A Survey of Introductory Programming Courses in Ireland

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Motivation

• Map the Introductory Programming (CS1) landscape in Ireland
  • Spring 2018

• Serve as a baseline:
  • National Computer Science senior cycle (high school) curriculum (non-compulsory) pilot began September 2018
    • Computing intake at third level could change soon
    • These students won’t be in university until September 2020

• Allow comparison between Irish CS1 landscape and other countries, particularly UK and Australasia where recent surveys have been conducted
Motivation

- I Teach CS1
- I Research CS1
- External Expert to Dept. of Education Committee on second-level curriculum (specifically teacher-training subgroup)
- I Teach graduate program for second-level teachers (to teach computing)
- More...
Background

- Ireland is small in terms of population at 4.8 million
  - New Zealand is also 4.8
  - Scotland is 5.6

- Possible to get almost complete picture of national activity
  - However, there might be ‘group think’ happening?

3.6 million sheep  Whiskey exports €0.6 billion

30 million sheep  Whiskey exports £2.4 billion

30m >> 3.6m
£2.4 >> €0.6
Approach

• UK survey generously provided by those authors (see paper)
  • Based on Australasia survey – whose authors are also very generous (see paper)

• Emailed survey to Irish Third-Level Computing Forum (meeting of all public HE heads of Computing schools/faculties)

• Emailed and talked to direct contacts (including private colleges)
Coverage

• At time of survey Ireland had 7 universities, 14 institutes of technology (IoTs) and a handful of smaller private colleges*.

• Responses from the instructors of 39 courses at 25 institutions, including 6 of 7 universities, 13 of 14 institutes of technology, and four private colleges.

• This represents **90% of all publicly funded higher education institutions in Ireland**
  • **Plus 80% (four out of five) of the private colleges** recognized by the Higher Education Colleges Association that offer computing degrees.

*Jan 2019: 3 IoTs -> 1 Technological University, so now 8 Universities, 11 IoTs
Coverage

- Did collect information from 2 universities in Northern Ireland
- Did not include as these are covered in UK surveys
- Also, plans to do international survey (more later)
### CS1 in Ireland (Overview)

#### Course titles (for fun)

<table>
<thead>
<tr>
<th>Computer Programming</th>
<th>Programming Essentials</th>
<th>Programming 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Programming 1 using C#</td>
<td>Software Development 1</td>
<td>Introduction to Programming I</td>
</tr>
<tr>
<td>Introduction to Programming</td>
<td>Algorithmic Programming 2</td>
<td>Fundamentals of Programming</td>
</tr>
<tr>
<td>Programming</td>
<td>Computer Programming II</td>
<td>Programming</td>
</tr>
<tr>
<td>Software Development</td>
<td>Programming</td>
<td>Procedural Programming</td>
</tr>
<tr>
<td>Software Development (Mobile Apps &amp; Connected Devices)</td>
<td>Computer Programming</td>
<td>Programming 1</td>
</tr>
<tr>
<td>Introduction to Programming</td>
<td>Introduction to Computer Science I</td>
<td>Fundamentals of Programming</td>
</tr>
<tr>
<td>Introduction to Programming</td>
<td>Programming &amp; Algorithms 1</td>
<td>Introduction to Programming</td>
</tr>
<tr>
<td>Programming</td>
<td>Programming Fundamentals 1</td>
<td>Computer Programming I</td>
</tr>
<tr>
<td>Software Development</td>
<td>Introductory Programming in Python</td>
<td>Introduction to Programming</td>
</tr>
<tr>
<td>Software Development 1</td>
<td>Introduction to Programming</td>
<td>Computer Software 1</td>
</tr>
<tr>
<td>Graphical User Interface and Web Development</td>
<td>Programming Fundamentals 1</td>
<td>Structured Programming 1</td>
</tr>
<tr>
<td>Principles of Programming</td>
<td>Introduction to Programming</td>
<td></td>
</tr>
</tbody>
</table>

*7/15/2019 ITICSE 2019, ABERDEEN, SCOTLAND*
CS1 in Ireland (Overview)

• 82% have no prerequisites, 18% do have prerequisite(s)

• 87% required for Computing majors, 13% not
  • 67% restricted to majors, 33% open to other majors, 10% for non-majors only

74% are classified as CS1 by Guo’s definition (first programming course that has no prerequisites, and is required for computing majors)
CS1 in Ireland (Overview)

- Average attendance: 123 (min 30, max 400)
- 54% in semester 1 (fall), 13% in semester 2 (spring), 33% year-long
- 5% offer external delivery*

*options for course where students are not required to attend regular lectures, workshops, labs or tutorials
CS1 in Ireland (Overview)

- Percentage of experience of instructors
CS1 in Ireland (Languages)

- Paradigms

<table>
<thead>
<tr>
<th>Paradigm</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object-Oriented</td>
<td>43</td>
</tr>
<tr>
<td>Procedural</td>
<td>23</td>
</tr>
<tr>
<td>Functional</td>
<td>15</td>
</tr>
<tr>
<td>Logical</td>
<td>8</td>
</tr>
<tr>
<td>Other / mixed</td>
<td>8</td>
</tr>
<tr>
<td>No particular paradigm</td>
<td>5</td>
</tr>
</tbody>
</table>

- Languages

![Bar chart showing the percentage of languages taught in CS1](chart)
CS1 in Ireland (Languages)

- Multiple languages

![Bar chart showing the percentage of those that use different programming languages in CS1 courses.

- Language is used for the whole of the first programming course.
- Language is used for the first part of the first programming course, followed by another language.
- Language is used after another language in the first programming course.]
CS1 in Ireland (Languages)

• Why are languages chosen?

- Relevant to industry
- Availability/Cost to students
- Pedagogical benefits
- Object-oriented language
- Easy to find appropriate texts
- Ease of installation
- Platform independence
- Extensions/Libraries available
- Online community & help available
- Structure of degree
- GUI interface available
- Department politics
- Marketable to students
- Interpreted language
- OS/Machine limitations
CS1 in Ireland (Languages)

- Perceived difficulty to learn
- Perceived usefulness for teaching
CS1 in Ireland (Languages)

• Ease of Learning + Usefulness for Teaching
  • Derived from last slide
  • A bit “back of the envelope”
CS1 in Ireland (Instructor Viewpoints)

• The following seem to be problematic:
  • language and environment choice
  • student engagement and interest
  • difficulty with programming, specifically with how students relate to the context of computer programming
  • teaching to large numbers of students
  • assessment (e.g. theory and paper-based exams vs lab-based practical ability)
  • teaching resources, including lab assistants
Bonus Data for ITiCSE Aberdeen Attendees

% of courses providing named resources

- Slides or notes – provided by LECTURER
- Worked examples: programming problems/solutions
- Assignment hints
- Textbook is specified
- Discussion Boards/Forums
- Online tutorials
- Online examinations
- Open book examinations
- Topic summaries
- Self-assessment questions
- Slides or notes - provided by TEXTBOOK PUBLISHER
- Recorded lectures
- Mailing list
- “Cheat sheets” (student produced notes) in exams
Do you encourage students in this first programming course to use environments and/or tools beyond simple text editors and command line compilers?
## Bonus Data for ITiCSE Aberdeen Attendees

### Faculty delivering CS1 | number of faculties | % overall

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computing</td>
<td>10</td>
<td>32%</td>
</tr>
<tr>
<td>Computer Science</td>
<td>3</td>
<td>10%</td>
</tr>
<tr>
<td>Engineering &amp; Design</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Computing &amp; Creative Practices</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Film, Art &amp; Creative Technologies</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Information Technology</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Computer Science &amp; Applied Physics</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Science</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Business &amp; IT</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Business &amp; Law</td>
<td>1</td>
<td>3%</td>
</tr>
</tbody>
</table>

42% of courses are within a “Computing” OR “Computer Science” faculty.

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computing, Engineering &amp; Intelligent Systems</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Computing &amp; Mathematics</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Electronic &amp; Electrical Engineering &amp; Computer Science</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Computing Science &amp; Mathematics</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Engineering</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Informatics &amp; Engineering</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Informatics &amp; Creative Arts</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Electronic &amp; Computer Engineering</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Business, Computing &amp; Humanities</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Computing Science &amp; Mathematics</td>
<td>1</td>
<td>3%</td>
</tr>
</tbody>
</table>
Conclusions

• Ireland is small in terms of population (<5 million)
  • Possible to get almost complete picture of national activity
  • However, there might be ‘group think’ happening in some areas?

• There are issues, but no findings indicated that they are particularly specific to the Irish context.
  • At second level this would most likely be quite different.
Future Work

• Teaming up with UK & Australasia efforts to paint a larger, more generalisable picture

• Repeat this survey in Ireland in 2? 3? years

• Play my part to support second-level curriculum roll-out
Acknowledgements

• Ellen Murphy and James Davenport (University of Bath)
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• Respondents