

Applied Data Science & Artificial Intelligence

Exchange Handbook



CREATING MEANINGFUL EXPERIENCES

Introduction

Hello and welcome to Applied Data Science and Artificial Intelligence (ADS&AI)!

ADS&AI was first founded in 2021 with the aim to prepare students for careers in the international world of Data & Artificial Intelligence. In the projects and study units, our students explore various types of data and Artificial Intelligence applications, like Machine Learning, computer vision, robotics, natural language processing, etc. The programme, a project-based curriculum, has a practical orientation and offers collaborative learning in integrated multidisciplinary projects where students learn to continuously develop themselves as professionals. Highly qualified and international lecturers with years of experience in the industry deliver their expertise to the students. Approximately 60% of our students have an international background, while more than 75% of ADS & AI's lecturing staff have joined the academy from a number of places around the world.

In keeping with our international nature, and in order to ensure transparent communication within the academy, the language of both instruction and communication is English.

Students who would like to attend ADS & AI for an exchange programme of one or two semesters are welcome to join courses from either the second or third year in **either** the spring semester or autumn semester. Exchange students in ADS & AI get added to a regular class of our students which ensures greater integration and participation in student life outside of the classroom.

Key Dates:

22 August 2024	Start of first semester
26 – 30 August 2024	Introduction Academy
2 September 2024	Start of first semester
21 - 25 October 2024	Autumn holiday
23 December 2024 - 3 January 2025	Christmas holiday
24 January 2025	End of first semester (end of block B)
3 February 2025	Start of second semester
3 March - 7 March 2025	Spring holiday
28 April - 2 May 2025	May holiday
27 June 2025	End of second semester

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How ADS&AI is structured?

- In the second year students work in blocks: autumn semester: block A & block B; spring semester: block C & block D.
- Year three has two semesters (autumn and spring).
- Attendance of classes is mandatory, so, unfortunately, it is not possible to travel during school weeks. However, there are a number of holiday weeks throughout the year that are suitable for travelling, which ensures that our exchange students get plenty of chances to travel around Europe.
- The minimum pass mark in ADS & AI is a 5.5 out of 10.
- Our programme is recognised for its special emphasis on 'small-scale and intensive education,' a distinction awarded by the NVAO (Accreditation Organisation of the Netherlands and Flanders). As a result, you will receive intensive supervision and support from your mentor during your semester at BUAs. This is closely tied to our exclusive student in-house training company known as the DataLab.
- One study credit (1 ECTS credit) represents 28 hours of study. One block is 15 ECTS credits. A student will therefore spend approximately 420 hours (15 x 28 hours), which includes time spent in class (i.e., attending DataLabs) as well as time required for independent study (i.e., homework, revision for projects, independent study days).

What is the DataLab?

- In the DataLab, you will carry out a wide variety of assignments. Data analysis, data collection, data visualisation and deployment of models all are subject to students' activities.
- The DataLab is held twice a week and participation is mandatory. During the Datalab you will have a chance to work on your project and get feedback and support from your mentors. The rest of the week you will be busy with the self-study material.

Whom ADS&AI is suitable for?

ADS & AI is most suitable for exchange students with an AI profile, computer science, big data, robotics, data science, digital transformation and creative technologies major as the projects have a strong focus on these subjects.

Additional ADS & AI information

- If you are joining ADS & AI in the Fall semester, classes are scheduled to begin in the week starting September 2nd. To ensure a smooth transition and to acquaint yourself with Breda and our university, we recommend arriving well in advance. An Introduction Week will be held the week of the 26th of August and further information regarding this will be provided to you.
- If you are joining ADS & AI in the Spring semester, classes are scheduled to commence in the week beginning from the 3rd of February. Please make sure to arrive before the starting date to ensure you have enough time to settle in Breda before the beginning of classes.
- As an exchange student you are welcome to choose an ADS & AI Study Package per semester. Each package consists of courses from either the second or third year. Unfortunately, it is not possible to choose courses from different study years within the same semester as this results in scheduling conflicts.
- We welcome our exchange students to join the Dutch for Foreigners course which will teach you the basics of the Dutch language. Beginner's level is offered in Fall and Spring semester, runs across the whole semester, and is worth 3 ECTS.
- It is essential to bring your own laptop when studying in ADS & AI.

Choosing ADS&AI study path

As an exchange student joining ADS & AI for a semester, you are welcome to choose from one of a number of ADS & AI Study Packages.

Please be aware that we are undergoing a minor restructuring of our curriculum and there may be some minor changes between what is described and what runs in the 2024-2025 academic year.

1.1 Autumn Semester

In the autumn semester students are able to select one of the following study packages (see appendix A for full course information):

- **Year 2, First Semester:** In this package, students will initially (block A) engage in a project focusing on the key competencies of a role unique to the data science and AI industry—the analytics translator. In block B, students will learn about traditional computer vision methods, deep learning models for object detection and image segmentation, and reinforcement learning for robotic control.

A total of 30 ECTS credits are available within this package. Additionally, students have the option to take Dutch for Foreigners, earning an additional 3 ECTS credits.

- **Year 3, First Semester:** In this package you can choose your own cross-disciplinary project with students from other BUAs programmes. A total of 30 ECTS credits are available within this package. It is also possible to take Dutch for Foreigners for an additional 3 ECTS credits.

1.2 Spring Semester

In the spring semester students are able to select one of the following study packages (see appendix A for full course information):

- **Year 2, Second Semester:** In this package, students will participate in the project (block C) on Natural Language Processing. The main topic that you will work on this block is the task of emotion classification. During the second part of the semester (block D) you will learn how to productionise and deploy your model(s) to a cloud platform.

A total of 30 ECTS credits are available within this package. It is also possible to take Dutch for Foreigners for an additional 3 ECTS credits.

- **Year 3, Second Semester:** In this package you can choose your own cross-disciplinary project with students from other BUAs programmes. A total of 30 ECTS credits are available within this package. It is also possible to take Dutch for Foreigners for an additional 3 ECTS credits.

The full details of all study packages and their course content can be found in appendix A (Study Package Details). Please ensure that you obtain approval from your home university before applying for a study package. It is important to realise that some course packages might require prerequisite knowledge. If you have any questions about the content of the packages, please get in touch with Zhanna Kozlova (kozlova.z@buas.nl).

FAQ

I am an American student and have to leave before the spring semester starts in January at my home university. Can I do an exchange taking AI courses during autumn?

It is important to double check the start and end dates of each block. If you are an American student, you have to take into account that our autumn semester runs until the end of January. It is not possible to finish any courses before the Christmas holidays.

I wish to do a course package but my exchange supervisor (from my home university) said that there is a course I do not need to take. Can I choose to skip that course in this package?

No. Due to the nature of the courses, and their interconnection, it is not possible to skip a course within a package as this would prevent you from being awarded the necessary ECTS credits.

I wish to do an exchange taking AI courses, but my home university does not have a partnership with Breda University of Applied Sciences. What do I have to do?

Please ask the International Office at your home university to contact Zhanna Kozlova (kozlova.z@buas.nl) to discuss possibilities to set up a partnership with AI.

Appendix A: Study Package Details

In this section you can find a full breakdown of courses contained within each of the AI study packages. Be aware that, due to a curriculum update, there may be some slight changes to the details published within this appendix. Please bear in mind that it is essential to attend all the courses as they are interconnected with each other.

Year 2, First Semester

Block 2A (15 ECTS credits):

In the current block, the creative brief will span the whole block (**8 weeks**) and will focus on key competencies of a role unique to the data science and AI industry - **the analytics translator**. Another role you will embody is that of a data scientist doing traditional research and statistical data analysis where we specifically focus on proving causal relationships.

The analytics translator role encompasses several skills, such as communication, research, data analysis, and to a large extent, decision-making. An analytics translator is a professional who bridges the gap between data analytics and business strategy. They play a critical role in organisations by translating complex data and insights into meaningful, actionable information for decision-makers.

The main responsibilities of an analytics translator include:

- **Understanding business goals:** Analytics translators work closely with stakeholders and business leaders to understand their objectives, strategies, challenges, and needs. They ensure that analytics efforts are aligned with business goals.
- **Data analysis and interpretation:** Analytics translators possess strong analytical skills and can work with various data sources. They extract, clean, and analyse data to identify trends, patterns, and insights relevant to the business.
- **Communication and storytelling:** One of the key roles of an analytics translator is to effectively communicate complex analytics concepts to non-technical stakeholders. They use data visualisation and storytelling techniques to present insights in a compelling and understandable manner.
- **Business strategy alignment:** Analytics translators bridge the gap between technical teams and business units. They translate technical findings into actionable recommendations that can drive strategic decision-making.
- **Collaboration and teamwork:** Analytics translators often work in cross-functional teams collaborating with data scientists, business analysts, and other stakeholders. They facilitate communication, understanding, and cooperation between these teams to ensure the successful implementation of analytics projects.
- **Continuous learning and innovation:** Analytics translators stay updated on the latest trends and technologies in analytics. They continuously learn new methodologies and tools to enhance their skills and drive innovation in data-driven decision-making processes.

Block 2B (15 ECTS credits):

In block 2B you will delve into the dynamic intersection of perceiving and interacting with the world through machines. You will learn traditional computer vision methods, deep learning models for object detection and

image segmentation, and reinforcement learning for robotic control. This block is designed to provide you with a practical understanding of implementing these techniques to solve real-world challenges, preparing you to use these skills in the field.

Year 3, First Semester (30 ECTS credits)

In this package you can choose your own cross-disciplinary project with students from other BUAs programmes. Examples of the projects are given below:

Example 1

Games Project: Enhancing Immersion in AAA Games using AI Tools

In the contemporary world of games, AAA titles are renowned for their high-quality graphics, storytelling, and gameplay. However, the quest for more immersive and engaging gaming experiences is an ongoing endeavour. As a third-year Applied Data Science and Artificial Intelligence student, you are given the challenge to explore, investigate, and implement AI tools that can enhance the immersion and engagement in AAA games. Over a six-month period, your task will be to devise a toolkit of AI solutions for games.

Project Scope:

The scope of the project involves research, investigation, and proof-of-concept development of various AI tools focusing on:

1. Large Language Models: Evaluate how narrative and NPC speech/actions can be driven using advanced language models to deliver more coherent and immersive narratives.
2. Speech to Text: Investigate possibilities to enhance player voice interaction and communication with in-game characters and systems.
3. Text to Speech: Explore the application of AI for character voice generation, aiming to create a more realistic and engaging dialogue system.
4. Facial Recognition: Investigate the possibilities of utilizing gaze detection, emotion recognition, and other aspects to enhance in-game character interactions.
5. Behaviour Recognition: Investigate the use of machine learning to identify player behaviours based on gameplay data, which can be used to dynamically adapt enemy behaviours, narrative, and gameplay elements.
6. Reinforcement Learning for Games: Explore how reinforcement learning can be used to improve NPC behaviour, enemy actions, and game difficulty scaling, making gameplay more responsive and challenging.
7. Diffusion Models for 2D and 3D Asset Generation: Explore how AI-driven generation can create a more visually engaging and adaptive game environment.
8. Vector Databases for Game Story and State: Develop an approach to use vector databases for managing game story and states for dynamic and reactive storytelling.
9. Transformer models to infer game state from audio-visual input: Investigate how transformer models can be used to infer game state from audio-visual input, allowing for more dynamic and adaptive gameplay.

10. Game analytics: Investigate the use game analytics techniques to analyse gameplay data and generate insights about player behaviours and business decisions.

The goal is to develop a toolkit consisting of APIs with simple front-ends as proofs of concept for a few of the above techniques. Integrating and aligning several of these techniques into high-level game features will increase the overall immersion in games. The APIs should be designed with integration in mind. The toolkit should be well documented and presented in a final presentation at the end of the project.

This is not an exhaustive list and you are free to include other techniques not listed here if they contribute towards the overall goal of the project (i.e., enhancing immersion in games).

Example 2

Logistics Project: Customer Journey Clothing Shopping

Before going shopping, people had a rough idea of what they needed and what their budget was. They went physically to a mall / town centre and visited multiple shops where they tried on their clothing. After evaluating the different options, they went back to the shops with their goods of interest and made the purchase.

FastForward to 2023 the customer in principle follows the same process, although he is not physically going to a shop, but is ordering his clothing online based on pictures and filters per shop. This results in approximately 20% of reverse flows (the new fitting process) and large volumes of traffic on distribution vehicles from a logistics point of view. However, most importantly, it is still product driven and not a customer-driven process.

Wouldn't it be great if we could have a solution in which we "chat" our way through the clothing selection process and are supported in making the decisions that matter most to us. We create a front-end solution based on an algorithm that supports customers (like you and me) to simplify and make the searching of clothing really fit for the customer.

Project Scope:

Below some examples are given to hopefully clarify: Minimum Viable Product "Configurator"

A (visual) chat function in which I can state the following prompt (or something better): I am looking for clothes, and I am on a tight budget for this month. As a teacher I want to be representative in front of class and do want to dress up. My favourite colour is black and I am wearing PME jeans size 32-34. One of my guiding principles is that I want to have a limited impact on the environment. However, I do not want to exceed a budget of €350 in purchasing two pairs of trousers, four shirts and two pairs of shoes, that, in the end, should match with each other. And oh yeah, I am not that fond of ironing. As a result of this prompt: it will give me the different options I have in different online shops, with maybe even the option to change / find alternatives.

The evolution of this way of shopping might expand in a cross-sectoral way (for other complex purchases) but can also go into depth in the decision-making process (including origin, CSR, logistic optimisations).

The aim of this business project is to increase customer satisfaction of the information collection and decision-making process for consumers and, on the other end, also improve the fulfilment of the selected clothing in relation to the sustainability, quality, speed and costs of the processes.

The project is supported by an entrepreneur who has successfully started and managed two companies. His name is Remko Been. The companies he has been involved in so far are ISTIA and StockSpots.

Project Outcomes:

The execution of this project is in close collaboration / co-creation between the Academy for Applied Data Science & Artificial Intelligence and Logistics. Three third-year students from Data Science will be joining three

placement students of Logistics and we aim to reach a shared outcome. For the logistics part of this assignment, we see three professional products, which are described briefly below:

1) In this exploration of an innovative solution, where we are entering a greenfield situation we need to review and evaluate the possible business models behind a solution like this. There are multiple stakeholders in the customer journey and fulfilment and the assignment in this part is to recommend on the basis of research what possible business model is best and what the profitability of this model will be. In the research the elements of the business model canvas will be explored and the possible scenarios calculated. This part of the assignment requires a person with a helicopter view and who can look at the concept from different perspectives and different angles to see what can be learned for innovations and disruptions in other segments. A desirable product can be an AI solution for a digitalised business model canvas to compare different customer journeys with calculated costs and profitability.

2) To see what possibilities there are in the customer journey the second professional product will deep dive into the different customer journeys per persona to see where an automated solution can support the decision-making process or maybe even take over. This will be a research where qualitative data needs to be translated into an "algorithm" and requires a person with good communication skills, and who loves to contact and interview professionals in relevant business and customers. A desirable product can be an AI solution that can recommend varied options in the clients' customer journeys for their decisions in the logistic chain.

3) The final part in this assignment is more hard-core logistics-related. To succeed we need to create insight into the different logistics and fulfilment activities triggered by current customer processes. We need to see what waste is created in the chain and for fulfilment and returns to quantify the current state in costs, time, sustainability and customer satisfaction. To understand the current state, we need someone who is keen on details and figures and not afraid to ask triggering questions. A desirable product can be an AI solution to automatically collect the data and to visualise the waste, cost, time and satisfaction of the above-mentioned options for all the current activities in the logistic chain.

All assignments will be coached by one lecturer of logistics with support of different Subject Matter Experts in the logistics field, and one lecturer from the Data Science team will be appointed. The assignment will be executed as a team whereby everybody has their own focus point to contribute to the shared success of this discovery journey.

These assignments will offer students a unique and challenging opportunity to learn and work with professionals and students of logistics and in other very relevant industries, like data science, AI and consumer products. It offers an opportunity to do applied research and contribute to an innovative solution for logistics and supply chain.

Year 2, Second Semester

Block 2C (15 ECTS credits)

Natural language is a language that has evolved naturally as a means of communication among people. Every language on earth, whether that is spoken, written or signed, is considered a natural language. Computer analysis of natural language is called Natural Language Processing (NLP). NLP is, among other things, used for email classification, smart assistants, search engines, language translation, and many more applications.

NLP is an interdisciplinary field combining linguistics, computer science, and AI. Linguistic knowledge is key for building NLP models. A word can have multiple meanings, that is, **polysemous**. *Mouse* refers to an animal as well as computer hardware. Two words can be **synonyms**, meaning the same thing, such as *train* and *educate*. Yet you *train* a machine learning model, not *educate* a machine learning model, because *train* is part of the machine learning **lexicon**. There are a lot of words that are not synonyms but can be **similar** such as *cat* and *dog*. The meaning of two words can be **related** in ways other than similarity (*coffee* and *cup*). Words also have **connotations**, meaning the reader's sentiment about the word. *Happy* has a positive connotation. Similar words can have different connotations. *Fake* and *replica* are similar words yet *fake* has a more negative connotation. On top

of that, word usage evolves. *Awful* originally meant impressive instead of extremely bad. Add to these irony, slang, idioms, humour, and differences between the 7,000 languages that exist...

Block 2D (15 ECTS credits)

In this block you will learn how to productionise and deploy your model(s) to a cloud platform. You will also learn how to monitor your model(s) and ensure that they are continuously retrained on new data. You will create a robust codebase and establish data ingestion and model training pipelines. Additionally, you will learn how to devise a model deployment approach and implement a monitoring strategy. Finally, you will learn how to demonstrate your deployed model(s) in action.

Learning Objectives:

By the end of this block you will be able to:

- Understand the concept of MLOps and the role of DevOps in the ML lifecycle.
- Create a robust codebase and establish data ingestion and model training pipelines.
- Productionise and deploy your model(s) to a cloud platform using different deployment strategies.
- Monitor your model(s) and ensure that they are continuously retrained on new data.
- Create professional documentation for your project.

Year 3, Second Semester (30 ECTS credits)

In this package you can choose your own cross-disciplinary project with students from other BUAs programmes. Examples of the projects are given below:

Example 1

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Games



Leisure & Events



Tourism



Media



Data Science & AI



Hotel



Logistics



Built Environment



Facility

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CREATING MEANINGFUL EXPERIENCES