Informatics Doctorate in Europe: Some Facts and Figures

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Motivation

- Different university structures:
  private elite university USA, college university UK, grandes ecoles F, Humboldt model, ...
- Different cultures in different disciplines
  preciseness: from math to art
  constructiveness: from liberal arts to engineering
  ...
- Not too different in a discipline?

- Investigation for Informatics Europe‘s ECSS main topic „What makes a good PhD?“
  Looking for Informatics doctorates in Europe „How different?“
- Doctorates determine a big part of the scientific outcome
Contents

- The investigation and its simple method
- Characterization of the process and its results
  - Formal parameters
  - Organization of the doctoral process
  - Candidates’ profiles and the “Doctoral Environment”
  - Thesis / publications / qualifications
- Character of Informatics research
- Conclusions
  - What is similar / different
  - Is there a necessity for the some unification / coherence?
The investigation and its simple method

- Questionaire by JvL, UH and
- 1 hour for giving an answer
- Was sent to 2-5 colleagues per country of IE members
- Experienced colleagues: knowledge of their university and their country
- 70 answers, ratio ≈ 80%
- European countries covered
- Evaluation
- 2 folder
- Excel sheet
- Report first draft after ECSS conference
Characterization of the process and its results (1)

Formal parameters

- Duration
- Age
- Females
- Foreigners
- How many go for PhD? ≈15%, from 5 to 30
Characterization of the process and its results (2)

Organization of the doctoral process

Entrance  Working  Finalisation

Recruiting  Defence

Entrance level
Ma or Ba+Ma courses

PhD title in different names

All these steps can be more or less formalized

\[ \text{Entrance level (Ma or Ba+Ma courses)} + \text{language} \]
Characterization of the process and its results (2)

Organization of the doctoral process

How to get new students?
Who is hiring?
Is this done regularly or at a few dates?
How much competition?
Multilevel selection
Formal exam?

Mostly own students
Organization of the doctoral process

Entrance

Getting started

Working

Finalisation

- Lectures/seminars: general/specific (10-90 ECTS)
- Reading literature
- First idea after 1 year
- Go NoGo Decision
- Transfer/Upgrade in UK
Characterization of the process and its results (2)

Organization of the doctoral process

Entrance → Working → Finalisation

- Recruiting
- On solid ground
- Defence

After 2 or 3 years
Topic of thesis clear
Outline of how to approach
Might include approval

| Candidate Licentiate in Sweden |
Characterization of the process and its results (2)

Organization of the doctoral process

Entrance → Working → Finalisation

- Recruting
- Getting done
- Defen ce

Doing research
Working out thesis
Characterization of the process and its results (2)

Organization of the doctoral process

After thesis submission
Reference organisation
In 1 or 2 steps
Reviewers or opponents
Formal decision (on predefence)
Defence/exam: talk, discussion, questions
from 1 to 6 hours
Passed/failed or up to n grades
Afterwards approvement/certification
Doctoral process: General aspects

PhD plan
Res./teaching/further topics dev. in group
Approved by comm.
Formally accepted
Incl. budget

execution

monitoring
Characterization of the process and its results (2)

Doctoral process: General aspects

- Entrance
  - Recruiting
- Working
  - Person/institution handling
  - Most active supervision
  - Milestones evaluation/reporting
- Finalisation
  - Drop-out quote

Process:

- Entrance
- Working
- Finalisation
Characterization of the process and its results (3)

Candidates’ profiles and environments

<table>
<thead>
<tr>
<th>Formal position</th>
<th>Research/other duties</th>
<th>Scientific achievements / soft skills</th>
<th>Independence</th>
<th>International experience</th>
<th>Competences</th>
<th>Career perspectives</th>
<th>Relevance for industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students/employees of which sort</td>
<td>Research plus some duty (research +) Administration, management</td>
<td>Study Compare Create ideas Present Discuss Defend Soft skills depend on the project, esp. on the employee status</td>
<td>Student being guided for independence Young scientists developing</td>
<td>Conferences Visiting/ staying in other groups</td>
<td>Scientific competences And others</td>
<td>Only academic position Industry Now industry as nothing else is available</td>
<td>Industry not interested Relevance increases Industry appreciates (but importance decreases)</td>
</tr>
</tbody>
</table>
Characterization of the process and its results (4)

## Thesis, publications, qualifications

<table>
<thead>
<tr>
<th>Formal Degree</th>
<th>Length</th>
<th>Language</th>
<th>Publication</th>
<th>Format</th>
<th>Professional Doctorate</th>
<th>Public. before</th>
<th>#Public.</th>
<th>Authors</th>
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<tr>
<td>PhD</td>
<td>≈200pp. (50-400)</td>
<td>≈70% English (0-100) Dramatic change</td>
<td>Internal rep book ISBN ePubl. very often Only an abstract is published</td>
<td>Mostly monograph Cummulative thesis</td>
<td>Not one Some saying not in our dept. or some other univ</td>
<td>Social must Some require minimum (or 80% has to be publ.) (or with score in cit.)</td>
<td>≈5-10 Conf./journal papers Nearly all in English</td>
<td>Mostly group papers</td>
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<td>Dr. Sci. (CS)</td>
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## Character informatics research (1)

<table>
<thead>
<tr>
<th>Theory/Pr Appl</th>
<th>Core Inf./Appl.</th>
<th>Appl. and methods</th>
<th>Depth/Breadth</th>
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<tbody>
<tr>
<td>or variety</td>
<td>or variety</td>
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≈ 40:60?
Some depth required
Informatics is 55% Engineering, 25% Natural Sciences, 10% Business Administration, 10% Arts and alike

Informatics is aimed at understanding and analyzing the essence of natural and imagined information processing and communication systems. It is different in that it explicitly also includes the study of artifacts (constructed in the field). A vibrant industry is pushing and pulling the field.

Informatics research is getting more and more interdisciplinary

Informatics is mostly constructing something, a system, a nontrivial design, a proof. Informatics should be formal, for practical solutions also experience and intuition pay a role. Theoretical results should discuss applicability, practical results should be formal where possible. Practical solutions should not be only present their technical details. The way to get the solution, what has been learnt, how method, product, process, and domain knowledge has been improved is an essential part. So, Informatics is not building one solution after the other. It is an intellectual discussion about ideas, varieties of solutions, learning, and improvement.
Character informatics research (2)

Informatics contains math, engineering, natural science aspects, and nowadays also social or societal. The core is algorithmic thinking and constructive problem solving. A research cycle proceeds in the following iterated steps: Specification and conceptualization of the problem, design and analysis of a solution (algorithm), software implementation, experimental and empirical analysis of the software. That is not all but covers a lot.

Informatics is the continuation of Logic by other means. It is a deeply mathematical discipline with some engineering aspects. It is on the other hand very multi-disciplinary. I feel there is no universally valid formula of how research in informatics might be characterized.

Informatics offers better possibilities to come up with completely new theory and ideas (theory-driven) compared to traditional engineering disciplines. Practice-driven research is sometimes motivated by challenges coming from industrial collaboration.
Character informatics research (2)

Informatics research – even theoretical one – may deeply and directly affect the way people live, work, and get entertained. This short cut between Informatics as a scientific discipline and its large scale effects is what makes Informatics appealing to the most brilliant students. We should underline the unique potential of innovation in Informatics to preserve its appeal.

Informatics is designing and implementing formal models that are executable and work efficiently: Informatics solutions are formal (vs. Engineering) and working efficiently (vs. Mathematics).

Informatics research is somehow success-driven, appropriate proofs, statistical analysis, and math-like development are common. All research forms are goal-driven: There has to be a system, an artifact, an approach that will override the previous existing ideas and artifacts.
Character informatics research (2)

Informatics involves a range of sub-areas (as formal systems, algorithmic thinking, language design etc) like other disciplines but is different in having technological and engineering components at the same time, aimed at mimicking or realizing information processing and communication systems in practice for the benefit of mankind. Informatics spans the entire spectrum from science-oriented to engineering- and use-oriented. This characterizes the field and its research, making it a science and engineering and a management discipline at the same time.

Informatics contains mathematical aspects (rigor, proofs), engineering aspects (realizing concepts in pieces of software or systems), empirical ones (evaluation of implemented concepts by experiments). There are also speculative aspects (how things should be done instead of doing it) or social/societal aspects.

Informatics research has 3 types: (1) to develop new types of software systems, (2) to develop approaches how development processes can be improved, and (3) to solve practical problems by actively using IT potentials.
Informatics research has different facets: (a) applying mathematical formalisms and developing abstractions (such as meta and meta-meta models), (b) understanding and systematically solving interdisciplinary problems and issues, (c) creating generalized and long-lasting solutions to problems. (d) Interpersonal and communication skills are necessary to cooperate with professionals from other disciplines in large teams. (e) The essence is to understand, model, construct, and integrate complex systems.

Informatics covers a wide range from (i) theoretical research similar to math to (ii) experimental work similar to experimental physics and biology. There is also (iii) a big engineering core, where research focuses on other aspects.
Conclusions (1)

What is similar / different?

**Similar**: essential figures for age, duration, structure, how many go for a PhD, drop-out rate, even females, foreigners

Thesis: length, English, publications, monograph

**Different**: details vary and their degree of formality

Some differences come from the environment and not from the process/product.
Conclusions (2) - personal

Is there a necessity for coherence / unification?

**Essence:**

- supervisor devoted to ambitious research, is precise and fair to the candidate, cares about progress of the candidate’s research

- faculty giving the framework for process and controls following good academic practice

Europe is **colourful**. Does that upset anybody?