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).
  - 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

<table>
<thead>
<tr>
<th>1.</th>
<th>Natural Sciences</th>
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<tbody>
<tr>
<td>1.</td>
<td>Mathematics</td>
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<td>2.</td>
<td>Computer and information sciences</td>
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<td>3.</td>
<td>Physical sciences</td>
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<td>4.</td>
<td>Chemical sciences</td>
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<td>5.</td>
<td>Earth and related environmental sciences</td>
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<td>6.</td>
<td>Biological sciences</td>
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<td>7.</td>
<td>Other natural sciences</td>
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<th>2.</th>
<th>Engineering and Technology</th>
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<tr>
<td>1.</td>
<td>Civil engineering</td>
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<td>2.</td>
<td>Electrical engineering, electronic engineering, information engineering</td>
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<td>3.</td>
<td>Mechanical engineering</td>
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<td>4.</td>
<td>Chemical engineering</td>
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<td>5.</td>
<td>Materials engineering</td>
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<td>6.</td>
<td>Medical engineering</td>
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<td>7.</td>
<td>Environmental engineering</td>
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<th>3.</th>
<th>Medical and Health Sciences</th>
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<tr>
<td>1.</td>
<td>Basic medicine</td>
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<td>2.</td>
<td>Clinical medicine</td>
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<td>3.</td>
<td>Health sciences</td>
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<td>4.</td>
<td>Health biotechnology</td>
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<td>5.</td>
<td>Other medical sciences</td>
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<th>4.</th>
<th>Agricultural Sciences</th>
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<tbody>
<tr>
<td>1.</td>
<td>Agriculture, forestry, and fisheries</td>
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<td>2.</td>
<td>Animals and dairy science</td>
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<td>3.</td>
<td>Veterinary science</td>
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<td>4.</td>
<td>Agricultural biotechnology</td>
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<td>5.</td>
<td>Other agricultural sciences</td>
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<th>5.</th>
<th>Social Sciences</th>
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<tbody>
<tr>
<td>1.</td>
<td>Psychology</td>
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<td>2.</td>
<td>Economics and business</td>
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<td>3.</td>
<td>Educational sciences</td>
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<td>4.</td>
<td>Sociology</td>
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<td>5.</td>
<td>Law</td>
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<td>6.</td>
<td>Political Science</td>
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<td>7.</td>
<td>Social and economic geography</td>
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<td>8.</td>
<td>Media and communications</td>
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<td>9.</td>
<td>Other social sciences</td>
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<th>6.</th>
<th>Humanities</th>
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<tr>
<td>1.</td>
<td>Humanities: History and archaeology</td>
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<td>2.</td>
<td>Languages and literature</td>
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<td>3.</td>
<td>Philosophy, ethics and religion</td>
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<td>4.</td>
<td>Art (arts, history of arts, performing arts, music)</td>
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<td>5.</td>
<td>Other humanities</td>
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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?] [~ programming?] 13
  - Computational Science 12
  - Software Engineering 12 [~ programming?] 12
  - 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?