COMPUTER SCIENCE STANDARDS DRAFT FOR NRC 12.5.19

STANDARDS FOR COMPUTER SCIENCE FOR GRADES K-12

1. The content areas covered by the computer science standards include:
    a. algorithms and programming;
    b. computing systems;
    c. data and analysis;
    d. impacts of computing; and,
    e. computer science networks and the internet
2. When a district incorporates or integrates computer science content into district curriculum or offers a course in computer science, the following skills at each grade level apply:
    a. fostering an inclusive computing culture
    b. collaborating around computing
    c. recognizing and defining computational problems
    d. developing and using abstractions
    e. creating computational artifacts
    f. testing and refining computational artifacts
    g. communicating about computing

COMPUTER SCIENCE CONTENT STANDARDS FOR KINDERGARTEN

1. Computer science algorithms and programming standards for kindergarten are:
    a. follow step-by-step instructions
    b. recognize that numbers and symbols represent information
2. Computer science computing systems standards for kindergarten are:
    a. identify computing devices
    b. identify examples of common hardware and software
3. Computer science data and analysis standards for kindergarten are:
    a. collect and categorize data
    b. retrieve information
    c. identify patterns in data
4. Computer science impacts of computing standards for kindergarten are:
    a. work respectfully and responsibly in groups
    b. keep login information private and log off devices appropriately

THE COMPUTER SCIENCE CONTENT STANDARDS FOR FIRST GRADE

1. Computer science algorithms and programming standards for first grade are:
    a. retell step-by-step instructions to complete a task
    b. use numbers and symbols to represent information
    c. arrange sequences and simple loops in correct order
2. Computer science computing systems standards for first grade are:
    a. identify tasks that can be performed by computing devices
    b. use appropriate terminology in identifying common hardware and software
    c. identify simple hardware and software problems
3. Computer science data and analysis standards for first grade are:
    a. collect and categorize data in up to three categories
    b. retrieve, arrange, and modify information
    c. identify patterns in data
4. Computer science impacts of computing standards for first grade are:
    a. work respectfully and responsibly in groups
    b. keep login information private and log off devices appropriately

THE COMPUTER SCIENCE CONTENT STANDARDS FOR SECOND GRADE

1. Computer science algorithms and programming standards for second grade are:
    a. model daily processes by creating and following sets of step-by-step instructions to complete tasks
    b. model the way programs store and manipulate data by using numbers or other symbols to represent information
    c. develop programs with sequences and simple loops, to express ideas or address a problem
    d. break down the steps needed to solve a problem into a precise sequence of instructions
2. Computer science computing systems standards for second grade are:
    a. select and operate appropriate devices to perform a variety of tasks
    b. use appropriate terminology in identifying and describing the function of common hardware and software
    c. describe basic hardware and software problems using accurate terminology
3. Computer science data and analysis standards for second grade are:
    a. collect and present the data in various visual formats
    b. define data as gathered and stored information
    c. identify and describe patterns in data visualizations, such as charts or graphs, to make predictions
4. Computer science impacts of computing standards for second grade are:
    a. identify how people live and work differently after the implementation of new computing technology, including American Indians
    b. work respectfully and responsibly online
    c. keep login information private and log off devices appropriately
5. Computer science networks and the internet standards for second grade are:
    a. explain what passwords are and why we use them
    b. recognize that computing devices and the internet enable us to connect with other people, places, information, and ideas

THE COMPUTER SCIENCE CONTENT STANDARDS FOR THIRD GRADE

1. Computer science algorithms and programming standards for third grade are:
    a. compare and contrast multiple algorithms to complete the same task
    b. break down problems into smaller, manageable subproblems to facilitate the program development process
    c. describe steps taken and choices made during the process of program development
    d. identify intellectual property rights and give appropriate credit when creating or remixing programs
2. Computer science computing systems standards for third grade are:
    a. identify the internal and external parts of computing devices
    b. determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies
3. Computer science data and analysis standards for third grade are:
    a. collect data from multiple sources and display the data in graphs
    b. describe multiple types of data
    c. understand the accuracy of predictions and how they are influenced by the amount of data collected
4. Computer science impacts of computing standards for third grade are:
    a. seek diverse perspectives for the purpose of improving computational artifacts
    b. apply laws associated with digital information
    c. describe ethical issues that relate to computing devices and networks
5. Computer science networks and the internet standards for third grade are:
    a. identify real-world cybersecurity problems and how personal information can be protected

THE COMPUTER SCIENCE CONTENT STANDARDS FOR FOURTH GRADE

1. Computer science algorithms and programming standards for fourth grade are:
    a. compare and refine multiple algorithms for the same task and determine which is the most appropriate
    b. decompose problems into smaller, manageable subproblems to facilitate the program development process
    c. test and debug a program or algorithm to ensure it runs as intended
2. Computer science computing systems standards for fourth grade are:
    a. explain the function of individual internal and external parts
    b. determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies
3. Computer science data and analysis standards for fourth grade are:
    a. select and use appropriate non-digital and digital tools to collect and represent data
    b. identify and use multiple types of data to complete a task
    c. evaluate the validity of data based on accuracy and relevance
4. Computer science impacts of computing standards for fourth grade are:
    a. seek diverse perspectives for the purpose of improving computational artifacts
    b. apply laws associated with digital information
    c. describe ethical issues that relate to computing devices and networks
5. Computer science networks and the internet standards for fourth grade are:
    a. identify real-world cybersecurity problems and how personal information can be protected

THE COMPUTER SCIENCE CONTENT STANDARDS FOR FIFTH GRADE

1. Computer science algorithms and programming standards for fifth grade are:
    a. compare and refine multiple algorithms for the same task and determine which is the most appropriate
    b. create programs that use variables to store and modify data
    c. create programs that include sequences, events, loops, and conditionals
    d. modify, remix, or incorporate portions of an existing program into one's own work, to develop something new or add more advanced features
    e. describe choices made during program development
2. Computer science computing systems standards for fifth grade are:
    a. describe how internal and external parts of computing devices function to form a system
    b. model how computer hardware and software work together as a system to accomplish tasks
    c. determine potential solutions to solve simple hardware and software problems using common troubleshooting strategies
3. Computer science data and analysis standards for fifth grade are:
    a. organize and present collected data visually to highlight relationships and support a claim
    b. demonstrate how to store, copy, search, retrieve, modify, and delete information using a computing device
    c. use accurate and relevant data to highlight or propose cause-and-effect relationships, predict outcomes, or communicate an idea
4. Computer science impacts of computing standards for fifth grade are:
    a. explain how computing technologies have changed Montana and the world, and express how those technologies influence, and are influenced by, cultural practices, including American Indians
    b. identify ways to improve the accessibility and usability of technology products for the diverse needs and wants of users
    c. utilize diverse perspectives for the purpose of improving computational artifacts
    d. apply laws associated with digital information and intellectual property
    e. describe ethical issues that relate to computing devices and networks
5. Computer science networks and the internet standards for fifth grade are:
    a. explain real-world cybersecurity problems and how personal information can be protected
    b. model how information is broken down and transmitted through multiple devices over networks and the internet and reassembled at the destination

THE COMPUTER SCIENCE CONTENT STANDARDS FOR SIXTH THROUGH EIGHTH GRADE

1. Computer science algorithms and programming standards for sixth through eighth grades are:
    a. use algorithms to address complex problems
    b. create clearly named variables that represent different data types and perform operations on their values
    c. develop programs that combine control structures, including nested loops and compound conditionals
    d. decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs
    e. create procedures with parameters to organize code and make it easier to reuse
    f. seek and incorporate feedback from team members and users to refine a solution that meets user needs
    g. incorporate existing code, media, and libraries into original programs, and give attribution
    h. systematically test and refine programs using a range of test cases
    i. distribute tasks and maintain a project timeline when collaboratively developing computational artifacts
    j. document programs in order to make them easier to follow, test, and debug
2. Computer science computing systems standards for sixth through eighth grades are:
    a. recommend improvements to the design of computing devices, based on an analysis of how users interact with the devices
    b. design projects that combine hardware and software components to collect and exchange data
    c. systematically identify and fix problems with computing devices and their components
3. Computer science data and analysis standards for sixth through eighth grades are:
    a. collect data using computational tools and transform the data to make it more useful and reliable
    b. represent data using multiple formats
    c. refine computational models based on the data they have generated
4. Computer science impacts of computing standards for sixth through eighth grades are:
    a. compare tradeoffs associated with computing technologies that affect people's everyday activities and career options in Montana and the world, including American Indians
    b. discuss issues of bias and accessibility in the design of existing technologies
    c. collaborate with many contributors when creating a computational artifact
    d. describe tradeoffs between allowing information, personal or intellectual, to be public and keeping information private and secure

5. Computer science networks and the internet standards for sixth through eighth grades are:
    a. explain how physical and digital security measures protect electronic information
    b. apply multiple methods of encryption to model the secure transmission of information
    c. model the role of packets and protocols in transmitting data across networks and the internet

THE COMPUTER SCIENCE CONTENT STANDARDS FOR NINTH THROUGH TWELFTH GRADES

1. Computer science algorithms and programming standards for ninth through twelfth grades are:
    a. create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests
    b. describe how artificial intelligence drives many software and physical systems
    c. implement an artificial intelligence algorithm to play a game against a human opponent or solve a problem
    d. use and adapt classic algorithms to solve computational problems
    e. evaluate algorithms in terms of their efficiency, correctness, and clarity
    f. use lists to simplify solutions, generalizing computational problems instead of repeatedly using simple variables
    g. compare and contrast fundamental data structures and their uses
    h. justify the selection of specific control structures when tradeoffs involve implementation, readability, and program performance, and explain the benefits and drawbacks of choices made
    i. design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using events to initiate instructions
    j. decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, or objects
    k. create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs
    l. construct solutions to problems using student-created components, such as procedures, modules or objects
    m. analyze a large-scale computational problem and identify generalizable patterns that can be applied to a solution
    n. demonstrate code reuse by creating programming solutions using libraries and application programming interfaces
    o. systematically design and develop programs for broad audiences by incorporating feedback from users
    p. evaluate and refine computational artifacts to make them more usable and accessible
    q. design and develop computational artifacts working in team roles using collaborative tools
    r. document design decisions using text, graphics, presentations, or demonstrations in the development of complex programs
    s. plan and develop programs for broad audiences using a software life cycle process

t. explain security issues that might lead to compromised computer programs
u. develop programs for multiple computing platforms
v. use version control systems, integrated development environments, and collaborative tools and practices in a group software project
w. develop and use a series of test cases to verify that a program performs according to its design specifications
x. modify an existing program to add additional functionality and discuss intended and unintended implications
y. evaluate key qualities of a program through a process such as a code review
z. compare multiple programming languages and discuss how their features make them suitable for solving different types of problems

2. Computer science computing systems standards for ninth through twelfth grades are:
    a. explain how abstractions hide the underlying implementation details of computing systems embedded in everyday objects
    b. compare levels of abstraction and interactions between application software, system software, and hardware layers
    c. categorize the roles of operating system software
    d. develop guidelines that convey systematic troubleshooting strategies that others can use to identify and fix errors
    e. illustrate ways computing systems implement logic, input, and output through hardware components
3. Computer science data and analysis standards for ninth through twelfth grades are:
    a. create interactive data visualizations using software tools to help others better understand real-world phenomena
    b. use data analysis tools and techniques to identify patterns in data representing complex systems
    c. select data collection tools and techniques to generate data sets that support a claim or communicate information
    d. translate between different bit representations of real-world phenomena, such as characters, numbers, and images
    e. evaluate the tradeoffs in how data elements are organized and where data is stored
    f. create computational models that represent the relationships among different elements of data collected from a phenomenon or process
    g. evaluate the ability of models and simulations to test and support the refinement of hypotheses
4. Computer science impacts of computing standards for ninth through twelfth grades are:
    a. evaluate the ways computing technologies, globally and locally, impact personal, ethical, social, economic, and cultural practices, including American Indians
    b. test and refine computational artifacts to reduce bias and equity deficits

c. demonstrate ways a given algorithm applies to problems across disciplines
d. evaluate computational artifacts to maximize their beneficial effects and minimize harmful effects on society
e. evaluate the impact of equity, access, and influence on the distribution of computing resources in a global society
f. predict how computational innovations that have revolutionized aspects of our culture might evolve
g. use tools and methods for collaboration on a project to increase connectivity of people in different cultures and career fields
h. explain the beneficial and harmful effects that intellectual property laws can have on innovation
i. explain the privacy concerns related to the collection and generation of data through automated processes that may not be evident to users
j. evaluate the social and economic implications of privacy in the context of safety, law, or ethics
k. debate laws and regulations that impact the development and use of software

5. Computer science networks and the internet standards for ninth through twelfth grades are:
    a. recommend security measures to address various scenarios based on factors such as efficiency, feasibility, and ethical impacts
    b. explain tradeoffs when selecting and implementing cybersecurity recommendations
    c. compare ways software developers protect devices and information from unauthorized access
    d. evaluate the scalability and reliability of networks, by describing the relationship between routers, switches, servers, topology, and addressing
    e. give examples to illustrate how sensitive data can be affected by malware and other attacks
    f. compare various security measures, considering tradeoffs between the usability and security of a computing system
    g. discuss the issues that impact functionality

Administrative Rules of Montana Chapter 55 – NEW RULE PROPOSAL

Computer Science Program Delivery Standards

1. In general, a basic program in computer science education shall:
    a. meet the following conditions:
        i. provide a well-articulated integrated curriculum that challenges students to learn increasingly more sophisticated computer science concepts
        ii. foster a collaborative environment that embraces creativity, communication, and problem solving
    b. include the following practices:
        i. ensures students become informed citizens who can critically engage in public discussion on computer science related topics
        ii. ensures students develop as learners, users, and creators of computer science knowledge and artifacts
        iii. ensures students understand the role of computing in the world around them, leveraging computer technology to create solutions
        iv. increase career and college readiness