BQA NCQF QUALIFICATION TEMPLATE

SECTION A:	QUALIFICATION DETAILS		
QUALIFICATION DEVELOPER (S)	University of Botswana		
TITLE	Master of Science in Data Science and Artificial Intelligence	**NCQF LEVEL**	9
STRANDS (where applicable)	N/A		
FIELD	Information and Communications Technology	**CREDIT VALUE**	240
SUB FIELD	Information Technology		

New Qualification	✓	Legacy Qualification		Renewal Qualification	
				Registration Code	

SUB-FRAMEWORK	General Education		TVET		Higher Education	✓							
QUALIFICATION TYPE	Certificate	I		II		III		IV		V		Diploma		Bachelor	
	Bachelor Honours		Post Graduate Certificate		Post Graduate Diploma								
	Masters	✓	Doctorate/ PhD										

RATIONALE AND PURPOSE OF THE QUALIFICATION

RATIONALE:

The rise of digital transformation globally has created a critical demand for professionals with expertise in Data Science and Artificial Intelligence (AI) to solve complex problems, drive innovation, and create competitive advantages. The proposed MSc in Data Science and Artificial Intelligence qualification addresses this demand by providing advanced knowledge and skills, enabling graduates to lead in this rapidly evolving field.

Botswana's transition to a knowledge-based economy, as outlined in Vision 2036 Pillars 1 and 2, requires advanced technical and research skills to foster economic diversification and sustainability. The National Development Plan (NDP 11) highlights the importance of leveraging technology to accelerate economic growth and enhance global competitiveness. Furthermore, the Human Resource

Development Council (HRDC) emphasizes the priority of developing skills in data analytics, machine learning, software engineering, and AI to meet labour market needs and national development goals.

The Edison Data Science Framework (2017) underscores the need for multidisciplinary expertise, ethical responsibility, and practical application, all of which are integrated into this program. Findings from the Department of Computer Science's AI Skills Survey (2024) revealed significant gaps in advanced data science and AI capabilities, further validating the need for this qualification. Industry feedback corroborates these findings, indicating strong demand for professionals adept in algorithmic modelling, big data analytics, and the ethical application of AI.

The proposed qualification leverages insights from global standards, including the ACM/IEEE/AAAI Curricula (2023) and Edison Data Science Framework (2017), aligning with cutting-edge developments to produce graduates capable of addressing challenges both locally and globally.

Global trends in education and industry, as identified in the ACM/IEEE/AAAI Model Curricula (2023), emphasize the importance of specialized postgraduate programs to prepare experts in data analytics, machine learning, and artificial intelligence. This serves to highlight current focus areas in computing in general.

Across many industry sectors, including banking, finance, education, agriculture and telecommunications, organizations in Botswana are making efforts to improve their products and services through data-driven techniques, which are taught in Data Science (DS) and Artificial Intelligence (AI) curricula. For these endeavours to progress successfully, it is important to have graduates with advanced skillsets in Data Science and Artificial Intelligence.

The proposed qualification also borrows from the EU-funded Erasmus+ Data Science and Artificial Intelligence project (2019), which develops curricula for Master degrees in Data Science and Artificial Intelligence. Data Science is concerned with the extraction of knowledge from large and complex datasets. It draws on the fields of Statistics, Machine Learning, and Software Development, as well as domain knowledge. It supports decision making based on statistically significant patterns. Artificial Intelligence is concerned with enabling machines to perform tasks inspired by human intelligence. It includes the following paradigms.

- Symbolic AI – comprising of Inductive Logic Programming, and expert and fuzzy systems.
- Statistical AI - comprising Probabilistic Models, Computer Vision, Natural Language Processing, and Machine Learning.
- Subsymbolic AI – comprising Distributed AI (agent-based modelling, swarm intelligence, and multi-agent systems), multi-objective optimization, and autonomous systems.

European qualifications which specialize in Data Science and Artificial Intelligence cover all the paradigms. In addition, they cover didactic principles in Research-oriented education, Problem-based education, and Student activating education.

Students who graduate with a dedicated Master's qualification in Data Science and Artificial Intelligence are better off, that is, have better subject knowledge and skills in this field, than those who study generic degrees in Computer Science, Information Technology, or Computer Engineering.

Based on the AI-Related Skills Survey (2024), organizations have a great demand for employees in Data Science and Artificial Intelligence. The need for a master qualification in these fields is vital for companies to grown larger and keep pace with the advancement in the rest of the world, more importantly in USA, China and Europe.

According to the Human Resource Development Council (2023), priority technical skills in Botswana include Data Analytics, AI, Machine Learning, Big Data Engineering, and Cybersecurity. Feedback

from the Department of Computer Science's National Skills Survey (2024) indicates a strong demand for professionals with advanced competencies in data management, algorithmic innovation, and Data-driven and AI-driven solutions. This qualification will ensure graduates are equipped with these technical capabilities alongside critical soft skills such as leadership, innovation, and ethical responsibility, enabling them to drive transformation in both local and global contexts.

Project Edison (2017). https://edison-project.eu/

MSc Data Science and Artificial Intelligence Project (2022). https://dsai-project.eu/site/

PURPOSE:

The purpose of this qualification is to produce graduates with advanced knowledge, skills, and competence to:

1. Apply Advanced Analytical Proficiency in Data Science and Artificial Intelligence.
2. Conduct Specialised Research in Data Science and Artificial Intelligence.
3. Apply Ethical and Responsible AI Practices.
4. Apply Innovative and Entrepreneurial Thinking and Strategic Decision Making and Problem-Solving in Data Science and Artificial Intelligence.
5. Work in collaboration with others on Data Science and Artificial Intelligence Projects.
6. Apply appropriate mathematical techniques for solving Data Science and Artificial Intelligence problems.

MINIMUM ENTRY REQUIREMENTS (including access and inclusion)

To be admitted to **Master of Science in Data Science and Artificial Intelligence**, an applicant shall normally have:

- NCQF Level 7 (Bachelor's degree) qualification or its equivalent.
- Entry through Recognition of Prior Learning in line with institutional and National policies where necessary.

(Note: Please use Arial 11 font for completing the template)

SECTION B	**QUALIFICATION SPECIFICATION**
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
1. Apply advanced data analysis techniques and select appropriate Artificial Intelligence and Machine Learning algorithms to solve real-world problems in organizations	1.1. Design, implement, and evaluate experiments and processes that effectively manage the entire data lifecycle in industrial settings. 1.2. Evaluate and optimize AI-driven solutions, using quantitative measures to assess performance, as required in industry. 1.3. Document methodologies, analyses, and results clearly, demonstrating transparency

	and reproducibility, as is needed in industrial settings.
2. Conduct specialized research in the fields of Data Science and Artificial Intelligence in organizational environments.	2.1 Formulate relevant and impactful research questions to source informative findings in the fields of Data Science and AI. 2.2 Apply rigorous scientific methodologies, including hypothesis formulation, systematic testing, and validation, to achieve research objectives. 2.3 Review literature to contextualize and justify research contributions as a step towards problem-solving. 2.4 Develop novel approaches and innovative solutions, contributing original knowledge to the community and industry. 2.5 Produce research outputs that meet international scholarly standards for improvement of organizational processes.
3. Apply ethical and responsible Artificial Intelligence practices, as recommended in EU and IEEE AI guidelines, in the field of AI.	3.1 Identify and critically assess ethical implications of AI technologies and data-driven practices. 3.2 Implement and evaluate AI solutions with a clear commitment to transparency, fairness, privacy, and social responsibility. 3.3 Demonstrate awareness of global standards and frameworks guiding ethical AI deployment.
4. Apply innovative and entrepreneurial thinking which takes advantage of Data Science and Artificial Intelligence technologies, for success of organizations.	4.1 Recognize opportunities for innovation in Data Science and AI, both within organizational contexts and entrepreneurial ventures. 4.2 Develop and articulate strategic plans for technological advancement and economic growth leveraging data-driven insights in industry. 4.3 Critically analyze market needs, competitive landscapes, and potential impacts of innovative AI-based solutions in industry.
5. Apply Data Science and Artificial Intelligence skills for strategic decision-making and problem-Solving in organizations.	5.1 Apply predictive analytics and AI models to derive actionable insights for strategic decision-making in organizations. 5.2 Evaluate and optimize complex processes and systems through informed decision-making driven by data analytics, in industry. 5.3 Leverage data insights and AI models to inform strategic decisions, optimize processes, and innovate complex systems in organizations. 5.4 Effectively manage uncertainty, employing

	probabilistic reasoning and robust analytical frameworks in the industry.
6. Work effectively in collaborative teams on Data Science and Artificial Intelligence projects.	6.1 Communicate complex data-driven insights clearly and concisely to diverse audiences in the industry. 6.2 Lead and participate effectively in teams, utilizing appropriate collaborative technologies and methodologies in industry. 6.3 Exhibit strong interpersonal and professional skills to foster productive team dynamics and achieve project objectives in organizations. 6.4 Apply appropriate collaborative techniques and tools to facilitate teamwork in organizations. 6.5 Build new Data Science and Artificial Intelligence-based systems through teamwork, for the industry.
7. Apply appropriate mathematical techniques for solving Data Science and Artificial Intelligence problems in relevant fields.	7.1 Evaluate and select appropriate mathematical techniques, such as optimization, probability, linear algebra, and statistics, to analyze the performance and efficiency of data science and AI algorithms in industrial settings. 7.2 Diagnose algorithmic performance issues using mathematical methods, such as complexity analysis and numerical stability evaluation, to debug and refine existing algorithms in industrial settings. 7.3 Design and implement algorithmic solutions by leveraging advanced mathematical frameworks, including statistical inference, numerical optimization, and matrix computations, to solve complex problems in data science and AI in organizations. 7.4 Validate algorithm correctness and efficiency through rigorous mathematical proofs, simulations, or empirical testing, demonstrating clear understanding and justification of chosen approaches for industrial problems. 7.5 Communicate mathematical reasoning and algorithmic solutions clearly and coherently, documenting the theoretical foundations, implementation details, and analytical findings comprehensively, for organizations.

Note: Please use Arial 11 font for completing the template)

SECTION C	QUALIFICATION STRUCTURE				
COMPONENT	TITLE	Credits Per Relevant NCQF Level			Total Credits
		Level [ ]	Level [ ]	Level [9]	
FUNDAMENTAL COMPONENT Subjects/ Courses/ Modules/Units	Mathematics and Statistics for Data Science and Artificial Intelligence			**16**	**16**
	Data Science and Artificial Intelligence Research Methods			**16**	**16**
CORE COMPONENT Subjects/Courses/ Modules/Units	Advanced Data Science Methods			**16**	**16**
	Advanced Artificial Intelligence and Machine Learning			**16**	**16**
	Topics in Data Science and Artificial Intelligence			**16**	**16**
	Natural Language Processing and Information Retrieval			**16**	**16**
	Supervised Research and Dissertation			**120**	**120**
	Subjects/ Courses/ Modules/Units				**Total Credits**

STRANDS/ SPECIALIZATION			Level [ ]	Level [9]	
1.					
2.					
Electives (Select Two out of Six).	Advanced Software Engineering for Machine Learning			12	12
	Cloud Computing for Artificial Intelligence			12	12
	Data Science and Artificial Intelligence for Health			12	12
	High Performance Computing for Data Science and Artificial Intelligence			12	12
	Deep Learning for Computer Vision			12	12
	Theoretical Data Science and Artificial Intelligence			12	12

SUMMARY OF CREDIT DISTRIBUTION FOR EACH COMPONENT PER NCQF LEVEL	
TOTAL CREDITS PER NCQF LEVEL	
NCQF Level	**Credit Value**
9	**240**
TOTAL CREDITS	**240**
Rules of Combination: **(Please Indicate combinations for the different constituent components of the qualification)**	
This qualification is worth a total of **240 credits,** and it comprises of the fundamental, core, and elective components as follows: The qualification requires 32 credits of fundamental courses, **194** credits of core courses, and **24** credits of any two (2) elective courses. The total credit a learner must achieve is **240**.	

(Note: Please use Arial 11 font for completing the template)

ASSESSMENT ARRANGEMENTS

Assessment will consist of both formative and summative assessments and should be aligned with learning outcomes and sub-outcomes. Assessment will be conducted by registered and accredited assessors by a recognized regulatory body.

1. **Formative assessment**

The Formative assessment shall contribute 50% of the final grade.

2. **Summative assessment**

Summative assessment shall contribute 50% of the final grade.

MODERATION ARRANGEMENTS

In accordance with the university policies and regulations, internal and external moderations shall be conducted by BQA registered and accredited moderators or by a recognized regulatory body.

1. **Internal moderation requirements**

Internal moderation is carried out by registered and accredited moderators whose area of expertise is in with the courses to be moderated.

2. **External moderation requirements**

External moderation is carried out by accredited moderators from other institutions recruited for this purpose.

RECOGNITION OF PRIOR LEARNING

There is a provision for award of this qualification through RPL in line with institutional and national policies.

Candidates may submit evidence of prior learning and current competence and/or undergo appropriate forms of RPL assessment for the award of credits towards the qualification in accordance with applicable university RPL policies and relevant national-level policy and legislative framework. Implementation of RPL shall also be consistent with requirements, if any, prescribed for the field or sub-field of study by relevant national, regional, or international professional bodies.

CREDIT ACCUMULATION AND TRANSFER

There is a provision for award of this qualification through credit accumulation in line with institutional and national CAT policies.

PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Horizontal Articulation

- Master of Science in Computer Science.
- Master of Science in Computer Information Systems.

- Master of Science in Statistics.

Vertical Articulation

Graduates of this qualification will have the following options for postgraduate education:

- Doctor of Philosophy in Computer Science.
- Doctor of Philosophy in Data Science.
- Doctor of Philosophy in Artificial Intelligence.

Employment Pathways

Graduates of this qualification will be able to take up the following jobs

- Lead Data Scientist.
- Senior Artificial Intelligence Engineer.
- Data Scientist
- Machine Learning Engineer
- Artificial Intelligence Specialist
- Data Analyst
- Business Intelligence Analyst
- Natural Language Processing Engineer
- Data Engineer
- AI Researcher
- Computer Vision Engineer
- AI Ethics Consultant

QUALIFICATION AWARD AND CERTIFICATION

1. Minimum standards of achievement for the award of the qualification

To be awarded Master of Science in Data Science and Artificial Intelligence qualification, a learner must meet the minimum requirement for credits from the fundamental, core, and elective courses.

The qualification requires candidates to pass 32 credits of fundamental courses, 194 credits of core courses, and 24 credits of elective courses. The total credits a learner must achieve is **240**.

2. Certification

Candidates meeting prescribed requirements will be awarded the qualification Master of Science in Data Science and Artificial Intelligence in accordance with standards prescribed for the award of the qualification and applicable policies of the university.

SUMMARY OF REGIONAL AND INTERNATIONAL COMPARABILITY

A comparison was made for the proposed qualification both regionally and internationally.

Regionally

It was compared with the following qualifications:

- Master of Science in Artificial Intelligence (University of the Witwatersrand, South Africa).
- Master of Science in Machine Learning and Artificial Intelligence (Stellenbosch University, South Africa).
- Master of Applied Data Science (University of Johannesburg, South Africa).
- Master of Science in Data Science (University of KwaZulu-Natal, South Africa).

Similarities

- Master of Science in Artificial Intelligence qualification for University of the Witwatersrand, has a research component. It also covers core Machine Learning and AI areas in the main exit outcomes, and fundamental, core, and elective courses. The assessments also include coursework. Coursework and the research report have to be completed for completion. Education and employment pathways cover roles in Artificial Intelligence.
- Master of Science in Machine Learning and Artificial Intelligence for Stellenbosch University has a research component. It also covers core Machine Learning and AI areas in the main exit outcomes, and fundamental, core, and elective courses. The assessments also include coursework. Coursework and the research report have to be completed for completion. Education and employment pathways cover roles in Artificial Intelligence.
- Master of Applied Data Science for the University of Johannesburg and Master of Science in Data Science for University of KwaZulu-Natal both cover Data Science areas in the main exit outcomes, and the fundamental, core, and elective course options (Statistics, data-driven business solutions, etc.). Education and employment pathways cover roles in Data Science, including PhD studies.
- Master of Science in Data Science for University of KwaZulu-Natal is also of two-year duration.
- All the above are at South African NQF level 9, which is equivalent to Botswana NCQF level 9 for the proposed qualification.

Differences

- Master of Science in Artificial Intelligence qualification for University of the Witwatersrand and Master of Science in Machine Learning and Artificial Intelligence for Stellenbosch University research components (mini dissertations) are smaller than the proposed qualification (a full dissertation). They also have shorter durations (1-year versus 2 years for the proposed qualification), with a smaller credit load. There is also less focus on Data Science in the main exit outcomes and the courses offered.
- Master of Applied Data Science for the University of Johannesburg and Master of Science in Data Science for University of KwaZulu-Natal focus more on Data Science, with little AI-focused content in the main exit outcomes and the courses offered. The University of Johannesburg qualification has a shorter duration (1-year) with a shorter research component (research project).
- The proposed qualification prepares learners better for research, since the dissertation is of longer duration (1-year).
- The proposed qualification has a higher credit load than those of the South African qualifications.
- The proposed qualification generally compares well with the qualifications selected in terms of content scope, the core areas of Data Science and Artificial Intelligence.

Internationally

- Master of Science in Data Science and Artificial Intelligence (University of Central Missouri, USA).
- Master of Science in Data Science (University of Texas at Austin, USA).
- Master of Science in Data Science (University of Exeter, UK).
- Master of Science in Data Science and Artificial Intelligence (Université Côte d'Azur, France).
- Master of Science in Data Science and Artificial Intelligence (San Francisco State University, USA).
- Master of Science in Data Science and Artificial Intelligence (University of Sri Jayewardenepura, Sri Lanka).

Similarities

- Master of Science in Data Science and Artificial Intelligence for the University of Central Missouri, Master of Science in Data Science and Artificial Intelligence for Université Côte d'Azur, Master of Science in Data Science and Artificial Intelligence for San Francisco State University, and the Master of Science in Data Science and Artificial Intelligence for the University of Sri Jayewardenepura have a focus on Data Science as well as Artificial Intelligence, and this is evident in the main exit outcomes, as well as the fundamental, core, and elective courses offered. The assessments also include coursework. Coursework and the research report must be completed for completion. Education and employment pathways cover roles in Data Science and Artificial Intelligence.
- Master of Science in Data Science and Artificial Intelligence for Université Côte d'Azur, Master of Science in Data Science and Artificial Intelligence for San Francisco State University, and the Master of Science in Data Science and Artificial Intelligence for the University of Sri Jayewardenepura of 2-years duration.
- Master of Science in Data Science for University of Texas at Austin and Master of Science in Data Science for the University of Exeter both cover Data Science areas in the main exit outcomes, and the fundamental, core, and elective course options (Statistics, data-driven business solutions, etc.). Education and employment pathways cover roles in Data Science, including PhD studies.
- All the international qualifications offer a project of some sort, some more research focused, others more applied.

Differences

- Master of Science in Data Science for University of Texas at Austin and Master of Science in Data Science for the University of Exeter focus more on Data Science.
- Master of Science in Data Science and Artificial Intelligence for the University of Central Missouri with a thesis as an elective.
- Master of Science in Data Science for the University of Exeter is a 1-year conversion programme, of shorter duration than the proposed qualification, which is not a conversion programme. It does not have a dissertation.
- Master of Science in Data Science for University of Texas at Austin is an online qualification with shorter duration (1-year), with no dissertation.
- Master of Science in Data Science and Artificial Intelligence for Université Côte d'Azur is more mathematically intensive than the proposed qualification, and includes an internship.
- Master of Science in Data Science and Artificial Intelligence for San Francisco State University has an option of an applied research project or a dissertation.

- The proposed qualification generally compares well with the qualifications selected in terms of content scope, the core areas of Data Science and Artificial Intelligence, as evidenced in the exit level outcomes and the fundamental, core, and elective courses.
- The proposed qualification prepares learners better for research, since the dissertation is of longer duration (1-year dedicated to research) than the other qualifications. The proposed qualification also has a dedicated research methods course, which the compared qualifications do not have.

REVIEW PERIOD
The qualification will be reviewed every 5 years.

(Note: Please use Arial 11 font for completing the template)

For Official Use Only:

CODE (ID)			
REGISTRATION STATUS	**BQA DECISION NO.**	**REGISTRATION START DATE**	**REGISTRATION END DATE**
LAST DATE FOR ENROLMENT		**LAST DATE FOR ACHIEVEMENT**	