

# Engineering Algorithms and Visualization

## MTRE 2610 – Fall 2016

### Instructor

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**Office Hours:** 9-10 am TWHF

### Course Description

#### Catalog Description

This course covers the development of algorithms to solve mechatronics related problems, using the tools C++, MATLAB, and Simulink. Object-oriented programming will be covered including classes, inheritance, and operator overloading. Basic numerical methods topics include matrix operations, solving linear systems, and curve fitting. Visualizing data in two and three dimensions with parametric curve plots, histograms, surface plots, and contour plots will be introduced. The laboratory component will focus on assignments relevant to mechatronics including robotics, controls, sensors, pneumatics, etc.

#### Course Details

Term: Fall 2016

Course name: Engineering Algorithms and Visualization

Course number: MTRE 2610

Section numbers: 1 and 2

Meeting times: Lecture Mon/Wed 10:00 am – 10:50 am, Lab Mon/Wed 2:00 – 4:50 pm

Room number: Lecture Q 105, Lab Q 245

#### Learning Outcomes

By the end of this course, students should:

- Increase proficiency with programming skills
- Understand functional and data encapsulation using object oriented programming
- Apply numerical methods to solve engineering-related problems
- Visualize and manipulate data in two and three dimensions
- Program actuation control using sensor readings



## Textbook

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Every student must purchase their own safety glasses which must be work in laboratory at all times. They should be available for purchase at the book store.

Strongly recommended online resource: *Programming in MATLAB*, [zyBooks.com](http://zybooks.com), details will be provided before MATLAB portion of the course begins, cost  $\approx$  \$57

Recommended textbooks: [How to Think Like a Computer Scientist, C++ version](http://greenteapress.com/thinkc++/)<sup>1</sup> by Allen B. Downey, [C++ Annotations](http://cppannotations.sourceforge.net/annotations/html/)<sup>2</sup> by Frank B. Brokken, and [An Introduction to MATLAB](http://bookboon.com/en/an-introduction-to-matlab-ebook)<sup>3</sup> by Krister Ahlersten all available for free online.

## Technical Requirements

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Even more important than the textbooks are the required software MATLAB, [available free of charge for KSU students](http://www.mathworks.com/education/k12/free-of-charge-for-ksu-students)<sup>4</sup>, and the free [Visual Studio Community](http://visualstudio.com)<sup>5</sup>.

## Grading Policy

Homework	20%
Test 01	15%
Test 02	15%
Test 03	15%
Laboratories	20%
Final exam	15%
<b>Total</b>	<b>100%</b>

**Grade Conversion:** A: (90-100), B: (80-89), C: (70-79), D: (60-69), F: (0-59)

## Homework

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Several programming assignments will be collected which can be completed individually or in groups of two. Source code will be submitted in a D2L Dropbox with filenames beginning with “HW” followed by 2 digits for the homework number, followed by the last name(s) of the student(s). Homework written in MATLAB will be submitted as a single .m file with the filename as described. C++ homework is submitted instead as a .zip file with the required file name. The .zip file will contain a folder for each problem containing the Visual Studio project. Each folder will contain all the required files and subfolders so that the project can be opened and the code executed. Only a single submission for groups of two is required. When executed, the program will output to the screen the problem numbers and answers. Problems with graphical output will display which figure number contains the solution.

- Submission requirements satisfied (1 point)
- Significant progress made toward solution (1 point)
- Correct output generated (1 point)
- All elements of problem description properly addressed (1 point)

<sup>1</sup> <http://greenteapress.com/thinkc++/>

<sup>2</sup> <http://cppannotations.sourceforge.net/annotations/html/>

<sup>3</sup> <http://bookboon.com/en/an-introduction-to-matlab-ebook>

<sup>4</sup> [https://apps.kennesaw.edu/files/pr\\_app\\_uni\\_cd/doc/Matlab\\_DownloadInstructions.pdf](https://apps.kennesaw.edu/files/pr_app_uni_cd/doc/Matlab_DownloadInstructions.pdf)

<sup>5</sup> <https://www.visualstudio.com/downloads/download-visual-studio-vs>

## Tests

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Three in-class tests will be administered where students have access to internet-connected computers to compile and execute programs. Test grades may be curved in an attempt to maintain the class average in the C range. No assistance from any human may be solicited during the test period. Source code solving each problem will be uploaded to a D2L Dropbox before the end of the test in the same manner as homework but with “HW” replaced with “Test”. Problems will be graded according to the following rubric:

0	No content relevant to solving the problem
30 (F)	Some relevant content but no indication of how to solve the problem
60 (D)	Some indication that the correct solution method is being followed
70 (C)	Significant work showing understanding of how to approach the problem
80 (B)	Most details of problem solution complete but significant mistakes made
90 (A)	Correct solution except for minor mistakes such as sign or algebra errors
100	Problem is answered completely with the correct answer

## Laboratory Exercises

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Laboratory exercises will generally be graded during the scheduled laboratory time and groups not completing in time will be assessed on what is finished. Grades will be assigned according to the fraction of the lab content correctly addressed.

## Final Exam

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A cumulative final exam will follow the same format as the tests with “Final” in the submitted filename.

# Course Expectations

## Attendance Policy

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Forcing everyone to come to every class is not practical. Each student bears responsibility for material covered in class. If students choose to miss class, that is their decision. Class time will be spent explaining the day’s content and working problems, under the assumption that all students have read and attempted to understand the reading assignment. In general, late assignments are not accepted nor can make-up tests be administered. Extenuating circumstances can result in exceptions to these rules, but agreement must be reached with the instructor in advance of the assignment or test that will be missed.

## Course Communication

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Course material will be disseminated in D2L including lecture notes, homework solutions, etc. All official course announcements, including instructions when class may be cancelled, will be posted in the D2L course news. Be sure to check D2L regularly.

## Course Outline

Day	Date	Description	Reading	HW due	Lab exercise
Mon	Aug 15	0 <sup>6</sup> : Pointers and dynamic arrays			C++ review
Wed	Aug 17	1: Structure data and functions	8, 11 <sup>7</sup> , 3.2 <sup>8</sup>		
Mon	Aug 22	2: Classes	14 <sup>7</sup> , 7,9 <sup>8</sup>		Arduino basics
Wed	Aug 24	3: Function/operator overloading		HW01	
Mon	Aug 29	4: Recitation			H-bridge motor drivers
Wed	Aug 31	5: File I/O	11 <sup>8</sup>	HW02	
Wed	Sep 07	6: Inheritance	13 <sup>8</sup>		No laboratory
Mon	Sep 12	7: Constructors/destructors			No laboratory
Wed	Sep 14	8: Recitation			
Mon	Sep 19	Review		HW03	Controlling motor motion
Wed	Sep 21	Test 03			
Mon	Sep 26	9: MATLAB environment	1, 2, 3, 8, 10, 13 <sup>9</sup>		Pneumatics and active light sensors
Wed	Sep 28	10: Vector and matrix indexing	4 <sup>9</sup>		
Mon	Oct 03	11: 2D plotting and searching	7 <sup>9</sup>		Color sorting robot
Wed	Oct 05	12: User defined functions	9 <sup>9</sup>		
Mon	Oct 10	13: Surface and contour plotting		HW04	Complex class
Wed	Oct 12	Debugging	12 <sup>9</sup>		
Mon	Oct 17	14: Structures and cell arrays			Mandelbrot
Wed	Oct 19	15: File I/O	6 <sup>9</sup>		
Mon	Oct 24	16: Recitation			Mandelbrot continued
Wed	Oct 26	17: Review		HW05	
Mon	Oct 31	Test 01			Image processing
Wed	Nov 02	18: Curve fitting	5.5, 11.4 <sup>9</sup>		
Mon	Nov 07	19: Root finding and equation solving	11.1-11.2 <sup>9</sup>		Machine vision
Wed	Nov 09	20: Linear algebra and symbolic math	5.1-5.4 <sup>9</sup>		
Mon	Nov 16	21-22: Differentiation/integration	11.3 <sup>9</sup>	HW06	Distance sensor
Wed	Nov 16	23-24: Recitation			
Mon	Nov 28	25: Review		HW07	PI control
Wed	Nov 30	Test 02			
Mon	Dec 05	Review			No laboratory

<sup>6</sup> These numbers indicated which [recorded lectures](#) should be reviewed before coming to class.

<sup>7</sup> *How to Think Like a Computer Scientist*

<sup>8</sup> *C++ Annotations Version 10.2.0*

<sup>9</sup> *An Introduction to MATLAB*

## Help Resources

### Contacts to get Help

Student Help Desk [studenthelpdesk@kennesaw.edu](mailto:studenthelpdesk@kennesaw.edu) or call 470.578.3555

[KSU Service Desk](#)<sup>10</sup>

[D2L Student User's Guide](#)<sup>11</sup>

### Additional Resources

[Remote access to Library Resources](#)<sup>12</sup>

[Student success Services](#)<sup>13</sup>

[Tutoring and Academic Support](#)<sup>14</sup>

[Academic Advising](#)<sup>15</sup>

[University bookstore](#)<sup>16</sup>

## University Policies

### Academic Honesty

Every KSU student is responsible for upholding the provisions of the Student Code of Conduct, as published in the Undergraduate and Graduate Catalogs. Section II of the Student Code of Conduct addresses the University's policy on academic honesty, including provisions regarding plagiarism and cheating, unauthorized access to University materials, misrepresentation/ falsification of University records or academic work, malicious removal, retention, or destruction of library materials, malicious/intentional misuse of computer facilities and/or services, and misuse of student identification cards. Incidents of alleged academic misconduct will be handled through the established procedures of the University Judiciary Program, which includes either an "informal" resolution by a faculty member, resulting in a grade adjustment, or a formal hearing procedure, which may subject a student to the Code of Conduct's minimum one semester suspension requirement.

### Plagiarism Policy

No student shall receive, attempt to receive, knowingly give or attempt to give unauthorized assistance in the preparation of any work required to be submitted for credit as part of a course (including examinations, laboratory reports, essays, themes, term papers, etc.). When direct quotations are used, they should be indicated, and when the ideas, theories, data, figures, graphs, programs, electronic based information or

<sup>10</sup> [https://apps.kennesaw.edu/portal/prod/app\\_its\\_ask\\_stu\\_publ/student/](https://apps.kennesaw.edu/portal/prod/app_its_ask_stu_publ/student/)

<sup>11</sup> [https://apps.kennesaw.edu/files/pr\\_app\\_uni\\_cdoc/doc/D2LBrightspaceStudentguide\\_10.3.pdf](https://apps.kennesaw.edu/files/pr_app_uni_cdoc/doc/D2LBrightspaceStudentguide_10.3.pdf)

<sup>12</sup> <http://library.kennesaw.edu/>

<sup>13</sup> <http://www.kennesaw.edu/studentsuccessservices/>

<sup>14</sup> <http://learnonline.kennesaw.edu/student-resources/tutoring.php>

<sup>15</sup> <http://advising.kennesaw.edu/>

<sup>16</sup> <http://bookstore.kennesaw.edu/home.aspx>

illustrations of someone other than the student are incorporated into a paper or used in a project, they should be duly acknowledged.

Collaboration on assignments among students and other individuals is wholeheartedly encouraged. In order to avoid possible plagiarism issues, limit such collaboration to discussion of how to approach the problem and what strategies, equations, and techniques should be used to solve it. When actually writing down your solution, ensure you are not in the same room as outside collaborators nor referencing a copy of their work. Your solution will then be written in your own words and therefore not plagiarized.

## Disability Statement

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Kennesaw State University provides program accessibility and reasonable accommodations for persons defined as disabled under Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. Kennesaw State University does not deny admission or subject to discrimination in admission any qualified disabled student.

A number of services are available to help students with disabilities with their academic work. In order to make arrangements for special services, students must visit the Office for Student Disability Services and make an appointment to arrange an individual assistance plan. In most cases, certification of disability is required.

Special services are based on

- medical and/or psychological certification of disability,
- eligibility for services by outside agencies, and
- ability to complete tasks required in courses.

## ADA Position Statement

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Kennesaw State University, a member of the University System of Georgia, does not discriminate on the basis of race, color, religion, age, sex, national origin or disability in employment or provision of services. Kennesaw State University does not discriminate on the basis of disability in the admission or access to, or treatment or employment in, its programs or activities.

The Americans with Disabilities Act (ADA), Public Law 101-336, gives civil rights protections to individuals with disabilities. This statute guarantees equal opportunity for this protected group in the areas of public accommodations, employment, transportation, state and local government services and telecommunications.

The following individuals have been designated by the President of the University to provide assistance and ensure compliance with the ADA. Should you require assistance or have further questions about the ADA, please contact:

- ADA Compliance Officer for Students: 470-578-6443

- ADA Compliance Officer for Facilities: 470-578-6224
- ADA Compliance Officer for Employees: 470-578-6030

For more information, go to: [http://www.kennesaw.edu/stu\\_dev/dsss](http://www.kennesaw.edu/stu_dev/dsss).