ADS-AI

Block C - Data Modelling

In block A, you explored the foundations of artificial intelligence and data science by developing an interactive data visualization dashboard. In block B, you expanded your skills by analyzing a healthcare dataset and applying various preprocessing and machine learning methods to extract insights.

This block will focus on the ***Modeling*** phase of the ***CRISP-DM*** lifecycle (Figure 1). You will learn how to conduct market/consumer research and how to build transparent, interpretable, and fair deep-learning models for image classification. In addition, you will learn how to integrate these concepts for the development of user-centered applications.

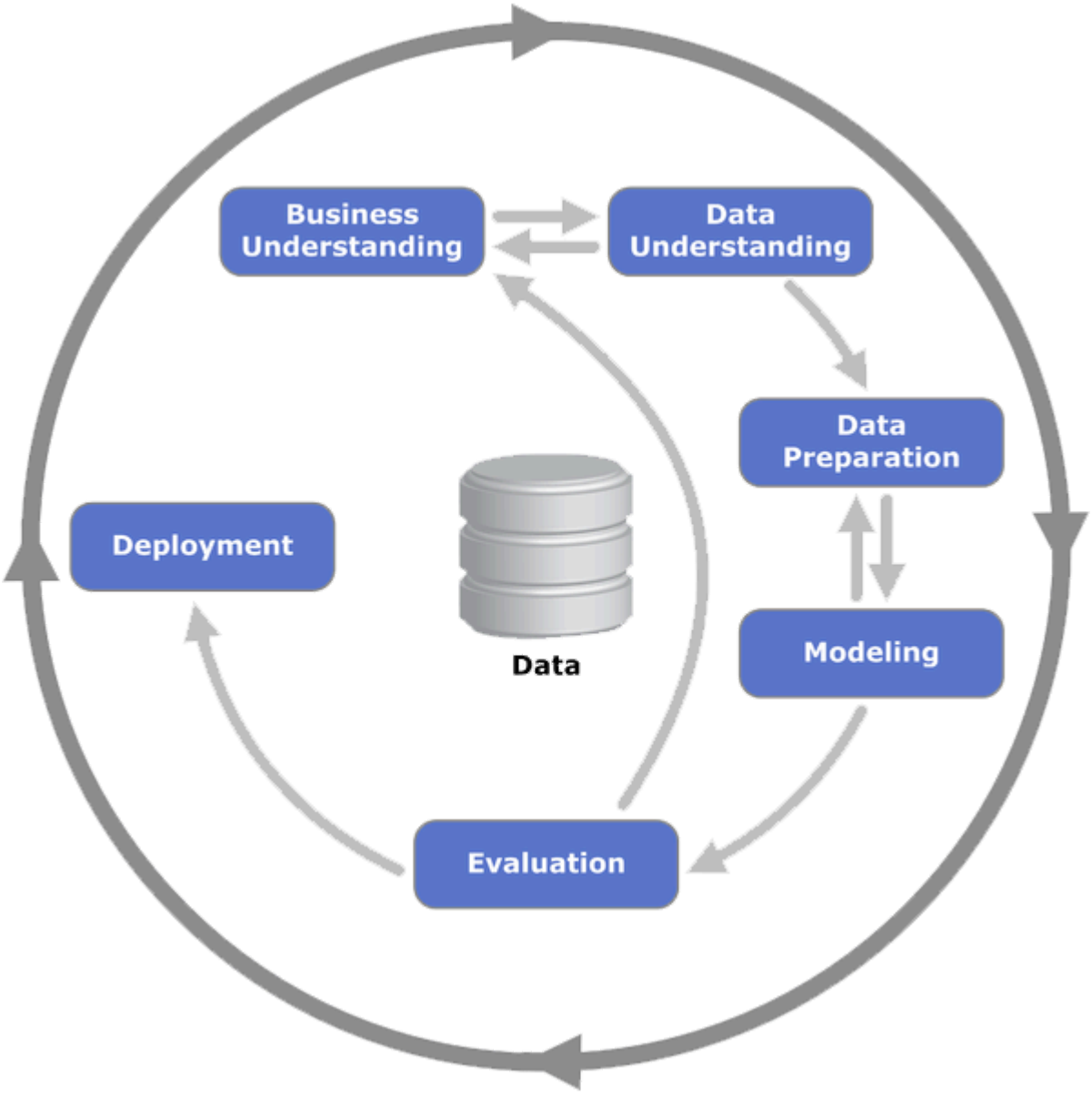


Figure 1. CRISP-DM Lifecycle.

Student Groups

> Important: please notice that some student groups were changed for this block!

In order to balance the number of students per mentor group, the following changes were made to the student groups:

- **Group 6** ceased to exist.
- Students from the former **Group 6** were allocated across multiple groups.
- Students from **Group 8** were allocated to the **new Group 6**.

You can check your current group by entering your student number here:

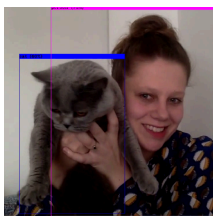
Student Number: Find Group

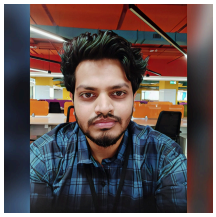
Classrooms

The classroom of each group also changed for this block. Here is the new distribution of groups and classrooms for DataLabs:

Room ID	Groups
Hn2.003	6
Hn2.007	1 , 4 , 5
Hn2.010	2 , 3, 7

Staff Members

Name	Availability	Mentor Group	Email	Responsible for Knowledge Module
Avril Hayden (Lecturer), MSc. 	Mon, Tue, Wed, Thu, Fri	Group 1	hayden.a@buas.nl	NA
Edirlei Soares de Lima (Lecturer), Ph.D. 	Mon, Tue, Wed, Thu, Fri	Group 4	soaresdelima.e@buas.nl	Deep Learning & Block Responsible
Elavendan Rajendran (Lecturer), MBA. 	Mon, Tue, Wed, Thu, Fri	Group 7	rajendran.e@buas.nl	NA
Irene van Blerck (Lecturer), MSc. 	Tue, Wed, Thu, Fri	Group 6	blerck.i@buas.nl	Responsible AI
Karna Rewatkar (Lecturer),	Mon, Tue, Wed, Thu, Fri	Group 3	rewatkar.k@buas.nl	NA

Name	Availability	Mentor Group	Email	Responsible for Knowledge Module
M.Sc. 				
Margot Neggers (Lecturer), Ph.D. 	Mon, Tue, Thu, Fri	Group 2	neggers.m@buas.nl	Human-Centered AI
Shival Indermun (Lecturer), Ph.D. 	Mon, Tues, Wed, Thur, Fri	Group 5	indermun.s@buas.nl	NA
Zhanna Kozlova (Lecturer), MA. 	Mon, Tue, Wed, Thu, Fri	Group 6	kozlova.z@buas.nl	Business Understanding
Frank Peters (Program Manager), Ph.D. 	Mon, Tue, Wed, Thu	Omnipresent	peters.f@buas.nl	Omnipotent

Creative Brief

The Innovation Square is your client in this block. The Innovation Square is a dynamic hub at Breda University of Applied Sciences that integrates education, research, and industry. It's a place where collaboration and innovation connect education and practice-oriented research to activities in the relevant industries. They approached you - as an aspiring **Data Scientist** - to apply your expertise in providing innovative data-driven solutions. In particular, they require your assistance in proposing and developing a creative and innovative application utilizing deep learning for image classification. The challenge is to identify a problem where image classification can provide significant business value and/or societal impact in any area or industry.

Figure 2. The Innovation Square.

Therefore, the main objective of this project is to develop an image classification application using deep learning and your own image dataset. To this end, you will need to create a project proposal that touches upon the following topics:

- Market/consumer research and risk assessment;
- The design and evaluation of a transparent, interpretable (and fair) deep learning-based image classifier;
- The development of a user-centered prototype application for your image classifier.

The top 3 projects with the best business value will have the unique opportunity to present their results directly to the Innovation Square and a specially invited group of entrepreneurs from BUas Startup Support (like in the TV shows Shark Tank and Dragons' Den), which can provide valuable insights and even support for further development of the projects, potentially transforming your academic projects into viable and standalone business ventures. This is more than just a project; it's a potential launchpad for your entrepreneurial journey!

Knowledge Modules

The ADS&AI program is structured into 8-week blocks. On Monday, Wednesday, and Thursday you work individually on the development of fundamental skills, which are needed to successfully complete the Creative brief. In ***DataLab*** (Mandatory! See DataLab Attendance, for more information), scheduled on Tuesdays and Fridays, you apply your knowledge to the Creative Brief by completing a list of tasks, which you can find in the DataLab Tasks.

This block is centered around four ***knowledge modules***:

- Business Understanding
- Responsible AI
- Deep Learning
- Human-Centered AI

The project of this block aims to develop an image classification application prototype. Below, you will find the project timeline, which gives you an overview of the topics explored by each knowledge module:


Week 1
Business Understanding
- Market Research
- Problem Definition
- Stakeholders
- DAPS
Human-Centered AI
- Introduction
Responsible AI
- Fairness & Bias
Deep Learning
- Image Dataset
Week 2
Responsible AI
- Fairness Metrics
- Socratic Dialogue
Deep Learning
- Multilayer Perceptron
Week 3
Deep Learning
- Model Performance
- MLP from Scratch
Human-Centered AI
- Interaction Design
- Interface Design
Business Understanding
- DAPS Review
Week 4
Deep Learning
- Convolutional Neural Networks
- Data Augmentation
- Transfer Learning
Human-Centered AI
- User Testing
Week 5
Deep Learning
- The Machine Learning Project Lifecycle
- Error Analysis
Human-Centered AI
- UX Design
Week 6
Deep Learning
- The Machine Learning Project Lifecycle
Human-Centered AI
- Think-Aloud Study
Week 7
Responsible AI
- Transparency & Interpretability
- Explainable AI
Week 8
Human-Centered AI

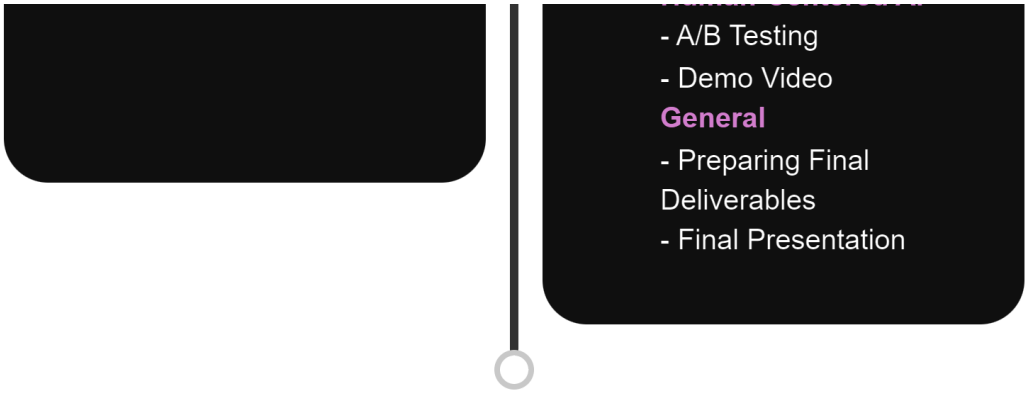


Figure 2. Project timeline.

1. Business Understanding

For Business Understanding, you will conduct market research to identify a consumer related problem in a industry or company. Based on the stakeholder analysis and DAPS diagram, you will then create your first idea for an application aimed at solving a potential problem within that industry or company.

2. Responsible AI

For Responsible AI, you will perform an exploratory data analysis to uncover hidden biases in your custom image dataset or in the Imsitu dataset. In addition, after you have built and trained your image classification model, you will learn how to make it more transparent and interpretable by applying various explainable AI methods.

3. Deep Learning

For Deep Learning, you will explore various artificial neural network architectures and develop the skills to design and implement your own image classifier. Your model will demonstrate the feasibility of applying deep learning techniques to solve an image classification problem.

4. Human-Centered AI

For Human-Centered AI, you will design an application (wireframe prototype) based on your idea and DAPS diagram that incorporates your image classifier model. While designing the application, you also will conduct user tests (think-aloud study and A/B testing).

Medal Challenges

You are encouraged to get the best out of yourself. Therefore, within the ADS&AI program, we regularly allow you to push yourself further by giving you so-called bronze-silver-gold challenges. By achieving these, you can earn badges for your GitHub page, which mark excellent students:

ADS&AI 1x Build an **interactive explainable AI dashboard** that visualizes and interprets the predictions of your image classification model using techniques like Grad-CAM, LIME, or SHAP.

The dashboard should allow users to upload new images, display the predictions, and show visual explanations highlighting the parts of the image that influenced the model's decision.

ADS&AI 1x Implement a **fully functional application** for the project, which includes the process of **deploying the image classification model on a server** and building a **functional client interface** to use the model.

ADS&AI 1x Get selected as one of the **top 3 projects** that will present their results to the Innovation Square and BUas Startup Support team. The selection of the best projects will be mainly based on business value, but keep in mind that other factors, such as model accuracy, interpretability, and interface design, also contribute to the viability of the project.

Timeline

Week 1: Business Understanding and Responsible AI

MONDAY

- Market Research for Consumer-Focused Product Development

TUESDAY

- DataLab I: Kick-Off Presentation & Business Understanding
- Kick-Off Presentation: 9:00 - 9:45 (Lecture Hall **Fe1.016**)
- Innovation Square Presentation (Block Client) by Tijs van Es: 9:45 - 10:00 (Lecture Hall **Fe1.016**)
- Guest Lecture on Entrepreneurship by Gerben Beijneveld: 10:00 - 11:00 (Lecture Hall **Fe1.016**)

WEDNESDAY

- Introduction to Human-Centered AI

THURSDAY

- Fairness & Bias: Definitions

FRIDAY

- DataLab II: Image Dataset & Bias Analysis

Week 2: Responsible AI and Introduction to Deep Learning

MONDAY

- Fairness & Bias: Individual Fairness vs. Group Fairness

TUESDAY

- DataLab I: Fairness Metrics
- Guest Lecture on Fairness Metrics by Marco Favier from Antwerp University: 11:00 - 12:00 (Lecture Hall **Fe1.016**)
- Lecture on Public Speaking by Bert Heesakkers: 13:00 - 14:30 (Lecture Hall **Fe1.016**)

WEDNESDAY

- Socratic Dialogue Preparation

THURSDAY

- Introduction to Deep Learning

FRIDAY

- DataLab II: Multilayer Perceptrons & Socratic Dialogue
- Review Session on Fairness and Bias (in person only): 10:00 - 10:30 (Lecture Hall **Fe1.017**)
- Socratic Dialogue with Oscar Bastiaens and Irene van Blerck: 13:00 - 17:00

Week 3: Understanding Neural Networks

MONDAY

- Improving Model Performance

TUESDAY

- DataLab I: Multilayer Perceptrons
- BUas Startup Support Q&A and Coaching with Tijs van Es, Marc Holvoet, and Shival Indermun: 10:00 - 12:00 (DataLab)
- DAPS Review with Zhanna Kozlova and Shival Indermun: 13:00 - 15:00 (DataLab)

WEDNESDAY

- Interaction Design

THURSDAY

- Understanding Neural Networks

FRIDAY

- DataLab II: Multilayer Perceptron from Scratch

Week 4: Convolutional Neural Networks with Keras

MONDAY

- Introduction to Convolutional Neural Networks

TUESDAY

- DataLab I: Convolutional Neural Networks

WEDNESDAY

- User Testing

THURSDAY

- Working with Small Datasets

FRIDAY

- DataLab II: Convolutional Neural Networks
- Review Session on Convolutional Neural Networks (in person only): 10:00 - 11:00 (Lecture Hall **Fe1.017**)

Week 5: The Machine Learning Project Lifecycle

MONDAY

- Machine Learning Project Lifecycle I

TUESDAY

- DataLab I: Machine Learning Project Lifecycle
- Guest Lecture on AI Ethics and Responsible AI by Wietse van Kooten from IBM: 11:00 - 12:00 (Lecture Hall **Fe1.018**)

WEDNESDAY

- UX-Design for AI & Machine Learning Project Lifecycle II

THURSDAY

- Error Analysis

FRIDAY

- DataLab II: Error Analysis
- Lecture on Public Speaking by Bert Heesakkers: 10:00 - 11:00 (Room **Oc0.016**)

Week 6: The Machine Learning Project Lifecycle and Human-Centered AI

MONDAY

- Machine Learning Project Lifecycle III

TUESDAY

- DataLab I: Machine Learning Project Lifecycle
- Workshop on Public Speaking by Bert Heesakkers: 13:00 - 17:00

WEDNESDAY

- Finalizing Deep Learning and Responsible AI

THURSDAY

- Preparation for Think-Aloud Study

FRIDAY

- DataLab II: Think-Aloud Study

Week 7: Explainable AI

MONDAY

- Transparency & Interpretability: Definitions

TUESDAY

- DataLab I: Accuracy vs. Interpretability
- Optional Public Speaking Practice with Bert Heesakkers: 13:00 - 15:00

WEDNESDAY

- Methods I: Gradient-Based

THURSDAY

- Methods II: Perturbation-Based

FRIDAY

- DataLab II: Implementing XAI for Image Classification
- Review Session on XAI (in person only): 10:00 - 11:00 (Lecture Hall **Fe1.017**)

Week 8: Human-Centered AI

MONDAY

- Preparation for A/B Testing

TUESDAY

- DataLab II: A/B Testing

WEDNESDAY

- Finalizing Human-Centered AI and Demo Video

THURSDAY

- Wrapping up Final Deliverables: use the time you have available today to prepare your final deliverables for submission.

FRIDAY

- DataLab II: Final Project Presentations

TABLE OF CONTENTS

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