

# Grades 9-12

## Computational Thinker

### Abstraction

- 1 Decompose problems into component parts, extract key information, and develop descriptive models to understand the levels of abstractions in complex systems. [9-12.1](#)
- 2 Explain how computing systems are often integrated with other systems and embedded in ways that may not be apparent to the user. Examples: Millions of lines of code control the subsystems within an automobile (e.g., antilock braking systems, lane detection, and self-parking). [9-12.2](#)

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### Algorithms

- 3 Differentiate between a generalized expression of an algorithm in pseudocode and its concrete implementation in a programming language. [9-12.3](#)
  - a Explain that some algorithms do not lead to exact solutions in a reasonable amount of time and thus approximations are acceptable. [9-12.3.A](#)
  - b Compare and contrast the difference between specific control structures such as sequential statements, conditional, iteration, and explain the benefits and drawbacks of choices made. Examples: Tradeoffs involving implementation, readability, and program performance. [9-12.3.B](#)
  - c Distinguish when a problem solution requires decisions to be made among alternatives, such as selection constructs, or when a solution needs to be iteratively processed to arrive at a result, such as iterative “loop” constructs or recursion. [9-12.3.C](#)
  - d Evaluate and select algorithms based on performance, reusability, and ease of implementation. [9-12.3.D](#)
  - e Explain how more than one algorithm may solve the same problem and yet be characterized with different priorities. Examples: All self-driving cars have a common goal of taking a passenger to a designation but may have different priorities such as safety, speed, or conservation; web search engines have their own algorithms for search with their own priorities. [9-12.3.E](#)
- 4 Use and adapt classic algorithms to solve computational problems. Examples: Sorting, searching, shortest path, and data compression. [9-12.4](#)

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## Programming and Development

- 5 Design and iteratively develop computational artifacts for practical intent, personal expression, or to address a societal issue by using current events. 9-12.5
- 6 Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects, with parameters, and which return a result. 9-12.6
- 7 Compare and contrast fundamental data structures and their uses. Examples: Strings, lists, arrays, stacks, queues. 9-12.7
- 8 Demonstrate code reuse by creating programming solutions using libraries and Application Programming Interfaces. 9-12.8
- 9 Demonstrate the ability to verify the correctness of a program. 9-12.9
  - a Develop and use a series of test cases to verify that a program performs according to its design specifications 9-12.9.A
  - b Collaborate in a code review process to identify correctness, efficiency, scalability and readability of program code. 9-12.9.B
- 10 Resolve or debug errors encountered during testing using iterative design process. Examples: Test for infinite loops, check for bad input, check edge-cases. 9-12.10

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## Citizen of a Digital Culture

### Safety, Privacy, and Security

- 11 Model and demonstrate behaviors that are safe, legal, and ethical while living, learning, and working in an interconnected digital world. 9-12.11
  - a Recognize user tracking methods and hazards. Examples: Cookies, WiFi packet sniffing. 9-12.11.A
  - b Understand how to apply techniques to mitigate effects of user tracking methods. 9-12.11.B
  - c Understand the ramifications of end-user license agreements and terms of service associated with granting rights to personal data and media to other entities. 9-12.11.C
  - d Explain the relationship between online privacy and personal security. Examples: Convenience and accessibility, data mining, digital marketing, online wallets, theft of personal information. 9-12.11.D
  - e Identify physical, legal, and ethical consequences of inappropriate digital behaviors. Examples: Cyberbullying/harassment, inappropriate sexual communications. 9-12.11.E
  - f Explain strategies to lessen the impact of negative digital behaviors and assess when to apply them. 9-12.11.F
- 12 Describe how sensitive data can be affected by malware and other attacks. 9-12.12
- 13 Compare various security measures of a computer system. Examples: Usability, security, portability, and scalability. 9-12.13
- 14 Compare ways to protect devices, software, and data. 9-12.14

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### **Legal and Ethical Behavior**

- 15 Explain the necessity for the school’s Acceptable Use Policy. 9-12.15
- 16 Identify laws regarding the use of technology and their consequences and implications. Examples: Unmanned vehicles, net neutrality/common carriers, hacking, intellectual property, piracy, plagiarism. 9-12.16
- 17 Discuss the ethical ramifications of malicious hacking and its impact on society. Examples: Dissemination of privileged information, ransomware. 9-12.17
- 18 Explain the beneficial and harmful effects that intellectual property laws can have on innovation. 9-12.18

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### **Digital Identity**

- 19 Prove that digital identity is a reflection of persistent, publicly available artifacts. 9-12.19
- 20 Evaluate strategies to manage digital identity and reputation with awareness of the permanent impact of actions in a digital world. 9-12.20

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### **Impact of Computing**

- 21 Explain how technology facilitates the disruption of traditional institutions and services. Examples: Digital currencies, ridesharing, autonomous vehicles, retail, Internet of Things. 9-12.21
- 22 Research the impact of computing technology on possible career pathways. Examples: Government, business, medicine, entertainment, education, transportation. 9-12.22
- 23 Debate the positive and negative effects of computing innovations in personal, ethical, social, economic, and cultural spheres. Examples: Artificial Intelligence/machine learning, mobile applications, automation of traditional occupational skills. 9-12.23

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## **Global Collaborator**

### **Creative Communication**

- 24 Compare and contrast Internet publishing platforms, including suitability for media types, target audience, and feedback mechanism. 9-12.24
  - a Apply version control capabilities within a digital tool to understand the importance of managing historical changes across suggestions made by a collaborative team. 9-12.24.A

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### **Digital Tools**

- 25 Utilize a variety of digital tools to create digital artifacts across content areas. 9-12.25

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### **Collaborative Research**

- 26 Use collaborative technologies to work with others including peers, experts, or community members to examine local, national, and global issues and problems from multiple viewpoints. 9-12.26

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## Social Interactions

- 27 Apply tools and methods for collaboration on a project to increase connectivity among people in different cultures and career fields. Examples: Collaborative documents, webinars, teleconferencing, and virtual fieldtrips [9-12.27](#)
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## Computing Analyst

### Data

- 28 Develop a model that reflects the methods, procedures and concepts used by computing devices in translating digital bits as real-world phenomena, such as print characters, sound, images, and video. [9-12.28](#)
- 29 Summarize the role of compression and encryption in modifying the structure of digital artifacts and the varieties of information carried in the metadata of these artifacts. [9-12.29](#)
- 30 Evaluate the tradeoffs involved in choosing methods for the organization of data elements and the location of data storage, including the advantages and disadvantages of networked computing. Examples: Client server, peer-to-peer, cloud computing. [9-12.30](#)
- 31 Create interactive data visualizations using software tools to help others understand real-world phenomena. [9-12.31](#)
- 32 Use data analysis tools and techniques to identify patterns in data representing complex systems. [9-12.32](#)
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### Systems

- 33 Evaluate the scalability and reliability of networks by describing the relationship between routers, switches, servers, topology, packets, or addressing, as well as the issues that impact network functionality. Examples: Bandwidth, load, delay. [9-12.33](#)
- a Explain the purpose of Internet Protocol addresses and how domain names are resolved to IP addresses through a Domain Name System server. [9-12.33.A](#)
  - b Understand the need for networking protocols and examples of common protocols. Examples: HTTP, SMTP, and FTP [9-12.33.B](#)
- 34 Categorize the roles of operating system software. [9-12.34](#)
- 35 Appraise the role of artificial intelligence in guiding software and physical systems. Examples: predictive modeling, self-driving cars. [9-12.35](#)
- 36 Explain the tradeoffs when selecting and implementing cybersecurity recommendations. Examples: Two-factor authentication, password requirements, geolocation requirements. [9-12.36](#)

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## Modeling and Simulation

- 37 Evaluate the ability of models and simulations to test and support the refinement of hypotheses. 9-12.37
- a Create and utilize models and simulations to help formulate, test, and refine a hypothesis. 9-12.37.A
  - b Form a model of a hypothesis, testing the hypothesis by the collection and analysis of data generated by simulations. Examples: Science lab, robotics lab, manufacturing, space exploration. 9-12.37.B
  - c Explore situations where a flawed model provided an incorrect answer. 9-12.37.C
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## Innovative Designer

### Human/Computer Partnerships

- 38 Systematically design and develop programs for broad audiences by incorporating feedback from users. Examples: Games, utilities, mobile applications. 9-12.38
- 39 Identify a problem that cannot be solved by either humans or machines alone and discuss a solution for it by decomposing the task into sub-problems suited for a human or machine to accomplish. Examples: Forecasting weather, piloting airplanes. 9-12.39
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### Design Thinking

- 40 Use an iterative design process, including learning from mistakes, to gain a better understanding of a problem domain. 9-12.40