How to be a good PhD student

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Objectives of the course

- To improve your ability to present your research results, i.e. to learn how to:
  1. Write a good research paper
  2. Give a good technical presentation
  3. Write a successful project proposal
- To inform you about research ethics
Content of the course

• The course consists of an introductory part, 3 main parts focusing on the objectives described on the previous slide, and the research ethics part

• Introductory part will cover major phases of a PhD study:
  – Background study, Literature survey, Detailed problem formulation, Execution, Publishing
First part: Writing papers

• Gives general guidelines and specific suggestions about writing technical papers

• We will study major sections of a paper:
  – Introduction, Related work, Research presentation, Experimental results, Conclusion, Future work

• We will cover different paper categories:
  – Concept paper, paper presenting experimental results, theoretical work, methodology, etc.
Second part: Giving talks

• Covers techniques for giving technical talks
• We will review common ways to format the slides and to convey the information to the audience
• We will discuss typical ways to organize a conference talk:
  – Problem description, Motivation, Background, Previous Work, Novelty and Contribution, Experimental results, Conclusion and Future Work
Third part: Writing proposals

• Provides information about sources of external funding and guidelines in writing project applications

• We will learn how to organize a comprehensive funding application and to present it to the outside world in a format that is recognized and accepted
Last Part: Research Ethics

- This part covers the main aspects of research ethics, including the design and implementation of research involving human and animal experimentation, various aspects of scientific misconduct (such as fraud, fabrication of data and plagiarism), as well as codes of ethics and professional conduct.
Theory vs practice

• The theoretical part of the course will be complemented by practical exercises
• Each student will apply the techniques learned in the course to write a conference paper in his/her area of research, to present this paper in the class, and to apply for a travel grant (e.g. supporting a conference trip or a research visit)
Course structure

• Length:
  – one academic year Sept 2018 – May 2019

• Lectures
  – Typically every other week, on Tuesdays 10:15-12:00, see course web page for the schedule:
    https://people.kth.se/~dubrova/coursePhD.html
Lecture 1: Introductory Part
Introductory part

• Major phases of a PhD study are:
  – Background study
  – Literature survey
  – Detailed problem formulation
  – Execution
  – Publishing
Background study

• The goal is to understand needs in your area in order to focus your PhD research on an important problem
• This task is hardest of all
Important to know

• An essential feature of a good paper, talk, or proposal is:
  – The ratio information/noise is maximized

• Why so many papers, talk, and proposals are bad?
  – Because the author does not have a clear picture of the goal, objectives, and results of the presented research, as well as its place in the world
Basic Terminology: Goal

- **Goal** should explain what the core problem is and why it is important
  - There should be only one goal
  - The goal should be connected to the vision for development
  - It should be difficult or impossible to measure the accomplishment of the goal using measurable indicators, but it should be possible to prove its merit and contribution to the vision
Basic terminology: Objectives

- Objectives should address the core problem in terms of the benefits to be received by the target group.
- Objectives provide a more detailed breakthrough of the project goal.
Basic terminology: Results

- **Results** describe the services or products to be delivered to the intended target group.
- To ensure relevant results, one should have correctly identified the group's needs.
- It should be possible to measure results through the use of objective indicators.
Basic Terminology: Indicators

- Indicators are used to evaluate the success
  - Quality
  - Target group (who?)
  - Place (where?)
  - Quantity (how much?)
  - Time (by when?)
Example I

- White paper on “Physical Synthesis for Power Under Process Variation” of J. Cong

- Structure:
  - Motivation
  - Objectives
  - Technical approaches
  - Anticipated results
Motivation

The most significant progress in EDA in the past ten years is arguably the development of physical synthesis technology and its wide adoption by the IC design industry today. However, the existing physical synthesis technology has several limitations:

(1) It was originally developed to address the “timing closure” problem, thus, did not give sufficient consideration of power optimization. Although a number of power optimization techniques have been added in many physical synthesis flows (such as cell sizing, multiple Vt and Vdd selections), there is lack of general and efficient algorithmic framework to consider and balance all available power optimization opportunities, especially in connection with placement.

(2) It did not consider increasing process variations in nanometer designs, therefore, the results by existing physical optimization algorithms may not work under all “timing corners”. A considerable “safe margin” is added to guard-band the statistical variation, resulting in a sizable waste of power, area, and performance.
Objectives

(a) Develop a unified and efficient mathematical foundation and algorithmic framework for physical synthesis to support power optimization guided by both physical locality and an evolving netlist structure. For example, the placement engine should support multi-Vdd islands, clock gating and power gating, where physical locality has a big impact on optimization quality. But it should also support cell sizing, buffering, logic structuring, where an evolving netlist and thus changing logic density need to be considered, during placement, for correct power optimization.

(b) Develop efficient theory and algorithms to support statistical optimization under process variation so that the physical synthesis results satisfy all timing constraints under all timing corners or achieve the required timing-yield constraints under given probability density functions (PDFs).

(c) Consider the efficient use of multi-core CPUs (as they become widely available) to further improve the runtime efficiency for coping with the high complexity of the proposed problem.
Anticipated results

Anticipated results of the proposed research include technical reports, published papers in major EDA conferences and journals, and a software prototype of a novel physical synthesis flow for power optimization under process variation. Our research group has a strong track record in delivering the results and transferring the technology to the SRC companies – our latest SRC project on placement (ending June’06) promised a Moore’s law generation reduction of wirelength (30%) and we already exceeded that goal considerably [Chan05].
GOAL

SECURE AND HARDWARE-EFFICIENT ENCRYPTION AND AUTHENTICATION

OBJECTIVES

To construct hardware-efficient cryptographic primitives
To design a hardware-efficient and secure cryptographic system
To evaluate security of primitives

RESULTS

Supporting Theory Algorithm
Quantitative Metric Algorithm
Prototype (Hardware)

80-bit security can be achieved with < 1000 gates
At least as secure as AES. Smaller, faster and less power consuming than AES

INDICATORS OF SUCCESS
Good source of needs - ITRS

- International Technology Roadmap for Semiconductors forecasts needs of semiconductor industry in the near term (3 years) and long term (up to 10 years)
  - Design and test challenges, emerging devices, assembly and packaging, etc.

- Home page at
  http://www.itrs.net/
Examples of design challenges from ITRS

- The following 5 problems are considered to be the largest future challenges:
  1. Design productivity
  2. Power consumption
  3. Manufacturability
  4. Interference
  5. Error tolerance
First assignment

• The purpose is to persuade you that you will be able to produce a good paper/talk/proposal with a maximum information/noise ratio only if:
  1. You understand the core problem which you are addressing, and
  2. You are aware of the needs for solving this problem, and
  3. You have a clear picture of the goal, objectives, and expected results of your research
First assignment, cont.

- Find one problem which you consider important
  - For example, take the project on which you are working for your PhD
- Define what would be your goal, objectives, expected results and indicators of success
- Present your answer in the form of a diagram similar to the example on p. 22
- The assignment is due on Sunday, Sept. 16th. Send it by email (dubrova@kth.se) as a pdf file with subject “Assignment 1 IL3606”