Computational Intelligence (CI) is a relatively new research field, which has demonstrated an explosive development since the 80’s. Despite the fact that a significant amount of educational material is accessible and available, fundamental achievements have not been organized into a comprehensive CI curriculum yet. To give a prosperous future to the Society, we have to nurture undergraduate and graduate level students by means of high-quality and effective educational materials. This will attract talented and enthusiastic students as well as document the progress of the field. Here, we discuss what we can do in our capacity of researchers and educators to achieve this fundamental goal, and how the CIS University Curriculum Subcommittee supports this activity.

Progress in Main Focus Areas—
The CIS University Curriculum Subcommittee (UCSC) http://cis.ieee.org/university-curricula.html is part of the CIS Education Committee http://cis.ieee.org/education.html, and promotes the development and proliferation of Computational Intelligence courses in the undergraduate and graduate curricula. The following members are involved in the work of the UCSC: Damien Coyle (Northern Ireland, UK), Bruno DiStefano (Canada), Simona Doboli (US), Peter Erdi (US & Hungary), Haibo He (US), Robert Kozma (US, Chair of the subcommittee), Luis Magdalena (Spain), Jose Iglesias Martinez (Spain, representing the Standards Committee), Janusz Kacprzyk (Poland), LiPo Wang (Singapore), Mike Watts (Australia). UCSC members provide a broad geographic coverage as well as represent the academic, government, and industry sectors. Each member participated in working groups to support three focus areas so as to: (A) create and maintain the university curriculum database; (B) promote the creation of textbooks on Computational Intelligence; (C) maintain visibility and web presence. The present status of the activities is as follows.

A. Database of University Courses on Computational Intelligence
At present, we have a database of over 100 courses covering various aspects of computational intelligence taught both at undergraduate and graduate levels, see [1]. The database has been created by Luis Magdalena and his colleagues from the European Centre for Soft Computing, Spain. Interested readers are encouraged to visit the database, review existing courses and explore the materials of the courses. We are collecting course materials all over the world. If you are involved in education, you are encouraged to make your course material available for broader use through our database. In this way, you increase your own visibility, receive a useful feedback from the benefited and help the community: a win-win situation.

Courses with complete materials are assessed by our subcommittee. Once a course, present on a web site, and its online material has been reviewed for completeness and accessibility, this course may be recommended for CIS educators and the course web site linked through the IEEE CIS Education Center http://education.ieee-cis.org/, to promote a wider availability.

B. Computational Intelligence Textbooks
Although there are hundreds of relevant textbooks, there is still space and need for comprehensive textbooks presenting a truly integrated approach to CI as an emerging discipline. The success of this task would strengthen Computational Intelligence on a long-term basis. At the same time, our goal is to reach our members and make them understand the great opportunity associated with the design of education textbooks at the University level. Major action items include:
WCCI2012 Panel Session “Computational Intelligence in Education and University Curricula,”
June 14, 2012, Brisbane, Australia

This panel has been organized by Robert Kozma and Jennie Si, with panelists Janusz Kacprzyk, Jim Keller, Luis Magdalena, Marios Polycarpou, Kumar Venayagamoorthy, Lipo Wang, and Jerry Mendel. Various areas of CI education, including databases and course materials, online resources, development of new curricula, textbooks, open-source software were fruitfully discussed and several recommendations for future actions made. Major points discussed:

1. Problem Definition:
   - There are some books that can be viewed as textbooks but not many. Unfortunately, it is not easy to write a textbook, and many people do not want to do this. However, we do need textbooks and the Subcommittee can be pivotal in promoting these ideas.

2. Where to Position Textbooks?
   - Undergraduate or Graduate level: It is agreed that we are more advanced at the graduated level and that there it is a critical need to work on undergraduate texts.
   - Prerequisites: Some calculus, math, comp science, biomed can be expected. Or one should try minimizing prerequisites? The textbook should be available to different backgrounds (e.g., science, engineering, biology, business, etc.).

3. Possible Course Structure:
   - Modular course structure: Right now we could start/test the material through modules in existing courses (like AI, machine learning, signal processing) and then move into a self-standing course based on the acquired experiences. Other panelists encouraged an aggressive promotion of new stand-alone courses.
   - Problem-based learning: an example could be in business schools problem-solving approach based on case studies.
   - No cookbook: it should not be just a recipe book. Problems can be used for good motivation, followed by comprehensive treatment of fundamentals. Depending on the course level, it may be lighter (undergrad), or heavier (grad) text.
   - Key/killer application areas: need to outline areas where CI is inevitable and aggressively promote those, such as biomedical, finance/economy, and robotics.

4. Broader Societal Impact:
   - Define a possible course sequence starting from UG low levels, then upper UG/grad, and advanced graduate levels. Textbooks should have a uniform coverage of the topics with a variety of homework problems.

5. Action Items:
   - Write a pamphlet for textbook/s, or a series? Then gather feedback in the Society. Propose competitions and awards for the best textbooks, course materials, etc.
   - Maybe a good solution would be to join forces and prepare a textbook written by a number of people, as a combined effort.
   - Come up with a list of main topics and some related areas, then group courses in different categories. In addition to neural networks, fuzzy systems, evolutionary computing, swarms, and immune systems, topics can include cognitive computing, large-scale dynamic networks and complex systems [4–7].
   - Consider suggesting open-source textbooks, which likely would have more significant impact.
A comprehensive thinking of what a good CI curriculum should need. What is available now, what is used by various universities? Examples of successful textbooks. What is missing there? It would be very useful to have a well-thought out list of topics, from a holistic viewpoint, for introductory, as well as for advanced textbooks. A feedback from students who took CI courses would provide crucial support in answering the above questions.

Some of our members work actively on new comprehensive textbooks. We need to identify gaps in CI curricula and provide incentive to fill the gaps by writing textbooks. We have a discussion group at http://watts.net.nz/forum/; interested fellows are strongly encouraged to join and contribute.

We had a Panel at WCCI2012 in Brisbane on “Computational Intelligence in Education and University Curricula,” refer to the inset in the previous page. The Panel extensively discussed textbook issues; the lessons learnt are given at http://computational-intelligence.blogspot.com/2012/05/wcci-2012-panel-session-on.html.

C. Publicity of University Curriculum Activities
We work to continuously maintain the updated website of our University Curriculum Subcommittee, display information on ongoing activities, and provide access to available resources. In particular:

- We are working to improve the accessibility and attraction of the university curriculum portal. This site will soon be linked to course materials with the option to connect to the CIS Educational Repository http://cis.ieee.org/cis-educational-repository.html.
- We are aiming at improving the coordination of our activities with other education sub-committees. Potential areas are the educational repository and tutorials as well as standards, and webinars [3].
- We are sending regular updates to the CIS newsletter, publish material in blogs, and forums. We wish to propose a special issue in relevant periodicals (e.g., CIM) on university curriculum issues as well as Panels and Special Sessions at the CI flagship conferences, e.g., SCCI, IJCNN, Fuzz, CEC.

In conclusion, Computational Intelligence in higher education and in university curricula is a crucial area for maintaining the dynamic development of our field and to establish CI as one of the basic disciplines of modern science and engineering. A combined effort of our experts, i.e., you, is needed for a breakthrough in this area. Our volunteers in the University Curriculum Sub Committee has devoted much time and effort to this endeavor, but we cannot succeed without the active support and participation of our members. Please consider supporting our initiatives. For updates on UCSC activities please visit http://cis.ieee.org/university-curricula.html.

References

by the IEEE CIS Vietnam Chapter which was established in 2011. We hope you are as inspired and encouraged as we are here at CIM, to look beyond the various researches that are featured in this issue. Please continue to keep us posted of your progress. The success of this publication depends greatly on your active participation, submission of new research findings, sharing of ideas and valuable feedback. On behalf of the Editorial Board, I encourage you to contact me at eletankc@nus.edu.sg with any comments and suggestions.

I look forward to speaking to you again in our year-end issue.

K.C. Tan