SYLLABUS OF INSTRUCTION



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OPER 782

Data Science Practice

Three Graduate Quarter Hours Credit

Maj. Jason K. Freels, PhD

Assistant Professor

Winter Quarter 2020

6 January – 12 March

Graduate School of Engineering and Management

Air Force Institute of Technology

Air Education and Training Command

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OPER 782 – Data Science Practice

Winter Quarter 2020

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**Course Overview**

Data Science is the study of the generalizable extraction of knowledge from data. Being a data scientist requires an integrated skill set spanning operations research, statistics, and computer science along with a good understanding of crafting a problem formulation for effective solutions. In this course, students will use these skills to explore various methods of integrating data and algorithms into an operationalized analytic data product (aka ‘analytic’). Using these methods, students will develop and deploy their own analytic in the form of an R package with an embedded interactive Shiny application/gadget.

**Course Objectives**

The primary objective of this course is to ensure that students can implement & integrate various tools for developing analytic data products that allow end-users to make better decisions. More generally, at the completion of the course, each student should be able to:

1. Understand the importance of deploying analytic data products
2. Describe various approaches to deploying analytic data products
3. Operationalize analyses by developing a Shiny application or Shiny gadget
4. Operationalize analyses by developing R packages
5. Prioritize efforts to develop analytic data products under time contraints
6. Relate the knowledge and skills learned in this course to decision making processes within the Air Force and/or DoD.

**Textbook**

No textbook is required for this course, but occasional readings will be assigned

**Required Materials**

Students registered for this course are expected to have their own project to serve as the basis for developing an analytic data product. This requirement is in place because it can be very difficult for students to understand the methods presented in this course without a concrete problem to which these methods can be applied.

Students may request to work together on a project with another student in the class. These requests must be submitted in writing (via email) to the instructor and must include (a) the names of each person wishing to work together (b) a description of the project and (c) an explanation detailing why a group effort is needed.

Students who do not have a project, may request to be assigned a project from the instructor. Requests for topics must be submitted in writing (via email) to the instructor and must include (a) the name of the person making the request and (b) a description of the requestor’s thesis topic.

**Course Format**

This course includes lectures, presentations, and demonstrations that emphasize discussion and illustration of methods, as well as hands-on, practical exercises that provide both a sound base of learning and an opportunity to test and develop skills. The use of R & RStudio open source software supports the presentation of the material. Students complete assignments and participate in exercises and discussions. At the conclusion of the course, each student will have developed an R software package with an embedded Shiny app/gadget. Students should expect to dedicate approximately 2 hours of time outside of the classroom performing coursework for every 1 hour in the classroom. Students will use GitHub throughout the course to review course materials and host/update their projects.

**Performance Evaluation**

Your final course grade will be determined according to the following requirements and their respective weights. Details regarding items 1 – 3 will be provided in class.

1. Analytic Proposal Review 1 **20%**

2. Analytic Proposal Review 2 **20%**

3. Analytic Deployment Review **50%**

4. Engagement **10%**

TOTAL 100%

Final grades will be distributed according to the following cutoffs:

A 94 – 100 %

A- 90 – 93 %

B+ 87 – 89 %

B 83 – 86 %

B- 80 – 82 %

C+ 77 – 79 %

C 73 – 76 %

C- 70 – 72 %

D & F Hopefully None!

**Engagement**

Engagement includes completing the required readings, participating in class discussions, providing detailed feedback in code reviews, and being involved in discussions on Slack. At the end of the term, I will ask you to assess your peers. I’ll use the feedback I receive from these assessments to help determine each student’s level of engagement. Furthermore, because I don’t like to complicate the grading process, your level of engagement will be graded as

* Fully engaged (10.0 pts)
* Engaged ( 5.0 pts)
* Not engaged ( 0.0 pts)

**Important Dates**

* 20 January Martin Luther King Day (No Class)
* 17 February President’s Day (No Class)
* 13 March Last Day of Classes
* 16 March Final Exams Begin
* 19 March Final Exams End

**Academic Integrity Policy Statement**

All students must adhere to the highest standards of academic integrity. Students are prohibited from engaging in plagiarism, cheating, misrepresentation, or any other act constituting a lack of academic integrity. Failure on the part of any individual to practice academic integrity is not condoned and will not be tolerated. Individuals who violate this policy are subject to adverse administrative action including disenrollment from school and disciplinary action. Individuals subject to the Uniform Code of Military Justice may be prosecuted under the UCMJ. Violations by government civilian employees may result in administrative disciplinary action without regard to otherwise applicable criminal or civil sanctions for violations of related laws. (References: AFIT Student Handbook, ENOI 36-107 - *Academic Integrity*)

**Attendance Policy Statement**

Attendance at all class sessions and exams is mandatory for military and civilians assigned to AFIT as full-time students except for extenuating circumstances. Part-time students are expected to attend scheduled classes, and absences should be explained to the instructor. The student should provide advance notice, if possible. Scheduled classes and exams are defined by the instructor and they are documented in the course schedule. (References: AFIT Student Handbook, AFIT Graduate School Catalog)

**Academic Grievance Policy Statement**

AFIT and the Graduate School of Engineering and Management affirm the right of each student to resolve grievances with the Institution. Students are guaranteed the right of fair hearing and appeal in all matters of judgment of academic performance. Procedures are detailed in ENOI 36-138 - *Student Academic Performance Appeals*.

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Course Schedule

(tentative – subject to change)

|  |  |  |  |
| --- | --- | --- | --- |
| Week | Dates | Topics Discussed | Notes |
| 1 |  | **Introduction to operational analytics** |  |
| 2 |  | **Collaborative Development Using Git & GitHub** |  |
| 3 |  | **R package development I**   * Building the R package structure * Understanding R package files & directories * Creating user-defined functions | **Analytic**  **Proposal**  **Review 1** |
| 4 |  | **Shiny app development I**   * Building simple single-page apps (fixedPage, basicPage, etc.) * Custom styling * Sharing apps with shinyapps.io | **Analytic**  **Proposal**  **Review 2** |
| 5 |  | **R package development II**   * Documenting functions * Package checks & continuous integration * Testing |  |
| 6 |  | **Shiny app development II**   * Building complex multi-page apps (navbarPage, shinydashboard, flexdashboard) * Reactive events and observers * Adding custom styles with CSS3 & HTML |  |
| 7 |  | **R package development III**   * Integrating Rcpp * Publishing packages * Integrating shiny apps into packages |  |
| 8 |  | **Shiny app development III**   * Integrating apps into a package / shinygadgets * Speeding up your apps * Accessing external data sources |  |
| 9 |  | Project work |  |
| 10 |  | Project work |  |
| 11 |  | Review analytic deployment projects | **Analytic Deployment**  **Review** |