PhD Course: ADVANCED TOPICS in DESIGN AUTOMATION

(博士课程：集成电路设计自动化专题)

Lecture 1.
Course Overview

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Course History

- 1st offer in Fall 2008
  - Focused on interconnect modeling
  - 3 students
- 2nd offer in Spring 2013
  - Focused on system-level synthesis
  - 3 students
- 3rd offer in Fall 2015 (this year)
  - Focus on programming, software engineering, algorithms, and complex software implementation
  - Using (possibly) a circuit simulator for case study
  - Also explore some recently hot subjects: Machine learning, Data analytics, Compressed sensing, etc.

Course Info

- **Course credit: 2 credits (x 16 = 32 hours)**
- **3 hrs x 11 weeks (Week 2 ~ 12)**
- **3 hours / week (Thu)**
- **Lecture time: 14:00 – 16:40 (3 x 45 min)**
- **Room 105 (SoME bldg)**
- **Teaching format:**
  - **Lecturing, free discussion**
  - **C++ programming projects**
  - **In class seminar**
- **Teaching assistance will be provided (my own MS students)**

Course Motivation

- **EDA is a programming-intensive area**
- **Training new PhD students to have some basic skills in software and awareness of software engineering**
- **Other skills required for EDA research are**
  - **capability to manage complexity**
  - **capability to learn cross-disciplinary knowledge**
  - **capability to go deep ...**

- **In this semester I choose software engineering to be the main subject.**

The Key to SE

- **The key to software engineering is on how to manage "complexity".**
- **Nowadays EDA software tools are mostly big and complex.**
- **In other areas, IoT, big data, cloud computing, the same issue of "complexity" exists.**

Structural Approach

- **"Structural thinking" is considered an effective approach to addressing "complexity".**
- **In terms of programming, probably the C++ programming language can best serve us "structural thinking".**
- **"Structural thinking" means the following abilities:**
  - **to formulate a top-level problem**
  - **to decompose it into components**
  - **to come up with solutions to components**
  - **to assemble component-level solutions**
  - **to develop software that solves the problem**

Tentative Lectures

- **Lecture 2: Quick review of C++ programming**
  - **will go thru the MIT open course lectures**
  - http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-096-introduction-to-c-january-iap-2011/lecture-notes/
- **Lecture 3: Programming environment (Cygwin, etc.)**
- **Lecture 4: Software engineering (A)**
- **Lecture 5: Programming assignment (2D plotter or others)**
- **Lecture 6: Software engineering (B)**
- **Lecture 7: EDA Software (Circuit Simulator case study)**

Teaching Method

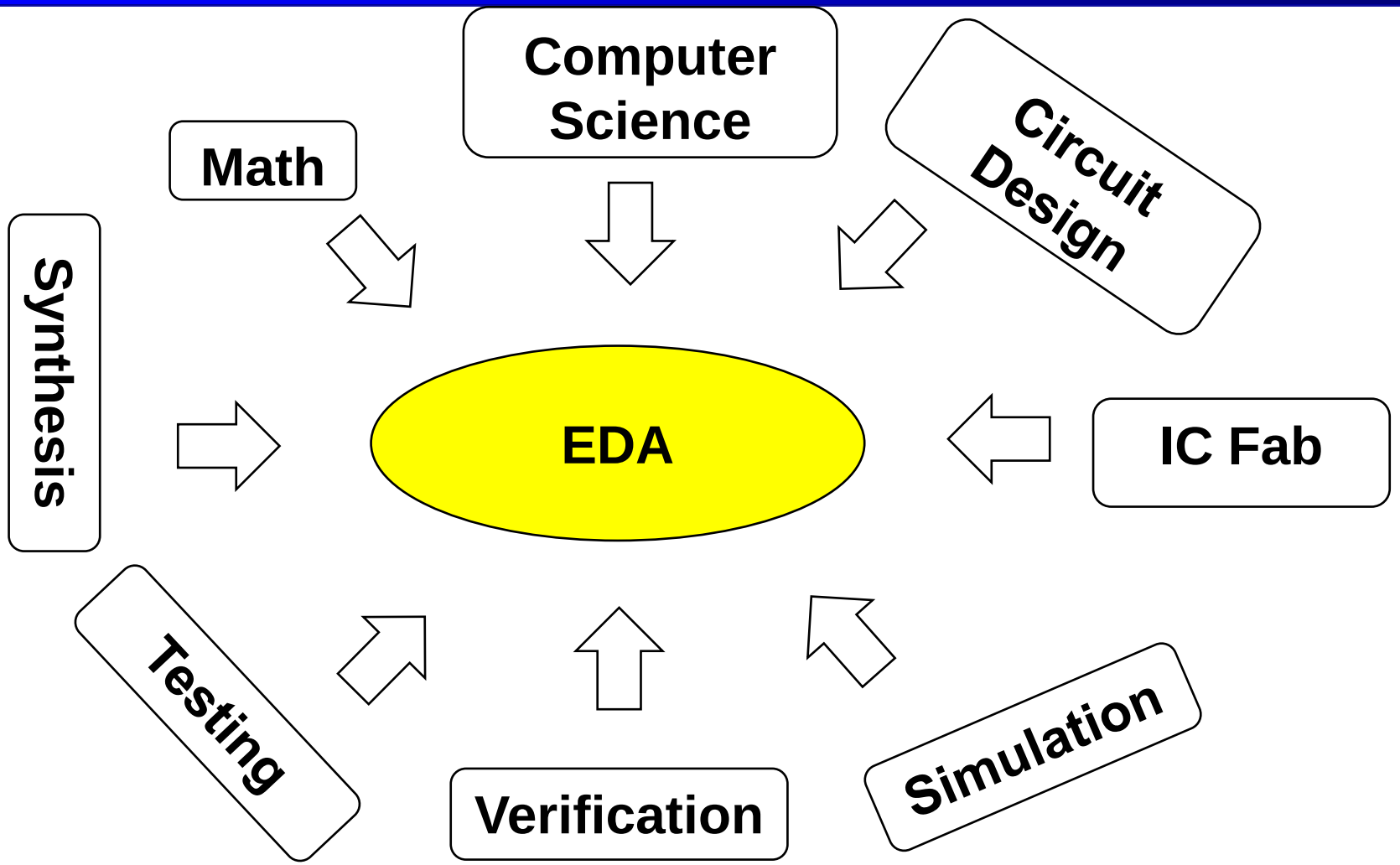
- **Have programming assignments**
  - **Write a 2D plotter in C++ (must be C++)**
  - **Use a graphical toolkit compatible to C++ (like Qt)**
  - **Will provide reference code (with student assistance)**

- **Teaching Software Engineering Principles**
  - **Apply some of them in your programming exercise**
  - **Student should learn to decompose a BIG assignment into smaller tasks**
  - **Should learn to design structural code**

In-Class Seminars

- **We shall constantly discuss your programming progress in every class !**
  - **Students are encouraged to present**
    - **code design details**
    - **coding details**
    - **difficulty**
    - **achievements**
    - **possibility to improve (by discussion)**
    - **extensions to the current assignment**

Thoughts on this Course



Thoughts on this Course

- **So EDA is highly multi-disciplinary!**
- **Then where to begin with?**
- **As a course designed for PhD students working on EDA, I'm responsible to guide you to enter this area.**
- **But we cannot learn everything in one course.**
- **I think a good start is to learn programming & software skills**

- **Such skills are indispensible to do PhD research,**
- **they are also useful for those working in related areas.**

Programming + Explorations

- **Along with programming training in this course, we also explore some recently attractive areas:**

- **Machine Learning (not new, just rejuvenating)**
  - **Assign reading of my own papers published 15 years ago**
- **Data analytics – statistical methods**
- **Compressed sensing (has existed for a decade)**
  - **Also caught attention of circuit designers**

Actions to Take

- **Actions:**
  - **read recommended papers,**
  - **discuss in-class, and**
  - **write programs to implement some algorithms**

- **So be prepared to do self-study ...**