OFFICE OF CHIEF ACCOUNTABILITY OFFICER
Summary of State Board of Education Agenda Items
Consent Agenda
April 19, 2018

OFFICE OF EDUCATOR LICENSURE

S. Approval to establish a passing score for the Praxis Subject Assessment, *Computer Science* (Test Code 5652) as recommended by the Commission on Teacher and Administrator Education, Certification and Licensure and Development

Background Information: On March 2, 2018, the Commission on Teacher and Administrator Education, Certification and Licensure and Development met in its regularly scheduled meeting and approved the recommendation received from an Ad Hoc Committee of the Commission on Teacher and Administrator Education, Certification and Licensure and Development to adopt a qualifying passing score of (149) for the Praxis Subject Assessment, *Computer Science* (Test Code 5652). The qualifying passing score of (149) for the Praxis Subject Assessment, *Computer Science* (Test Code 5652) will be effective September 1, 2018.

A passing score, as required by the State Board of Education, on the *Computer Science* assessment will be used as one option for adding the Computer Science secondary (7-12) supplemental endorsement to standard secondary (7-12) five (5) year or provisional secondary (7-12) alternate route three (3) year teaching licenses. A new (7-12) endorsement code will be established upon final approval by the Mississippi State Board of Education.

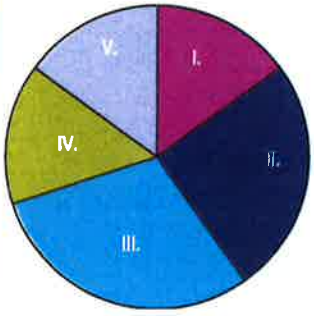
Recommendation: Approval

Back-up material attached

PRAXIS

Computer Science (5652)

Test at a Glance	
Test Name	Computer Science
Test Code	5652
Time	180 minutes
Number of Questions	100
Format	The test consists of a variety of short-answer questions such as selected-response questions (where you select one or multiple answer choices, depending on what the question asks for), questions where you enter your answer in a text box, and other types of questions. You can review the possible question types in chapter 2, Familiarize Yourself with Test Questions.
Test Delivery	Computer delivered



Content Categories	Approximate Number of Questions	Approximate Percentage of Examination
I. Impacts of Computing	15	15%
II. Algorithms and Computational Thinking	25	25%
III. Programming	30	30%
IV. Data	15	15%
V. Computing Systems and Networks	15	15%

About This Test

The *Praxis* Computer Science test is designed to assess the computer science knowledge and competencies necessary for a beginning teacher of secondary school computer science. Examinees have typically completed a bachelor's program with an emphasis in computer science or computer science education.

The examinee will be required to understand and work with computer science concepts, use algorithms and computational thinking, work with code, manipulate data, and demonstrate knowledge of computing systems and networks.

The test is not designed to be aligned with any particular computer science curriculum, but it is intended to be consistent with the recommendations of national studies on computer science education, such as the Code.org

K-12 Computer Science Framework (2016), the Computer Science Teachers Association (CSTA) *K-12 Computer Science Standards* (2017), and the International Society for Technology in Education (ISTE) *Standards for Computer Science Educators* (2011).

This test may contain some questions that do not count toward your score.

Topics Covered

Representative descriptions of topics covered in each category are provided below.

I. Impacts of Computing

A. Understands and applies knowledge of impact of, obstacles to, and effects of computing

1. Understand computing as a way of expressing creativity, solving problems, enabling communication, and fostering innovation in a variety of fields and careers
   a. recognize that computers can be used to showcase creativity
   b. recognize the benefits of using computers to solve problems
   c. provide examples of how computers enable communication and collaboration
   d. provide examples of how computers foster innovation
2. Know the obstacles to equal access to computing among different groups and the impact of those obstacles
   a. identify obstacles to equal access to computing among different groups (e.g., groups defined by gender, socioeconomic status, disability/accessibility needs) and the impact of those obstacles
   b. identify factors that contribute to the digital divide
   c. match obstacles to equal access with effective solutions
3. Understand beneficial and harmful effects of computing innovations and the trade-offs between them
   a. analyze computing innovations in terms of their social, economic, and cultural impacts, both beneficial and harmful
   b. identify trade-offs between beneficial and harmful effects of computer innovations

B. Understands and applies knowledge of issues regarding intellectual property, ethics, privacy, and security in computing

1. Know different methods of protecting intellectual property rights and the trade-offs between them in a variety of contexts (e.g., Creative Commons, open source, copyright)
   a. using correct vocabulary, describe how different methods of protecting intellectual property rights work
   b. given a context, identify appropriate methods of protecting intellectual property rights
   c. identify and compare trade-offs between different methods of protecting intellectual property rights
2. Understand ethical and unethical computing practices and their social, economic, and cultural implications
   a. identify ethical and unethical computing practices in context
   b. describe the social, economic, and cultural implications of ethical and unethical computing practices
   c. identify the conditions under which a given computing practice is ethical or legal
3. Know privacy and security issues regarding the acquisition, use, and disclosure of information in a digital world
   a. using correct vocabulary, describe privacy and security issues
   b. in context, identify appropriate strategies to safeguard privacy and ensure security
   c. describe trade-offs between local and cloud-based data storage
   d. identify methods that digital services use to collect information about users

II. Algorithms and Computational Thinking

A. Understands and applies knowledge of abstraction, pattern recognition, problem decomposition, number base conversion, and algorithm formats

1. Understand abstraction as a foundation of computer science
   a. identify, create, or complete the correct ordering, from low to high, of an abstraction hierarchy
   b. identify abstractions in context
   c. identify details that can be removed from a solution in order to generalize it
2. Know how to use pattern recognition, problem decomposition, and abstraction to develop an algorithm
   a. given a table of values or other data source, identify the patterns in the data and identify algorithms that could produce the patterns
   b. identify components that could be part of an algorithm to solve a problem
   c. identify actions and actors when decomposing a problem
   d. identify appropriate decomposition strategies
3. Understand number base conversion and binary, decimal, and hexadecimal number systems
   a. convert between number bases
   b. analyze and compare representations of numbers in different bases
4. Understand how to develop and analyze algorithms expressed in multiple formats (e.g., natural language, flowcharts, pseudocode)
   a. interpret diagrams that describe algorithms, given an explanation of the symbols used
   b. compare algorithms written in multiple formats
   c. trace and analyze algorithms written in different formats
   d. identify correct sequencing of steps in an algorithm and errors in sequencing

B. Understands and applies knowledge of algorithm analysis, searching and sorting algorithms, recursive algorithms, and randomization

1. Be familiar with the limitations of computing in terms of time, space, and solvability as well as with the use of heuristic solutions that can address these limitations
   a. identify and compare algorithms that are linear, quadratic, exponential, or logarithmic
   b. recognize the existence of problems that cannot be solved by a computer
   c. in context, identify factors that prevent a problem from being solvable
   d. identify situations where heuristic solutions are useful
   e. in context, identify space and time limitations of computational solutions to problems
2. Understand searching and sorting algorithms; can analyze sorting algorithms for correctness and can analyze searching algorithms for correctness and efficiency
   a. trace algorithms and predict output and intermediate results
   b. calculate the number of comparisons required for linear and binary search algorithms
3. Understand simple recursive algorithms (e.g., *n* factorial, sum of first *n* integers)
   a. trace simple recursive algorithms
   b. provide missing steps in incomplete simple recursive algorithms
   c. identify parts of a recursive algorithm (e.g., base or stopping condition, recursive call)
   d. identify errors in simple recursive algorithms
   e. identify an iterative algorithm that is equivalent to a recursive algorithm
4. Be familiar with the use of randomization in computing
   a. identify appropriate uses of randomization in a variety of applications
   b. identify the difference between random and pseudorandom numbers

III. Programming

A. Understands and applies knowledge of programming control structures, standard operators, variables, correctness, extensibility, modifiability, and reusability

1. Understand how to write and modify computer programs in a text-based programming language
   a. describe what a program does or be able to choose the code segment that correctly implements a given intended purpose
   b. identify missing code in a code segment with a stated intended purpose
   c. place statements in appropriate order to create a correct program
   d. identify how changing one part of a code segment will affect the output
2. Understand how to analyze computer programs in terms of correctness
   a. trace code and indicate the output printed or the value of variables after code segment execution
   b. indicate the inputs that produce given outputs for a code segment
   c. describe what a program does or choose the code segment that correctly implements a given intended purpose
   d. identify valid preconditions and postconditions
   e. compare two code segments or algorithms
   f. identify the type of error produced by a code segment (i.e., syntax, runtime, compile-time, overflow, round-off, logic)
   g. identify errors in incorrect code and changes that can be made to correct them
3. Know the concepts of extensibility, modifiability, and reusability
   a. identify the meaning of the terms
   b. identify functionally equivalent statements or code segments that differ in one of these three ways
   c. identify situations where the use of constants or variables would be preferred over hard-coded values
   d. identify opportunities for parameterization
   e. choose code that improves on given code by making it more extensible, modifiable, or reusable
   f. identify changes that would improve a given code segment
4. Understand the three basic constructs used in programming: sequence, selection, and iteration
   a. trace code and indicate the output printed or the value of variables after code segment execution
   b. indicate inputs that produce given outputs for a code segment
   c. describe what a program does or choose the code segment that correctly implements a given intended purpose
   d. identify missing code in a code segment with a stated intended purpose
   e. identify equivalent statements or code segments
   f. identify the three constructs when used in code
   g. identify which of the constructs are needed to implement given functionality
   h. convert code that does not use iteration to equivalent code that uses iteration

5. Understand how to use standard operators (i.e., assignment, arithmetic, relational, logical) and operator precedence to write programs
   a. trace code and indicate the output displayed or the value of variables after code segment execution
   b. indicate inputs that produce given outputs for a code segment
   c. describe what a program does or choose the code segment that correctly implements a stated intended purpose
   d. identify missing code in a code segment with a stated intended purpose
   e. identify equivalent statements or code segments
   f. place statements in appropriate order to create a correct program
   g. use Boolean algebra to identify equivalent Boolean expressions
   h. write a Boolean expression equivalent to given code, or identify code equivalent to a given Boolean expression or English description
   i. identify the correct implementation of a given formula, including formulas with fractions
   j. evaluate expressions that include arithmetic operations
6. Understand how to use variables and a variety of data types
   a. identify variables and data types (e.g., integers, floating point, string, Booleans, arrays/lists)
   b. identify the need for type conversion
   c. trace code and indicate the output printed or the value of variables after code segment execution
   d. indicate the inputs that produce given outputs for a code segment
   e. describe what a program does or choose the code segment that correctly implements a stated intended purpose
   f. identify missing code in a code segment with a stated intended purpose
   g. identify equivalent statements or code segments
   h. place statements in appropriate order to create a correct program
   i. describe the difference between integer and floating point numeric data types
   j. describe the difference between integer and floating point division
   k. describe the benefits of the use of each data type
   l. distinguish between global and local scope
   m. identify the most appropriate data type in a given context
   n. identify the correct sequence of string operations to produce a given output

B. Understands and applies knowledge of procedures, event-driven programs, usability, data structures, debugging, documenting and reviewing code, libraries and APIs, IDEs, and programming language paradigms, including object-oriented concepts
   1. Understand how to write and call procedures with parameters and return values
      a. trace code and indicate the output printed or the value of variables after code segment execution
      b. indicate inputs that produce given outputs for a code segment
      c. describe what a program does or choose the code segment that correctly implements a stated intended purpose
      d. identify missing code in a code segment with a stated intended purpose
      e. identify equivalent statements or code segments
      f. place statements in appropriate order to create a correct program
      g. trace code when references to objects and arrays are passed to procedures
      h. trace code that includes nested procedure calls
   2. Know the concepts of event-driven programs that respond to external events (e.g., sensors, messages, clicks)
      a. trace code and indicate the output printed or the value of variables after code segment execution
      b. indicate inputs that produce given outputs for a code segment
      c. describe what a program does or choose the code segment that correctly implements a stated intended purpose
      d. identify missing code in a code segment with a stated intended purpose
      e. identify possible errors due to asynchronous events
      f. identify aspects of concurrency in event-driven programming

3. Be familiar with usability and user experience (e.g., ease of use and accessibility)
   a. identify code that improves on given code in terms of usability or user experience
   b. identify meaningful error messages
   c. identify features that improve accessibility
4. Be familiar with dictionaries/maps, stacks, and queues
   a. identify a data structure based on a description of behavior or appropriate use
   b. given goals, constraints, or context, identify the most appropriate data structure
   c. trace code that uses a particular data structure
5. Understand how to use debugging techniques and appropriate test cases
   a. identify which test cases are most useful for given code
   b. differentiate between different types of errors (e.g., overflow, round-off, syntax, runtime, compile-time, logic)
   c. describe useful debugging techniques (e.g., where to put print statements)
   d. differentiate between empirical testing and proof
   e. identify errors in code and solutions to those errors
6. Be familiar with characteristics of well-documented computer programs that are usable, readable, and modular
   a. identify characteristics of good documentation
   b. identify good and poor documentation practices in context
7. Be familiar with techniques to obtain and use feedback to produce high-quality code (e.g., code reviews, peer feedback, end user feedback)
   a. identify situations in which each of the three listed techniques are useful
8. Know how to use libraries and APIs
   a. identify correct call(s) and use of return values given an API definition
   b. identify reasons to use or not use libraries in place of writing original code
   c. identify applications (e.g., math libraries, random number generation) that use APIs
9. Understand programming techniques to validate correct input and detect incorrect input
   a. identify effective input data validation strategies
   b. compare data validation (proper range and format) and data verification (e.g., password verification)
   c. identify improvements to code for which data validation is required
10. Be familiar with the features and capabilities of integrated development environments (IDEs)
   a. identify components of IDEs
   b. identify benefits and drawbacks of using IDEs
   c. identify the costs and benefits of context editors
11. Be familiar with the differences between low- and high-level programming languages
   a. identify characteristics of low- and high-level languages
12. Be familiar with different programming paradigms
   a. identify the terminology of procedural programming
   b. identify the terminology of object-oriented programming
   c. compare programming paradigms
13. Know object-oriented programming concepts
   a. identify classes, instance variables, and methods given a diagram
   b. identify the benefits of inheritance and encapsulation
   c. identify distinctions between overloading and overriding
14. Be familiar with program compilation and program interpretation
   a. identify differences between compilation and interpretation
   b. identify differences between source code and object code

IV. Data

A. Understands and applies knowledge of digitalization, data encryption and decryption, and computational tools

1. Understand bits as the universal medium for expressing digital information
   a. perform calculations, using bits and bytes
   b. determine the number of bits and bytes required to store a given amount of data
   c. given the description of an encoding scheme, encode or decode data
   d. describe lossy and lossless data compression
   e. explain why binary numbers are fundamental to the operation of computer systems
2. Be familiar with concepts of data encryption and decryption
   a. distinguish between encoding and encryption
   b. identify trade-offs in the use of data encryption
3. Know how to use computational tools, including spreadsheets, to analyze data in order to discover, explain, and visualize patterns, connections, and trends
   a. transform data to make it more useful
   b. identify specific data or characteristics of specific data that need to be removed or modified before an entire data set can be used
   c. describe the use of spreadsheet operations (e.g., formulas, filters, sorts, charts, graphs) to analyze and visualize data

B. Understands and applies knowledge of simulation, modeling, and manipulation of data

1. Be familiar with the use of computing in simulation and modeling
   a. describe questions that can be answered with a given simulation, or explain what data and process are required in a simulation in order to answer a given question
   b. trace code in a simulation context
   c. identify missing code in a simulation context
   d. identify the impact of changes to simulations (e.g., more or fewer variables, more or less data)
   e. identify applications of simulation and modeling
2. Be familiar with methods to store, manage, and manipulate data
   a. use terminology and concepts of files and databases
   b. identify measures of file size (e.g., byte, kilo, mega, giga, tera, peta)
   c. identify issues connected with the storage requirements of computing applications, including scale, redundancy, and backup
3. Be familiar with a variety of computational methods for data collection, aggregation, and generation
   a. identify the benefits of working with publicly available data sets
   b. identify the types of data generated by surveys and sensors
   c. identify examples of crowdsourcing and citizen science
   d. identify appropriate data-collection methods for a given context and purpose

V. Computing Systems and Networks

A. Understands and applies knowledge of operating systems, computing systems, communication between devices, and cloud computing

1. Know that operating systems are programs that control and coordinate interactions between hardware and software components
   a. identify hardware components and their functions
   b. identify software components and their functions
   c. identify common operating systems tasks
   d. identify resource issues that have an impact on functionality

2. Be familiar with computing systems embedded in everyday objects (e.g., Internet of Things [IoT], ATMs, medical devices)
   a. describe what an embedded system is
   b. define what the IoT is and how it is used
   c. describe how sensors are used in embedded systems
3. Know the capabilities, features, and uses of different types of computing systems (e.g., desktop, mobile, cluster)
   a. identify capabilities, features, and uses for each type of computer system
   b. identify criteria to evaluate and compare computing systems
4. Be familiar with computers as layers of abstraction from hardware (e.g., logic gates, chips) to software (e.g., system software, applications)
   a. identify appropriate abstraction layers for hardware and software components
5. Be familiar with the steps required to execute a computer program (fetch-decode-execute cycles)
   a. describe what happens during fetch, decode, and execute, including the order of the steps in the cycle
6. Be familiar with trade-offs between local, network, and cloud computing and storage
   a. identify advantages and disadvantages in terms of performance, cost, security, reliability, and collaboration
   b. identify means of storing binary data
7. Be familiar with communication between devices
   a. identify and compare wireless communication systems
   b. identify and compare wired communication systems
   c. identify and compare network types

B. Understands and applies knowledge of networks, including security issues and the Web

1. Know components of networks
   a. identify network hardware devices and their functions
   b. describe possible abstraction models of networks
2. Be familiar with factors that have an impact on network functionality
   a. define basic terminology (e.g., bandwidth, load, latency)
   b. estimate necessary bandwidth and data size for a given situation
   c. identify critical resources for a given situation
3. Be familiar with how Internet and Web protocols work
   a. describe the purpose of protocols and identify common Internet and Web protocols
   b. compare IPv4 and IPv6
   c. identify and describe the basic parts of a URL (e.g., protocol, subdomain, domain name, port, path)
   d. describe the hierarchical structure of names in the domain name system (DNS)
   e. describe the purpose and function of IP addressing
   f. identify how Internet protocols address reliability, redundancy, and error handling
4. Be familiar with digital and physical strategies for maintaining security
   a. identify characteristics of strong passwords (e.g., length, bits per character)
   b. identify digital and physical security strategies
   c. identify trade-offs in the use of security measures (e.g., encryption, decryption, digital signatures and certificates)
5. Be familiar with concepts of cybersecurity
   a. identify and define the five pillars of cybersecurity: confidentiality, integrity, availability, nonrepudiation, and authentication
6. Be familiar with the components that make up the Web (e.g., HTTP, HTML, browsers, servers, clients)
   a. identify the uses of markup languages
   b. identify the purposes of browsers, servers, and clients

Code Segments

Some stimulus material contains code segments written in pseudocode. The notation used in the pseudocode is described below.

PSEUDOCODE NOTATION

Explanation	Notation
Assignment operator	←
Arithmetic operators	+ - / * ^ % Note that / indicates floating point division unless stated otherwise.
Relational operators	== < > ≤ ≥ ≠
Logical operators	**and** **or** **not**
String concatenation operator	+
Boolean values	**true** **false**
Null	**null**
Comments	`// this is a single-line comment`

Placeholder for missing code	For example,
	`/* missing code */`
	`/* missing condition */`

Print A comment is used where necessary to indicate if a line feed or blank is appended to the argument.	**print** arg
Data types	**boolean** **char** **double** **float** **int** **int[]** **int[][]** **short** **String**
Array initialization and reference	**int[]** a ← {1, 2, 3} **int** b[0..2] ← {1, 2, 3} **int[][]** c a[0]

Conditional statements: Indentation and **end if** statements are significant.
 	
Example:
`if ( x > 10 )`
`  print "big number"`
`else`
`  print "small number"`
`end if`
	if (condition)
	  block of statements
	end if
	
	if (condition)
	  block of statements
	else
	  another block of statements
	end if

Iterative statements: Indentation and **end** statements are significant.	**for** (initialization; condition; increment)
	  block of statements
	end for
	
	while (condition)
	  block of statements
	end while
	
	do
	  block of statements
	while (condition)
	
	repeat
	  block of statements
	until (condition)

Procedures: Indentation and **end** statements are significant.
 	
The return type is indicated in the procedure header and is based on the value returned by the procedure or is **void** if the procedure does not return a value.
	int procedureName (arg1,
	  arg2,
	  ...)
	  block of statements
	  return value
	end procedureName
	
	void procedureName (arg1,
	  arg2,
	  ...)
	  block of statements
	end procedureName

Classes	**class** className
	  variable declarations
	  procedures
	end class className

Object-oriented keywords	**extends** **new** **public** **private**