

**IE 6303: Combinatorial Optimization**  
**Spring 2018**

**Instructor:** Jay Rosenberger

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**Office Hours:** Woolf 420-D, MWF 11:00 AM – 11:50 AM

**Section Information:** IE 6303-001/002/003

**Time and Place of Class Meetings:** Woolf 208, MWF 10:00 AM -10:50 AM

**Description of Course Content:** A survey of problems and algorithms in combinatorial optimization. Topics include integer programming formulation, branch-and-bound and cutting plane algorithms, polyhedral theory, Lagrangian relaxation, and Benders' decomposition.

**Student Learning Outcomes** At the end of this course students should be able (1) to understand the basic concepts of integer programming, (2) to apply those concepts to solving numerical problems, and (3) to use some software to solve integer programs.

**Required Textbooks and Other Course Materials:** Mobile phone or tablet with CourseKey (<http://thecoursekey.com/>) and GPS capability. CourseKey is in iTunes, Google Play, and other app stores.

**Supplemental Textbooks:** *Integer and Combinatorial Optimization* by Nemhauser and Wolsey.

**GTA:** Antonio Alanis Pena ([antonio.alanispina@mavs.uta.edu](mailto:antonio.alanispina@mavs.uta.edu))

**GTA Office Hours:** ELB 308, Fridays 12:30 PM – 2:00 PM

**Descriptions of major assignments and examinations:** There are two midterm exams, homework assignments, and a group project. Midterm 1 is on integer programming formulation. Midterm 2 is branch-and-bound and cutting plane algorithms. The group project will be assigned after the second midterm and will include both a written report and an oral presentation during the final exam period.

**Prerequisites:** IE 5301 (Introduction to Operations Research) or equivalent.

**Test Policies:**

- **Before exam:** Students are allowed to use 4 (8.5 \* 11 inch front and back) pages of notes, and students must bring a UTA I.D. card and a calculator with them to the exam. Students are not allowed to leave the exam room and return to take the test, so students should use the restroom **before** the exam. The instructor may provide a seating chart for the exam. Students should sit in their assigned seats and clear the desk area of all materials except: pens, pencils, erasers, calculators, and 4 pages of notes.
- **During an exam:** Students are only allowed to use pens, pencils, erasers, calculators, and notes. Mobile phones, computers, and other communication devices must be turned off. Students should keep their eyes on their own exams. Doing otherwise constitutes evidence of scholastic dishonesty for which the instructor can refer you to the Office of Student Conduct. Students are

not allowed to leave the exam room and return to take the test. Exams are to be opened and closed at the times announced in class (or by the proctor). Anyone opening an exam early or closing an exam late will be deducted 5 points for each minute outside the exam period. All suspicious behavior during the exam will be noted by the instructor. In certain circumstances, students will be confronted by the instructor and could be referred to the Office of Student Conduct.

- **After an exam:** When all of the exams have been graded, the GTA will email scores to the students. The exams will be reviewed in class. Students who wish to see their graded exams must come to office hours. Students who wish to keep a copy of their exams must come to office hours and remove the exam staple, so the exam can be copied. The instructor highly encourages students who perform poorly on exams to come during office hours.

**Attendance:** At The University of Texas at Arlington, taking attendance is not required but attendance is a critical indicator in student success. Each faculty member is free to develop his or her own methods of evaluating students' academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, I have established following attendance policy: Daily attendance will be taken on and after census date. For in class students, CourseKey will be used to take attendance 10:00 am-10:50 am in WH 208. Distance students may receive attendance credit either using CourseKey or streaming one of the videos on each class date on their own student ID login on or before 5:00 pm on the last day of class. Downloading the video or watching it on someone else's student ID login will not count towards a distance student's attendance. The percentage of daily attendance will be scaled to 5% and added to your class score. However, while UT Arlington does not require instructors to take attendance in their courses, the U.S. Department of Education requires that the University have a mechanism in place to mark when Federal Student Aid recipients "begin attendance in a course." UT Arlington instructors will report when students begin attendance in a course as part of the final grading process. Specifically, when assigning a student a grade of F, faculty report the last date a student attended their class based on evidence such as a test, participation in a class project or presentation, or an engagement online via Blackboard. This date is reported to the Department of Education for federal financial aid recipients.

**Homework:** During some lecture periods, the instructor will announce a short homework assignment. Homework should be submitted via Blackboard by either 5:00 PM on the date of the third subsequent lecture (usually one week) or 5:00 PM on the date of the first lecture after census date, whichever date is later. Blackboard shuts down the assignment afterwards, so **all homework submitted after the due date and time will not be given credit.** The percentage of homework will be scaled to 15% and added to your class score. Homework is not rigorously graded and will be given full credit for a "good attempt". Homework may only be graded weekly. Students are encouraged to work together on homework assignments. All forms of collaboration should be documented on the submitted homework assignment. Specifically, students should include the following statement:

*For this assignment, I worked with [collaborators' names]*

**Class Courtesy:** The instructor insists on a quiet classroom. This includes silencing cell phones before class and no whispering during class. Texting in class is fine but not during exams. Students who come to class late should try to enter the classroom as discreetly as possible. Due to noise in the hallway, the hallway door, which may be locked, may be shut 10 minutes after class begins. Students who do not come to class within the first 10 minutes of the start of class may not be able to attend class. In this case, the student should watch the recorded video. *Do not knock on the door if it has already been shut. Students who are disruptive in class will be asked to leave.*

**Grading:** Grading Format: A = 90, B = 80, C = 65, D = 55, F = below 55. Exams are curved as described below, but homework is not curved. The grade weights are as follows:

- Midterm exam 1 is 25%
- Midterm exam 2 is 25%
- Written group project is 20%

- Oral group project is 10%
- Homework is 15%
- Lecture mastery is 5%

*There is no other course credit available, and students frequently regret not submitting all homework and attending classes.*

Each exam receives a raw score based upon performance on problems and the point allocations described on the exam. Usually these points total 100 but sometimes there are bonus points. Using the average and standard deviation of the raw scores, each exam receives a preliminary curved score based upon a predetermined bell curve. Usually, the predetermined bell curve has a mean of 85 and a standard deviation of 5. Finally, each exam receives a curved score that is the maximum of the raw score and the preliminary curved score. An exam's curved score is what is used to determine the final class grade. The GTA will email exam scores as soon as exam scores have been curved.

*Students are expected to keep track of their performance throughout the semester and seek guidance from available sources (including the instructor) if their performance drops below satisfactory levels.*

**Make-up Exams:** Makeup tests will only be given for documented illnesses or emergencies. If you cannot attend a test for any reason, you should make every effort to contact the instructor beforehand. Exams missed due to an unexcused absence will be penalized 20% initially and an additional 20% for every subsequent 24-hour period in which the student has not taken the exam.

**Expectations for Out-of-Class Study:** Beyond the time required to attend each class meeting, students enrolled in this course should expect to spend at least an additional 9 hours per week of their own time in course-related activities, including reading required materials, completing assignments, preparing for exams, etc.

**Grade Grievances:** Students who would like an exam regraded must submit a written statement, which clearly explains the reason for a regrade. If an exam is submitted for regrading, the entire exam is regraded, and it is possible the score could go down. An appeal of a grade, which is more than a regrade, in this course must follow the procedures and deadlines for grade-related grievances as published in the current University Catalog.

**Drop Policy:** Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://www.uta.edu/aao/faol/>).

**Disability Accommodations:** UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA)*, *The Americans with Disabilities Amendments Act (ADAAA)*, and *Section 504 of the Rehabilitation Act*. All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a **letter certified** by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting: **The Office for Students with Disabilities, (OSD)** [www.uta.edu/disability](http://www.uta.edu/disability) or calling 817-272-3364. Information regarding diagnostic

criteria and policies for obtaining disability-based academic accommodations can be found at [www.uta.edu/disability](http://www.uta.edu/disability).

Counseling and Psychological Services (CAPS) [www.uta.edu/caps/](http://www.uta.edu/caps/) or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

**Non-Discrimination Policy:** *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit [uta.edu/eos](http://uta.edu/eos).*

**Title IX Policy:** The University of Texas at Arlington ("University") is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit [www.uta.edu/titleIX](http://www.uta.edu/titleIX) or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or [jmhood@uta.edu](mailto:jmhood@uta.edu).*

**Academic Integrity:** Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

*I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.*

*I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University. Additional information is available at <https://www.uta.edu/conduct/>.

**Instructor Comments on Scholastic Dishonesty:** While not on the standard syllabus, the instructor is compelled to warn students about scholastic dishonesty. Please read all 5 points below that include a description of what will happen if the instructor finds evidence that a student has cheated, colluded, or plagiarized **in any way** on submitted materials in this class.

1. The instructor will submit a referral to the Office of Student Conduct with the intention of reducing that submitted material grade to 0, which will likely lower the student's final grade in the class. **The instructor will not accept any excuse, plea, apology, or justification for the student's actions. Any question about cheating, colluding, or plagiarism should be discussed with the instructor before submitting the materials.**
2. More than likely the Office of Student Conduct will agree with the instructor's conclusion and allow him to make the grade change. If the student is not already on Scholastic Dishonesty Disciplinary Probation, the Office of Student Conduct will almost certainly put him/her on probation. If the student is already on Scholastic Dishonesty Disciplinary Probation, the University will likely dismiss the student from the University.
3. The low final grade received in the class may require the student to retake this class or take another class in a subsequent semester to fulfill graduation requirements, which could delay graduation.

4. The low final grade received in the class may put the student on Academic Probation if s/he is not already on Academic Probation. Academic Probation can lead to the student being dismissed from the IMSE Program.
5. Scholastic Dishonesty Disciplinary and/or Academic Probation ensure that the student cannot have a Graduate Teaching Assistantship (GTA). In addition, although this is not a formal policy, a student who was previously on either Scholastic Dishonesty Disciplinary Probation or Academic Probation has almost never been offered a GTA or any IMSE scholarship or award.

Although the above may sound severe, the instructor, the IMSE Department, and the University take scholastic dishonesty extremely seriously. For more on UTA's Scholastic Dishonesty Policy, please see the following link:

<https://www.uta.edu/conduct/faculty/suspected-dishonesty.php>

Let's try to make this a successful honest class.

**Electronic Communication:** UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

**Campus Carry:** Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

**Student Feedback Survey:** At the end of each term, students enrolled in face-to-face and online classes categorized as "lecture," "seminar," or "laboratory" are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback via the SFS database is aggregated with that of other students enrolled in the course. Students' anonymity will be protected to the extent that the law allows. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

**Final Review Week:** for semester-long courses, a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

**Emergency Exit Procedures:** Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit, which is stairway just outside the classroom. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Students should also subscribe to the MavAlert system that will send information in case of an emergency to their cell phones or email accounts. Anyone can subscribe at <https://mavalert.uta.edu/> or <https://mavalert.uta.edu/register.php>

**Student Support Services:** UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include [tutoring](#), [major-based learning centers](#), developmental education, [advising and mentoring](#), personal counseling, and [federally funded programs](#). For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to [resources@uta.edu](mailto:resources@uta.edu), or view the information at <http://www.uta.edu/universitycollege/resources/index.php>.

**University Tutorial & Supplemental Instruction (Ransom Hall 205):** UTSI offers a variety of academic support services for undergraduate students, including: 60 minute one-on-one [tutoring sessions](#), [Start Strong Freshman tutoring program](#), and [Supplemental Instruction](#). Office hours are Monday-Friday 8:00am-5:00pm. For more information visit [www.uta.edu/utsi](http://www.uta.edu/utsi) or call 817-272-2617.

**The IDEAS Center (2<sup>nd</sup> Floor of Central Library)** offers **FREE** tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. Students can drop in, or check the schedule of available peer tutors at [www.uta.edu/IDEAS](http://www.uta.edu/IDEAS), or call (817) 272-6593.

**The English Writing Center (411LIBR):** [Optional.] The Writing Center offers **FREE** tutoring in 15-, 30-, 45-, and 60-minute face-to-face and online sessions to all UTA students on any phase of their UTA coursework. Register and make appointments online at <https://uta.mywconline.com>. Classroom visits, workshops, and specialized services for graduate students and faculty are also available. Please see [www.uta.edu/owl](http://www.uta.edu/owl) for detailed information on all our programs and services.

The Library's 2<sup>nd</sup> floor Academic Plaza offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the library's hours of operation. <http://library.uta.edu/academic-plaza>

**Librarian to Contact:**

Martin Wallace  
[martin.wallace@uta.edu](mailto:martin.wallace@uta.edu)  
817-272-3924  
<http://library.uta.edu/staff/martin-wallace>

**Website:** Blackboard (<http://elearn.uta.edu>)

**Blackboard Help:** Richard Zercher ([zercher@uta.edu](mailto:zercher@uta.edu))

**Echo 360 Help:** For problems viewing ClassRev (Echo360) recordings contact [classroomsupport@uta.edu](mailto:classroomsupport@uta.edu).

**Distance Student Test Policies:** Exams must be taken with 24 hours of the regularly scheduled exam. Students who live within 50 miles of campus must come to campus to take all exams. Students should make every effort to take exams on-campus during the regularly scheduled time. If this is not possible, alternate exam times may be scheduled. Students living more than 50 miles from campus may take the exam with an approved proctor. Students will be responsible for identifying a proctor. Proctors must be approved by the faculty at least two weeks before the first exam. Distance testing must follow all the College of Engineering guidelines, located at <http://www.uta.edu/engineering/future-students/engineering-online/proctor-information.php>.

**Distance Student Contact and Assignment Policies:** Distance students are required to communicate with the faculty before the second class period. Distance students are expected to complete all of the regular requirements for a class. **This includes submission of homework by the same due date and**



**time as those of the in-class students via Blackboard.** Distance students are encouraged to attend classes when possible. **To receive attendance credit, distance students who attend the lecture classes should sign the attendance sheet, and distance students who watch the video need to watch at least 95% of it on their own student ID login.**

### Course Schedule

Date	10:00-10:50	Topic
		syllabus review integer programming
1/17/17	Lecture 1	formulation
1/19/17	Lecture 2	integer programming formulation
1/22/17	Lecture 3	integer programming formulation
1/24/17	Lecture 4	integer programming formulation
1/26/17	Lecture 5	integer programming formulation
1/29/17	Lecture 6	integer programming formulation
1/31/17	Lecture 7	integer programming formulation
2/2/17	Lecture 8	integer programming formulation
2/5/17	Lecture 9	integer programming formulation
2/7/17	Lecture 10	integer programming formulation
2/9/17	Lecture 11	integer programming formulation
2/12/17	Lecture 12	integer programming formulation
2/14/17	Review	
2/16/17	Midterm 1	
2/19/17	Lecture 13	branch & bound
2/21/17	Lecture 14	branch & bound
2/23/17	Lecture 15	branch & bound
2/26/17	Lecture 16	branch & bound
2/28/17	Lecture 17	branch & bound
3/2/17	Lecture 18	branch & bound
3/5/17	Lecture 19	branch & bound
3/7/17	Lecture 20	branch & bound
3/9/17	Lecture 21	branch & bound
3/12/17	Spring Break	
3/14/17	Spring Break	
3/16/17	Spring Break	
3/19/17	Lecture 22	cutting plane algorithms
3/21/17	Lecture 23	cutting plane algorithms
3/23/17	Lecture 24	cutting plane algorithms
3/26/17	Review	
3/28/17	Midterm 2	
3/30/17	Lecture 3	Benders' decomposition
4/2/17	Lecture 4	Benders' decomposition
4/4/17	Lecture 5	Benders' decomposition
4/6/17	Lecture 6	Benders' decomposition
4/9/17	Lecture 7	Benders' decomposition
4/11/17	Lecture 8	Benders' decomposition
4/13/17	Lecture 9	Benders' decomposition

4/16/17	Lecture 10	Benders' decomposition
4/18/17	Lecture 11	Benders' decomposition
4/20/17	Lecture 12	Benders' decomposition
4/23/17	Lecture 13	polyhedral theory
4/25/17	Lecture 14	polyhedral theory
4/27/17	Lecture 15	polyhedral theory
4/30/17	Lecture 16	polyhedral theory
5/2/17	Lecture 17	polyhedral theory
5/4/17	Lecture 18	polyhedral theory
5/7/2017 @	Project	
8:00 AM	Presentations	

*The instructor for this course reserves the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course.*

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<p><b>Emergency Phone Numbers:</b> In case of an on-campus emergency, call the UT Arlington Police Department at <b>817-272-3003</b> (non-campus phone), <b>2-3003</b> (campus phone). You may also dial 911. Non-emergency number 817-272-3381</p>
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