Comparing Global Curricula and Local Computing Degree programs using the CC2020 Curriculum Visualization Tool

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***Abstract*— This special session will introduce the participants to the CC2020 Visualization Tool based on the Landscape of Computing Knowledge Table and its 34 topics areas. It will guide them through the process of assigning a minimum and maximum value to the discipline areas of their own degree programme, then enter them into the application and allow the participants to see where in the landscape of computing their own program fits. It will also allow participants to compare their own programme with any other programme entered into the application. We hope to populate the database with programmes from all over the world over the next few months to ensure a global reach for comparison. There has never been a tool to compare computing degrees and this tool not only allows for comparison with current approved curricula but also allows participants to compare their degree with each other. This tool also enables employers to develop a guideline for potential employees and compare with job definitions to help with alignment of qualifications and competencies.**

Keywords—Computing curricula, visualization, CC2020, Computing Programs, Professional Computing Job Profiles

I. Introduction

The goals of this Special Session will be to introduce the participants to the CC2020 Visualization Tool based on the Landscape of Computing Knowledge Table, the six topic areas and the 34 subsection topics areas. [1] This session will describe the development of the Landscape of Computing Knowledge Table its contents. Each subsection specifies a minimum and maximum value for each topic suggesting an importance range within which most degree programs are likely to fall. Participants will then be able to log into the tool and develop their own degree program profile and compare it to the ACM/IEEE approved curricula guidelines as well as other degree programs globally. This tool may also help with accreditation of university degree programs. The anticipated audience for this special session will be any educator in any of the six disciplines of computing who wish to benchmark their degree program with the ACM/IEEE approved curricula and also other similar programs worldwide. We will also conduct an exercise demonstrating the potential for industry employers to apply the tool in the mapping of job profiles to computing topics and degree programs.

II. Description of the Knowledge Table and Tool

A. The Landscape of Computing Knowledge Table

A significant part of the recently published ACM and IEEE-CS report "Computing Curricula 2020: Paradigms for Global Computing Education" [1,2] was the development of the Landscape of Computing Knowledge Table [1, pp64] At the time of publication of the CC2020 report there were six discipline areas that had approved curricula:

- Computer Engineering
- Computer Science
- Software Engineering
- Information Systems
- Information Technology
- Cyber Security.

Since publication of the report a new Data Science curriculum has been approved so this will have to be added to the Knowledge table in due course.

The CC2020 Steering Committee analysed all the approved curricula in the six discipline areas and looked for any overlaps. For example, all the areas have some aspect of programming but not all at the same level. Based on this data and using a thematic analysis methodology, the Landscape of Computing Knowledge table was developed with six main themes representing topic areas:

- Users and Organisations
- Systems Modelling
- Systems Architecture and Infrastructure

- Software Development
- Software Fundamentals
- Hardware.

For each topic area 34 sub sections constituted their underlying codes which were mapped to the six disciplines approved computing curricula. This table was then further developed to include the minimum (0) and maximum (5) values required for each topic subsection for each of the six disciplines. See Appendix 1.

B. *The Visualization Tool*

As part of the Landscape of Computing Knowledge project an online application was developed by institutions in Peru. See Fig 1.

The six approved curricula were mapped as baseline data with the minimum and maximum values to enable the comparison of individual programs or profiles.

Fig 1. Intro screen of the CC2020 Visualization Tool

Stakeholders are able to assign a minimum and maximum value to each of the topic subsections that are implemented in their own degree program(s) and then that program(s) can be matched against the current ACM/IEEE-CS approved curricula. See Fig 2.

The tool also enables comparisons between the approved curricula and selected programs from individual institutions. It is further possible to design a tailored job profile and compare that to the approved curricula and selected programs. This ability will support exploration of job profiles and their mapping to appropriate curricula by industry practitioners and vice versa by educational curricula designers.

III. AGENDA OF THE SPECIAL SESSION

This special session builds on a sequence of workshops previously held, initially in New Zealand, [2,3] South America, Japan and subsequently at the global SIGCSE Technical Symposium [4] and now brings the Knowledge Table and Tool to the global IEEE and FIE community to broaden awareness across the computing and engineering communities

- Introduction (10 mins) – An introduction to the research and methodology of the Landscape of Computing Knowledge Table and the development of the values (0-5) given to each topic area
- A demonstration of the visualization tool (10 mins)
- Participants will be invited to log into the tool and create a profile for the computing degree program(s) offered at their university. These profiles can then be compared to the ACM/IEEE-CS approved curricula guidelines and other universities. (30 mins)
- Discussion on the usability of the tool and possible uses and enhancements (20 mins).
- A summary of the discussion and refinements will be to the developers. (10 mins).

When the participants have completed entering the minimum and maximum values for each of the 34 subsections of their own degree programs there will be the opportunity for comparing programs against the benchmark curriculum.

For example in Fig 2 the chosen program is depicted with the line graph and its mapping to the approved Computer Science curriculum is shown in the shaded area. Thus the emphasis of a specific program can be compared against any of the approved curriculum.

IV. OUTCOMES AND FUTURE WORK

The live database will be populated with the participants academic programs and illustrate their alignment with academic curricula and industrial job descriptions and profiles. Discussion and feedback from the participants will allow the developers to update the tool. This is an opportunity to gain exposure from the IEEE community to add to the New Zealand and ACM SIGCSE global community who have already participated in populating the tool. This will have significant importance for the educators, industry, current and potential students and other stakeholders of all computing degree programs.

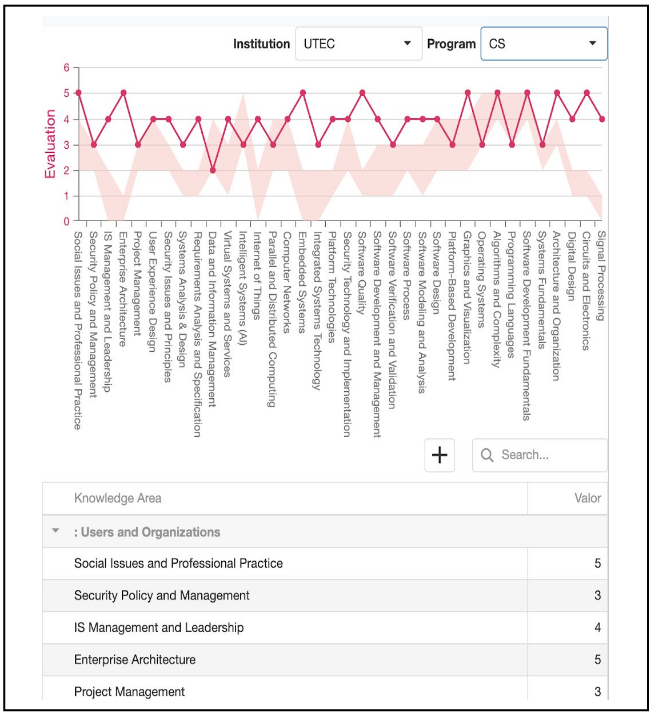

Fig 2: Program Comparison

V. BIOGRAPHIES

Alison Clear is an Adjunct Associate Professor at the Eastern Institute of Technology. Alison is an invited international keynote speaker, has been a member of the international ACM Educational Advisory Committee, member and vice chair of the ACM Special Interest Group in Computer Science Education, currently Board member of the ACM Special Interest Group on Computers and Society, Fellow of the Institute of Information Technology Professionals (IITP) and Fellow of the Computing and Information Technology Research and Education in New Zealand (CITRENZ). In 2020 she received the ACM SIGCSE award for Lifetime Service to Computer Science education. She recently led an international research project, Computing Curriculum 2020 (CC2020,) to redefine the computing curricula for 2020 forward. Alison is the newly elected Chair of ACM SIGCSE.

Tony Clear is an Associate Professor in the School of Engineering, Computer and Mathematical Sciences and Co-Director of the Software Engineering Research Lab at Auckland University of Technology. He is an Associate Editor for ACM Transactions on Computing Education, for Computer Science Education, and ACM Inroads for which he is also a regular columnist and Editorial Board member. He is active in research and teaching within the computer science education and software engineering communities. Building on the work foreshadowed in the Computing Curricula 2020 report, has co-led an ACM ITiCSE 2020 working group report, titled: Designing Computer Science Competency Statements: A Process and Curriculum Model for the 21st Century.

Prof. Dr. Ernesto Cuadros-Vargas received his PhD in Computer Science at the University of Sao Paulo-Brazil(2004). He is a founder member of Peruvian Computer Society (SPC) and he was president during 2001-2007 and 2009. He was also Executive Secretary of the Latin American Computing Center (CLEI) (2009-2016) and is currently member of the Board of Governors of IEEE Computer Society (2020-2022). He was the only Latin American member of the Steering Committee of both ACM/IEEE-CS Computing Curricula (CS2020). Computer Science (CS2013).

Shingo Takada is a Professor at the Department of Information and Computer Science, Keio University in Japan. He has been active in the education community in Japan serving on the IPSJ Education Committee as well as a task force member of the J17 curriculum project. Internationally, he has served as a Steering Committee member of the Computing Curriculum 2020 (CC2020) project.

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Appendix 1

TABLE 1 CC2020 Landscape of Computing Knowledge Table

		CE		CS		CSEC		IS		IT		SE	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
1. Users and Organizations	1.1. Social Issues and Professional Practice	2	5	2	4	2	4	3	5	2	4	3	5
	1.2. Security Policy and Management	1	3	2	3	4	5	2	3	2	4	2	4
	1.3. IS Management and Leadership	0	2	0	2	1	2	4	5	1	2	1	2
	1.4. Enterprise Architecture	0	1	0	1	1	2	3	5	1	3	1	3
	1.5. Project Management	1	3	2	3	1	2	4	5	2	3	2	4
	1.6. User Experience Design	1	3	2	4	1	3	2	4	3	4	3	5
2. Systems Modeling	2.1. Security Issues and Principles	2	3	2	3	4	5	2	4	3	4	2	4
	2.2. Systems Analysis & Design	1	2	1	2	1	2	4	5	1	3	2	4
	2.3. Requirements Analysis and Specification	1	2	1	2	0	2	2	4	1	3	3	5
	2.4. Data and Information Management	1	2	2	4	2	3	3	5	2	3	2	4
3. Systems Architecture and Infrastructure	3.1. Virtual Systems and Services	1	3	1	3	1	2	1	2	3	4	1	3
	3.2. Intelligent Systems (AI)	1	3	3	5	1	2	1	2	1	2	0	1
	3.3. Internet of Things	2	4	0	2	1	3	1	3	2	4	1	3
	3.4. Parallel and Distributed Computing	2	4	2	4	1	2	1	3	1	3	2	3
	3.5. Computer Networks	2	4	2	4	2	4	1	3	3	4	2	2
	3.6. Embedded Systems	3	5	0	2	1	3	0	1	0	1	0	3
	3.7. Integrated Systems Technology	1	2	0	2	0	2	1	3	3	4	1	3
	3.8. Platform Technologies	0	1	1	2	1	2	1	3	2	4	0	2
	3.9. Security Technology and Implementation	2	3	2	4	4	5	1	3	2	4	2	4
4. Software Development	4.1. Software Quality, Verification and Validation	1	3	1	3	1	2	1	3	1	2	3	5
	4.2. Software Process	1	2	1	3	0	2	1	3	1	3	3	5
	4.3. Software Modeling and Analysis	1	3	1	3	1	2	2	4	1	3	4	5
	4.4. Software Design	2	4	2	4	1	3	1	3	1	2	4	5
	4.5. Platform-Based Development	0	2	2	4	0	1	1	3	2	4	1	3
5. Software Fundamentals	5.1. Graphics and Visualization	1	2	2	4	0	1	1	1	0	1	0	2
	5.2. Operating Systems	2	4	3	5	2	3	1	2	1	3	1	3
	5.3. Data Structures, Algorithms and Complexity	2	4	4	5	1	3	1	3	1	2	2	4
	5.4. Programming Languages	2	3	3	5	1	2	1	2	1	2	2	3
	5.5. Programming Fundamentals	2	4	4	5	2	3	1	3	2	4	3	5
	5.6. Computing Systems Fundamentals	2	3	2	3	1	2	2	3	1	3	2	3
6. Hardware	6.1. Architecture and Organization	4	5	3	4	1	3	1	2	1	2	1	3
	6.2. Digital Design	4	5	1	2	0	2	0	1	0	1	0	2
	6.3. Circuits and Electronics	4	5	1	2	0	1	0	1	1	2	0	1
	6.4. Signal Processing	3	4	0	1	0	2	0	1	0	1	0	1