RWTH AACHEN UNIVERSITY

INFORMATICS EUROPE

Informatics Doctorate in Europe: Models and Equivalence

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Motivation

- Different structures for research universities:
  private elite university USA, collegiate university UK, grandes écoles F, Humboldt model, …
- Different cultures in different disciplines
  preciseness: from math to art
  constructiveness: from liberal arts to engineering
- Doctorates determine a big part of the scientific outcome

> **Not too different in a discipline?**

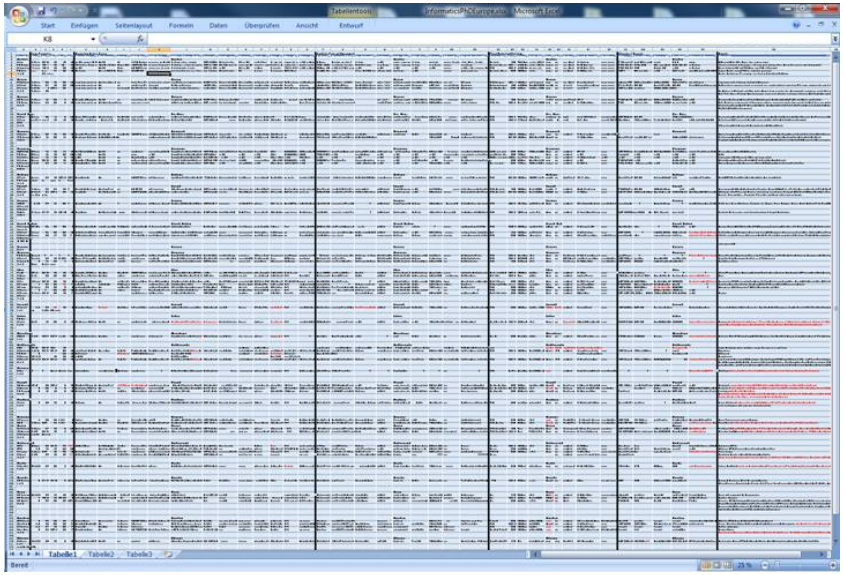
- Investigation for Informatics Europe 2012 „What makes a good PhD?“ Looking for Informatics doctorates in Europe „How different?“
- Study/ conferences about doctorates in Engg. and Informatics in Germany/ Europe for 4ING, Acatech, TU9, conferences 2008, 2009
- Ombudsman for Doctoral Students in a Faculty of 120 professors

Contents

- The investigation and its simple method
- Characterization of the process
  - Formal parameters (duration,…)
  - Organization of the doctoral process
- Outcome: Dissertation and Ph.D.s' profiles
  - Thesis / publications / qualifications
  - Profiles and the "Doctoral Environment"
- Models
  - Character of Informatics research (very short)
  - Variety of Doctoral Models
  - The Central European Model
- Conclusions
  - What is similar / different
  - The essential difference comes from outside

The investigation and its simple method

- Questionaire by JvL,UH,MN
- Was sent to 2-5 colleagues p.c.
- Experienced colleagues:
  their university and their country
- 70 answers, ratio ≈ 80%
- European countries covered
- Evaluation
- 2 folder
- Excel sheet
- Report after ECSS 2012 conf.



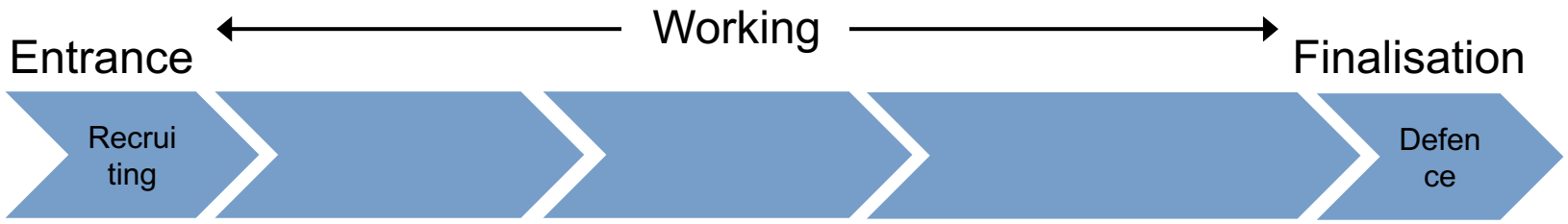
Characterization of the process (1)

Formal parameters

- Duration
- Age
- Females
- Foreigners
- How many go for PhD? ≈15%, from 5 to 30

Characterization of the process (2)

Organization of the doctoral process



All these steps can be
more or less formalized

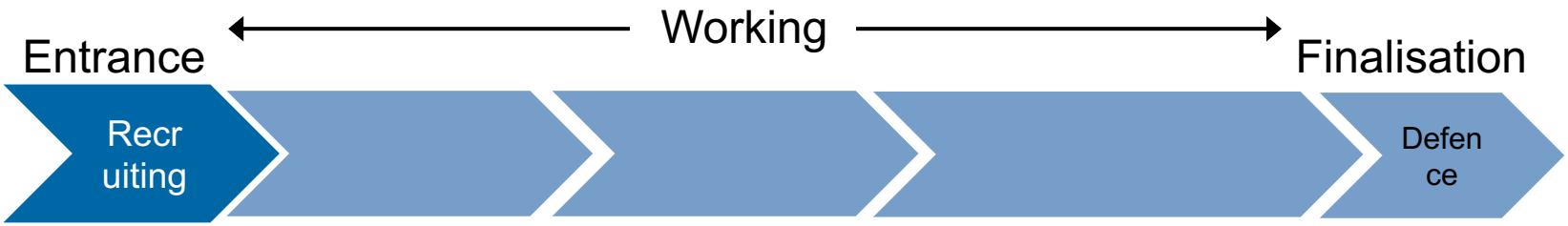
Entrance level
Ma
or Ba+Ma courses

} + language

PhD title in
different names

Characterization of the process (2)

Organization of the doctoral process

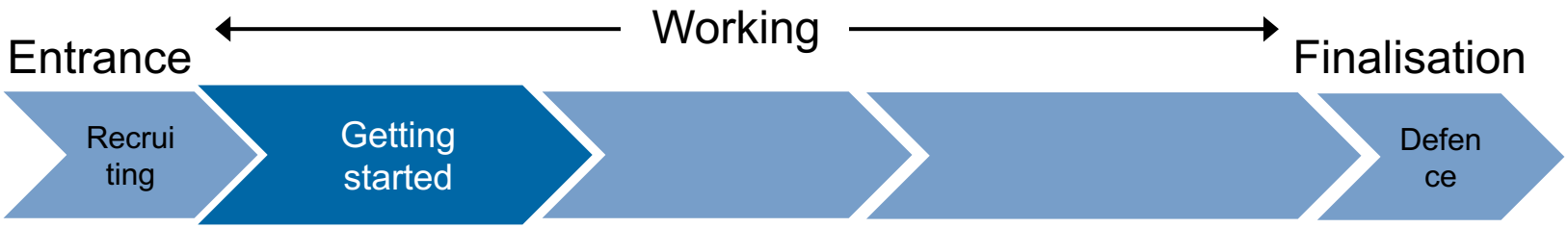


How to get new students?
Who is hiring?
Is this done regularly or at a few dates?
How much competion?
Multilevel selection
Formal exam?

Mostly own students

Characterization of the process (2)

Organization of the doctoral process

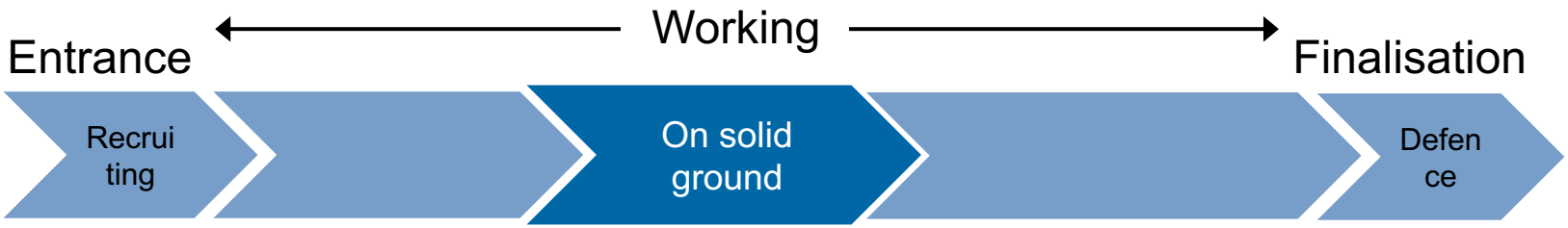


Lectures/seminars: general/specific (10-90 ECTS)
Reading literature
First idea after 1 year
Go NoGo Decision

Transfer/
Upgrade in UK

Characterization of the process (2)

Organization of the doctoral process

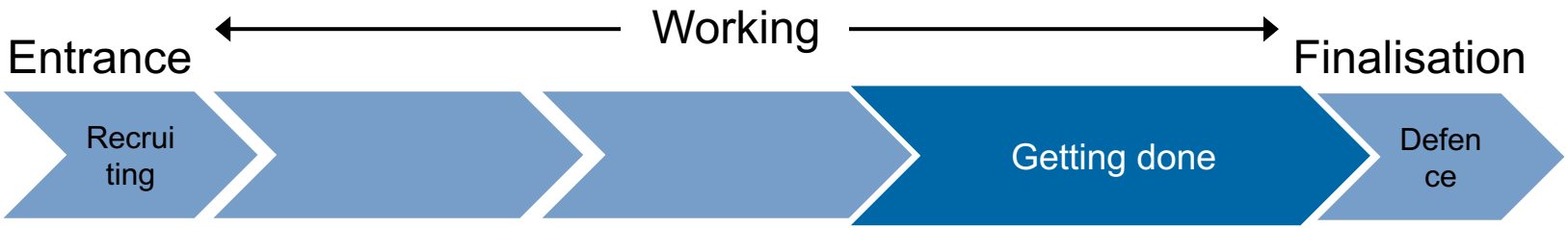


After 2 or 3 years
Topic of thesis clear
Outline of how to approach
Might include approval

Candidate
Licentiate in Sweden

Characterization of the process (2)

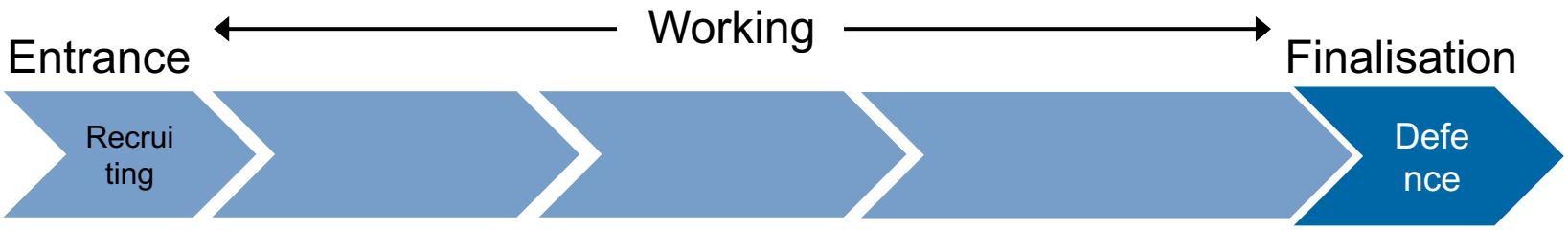
Organization of the doctoral process



Doing research
Working out thesis

Characterization of the process and its results (2)

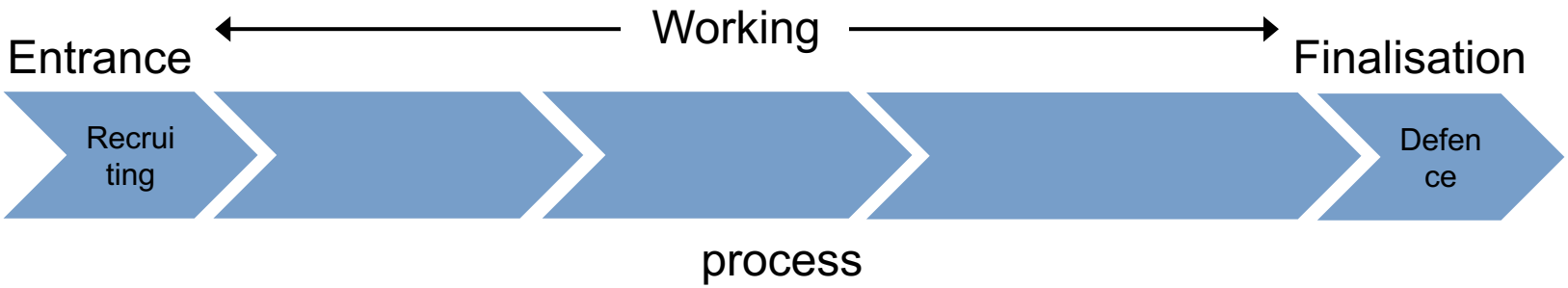
Organization of the doctoral process



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

Characterization of the process (3)

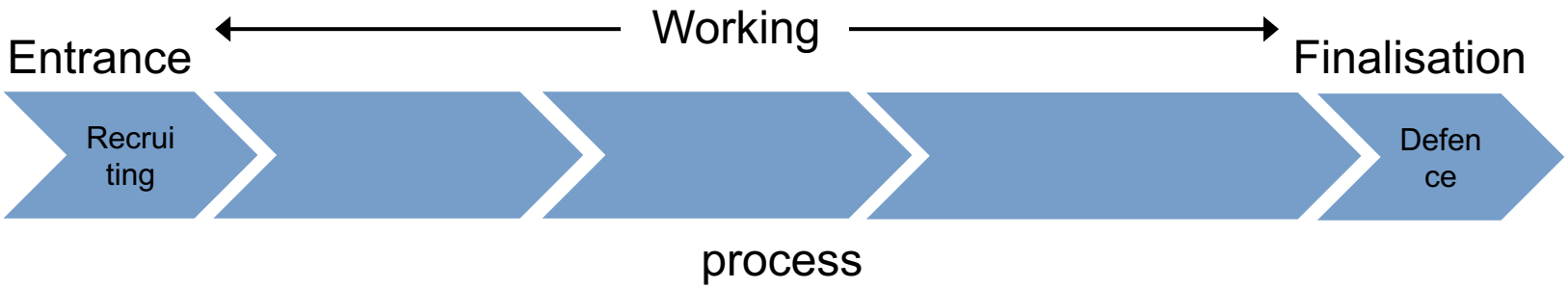
Doctoral process: General aspects



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

Characterization of the process (2)

Doctoral process: General aspects



person/institution most active

handling supervision

milestones evaluation/reporting

drop-out quote

Outcome (1)

Dissertation, publications, qualifications

Formal Degree	Length	Language	Publication	Format	Professional Doctorate	Public. before	#Public.	Authors
PhD Dr. Dr. Sci. (CS) Dr. tech. Dr. rer.nat. Dr. Ing. Dr. Eng.Sc. D Phil. Dottore di Ricerca Cand. Sci. Sci D Tekn D	≈200pp. (50-400)	≈70% English (0-100) Dramatic change	Internal rep book ISBN ePubl. very often Only an abstract is published	Mostly monograph Cummulative thesis	Not one Some saying not in our dept. or some other univ	Social must Some require minimum (or 80% has to be publ.) (or with score in cit.)	≈5-10 Conf./journal papers Nearly all in English	Mostly group papers

Outcome (2)

Candidates‘ Profiles and Environments

Formal position	Research/ other duties	Scientific achieve-ments / soft skills	Indepen-dence	International experience	Competen-ces	Career perspectives	Relevance for industry
Students/ employees of which sort Salary in relation to Ma salary	Research plus some duty (research +) Administra-tion, mana-gement	Study Compare Create ideas Present Discuss Defend Soft skills depend on the project, esp. on the employee status	Student be-ing guided for indepen-dence Young scien-tists develo-ping	Conferences Visiting/ stay-ing in other groups	Scientific competences And others	Only acade-mic position Industry Now industry as nothing else is avail-able	Industry not interested Relevance increases Industry appreciates (but impor-tance de-creases)

Models (1)

Character of Informatics Research

Theory/Pr Appl	Core Inf./Appl.	Appl. and methods	Depth/Breadth
≈ 30:70	≈ 60% core	Engg. BA	≈ 40:60?
or	or	Bio/Neuro/Med/ LifeSci.	Some depth
variety	variety	Nat.Sci.	required

Models (2)

Variety of Models

Classification Dimensions:

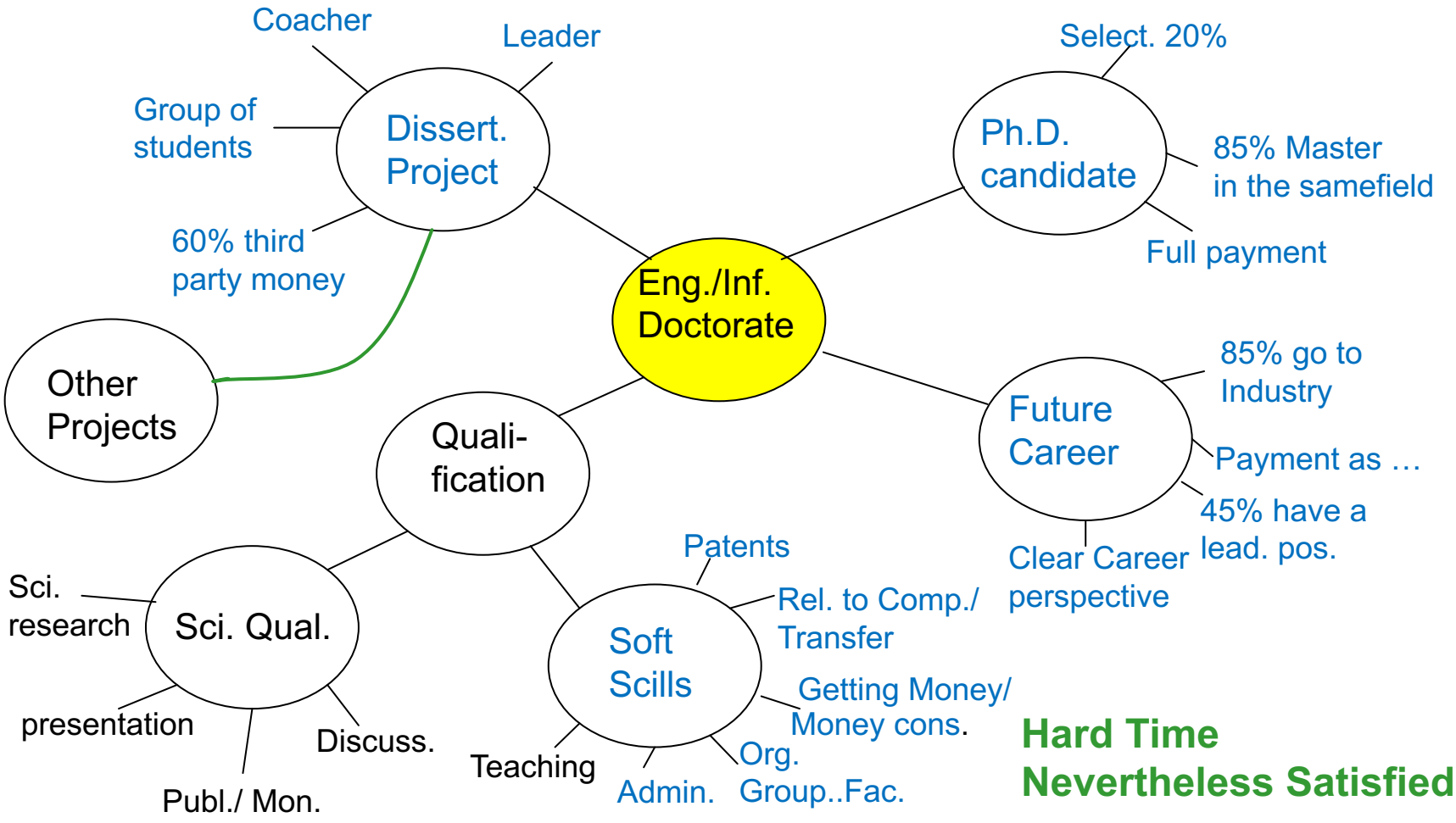
- Handling of the process,
- Curriculum,
- Status,
- Role of supervisor,
- Responsibility,
- Financial support,
- Dissertation Format,
- Reviewer / Opponent
- Examination Form,
- Title,
- Grades

Three Models and many in between:

- Anglo-American Model
- Central European Model
- 1North European Model

Models (3)

The Central European Model



Conclusions (1)

What is similar / different?

- **Similar**:
  Process/ cand.: age, duration, structure, how many for a PhD, drop-out rate, females, foreigners

  Thesis: length, English, publications, monograph

- **Difference of formals**: details vary and their degree of formality

- **Main differences** come from the **environment**
  Appl. , …, theory
  Role, importance, estimation

not from the scientific process/ product.

Conclusions (2)

Is there a necessity for coherence / unification?

- **Essence of talk**:

  Dissertation) in Informatics devoted to ambitious research, is precise and more or less constructive
  Process is fair to the candidate, supervisor cares about progress of the candidate‘s research
  Faculty giving the framework for process and controls, following good academic practice

- Nevertheless there are **differences** in accademic **habits** and **role** of Ph.D.s in society

Europe is colourful. Does that upset anybody?
Do we want to learn from each other?

Character informatics research (2)

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.

Character informatics research (2)

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.