INFORMATICS EUROPE

Informatics in Interdisciplinary Curricula

Summary of Survey Results 2021

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The Interdisciplinary Informatics Curricula project

Initiated at the ECSS 2020 IE/NIA workshop on ”Informatics and Interdisciplinarity” (Online, Wed 28 Oct 2020)

Goals:

- Map out the landscape of current Informatics teaching arrangements in interdisciplinary curricula.
- See if one could derive from these data some common models and/or recommendations on how Informatics teaching in an interdisciplinary context should be organised.
- The eventual outcome could be either a common "Informatics core" curriculum or, more likely, some discipline-specific planning models or recommendations.

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Timeline 2021:

- Planning team meetings 12 Jan, 17 Mar
- Pilot data collection and analysis 15 Jan – 28 Feb
- IE/NIA Status Update and Outlook meeting 16 Apr
- Full data collection 26 Apr – 20 May
- Reporting at ECSS 2021 (Madrid, Oct 27 2021)

Data Collection: Outline

- A link to the online survey form was mailed to all Informatics Europe NIA contacts (~ 30 persons) and member departments (~ 150 departments) on 23 Apr 2021, with a request to forward.
- By the (extended) deadline of 25 May, data on 65 programmes (22 BSc, 43 MSc) at 35 universities in 13 countries was received.
  - To be precise: the counts are ”specialisations” (majors, tracks etc.) Thus, a single curricular study programme may contribute several specialisations.
- In the data-cleaning phase, five programmes were left out because they were considered generic Informatics/CS rather than interdisciplinary, and one submission was discovered to be in duplicate.
- Thus the final count of programmes for further analysis was 59.

Data Collection: Essentials

- Two key aspects of the survey form were how to classify: (1) the addressed interdisciplinary fields and (2) the contributing Informatics areas.
- The interdisciplinary fields were identified by the OECD Classification of Fields of Science and Technology (2006)
- Computer Science and Computer Engineering competency classifications in the ACM/IEEE Computing Curricula 2020 recommendations.
  - Some notes on the ACM/IEEE Curricula: This has grown to a 205-page(!) handbook, and sadly no longer contains a single taxonomy but seven(!) partially overlapping and conflicting taxonomies. Moreover the topical one of Data Science has no content but is described as being "under development".
  - The taxonomy used for this data collection is a merger of the CS and CE taxonomies, to which an *ad hoc* competency "Data Analysis" was added.

The OECD classification

1. Natural Sciences
   1. Mathematics
   2. Computer and information sciences
   3. Physical sciences
   4. Chemical sciences
   5. Earth and related environmental sciences
   6. Biological sciences
   7. Other natural sciences
2. Engineering and Technology
   1. Civil engineering
   2. Electrical engineering, electronic engineering, information engineering
   3. Mechanical engineering
   4. Chemical engineering
   5. Materials engineering
   6. Medical engineering
   7. Environmental engineering
   8. Environmental biotechnology
   9. Industrial biotechnology
   10. Nano-technology
   11. Other engineering and technologies
3. Medical and Health Sciences
   1. Basic medicine
   2. Clinical medicine
   3. Health sciences
   4. Health biotechnology
   5. Other medical sciences
4. Agricultural Sciences
   1. Agriculture, forestry, and fisheries
   2. Animals and dairy science
   3. Veterinary science
   4. Agricultural biotechnology
   5. Other agricultural sciences
5. Social Sciences
   1. Psychology
   2. Economics and business
   3. Educational sciences
   4. Sociology
   5. Law
   6. Political Science
   7. Social and economic geography
   8. Media and communications
   9. Other social sciences
6. Humanities
   1. Humanities: History and archaeology
   2. Languages and literature
   3. Philosophy, ethics and religion
   4. Art (arts, history of arts, performing arts, music)
   5. Other humanities

The Adapted ACM/IEEE CS+CE Taxonomy

AL - Algorithms and Complexity

CAE - Circuits and Electronics

CAO - Computer Architecture & Organisation

CN - Computational Science

DA - Data Analysis

DIG - Digital Systems Design

DS - Discrete Structures

ESY - Embedded Systems

GV - Graphics and Visualisation

HCI - Human-Computer Interaction

IM - Information Management

IS - Intelligent Systems

NWK - Computer Networks

OS - Operating Systems

PBD - Platform-based Development

PD - Parallel and Distributed Computing

PL - Programming Languages

SDF - Software Development (Fundamentals)

SE - Software Engineering

SEC - Information Security

SGP - Signal Processing

SRM - Systems Resource Management

SP - Social Issues and Professional Practice

Other

Key Informatics Competencies

- The respondents were asked to identify Informatics competencies as *Required*, *Elective* or *Optional* in their programmes.
- The top-10 competencies identified as *Required* or *Elective* were as follows (out of 59 programmes):

Data Analysis	21	
Software Development Fundamentals	19	[= programming]
Information Management	17	
Algorithms and Complexity	14	
Intelligent Systems	14	
Graphics and Visualisation	13	
Programming Languages	13	[~ programming?]
Computational Science	12	
Software Engineering	12	[~ programming?]
Social Issues and Professional Practice	12	

Informatics Competencies by Themes

- A closer analysis of the 59 programme descriptions suggests a grouping of them into 13 broad themes:
  - Agriculture and Forestry (1 programme)
  - Biosciences (7 programmes)
  - Health and Medicine (6 programmes)
  - Business and Economics (9 programmes)
  - Data Science (3 programmes)
  - Engineering (7 programmes)
  - Games (1 programme)
  - Humanities (6 programmes)
  - Languages and Cognition (2 programmes)
  - Law and Governance (2 programmes)
  - Media and Communications (12 programmes)
  - Quantum Technology (1 programme)
  - Social Sciences (2 programmes)

Key Competencies: Biosciences

- The top-5 competencies identified as *Required* or *Elective* in the 7 Biosciences programmes were as follows:
  - Algorithms and Complexity 5
  - Data Analysis 5
  - Software Development Fundamentals 4
  - Information Management 4
  - Computational Science 4

Key Competencies: Health and Medicine

- The top-6 competencies identified as *Required* or *Elective* in the 7 Health and Medicine programmes were as follows:
  - Data Analysis 4
  - Information Management 4
  - Intelligent Systems 3
  - Signal Processing 3
  - Algorithms and Complexity 2
  - Computational Science 2

Key Competencies: Business and Economics

- The top-7 competencies identified as *Required* or *Elective* in the 9 Business and Economics programmes were as follows:
  - Information Management 5
  - Data Analysis 4
  - Intelligent Systems 4
  - Algorithms and Complexity 3
  - Operating Systems 3
  - Software Development Fundamentals 3
  - Software Engineering 3

Key Competencies: Engineering

- The top-3 competencies identified as *Required* or *Elective* in the 7 Engineering programmes were as follows:
  - Algorithms and Complexity 3
  - Computational Science 3
  - Software Development Fundamentals 3

Key Competencies: Media and Communications

- The top-7 competencies identified as *Required* or *Elective* in the 12 Media and Communications programmes were as follows:
  - Graphics and Visualisation 4
  - Human-Computer Interaction 4
  - Information Management 3
  - Computer Networks 3
  - Software Development Fundamentals 3

Observations and Conclusions (1/2)

- Would have been good to have more replies (as always), and also greater diversity across countries and themes
  - 30/59 programmes from Italy, 10/59 from Finland
  - 13 programmes in Biosciences + Health&Medicine, 12 in Media&Communications vs. 3 in Engineering, 2 in Social Sciences
- Challenges with taxonomies
  - The OECD taxonomy was too detailed to use on this small amount of data
  - The ACM/IEEE computing (= Informatics) competencies taxonomy was surprisingly confused and also in some ways outdated; is this a reflection on the taxonomy work or the nature of the field?

Observations and Conclusions (2/2)

- Almost all of the identified Informatics competences received a few mentions in the survey, but Data Analysis and Programming (broadly understood) were the clear leaders
- There were noticeable differences in the responses across different thematic interdisciplinary areas, but the amount of data was too small to make very strong conclusions
- Detailed report with brief summaries of all the programmes forthcoming
- Suggestions for recommendations or other followup?