



# Applied Programming

## Competency

Educator designs integrated learning experiences that include computational thinking, algorithm development, and coding as tools to solve problems.

## Key Method

The educator demonstrates the use of programming to solve a problem within a community, guides students in the design of a flowchart or pseudocode to illustrate the algorithm design process, and collaborates with students to proofread to trace code and/or debug programs to solve logic and syntax errors.

## Method Components

### What is Computer Science?

Computer science moves beyond using technology tools toward an understanding of how they work and ultimately designing new solutions to enduring human problems. Despite common misperceptions, computer science is not simply programming. Like any scientific discipline, computer science consists of a body of knowledge that informs how people understand and perceive the world around them, as well as practices for exploration, creation, and experimentation. Programming, defined as giving computers instructions to follow, is a practice used in computer science. The field itself is much broader, much as biology is not simply conducting lab experiments.

### Why Should Students Learn Computer Science?

- Over 70% of jobs in STEM are actually computing jobs, and most of the others use computer science as a core part of the job.
- Many future jobs and opportunities will require knowledge and skills in the area of computer science. Therefore, students need multiple opportunities to use computer science to help them explore and understand the world.



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- Even a student who does not end up programming in their job will still need to understand the central principles of how data, networking, the Internet, and cybersecurity impact the lives of people in their families and communities.
- Students need to know that when they use a free social media platform, their data can be shared with anyone.
- All of the strands of computer science have drastic impacts on how we live our lives.
- Understanding the basic principles of computer science influences how students will interact with the world around them.

## What is Programming?

Programming is the art of encoding algorithms into a programming language. The programming language will provide instructions for a computing device to perform various tasks. Flowcharts and algorithms are the graphical and text representations of the procedures in the computer program. Both flowcharts and pseudocode are “language agnostic,” which means that the process is emphasized, rather than the syntax of a specific language.

### Flowcharts and Pseudocode

Flowcharts are graphical. There are standardized boxes that represent start and end points, inputs, decision statements, processing, and other events within a program.

Pseudocode is a detailed list of the steps used in a program. Rather than using the syntax of a specific coding language, pseudocode is written in natural language. Using pseudocode allows the designers to create the process without focusing on the syntax of the coding language. Once a program is written in pseudocode, it can then be coded using the computer language.

### Programming Concepts

- Flowcharts or Pseudocode
- Variables (declaring, initializing, data types, and/or data structures)
- Variable Scope
- Operators/Operands
- Logical Operators
- Methods/Functions
- Arguments/Parameters

### Program Design

- User Input, Reading User Input, and/or File Input/Output
- Conditional Statements (If, If-Else, Switch statements)
- Repetitive Statements (While, Do-While, For Loops, may include Recursion)
- Nested Structures
- Data Structures



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### Best Practices

- Pair Programming
- Use of Comments
- Programming Efficiency
- Intellectual Property Rights

## Supporting Rationale and Research

Burgstahler, Sheryl. "Differentiating for Diversity: Using Universal Design for Learning in Elementary Computer Science Education." Universal Design: Implications for Computing Education, ACM Transactions on Computing Education, Oct. 2011, [https://staff.washington.edu/sherylb/ud\\_computing.html](https://staff.washington.edu/sherylb/ud_computing.html)

Honey, Margaret, et al. "STEM Integration in K–12 Education: Status, Prospects, and an Agenda for Research." The National Academies Press, National Academy of Engineering and National Research Council of The National Academies, 7 Feb. 2014, <http://www.nap.edu/catalog/18612/stem-integration-in-k-12-education-status-prospects-and-an>

Lewis, Colleen, and Niral Shah. "How Equity and Inequity Can Emerge in Pair Programming." Association for Computing Machinery, ICER '15 Proceedings of the Eleventh Annual International Conference on International Computing Education Research, July 2015, [http://blogs.hmc.edu/lewis/wp-content/uploads/sites/2/2013/07/LewisShah2015\\_EquitySpeed.pdf](http://blogs.hmc.edu/lewis/wp-content/uploads/sites/2/2013/07/LewisShah2015_EquitySpeed.pdf)

Lewis, Colleen M. "Good (and Bad) Reasons to Teach All Students Computer Science." SpringerLink, Springer, Cham, 1 Jan. 2017, <https://docs.google.com/document/d/1R57kol5El5B6jZQyZkmG4NY9MM4wwfJ13V13Yx4gWzw/edit#heading=h.gjdqxs>

## Resources

Understanding Flowchart/Pseudocode

[ALGORITHM & FLOWCHART MANUAL for STUDENTS](#)

[Create a basic flowchart in Vision](#)

[Flowchart Lesson](#)



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**Computer Science Stack**

Last Revised on Jan 1, 2022

[Guide to Inclusive Computer Science Education: How educators can encourage and engage all students in computer science | National Center for Women & Information Technology](#)

[Introduction to Pseudocode](#)

[Pseudocode Standard](#)

Tools to create Flowcharts:

[Google Drawings - create diagrams and charts, for free](#)

[Flowchart Maker & Online Diagram Software](#)

[Free Online Flowchart Maker: Design Custom Flowcharts in Canva](#)

[Twine](#)

Programming Concepts

[All Courses & Tutorials | Codecademy](#)

[Computer programming: Khan academy](#)

[Introduction to Python Programming Professional Certificate | edX](#)

[Programming for Everybody \(Getting Started with Python\) | Coursera](#)

[Java Programming and Software Engineering Fundamentals | Coursera](#)

## Submission Guidelines & Evaluation Criteria

*To earn the micro-credential, you must receive a passing score in Parts 1 and 3 and receive a proficient for all components in Part 2.*

### Part 1. Overview Questions (Provides Context)

250–500 words

*Please answer the following contextual questions to help our assessor understand your current situation. Please do not include any information that will make you identifiable to your reviewers.*

1. Identify your current position and title, number of years working in education, and description of your school community climate (demographic information).
2. Describe your current knowledge level with programming, including any formal or informal training you have had.



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Last Revised on Jan 1, 2022

3. What impact on your students do you hope completing this micro-credential will have?
4. In the field of computer science, women and minorities are underrepresented. How will you intentionally differentiate instruction to engage and inspire underrepresented groups through the design of your unit?

**Passing:** Response provides accurate information that justifies the reason for choosing this micro-credential to address specific needs of both the teacher and the student. Educator includes a learning goal that describes what they hope to gain from earning this micro-credential. Specific details about how you will engage and inspire underrepresented minorities and girls are included.

## Part 2. Work Examples/Artifacts/Evidence

To earn this micro-credential, please submit the following **four artifacts** as evidence of your learning. *Please do not include any information that will make you or your students identifiable to your reviewers.*

### **Artifact 1: Lesson Plan or Unit of Study**

Design an integrated lesson or unit of study that incorporates:

- Computer Science Teacher Association and/or State Computer Science Standards
- Rationale for using programming as a tool to solve an identified problem
- Explanation of how your lesson plan integrates computational thinking strategies: decomposition, pattern recognition, abstraction, and algorithm design
- Action steps for guiding students in tracing code or debugging errors
- Strategies for assessment
- Strategies to engage and inspire underrepresented minorities and girls through the design of your unit
- Integration with a Content Standard

### **Artifact 2: Teacher Programming File**

Develop a program using a programming tool/language of your choice. The program should be designed to solve a pre-identified problem (this can be the solution to Artifact 1). Submit the Teacher Programming File via a pdf, screenshot, or text file.

### **Artifact 3: Student Programming File**

Develop a program using a programming tool/language of your choice. The program should be designed to solve a pre-identified problem. Submit the Student Programming File as a pdf, screenshot, or text file.

### **Artifact 4: Video of Program in Action**

Create a short video that includes teacher or student narration or written caption of the program submitted for Artifact 2 or Artifact 3. Video should illustrate the program in



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**Computer Science Stack**

Last Revised on Jan 1, 2022

action (executed/running), completing the task. Adhere to district policies on media recording in the classroom.

## Part 2. Rubric

	<b>Proficient</b>	<b>Basic</b>	<b>Developing</b>
<b>Artifact 1: Lesson Plan or Unit of Study</b>	<p>The lesson plan includes all of the following:</p> <ul style="list-style-type: none"> <li>-Computer Science Teacher Association and/or State Computer Science Standards</li> <li>-Rationale for using programming as a tool to solve an identified problem</li> <li>-Explanation of how your lesson plan integrates computational thinking strategies: decomposition, pattern recognition, abstraction, and algorithm design</li> <li>-Action steps for guiding students in tracing code or debugging errors</li> <li>-Strategies for assessment</li> <li>-Strategies to engage and inspire</li> </ul>	<p>The lesson plan includes most of the following:</p> <ul style="list-style-type: none"> <li>-Computer Science Teacher Association and/or State Computer Science Standards</li> <li>-Rationale for using programming as a tool to solve an identified problem</li> <li>-Explanation of how your lesson plan integrates computational thinking strategies: decomposition, pattern recognition, abstraction, and algorithm design</li> <li>-Action steps for guiding students in tracing code or debugging errors</li> <li>-Strategies for assessment</li> <li>-Strategies to engage and inspire underrepresented minorities and girls through the design of your unit</li> </ul>	<p>The lesson plan includes only a few of the following:</p> <ul style="list-style-type: none"> <li>-Computer Science Teacher Association and/or State Computer Science Standards</li> <li>-Rationale for using programming as a tool to solve an identified problem</li> <li>-Explanation of how your lesson plan integrates computational thinking strategies: decomposition, pattern recognition, abstraction, and algorithm design</li> <li>-Action steps for guiding students in tracing code or debugging errors</li> <li>-Strategies for assessment</li> <li>-Strategies to engage and inspire underrepresented minorities and girls through the design of your unit</li> </ul>



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Last Revised on Jan 1, 2022

	<p>underrepresented minorities and girls through the design of your unit</p> <p>- Integration with a Content Standard</p>	-Integration with a Content Standard	- Integration with a Content Standard
<b>Artifact 2: Teacher Programming File</b>	<p>Program is easy to read and includes the use of comments within the code that illustrate use of:</p> <p>Minimum of <b>five</b> programming concepts</p> <p>AND</p> <p>Minimum of <b>three</b> programming design elements</p>	<p>Program is easy to read and includes the use of comments within the code that illustrate the use of:</p> <p>Only two to four programming concepts</p> <p>AND</p> <p>Only <b>two</b> programming design elements</p>	<p>Program is easy to read and includes the use of comments within the code that illustrate the use of:</p> <p>Only <b>one</b> programming concept</p> <p>AND</p> <p>Only <b>one</b> programming design element</p>
<b>Artifact 3: Two Student Programming Files</b>	<p>Program is easy to read and includes the use of comments within the code that illustrate use of:</p> <p>Minimum of <b>five</b> programming concepts</p> <p>AND</p> <p>Minimum of <b>three</b> programming design elements</p>	<p>Program is easy to read and includes the use of comments within the code that illustrate the use of:</p> <p>Only <b>two</b> programming concepts</p> <p>AND</p> <p>Only <b>two</b> programming design elements</p>	<p>Program is easy to read and includes the use of comments within the code that illustrate the use of:</p> <p>Only <b>one</b> programming concept</p> <p>AND</p> <p>Only <b>one</b> programming design element</p>
<b>Artifact 4: Video File</b>	Video must have all of the elements listed below:	Video has only some of the elements listed below:	Video is missing most of the elements listed below:



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**Computer Science Stack**

Last Revised on Jan 1, 2022

	<p>-Teacher or student narration or written caption of the program</p> <p>-Demonstration of the program in action (executed/running), completing the task</p> <p>-Adheres to district policies on media recording in the classroom</p>	<p>-Teacher or student narration or written caption of the program</p> <p>-Demonstration of the program in action (executed/running), completing the task</p> <p>-Adheres to district policies on media recording in the classroom</p>	<p>-Teacher or student narration or written caption of the program</p> <p>-Demonstration of the program in action (executed/running), completing the task</p> <p>-Adheres to district policies on media recording in the classroom</p>
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### Part 3 Reflection

250–500 words

Use the word count as a guide to write a personal reflection about your work on this micro-credential. For tips on writing a good reflection review the following resource:

[How Do I Write a Good Personal Reflection?](#)

*Please do not include any information that will make you identifiable to your reviewers.*

1. How did completing this micro-credential impact your understanding of teaching programming?
2. What factors influenced your choice of programming tool/programming language?
3. What was the change in your students' belief in themselves as a computer programmer (note if there are any students in underrepresented groups that were impacted)?
4. How did you and your students handle challenges encountered during the development process?

**Passing:** Reflection provides evidence that this activity has had a positive impact on both educator practice and student success. Specific examples are cited directly from personal or work-related experiences to support claims. Also included are specific actionable steps that demonstrate how new learning will be integrated into future practice.



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