

ESE 326: Fundamental Algorithms for Automated Electronic Design

Co-listed with ESE 556 (VLSI Physical and Logic Level Design Automation)

Instructor: Alex Doboli, Ph.D.

Light Engineering Building, Room 241,

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Course Description: Upon completion of the course, students will know to design and implement the fundamental algorithms for automated electronic design, such as system and circuit design. The discussed core algorithms include greedy algorithms, divide-and-conquer, quicksort, dynamic programming, graph algorithms, and string matching. Analysis of algorithms is also discussed. These algorithms are exemplified for basic electronic design tasks, like circuit partitioning, floorplanning, module placement, signal routing, task scheduling, resource allocation, and technology mapping. The course work involves programming exercises and one course project.

Course objectives: Students will learn the characteristics of the enumerated topics, and devise and implement software programs for the discussed algorithms as part of their homeworks and project work for the course. Student projects will be assessed using standard benchmarks.

Catalog Description: Upon completion of the course, students will know to design and implement the fundamental algorithms for automated electronic design, such as system and circuit design. The discussed core algorithms include greedy algorithms, divide-and-conquer, quicksort, dynamic programming, graph algorithms, and string matching. Analysis of algorithms is also discussed. These algorithms are exemplified for basic electronic design tasks, like circuit partitioning, floorplanning, module placement, signal routing, task scheduling, resource allocation, and technology mapping. The course work involves programming exercises and one course project.

Prerequisites: ESE 224.

Course schedule: As a 3-credit course, it will meet either 3 times per week for one hour each, or twice per week for 90 minutes.

No. credits: 3 credits

Grading: A B C F

Textbooks:

- 1) T. Cormen, C. Leiserson, R. Rivest, C. Stein, *“Introduction to Algorithms”*, Third edition, MIT Press and McGraw-Hill, 2009.
- 2) N. Sherwani, *“Algorithms for VLSI Physical Design Automation”*, Kluwer, 1999.

- 3) **Reference:** Giovanni De Micheli, *“Synthesis and Optimization of Digital Circuits”*, McGraw Hill, 1994.

Assignments: The course requirements include bi-weekly programming homeworks and one project.

The project involves designing, implementing, and experimenting a main algorithm used in electronic design automation. Students must prepare a detailed report of their project work including project description, description of the solutions and experimental results. Students must submit the project report and the software code of their implementation.

Covered topics:

- Introduction to Electronic Design Automation (EDA) and CAD Tools
- Basic Data Structures and Algorithms used in EDA
- Algorithm types. Analysis of algorithms.
- Greedy algorithms. Application to task scheduling and resource allocation.
- Greedy algorithms. Application to circuit partitioning
- Divide-and-conquer. Quicksort.
- Divide-and-conquer. Application to circuit partitioning
- Divide-and-conquer. Application to floorplanning and placement
- Graph algorithms. Application to global and detailed routing
- Graph algorithms. Application to task scheduling and resource allocation.
- Graph algorithms. Application to incremental design.
- Dynamic programming. Technology mapping (cell library binding)
- String matching. Application in incremental design.

Course Grading:

Homework assignments Homework assignments include programming exercises for each of the discussed topics.	30%
Final exam	40%
Project 3 Developing EDA tools using the taught algorithms. The project work is organized in groups of three students. Project requirements include preparing a formal project report and presentation of the project work.	30%

The following grading scale will be used: A: 90 and higher; B: 80-89; C: 65-79; F: 64 and bellow.

Lecture delivery: All lectures will be delivered in-person at the scheduled time and location.

Office hours: Monday, Wednesday: 1.00-2.00 PM

All office will be conducted through zoom. Please notify me by email a day before the scheduled office hours, so that I can post the zoom link for videoconferencing.

Final exams: The final exam is as officially scheduled by the university.

Monday, January 24th, 2022 is the first day of classes.

Family Education and Privacy Act (FERPA): Stony Brook University maintains various student records to document academic progress as well as to record interactions with University staff and officials. To protect the student's rights to privacy, and to conform to federal and State laws the University has an established policy for handling students' records. Notice of this policy and of students' rights under federal law is given annually to the campus community. With very limited exceptions, student information must not be transmitted by any University employee to anyone outside the University without the express written release by the student or pursuant to a lawfully executed subpoena/order, coordinated by the Office of University Counsel.

Please refer to the following campus website for guidance with laws regulating confidentiality of student records and dissemination of other student personal and academic information: <http://www.stonybrook.edu/commcms/registrar/policies/ferpa.php>

Please note without a signed FERPA release faculty cannot discuss a student with their parents under any circumstances. Faculty may not release student directory information (including email addresses) to any 3rd party vendors, including book publishers.

Required Syllabi Statements: The University Senate Undergraduate and Graduate Councils have authorized that the following required statements appear in all teaching syllabi (graduate and undergraduate courses) on the Stony Brook Campus. https://www.stonybrook.edu/commcms/provost/faculty/handbook/academic_policies/syllabus_statement.php

Americans with Disabilities Act: If you have a physical, psychological, medical or learning disability that may impact your course work, please contact the Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631)632-6748.

They will determine with you what accommodations, if any, are necessary and appropriate.

All information and documentation is confidential.

<https://www.stonybrook.edu/commcms/studentaffairs/sasc/facstaff/syllabus.php>

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website:

<https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-people-with-disabilities>

- To access mental health services, call Counseling and Psychological Services at 631-632-6720; are available to speak with 24/7.
- For updated information on the Academic Success and Tutoring Center please check www.stonybrook.edu/tutoring for the most up-to-date information.

- For IT Support: Students can visit the Keep Learning website at <https://sites.google.com/stonybrook.edu/keeplearning> for information on the tools you need for alternative and online learning. Need help? Report technical issues at <https://it.stonybrook.edu/services/itsm> or call 631-632-2358.
- For information on Library services and resources please visit the Continuity of Library Operations

Student Accessibility Support Center Statement. If you have a physical, psychological, medical, disability that may impact your course work, please contact the Student Accessibility Support Center, Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information following website: <https://ehs.stonybrook.edu//programs/fire-safety/emergency-evacuation/evacuation-guide-disabilities> and search Fire Safety and Evacuation and Disabilities.

Academic Integrity Statement. Each student must pursue his or her academic goals honestly and is personally accountable for all submitted work. Representing another person's work as your own is wrong. Faculty is required to report any suspected instances of academic dishonesty to the Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific policies. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management: Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Until/unless the [latest COVID guidance](#) is explicitly amended by SBU, during Spring 2022 "disruptive behavior" will include refusal to wear a mask during classes.

For the latest COVID guidance, please refer to: <https://www.stonybrook.edu/commcms/strongertogether/latest.php>

Accessibility of all course material. To provide equal access for our diverse Seawolves, it is important for content creators to understand the responsibilities for ensuring that the remote instruction materials you distribute (required readings, videos, etc.) to students do not pose barriers. By doing this, you are creating an environment that is inclusive of all students, regardless of individual ability.

To learn more about creating accessible course content, please see the links below:
https://help.blackboard.com/Ally/Ally_for_LMS/Instructor/Quick_Start
https://help.blackboard.com/Accessibility/Caption_Video_Content

To learn more information on how to accommodate students with extended time on online exams, please see the following link:

<https://blackboardhelp.usc.edu/assessments/tests-and-quizzes/setting-test-availability-exceptions/>

Should you have any questions regarding the accessibility of course content, please contact the Center for Excellence in Learning and Teaching: AcademicTechnologies@stonybrook.edu or (631) 632-2358.

For questions regarding implementing disability related accommodations, please contact the Student Accessibility Support Center at sasc@stonybrook.edu or (631) 632-6748.

Instructional/Student Responsibilities: The University Senate's Undergraduate Council updated the University's statement of Minimal Instruction and Students Responsibilities in Fall 2008. Please review carefully. Also listed are the Minimal Undergraduate Student Responsibilities. You may wish to copy these for your classes or direct students to the website. Both statements may be found in the Academic Policies and Regulations section of the on-line Undergraduate Bulletin https://www.stonybrook.edu/sb/bulletin/current/policiesandregulations/policies_expectations/min_instructional_student_resp.php

Student Participation in University-Sponsored Activities: Students may be required to miss class as a result of their participation in an event or activity sponsored by the University. Please see the Undergraduate Bulletin for the policy regulating the accommodations that should be made for these students: https://www.stonybrook.edu/sb/bulletin/current/policiesandregulations/policies_expectations/participation_univspnsored_activities.php

Withdrawals from Classes: The academic calendar, published in the Undergraduate Class Schedule, lists various dates that students must follow. Only the Arts and Sciences Committee on Academic Standing and Appeals or the Engineering and Applied Sciences Committee on Academic Standing may grant permission for a student to withdraw from a course after the deadline. The same is true of withdrawals that will result in an academic under-load. A note from the instructor is not sufficient to secure withdrawal from a course in the above circumstances.

Exceptions to University and College Graduation Requirements: Neither individual faculty members nor departments may grant waivers or substitutions for general education requirements or any other College-wide or University-wide requirements. Students should be directed to the Division of Undergraduate Education or the CEAS Undergraduate Student Office for information about the process for requesting and exception.

Learning Objectives: It is expected that all course syllabi will contain measurable learning objectives. This is always good pedagogical practice and a University requirement. CELT staff are available to assist you: 631-632-2358, celt@stonybrook.edu

Posting Course Syllabi: All course syllabi should be available to students as early as possible for the upcoming semester, but definitely must be available before the first day of class. We ask

that you post your course syllabi in the Syllabus area of your Blackboard courses prior to the start of the upcoming semester.

DoIT collects syllabi from Blackboard and places them into Classie (which is password protected) to provide students the ability to review course syllabi and the course requirements prior to the start of the semester and provide central repository for syllabi in the event of a campus national emergency. If you have concerns about your syllabi being collected and posted on this site, please reach out for assistance at CELT@stonybrook.edu

Stony Brook Curriculum: All First Time Full Time and transfer students are following the Stony Brook Curriculum to satisfy their general education requirements. For additional information please

see: https://www.stonybrook.edu/sb/bulletin/current/policiesandregulations/degree_requirements/categoriesandlearningoutcomes.php

Continuing students who followed the DEC at their point of matriculation will continue to do so until they graduate.

Religious Holiday Statement: All faculty should be familiar with the Religious Holiday Statement and Academic Calendar found on the Office of the Provost website: https://www.stonybrook.edu/commcms/provost/faculty/handbook/employment/religious_holidays_policy

The Academic Calendar can also be found on the Registrar's website: https://www.stonybrook.edu/commcms/registrar/calendars/academic_calendars

It is important that you respond appropriately to all student requests for accommodation. A good practice is to remind students at the beginning of the course that they should notify you of all potential conflicts prior to the end of the add/drop period.

Student Success Resources: One concern often expressed by faculty is not being sure where to refer students who need assistance. A new Student Success Website can be found at: https://www.stonybrook.edu/commcms/du/student_success/index.php

Another helpful resource is the Division of Undergraduate Education website: <https://www.stonybrook.edu/commcms/du/index.htm>

Academic Success and Tutoring Center: Please be sure that your students are aware of the available services. Information can be found at: http://www.stonybrook.edu/commcms/academic_success

Academic Integrity: Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health and Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic judiciary website at: https://www.stonybrook.edu/commcms/academic_integrity

Responding to Student Disruptions in the Classroom: Faculty should be aware of the policies related to student disruptions in the classroom. You can find this information at the following link: <https://www.stonybrook.edu/commcms/studentaffairs/ucs/policies/disruption>

Please be advised that Dr. Julian Pessier, Director, University Counseling and Psychological

Services and I are available to meet with you and your department to discuss this or related matters of concern.

Red Book

In November, you received information about Stony Brook Red Book. Please review and refer to the Red Book at: <https://www.stonybrook.edu/commcms/studentaffairs/redbook/>

It includes signs to look for and how to respond to student situations including emotional distress, disruptive behavior, medical emergency, or other concern that requires support or intervention. Information is provided on resources to contact, including the University Police Department (UPD), Community Standards, the CARE Team, Counseling and Psychological Services (CAPS), the Student Support Team, and more.

How can I report a student of concern?

Familiarize yourself with the link at the top of the Red Book called "Report a Student of Concern." In an emergency, call University Police at (631) 632-3333 (333 from a campus phone). For all other situations, send an email to care@stonybrook.edu or call (631) 632-CARE (2273) during regular business hours (M-F, 9 am-5 pm). A CARE Team or Student Support Team member will provide you and/or the students for whom there is a concern with guidance and assistance.

What should I say when I am speaking with a student and have concerns about their well-being?

We ask that you complete Kognito, a 40-minute online simulation which presents different situations and offers suggestions on the approach and language to use when speaking with a student you are concerned about. The simulation consists of you playing the role of an instructor engaging in challenging conversations with three different students. Each student is dealing with different concerns that affect their well-being including overwhelming stress, paranoia, social isolation, and thoughts of suicide. The simulation uses an avatar to depict the instructor role. While the avatar is not representative of all identities and roles on our campus, the simulation provides valuable tools. Follow the steps below to complete the simulation

- Go to <https://www.kognitocampus.com/>
- Create a new account
- Enter the Enrollment Key: sbucare

It may take a few seconds to launch the simulation. We recommend using the following browsers: Chrome, Firefox, Safari, and Edge; the simulation will not work on Internet Explorer. To receive a certificate of completion, follow the instructions at the end of the simulations. For technical support issues, contact Kognito at (866) 449-8834.

Attendance Verification: To remain in compliance with Federal Regulations, Stony Brook University must determine if a student maintained eligibility for Title IV Financial Aid. Financial Aid eligibility is determined based on a student's attendance or participation in an academically related activity in the class.

Beginning of Term Verification: At the beginning of the term, instructors will be asked to indicate if a student enrolled in a course has not attended at all.

Last Date of Attendance: After final grades have been posted, for any students receiving a failing grade, instructors will be asked to enter if a student has not attended at all, completed

the course, or has not attended since a specific date (the last date of attendance will need to be entered).

For more information, visit: <https://www.stonybrook.edu/commcms/registrar/policies/tracking.php>

Student Accessibility Support Services (SASC) Exam Policy Information for Faculty

SASC may proctor exams for students who have accommodations registered with SASC. Said accommodations are communicated to faculty through a letter of accommodation, via email. All exams must be scheduled during hours when the SASC office is open. Examinations scheduled outside of the University assigned class or exam time must be approved by faculty, and communicated to SASC, via email to: SASCExams@stonybrook.edu

Exam information request form

Within 5 days of receiving a letter of accommodation, SASC requests that faculty complete an Exam Information Request Form: <https://goo.gl/fiuiinL>. The form may be completed once per semester for each course. When there are multiple sections of the same course, please indicate the course number, section numbers, and appropriate information on a single form. Please note that SASC cannot proctor exams for a course without completed form on file. Updates to the form can be communicated to SASC at sasceexams@stonybrook.edu.

Scheduling Exams

SASC utilizes the schedule the instructor provides, on the Exam Information Request form, to allocate exam proctors and testing space. As such, SASC requests that faculty communicate any changes to their testing schedule as soon as possible, in writing, to sasceexams@stonybrook.edu. Please note that exam appointments are not confirmed until a student requests a seat at SASC. When exam appointments are confirmed, Professors will receive an email requesting that a copy of the exam be delivered to SASC. Professors are encouraged to submit exams for all students, whose accommodations outlined in their letter of accommodation require testing accommodations, even if they do not receive an email from SASC.

Delivering Exams to SASC

Professors are to deliver exams at least 2 business days in advance of the, scheduled at SASC, exam start time. Exams requiring conversion into alternative format (e.g. reader, braille, or enlarged font accommodations) or that contain audio-visual components (e.g. slides audio files, videos) often require additional lead time. If such time is needed, SASC will notify the Professor, in writing, via their Stony Brook email address.

Exams may be delivered to SASC, in person, to room 128 of the Educational Communications Center, or via email to: sasceexams@stonybrook.edu, as a PDF or word documents. SASC encourages Professors to provide exams electronically. All exams requiring an alternate format must be delivered to SASC as word or formatted files, as other formats cannot be converted. Professors who do not wish to use SASC's conversion service may provide appropriate converted copies to SASC. Files sent to SASC must be attached to emails and not sent through cloud services or file sharing

Exams which are not delivered to SASC by the start of a student's exam time may have to be rescheduled at a time convenient to the SASC office and the student, with approval by the instructor. Students cannot be required to travel to class to pick up the exam.

Retrieving Exams from SASC

Exams proctored at SASC are held until signed for and retrieved by faculty or a department representative. SASC cannot sign out an exam without knowing the complete course number (e.g. BIO 101.01). Faculty are responsible to ensure that exams retrieved promptly.

Persons other than the instructor of record for the course must identify the course and full section number for which exam they wish to retrieve and may be asked to provide their University issued photo identification when signing out exams.

Final Exam Scheduling

Final exams, at SASC, are scheduled at the following start times: 8:00 AM, 11:00 AM, 2:00 PM, 4:00 PM, and 5:00 PM. Exams are scheduled at the nearest time to the time assigned by the registrar (e.g. exams scheduled at 5:15 PM in the classroom are scheduled at 5:00 PM at SASC). Exams scheduled for 8:00 PM will be seated at either 4:00 PM or 5:00 PM at SASC.

Communicating with Students Taking Their Exam at SASC

If faculty allows students in class to ask questions or receive clarification during the exam, they must provide the same opportunity to students testing with SASC. SASC may contact faculty via phone or email, based on faculty preference. Faculty may elect to come to SASC, or send a TA or other department representative to SASC during the exam.

Restroom Break

Professors will be asked to indicate whether or not they allow restroom breaks when delivering their exam to the Student Accessibility Support Center (SASC). In the event that no restroom prohibition is indicated to SASC staff, it will be assumed that restroom breaks are permitted during the student's exam.

Restroom breaks will be provided for students whose exam time exceeds one hour.

Students whose accommodations include use of the restroom, or students experiencing a medical need will be permitted use of the restroom. Students who use the restroom resulting from medical need will be encouraged to discuss circumstances with their Professor and the Dean of Students office when necessary.

Use of the restroom will not extend student's allotted exam time. A student's use of the restroom during the exam time does not result in additional exam time and does not freeze the exam clock.

Procedure

All students needing to make use of the restroom after their exam has begun must sign out and back in with the SASC proctor. The documented times a student left and returned from the restroom will be provided to faculty upon request.

Updated: 01/20/2022 by Dr. Alex Doboli.