



ILAYS NATIONAL UNIVERSITY JAAMACADDA UMMADDA ILAYS



Faculty of Computer Science



Department of Data Science and
Artificial Intelligence



Bachelor of Data Science and
Artificial Intelligence



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| ILAYS NATIONAL UNIVERSITY

1. Overview

The Department of Data Science and Artificial Intelligence is the academic unit of the Faculty of Computing at Ilays National University responsible for teaching, research, and community engagement in the analysis of data and the design of intelligent systems. It prepares graduates who can turn raw and messy data into reliable evidence, build and deploy machine learning systems responsibly, and support decision making in organizations that are collecting far more data than they currently know how to use.

The department exists to close a specific and measurable gap. Institutions across the country generate substantial operational data through mobile money platforms, telecommunications networks, health information systems, humanitarian registries, customs and revenue systems, and routine public administration. Very little of that data is modelled locally. Where analysis is done at all, it is frequently outsourced to consultants outside the region, which is expensive, slow, and leaves no capability behind. The department was established to build that capability at home.

The department currently offers the Bachelor of Data Science and Artificial Intelligence of Ilays National University, a foundation year followed by four years of degree study, comprising ten semesters and 155 credit units. The full curriculum is set out in Appendix A. The programme is delivered in close cooperation with the Bachelor of Software Engineering, with which it shares roughly three quarters of its coursework. This shared model gives students a genuine computing foundation rather than a narrow analytics training, and it allows the faculty to run both degrees efficiently with a single teaching establishment.

2. Vision, Mission, and Values

2.1 Vision

OUR VISION



To be a recognised centre of excellence in data science and artificial intelligence in the Horn of Africa, producing graduates and applied research that measurably improve how institutions in the region make decisions.

2.2 Mission

OUR MISSION



EDUCATE

Rigorous, practice oriented teaching in statistics, computing, and machine learning.



RESEARCH

Applied research on local challenges, from language technology to livelihoods.



ACT ETHICALLY

Responsible, lawful, and fair use of data and automated decisions.



PARTNER

Work with industry, government, and humanitarian organisations on real problems.



SERVE

Build national data literacy through short courses, workshops, and open materials.

Stated in full, the mission of the department is:

- **To deliver** rigorous, practice-oriented education in statistics, computing, and machine learning, taught by staff who have applied these methods to real problems.
- **To develop** applied research that addresses problems of local consequence, including low resource language technology, health analytics, climate and agricultural forecasting, and financial integrity.
- **To promote** the ethical, lawful, and socially responsible use of data and automated decision systems in every course the department teaches.
- **To build** durable partnerships with industry, government, and the humanitarian sector so that student projects, internships, and research answer questions those partners actually have.
- **To serve** as a national resource for data literacy through short professional courses, public workshops, and open teaching materials.

2.3 Core values

- **Academic rigour.** Students are held to a real standard in mathematics, statistics, and programming, because credible analysis is not possible without it.
- **Practical relevance.** Every core course carries substantial practical hours. Students work with imperfect, real datasets rather than cleaned teaching examples.
- **Ethical responsibility.** Graduates are taught to ask who is affected by a model, who is excluded from the data, and what happens when the system is wrong.
- **Openness.** The department shares courses, laboratories, and staff with sister departments and publishes its methods and teaching materials wherever possible.
- **Service.** The department measures its success by the capability it leaves behind in the institutions its graduates join.

3. Rationale and National Relevance

Data science is often presented as a global technology trend. The case for this department is more concrete than that. Several sectors of the national economy have already crossed the threshold where their data

volume exceeds what manual reporting can handle, and each of them currently lacks the staff to do anything about it.

Sector	Existing data	What trained graduates would enable
Telecommunications and mobile money	Call detail records, transaction logs, subscriber and agent networks	Churn prediction, network planning, fraud and money laundering detection, credit scoring for the unbanked
Banking and financial services	Core banking records, remittance flows, loan performance	Risk modelling, automated credit assessment, transaction monitoring
Health	Facility reporting, immunization and nutrition registries, disease surveillance	Outbreak detection and forecasting, resource allocation, service coverage analysis
Agriculture, livestock, and climate	Rainfall and satellite records, market prices, livestock movement	Drought and yield forecasting, early warning systems, market price prediction
Humanitarian and development	Beneficiary registries, needs assessments, logistics and distribution records	Targeting and duplication control, needs forecasting, programme evaluation
Public administration	Census and survey data, revenue and customs records, education statistics	Evidence based policy, revenue analytics, national statistical capacity

The common obstacle in all six sectors is not the absence of data and not the absence of software. It is the absence of people who can frame a question statistically, prepare the data honestly, choose an appropriate method, and communicate the result to a decision maker who is not a technical specialist. That is the graduate this department produces.

4. Academic Programmes

4.1 Bachelor of Data Science and Artificial Intelligence

The degree is awarded by Ilays National University and runs over a foundation year and four years of degree study, ten semesters in total, carrying 155 credit units. Teaching is organized around a stated ratio of lecture hours to practical hours in every course, and the practical component dominates in all programming, machine learning, and data engineering courses. The complete semester by semester schedule appears in Appendix A.

Excluding the three programme projects, the degree comprises fifty-two courses. Thirty seven of the forty-nine taught courses are shared with the Bachelor of Software Engineering and carry the same course codes, as do the internship, the capstone project, and the capstone seminar. Twelve taught courses and the three programme projects are specific to this degree.

4.2 Credit distribution

Year	Semester I	Semester II	Year total
Foundation Year	16	20	36

Year	Semester I	Semester II	Year total
Year I	18	15	33
Year II	15	14	29
Year III	15	12	27
Year IV	12	18	30
Programme total			155

4.3 Structure and progression

Stage	Semesters	Focus
Foundation	Foundation I and II	Academic English, pre-calculus and calculus, computer fundamentals and applications, introductory programming, web and hardware basics, general education
Computing core	Year I	Programming in C and Python, discrete mathematics, probability and statistics, linear algebra, data structures and algorithms, object-oriented programming, databases, computer organisation, operating systems
Data and statistical core	Year II	Data analysis, statistical inference and experimental design, database and data management, software engineering, systems analysis, algorithms, cloud and distributed computing, machine learning foundations, ethics and entrepreneurship
AI specialisation	Year III and Year IV, Semester I	Deep learning, data engineering and big data, data visualisation, natural language processing, time series forecasting, computer vision, reinforcement learning, MLOps, distributed systems, research methods
Professional integration	Year IV, Semester II	Generative AI and large language models, AI ethics and governance, internship, capstone project, capstone seminar and portfolio

Progression through the degree is deliberately sequenced. Linear algebra, probability, and Python are taught in Year I so that machine learning can begin in Year II rather than being compressed into the final year. Statistical inference precedes machine learning, machine learning precedes deep learning, and deep learning precedes natural language processing, computer vision, and generative models. No specialization course is taught before its mathematical prerequisite has been examined.

4.4 Planned future provision

Subject to staffing and demand, the department intends to develop three further lines of provision. Short professional certificates of eight to twelve weeks in applied data analytics, business intelligence, and applied machine learning, aimed at working professionals in the banking, telecommunications, and humanitarian sectors. A postgraduate diploma for graduates of other computing and quantitative disciplines who need a conversion route. A Master of Science in Data Science and Artificial Intelligence, to be introduced once the department has a sufficient body of research active staff and the approval of the Ilays National University senate.

4.5 Service teaching

The department provides service teaching to other academic units of Ilays National University, principally in probability and statistics, data analysis, and research methods. It also supports quantitative components of programmes in business, health sciences, and social sciences where those faculties request it.

5. Programme Educational Objectives

These objectives describe what graduates are expected to have achieved three to five years after completing the degree.

- **PEO 1.** Graduates practice competently as data scientists, data analysts, data engineers, or machine learning engineers in industry, government, or the development sector, and take responsibility for the technical quality of their work.
- **PEO 2.** Graduates design and deliver end to end data and AI solutions, from problem framing and data acquisition through modelling to deployment, monitoring, and communication of results.
- **PEO 3.** Graduates exercise professional and ethical judgement, recognizing the legal, privacy, fairness, and social implications of the systems they build.
- **PEO 4.** Graduates continue to learn independently, adopting new methods and tools as the field changes, and a proportion progress to postgraduate study or research.
- **PEO 5.** Graduates contribute to building data capability in the institutions they join, mentoring colleagues and improving how those institutions use evidence.

6. Programme Learning Outcomes

On successful completion of the degree, graduates will be able to:

- **PLO 1.** Apply calculus, linear algebra, probability, and statistical theory to formulate and solve data driven problems.
- **PLO 2.** Write correct, efficient, and maintainable programs in C, Java, and Python, and select appropriate data structures and algorithms for a given computational task.
- **PLO 3.** Design, query, and manage relational and non-relational data stores, and build data pipelines that acquire, clean, transform, and integrate data from heterogeneous sources.
- **PLO 4.** Conduct exploratory and confirmatory statistical analysis, including estimation, hypothesis testing, regression, and the design of experiments and controlled trials.
- **PLO 5.** Select, train, tune, and rigorously evaluate supervised and unsupervised machine learning models, and explain the assumptions and failure modes of each method used.
- **PLO 6.** Design and train deep neural network architectures and apply them to problems in natural language, vision, and sequential data.
- **PLO 7.** Build, analyse, and forecast time dependent data using classical and machine learning approaches.
- **PLO 8.** Deploy models into production environments and monitor them for performance degradation, data drift, and operational failure.
- **PLO 9.** Communicate quantitative findings clearly through visualisation, written reports, and oral presentation to both technical and non-technical audiences.

- **PLO 10.** Evaluate the ethical, legal, privacy, and fairness implications of data collection and automated decision making, and apply appropriate safeguards.
- **PLO 11.** Plan and conduct an independent investigation, including a literature review, a defensible methodology, and a critical discussion of results and limitations.
- **PLO 12.** Work effectively in a team, manage a project against a schedule, and apply professional software engineering practice to data and AI systems.

7. Teaching, Learning, and Assessment

Every course specifies lecture hours and practical hours separately, and the practical hours are protected. In the technical courses of Years II, III, and IV the practical allocation is typically twice the lecture allocation, which reflects the reality that data science is learned by working with data rather than by hearing about it.

Teaching methods across the department include structured lectures for theory and derivation, supervised laboratory sessions in which students implement methods themselves, problem sets that require working from raw data rather than prepared extracts, case studies drawn from partner organizations, seminar discussion for the ethics and governance courses, and individual and team projects at four points in the programme.

Assessment combines continuous assessment with end of semester examination. Continuous assessment includes laboratory work, assignments, quizzes, project deliverables, and presentations. Courses with a heavy practical component weight continuous assessment more heavily than lecture-based courses. Projects and the capstone are assessed on a documented rubric covering problem formulation, technical soundness, code quality and reproducibility, ethical treatment of data, written report, and oral defence.

The four staged projects give the programme its spine. Project I in Year II is an individual data analytics project. Project II is a team machine learning project. Project III in Year III is an integrated data science project spanning acquisition, modelling, and deployment. The Year IV capstone is a substantial supervised piece of work, wherever possible carried out on a real problem supplied by an external partner, and is defended publicly before a panel.

8. Laboratories, Infrastructure, and Software

The teaching model depends on reliable access to computing resources. The department maintains or requires access to the following.

Facility	Purpose	Minimum provision
General computing laboratory	Foundation and Year I programming, databases, operating systems	Shared with the Faculty of Computing, one workstation per student per session
Data science laboratory	Data analysis, statistics, visualisation, machine learning	Dedicated laboratory, 16 GB RAM and multi-core CPU per workstation
AI and deep learning facility	Deep learning, computer vision, natural language processing, generative models	At least one GPU server accessible over the campus network, supplemented by cloud credits
Data engineering environment	Big data, distributed processing, pipelines, MLOps	Virtualised cluster or containerised environment supporting Spark, orchestration, and container registries
Project and research space	Team projects, capstone work, research students	Bookable room with presentation facilities and secure storage for project data

The standard software stack is deliberately open source so that graduates can reproduce their working environment anywhere and employers face no licensing barrier. It comprises Python with the scientific stack, R for statistical work, PostgreSQL and at least one non-relational store, Apache Spark, Git and a self hosted or cloud repository service, Docker, Jupyter, PyTorch and TensorFlow, a workflow orchestration tool, and an experiment tracking tool. Commercial business intelligence software is introduced in the visualisation course because graduates will encounter it in employment.

9. Faculty and Staffing

The department is led by a Head of Department, accountable to the Dean of the Faculty of Computing, who is responsible for academic standards, staffing, timetabling, and external liaison. The teaching establishment is planned around the twelve programme specific courses, since the remaining coursework is delivered jointly with the Department of Software Engineering.

The department requires, as a minimum, academic staff covering statistics and probability, machine learning and deep learning, data engineering and database systems, and applied AI in at least one specialist area such as language or vision. Staff are expected to hold a master's degree as a minimum, with doctoral qualification required for research supervision and expected of a growing proportion of the establishment. Laboratory technicians support the practical hours and maintain the computing environment.

Practicing professionals from the telecommunications, banking, and humanitarian sectors are engaged as adjunct teaching staff and as capstone co-supervisors. This is not a cost measure. It is how the department keeps its curriculum honest about what employers actually need.

The department maintains a staff development plan covering postgraduate study, participation in academic and professional conferences, structured self-study against the tools used in the curriculum, and periodic industry placement so that teaching staff maintain current practical experience.

10. Research Agenda

Departmental research is deliberately applied and regionally grounded. Rather than competing on general method development, the department concentrates on problems where local data, local languages, and local context give it a genuine advantage. Five clusters define the initial agenda.

- **Low resource language technology.** Corpus building, tokenization, machine translation, speech recognition, and text classification for Somali and other regional languages, which remain severely under-represented in mainstream language technology.
- **Health data science.** Disease surveillance and outbreak forecasting, service coverage analysis, and decision support for facilities operating with incomplete records.
- **Climate, agriculture, and food security.** Drought and rainfall forecasting, remote sensing for rangeland and crop monitoring, livestock market price prediction, and early warning systems.
- **Financial analytics and integrity.** Credit scoring for populations without formal credit histories, fraud and anomaly detection in mobile money systems, and remittance flow analysis.
- **Public sector data and statistical capacity.** Improving the quality and usability of official statistics, survey methodology, record linkage, and open data infrastructure for public institutions.

Undergraduate students enter research through the research methods course in Year IV and through capstone projects supervised within these clusters. The department encourages publication of student work where it reaches an appropriate standard, and maintains a repository of datasets, code, and reports produced by its students and staff.

11. Admission and Progression

11.1 Admission requirements

- A recognised secondary school leaving certificate, with a satisfactory result in mathematics.
- Successful completion of the Ilays National University placement assessment in mathematics and English, which determines entry into the foundation year or, where performance permits, direct entry to Year I.
- Completion of the foundation year with the required minimum grade before proceeding to Year I.
- Transfer applicants and holders of a relevant diploma may apply for exemption from individual courses. Exemptions are assessed course by course against syllabus content and contact hours, and are capped by Ilays National University regulation.

The department actively encourages applications from women, who remain under-represented in computing across the region, and monitors intake and completion by gender as part of its annual reporting.

11.2 Graduation requirements

- Successful completion of all prescribed courses totalling 155 credit units.
- Satisfactory completion of Project I, Project II, and Project III.
- Completion of the supervised internship, comprising 192 practical hours with an approved host organisation, together with the internship report and host evaluation.
- Successful completion and public defence of the capstone project, and submission of the professional portfolio required by the capstone seminar.
- Attainment of the minimum cumulative grade point average prescribed by Ilays National University regulation.

12. Graduate Profile and Career Pathways

The degree is built backwards from the roles graduates are expected to enter. The technical spine of programming, databases, statistics, machine learning, and deployment is common to all of them, and the specialisation courses of Years III and IV allow students to weight their capstone and portfolio towards a particular destination.

Role	What the graduate does	Typical employers
Data analyst	Prepares, analyses, and reports on operational data; builds dashboards and recurring reporting	Banks, telecommunications operators, NGOs, ministries
Data scientist	Frames problems statistically, builds predictive and inferential models, communicates findings	Financial services, telecommunications, research institutes
Machine learning engineer	Builds, trains, and optimises models and integrates them into production systems	Technology firms, fintech, larger operators

Role	What the graduate does	Typical employers
Data engineer	Designs and operates data pipelines, warehouses, and processing infrastructure	Any organisation with substantial data volume
MLOps engineer	Deploys, monitors, and maintains models in production	Technology and financial services firms
Business intelligence analyst	Translates business questions into measures, reports, and decision support	Commercial enterprises, public agencies
Monitoring and evaluation analyst	Designs indicators, analyses programme data, evaluates impact	Humanitarian and development organisations, UN agencies
Statistician or survey analyst	Designs samples and surveys, produces and quality assures official statistics	National statistics offices, research organisations
Database administrator	Designs, secures, and maintains organisational data stores	Banks, hospitals, government, telecommunications
Postgraduate researcher	Continues to master's or doctoral study in data science, AI, or a quantitative discipline	Universities in the region and abroad

Graduates are also well placed to found their own ventures. The entrepreneurship course in Year II is taught with this in mind, and the department supports student teams whose capstone work has commercial potential.

13. Industry Engagement and Employability

The department maintains formal relationships with employers in the telecommunications, banking and mobile money, health, humanitarian, and public sectors. These relationships serve four purposes: they supply internship places, they supply real problems and, where permissible, real data for student projects, they supply adjunct teaching staff and guest speakers, and they inform curriculum review through the departmental advisory board.

Every student completes a supervised internship in Year IV. The department places students, agrees learning objectives with the host in advance, assigns an academic supervisor, and assesses the internship on the basis of a student report, a supervisor visit or review, and a structured evaluation from the host. Where a student secures a placement independently, the department approves it against the same criteria.

The capstone seminar and professional portfolio course exists to make graduates employable in practice rather than on paper. Students assemble a documented portfolio of their project work, publish selected code repositories, prepare a technical curriculum vitae, and rehearse technical interviews and presentations.

14. Ethics, Data Protection, and Responsible AI

Data science and artificial intelligence carry a capacity for harm that is not always visible to the people building the systems. Models trained on unrepresentative data exclude the people missing from it. Automated decisions about credit, eligibility, or targeting affect livelihoods. Personal data collected for one purpose is easily repurposed for another. The department treats these as core professional concerns rather than optional commentary.

Ethics is addressed at two points in the curriculum and reinforced throughout. The Year II course in computing ethics and professional practice establishes general professional obligations. The Year IV

course in AI ethics, governance, and data privacy addresses fairness and bias, transparency and explainability, accountability for automated decisions, privacy preserving techniques, data protection regulation, and emerging AI governance frameworks.

Beyond the taught courses, all student projects that involve personal or sensitive data require ethical clearance from the department before data collection or analysis begins. Project rubrics include an explicit assessment of how data was obtained, how it was protected, who the model affects, and what the consequences of error would be. Students are expected to be able to justify these choices at defence.

15. Quality Assurance and Continuous Improvement

The department operates a documented quality cycle. Course learning outcomes are mapped to programme learning outcomes, and each programme learning outcome is assessed at more than one point in the degree. Assessment evidence is reviewed annually to identify outcomes that are being met weakly.

- Course files are maintained for every course, containing the syllabus, teaching materials, assessment instruments, samples of marked student work across the grade range, and the lecturer's end of semester reflection.
- Student feedback is collected each semester and reviewed by the Head of Department with the course lecturer.
- An advisory board drawn from industry, government, and the development sector meets at least annually to review curriculum relevance.
- A full curriculum review is conducted every three to four years, which is a necessarily short cycle in a field where methods and tools change quickly.
- Graduate destinations are tracked at six months and at three years after graduation, and the results are reported against the programme educational objectives.
- External examiners or peer reviewers are invited to moderate final year assessment and capstone defences.

16. Relationship with Other Academic Units

The department is not designed to operate in isolation. Its closest relationship is with the Department of Software Engineering, with which it shares the entire foundation year, the whole of the computing core in Year I, and a substantial part of Years II and III. Shared courses carry identical course codes and are delivered in joint sections. This arrangement keeps class sizes viable, allows specialist staff to be used efficiently across both degrees, and lets students transfer between the two programmes in the early years without loss of credit.

The department also works with the other faculties of Ilays National University, including business, health sciences, and social sciences, both by providing service teaching in statistics and data analysis and by supervising joint capstone projects where a data problem originates in another discipline. These cross-disciplinary projects are among the most valuable work the department produces, because the questions come from people who genuinely need the answers.

Appendix A: Curriculum of the Bachelor of Data Science and Artificial Intelligence

Ilays National University, Faculty of Computing, Department of Data Science and Artificial Intelligence.

LH = lecture hours, PH = practical hours, CU = credit units.

Foundation Year – Semester I					
No.	Course Code	Course Name	LH	PH	CU
1	FE000	Freshman English	48	0	3
2	PC001	Pre-Calculus	48	0	3
3	SH002	Somali History and Culture I	32	0	2
4	CT003	Critical Thinking	32	0	2
5	CF004	Computer Fundamentals	32	32	3
6	CA005	Computer Applications	16	64	3
					16

Foundation Year – Semester II					
No.	Course Code	Course Name	LH	PH	CU
1	AE007	Academic English I	48	0	3
2	CL008	Calculus	48	0	3
3	IS009	Islamic Studies	32	0	2
4	IP010	Introduction to Programming & Computing	32	64	4
5	WD105	Web Development Fundamentals (HTML/CSS/JavaScript)	32	32	3
6	SH012	Somali History and Culture II	32	0	2
7	CM013	Computer Hardware Fundamentals & Maintenance	16	64	3
					20

Year I – Semester I					
No.	Course Code	Course Name	LH	PH	CU
1	AE100	Academic English II	48	0	3
2	PF106	Programming Fundamentals (C)	32	64	3
3	DM102	Discrete Mathematics	48	0	3
4	PS103	Probability and Statistics	48	0	3
5	PP201	Python Programming	32	64	3
6	DB105	Database Systems I	32	32	3
					18

Year I – Semester II					
No.	Course Code	Course Name	LH	PH	CU
1	OP107	Object-Oriented Programming using Java	32	64	3
2	DS108	Data Structures & Algorithms	48	32	3
3	LA304	Linear Algebra for Computing	48	0	3
4	CO110	Computer Organization & Architecture	48	32	3
5	OS111	Operating Systems	48	32	3
					15

Year II – Semester I					
No.	Course Code	Course Name	LH	PH	CU
1	SA200	Systems Analysis & Design	32	32	3
2	DB202	Database Systems II & Data Management	32	32	3
3	DA302	Data Analysis	32	64	3
4	SI211	Statistical Inference & Experimental Design	48	32	3
5	SE204	Software Engineering	48	32	3
6	PR212	Project I - Data Analytics Project	0	96	
					15

Year II – Semester II					
No.	Course Code	Course Name	LH	PH	CU
1	AA206	Design & Analysis of Algorithms	48	32	3
2	ML213	Machine Learning I - Foundations	32	64	3
3	CC208	Cloud & Distributed Computing Fundamentals	32	32	3
4	ET209	Computing Ethics & Professional Practice	32	0	2
5	EP210	Entrepreneurship for Computing	32	32	3
6	PR214	Project II - Team Machine Learning Project	0	96	
					14

Year III – Semester I					
No.	Course Code	Course Name	LH	PH	CU
1	DL300	Deep Learning & Neural Networks	32	64	3
2	DE311	Data Engineering & Big Data Systems	32	64	3
3	DV312	Data Visualization & Storytelling	32	32	3
4	CS301	Cybersecurity I	32	32	3
5	SP303	Systems Programming & Linux	32	64	3
					15

Year III – Semester II					
No.	Course Code	Course Name	LH	PH	CU
1	NL313	Natural Language Processing	32	64	3
2	TS316	Time Series Analysis & Forecasting	48	32	3
3	DS307	Distributed Systems	48	32	3
4	PM308	Project Management	48	0	3
5	PR317	Project III - Integrated Data Science Project	0	128	
					12

Year IV – Semester I					
No.	Course Code	Course Name	LH	PH	CU
1	CV400	Computer Vision	32	64	3
2	RL401	Reinforcement Learning & Intelligent Agents	32	64	3
3	MO402	MLOps & Model Deployment	32	64	3
4	RM403	Research Methods in Computing	32	32	3
					12

Year IV – Semester II					
No.	Course Code	Course Name	LH	PH	CU
1	GA404	Generative AI & Large Language Models	32	64	3
2	AG408	AI Ethics, Governance & Data Privacy	48	0	3
3	IN405	Internship	0	192	6
4	CP406	Capstone Project	16	192	6
5	SM407	Capstone Seminar & Professional Portfolio	16	32	
					18

Appendix B: Relationship to the Bachelor of Software Engineering

Excluding the three programme projects, this degree comprises 52 courses. Thirty seven of the forty-nine taught courses are shared with the Bachelor of Software Engineering and carry the same course codes, as

do the internship, the capstone project and the capstone seminar, so all forty can be delivered in joint sections. The entire foundation year is identical. Twelve taught courses and the three programme projects are specific to this programme.

B.1 Shared courses scheduled in a different semester

Course Code	Course Name	BSc SE Placement	BSc DS & AI Placement
PP201	Python Programming	Year II, Sem I	Year I, Sem I
LA304	Linear Algebra for Computing	Year III, Sem I	Year I, Sem II
DA302	Data Analysis	Year III, Sem I	Year II, Sem I

B.2 Software engineering courses not carried into this programme

Course Code	Course Name	Reason
CN104	Computer Networks I	Networking depth replaced by cloud and distributed computing content
CN109	Computer Networks II	Networking depth replaced by cloud and distributed computing content
WA203	Full-Stack Web Application Development	Application delivery covered through MLOps and model deployment
AP207	Advanced Programming & Software Design	Replaced by Machine Learning I
TC300	Theory of Computation	Theory load shifted to statistics and linear algebra
CS306	Cybersecurity II	Cybersecurity I retained; security depth not required
MA309	Mobile App Development	Replaced by Time Series Analysis & Forecasting
AI400	Artificial Intelligence & Machine Learning	Superseded by the dedicated ML, deep learning and AI sequence
IT401	Internet of Things (IoT)	Replaced by Reinforcement Learning & Intelligent Agents
AS308	Advanced Software Engineering	Replaced by MLOps & Model Deployment
CG402	Cryptography	Replaced by Generative AI & Large Language Models
EH403	Ethical Hacking & Penetration Testing	Replaced by AI Ethics, Governance & Data Privacy

Appendix C: Descriptions of the Programme Specific Courses

Course Code	Course Name	Description
SI211	Statistical Inference & Experimental Design	Estimation, confidence intervals, hypothesis testing, ANOVA, regression diagnostics, sampling and the design of experiments and A/B tests. Builds directly on PS103.
ML213	Machine Learning I - Foundations	Supervised and unsupervised learning: regression, classification, decision trees, ensembles, clustering and dimensionality reduction, with cross-validation, regularization and model evaluation in scikit-learn.
DL300	Deep Learning & Neural Networks	Feedforward, convolutional and recurrent architectures, backpropagation, optimizers, regularization and transfer learning, implemented in PyTorch or TensorFlow.
DE311	Data Engineering & Big Data Systems	Data pipelines, ETL and ELT, batch and streaming processing, distributed storage, warehouses and lakes, Spark and workflow orchestration.
DV312	Data Visualization & Storytelling	Principles of visual encoding, exploratory and explanatory graphics, dashboard design and communicating quantitative findings to non-technical audiences.
NL313	Natural Language Processing	Text preprocessing, representation learning, sequence models, transformers, and applications such as classification, named entity recognition and question answering.
TS316	Time Series Analysis & Forecasting	Stationarity, decomposition, ARIMA and exponential smoothing, state space models and modern machine learning approaches to forecasting.
CV400	Computer Vision	Image formation and processing, feature extraction, convolutional networks for classification, detection and segmentation, and vision model evaluation.
RL401	Reinforcement Learning & Intelligent Agents	Markov decision processes, dynamic programming, Monte Carlo and temporal difference methods, policy gradients and deep reinforcement learning agents.
MO402	MLOps & Model Deployment	Packaging, serving and monitoring models in production: experiment tracking, CI/CD for ML, containerization, drift detection and model lifecycle management.
GA404	Generative AI & Large Language Models	Transformer based generative models, pretraining and fine-tuning, prompting, retrieval augmented generation, evaluation and the limits of generative systems.
AG408	AI Ethics, Governance & Data Privacy	Fairness, bias, transparency and accountability in data and AI systems, privacy preserving techniques, data protection regulation and emerging AI governance frameworks.