OBJECTIVE 2 – QUALIFICATION BENCHMARKING

Master of Informatics and Computer Engineering (ICE)
Vietnam National University (VNU)

Table of Contents

Introduction

The Master of Informatics and Computer Engineering (ICE) programme at Vietnam National University (VNU) addresses the needs of local employers and addresses the challenges of the digital transformation ambition of Vietnamese industries and government.

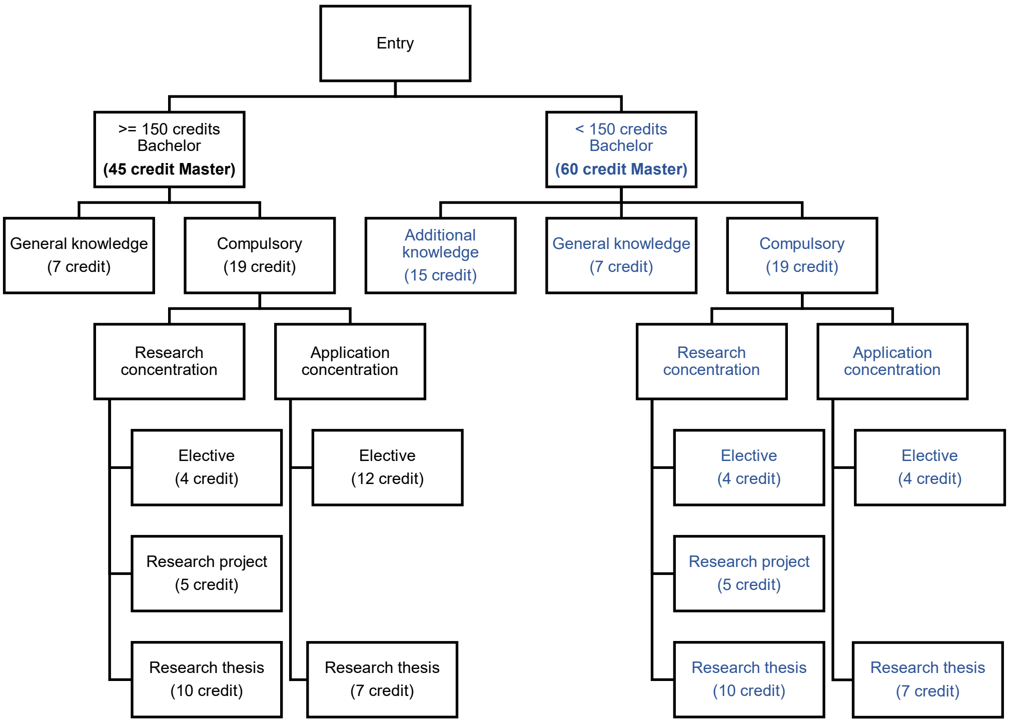
For this benchmarking exercise we have developed a scoring matrix where we identified 5 themes (programming, knowledge management, knowledge abstraction, knowledge representation/communication and research/soft skills). **Programming** theme entails criteria related to design and development of not only software but also other artefacts like algorithms, network, IoT framework etc. The theme also includes the evaluation process and collaborative management of the artefacts. **Knowledge management** primarily focuses on processes and techniques of warehousing different types of data. The theme also includes security and privacy issues related to data management. **Knowledge abstraction** theme focuses on different data analytics and machine learning techniques applied to different types of data. **Knowledge representation/communication** theme includes different visualisation techniques used to represent the results (from database query through to data analytics to algorithm) to a wide range of stakeholders. **Research/Soft skills** theme focuses on the understanding and practice of research methods along with the ability to undertake team work and present results to a wider audience.

Within each theme, we have a set list of criteria against which each course is scored. The score is within the range of 50 – 100. 90 – 100 (fully meets the criteria); 75 – 89 (mostly meets the criteria); 60 – 74 (partially meets the criteria); 50 – 59 (barely meets the criteria). The marks are indeed subjective and therefore debatable. However, the pattern that emerges as a result of the scoring of each module/course provides a holistic view of the programme and clearly identifies the areas of strengths and improvements.

Design of the programme

1. The programme offers three types of courses (modules) (1) general knowledge courses (2) compulsory courses (3) additional knowledge courses, applicable to students who do not have sufficient programming/ Informatics and Computer Engineering courses in their Bachelor’s programme.
2. Irrespective of the point of entry to the programme, there are two pathways for graduation; research concentration and application concentration. For research concentration the students need to undertake a 5 credit research project, whereas the application concentration allows more taught courses instead of the research project.

3. Credit for general courses ranges between 3 to 4 credits, while most of the compulsory and elective courses have 2 credits. The additional courses have 3 credits.


Entry
>= 150 credits Bachelor
(45 credit Master)
< 150 credits Bachelor
(60 credit Master)
General knowledge (7 credit)
Compulsory (19 credit)
Additional knowledge (15 credit)
General knowledge (7 credit)
Compulsory (19 credit)
Research concentration
Application concentration
Research concentration
Application concentration
Elective (4 credit)
Elective (12 credit)
Elective (4 credit)
Elective (4 credit)
Research project (5 credit)
Research project (5 credit)
Research thesis (10 credit)
Research thesis (7 credit)
Research thesis (10 credit)
Research thesis (7 credit)

Mode of delivery

4. All courses are delivered in English and have theory, practice and self-study credit hours. The self-study hours vary with students and are usually 3 hours/credit.
5. Almost all courses have some degree of soft skill development elements. Acquiring such soft skills is pivotal in the ICT sector. From the syllabus it is evident that most of the courses are exam based and courses have projects through which students experience teamwork. Setting marks (10-20%) for these informal projects would formalise the work/collaboration undertaken in these projects.
6. The courses are delivered through a mixture of lectures, discussions and case studies. To further increase student engagement, flipped classroom or peer assessment approaches can be introduced.
7. For practical sessions, information regarding class size and available resources is necessary to evaluate the effectiveness of the practical sessions.

Learning and Teaching

8. With regard to the programming theme, most of the courses addressed different aspects of software and/or algorithm design and development. Python is the dominant language across the courses, which is built on the strong object-oriented programming background students achieve through their UG programme.
9. Within the programming theme, the security aspect of software/algorithm design and development can be improved by incorporating some topics from cyber security, particularly access control to source code and sensitive data (if any).
10. Critical understanding about code sharing (github etc.) seems to be missing. For modern ICT programmes it is important that students are aware and have experience of code

sharing, documentation and different licenses used for open-source software/algorithm development.

11. In addition to text books (required/recommended), online materials can be included. Books require updated versions and need to be changed more regularly (one of the required books is the 1997 edition).
12. Communicating the results and/or artifacts is an important part of any ICT programme. Including a presentation part with most of the model enables students to develop their communication skills. Also, having visualisation courses and/or elements integrated with existing courses will facilitate students to develop communication skills.
13. There needs to be at least one math/stat focused course as compulsory.
14. Courses focusing on algorithms (knowledge abstraction) can be improved by reducing the amount of theoretical knowledge and incorporating more case studies and/or application of the algorithm in real life scenarios. In these approaches students would gain more experience of application of the appropriate algorithm in the right context.

Assessment and Feedback

15. No information was available with regard to assessment or exam samples.
16. Student feedback is captured via an end of semester form. Feedback on four categories – module content, teaching activities, exams/assessment and facilities are captured via a 1 – 5 scale.

Conclusion and Recommendations

17. Teaching modality
    a. More discussion-based teaching approach including flip classroom type teaching model can be introduced to increase student engagement and self-directed study.
    b. Project-based learning approach can be implemented to get more knowledge about different real-life projects, their short comings etc.
18. Teaching content
    a. Low code/No code based programming are becoming popular (10.3390/electronics10101192) in universities with the rise of online education and as a result of COVID-19. Adaptation with new trends will help students to develop new applications/algorithms more easily. This impacts not only skill development but confidence also.
    b. In this regard API based programming like GPT-3 like language model (from OpenAI etc.) to any software/app would benefit students with high quality trained dataset/model integration.
    c. Analysis of real-life data from different domains (finance, healthcare, social media etc.) is essential to get understanding about different data sources and types.
    d. Engagement with stakeholders and requirement capture is pivotal. Therefore, with different types of programming/machine learning courses these aspects needs to be included.
    e. Use of online content/courses can introduce students to new topics and choice of learning sources (in contrast to recommended book). This diversity of content and modality of delivery not only helps students to be in line with current trends but also initiates peer learning.
    f. Skill development on code sharing (through github etc.) and open licence needs to added to the course curriculum along with collaborative code development (e.g. Google Colab, AWS).

- g. Cyber security aspect of software/algorithm design and development can be improved by incorporating some topics from cyber security particularly access control to source code and sensitive data (e.g. health data).
- h. Basic understanding of how to protect intellectual property rights related to algorithms and the process of protecting these rights through third party.
- i. Critical understanding of research methods in higher education and steps involved from idea generation through to publication and/or application can be incorporated.
- j. Basic knowledge of social media-based profile creation e.g. LinkedIn profile that will facilitate future job prospects can be incorporated to develop profile.

19. Assessment
    - a. More emphasis on project based assessments (instead of exams) would help students to get experience of team work and other aspects of project management.

CRITERIA	Philosophy	Specialized English	Advanced Database Systems	Design Embedded Systems	Modern Machine Learning & Application	Advanced Digital Signal Processing	Big Data Analytics	Advanced Computer Network	Advanced Topics in ICT	Electronic Circuits Design	Information Security	Develop Applications from Computer	Software Development	Programming for Data Analytics	Data Mining	Artificial Intelligence Fundamentals	Biomedical Engineering Systems	GPU Programming and Parallel Computing	Blockchain and Application	Natural Language Processing	Digital Image Processing	Developing ERP Systems for Enterprises	IoT Systems Design and Development	Mobile Programming	Optimization Models and Algorithms	Quantum Information	Seminar	Research Methodology	Research Project	Thesis
PROGRAMMING																														
General knowledge on different software/algorithm, their application, strenghts and limitations.								80	99		99		90	70	80	90		98	98	98	98	95	95	98						
Knowledge and skill to undertake requirement analysis. Ability to collect and summarise the requirements. Also understand the market demand/trend in context of software/algorithm development.											95		98			70				90	90	95	80	85						
Ability to work in a team environment and understanding of the importance of communication in a multi disciplinary/institutional team environment.								60					90			50		95		90	60	95	60	81						
Demonstrate the knowledge and skill of project management. Particularly the differentiation and applicability of different types of project management approaches and the relevance to the project in hand.													80					65		50		92		85						
Demonstrate critical understanding of the software/algorithm design approaches and availability of design tools								98			80		98		90			98	80	91	80		95	95						
Demonstrate critical understanding of the software/algorithm development approaches and availability of development tools/languages.								90			90		90	90	95	80		98	60	98	90		95	95						
Critical knowledge about the importance of software/algorithm evaluation/testing and the steps of releasing.								95			70		98			90		98	60	60	60		94							
Critical knowledge about the importance of software/algorithm security related issues.											99		80						85											
Demonstrate critical knowledge on both object oriented and scripting languages.													60	98						60	70			89						
Ability to code in distributed cloud as well as stand-alone environement using wide range of programming languages.								95					60	98		90							98							
Good knowledge on privacy, security issues related to software/hardware/algorithm.								75			99		85						80											
Critical understanding of code sharing, archiving and protection through cloud-based repository platforms.													60						95											
Good knowledge about different cloud based computing platforms, e.g. AWS													80																	
Understanding about opensource/stand-alone/cloud-based software/hardware/algorithm.									89		80		90	98				80	94											
Critical knowledge on computing performance and how to address performance related challenges.									70		99		80					98	80	92										
KNOWLEDGE MANAGEMENT																														
Good understanding about big data and their impact on business and society.			90				50		60																					
Critical knowledge about different steps of data management pipeline – from collection to data analytics							50															82								
Critical understanding about different data types, sources of data types and their strengths and limitations.			80																				89							
Critical understanding about different data collection processes and resources along with regulations associated to the processes including ethics and permission requirements.																						91								
Demonstrate the knowledge on data privacy and it differs in different domains – manufacturing, medical etc.																						95								
Critical understanding about data quality, particularly standard process of measuring data quality.			90																											
Demonstrate the appreciation towards the importance of data cleaning and knowledge on different steps, tools used for data cleaning.																														
Understanding about the data validation process and its importance towards data management.																						80								
Good knowledge about different data warehousing techniques and technical details for implementing different types of databases.			98																			95								
Updated knowledge about data warehousing for both structured and unstructured data.			98																			92								
Critical knowledge about the approach to query the data as per the requirements of the users.			90																			90								
Good understanding about the process of data transformation in relation to the users requirements.			80																			95								
Provide detailed knowledge and skill on different data security related issues and how to identify different types of threats.			95																			90								
Explain different types of data protection measures that can be taken to safeguard data breach.			95																			95								
Understand institutional policies related to data security and privacy and tools required to implement these policies.			70																			91								
Good understanding about intellectual property rights and governance laws.																														
KNOWLEDGE ABSTRACTION																														
Demonstrate good knowledge of algebra and calculus that enables students to refresh their high school math knowledge.																									98					
Provide detailed understanding of distribution and probability statistics.																									80					
Critical understanding on intelligent agent and different types of logic representations.					89		70								60	98														
Different algorithms (structured, unstructured, adaptive) – their applications and refinement of algorithm parameters.					99		99								95	90									95					
Critical knowledge on algorithm testing, evaluation and optimisation.					80		80								60	60									95					
Good understanding of ethics and policy related to algorithm development and deployment.																														
Up to date knowledge on state of the art algorithms implemented by different stakeholders.					98		80								60	90														
Basic understanding on how to protect intellectual property rights related to algorithms and the process of protecting these rights through third party.																														
Provide detailed understanding of algorithms used for image analysis and object detection from including timelapse and multimodal images.							80														98									
KNOWLEDGE REPRESENTATION/COMMUNICATION																														
Evaluate and apply data visualisation grammar and principle to the whole of the visualisation process and the resulting presentations.																											85			
Evaluate the capabilities of different visualisation tools and programming languages, both proprietary and open-source, to support the discovery and display of critical and valuable answers hidden in small, medium and large data.																														
Implement analysis and visualisation techniques using realistic data sources from disparate disciplines and using the most appropriate visualisation tools in order to identify the valuable questions and to develop well justified, actionable answers.																														
Good understanding of processes to know the audience in terms of their requirements, domain knowledge etc.																											85			
Differentiate between exploratory and explanatory data visualisation and or knowledge representation.																											68			
RESEARCH/SOFT SKILLS																														
Understanding of core aspects of philosophy and its sub discipline.																					80						85	85		
Explore and express different ideas of philosophy and their relevance to research in higher education.																					81						71	82		
Introduction to the main ideas of logic and methods of recognising relevant information to construct persuasive arguments.									56																		85	75		
Develop analytical, argumentative problem-solving skills.					60		50	30	56				60			80		80	90	90							56	65		
Develop critical thinking and problem-solving skill in a collaborative manner.					80		60						80			60		60		80	80									
Critical understanding of research methods in higher education and steps involved from idea generation through to publication and or application.																				60										
Critical understanding of project management and role of different team members at different levels along with the interplay.					60		60	40					60							80	95		65							
Knowledge about different administrative and operational tasks required for successful project management.					60		70	30	30				70							65	94									
Basic understanding of activities related to dissemination of research outcome to wider audience.					80																						95			
Basic knowledge of social media-based profile creation e.g. LinkedIn profile that will facilitate future job prospects.																														