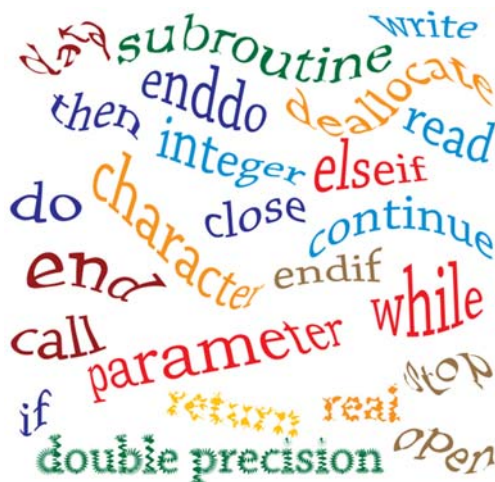# FORTRAN FOR METEOROLOGISTS
## ATMS 230
### SPRING 2022

While interest in Fortran has waned among engineers and computer scientists in favor of other programming languages, its pervasive use in meteorology makes it an essential tool for obtaining employment or performing research in the field. All major numerical weather prediction models are written in Fortran. Thus, modifying numerical weather prediction models and interpreting the results requires a basic understanding of Fortran syntax. Many researchers prefer the ease and simplicity of Fortran when working with meteorological data and most employers in the government and private sectors require Fortran programming skills. This course will introduce you to the Fortran programming language with examples and assignments tailored for meteorological applications. You will benefit the most if you ask lots of questions both in and out of class and remember that the computer only does what you tell it to do!

**PROFESSOR**

Dr. Christopher Godfrey
Office: Robinson Hall, room 236C
Phone: 828-232-5160
E-mail: cgodfrey at unca dot edu
Office hours: Via virtual meetings through Google Meet on **Mondays and Thursdays 11:00 a.m.–12:00 p.m.** or by appointment. You may call my office (it bounces to my cell phone) during regular business hours. You may send me as many email messages as you wish. Check Moodle for the Google Meet link.

**CLASS INFORMATION**

| | |
|---|---|
| Meeting times: | MW 9:30–10:45 a.m. |
| Location: | Robinson Hall, room 209 or via Zoom |
| Required text: | None. The Internet provides plenty of useful information and examples of Fortran. If you need help with your programming, consult Google or ask your professor. |
| Website: | http://www.atms.unca.edu/cgodfrey/courses/atms230/ |

**GETTING QUESTIONS ANSWERED**

I will be available on Google Meet during scheduled office hours. Just drop in. If at any other time you have a question, you are more than welcome to call me or send me an email. E-mail is by far the best way to reach me and you will usually get a speedy reply. You may also schedule an appointment with me for a virtual meeting. Since you may not consult classmates with programming problems, I fully expect to answer lots of questions, so please do not hesitate to ask. Really!

**IMPORTANT DATES**

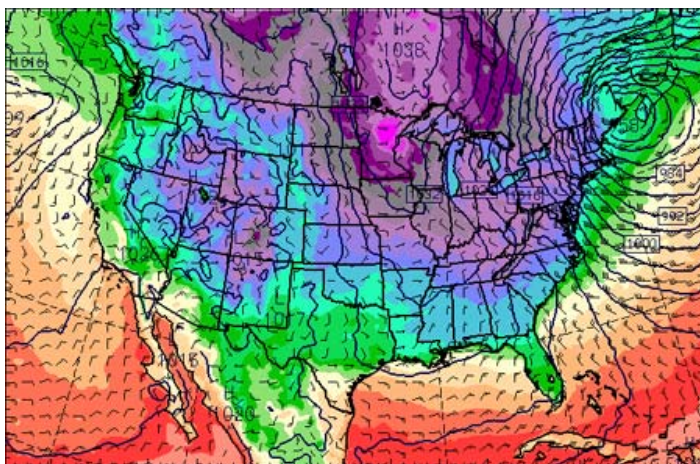| | | |
|---|---|---|
| Monday, 7 February 2022 | Quiz 1 | 9:30–10:45 a.m. |
| Wednesday, 2 March 2022 | Midterm Exam (take-home) | Due at 5:00 p.m. |
| Monday, 21 March 2022 | Quiz 2 | 9:30–10:45 a.m. |
| Wednesday, 13 April 2022 | Quiz 3 | 9:30–10:45 a.m. |
| Monday, 2 May 2022 | Quiz 4 | 8:00 a.m. – 10:30 a.m. |
| Monday, 2 May 2022 | Final Exam (take-home) | Due at 10:30 a.m. |

## COMPUTER ACCESS

You will use your account on the atmospheric sciences department's Linux machine, *Blizzard*, to write and execute your Fortran code. This will require you to gain a working knowledge of the Linux command line and a text editor called Vim. Since most users of Fortran use Linux in some capacity, this knowledge will serve you well in the future. Detailed instructions for accessing Blizzard and getting started with the Linux command line are available at http://www.atms.unca.edu/cgodfrey/courses/advcomp/preps.shtml.

## COURSE OUTLINE

We will cover the following broad topics during the course of the semester. This outline is approximate and subject to modifications. Note that many concepts relate to one another and we may revisit more complicated examples as we progress through the course.

1. Fortran history and overview of current uses
2. Hardware and software components
3. Algorithm development
4. Creating and testing a program
5. Basic concepts of Fortran
   a. Constants and variables
   b. Arithmetic expressions
6. Programming style and documentation
7. Input and output
   a. File access
   b. Reading and writing to files
   c. Formatted input and output
8. Control structures
   a. Branching structures
   b. Loops
   c. Logical data
9. Character manipulation
10. Debugging
11. Multidimensional arrays
    a. Declaration and manipulation
    b. Allocatable arrays
12. Functions
13. Subroutines
14. Binary files
15. Numerical methods



20-km ARW WRF forecast valid at 06 UTC 3 January 2010. The WRF model is written primarily in Fortran.

## PARTICIPATION IN THE VIRTUAL CLASSROOM

Given the current state of the COVID-19 pandemic, we will undoubtedly hold classes virtually for a portion of the semester. Remote classes will be held synchronously and your frequent participation is required. Please join the class from a computer or phone with a camera and microphone. We will make extensive use of our Linux server and classes will alternate between lecture material and computer exercises. I strongly recommend that you participate from a computer while connected to *Blizzard* so that you can follow along with these exercises.

## EVALUATION

There will be four short quizzes, a take-home midterm exam, and a take-home final exam to assess your progress through the semester. The best way to learn how to program is actually to write a program, so you will complete several homework assignments that will strengthen your programming skills. Since life happens, I will drop the lowest quiz grade.

**There will be no opportunities for make-up quizzes or exams.** Quizzes must be taken on the scheduled date and at the scheduled time. If you miss the quiz or exam window on Moodle, you miss the grade. The *only* exceptions to this rule are: (1) serious medical condition (illness or injury) of you or an immediate family member; (2) University excused absence; (3) jury duty; or (4) military orders. Only in such instances will a quiz be dropped or rescheduled depending on your best interests, but *only if I am notified at least 24 hours in advance*. Except under the

circumstances described above, **homework is due at 5:00 p.m.** on the date listed on the assignment. I will accept homework up to 24 hours late (5:00 p.m. the following day) for a 50% late penalty. *Homework more than 24 hours late will not be graded*. In the event of an unforeseen circumstance that causes you to miss a quiz, exam, or homework due date, *you must notify me by phone or e-mail within 24 hours of the event*. Appropriate documentation must accompany any excused absence from a quiz and should be attached to a late homework assignment.

## GRADING

| | | |
|---|---|---|
| Homework Assignments | 50% | |
| Quizzes | 20% | Lowest grade dropped |
| Midterm Exam | 15% | |
| Final Exam | 15% | |

I reserve the option to curve the final grades upward at my discretion.  However, you are guaranteed *at least* the following based on your final score before applying any curve:

| | | | | |
|---|---|---|---|---|
| A | ≥92.0% | | C | 72.0–77.9% |
| A- | 90.0–91.9% | | C- | 70.0–71.9% |
| B+ | 88.0–89.9% | | D+ | 68.0–69.9% |
| B | 82.0–87.9% | | D | 60.0–67.9% |
| B- | 80.0–81.9% | | F | <60.0 |
| C+ | 78.0–79.9% | | | |

Final grades are not negotiable.  If you see a problem with a quiz, exam, or homework grade, you may plead your case no later than 14 days from the date I return the assignment to the class.  I do make mistakes.  Under no circumstances will your grade be *lower* if you see me with a question.

## ACADEMIC INTEGRITY

**All assignments must be completed individually.** Any collaboration, no matter how small, will result in failure for the assignment. Note that this is somewhat different from my philosophy for other courses. The best way to learn how to program is to solve the problems and debug the code on your own. Copying someone else's code will not help you learn to do it for yourself (and it will be quite obvious to me that the code has been copied). If you do make the unfortunate mistake of repeatedly copying code from anyone who has ever taken this class, now or in the past, you will fail the course immediately.

The Internet is a vast resource for programming information. You may use it to help <u>guide</u> your own programming, but you may not copy code and pass it off as your own. When you have questions (and you will), please ask me! Take your time and think the problems through. Because programming often takes much longer than you expect, *start the problems early*. Please don't bombard me with questions an hour before an assignment is due.

## NOTES

Students with disabilities who require accommodations in this course are requested to speak with the professor as early in the semester as possible. Students requiring reasonable accommodations must register with the Office of Academic Accessibility by providing supporting documentation. The Office of Academic Accessibility is located in the OneStop Student Services Center, 011 Ramsey Library, phone (828) 232-5050.

## COVID-19 ADDENDUM

Following university guidelines, **masks are required** at all times during the course of the semester, regardless of vaccination status. This includes before, during, and after in-person class meetings both inside the classroom and in the hallway. As such, **eating and drinking are not permitted** in the classroom. If you remove your mask, you will be asked to leave. **I have unvaccinated children at home.** While I will always happily entertain your questions from a distance during class and during virtual office hours, please **do not physically approach me** with questions before or after class. I ask for your patience and flexibility as we all navigate a global pandemic.