Course Information

- **ECE 66300:** Advanced Compilation and Automatic Programming
- **CRN:** 38452
- **Meeting time:** TuTh 9:00-10:15 (BHEE 224)
- **Instructional Modality:** Face-to-Face
- **Course credit hours:** 3
- **Prerequisites:** ECE 56500, CS 50200 or ECE 46800 or ECE 57300.

Instructor(s) Contact Information

Xiaokang Qiu (Instructor)

- **BHEE 329**
- **765-494-9987**
- **xkqiu@purdue.edu**
- **Office hours:** Tu 1:45-2:45, F 10:30-11:30 (or by appointment)

Course Description

This course presents the concepts needed to design and implement production quality code generators for any of the more popular languages and families of computer architecture (including various pipelined and macro-parallel machines). Flow analysis and concurrency detection, as well as optimizations and loop and irregular code parallelizations, are covered in detail. Using C on ECN UNIX, each student will complete a project implementing a simple optimizer/parallelizer.

Learning Resources, Technology & Texts

Course Websites

https://xkqiu.github.io/purdue-ece663/

Reference Textbook (not required)

- S. Gulwani, O. Polozov and R. Singh. Program Synthesis. 2017.

Learning Outcomes

A student who successfully fulfills the course requirements will have demonstrated an ability to:

- Apply automated reasoning techniques and tools to analyze and verify programs and reactive systems.
- Explain and implement program synthesis algorithms and methodologies.
- Apply program synthesis techniques to automate programming tasks in an application domain.

Assignments

Problem Sets

There will be 2-3 problem sets covering the core techniques.

Paper Presentation

You are expected to present a technique based on a research paper from a list prepared by the instructor.

Project

Project: You are expected to learn one particular technique in detail, and use it in a concrete project, giving a theoretical or practical contribution. Projects are expected to be done either individually or in groups of two. Project will hopefully be at the level of a conference publication.

There will be four milestones for the project:

- The first milestone is a 5-10 min quick pitch to introduce your research, followed by discussion which may help you find potential research problems that synthesis techniques can be helpful, and sometimes also teammates.
- The second milestone is a 1-page project proposal and a short presentation where you explain what you plan to do for your project and why you think it's a good idea. You should elaborate on the following: what are you proposing to do, why is it interesting or important, what are the expected challenges, how does it relate to the state of the art, what evidence do you have so far to suggest this may work. It is expected that for this milestone you will have already done some work towards the project, so it is advised that you seek help early on if you have questions about the suitability of your intended project.
- The third milestone will be a presentation describing your project; the exact length of the presentations will depend on the number of projects that are submitted.
- Finally, you are expected to submit a final report describing your project. The report should be around 5 pages in length in ACM Small format. The report should read like a short paper, so it should make it clear what you did, why you did it, and what you learned from doing it.

Overall, projects will be judged in terms of quality of execution, originality, and scope.

Grading Scale

The achievement of course objectives will be assessed through a combination of problem sets, paper presentation and course project.

Grades will be assigned as follows:

30% — Problem sets
20% — Paper presentation
50% — Project — 2% — Quick pitch of your research
13% — 1-page project proposal
15% — Project presentation
20% — Project final report

Your course grade will be determined using an absolute scale: 97–100: A+; 91–97: A; 88–91: A-; and continuing down.

Course Schedule (tentative)

Week	Topic
1	*Programming by example*
2	*Intent Formalization*
3	*Recurrences*

4	*Formal Verification*
5	*Syntax-Guided Synthesis*
6	*Constraint-Based Synthesis*
7	*Inductive Learning*
8	*Search-Based Synthesis*
9	*Reactive Synthesis*
10	*Spring break*
11	*Paper Discussion*
12	*Paper Discussion*
13	*Paper Discussion*
14	*Project Presentation*
15	*Project Presentation*
16	*Project Presentation*

* Schedule and assignments subject to change. Lecture slides will be posted on the course website.

Nondiscrimination Statement

A hyperlink to Purdue's full Nondiscrimination Policy Statement is included in the Academic Resources table on your Brightspace homepage.

Accessibility

Purdue University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, you are encouraged to contact the Disability Resource Center at: **drc@purdue.edu** or by phone: 765-494-1247, as soon as possible.
If the Disability Resource Center (DRC) has determined reasonable accommodations that you would like to utilize in my class, you must release your Course Accommodation Letter to me. Instructions on sharing your Course Accommodation Letter can be found by visiting: **https://www.purdue.edu/drc/students/course-accommodation-letter.php** Additionally, you are strongly encouraged to contact me as soon as possible to discuss implementation of your accommodations.

Mental Health/Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try Therapy Assistance Online (TAO), a web and app-based mental health resource available courtesy of Purdue Counseling and Psychological Services (CAPS)**.** TAO is available to all students at any time by creating an account on the TAO Connect website, or downloading the app from the App Store or Google Play. It offers free, confidential well-being resources through a self-guided program informed by psychotherapy research and strategies that may aid in overcoming anxiety, depression and other concerns. It provides accessible and effective resources including short videos, brief exercises, and self-reflection tools.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 a.m.- 5 p.m.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc., sign up for free one-on-one virtual or in-person sessions in West Lafayette with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is free and can

be done on BoilerConnect. Students in Indianapolis will find support services curated on the Vice Provost for Student Life website.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS offices in West Lafayette or Indianapolis.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.