K-12 Louisiana Student Standards for Computer Science

Draft for Public Comment

Standards Overview

The K-12 Computer Science Education Standards Writing Committee successfully met in May, June, July, and August to create the K-12 Louisiana Student Standards for Computer Science draft. The committee, consisting of parents, university professors, business and industry leaders, students, school administrators, and teachers, serves a crucial role as the Louisiana Department of Education initiates computer science education in Louisiana. The following standards are for public comment and will be shared with the Board of Elementary and Secondary Education (BESE) on October 9, 2024.

Louisiana's Vision for Computer Science Education

Louisiana's vision for K-12 Computer Science Education is to increase **digital literacy skills** through engagement with a **progression of computer science concepts and experiences** which prepare all students for success in society and future **career opportunities**.

Louisiana's computer science standards will ensure graduates

- apply analytical and critical thinking skills to real-world situations;
- demonstrate digital literacy and digital citizenship skills; and
- utilize technology skills as employable citizens to meet present and future workforce needs.

Summary and Design Considerations

The complexity of the standards progresses from kindergarten through grade twelve. This draft outlines the standards Louisiana students should master by the end of the elementary, middle, and high school grade bands. A standard represents a goal or outcome of an educational program and is not meant to serve as an instructional curriculum or assessment task.

The standards are organized into five core concepts from the Louisiana Computer Science Framework. Each concept is further subdivided into relevant subconcepts. A subconcept is a way to organize essential knowledge or computing skills.

The Louisiana Computer Science Framework is the structure that gives cohesion to the components that will make up computer science educational programs. The framework is adaptable to varying teaching styles and specific computer science content topics. The framework assists teachers in structuring student learning. The Louisiana Computer Science Framework is centered around five core concepts and seven core practices. The seven core practices are learning behaviors that reinforce logical and computational thinking.

Louisiana Computer Science Framework

Core Concepts	Core Practices
1. Computing Systems	1. Fostering responsible cyber citizenship
2. Networks and the Internet	2. Collaborating around computing
3. Data and Analysis	3. Recognizing and defining computational problems
4. Algorithms and Programming	4. Developing and using abstractions
5. Impacts of Computing	5. Creating computational artifacts
	6. Testing and refining computational artifacts
	7. Communicating about computing

Core Concept 1: Computing Systems

Overview

Students interact with a wide variety of computers each day. Computers are devices that can collect, store, analyze, and act upon information in ways that can positively and negatively affect human capabilities. The physical components or hardware and instructions or software that make up a computer are operated, programmed, and maintained by humans or users. The hardware, software, and users are collectively called computing systems. Understanding hardware and software is essential to help users solve problems in computing systems in a process known as troubleshooting.

Core Concept 1: Computing Systems (CS) Standards

Subconcepts for Core Concept 1	Elementary (K-5)	Middle (6-8)	High (9-12)
1. **Hardware and Software** *Core Practices 2, 4, and 7*	E.CS.1A. Identify and select the appropriate hardware to complete computing tasks.	M.CS.1A. Analyze the functions and interactions of core components within a computer system.	H.CS.1A. Analyze the levels of interactions between application software and system software as well as the hardware layers.
	E.CS.1B. Identify and select the appropriate software to complete computing tasks.	M.CS.1B. Explain how hardware and software components work together to perform specific tasks.	H.CS.1B. Explain how abstractions hide the underlying implementation details of computing systems embedded in everyday things.
	E.CS.1C. Evaluate hardware and software types to meet users' needs in completing various computing tasks.		

Subconcepts for Core Concept 1	Elementary (K-5)	Middle (6-8)	High (9-12)
2. Troubleshooting *Core Practices 1, 2, 6, and 7*	E.CS.2A. Propose potential ways to address computing problems using appropriate hardware or software.	M.CS.2A Evaluate possible solutions to a hardware or software problem.	H.CS.2A. Generate guidelines that convey systematic troubleshooting strategies that other users can utilize to identify and fix errors.

Core Concept 2: Networks and the Internet

Overview

Computing systems typically do not operate in isolation. Networks connect computers to share information and resources and are an increasingly integral part of computer and data science. Networks enable critical communication for computing systems that drive our economy and career sectors. The increased levels of connectivity brought about by the internet can provide fast and secure communication that facilitates innovations.

Core Concept 2: Networks and the Internet (NI) Standards

Subconcepts for Core Concept 2	Elementary (K-5)	Middle (6-8)	High (9-12)
1. **Hardware and Network Communication** *Core Practices: 1, 2, 3, 4, 5, 6, and 7*	E.NI.1A. Explain how networks connect computers to other computing systems and the internet.	E.NI.1A. Analyze the various structures and functions of a network.	E.NI.1A. Evaluate a network's scalability, reliability, and appropriateness by describing the relationship between routers, switches, devices, topology, and addressing (MAC, IP, Subnet, Gateway).
		E.NI.1B. Identify and differentiate the protocols utilized in data sharing across networks.	E.NI.1B. Illustrate how to trace data through a network model, explaining the interactions that occur throughout the process.

Subconcepts for Core Concept 2	Elementary (K-5)	Middle (6-8)	High (9-12)
Hardware and Network Communication (continued)			E.NI.1C. Describe and evaluate the internet as a digital public infrastructure (DPI) from the highest level to the private service provider level.
2. Cybersecurity *Core Practices: 1, 2, 3, 4, 5, 6, and 7*	E.NI.2A. Describe personally identifiable information (PII) and identify practices for when and where sharing PII is appropriate.	M.NI.2B. Analyze threats and vulnerabilities to information security for individuals and organizations.	H.NI.2B. Recommend security measures to address factors that create trade-offs between the usability and security of a computing system.
	E.NI.2B. Identify ways to maintain data security when using networks.	M.NI.2A. Explain how physical and digital security practices and measures proactively address threats to users, data, and devices within and across networks.	H.NI.2A. Interpret and analyze mechanisms through which malware and other types of cyber attacks can impact hardware, software, and sensitive data.
			H.NI.2C. Compare and contrast how software developers protect computing systems and information from unauthorized user access.

Core Concept 3: Data and Analysis

Overview

Computing systems operate through the processing and storage of data. The amount of data generated by objects worldwide is ever-expanding, and so is the need to process the data accurately and effectively. The ways that data is collected and securely stored are essential to many aspects of a person's private and professional life. Data Science is the cross-disciplinary use of data to inform daily practices, test hypotheses, predict trends, and develop accurate models.

Core Concept 3: Data and Analysis (DA) Standards

Subconcepts for Core Concept 3	Elementary (K-5)	Middle (6-8)	High (9-12)
1. **Data Representation** *Core Practices: 2, 3, and 5*	E.DA.1A. Organize and present data visually to highlight relationships and support claims.	M.DA.1A. Analyze and explain the connection between data sets and graphical representations.	H.DA.1A. Evaluate data representations, propose strategies to reconstruct the data, and visualize data in a variety of ways.
	E.DA.1B. Classify types of data and describe the attributes used to sort data.	M.DA.1B. Evaluate the most efficient and effective ways to arrange, collect, and visually represent data to inform others.	H.DA.1B. Define and describe database structures to optimize the search and retrieval of data.
2. **Data Collection** *1, 2, 3, 4, 5, 6, and 7*	E.DA.2A. Select the appropriate data collection tool and technique to gather data to support a claim or communicate information.	M.DA.2A. Compare and contrast how data is collected using computational and non-computational tools and processes.	H.DA.2A. Explain and describe the impacts of uncertainty and the limitations of data collection technology and tools.

Subconcepts for Core Concept 3	Elementary (K-5)	Middle (6-8)	High (9-12)
Data Collection (continued)	E.DA.2B. Describe and collect data utilizing the appropriate units of measure and discuss how data format impacts a computing system.	M.DA.2B. Analyze scenarios and computing systems to determine the appropriate data entry format for specific tasks.	H.DA.2B. Describe the personal and legal impacts of accumulated data, both collected and derived, for given scenarios. Propose tools and techniques to manage the accumulated data appropriately.
3. Data Storage *Core Practices: 1, 2, 3, 4, 5, 6, and 7*	E.DA.3A. Compare and contrast ways to store data using technology.	M.DA.3A. Propose methods to back up data safely and the appropriate practices for data risk management.	H.DA.3A. Justify choices on how data elements are organized and where data is stored considering cost, speed, reliability, accessibility, privacy, and integrity.
	E.DA.3B. Explain how to save and name data, search for data, retrieve data, modify data, and delete data using a computing device.	M.DA.3B. Describe how different representations of real-world phenomena such as letters, numbers, and images are encoded as data.	H.DA.3B. Explain and utilize the appropriate data structural organization system to collaborate and communicate data within a team or user group in given scenarios.
4. Visualizations and Transformations *Core Practices: 5 and 7*	E.DA.4A. Organize and present data visually in at least three ways to highlight relationships and evaluate a claim.	M.DA.4A. Utilize tools and techniques to locate, collect, and create visualizations of large-scale data sets.	H.DA.4A. Create interactive data visualizations using software tools that explain complex data to others.

Subconcepts for Core Concept 3	Elementary (K-5)	Middle (6-8)	High (9-12)
Visualizations and Transformations (continued)	E.DA.4B. Evaluate data quality and clean data when indicated using the criteria of validity, accuracy, completeness, consistency, and uniformity.	M.DA.4B. Collect and transform data using computational tools to make functional and reliable data for use in hypothesis testing.	H.DA.4B. Utilize data analysis tools to ingest (extract, transform, and load) and process data into relevant information.
5. Inference and Models *Core Practices: 3, 4, 5, 6, and 7*	E.DA.5A. Utilize data to create models, answer investigative questions, and make predictions.	M.DA.5A. Refine computational models based on data generated by the models.	H.DA.5A. Create a model utilizing data with the appropriate simulated variables to develop predictions for real-world phenomena.
	E.DA.5B. Analyze data for patterns and relationships.	M.DA.5B. Describe and evaluate the accuracy of a modeled system by comparing the generated results with observed data from the system the data represents.	H.DA.5B. Apply and evaluate data analysis techniques to identify patterns represented in complex systems.
			H.DA.5C. Analyze patterns in data visualizations, then select a collection tool to test a hypothesis and communicate the relevant information to others.
			H.DA.5D. Evaluate the impacts of the variables and the model on the performance of a simulation to refine a hypothesis.

Core Concept 4: Algorithms and Programming

Overview

An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing systems. Algorithms and programs control all computing systems, empowering people to communicate with the world in novel ways and solve compelling problems. The development process to create meaningful and efficient programs involves choosing which information to use, how to process the data, how to store the information, practicing the decomposition of more significant problems into simpler ones, recombining existing solutions, and analyzing various solutions to a problem to locate the most appropriate solution.

Core Concept 4: Algorithms and Programming (AP) Standards

Subconcepts for Core Concept 4	Elementary (K-5)	Middle (6-8)	High (9-12)
1. **Variables and Algorithms** *Core Practices: 2, 3, 4, 5, 6, and 7*	E.AP.1A. Create clearly named variables representing different data types and perform operations on the variables' values.	M.AP.1A. Evaluate and use naming conventions for variables to accurately communicate the variables' meaning to other users and programmers.	H.AP.1A. Assess variables, then classify the scope and type of variable.
	E.AP.1B. Create, use, and apply an algorithm to complete a task. Compare the results of algorithm usage trials and refine the algorithm.	M.AP.1B. Evaluate algorithms in terms of efficiency, correctness, and clarity.	H.AP.1B. Design algorithms that can be adapted to express an idea or solve a problem.
		M.AP.1C. Compare and contrast data constants and variables.	H.AP.1C. Use and adapt classical algorithms to solve computational problems.

Subconcepts for Core Concept 4	Elementary (K-5)	Middle (6-8)	High (9-12)
Variables and Algorithms (continued)			H.AP.1D. Explain what computer memory is and how variables are stored and retrieved.
			H.AP.1E. Identify and explain how a derived data type can be utilized in a real-world scenario.
2. Control Structures *Core Practices: 2, 3, 4, 5, 6, and 7*	E.AP.2. Define what a control structure is and create programs that include sequences, conditionals, events, and loops.	M.AP.2A. Explain the functions of various control structures. Compare and contrast examples of control structure types.	H.AP.2A. Justify the selection of control structures to balance implementation complexity, maintainability, and program performance.
		M.AP.2B. Design and iteratively develop programs that combine control structures into advanced control structures.	H.AP.2B. Design and iteratively develop computational artifacts using events to initiate instructions.
3. Modularity *Core Practices: 2, 3, 4, 5, 6, and 7*	E.AP.3A. Define and apply decomposition to a complex problem in order to create smaller subproblems that can be solved through step-by-step instructions.	M.AP.3A. Decompose problems to facilitate program design, implementation, and review.	H.AP.3A. Decompose problems into smaller components using constructs such as procedures, modules, and/or objects.

Subconcepts for Core Concept 4	Elementary (K-5)	Middle (6-8)	High (9-12)
Modularity (continued)	E.AP.3B. Modify, remix, or incorporate parts of an existing problem's solution to develop something new or add more advanced features to a program.	M.AP.3B. Create procedures with parameters to organize code and promote reusability.	H.AP.3B. Create computational artifacts using procedures within a program, combinations of data and procedures, or independent but interrelated programs.
4. Program Development *Core Practices: 1, 2, 3, 4, 5, 6, and 7*	E.AP.4A. Create a simple program to achieve a goal with expected outcomes.	M.AP.4A. Seek and incorporate feedback from peers to employ user-centered design solutions.	H.AP.4A. Utilize the Software Development Life Cycle (SDLC) to create software that is a minimum viable product.
	E.AP.4B. Test and debug a program or algorithm to ensure the program produces the intended outcome.	M.AP.4B. Use applicable industry practices to test, debug, document, and peer review code.	H.AP.4B. Develop and utilize test cases to verify that a program performs according to the program's design specifications.
	E.AP.4C. Collaborate with a team of peers to design, implement, test, and review the stages of program development.	M.AP.4C. Develop computational artifacts by working as a team, distributing tasks, and maintaining an iterative project timeline.	H.AP.4C. Design and develop programs by working in team roles using version control systems, integrated development environments (IDEs), and collaborative tools and practices.
	E.AP.4D. Identify intellectual property rights and apply the appropriate attribution when creating or remixing programs.	M.AP.4D. Incorporate existing resources into original programs and give the proper attributions.	H.AP.4D. Evaluate licenses that limit or restrict the use of computational artifacts when utilizing resources such as libraries.

Core Concept 5: Impacts of Computing

Overview

Computing affects many aspects of the world, in both positive and negative ways. The uses of computing systems vary greatly at the local, regional, national, and global levels. Individuals and communities influence computing through social interactions, behaviors, industry practices, and laws. Computer and data science reflexively impact individuals and communities by creating new means of communication, increasing information exchanges, and providing a cyberspace medium for people to work within. An informed and responsible individual must be aware of how computer and data science impacts the world.

Core Concept 5: Impacts of Computing (IC) Standards

Subconcepts for Core Concept 5	Elementary (K-5)	Middle (6-8)	High (9-12)
1. **Intellectual Achievements** *Core Practices: 1, 2, 6, and 7*	E.IC.1. Describe how computing has changed the ways people live and work.	M.IC.1A. Identify foundational computational advancements through the use of the technology innovation cycle.	H.IC.1A. Analyze the key milestones of computer science, historical events influenced by computer science, and the people connected to these achievements.
		M.IC.1B. Plan and devise new ideas and solutions for problems with inspiration from previous discoveries in computational knowledge.	H.IC.1B. Explain how innovations in computer science and technology enable advancements in other fields of study.

Subconcepts for Core Concept 5	Elementary (K-5)	Middle (6-8)	High (9-12)
2. Social Interaction *Core Practices: 1, 2, 6, and 7*	E.IC.2A. Identify and describe examples of appropriate versus inappropriate computer communications.	M.IC.2A. Develop and propose norms for informal versus formal online communications.	H.IC.2A. Evaluate the adoption and adaptation of social norms from the physical world to the cyber world.
	E.IC.2B. Identify examples of cyberbullying with age-appropriate responses.	M.IC.2B. Analyze communication technologies and then describe how the technology's use influences individuals and society.	H.IC.2B. Describe how cyberspace is becoming a universal medium for connecting humans, the economy, business, and computing.
		M.IC.2C. Generate designs that increase the accessibility and usability of technology for various groups of users.	H.IC.2C. Describe and critique how algorithmic feedback loops can shape perceptions, reinforce a limited data set, and limit the sources of information that may inform the individual user.
3. Laws, Safety, and Industry Practices *Core Practices: 1, 2, 6, and 7*	E.IC.3A. Explain how online actions have real-world consequences and that laws and rules may also apply online.	M.IC.3A. Identify applicable laws that impact personal, industry, or business computing practices.	H.IC.3A. Debate laws and industry regulations that impact the development and use of computational artifacts.
	E.IC.3B. Describe the safe versus unsafe uses of computing systems at age-appropriate levels.	M.IC.3B. Recommend and propose computing-use guidelines to maintain a user's personal safety, privacy, and well-being.	H.IC.3B. Describe and analyze the motives of online threat actors to a user's personal safety, privacy, and well-being.

Subconcepts for Core Concept 5	Elementary (K-5)	Middle (6-8)	High (9-12)
	E.IC.3C. Explain how the school and school system's computing rules and policies keep students safe.	M.IC.3C. Describe and categorize factors that affect user's access to computing resources locally, nationally, and globally.	H.IC.3C. Compare and contrast the varied approaches to govern data, intellectual property, control information access, and various ways for users to be aware of guidance.
			H.IC.3D. Explain how the interconnectedness of cyberspace can lead to physical and digital vulnerabilities.
			H.IC.3E. Debate the ethical considerations of creating and publishing computational artifacts.
			H.IC.3F. Analyze the data provenance of computational artifacts.
			H.IC.3G. Explain how individuals and organizations can exert influence on personal and societal perceptions and practices through computing technologies.