WIT Ph.D. Curriculum

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Abstract

This document is an introduction to the Women's Postgraduate College for Internet Technologies (WIT) Ph.D. Curriculum. It presents a guideline curriculum structure of Ph.D. study at WIT. The WIT Ph.D. Curriculum fosters a goal oriented realisation of the research work within three to four years and provides a detailed job specification of a Ph.D. student at WIT. The goal of the WIT Ph.D. Curriculum is to train students for careers in teaching and research positions in the academic world, as well as for positions in industry. Therefore, this curriculum is very balanced. It is based on education in the area of interest and surrounding areas, training in doing research as well as doing research, training in doing a comprehensive project, cooperating with other research groups, assessing other research results and approaches, teaching, and training in presenting and communicating ideas.

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Contents

1 Motivation

The Doctor of Philosophy (Ph.D.) is the highest degree awarded in any academic discipline for a thesis which demonstrates a candidate's ability to carry out independent research at an advanced level in a particular field of study. The Ph.D. Curriculum of the Women's Postgraduate College for Internet Technologies (WIT) is designed for the disciplines of computer science and information systems. The goal of the this Ph.D. Curriculum is to educate students for careers in teaching and research positions in the academic world, as well as for positions in industry.

A Ph.D. Curriculum of this kind is atypical for Austrian universities. In Austria, Ph.D. students have a high degree of academic freedom. The professional self-determination is a great opportunity, but bears the risk of pursuing an unsuccessful research strategy because the student is fully dependent on the experience, the willingness and the reliability of the supervisor. Generally, all Ph.D. students require similar assistance during their studies and face similar difficulties. A Ph.D. Curriculum is a means to address these issues by offering institutionalised guidance towards the doctoral dissertation. It provides fundamental advantages to the Ph.D. students as well as to the university. The WIT Ph.D.curriculum fosters a goal oriented realisation of the research work within 3 - 4 years and provides a detailed job specification of a Ph.D. student at WIT. Regardless of the Ph.D. Curriculum, the student's personal responsibility and commitment to pursuing research is an important prerequisite for a successful Ph.D. thesis.

The objective of the WIT Ph.D. Curriculum is to provide an environment that encourages students to contribute to the advancement of technology through independent creative research. WIT perceives a Ph.D. programme as many aspects: education in the area of interest and the surrounding areas, training in research, pursuing research, training in doing a comprehensive project, cooperating with other research groups, assessing relevant research results and approaches, teaching, and training in presenting and communicating ideas. An aim of doing a Ph.D. degree is to become an independent researcher, capable of generating, pursuing and communicating novel research ideas. Therefore, WIT Ph.D. students are encouraged to become involved in research activities as soon as they enter the programme.

The WIT Ph.D. Curriculum combines concepts of the best international Ph.D. programmes in Computer Science and the experiences of experts in the field. The best six Ph.D. programmes in the United States (Stanford University [8], Massachusetts Institute of Technology [6], University of California-Berkeley [13], Carnegie Mellon University [1], Cornell University [2], and Princeton University [7]) and six Ph.D. programmes ranked 5* or 5 in the United Kingdom (Imperial College London [4], University of Bristol [12], The University of Edinburgh [9], University College London [11], The University of Manchester [10], and King's College London [5]) have been chosen for closer analysis.

In the UK, a Ph.D. degree normally lasts three years, and in the US between four and six years. UK Ph.D. programmes are characterised by a tight timeframe with a strong focus on the Ph.D. research itself and on transferable skills (skills developed in one situation which can be transferred to another situation, e.g. research method, scientific writing, etc.). In the US, Ph.D. programmes have a broader focus and include comprehensive coursework, teaching assignments and programming projects. The entry requirements for Ph.D. admission are (in the US as well as in the UK) a BSc in Computer Science or a related discipline.

The entry requirements for Ph.D. admission at WIT is a MSc in Computer Science or Information Systems. The Ph.D. at WIT has a broad focus and requires work consisting of advanced studies in preparation for research, the preparation, completion and publication of original research, the approved examinations on courses, teaching assignments, development of a running prototype, acquiring

of transferable skills, and the production of a doctoral dissertation. These requirements are described in detail in the following sections.

2 Reports

The aim of these reports is to guide the student towards the Ph.D. Basically, writing internal reports is a good practice for communicating ideas and preparation for writing the Ph.D. thesis.

2.1 3 Month Report

2.1.1 Aim

The aim of the 3 month report is an initial survey of the research area and its principal literature. This analysis helps the Ph.D. student to familiarise herself with the field of research by doing general reading in the area of interest. The report is organised in a way to be reused in subsequent publications (e.g. the Ph.D. proposal, scientific workshops, scientific papers, dissertation etc.).

2.1.2 Content

- What computer science / information system research areas have been addressed?
- What are the technical and conceptual foundations? A presentation of the theoretical basis or framework the research area is based on.
- What is the major area of application?
- The main part of the report gives an overview of the principal literature relevant to the research topic, accompanied by references of relevant sources.
- What are the future directions of the student's work, including a timetable? What directions of the research areas are of less importance to this work and why?

2.1.3 Format

The format of the report is a common computer science publication format (e.g. Springer LNCS, IEEE, ACM) and must include the following points (besides the points addressing the main content):

- Student's name
- Student's affiliation
- Abstract
- Keywords
- Introduction
- Conclusion and future work
- References

The report should be about 1,000 words.

2.1.4 Deliverables

1. **Literature log:** All papers that have been read should be gathered, even those not used in the report. The literature log extends the references.
2. **Written 3 Month Report:** Read by the head of the group and other experts who give feedback, which must be included into the final version of the report.
3. **Oral presentation:** In the Ph.D. seminar.

2.1.5 Future Work

A few small projects should be defined in order to get a deeper understanding of the field of research and to vary the type of activities undertaken by the student.

2.2 6 Month Report

2.2.1 Aim

The aim of this report is a comprehensive and critical survey of the research area and literature, in order to identify limitations and what is missing in current literature. This analysis supports the Ph.D. student in eliciting ideas for further work and finally, to guide her towards the research question. More detailed reading in a fairly narrow, more technical area of the problem is required. The report is an extension of the 3 month report, and is organised in a way to be reused in subsequent publications (e.g. the Ph.D. proposal, scientific papers, scientific workshops, dissertation etc.).

2.2.2 Content

- What computer science or information system research areas have been addressed?
- What are the technical and conceptual foundations? A presentation of the theoretical basis or framework the research area is based on.
- What is the major area of application?
- Who originally 'invented' the area of research?
- Who and what institutions have had a major impact on the topic?
- What keywords describe the area of research?
- Give an overview of the literature relevant to the research topic, accompanied by a full bibliography of relevant sources.
- What are current trends in the area of research?
- What are the significant problems in the field of research? Outline the current knowledge of the problem domain, as well as the state of existing solutions.
- What research methods have been mainly used?
- What are the leading conferences and journals in the research area?
- What are the most important and very interesting projects?
- What are the future directions of the student's work, including a timetable?

2.2.3 Format

The format of the report is a common computer science publication format (e.g. Springer LNCS, IEEE, ACM) and must include the following points (besides the points addressing the main content):

- Student's name
- Student's affiliation
- Abstract
- Introduction
- Keywords
- Conclusion and future work
- References

The report should be about 2,000 words.

2.2.4 Deliverables

1. **Literature log:** All papers that have been read should be gathered, even those not used in the report.
2. **Written 6 Month Report:** Read by the head of the group and other experts who give feedback, which must be included into the final version of the report.
3. **Oral presentation:** In the Ph.D. seminar.

2.2.5 Future Work

- Defined projects should be continued.
- A Summer School in the area of research should be targeted.

2.3 Ph.D. Proposal

2.3.1 Aim

A Ph.D. Proposal is different from other research papers. This paper addresses specifically a student's thesis: that is the thesis, the whole thesis and nothing but the thesis. The aim of this proposal is an introductory presentation of the Ph.D. topic. The Ph.D. proposal covers a substantial discussion of the idea, the research question, the goal, the applied methodology and the evaluation approach of the Ph.D. thesis. As the Ph.D. proposal represents mainly the Ph.D. student's perspective, there is a need for feedback from a wide range of experienced researchers. Two external experts should review the Ph.D. proposal, if this is explicitly required by the Ph.D. student. The Ph.D. proposal is a means of communication to peers and other experts, in order to foster discussion, feedback and new ideas. The Ph.D. proposal integrates parts of the 6 month report and is organised in a way to be reused in subsequent publications (e.g. scientific papers, dissertation etc.). The final outcome of the Ph.D. proposal is the publication at a recognised Doctoral Consortium. The Ph.D. proposal is not an end in itself; rather it should be continuously revised until it is accepted at a Doctoral Consortium and should result in the final PhD thesis.

2.3.2 Content

Motivation and Research Question

- What is the motivation / problem statement of the thesis? What is the problem? Why is it a problem?
- What is the research question? For example: What is a better way to do / create / modify / evolve X? Is it possible to accomplish X at all? What is a good or better formal / conceptual / empirical model for X?
- What is the contribution of the thesis? What limitations, lacks or failings of current understanding, knowledge, methods, or technologies does this research result resolve? Why does it matter?

Critical Literature Review

- What are the significant problems in the field of research? Outline the current knowledge of the problem domain, as well as the state of existing solutions.

Research Design

- What is your research field? If there is more than one, how do they relate to each other?
- What is the research result you are proposing? Present preliminary ideas, the proposed approach.
- How does your proposed research result relate to existing work? What previous work do you build on? How is your research work different, new or better to existing approaches (with reference to the related literature and commercial / non- commercial products if available)?
- What is the target audience or user group?

Research Method

- What is the research method you are using?
- What type of research result (e.g. experiments, prototypes, models, studies etc.) will solve the research question?

Evaluation of Results

- How do you prove that the research result is valid?
- How do you evaluate your results?

Preliminary Results

- What are the results achieved so far?

Progress to Date / Research Plan

- What is the state of your thesis?
- What are your future plans including a timetable of activities, milestones and a publication plan?
- What corrective actions and risks to completion have you identified?

2.3.3 Format

The publication format of the report is the general format of research papers and must include the following points (besides the points addressing the main content):

- Student's name
- Student's affiliation
- Abstract
- Keywords
- Introduction
- Timetable
- Related Work
- Conclusion and future work
- References

The paper should be about 4,000 words.

2.3.4 Recommended Literature

Writing and Publishing

- Alan Bundy, Ben du Boulay, Jim Howe and Gordon Plotkin, The Researchers Bible, Teaching Paper, Division of Informatics at the University of Edinburgh, http://homepages.inf.ed.ac.uk/bundy/how-tos/resbible.html January 9, 2006.
- Alan Bundy, How to Write an Informatics Paper, Teaching Paper, Division of Informatics at the University of Edinburgh, http://homepages.inf.ed.ac.uk/bundy/how-tos/writingGuide.html January 9, 2006.
- Ralph E. Johnson, Kent Beck, Grady Booch, William Cook, Richard Gabriel and Rebecca Wirfs-Brock, How to Get a Paper Accepted at OOPSLA, Panel at the OOPSLA'93, Proceedings of the eighth annual conference on Object-oriented programming systems, languages, and applications, ACM Press, 1993.
- Alan Snyder, How to Get Your Paper Accepted at OOPSLA, Proceedings of the sixth annual conference on Object-oriented programming systems, languages, and applications, ACM Press, 1991.
- Mary Shaw, Writing good Software Engineering Research Papers: A Minitutorial, Proceedings of the 25th International Conference on Software Engineering, IEEE Press, 2003.

Presenting and Reviewing

- Presenting and Reviewing Simon P. Jones, John Hughes and John Launchbury, How to give a good research talk, ACM SIGPLAN Notices, Volume 28 Issue 11, 1993.
- Alan Jay Smith, The Task of the Referee, IEEE Computer Vol. 23, No. 4. pp. 65-71, 1990.

Research Methodologies

- Victor R. Basili, The Role of Experimentation in Software Engineering: Past, Current, and Future, Proceedings of the 18th International Conference on Software Engineering, IEEE Computer Society, 1996.
- Victor R. Basili, The Experimental Paradigm in Software Engineering, Springer-Verlag, Lecture Notes in Computer Software 706, 1993.
- Mary Shaw, What makes good research in software engineering?, International Journal of Software Tools for Technology Transfer, 2002.
- Paul Lukowicz, Ernst A. Heinz, Lutz Prechelt and Walter F. Tichy et al., Experimental Evaluation in Computer Science :A Quantitative Study, Journal of Systems and Software, Elsevier Science Inc., 1995.
- Walter F. Tichy, Should computer scientists experiment more?, IEEE Computer Vol. 31, No. 5. pp. 32-40, 1998.
- Experimental models for validating technology Marvin V. Zelkowitz, Dolores R. Wallace IEEE Computer Vol. 31, No. 5. pp. 23-31, 1998.

Research Career

- Richard Snodgrass and Merrie Brucks, Branding yourself, ACM SIGMOD Record, Volume 33, Issue 2, 2004.
- Anastassia Ailamaki and Johannes Gehrke, Time Management for New Faculty, ACM SIGMOD Record, Volume 32, Issue 2, 2003.

2.3.5 Deliverables

1. **Literature log:** All papers that have been read should be gathered, even those not used in the report.
2. **Ph.D. Proposal:** Read by the head of the group and two external experts who give feedback, which must be included into the final version of the report.
3. **Oral presentation:** In the Ph.D. seminar.

2.3.6 Future Work

Projects should be defined in order to support the research result of the dissertation at any stage. It is recommended that these projects are combined with the Ph.D. student's teaching activities. Master's and bachelor's theses are an opportunity for the Ph.D. student as well as for the MSc / BSc student to tackle demanding projects. It is a win-win situation for both: the MSc / BSc student undertake cutting-edge research projects and Ph.D. students exercise their project management skills. Seminars should be given on work done or on publications and projects analysed and assessed. A couple of Ph.D. Consortia ought to be selected and targeted for submission in the near future. A Summer School and Conferences in the area of research should be targeted.

2.4 Research Poster

The purpose of a research poster is to present information on current research that often is not totally complete, or to present information on methods or observations that are the result of ongoing research. By presenting information on research during its infancy, problem areas can be discussed with peers and methods can be adjusted to give optimum results. Research posters are intended to reach a large number of people and present the research topic graphically on one page. Research posters have a long tradition at computer science conferences. It is an opportunity for Ph.D. students to present their peer-reviewed research work the first time in their career to a wider academic audience. Research posters are also an ideal means to communicate the state of the Ph.D. student's research to peers, within the department and outside.

3 Courses

The Ph.D. curriculum of the Vienna University of Technology requires approved examinations on courses equivalent to 30 ECTS (European Credit Transfer System) points for the "Dr. rer. soc. oec." and the "Dr. techn." Ph.D. students should select specific courses in consultation with their supervisor. Their choice of courses must be approved by the dean of the faculty.

4 International Research Community

For developing a successful research career as well as a remarkable research record, it is of major importance that Ph.D. students become involved in the international academic community at an early stage of their Ph.D. thesis. The creation of a Ph.D. student's own research network is vital and can be achieved through systematic initiatives. The WIT Ph.D. curriculum is based on the following: participation in international conferences and workshops, summer schools, Doctoral Consortia and spending time as a visiting researcher or engineering intern at an internationally recognised institution.

4.1 Conferences and Workshops

Conferences and publications are main venues for reporting research findings, exchanging ideas, and developing new plans for research. Particularly, conferences are major venues for research communities. These communities often have a very powerful impact on career paths of researchers. Beside research topics, employment opportunities, visiting scientist positions, program committees, grants, or projects are topics raised in informal meetings at conferences. Conferences are a vital part of a research culture and career planning. Usually, Ph.D. students become involved in the international research community at conferences with the acceptance of their first paper. As the first publications of a Ph.D. student are generally accepted at conferences or workshops after one or two years of research, it is recommended that Ph.D. students first visit conferences without having a paper. This 'passive participation' at an early stage of the Ph.D. program fosters the integration of Ph.D. students in the research community, support the elicitation of new research ideas, provide an overview of latest research issues, and give the opportunity of getting to know general conference customs. WIT supports up to 3 'passive participations' in conferences or workshops.

Beside the unique opportunity of this Ph.D. curriculum to support the 'passive participation' in conferences, it is emphasised that Ph.D. students should actively

participate in conferences with publications and presentations as early as possible. With an 'active participation' in conferences and workshops, Ph.D. students learn to structure, communicate and present their research work as well as focus on a sound research methodology.

4.2 Education and Research Experiences

4.2.1 Summer School

International summer schools are addressed to young researchers at the Ph.D. student level. Summer schools offer the excellent opportunity of an intensive studying week (or two) to Ph.D. students and research fellows with excellent academic backgrounds. The attendance to summer schools is limited. The goal of summer schools is to have hot topics from fundamental as well as advanced areas of computer science and information systems presented by top researchers in the field, bringing participants to the frontiers of current research. A summer school is a forum for meeting new people and really getting acquainted with them. It is also a place to create collaboration networks between scholars working on similar issues. Activities in most summer schools are based on collaborative projects. Projects are done in heterogeneous groups in order to foster multi-disciplinary approaches and fruitful discussions. Lectures give inspiration and novel ideas to the students' work.

Summer schools support the continuous development of the research work of Ph.D. students. Therefore, it is recommended that Ph.D. students attend one or two summer schools at different stages of their Ph.D. program. The first one is dedicated to the elicitation of concrete ideas for the research question, and the second one to further develop and consolidate the research work. The student should participate in the first summer school within the first year of the Ph.D. program. Summer schools should be in the student's area of research or in a related field.

Examples:

- **EDBT Summer School** (`http://www.edbt.org/SummerSchoolsPage/`) is promoted by EDBT (Extending Database Technology) Endowment and focus on databases and information systems technology and applications.
- **Max-Planck Advanced Course on the Foundations of Computer Science (ADFOCS) Summer School** (`http://www.mpi-sb.mpg.de/~adfocs/`) has its focus on the fundamental areas of computer science.
- **International Summer School on Educational Technology** (`http://cs.joensuu.fi/pages/edtech/summer04/index.htm`) is organised in conjunction with the IEEE International Conference on Advanced Learning Technologies (ICALT).
- **European Summer School on Ontological Engineering and the Semantic Web** (`http://babage.dia.fi.upm.es/summerschool/`) is announced by the KnowledgeWeb Network of Excellence (`http://knowledgeweb.semanticweb.org/`).
- **International School for Computer Science Researchers** (`http://lipari.cs.unict.it/lipari/index.htm`)
- **Summer School on Generative and Transformational Techniques in Software Engineering** `http://wiki.di.uminho.pt/twiki/bin/view/GTTSE/WebHome`

- **List of Summer Schools gathered at the Department of Computer Systems at Uppsala University**
  `http://www.docs.uu.se/docs/grad-education/summer-schools.shtml`
- **List of Summer Schools gathered at the Department of Computer and Information Science at Università degli Studi di Genova** `http://www.disi.unige.it/dottorato/SCUOLE/`

4.2.2 Doctoral Consortium

A Doctoral Consortium (also called Doctoral Symposium or Doctoral Workshop) is a workshop for Ph.D. students at any stage of their thesis. Doctoral Consortia are mostly held in conjunction with large international conferences and benefit from the surrounding setting. A Doctoral Consortium is intended to bring Ph.D. students within the same area of research together, and to give them the opportunity of presenting and discussing their on-going thesis research in the context of an international conference, outside of their usual university atmosphere. The workshops last usually between two and five days, prior to the main conference. About 10 - 15 Ph.D. students have the possibility to participate. A Doctoral Consortium will be accompanied by four to six prominent professors, who will actively participate and contribute to the discussions. A Doctoral Consortium is a great forum for Ph.D. students to receive useful and constructive feedback from a knowledgeable audience, to exchange ideas, to compare approaches and meet fellow researchers in the field. Due to the mentoring nature of the event, mentors foster discussions related to future career perspectives, and give advice for possible future direction of the research work as well as general advice on doing research, e.g. publication strategy, research methodology etc.

As a Doctoral Consortium provides a unique environment, it is recommended that Ph.D. students attend one or two Doctoral Consortia at different stages of their Ph.D. thesis. The first Doctoral Consortium should be targeted after a summer school and after the first year of the student's Ph.D. program. A Doctoral Consortium should be in the area of research or in a related field.

Examples:

- **Conference on Advanced Information Systems Engineering (CAiSE) Doctoral Consortium** `http://www.caise.org`
- **Doctoral Symposium of the International Conference on the Unified Modeling Language** `http://www.umlconference.org/`
- **ACM Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA) Doctoral Symposium** `http://www.oopsla.org/`
- **European Conference on Information Systems (ECIS) Doctoral Consortium** `http://www.ecisnet.org/`

4.2.3 Visiting Researcher / Engineering Internship

In order to advance the thesis research and the professional background, the Ph.D. students should visit a internationally recognised research or development institution. In addition to the advantage of improving and maturing their research results, Ph.D. students have the opportunity to experience a new research culture or a professional development environment. The research or development institution must have a good reputation for the particular research or development area. It can either

be a university, a commercial research and development center (e.g. IBM Research, Microsoft Research, HP Research, etc.), a non-commercial national research center (e.g. INRIA - Institut National de Recherche en Informatique et en Automatique), or a non-commercial international research center (e.g. CERN - the European Organization for Nuclear Research). The maximum duration of the stay is 3 months per year.

4.2.4 Visiting Professor

WIT permanently hosts short-term and long-term visiting professors, who give courses in computer science as well as in transferable skills. The courses give impulses for further collaborations in research as well as general Ph.D. advice. Visiting professors provide a new research culture, new ideas, new perspectives, new networks, etc. to Ph.D. students.

5 Peer-Reviewed Publications

Publications are the most important tool for communicating a good idea and for demonstrating that the broader research community considers an idea to be important and well developed. The feedback obtained from referee reports or a conference presentation can be extremely helpful to appreciate the research result and to further develop research. Therefore, students are strongly encouraged to look for opportunities to publish their ideas and work. In Europe, it is common that Ph.D. candidates have a number of published papers. At least five peer-reviewed publications, either conference papers or workshop papers addressing the thesis research is the requirement for a Ph.D. at WIT.

The Ph.D. candidates are also required to take part in the review process of international conferences. The role of a referee teaches Ph.D. students to focus on publications from a different perspective. Ph.D. students learn how to review a paper and, as the expectations of programme committees become more transparent, they learn important criteria for getting a paper accepted.

6 Teaching

Regular contact with undergraduate students is valuable as preparation for a possible academic career. Presentation proficiency and experience in communicating ideas to groups will be important in any setting, academic as well as outside the university. Teaching expertise is a significant and integral requirement in computer science Ph.D. programmes at top US Universities (e.g. Stanford University, Massachusetts Institute of Technology, Carnegie Mellon University, Cornell University, Princeton University, etc.).

At WIT teaching experience is also considered to be a significant part of graduate education. Each doctoral student is expected to take part in the department's teaching programme. All Ph.D. candidates are required to assist with lectures, labs, practicals, seminars or theses. As teaching is a uniquely effective learning experience, the intent of this requirement is to assure that all doctoral students have the benefit of having taught for at least two terms.

7 Prototype Engineering and Project Management

Senior scientists or senior professionals act as technical leaders / principal investigators for new and ongoing research efforts and commercial projects. They lead

software development teams, coordinate research efforts, develop future research strategy, or define an organisation's long-term IT architecture. Therefore, project management, prototype engineering and programming qualifications are a fundamental technical requirement for a Ph.D. in Computer Science. Significant computer science projects or programming projects are compulsory at leading universities in the US. WIT requires Ph.D. candidates to specify, design, implement and test at least one prototype. A prototype can be the result itself or verify the research result. It is highly encouraged to establish a cooperation with industry or another research institution on this prototype.

8 Transferable Skills

Studying for a science degree provides benefits which last a lifetime and knowledge and skills which are valued by employers generally. Skills that are useful in more than one context are called transferable skills. Transferable skills, defined as "skills developed in one situation which can be transferred to another situation" [3], are known by a variety of other terms - key skills, core skills, soft skills, generic skills, generic competences etc. They can be equally useful in all areas of our lives - academic, work, social and personal - and form an important part of (post)graduate training, as they are rated by employers as of almost equal importance to specialist scientific and technical skills. Transferable skills programmes have become a common standard throughout UK universities for undergraduate, graduate and postgraduate students. Leading computer science departments at universities in the UK (e.g. The University of Edinburgh, The University of Manchester, Imperial College London, etc.) provide a comprehensive transferable skills programme to their Ph.D. students.

WIT acknowledges its responsibility in the provision of opportunities to develop transferable skills, and therefore features a transferable skills programme, but the responsibility of taking advantage of the opportunities provided rests with the students. Adaptability, self-direction, self-discipline, and resilience, together with the ability to think laterally and creatively, and to plan and manage projects are all needed for the completion of Ph.D. thesis. Writing, time management, and presentation skills are also crucial.

This programme concentrates on the professional development of postgraduates, providing courses directly linked to postgraduate study (e.g. thesis workshop, paper production) and future careers (e.g. career planning, team development), grouped into four categories: communication skills, research methodology, project planning and management skills, and special research topics and new technologies are described in the following.

8.1 Communication Skills

These courses cover the knowledge and skills Ph.D. students need to prepare and deliver structured and successful presentations, to moderate discussions, to lead a team or chair a committee, or to defend a research idea. Examples for courses: rhetoric, strategic communication, effective presentations, moderation seminars, group development, etc.

8.2 Research Methods

Publishing a paper at a conference, workshop or in a journal is the most important way of communicating the results of research to the scientific community. These courses offer advice and guidance on how to write a paper and get it published,

on research methodologies, and on skills for conducting research. Some examples for courses: scientific writing, "How to do a Ph.D.", thesis writing, philosophy of science, informatics research methods, etc.

8.3 Project Planning and Management Skills

Time management is a core skill of effective management - it affects the way one uses (or wastes) other people's valuable time as well as one's own. It has also a huge impact on career planning and on a balanced work life relationship. These courses offer advice on how to manage a career as well as professional projects like Ph.D. theses. Some examples for courses: time management, developing a successful career, work-life balance, fiscal law, intellectual property rights, etc.

8.4 Special Research Topics and New Technologies

Professional development in terms of latest research trends and new technologies in computer science are crucial for Ph.D. candidates. These courses keep Ph.D. students technically and research-wise up to date. These courses may be covered for example through tutorials at international conferences, courses at the university or talks at the WIT colloquium series.

9 Career Development

9.1 Mentoring

Mentoring relationships are needed for advice and guidance in career matters. Today more than ever, information about organisational culture is vital for pursuing a successful research career. Therefore, WIT provides mentors to all of its Ph.D. students. Two types of mentoring are offered: One is targeting a research career, while the other is focusing on an industry career. The mentors involve university professors, senior researchers, managers, or senior engineers acting as close, trusted, and experienced colleagues and guides in order to explain the working dynamics of both formal and informal systems within the institution.

9.2 Career Coaching

To accelerate the professional development at the actual workplace professional coaching is used more and more as a new approach. A coach and a willing individual enter into a powerful collaborative relationship aimed at creating a positive change. The individual creates results through a process of discovery, goal setting, and strategic actions. The coach acts as a thinking partner and provides support, encouragement and challenge. Coaching can focus on many different aspects of life including executive, leadership, management, business development, career planning, time management, life balance, etc. WIT provides personal and group coaching opportunities in order to support its PhD students during their PhD and prepare them for professional careers.

10 Doctoral Dissertation

The most important requirement for the Ph.D. degree is the dissertation. The dissertation is on a subject chosen by the candidate and related to an area of study supported by WIT. It must demonstrate the student's ability to carry out

independent research and study. The dissertation must be accepted by the student's supervisors.

11 Overview

Table 1: Overview of WIT Ph.D. Curriculum

Responsibities	**Description**	**Timeline**	**Status**
Reports			
3 Month Report	Initial survey of the research area and principal literature.	End of month 3	Optional
6 Month Report	Comprehensive and critical survey of the research area and literature.	End of month 6	Optional
Ph.D. Proposal	Introductory presentation of the Ph.D. topic: • Research Question • Critical Literature Review • Research Results • Research Method • Evaluation of Results • Progress to Date / Research Plan	End of month 9–12	Compulsory
Research Poster	Poster to graphically present the Ph.D. topic inside and outside the department and foster discussions.	End of month 9–12	Compulsory
Courses	Exams according to the Ph.D. curriculum of the Vienna University of Technology.	From the beginning	Compulsory
International Research Community			
Conferences and Workshops	'Active': Participation in conferences and presentation of accepted publications.	Beginning of year 2	Compulsory
	'Passive': Participation in conferences without accepted publications	From the beginning	Optional
Education and Research Experience	Summer School	From the beginning	Optional
	Doctoral Consortium	Beginning of year 2	Optional
	Visiting Researcher / Engineering Internship at an internationally recognised research and development institution: • University • Commercial research and development center (e.g. IBM Research, Microsoft Research, etc.) • Non-commercial national research center (e.g. INRIA) • Non-commercial international research center (e.g. CERN)	Beginning of year 2	Optional

Table 1: Overview of WIT Ph.D. Curriculum

Responsibities	**Description**	**Timeline**	**Status**
	Visiting Professors: Seminars and Ph.D. supervision of external researchers	From the beginning	Optional
Publications			
Peer-Reviewed Publications	Minimum five publications, either conference papers or workshop papers addressing the thesis research.	Beginning of year 2	Compulsory
Reviewing Publications	Act as a reviewer on behalf the head of the group.	From the beginning	Compulsory
Teaching	Supervise: Theses, labs, practicals or seminars Assist with: Lectures	Beginning of year 2	Compulsory
Prototype Engineering / Project Management	Specification, design, implementation and test of a prototype	Beginning of year 2	Compulsory
Transferable Skills			
Communication Skills	Example courses: rhetoric, strategic communication, effective presentations, moderation seminars, group development, etc.	From the beginning	Optional
Research Methods	Example courses: scientific writing, "How to do a Ph.D.", thesis writing, philosophy of science, informatics research methods, etc.		
Project Planning and Management Skills	Example courses: time management, developing a successful career, work-life balance, fiscal law, intellectual property rights, etc.		
Special Research Topics and New Technologie	Example courses: new software development methodologies, UML 2, Description Logic, etc.		
Career Development			
Mentoring	Mentoring relationships for advice and guidance in career matters	Beginning of year 2	Optional
Career Coaching	Coaching for professional development at the workplace	Beginning of year 2	Optional
Doctoral Dissertation	Written research work to communicate results	End of year 3–4	Compulsory

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[2] Cornell University. Computer Science Ph.D. Program. http://www.cs.cornell.edu/degreeprogs/grad/PhD/. September 13, 2004.

[3] Dublin City University, Trinity College Dublin and Waterford Institute of Technology. Transferable Skills in Third-Level Modern Languages Curricula. http://www.skillsproject.tcd.ie/. September 13, 2004.

[4] Imperial College London, Department of Computing. Ph.D. Programme. http://www.doc.ic.ac.uk/research/PhD/. September 13, 2004.

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[9] The University of Edinburgh, School of Informatics. Ph.D. Programme. http://www.inf.ed.ac.uk/postgraduate/phd.html. September 13, 2004.

[10] The University of Manchester Department of Computer Science. Ph.D. Programme. http://www.cs.man.ac.uk/Study_subweb/PhDWeb/. September 13, 2004.

[11] University College London, Department of Computer Science. Ph.D. Programme. http://www.cs.ucl.ac.uk/research/students/programme.html. September 13, 2004.

[12] University of Bristol, Department of Computer Science. Ph.D. Programme. http://www.cs.bris.ac.uk/Tools/Local/Handbook/research.html. September 13, 2004.

[13] University of California-Berkeley. Ph.D. degree program in Electrical Engineering and Computer Science. http://www.eecs.berkeley.edu/Gradnotes/grad.notes.html. September 13, 2004.