

# Detailed Syllabus for CSS 501

## Data Structures and Object-Oriented Programming I

This core computer science course covers the internal workings of algorithms and data structures, from mathematical principles to implementation in C++. Topics include development of algorithms; algorithm analysis; object-oriented programming; abstract data types including trees, priority queues, graphs, and tables; regular expressions and context-free grammars.

The objective of the course is to refine and extend the concepts and practical skills introduced in CSS 501. By the end of this quarter, you will be a confident C++ programmer and will be comfortable with the basics of object-oriented design and programming. You will understand how to analyze a problem and design a solution, recognizing when existing techniques and software are reusable. You will understand the tradeoffs among memory, running time, and implementation time associated with different data structures and algorithms.

The subject matter is highly technical so plan to put in considerable time and effort master the material. Expect to spend an average of more than 15 hours a week for this course; some of you may spend more, some less time.

## Course Objectives

The goals of this course are for you to be able to do the following:

- Be able to apply pictorial representations to explain the implementations of the data structures and their operations: Tree, Binary Search Tree (BST), Balanced BST, Heap, Graph, Hash Table.
- Be able to understand and implement algorithms associated with data structures: Binary Search Tree (BST), Heap, Graph, Hash Table.
- Be able to implement data structures of common data abstractions.
- Be able to write regular expressions and context-free grammars to generate languages.
- Be able to design and produce code using object-oriented programming and appropriate design patterns.

## ABET Student Outcomes

For engineering accreditation purposes, this course supports the following ABET student outcomes:

- Outcome (a): An ability to apply knowledge of mathematics, science, and engineering. (Strongly Supported)

- Outcome (b): An ability to design and conduct experiments, as well as to analyze and interpret data. (Supported)
- Outcome (c): An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. (Minimally Supported)
- Outcome (e): An ability to identify, formulate, and solve engineering problems. (Strongly Supported)
- Outcome (k): An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. (Supported)

## Instructors

Michael Stiber <[stiber@uw.edu](mailto:stiber@uw.edu)>, UW Bothell room UW1-340.

Praveen Bantwal <[pbantwal@uw.edu](mailto:pbantwal@uw.edu)>, T-Mobile HQ, Factoria.

Please see [Signing Up for Office Hours](https://canvas.uw.edu/courses/1345568/pages/signing-up-for-office-hours) (<https://canvas.uw.edu/courses/1345568/pages/signing-up-for-office-hours>) for how to schedule meetings with us.

## Textbooks

Frank M. Carrano and Timothy Henry, *Data Abstraction & Problem Solving with C++: Walls and Mirrors*, seventh edition, Pearson, 2017.

Charles A. Cusack and David A. Santos, *An Active Introduction to Discrete Mathematics and Algorithms*, version 2.6.4, May 24, 2019. Available as a free online PDF [here](#) (<https://cusack.hope.edu/Notes/Notes/Books/Active%20Introduction%20to%20Discrete%20Mathematics%20and%20Algorithms/ActiveIntroToDiscreteMathAndAlgorithms.2.6.4.pdf>). (Local cached copy is [here](#) (<https://canvas.uw.edu/courses/1345568/files/58187305/download?wrap=1>) .)

## Suggested Readings

Bruce Eckel, *Thinking in C++*, Second Edition, vols. 1 & 2, Prentice Hall, 2000 and 2003. A good “from scratch” introduction to the language. These have historically been available for free in electronic form on-line. Since the official links for them seems to be broken as of this writing, and I have not found anything requesting others take down any locally cached copies, you can download [volume 1](#) (<https://canvas.uw.edu/courses/1345568/files/58404407/download?wrap=1>) and [volume 2](#) (<https://canvas.uw.edu/courses/1345568/files/58404409/download?wrap=1>) from this Canvas course site.

Bjarne Stroustrup, *A Tour of C++*, Second Edition, Addison-Wesley, 2018. An accelerated intro to C++ for those already familiar with programming.

Bjarne Stroustrup, *The C++ Programming Language*, Fourth Edition, Addison-Wesley, 2013. The canonical reference, updated for C++11.

Nicolai M. Josuttis, [C++17: The Complete Guide](http://www.josuttis.com/cppstd17/) (<http://www.josuttis.com/cppstd17/>). No-nonsense book targeting folks familiar with C++ who need to update themselves to the latest standard. This is being published in an interesting way, with you deciding how much to pay for a draft and later, free, updates.

Harley Hahn, *Harley Hahn's Student Guide to UNIX*, 2nd edition, McGraw-Hill, 1996. If you're unfamiliar with Unix or Linux and want to learn more, get a book like this.

Nicolai M. Josuttis, *The C++ Standard Library: A Tutorial and Reference*, 2nd Edition, Addison Wesley Longman, 2012. Good introduction and useful reference for the C++11 standard library.

David Vandevoorde, Nicolai M. Josuttis, and Douglas Gregor, *C++ Templates: The Complete Guide*, 2nd Edition, Addison-Wesley, 2017. Tutorial and reference, updated for C++17.

## Major Assignments

We will have both *written* assignments and *programming* assignments. Subsequent sections of this syllabus carefully spell out (in detail) both the procedures for program submission and the content of what you should submit. *Please read this syllabus and the [All About Programming Assignments](https://canvas.uw.edu/courses/1345568/pages/all-about-programming-assignments) (<https://canvas.uw.edu/courses/1345568/pages/all-about-programming-assignments>) page carefully*. If there is anything you don't understand or are not sure about ask us. We will assume that you have done so, and will mark off if what you submit does not match what is required.

## Tests

Test will be online using the ProctorU test proctoring system. Please see our [Online Testing Using ProctorU](https://canvas.uw.edu/courses/1345568/pages/online-testing-using-proctoru) (<https://canvas.uw.edu/courses/1345568/pages/online-testing-using-proctoru>) page for more information and make sure you've got everything set well before the quarter.

## Grading

Your course average is computed as: 30% homework + 25% final + 20% midterm + 10% designs + 5% peer design reviews + 5% discussions + 5% Quizzes

We don't grade on a curve. We compute everyone's quarter average based on the formula above, and then use our judgment to determine what averages correspond to an 'A', 'B', etc. for the quarter. Some quarters' assignments, etc. turn out harder, and so the averages are lower. Other quarters, averages are higher. This is adjusted for that at the end. Decimal grades are then computed using the equivalences in the Time Schedule linearly interpolating between letter-grade boundaries. Furthermore we are well

and time constraints, thereby incorporating between letter grade boundaries. Furthermore, we are well aware of the significance of assigning a grade below 2.7, in terms of impact on your career here at UWB. We can assure you that we examine in detail the performance in this course of each student before assigning a grade below 2.7.

What is the difference between this and grading on a curve? With the latter, the goal is to have X% 'A's, Y % 'B's, etc. Our way, we would be happy to give out all 'A's (if they were earned). FYI, in a "typical" quarter, below 65% might be a 'D', 65%–75% a 'C', 75%–85% a 'B', and above 85% an 'A'. You may use this as a rough guide; however, if you really want to know how you're doing, please see us. *We reserve the right to adjust these scores to reflect the specifics of assignments, test questions, etc. for each quarter.*

## Problems

If you have problems with anything in the course, please use office hours or make an appointment to speak with one of the instructors at some other time. We want to make you a success in this course. If you have trouble with the assignments, see us before they are due. If you fall behind, it will be difficult to catch up. We will not give out grades of "incomplete" except in extreme circumstances.

## Etiquette, Etc. (the "rules")

- Read this entire detailed syllabus, the [All About Programming Assignments](#) (<https://canvas.uw.edu/courses/1345568/pages/all-about-programming-assignments>) page, and the other class documents listed under the "[Useful Links](#) (<https://canvas.uw.edu/courses/1345568/pages/supplementary-materials-and-useful-links>)" link to the left. Every word. Failure to follow instructions (for example, neglecting coding or documentation standards, trying to turn an assignment in the wrong way or after a deadline) will adversely impact your grade.
- Work through all of the materials in a module and write down questions you have as they occur to you. Play with code while you're doing this as appropriate. You will find that you are able to answer many of your questions yourself as you learn. However, it's important to remember that questions are good — they are gateways to greater understanding. Don't hesitate to use the topical discussion forums to air your questions and *contribute your findings* in response to others' questions. We learn as a community. Part of your grade is based on your contribution to the community.
- We will not try force you to use any particular development environment. However, your programs *must* compile with g++ and run on the CSS Linux machines. Please be advised that, if you use any other environment, it is possible that you will spend considerable extra time "porting" your code to the class compiler and computing environment. It is even possible that you will never get your program working. It is a worthwhile investment of your time for you to learn to use Unix and g++. If you use another development environment, then you assume all responsibility for getting your code running

on the class computing platform; we will *not* make exceptions and test programs otherwise.

- Similarly, there are certain class standards for documentation, including UML diagrams. If the tool you use does not produce diagrams that look like the class requirements, please find another tool. High-quality scans of neat hand drawings are perfectly acceptable.
- You are responsible for making back-up copies of your work. Disk crashes, etc. are *not* acceptable reasons for extensions of assignment due dates. Note that your Linux home directories are professionally backed up, as are Google Drive, Microsoft OneDrive, etc.
- Assignments are due when specified. Barring illness or similar extenuating circumstances, please do not attempt to submit amendments, bug fixes, or forgotten material after the fact.
- Please do not post your work to publicly accessible repositories (i.e., github). Use a private repo if you want to create a portfolio that you can grant access to.
- Do not seek out programming assignment solution code on the web (we will generally try to make our assignments so idiosyncratic that such code is unlikely to exist, anyway). You need to submit your own work.
- Please use your UW email (*netid@uw.edu*) for direct email communications with us (i.e., make sure that that shows as your return address). This is the only way that we can authenticate that you are who you say you are. We will endeavor to only email you at that address. We do this because that address is the only one guaranteed to be connected to you, based on information in the student database.
- We expect you to treat fellow students, and other UWB community members, with the utmost respect and consideration.
- You are expected to provide original work based on your own effort for this course. You will receive a zero for any coursework for which you are discovered cheating or plagiarizing. You will be referred to the University for further action. It is your responsibility to know and uphold the Student Conduct Code for the University of Washington.

# Course Syllabus

[Jump to Today](#)[!\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\) Edit](#)

**This is a summary and schedule for CSS 501; the full syllabus is located [here](#).**

## Course Summary

Covers data structures and object-oriented programming. Studies basic and advanced data types, their uses, and implementations. Students design solutions to programming problems using object-oriented techniques with various data types. Covers algorithms and their tradeoffs. Uses modern software engineering practices. Some discrete mathematics topics are covered.

This is a fast-paced, demanding course; students are expected to perform at a graduate level. On the other hand, I as an instructor am committed to your success. Please make ample use of resources such as the class discussion forum and, of course, me. Expect to spend an average of 15 hours a week outside of class time for this course; some of you may spend more, some less time.

## Course Summary:

Date	Details	
Wed Sep 25, 2019	 <a href="#">Office hours (Stiber)</a> <a href="https://canvas.uw.edu/appointment_groups/5744">(https://canvas.uw.edu/appointment_groups/5744)</a>	9:30am to 5pm
Thu Sep 26, 2019	 <a href="#">Syllabus Quiz</a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888665">(https://canvas.uw.edu/courses/1345568/assignments/4888665)</a>	due by 11:59pm
Fri Sep 27, 2019	 <a href="#">Office Hours</a> ( <a href="https://canvas.uw.edu/appointment_groups/5745">https://canvas.uw.edu/appointment_groups/5745</a> )	6pm to Oct 4 at 7pm
	 <a href="#">Ice Breaker</a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888673">(https://canvas.uw.edu/courses/1345568/assignments/4888673)</a>	due by 11:59pm
Mon Sep 30, 2019	 <a href="#">Office hours (Stiber)</a> <a href="https://canvas.uw.edu/appointment_groups/5779">(https://canvas.uw.edu/appointment_groups/5779)</a>	11am to Oct 2 at 12pm
	 <a href="#">C++ Post-Reading Quiz</a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888662">(https://canvas.uw.edu/courses/1345568/assignments/4888662)</a>	due by 11:59pm
	 <a href="#">Module 1 Quiz</a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888658">(https://canvas.uw.edu/courses/1345568/assignments/4888658)</a>	due by 11:59pm

Wed Oct 2, 2019

-  [\*\*Program 1 Design\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4888677\)](https://canvas.uw.edu/courses/1345568/assignments/4888677)

due by 11:59pm

Fri Oct 4, 2019

-  [\*\*Pre-module 2 Exercise\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4888664\)](https://canvas.uw.edu/courses/1345568/assignments/4888664)
-  [\*\*Program 1 Peer Design Review\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4888678\)](https://canvas.uw.edu/courses/1345568/assignments/4888678)

due by 11:59pm  
due by 11:59pm

Sat Oct 5, 2019

-  [\*\*Office Hours\*\*](#)  
[\(https://canvas.uw.edu/appointment\\_groups/5786\)](https://canvas.uw.edu/appointment_groups/5786)

10:30am to Oct 12 at 11am

-  [\*\*Office hours \(Stiber\)\*\*](#)  
[\(https://canvas.uw.edu/appointment\\_groups/5801\)](https://canvas.uw.edu/appointment_groups/5801)

11am to 12pm

Mon Oct 7, 2019

-  [\*\*Module 2 Quiz\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4888666\)](https://canvas.uw.edu/courses/1345568/assignments/4888666)
-  [\*\*Simple Sorting and Searching\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4998708\)](https://canvas.uw.edu/courses/1345568/assignments/4998708)

due by 11:59pm  
due by 11:59pm

Tue Oct 8, 2019

-  [\*\*Pre-module 3 Exercise\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4888655\)](https://canvas.uw.edu/courses/1345568/assignments/4888655)

due by 11:59pm

-  [\*\*Office hours \(Stiber\)\*\*](#)  
[\(https://canvas.uw.edu/appointment\\_groups/5823\)](https://canvas.uw.edu/appointment_groups/5823)

11am to 12pm

Wed Oct 9, 2019

-  [\*\*Program 1\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4888676\)](https://canvas.uw.edu/courses/1345568/assignments/4888676)
-  [\*\*Program 1 Discussion\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4888672\)](https://canvas.uw.edu/courses/1345568/assignments/4888672)

due by 11:59pm  
due by 11:59pm

Fri Oct 11, 2019

-  [\*\*Module 3 Quiz\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4888663\)](https://canvas.uw.edu/courses/1345568/assignments/4888663)

due by 11:59pm

-  [\*\*Office hours \(Stiber\)\*\*](#)  
[\(https://canvas.uw.edu/appointment\\_groups/5802\)](https://canvas.uw.edu/appointment_groups/5802)

11am to 12pm

Mon Oct 14, 2019

-  [\*\*Office Hours\*\*](#)  
[\(https://canvas.uw.edu/appointment\\_groups/5865\)](https://canvas.uw.edu/appointment_groups/5865)

8pm to Oct 19 at 11am

-  [\*\*Module 4 Quiz\*\*](#)  
[\(https://canvas.uw.edu/courses/1345568/assignments/4888660\)](https://canvas.uw.edu/courses/1345568/assignments/4888660)

due by 11:59pm

Wed Oct 16, 2019

	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4971397">(https://canvas.uw.edu/courses/1345568/assignments/4971397)</a>	due by 11:59pm
	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888680">Program 2 Design (https://canvas.uw.edu/courses/1345568/assignments/4888680)</a>	due by 11:59pm
Thu Oct 17, 2019	 <a href="https://canvas.uw.edu/appointment_groups/5855">Office hours (Stiber) (https://canvas.uw.edu/appointment_groups/5855)</a>	2pm to 3pm
Fri Oct 18, 2019	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888681">Program 2 Peer Design Review (https://canvas.uw.edu/courses/1345568/assignments/4888681)</a>	due by 11:59pm
	 <a href="https://canvas.uw.edu/appointment_groups/5866">Office hours (Stiber) (https://canvas.uw.edu/appointment_groups/5866)</a>	11am to 12pm
Mon Oct 21, 2019	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4998656">Iterators, Templates, STL Discussion (https://canvas.uw.edu/courses/1345568/assignments/4998656)</a>	due by 11:59pm
	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888661">Module 5 Quiz (https://canvas.uw.edu/courses/1345568/assignments/4888661)</a>	due by 11:59pm
Tue Oct 22, 2019	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888657">Pre-module 6 Exercise (https://canvas.uw.edu/courses/1345568/assignments/4888657)</a>	due by 11:59pm
	 <a href="https://canvas.uw.edu/appointment_groups/5867">Office hours (Stiber) (https://canvas.uw.edu/appointment_groups/5867)</a>	11am to 12pm
Wed Oct 23, 2019	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888679">Program 2 (https://canvas.uw.edu/courses/1345568/assignments/4888679)</a>	due by 11:59pm
	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888671">Program 2 Discussion (https://canvas.uw.edu/courses/1345568/assignments/4888671)</a>	due by 11:59pm
Mon Oct 28, 2019	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888675">Midterm (https://canvas.uw.edu/courses/1345568/assignments/4888675)</a>	due by 11:59pm
Tue Oct 29, 2019	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888656">Module 6 Quiz (https://canvas.uw.edu/courses/1345568/assignments/4888656)</a>	due by 11:59pm
Wed Oct 30, 2019	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4971428">Algorithm Analysis Discussion (https://canvas.uw.edu/courses/1345568/assignments/4971428)</a>	due by 11:59pm
	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888688">Written assignment 1 (https://canvas.uw.edu/courses/1345568/assignments/4888688)</a>	due by 11:59pm
Fri Nov 1, 2019	 <a href="https://canvas.uw.edu/courses/1345568/assignments/4888667">Module 7 Quiz (https://canvas.uw.edu/courses/1345568/assignments/4888667)</a>	due by 11:59pm

Mon Nov 4, 2019	 <a href="#"><b>Program 3 Design</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888683">https://canvas.uw.edu/courses/1345568/assignments/4888683</a>	due by 11:59pm
Tue Nov 5, 2019	 <a href="#"><b>Sorting/Searchng Discussion</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4981646">https://canvas.uw.edu/courses/1345568/assignments/4981646</a>	due by 11:59pm
Wed Nov 6, 2019	 <a href="#"><b>Program 3 Peer Design Review</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888684">https://canvas.uw.edu/courses/1345568/assignments/4888684</a>	due by 11:59pm
Mon Nov 11, 2019	 <a href="#"><b>Veterans' Day Holiday (US)</b></a> ( <a href="https://canvas.uw.edu/calendar?event_id=1286338&amp;include_contexts=course_1345568">https://canvas.uw.edu/calendar?event_id=1286338&amp;include_contexts=course_1345568</a> )	12am
Wed Nov 13, 2019	 <a href="#"><b>Program 3</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888682">https://canvas.uw.edu/courses/1345568/assignments/4888682</a>	due by 11:59pm
	 <a href="#"><b>Program 3 Discussion</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888670">https://canvas.uw.edu/courses/1345568/assignments/4888670</a>	due by 11:59pm
Tue Nov 19, 2019	 <a href="#"><b>Stack/Queue Discussion</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4984310">https://canvas.uw.edu/courses/1345568/assignments/4984310</a>	due by 11:59pm
Wed Nov 20, 2019	 <a href="#"><b>Program 4 Design</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888686">https://canvas.uw.edu/courses/1345568/assignments/4888686</a>	due by 11:59pm
Sun Nov 24, 2019	 <a href="#"><b>Program 4 Peer Design Review</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888687">https://canvas.uw.edu/courses/1345568/assignments/4888687</a>	due by 11:59pm
Tue Nov 26, 2019	 <a href="#"><b>Recurrence/Induction Discussion</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4984315">https://canvas.uw.edu/courses/1345568/assignments/4984315</a>	due by 11:59pm
Wed Nov 27, 2019	 <a href="#"><b>Program 4</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888685">https://canvas.uw.edu/courses/1345568/assignments/4888685</a>	due by 11:59pm
	 <a href="#"><b>Program 4 Discussion</b></a> <a href="https://canvas.uw.edu/courses/1345568/assignments/4888669">https://canvas.uw.edu/courses/1345568/assignments/4888669</a>	due by 11:59pm
Thu Nov 28, 2019	 <a href="#"><b>Thanksgiving Holiday (US)</b></a> ( <a href="https://canvas.uw.edu/calendar?event_id=1286388&amp;include_contexts=course_1345568">https://canvas.uw.edu/calendar?event_id=1286388&amp;include_contexts=course_1345568</a> )	12am
Fri Nov 29, 2019	 <a href="#"><b>Thanksgiving Holiday (US)</b></a> ( <a href="https://canvas.uw.edu/calendar?event_id=1286389&amp;include_contexts=course_1345568">https://canvas.uw.edu/calendar?event_id=1286389&amp;include_contexts=course_1345568</a> )	12am

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	 <a href="#"><b>Number Representation Discussion</b></a> ( <a href="https://canvas.uw.edu/courses/1345568/assignments/4984320">https://canvas.uw.edu/courses/1345568/assignments/4984320</a> )	due by 11:59pm
Mon Dec 2, 2019	 <a href="#"><b>Written assignment 2</b></a> ( <a href="https://canvas.uw.edu/courses/1345568/assignments/4888689">https://canvas.uw.edu/courses/1345568/assignments/4888689</a> )	due by 11:59pm
	 <a href="#"><b>Logic Discussion</b></a> ( <a href="https://canvas.uw.edu/courses/1345568/assignments/4984361">https://canvas.uw.edu/courses/1345568/assignments/4984361</a> )	due by 11:59pm
Fri Dec 6, 2019	 <a href="#"><b>Module 14 Quiz</b></a> ( <a href="https://canvas.uw.edu/courses/1345568/assignments/4888668">https://canvas.uw.edu/courses/1345568/assignments/4888668</a> )	due by 11:59pm
Mon Dec 9, 2019	 <a href="#"><b>Final</b></a> ( <a href="https://canvas.uw.edu/courses/1345568/assignments/4888674">https://canvas.uw.edu/courses/1345568/assignments/4888674</a> )	due by 11:59pm

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