NATIONAL COMPETENCY STANDARDS
FOR
MACHINE LEARNING TECHNICIAN
(NC3)

TVET Quality Council

Bhutan Qualifications and Professionals Certification Authority

(August 2022)

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FOREWORD

The TVET Quality Council, BQPCA is pleased to present the National Competency Standards (NCS) for Machine Learning Technician, NC3 which is developed in consultation with the field experts and trainers. The main objective of developing National Competency Standards is to set up a well-defined nationally recognized TVET Qualifications that will help in setting a benchmark for the TVET Qualifications in our country aligned to the international best practices.

The standards are developed to ensure that the TVET trainees possess the desired Skills, Knowledge and Attitude required by the industries. In order to ensure the relevancy of the competencies, the standards are developed in close consultation and partnership with industry experts and trainers from training institutes.

A training system based on National Competency Standards shall ensure that the training is relevant to the needs of the labour market. As a result, future TVET trainees will be better skilled to meet the needs and expectations of industries and employers. Such a positive impact on the employability of TVET graduates will enhance the reputation of the TVET system and make it attractive to the youths.

While acknowledging the existing level of cooperation and collaboration, the Council earnestly requests employers and training providers to extend the fullest support and cooperation in development and implementation of the National Competency Standards. The ultimate objective is to build a competent and productive national workforce that will contribute to the socio-economic development of our country.

We gratefully acknowledge the valuable contributions made by experts from industries and trainers during the consultation and validation processes of the NCS development. We further look forward to improved industry engagement and active participation of trainers in the development of a quality-assured demand driven TVET system.

Director
BQPCA

ACKNOWLEDGEMENT

Endorsement Date : 12th August, 2022

Validate Upto : July, 2025 (max. 3 years).

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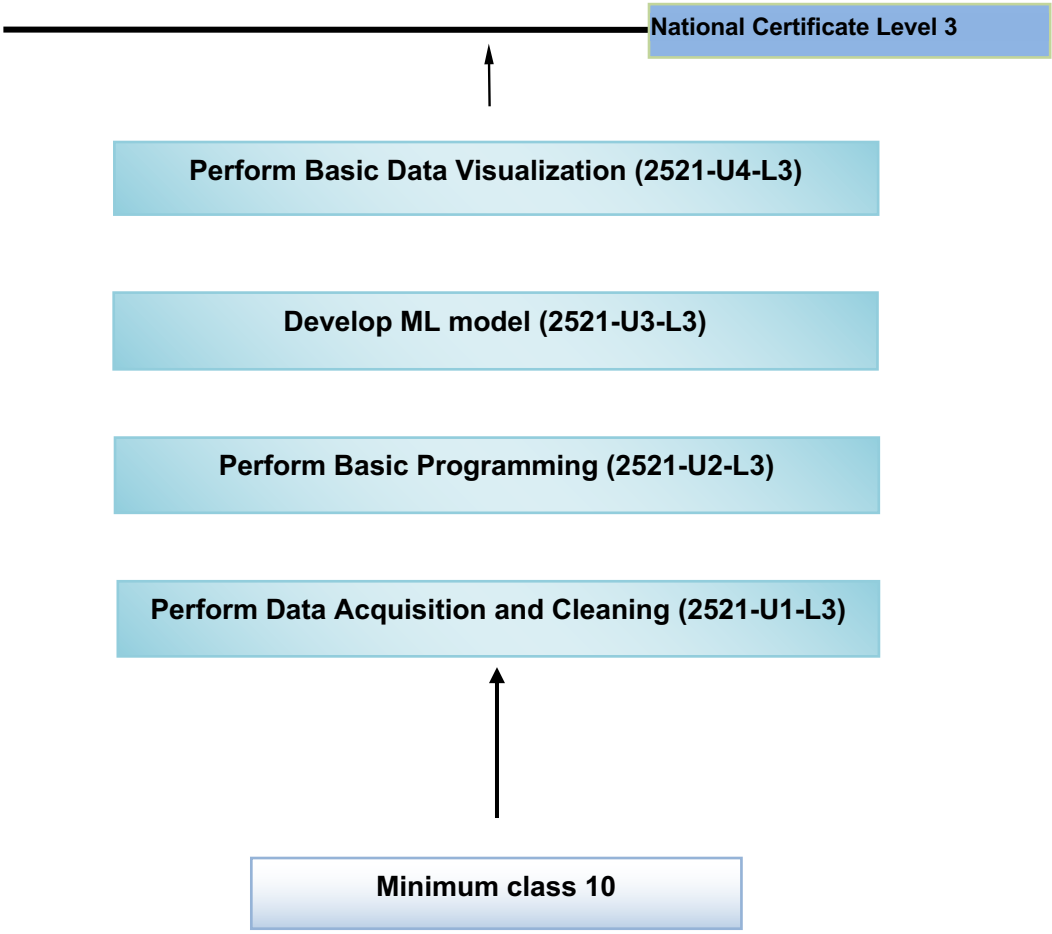
PACKAGING OF QUALIFICATIONS



OVERVIEW OF UNIT COMPETENCIES

National Certificate - Level 3

UNIT TITLE	ELEMENTS OF COMPETENCE
Perform Data Acquisition and Cleaning	1. Perform data ingestion from source data 2. Perform data preprocessing 3. Perform feature engineering
Perform Basic Programming	1. Perform fundamental programming 2. Perform advance programming
Develop ML model	1. Develop ML model 2. Perform evaluation, and fine tuning of the models 3. Test the ML models
Perform Basic Data Visualization	1. Perform exploratory data analysis 2. Use basic internet technologies

UNIT TITLE : Perform Data Acquisition and Cleaning

DESCRIPTOR: This unit covers the competencies required to perform data acquisition and cleaning.

CODE : 2521-U1-L3

ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Perform data ingestion from data source	1.1 Obtain business requirements as per the job requirements following the standard procedures 1.2 Apply query Standard Query Language (SQL) to extract the data as per the business requirement following the standard procedures
2. Perform data preprocessing	2.1 Perform data cleaning as per the job requirements following the standard procedures 2.2 Perform data normalization as per the job requirements following the standard procedures
3. Perform feature engineering	3.1 Perform EDA (Exploratory Data Analysis) as per the job requirements following the standard procedures 3.2 Perform feature extractions as per the job requirements following the standard procedures

Critical aspects:

- Demonstrate safe working practices at all times in accordance with OHS regulations.
- Apply query (SQL) to extract the data and ingest.

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and Integrity • Occupational Health and Safety (OHS) Regulations • Basics of mathematical concepts: matrix, statistics & probability and regression & correlation • Database management system • Relevant rules and regulations (Data governance framework and General Data Protection Regulations)	• Team work • Negotiation • Communication skills • Problem solving • Analytical Skills • Time Management

UNIT TITLE : Perform Basic Programming

DESCRIPTOR: This unit covers the competencies required to perform basic programming.

CODE : 2521-U2-L3

ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Perform fundamental programming	1.1 Write basic programming structures following the standards procedures 1.2 Implement control statement and functions following the standards procedures
2. Perform advance programming	2.1 Implement principles of OOP concepts following the standards procedures 2.2 Perform file management following the standards procedures

Critical aspects:

- Demonstrate safe working practices at all times in accordance with OHS regulations.
- Perform basic programming structure.

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and integrity • Occupational Health and Safety (OHS) Regulations • Basic programming knowledge • Computer knowledge • Mathematical knowledge • Relevant rules and regulations (Data governance framework and General Data Protection Regulations)	• Team work • Negotiation • Communication skills • Problem solving • Analytical Skills • Time Management

UNIT TITLE : Develop ML model

DESCRIPTOR: This unit covers the competencies required to develop Machine Learning Model.

CODE : 2521-U3-L3

ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Develop ML models	1.1 Implement Regression model following the standards procedures 1.2 Implement classification model following the standards procedures 1.3 Implement clustering model following the standards procedures
2. Perform evaluation and fine tuning of the models	2.1 Perform ***optimization*** of the model following the standards procedures 2.2 Perform evaluation of models using ***metrices*** following the standards procedures
3. Test the ML models	3.1 Test the ***robustness*** of the model following the standards procedures 3.2 Perform the model generalization following the standards procedures

RANGE STATEMENT	
Metrices may include but not limited to:	
• F1 score • Accuracy	• Recall precision • RMSE • R2
Robustness may include but not limited to:	
• Performance • Accuracy	• Behavior
Optimization may include but not limited to:	
• Hyper parameter	• Parameter tuning

Critical aspects:

- Demonstrate safe working practices at all times in accordance with OHS regulations.
- Perform evaluation of models using metrices.

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and Integrity • Occupational Health and Safety (OHS) Regulations • Basic programming knowledge • Computer knowledge • Mathematical knowledge: regression & correlation, differential calculus, probability, Fundamentals of ML • Relevant rules and regulations (Data governance framework and General Data Protection Regulations)	• Team work • Negotiation • Communication skills • Problem solving • Analytical Skills • Time Management

UNIT TITLE : Perform Basic Data Visualization

DESCRIPTOR: This unit covers the competencies required to perform basic data visualization.

CODE : 2521-U4-L3

ELEMENTS OF COMPETENCE	PERFORMANCE CRITERIA
1. Perform Visualization on performance of model	1.1 Perform ***graphic visualizations*** following the standards procedures. 1.2 Interpret the insights of the visualization following the standards procedures
2. Use basic internet technologies	2.1 Use ***web language*** following the standards procedures 2.2 Integrate ML model with simple User Interface following the standards procedures

RANGE STATEMENT
Graphic visualization may include but not limited to: • Confusion Matrix • Trend Graph • Time Series Graph
Web Language may include but not limited to: • HTML • CSS • JavaScript

Critical aspects:

- Demonstrate safe working practices at all times in accordance with OHS regulations.
- Interpret the insights of the visualization

UNDERPINNING KNOWLEDGE	UNDERPINNING SKILLS
• Ethics and Integrity • Occupational Health and Safety (OHS) Regulations • Basic programming knowledge • Computer knowledge • Mathematical knowledge: regression & correlation, differential calculus, Statistics & probability, Matrix. • Fundamentals of ML • Relevant rules and regulations (Data governance framework and General Data Protection Regulations)	• Team work • Negotiation • Communication skills • Problem solving • Analytical Skills • Time Management

Annexure:

1.1 National Competency Standards (NCS)

National Competency Standards specify the skill, knowledge and attitudes applied to a particular occupation. Standards also specify the standards or criteria of performance of a competent worker and the various contexts in which work may take place. Standards provide explicit advice to assessors regarding the skill and knowledge to be demonstrated by candidates seeking formal recognition either following training or through work experience.

1.2 Purpose of National Competency Standards

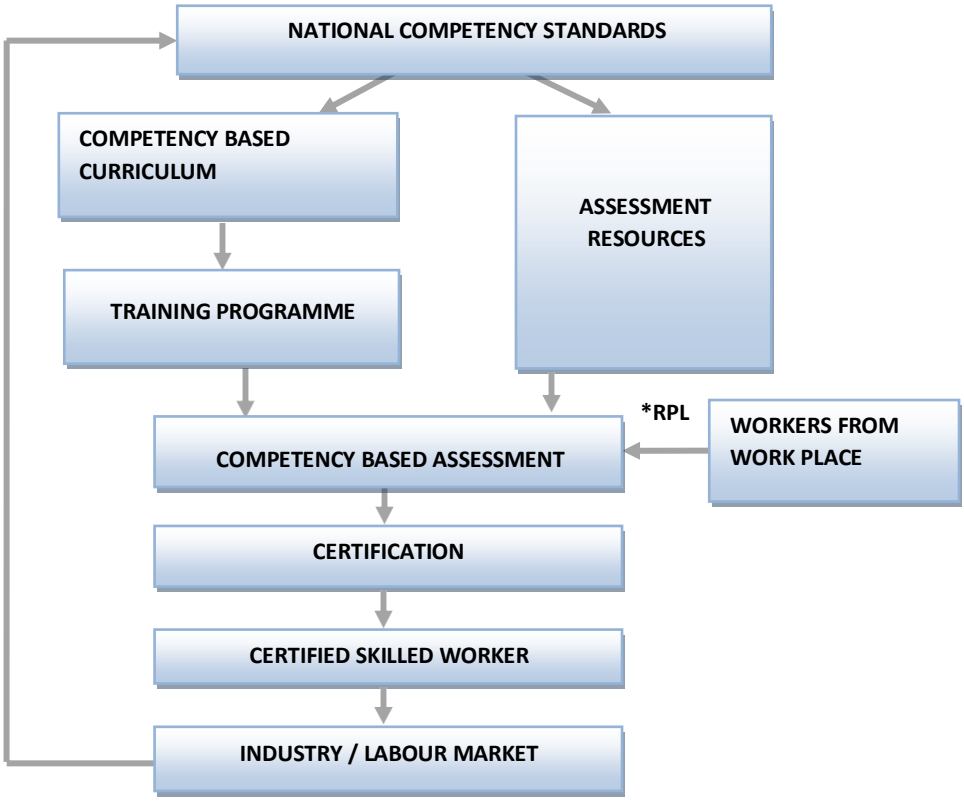
Competency Standards serve a number of purposes including:

- Providing advice to curriculum developers about the skill and knowledge to be included in curriculum.
- Providing specifications to assessment resource developers about the skill, knowledge and attitudes within an occupation to be demonstrated by candidates.
- Providing advice to industry/employers about job functions, which in turn can be used for the development of job descriptions, performance appraisal systems and work flow analysis.

1.3 Bhutan Vocational Qualifications Framework (BVQF)

Bhutan Vocational Qualifications Framework is an agreed system of Assessing, Certifying and Monitoring nationally recognized qualifications for all learning in the VET sector against national standards, in training institutions, in the workplace, in schools or anywhere where learning takes place.

Components of the Bhutan Vocational Qualification Framework (BVQF)



*** RPL = Recognition of Prior Learning**

1.4 BVQF Levels

The Bhutan Vocational Qualifications Framework has three levels classified based on the competency of the skilled workers. The three levels are:

- National Certificate Level 3 (NC 3) -Master Craftsman
- National Certificate Level 2 (NC 2) -Craftsman
- National Certificate Level 1 (NC 1) -Semi Skilled Worker

BVQF Level Descriptors

The qualification levels are decided based on level descriptors. The detail of the qualification level descriptor is as follows:

National Certificate Level 1 (Semi skilled)

Carry out processes that:	Learning demand:	Responsibilities Which are applied:
• Are narrow in range. • Are established and familiar. • Offer a clear choice of routine responses. • Involve some prioritizing of tasks from known solutions.	• Basic operational knowledge and skill. • Utilization of basic available information. • Known solutions to familiar problems. • Little generation of new ideas.	• In directed activity. • Under general supervision and quality control. • With some responsibility for quantity and quality. • With no responsibility for guiding others.

National Certificate Level 2 (Craftsman)

Carry out processes that:	Learning demand:	Responsibilities which are applied:
• Require a range of well-developed skills. • Offer a significant choice of procedures requiring prioritization. • Are employed within a range of familiar context.	• Some relevant theoretical knowledge. • Interpretation of available information. • Discretion and judgment. • A range of known responses to familiar problems	• In directed activity with some autonomy. • Under general supervision and quality checking. • With significant responsibility for the quantity and quality of output. • With some possible responsibility for the output of others.

National Certificate Level 3 (Master Craftsman)

Carry out processes that:	Learning demand:	Responsibilities which are applied:
• Requires a wide range of technical or scholastic skills. • Offer a considerable choice of procedures requiring prioritization to achieve optimum outcomes. • Are employed in a variety of familiar and unfamiliar contexts.	• A broad knowledge base which incorporates some theoretical concepts. • Analytical interpretation of information. • Informed judgment. • A range of sometimes innovative responses to concrete but often unfamiliar problems.	• In self–directed activity. • Under broad guidance and evaluation. • With complete responsibility for quantity and quality of output. • With possible responsibility for the output of others.

1.5 CODING USED FOR NATIONAL COMPETENCY STANDARDS

The coding and classification system developed in Bhutan is logical, easy to use, and also aligned with international best practices. The Bhutanese coding and classification system is based on the International Standard Classification of Occupations, 2008 (ISCO-08) developed by the International Labour Organisation (ILO).

The coding of the National Competency Standards forms the basis of the identification code for the Vocational Education and Training Management Information System (VET – MIS) both in terms of economic sector identification and that of the individual standard.
Coding the individual unit competency standard is to identify the level in qualification package to which it belongs.

While packaging, in order to follow a logical order, only competency standards related to each other and following a logical sequence in terms of training delivery, from the simple to the complex, are clustered into a qualification package.

1.6 ASSESSMENT GUIDE

Form of assessments

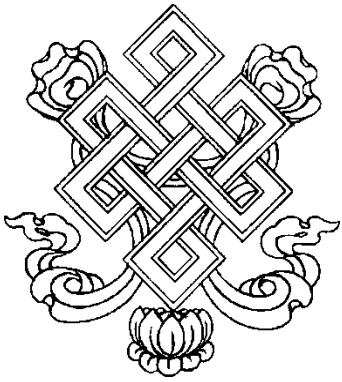
- Continuous assessment together with collected evidence of performance will be used.
- Evidence of the performance shall be based on practical demonstration.
- Knowledge can be assessed through diagrams, in writing or orally (viva- voce).

Assessment context

- Competency may be assessed in the actual work place or in a simulated workplace setting.

Assessment condition

- The candidate shall have access to all required tools, equipment, materials and documents.
- Candidate must complete the assessment in industry accepted time frame.



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