

# The University of Western Ontario

## CS2035 — Data Analysis and Visualization

London, Ontario, Canada  
Department of Computer Science  
Course Description - Winter 2019

### Instructor

- Name: Prof. John Barron
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- E-Mail: [barron@csd.uwo.ca](mailto:barron@csd.uwo.ca) (the preferred means of communication)
- Web: [www.csd.uwo.ca/faculty/barron/](http://www.csd.uwo.ca/faculty/barron/)
- **Office hours:** Thursday 10am-noon in my office MC379 (note that all assignments are due at 11:55pm on Sundays and this office hour should be a good time to straighten out any last minute problems on your assignments in a timely fashion). I am off-campus on Fridays.

### Calendar copy:

It is becoming increasingly common in a number of disciplines to be faced with an overwhelming quantity of data that must be processed, interpreted, and understood in order for it to be of value and truly useful. As a result, skills and background in **data analysis** and **data visualization** are quickly becoming essential to these disciplines. The purpose of this course is to develop and refine these skills and background, using MATLAB as a software platform for understanding and applying the fundamental techniques in statistics, mathematics, and computing necessary for gaining mastery over your data.

### Is this a MatLab Course?

YES, this is a MatLab course!!! However, this course assumes no prior programming knowledge, although some knowledge of programming in general would be very helpful. MatLab lets you start programming right away, with just some rudimentary knowledge.

## Obtaining a copy of The MatLab software

As a Western student, you are entitled to install a free copy of the MatLab software on your home computer or laptop. See the course webpage for details on how install MatLab on your personal computing device.

## Prerequisites

1.0 courses in Applied Mathematics, Calculus, Mathematics, Statistics (including Introductory Statistics), or the former Linear Algebra, or permission of the Department/Instructor. Beware of the following Dean's rule:

“Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.”

## Course Resources:

1. Recommended text: Mastering MATLAB, Duane Hanselmann and Bruce Littlefield, Pearson (Prentice Hall), 2012. However, any MATLAB textbook would mostly like be sufficient.
2. Another good text: MatLab Programming for Engineers (5<sup>th</sup> edition), Stephen J. Chapman, Cenage Learning, 2016 [has GUI, Object Oriented, I/O Chapters, updated for MatLab R2014b].
3. The course notes and some MATLAB functions and data will be on the course webpage. The course webpage is at [www.csd.uwo.ca/Courses/CS2035b](http://www.csd.uwo.ca/Courses/CS2035b). Just search for “CS2035b uwo” in your browser and you will be served this webpage.
4. All MATLAB toolboxes are fully documented on [www.mathworks.com/help/documentation-center.html](http://www.mathworks.com/help/documentation-center.html).
5. Mathworks offers a number of Webinars on various topics on [www.mathworks.com](http://www.mathworks.com).
6. Mathworks also offers online documentation, discussion forums, and numerous other resources.
7. Google can find just about anything to do with MATLAB!!!

## Class and Lab Time Schedule:

There are two 1  $\frac{1}{2}$  hour (75 minutes) classes each week:

- Tuesday, 12:30-2:30pm and Thursday, 3:30-5:30pm in Health Sciences Building HSB236. The classes will start at the indicated times and stop 75 minutes later.

There are two labs on Monday

- Monday 2:30-3:30pm - Health Sciences Building HSB14
- Monday 3:30-4:30pm - Health Sciences Building HSB16
- The timetable for the University of Western Ontario winter term lectures and labs for all undergraduate courses are posted at:

<https://studentservices.uwo.ca/secure/Timetables/mastertt/ttindex.cfm>

(Search for “timetable winter 2019 uwo” via your browser.)

## Important Dates

The following are important days that may affect students taking CS2035b:

1. First day of classes - Tuesday, January 8th
2. Family day - Monday, February 18th, (holiday)
3. Reading week (also known as slack/skiing week) - Tuesday to Friday, February 19th-22nd (There are no classes this week, and yes, it includes family day as the 1st day)
4. Midterm exam: Tuesday, February 26th in class
5. Good Friday, April 19th
6. Easter Sunday, April 21st
7. Last day of classes, Tuesday, April 9th
8. Study day (before exams) - Wednesday, April 10th
9. Exam Period - April 11th-30th (20 days) [Typically the final exam date will be released early in the term. Students are required to attend the exam. Purchasing a cheap ticket to go home and then finding out the exam is after your travel ternary is not sufficient grounds for as appeal.]

## Lab, Assignment and Exam Dates

1. Each lab must be submitted by Friday, 11:55pm, via Owl in the week of that lab, In addition, you **MUST** attend the lab and sign the attendance sheet. Failure to do both will result in a grade of 0 for that lab. Ideally, you should be able to complete the lab during the lab time and submit it via Owl at the end of the lab.
2. Lab dates: Lab 1: Jan. 14th, Lab 2: Jan. 21st, Lab 3: Jan. 28th, Lab 4: Feb. 4th, Lab 5: Feb. 11st, (Reading week, Feb. 18th-22nd), Lab 6: Feb. 25th, Lab 7: Mar. 4th, Lab 8: Mar. 11st, Lab 9: Mar. 18th, Lab 10: Mar. 25th, Lab 11: April 1st (last lab).
3. You are required to complete 8 labs. Each lab is worth 1.25 marks (for a maximum of 10 marks). Lab attendance is mandatory and attendance is taken (via signing an attendance sheet). Photo identification is required. There are 11 labs but you only have to attend 8 to obtain full marks. There are no bonus marks for completing more than 8 labs but note that there may be a final exam question based on the labs. Lastly note that full lab marks will be recorded as 1 on Owl as Owl cannot record 1.25 as a valid mark.
4. The purpose of the labs is to introduce or expand on the core material of this course, and to provide programming exercises with concepts. Unfortunately, the labs do not always align with the course lectures. Lab instructions are posted on the course website, and include material that must be read before the lab. Attendance at labs is a required part of the course. Missing labs is a stupid way to lose easy marks!!!
5. You must attend the lab session for which you are registered. There are no make-up labs and students who are absent from a lab do **NOT** have the option of just submitting the lab online via OWL. Attendance is required.
6. Assignment 1 is worth 9% and is due Sunday, January 27th at 11:55pm (via Owl).
7. Assignment 2 is worth 9% and is due Sunday, February 17th at 11:55pm (via Owl).
8. Assignment 3 is worth 9% and is due Sunday, March 17th at 11:55pm (via Owl).
9. Assignment 4 is worth 8% and is due Sunday, April 7th at 11:55pm (via Owl).
10. The midterm exam is Tuesday, February 26th in class (a 75 minute exam, open book but NO laptops or cellphones allowed) and worth 20%. There is no makeup midterm exam, rather if you miss the midterm (for any reason), your final exam will count for all the exam grade.
11. The final exam, TBA is a 3 hour, open book, with no laptops or cellphones allowed) and is worth 35% (or 55% if you do better on the final exam than on the midterm). For example is you get 60% on the midterm and 80% on the final you get  $0.55 \cdot 80$  as your total exam grade, If, on the other hand, you get 80% on the midterm and 60% on the final, your total exam grade is computed as  $0.2 \cdot 80 + 0.35 \cdot 60$ . If you get 0% on the midterm (you didn't

write the exam, the final exam counts for the entire 55% of the exam grade. It is definitely worth your while to write the midterm. Think of it as “marks in the bank”. It is risky to rely on the final exam as all your exam grade. Typically, students do not do as well on the final as on the midterm.

## **Email Contact:**

I occasionally need to send email messages to the class or to students individually. Email is sent to your Western email address as assigned to you by ITS (Information Technology Services). This is your university email address. It is your responsibility to read this email frequently and regularly (I recommend daily). You may wish to have this email forwarded to an alternative email address. See the ITS website for directions on forwarding email. Verify that any forwarding works! Nevertheless, emails sent out to your uwo email address will assume to have been received even if the forwarding does not work! Important emails about the class, assignments, etc will be sent to these email addresses. You should note that email at ITS and other email providers may have quotas or limits on the amount of space they dedicate to each account. Unchecked mail may accumulate beyond these limits and you may be unable to retrieve important messages from your instructors. It is your responsibility to monitor your email and is not an acceptable excuse for anything to not having received an email!!! You are encouraged to contact either the TA (first contact) or course instructor via email, with concise and appropriate questions you may have regarding course and lecture materials or clarification of assignments. Note that email sent from accounts different from ITS may not reach its destination (it might be waylaid by a spam filter, for example): hence you are instructed to send your questions with your Western account to be on the safe side.

## **Academic Policies Relevant to Email**

In accordance with policy, <http://www.uwo.ca/its/identity/activatenonstudent.html>, the centrally administered e-mail account provided to students will be considered the individuals official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner. The website for Registrarial Services is <http://www.registrar.uwo.ca>.

## **Course Website:**

Point your favourite browser at [www.csd.uwo.ca/courses/CS2035b](http://www.csd.uwo.ca/courses/CS2035b) for the course webpage. Assignment and lab pdf files will be available there. Also course lectures and MatLab programs referred to in the lectures will be available from there. On the other hand, all assignments and labs will be submitted via OWL and all marks will be posted on OWL.

## Lecture Notes:

Lecture notes are be available on the course website, [www.csd.uwo.ca/courses/CS2035b/](http://www.csd.uwo.ca/courses/CS2035b/). Pdfs of the lectures and MatLab code relevant to these lectures are password protected and the password will be given out in class. The username is “class”.

## Teaching Assistants:

Mozhgan Salimiparsa (nsalimip@uwo.ca), Office Hours TBA Seereen Noorwali (snoorwal@uwo.ca), Office Hours TBA

## Computing Facilities:

The labs are in HSB14 or HSB16, general ITS university computing labs. The latest version of MatLab is available there on all the machines. Many students will have their own MatLab software on their laptops: these are acceptable as long as they are version 2009 or better. Students are entitled to the latest version of MatLab for their laptops or home computers (see the course webpage for details). There are many labs being held in HSB14 or HSB16, so these labs are not generally available at all times.

## Other Labs:

- There are other labs available to you that are open on the weekend.
- These include NCB105 and SS1032 as well as the Genlab located in Taylor Library.
- Hours for the these labs can be found at:

<https://www.uwo.ca/its/genlabs/hours.html>

The locations of all Western labs can be found at:

<https://www.uwo.ca/its/genlabs/genlabs-western.pdf>

- All computers in the university computing labs will have MatLab available on them (probably MatLab R2018b or better).

## Course Outline:

This course is broken down into down into 3 modules.

# **Module 1: Introduction to MATLAB and the MATLAB toolboxes**

1. The components of MATLAB (command window, editor, figures, toolboxes)
2. Simple MATLAB programming
3. Data types (single, double, integer, character arrays, records, cells)
4. Variables and arrays
5. Control flow (loops, while, if-then-else, switch (case) statements)
6. Simple I/O (reading/writing binary, ASCII and mat files)
7. Some built-in mathematical MATLAB functions
8. Scripts and functions (\*.m files)
9. Arrays and simple array operations
10. Multidimensional arrays
11. Simple 2D/3D plots and the print statement
12. Matrix algebra
13. Serialization versus Vectorization, JIT compilation
14. Serialized versus Vectorized I/O
15. Graphical User Interfaces (GUIs) using GUIDE
16. MATLAB Programming Interfaces (such as C, Fortran and Java)
17. Object Oriented MatLab

# **Module 2: Basic Data Visualization**

1. Setting the camera and the lighting model
2. Mesh and surface plots
3. Colormaps and texture
4. Representation arbitrary shaped 3D objects using patches
5. Using transparency to display data

6. Volume Visualization: scalar values, slice planes, isosurfaces, vector data
7. Stream lines/ribbons and tubes
8. Images, movies and sound

## Module 3: Basic Data Analysis

1. Some basic operations: mean, standard deviation, weighted average, median, covariance matrices, other moments
2. Random number generation
3. Histograms
4. Data correlation (Pearson's coefficient)
5. Regression analysis (including linear, nonlinear and robust regression)
6. Scatter/Box/Distribution plotting

**Note:** This list of topics may be too ambitious to teach in a 0.5 credit 1 term course. In this case, an appropriate subset of this material will be taught.

## Other Grading Considerations

- If for any reason the assignment schedule cannot be adhered to, the assignment marks will be pro-rated. The assignments are worth 35% of the overall mark for the course. If an assignment has to be cancelled for any reason, the remaining assignment weights will be prorated to add up to 35%.
- If you obtain a higher grade on the final than on the midterm the final grade make will count for the complete exam grade.
- If you miss the midterm exam for any reason, the final exam make will comprise the entire exam mark. There will be no midterm makeup exam.
- You need to obtain at least 45% on the assignment grade and and 45% on the exam grade to pass the course. Failure to satisfy this condition means you final grade can be at most 45%.
- You need to obtain 50% on the assignment and exam grades to receive a grade of 65% or more in the course. Failure to satisfy this condition means you final grade can be at most 60%.
- Neither cellphones or laptop computed can be brought to exams. We cannot be responsible for the storage of these devices at the front of the class. Proccession of either of these devices will be considered to constitute cheating!!!



## Appeal of Assignment Marks

1. Appeals of assignment marks should be addressed to your T.A. first. If you and the T.A. cannot agree, then the T.A. and the student will discuss the situation with the instructor. That decision will be final.
2. Appeals must occur within 1 week from the first day that the marked assignments or midterm exam were made available to students. After that 1 week period has gone by, no further appeals will be considered and the marks are considered final. Note that this rule applies even if assignments are not picked up when passed back. The week (8 day) count down starts from the date the assignment is passed back.

## Late Assignment Policy:

Assignment due dates are always at 11:55pm (via Owl). It is not necessary to skip a class to put the final touches on an assignment. Hardcopies of your assignments are not necessary and the Owl date of submission will be the “official” date of submission. Assignments mailed to the instructor or TA will not be accepted. Assignments passed in 1 day late will have 10% deducted while assignments passed in 2 days late will have 20% deducted. No assignments will be accepted after 2 days. Saturday and Sunday count as 1 day in determining the lateness of an assignment but since all assignments are due on a Sunday this rule will not apply unless an assignment date is changed. Extensions can only be granted by the course instructor. If you have serious medical or compassionate grounds for an extension, you should take supporting documentation to the Academic Counseling office of your faculty, who will contact the instructor if an accommodation is recommended. Workload, exams, minor illnesses, and home computer problems are not valid reasons for being unable to complete an assignment within the allotted time (unless your academic councillor thinks otherwise).

## Academic Accommodation for Medical Illness:

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to your Academic Counseling office as soon as possible and contact your instructor immediately. It is the student’s responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. For further information please see:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_illness.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf)

A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or an Accommodation Certificate from Student Health Services. This form can be found at:

[https://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/medicalform.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf)

## Ethical Conduct:

Scholastic offenses are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offense, at the following Web site:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)

**Plagiarism:** Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offense. All assignments are individual assignments. You may discuss approaches to problems among yourselves; however, the actual details of the work (assignment coding, answers to concept questions, etc.) must be an individual effort. Assignments that are judged to be the result of academic dishonesty will, for the student's first offense, be given a mark of zero with an additional penalty equal to the weight of the assignment also being applied. You are responsible for reading and respecting the Department of Computer Science policy on Scholastic Offenses and Rules of Ethical Conduct. The University of Western Ontario may use software for plagiarism checking. Students may be required to submit their written work and programs in electronic form for plagiarism checking.

## Statement on Academic Offenses

Scholastic offenses are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offense, at the following web site:

[www.uwo.ca/univsec/handbook/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf).

Additionally,

1. All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com ( <http://www.turnitin.com>).
2. Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

## **Tutoring:**

The role of tutoring is to help students understand course material. Tutors should not write part or all of an assignment. Having employed the same tutor as another student is not a legitimate defense against an accusation of collusion, should two or more students hand in assignments considered similar beyond the possibility of coincidence.

## **Mental Health:**

Students who are in emotional/mental distress should refer to Mental Health website:

<http://www.uwo.ca/uwocom/mentalhealth/>

for a complete list of options about how to obtain help.

The policy on Accommodation for Students with Disabilities can be found here:

[http://www.uwo.ca/univsec/pdf/academic\\_policies/appeals/accommodation\\_disabilities.pdf](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf)

Additional student-run support services are offered by the USC, see

<http://westernusc.ca/services>.

## **Accessibility:**

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.