for a purpose and the value of AI is in its implementation. We begin with a "question to be answered" and progress through a process to choose the algorithm, learning approach and data required to answer the question. The overall approach and generic activities within each step of the approach should be known. The participant should be aware of pitfalls at each step and the need to assess the trustworthiness of a model.

Examination goal

- Recall of facts and concepts
- Aware of steps in an AI project
- Aware of roles in an AI project
- Aware of key tools and purpose
- Can apply organisational and procedural knowledge to an AI project

Elements included in exam

- Awareness of key tools for AI
  - ° Functionality, Software and Hardware
  - ° Use of cloud, batch/real time streaming, scalability
  - ° Visualisation at all phases, opensource tools e.g. ParaView – example contour lines
  - ° Online learning for fast moving or large data sets
  - ° Awareness of programming languages (Python, R)
  - ° Awareness of key software libraries (Scikit, TensorFlow) and Data Science Platforms
  - ° Awareness of no code / low code approach
  - ° Automatic ML

- Awareness of a generic approach (CRISP-DM) to building a model:
  1. Business Understanding
     - need to understand the business environment and question to be answered
  2. Data Understanding
     - need to understand the data that we need versus what is available

3. Data Preparation and validation
   - Training and test split
   - Cleaning and combining to create a trustworthy data set
   - Data annotation, synthetic data generation
   - Consideration of bias, outliers, unusual patterns etc
   - Handling missing data, the imputation problem
   - Recognising special values as invalid data (e.g. date 99-99-9999)

4. Modelling
   - Choosing an algorithm and processing the data
   - Understanding the outcome
   - Use of a cost function to evaluate model performance

5. Evaluation
   - Basic understanding of how to evaluate a model per main model type
   - Business relevance and data analytics validation (link to Trustworthiness)

6. Deployment / Presentation
   - Basic understanding of deployment and maintenance of models
   - Consider difference in environments and performance, speed issues

- Assessing the risks of a model – an overview
  - Understanding pitfalls and risks at each stage of the CRISP-DM process
  - Awareness of key pitfalls: overfitting, underfitting, bias, low data quality, IT security

- Organising the AI Project team
  - Gartner claims 85% of AI projects fail (2018), difficulties of getting into production
  - Roles needed – domain expert / agile coach / mathematics / programming etc
  - Need to be iterative, reflective, collaborative and open to learn (agile vs waterfall method)
  - Concept of Fit for Purpose and need for domain expert to assess this

Additional reference elements (for background reference or further study, not included in exam)
- Ability to apply key tools for AI
- Building and assessing a (simple) AI model
- Applying the CRISP model with assessment of result at each stage and iteration
- Using a programming language and library
- Ability to use a basic (AutoML) tool to produce a simple AI model with supplied data
- Difference in Data Science and IT system delivery approaches / culture

TOPIC 5 **Managing Data for AI**

Data makes or breaks an AI model. Without good quality and sufficient data, no model is trustworthy and many problems with AI applications can be traced back to bias or quality problems with data, rather than failures of an algorithm. Data is a key success factor for any AI initiative and the foundation certificate demonstrates that the holder understands this and has a generic knowledge of how to manage data for a trustworthy AI application.

Examination goal

- Recall of facts and concepts
- Aware of roles required to manage data
- Aware of key activities necessary to manage data (and link with Trustworthiness)

Elements included in exam

- What is data
  - ° Basic data literacy (Data, Information and Knowledge)
  - ° Semantic and Syntax of data
  - ° Privacy and data
  - ° Types of data e.g. structured, unstructured, text, image, video, up to 3D scans
  - ° Awareness of the deductive potential that lies within data (e.g. GPS location)
- What is data management – overview of the key elements:
  - ° Data Governance
  - ° Data Strategy
  - ° Data Architecture (including meta data and ontology)
  - ° Data Storage and Sharing (incl lineage)
  - ° Data Security ° Data Quality
  - ° FAIR and Linked data concept

Additional reference elements (for background reference or further study, not included in exam)

- Frameworks for data sharing
- FAIR and Linked Data
  - ° RDF and JSON in relation to sharing

TOPIC 6 Ethics, Risks, and Trustworthiness

AI is a powerful tool which can be used in a positive or a negative manner. There are already numerous examples of malicious applications and ethical questions which arise through the presence of AI. The exam ensures that the participant has a firm grounding in ethics and responsible use of AI and is aware of the key societal concerns around AI.

Examination goal

- Recall of facts and concepts
- Aware of risks and ethical issues with AI
- Aware of EU Approach to Ethical AI and Trustworthiness Framework

Elements included in exam

- Give examples of ethical questions, dilemma's and limitations of AI

  ° Fake news and mass, individual manipulation

  ° Medical diagnosis without permission

  ° Data used by one party to help you and another to charge you a higher price etc

  ° Synthetic human and video manipulation

  ° Discrimination and unintended bias in data

  ° Privacy versus security

  ° Surveillance using geographic location, image recognition and privacy concerns

- General definition of ethics and awareness of ethical guidelines (EU Framework)

  ° EU approach to Human Agency, Ethical Purpose and Trustworthy AI

- Aware of society concerns and objections to the use of AI

  ° Understand Ethical Purpose = Trustworthy and technical robustness

  ° Concept of Universal Design (Design for all)

  ° Human values versus use of AI and changes to humans, society and organisations

- Trustworthiness of AI

  ° Definition of Trustworthiness (EU Guidelines, ISO Standardisation)

  ° Awareness of trustworthiness including 7 criteria in EU definition

  ° Understand need for continual assessment and monitoring of AI

- Understand need for transparency
  - ° Aware of "Explainable AI"

- Aware of regulation and normalization for AI

Additional reference elements (for background reference or further study, not included in exam)

- UN three areas approach (Social, Economic, Environmental) to 17 sustainable goals
- Assessing trustworthiness using the 7 criteria in EU definition
- Security or military considerations
- Explainable AI
- Emerging standards e.g. ISO/NEN

TOPIC 7 **Human and Machine Coexistence**

Will AI take over from humans? Some think so (Singularity) but there is no evidence as yet that AI can ascend beyond the most basic layers of the cognitive taxonomy (Blooms or Dilt). The application of AI does however bring significant benefits and the companies or people who use AI can take over from those who don't. This requires an understanding of how to combine human and machine capability for success.

AI can play a key role in replacing humans in some specific areas such as data analysis, applying simple repetitive tasks, lifting heavy loads, warehouse operation or performing dangerous activities such as bomb disposal or working in a hazardous environment.

Examination goal

- Recall of facts and concepts
- Aware of singularity and counter arguments
- Aware of logical levels and position of human versus machine
- Aware of how to combine human with machine capability

Elements included in exam

- Able to list opportunities for AI including where humans and machines work together
  - ° e.g. radiologist using AI to analyse 3D scans to measure volume of tumour pre/post op
  - ° Use of smart wearables to aid human capability
- Awareness of a cognitive taxonomy and ability to describe AI with reference to one (Dilt)
  - ° Understand Narrow, General and Super Intelligence and map to taxonomy
- Understand the strengths and weaknesses of humans versus machines
  - ° Understand how to combine the strengths of humans with those of machines
    - Humans: higher value, cognitive tasks
    - Machine: dangerous, heavy lifting, monotone, analysis tasks
  - ° Machine learning will force humans and machines to work together
  - ° "Human in the loop" learning
  - ° "Cognitive augmentation" – magnifying human or organisational capability

       °   Identify key competencies needed by humans to work with AI and key roles of business management, domain expertise and analytics, and how these roles work together.

- Understand need to enable innovation and discovery within an AI initiative

Additional reference elements (for background reference or further study, not included in exam)

- Hard problem of consciousness (Chalmers)
- Human plus Machine – Daugherty Wilson
  - ° AI helps humans become more human ° Need to be more experimental, Agile
  - ° Missing middle between human and robot

TOPIC 8 **The future developments of AI**

AI is seen as a source of competitive advantage by business leaders but also a source of national competitive and strategic importance by sovereign governments. There are many initiatives providing funding for research and development of AI in addition to the application of existing AI technology.

Examination goal

- Recall of facts and concepts
- Aware of key future developments as identified/updated by the NL AIC

Elements included in exam

- Be aware of future developments in human / AI combination
- Quantum computing and neural networks
- Augmented human
- Fully autonomous driving and flying vehicles
- Reasoning?
- Cybernetics
- Virtual Assistants
- Human-device interaction
- Large Language Model developments

Additional reference elements (for background reference or further study, not included in exam)

- Fifth Industrial Revolution – in Space
- Regulatory developments e.g. EU AI Act

Exam topics and recommended literature

Despite being a highly innovative and future oriented topic, AI is not new. The first AI algorithms were developed in the 1950's and there is considerable literature around which helps the participant to learn about AI in all its facets. In addition, Wikipedia contains much of the information referenced in this syllabus.

In the table you will find a set of recommended literature.

	Subject	Recommended Literature
1.	Programming and Libraries (Optional)	Title: *Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems* Author: Aurélien Géron Publisher: O'Reilly Publication Date: 2017 ISBN 1491962291.
2.	Algorithms (Optional)	Title: *Linear Algebra and Learning from Data (1st edition)* Author: Gilbert Strang Publisher: Wellesley-Cambridge Press Publication Date: 2019 ISBN: 13 978-0692196380.
3.	Background to Machine Learning (Optional)	Title: *Machine Learning* Author: Tom Mitchell Publisher: McGraw-Hill Publication Date: 1997 ISBN: 0071154671.
4.	4th Industrial revolution (Required)	Title: T*he Fourth Industrial Revolution* Author: Klaus Schwab Publisher: Penguin Random House Publication Date: 2016 ISBN: 978-0-241-30075-6
5.	Ethics (Required)	Title: *Ethics Guidelines for Trustworthy AI* Author: High-Level Expert Group on Artificial Intelligence Publisher: European Commission B-1049 Brussels Publication Date: April 2019.
6.	Singularity (Optional)	Title: *The Singularity is Near* Author: Ray Kurzweil Publisher: Duckworth Overlook Publication Date: 2005 ISBN: 978-0715635612
7.	Additional optional literature:	Titel: *Dit is kunstmatige intelligentie* Authors: Simon Koolstra, Belle De Veer en Tijmen Veltman ISBN: 9789401808262

EXAM REGULATIONS

General rules

An AI B r e v e t , for Business & Government, via the AI Coalition is an honorary title, and fraud is not tolerated. Your exam will be immediately rejected if fraud is found to have been

committed during or after completion of the exam. As a result, you will not be reimbursed for your examination fees.

If you fail to pass the exam, you will not receive a certificate. This also means that you must

purchase and take a new exam for your certification. Every candidate only gets one attempt per exam to succeed.

Sharing of exam questions is illegal

It is not allowed to share exam questions with others or make them public. This is a violation of

the copyright and IP of the AI Coalition and Certifying Body. Doing so can lead to legal action by Certifying Body with potentially harmful consequences.

Feedback and questions

We have done our best to help you prepare for the AI Brevet Exam by publishing this syllabus.

We would like to know what you think of this syllabus and the exam. If you have any suggestions for us, we would love to hear from you.

Have fun and take your time preparing for the exam and good luck. Naturally, we also wish you lots of fun in putting what you've learned into practice!

On behalf of the team – Alex Dowdalls.

Amsterdam, September 2021

KEY TERMS, DEFINITIONS AND CONCEPTS

The AI Coalition has listed several key terms, concepts, and definitions in the list below. You can use these definitions to support and clarify topics related to the exam. Pay attention! If you only learn these terms, then you are often not sufficiently prepared to pass the exam.

Term	Meaning
AGI	Artificial General Intelligence
AI	Artificial Intelligence
DP	Deep Learning
IoT	Internet of Things
IT	Information Technology
ML	Machine Learning
NLP	Natural Language Processing
NN	Neural Network
OCR	Optical Character Recognition
RPA	Robotic Process Automation

Author

Alex Dowdalls, Axveco

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Contact:

Email — communicatie@nlaic.com

Website — nlaic.com

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