

Expected Student Performance Criteria

The following table summarizes the performance level students are expected to demonstrate at the time of graduation. Specific performance indicators are elaborated in the on the following pages.

I = Introduced R = Reinforced E = Emphasized ¹		Student Learning Outcomes								
		1. Professional and ethical behavior	2. Read technical literature and learn on their own	3. Function in teams and carry out assignments	4. Knowledge and skills need for employment	5. Theory, design, operation, project management, & DB ²	6. Understand and use algorithms	7. Debug programs	8. Verbal and writing skills	9. Evaluate information
Core Program Courses										
	CS 1400 Fundamentals of Programming	I			I					
	CS 1410 Object-Oriented Programming	R	I		R	I		I		
	CS 2130 Computational Structures	R			R		R			
	CS 2350 Web Development	R	R		R					
	CS 2420 Introduction to Data Structures & Algorithms	R			R		I			
	CS 2450 Software Engineering I	R	R	I	R		R	R	R	I
	CS 2550 Database Design & Application Development	R	R		R					
	CS 2650 Computer Architecture/Organization	R	R		R			R		
	CS 2705 Network Fundamentals and Design	R	R		R			R		
	CS 3100 Operating Systems	R	R		R	R			R	R
	CS 3230 Internet Multimedia and Applications Using Java		R		R	R	R	R		
	CS 3280 Object Oriented Windows Application Development w/ C#									
	CS 3550 Advanced Database Programming									
	CS 3750 Software Engineering II	E	R	R	R			R	E	E
	CS 4110 Concepts of Formal Languages and Algorithms				R	E	E			
Capstone Courses ³	CS 4230 Java Application Development		E	E	E			E		
	CS 4350 Advanced Internet Programming		E	E	E			E		
	CS 4650 Advanced Game Development		E	E	E			E		
	CS 4750 Advanced Software Engineering		E	E	E			E		
	CS 4790 N-Tier Web Programming		E	E	E			E		

¹ Program improvement statistics are collected for these courses

² This outcome is more fully enabled through elective courses

³ Students must select one course

Rubric for Student **Outcome 1**: Students will understand the importance of and will practice professional and ethical behavior, and will understand the professional, ethical, legal, security, and social responsibilities of computing professionals.

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
Comprehension	Unable to understand the importance of norms in guiding professional and ethical behavior among computing professionals.	Able to understand why norms play a role in defining what it means to be a computing professional. Can conceptualize and internalize some of these norms and some of the various ethical, legal, and social contexts where these norms are relevant.	Able to demonstrate many norms and the ways that they guide behavior among computing professionals. Can elaborate on a wide array of ethical, legal, and social contexts where these norms have relevance.	Can mentor other computing professionals in the proper practice of ethical norms. Can speak and advise with great specificity about the various professional, ethical, and legal situations where these norms come into play. Can articulate and demonstrate the social responsibilities that accompany these norms.
Compliance with Standards	Is unable or unwilling to comply with standards and/or norms that define professional conduct among computing professionals	Complies with many but not all norms that have been defined by a particular organization of computing professionals.	Complies with all norms that have been defined by a particular group of computing professionals that the person is working with. Any occurrences of noncompliance can be sufficiently addressed by proffering persuasive professional, ethical, legal and/or social rationale.	Complies faithfully with norms and models professional behavior for others. Can successfully navigate through situations where many norms come into play and where some of these norms may prescribe competing and conflicting courses of action. Can use disambiguation to clearly identify norms

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
				that are prescribing different courses of action and proffer new balanced courses of action that give proper consideration to each of these norms.

Rubric for Student **Outcome 2**: Students will be able to read and understand manuals, documentation and technical literature, find and understand sources of information, and learn on their own what they need to continue to perform professionally after graduation.

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
Use product manuals and documentation	Unable to use a product's manual or documentation for a tool or development environment	Able to search for and carry out a single-step operation following the manual or documentation for a tool or development environment	Able to search for and carry out a complex operation following the manual or documentation for a tool or development environment	Able to solve general problems involving the operation of a tool or development environment following the manual, and able to design and write documentation
Use Computer Language Specific Documentation	Unable to launch or use the documentation for a specific language	Able to use the documentation for a specific language to code simple API calls (e.g., <code>double sqrt(double);</code>)	Able to use the documentation for a specific language to code complex API calls (e.g., <code>int stat(struct* stat);</code>)	Able to use the documentation for a specific language to code sequences or nesting of API calls and able to design and write such documentation
Conduct Internet-based Research	Unable to use the Internet to answer simple computer-related questions and to appreciate when doing so is appropriate	Able to use the Internet to answer simple computer-related questions and to appreciate when doing so is appropriate	Able to use the Internet to answer complex computer-related questions and to appreciate when doing so is appropriate	Able to use the Internet to evaluate and recommend products, processes, designs, languages, etc., and able to write and publish such Internet resources
Conduct Formal Research	Unable to use appropriate sources of information.	Able to locate and cite multiple sources of appropriate computer-related information.	Write and present formal, well-structured, and documented research on an assigned topic	Able to collaboratively conduct formal research leading to a professional presentation or publication.

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
Self-Directed Learning	Unable to conduct self-directed learning.	Able to identify topics requiring individual study based on professional needs and to locate learning resources.	Able to identify topics requiring individual study based on professional needs, and able to use books, journals, and other resources to gain a working knowledge.	Able to master relevant new topics and teach that knowledge to others.

Rubric for Student **Outcome 3:** Students will be able to function as a team member and carry out assigned tasks.

Scale Performance	1. Novice Limited Knowledge and/or Application	2. Intermediate Base Knowledge	3. Capable Basic Application	4. Expert Intentional and Effective Application
Forming <i>The team meets and learns about the opportunity and challenges, and then agrees on goals and begins to tackle the tasks.</i>	Does not recognize the need for team work and/or lacks the motivation to form a team and/or actively resists participating in the team formation process.	Recognizes the need for team work but the instructor must initiate conversations with the student regarding group participation, motivation, and/or interpersonal skills.	Recognizes the need for team work and participates in conversations with others in the group to form a safe team environment.	Works enthusiastically with others in the group to create a safe team environment and comfortable atmosphere with little to no assistance from the instructor; helps identify resources to orient group to tasks or functions and breaks down interpersonal barriers.
Storming <i>The team addresses issues such as what problems they are really supposed to solve, how they will function independently (and together) and what leadership model they will accept</i>	Does not deal well with contentious, unpleasant and/or conflicting ideas or other team members.	Understands tolerance of each team member and their differences needs to be emphasized. Without tolerance and patience the team will fail.	Recognizes need for patience and tolerance in working with others; understands their role and responsibilities on the team; participates in conversation with others in the group to clarify group task and purpose.	Works with others on the team by initiating conversations, promoting new ideas, encouraging constructive and appropriate conflict management; reminding others of task and purpose of the group; ensuring all opinions and differences are respected.
Norming	Consistently goes against established team	Understands team rules, values, professional	Follows team rules, values, and professional	Demonstrates leadership skills by helping to

Scale Performance	1. Novice Limited Knowledge and/or Application	2. Intermediate Base Knowledge	3. Capable Basic Application	4. Expert Intentional and Effective Application
<i>Team members adjust their behavior to each other as they develop work habits that make teamwork seem more natural and fluid.</i>	rules, values, professional behavior, shared methods, and/or working tools.	behavior, shared methods, and/or working tools that promote trust and cohesion, communication, feedback and interdependence.	behaviors. Practices shared methods, and/or working tools. Is trusted by others on the team. Communicates effectively and provides feedback, as requested.	move the group from conflict to trust and cohesion; Practices interdependence with others on the team, promoting trust cohesion, communication, and feedback between the team members.
Performing <i>Team members are able to function as a unit as they find ways to get the job done smoothly and effectively without inappropriate conflict or the need for external supervision.</i>	Consistently does not deliver or turns in assigned work products late; demonstrates lack of proficiency in assigned team tasks; and/or does not work well with others in the group.	Understands his/her role on the team and the need to get the job done smoothly and effectively without inappropriate conflict or the need for external supervision.	Is a competent, autonomous and productive member of the team; works collaboratively and independently within the group to complete tasks.	Works collaboratively with others to produce and turn in quality work products on schedule; encourages others on their team; serves as a resource for the group; helps others; demonstrates proficiency in their ability to complete tasks independently within the group context.

Rubric for Student **Outcome 4:** Students will have the knowledge and the skills needed to be employable, and to be immediately and continuously productive.

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
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Programming ability	Unable to write software programs that meet exact specifications.	Able to write software programs that meet the exact specifications <i>sometimes</i>	Able to write software programs that meet the exact specifications <i>most of the time</i> .	Able to write software programs that meet the exact specifications <i>almost always</i> .
Conformance	Unable to conform to organizational rules	Able to conform to organizational rules <i>sometimes</i>	Able to conform to organizational rules <i>most of the time</i>	Able to conform to organizational rules <i>always</i> .
Adaptability	Unable to adapt to meet the growing or changing needs of the organization	Able to adapt to meet the growing or changing needs of the organization <i>sometimes</i>	Able to adapt to meet the growing or changing needs of the organization <i>most of the time</i>	Able to adapt to meet the growing or changing needs of the organization <i>almost always</i>

Rubric for Student **Outcome 5**: Students will have a basic understanding of computer theory, software design and operation, project management, databases, networking, and computer architecture.

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
Computer Theory	Unable to describe fundamental tenets of computability theory or the limitations inherent in computation.	Able to conceptualize and demonstrate the operation of Finite State Machines.	Able to demonstrate the relationship between Finite State Machines and formal languages, and to connect the functionality of these machines to computation.	Able to clearly articulate and demonstrate mathematical, machine, and language models of computing up through and including Turing Machines, Phrase-Structure Languages, and the Halting Problem.
Software Design	Unable to independently design a software system or to express a software system design in the UML	With guidance, able to analyze simple problems or system sub-components and produce simple UML diagrams and documents	Either independently or as a team member analyze a moderately difficult problem and express the results in the UML and to complete a system design with needed diagrams and documents	Either independently or as a team leader analyze a complex problem and express the results in the UML and to complete a system design with needed diagrams and documents
Software Operation	Unable to analyze or diagram the operation of a software system	Able to analyze a software system and produce class diagrams that describe the system	Able to analyze a software system and produce class, state chart, interaction and use-case diagrams that describe the system	Able to use analysis tools (cross-reference, profiler, code-to-diagram, etc.) to reverse engineer and document complex systems
Project Management	Unable to describe principles, methodologies, benefits	Able to identify basic principles, describe methodologies and state	Able to participate on a team using the methodologies of a	Able to lead a project using a variety of contemporary project

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
	and challenges of project management or to be responsible for deliverables on a project team.	benefits and challenges of project management and to contribute to the deliverables of a project.	managed project, describe the duties of a project manager, contribute to schedules, estimates, risk, quality and change management and accept accountability for deliverables according to project requirements, schedule and quality standards.	management methodologies; direct time, risk, quality and change management; design a project and take management responsibility for all phases from inception to completion; contribute to the project management standards of an organization and train team members in those standards; and contribute to program management, team management, outsourcing and enterprise strategic planning.
Database	Does not understand basic database terminology and basic SQL syntax.	Understands the issues of database design and implementation, understands basic SQL syntax, and can use SQL to retrieve data from a relational database.	Understands the steps and definition of database normalization, and is able to use SQL to perform multi-table query requests from a relational database.	Able to correctly design, normalize and model a relational database, to use SQL to perform complex query requests, and to use SQL to create and modify a relational database.
Networking	Is not familiar with the	Can identify TCP/IP	Able to describe	Able to describe

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
	TCP/IP layers or understand the TCP/IP layer responsibilities.	layers and some of the responsibilities of each layer.	interaction between TCP/IP layers and the responsibilities of each layer, recognize IP networks including subnets and can troubleshoot networking issues and use network diagnostic tools.	interaction between TCP/IP layers and the responsibilities of each layer, can create IP networks including subnets and can troubleshoot and solve all networking issues by using appropriate network diagnostic tools.
Computer Architecture	Unable to identify relationships between components, or explain the basic functions of each.	Able to identify basic relationships between components and explain the basic functions of each.	Able to explain each component in terms of relationship to other components, protocols, and basic physical function.	Able to select appropriate hardware to produce the most efficient hardware for a stated set of circumstances.

Rubric for Student **Outcome 6**: Students will understand algorithm design and how to express and how to implement algorithms using a variety of notation, programming languages, and paradigms.

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
Algorithm design	Unable to design and create basic algorithms to solve a computing problem.	With guidance, able to design and create basic algorithms to solve a computing problem.	With guidance, able to design and create more advanced algorithms to solve a computing problem, or independently design and create basic algorithms to solve a computing problem.	Able to independently design and create more advanced algorithms to solve a computing problem.
Algorithm Implementation	Unable to demonstrate knowledge about the notations, programming language suitability, and paradigms used in algorithm implementation.	Able to write working programs to correctly implement basic algorithms.	With guidance, able to write working programs to correctly implement more advanced algorithms.	Able to independently write working programs to correctly implement more advanced algorithms.
Theoretical Performance Analysis	Unable to analyze and describe time and space complexity of basic algorithms.	Unable to classify algorithms using Big-O notation but able to recognize relative performance among different algorithms.	Able to classify algorithms using Big-O notation.	Able to understand average case, worst case, and space Big-O classifications as well as gradations of algorithms within the same Big-O notation.
Understanding Real World Performance	Unable to understand benefits and drawbacks of running algorithms on a given hardware architecture.	Able to demonstrate awareness of how hardware architecture may affect the performance of algorithms.	Able to understand major factors that may affect the performance of algorithms running on a given hardware architecture.	Able to identify optimal algorithms for a given hardware architecture.

Rubric for Student **Outcome 7**: Students will be able to debug computer programs.

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
Identification	Unable to identify or classify syntax or logic errors through behavior or compilation errors.	Able to identify a syntax based error through a description or the observation of behavior.	Able to identify and classify syntax, runtime, and logic based errors based on behavior or through a description.	Able to identify and classify syntax, runtime, logic based errors, and Heisenbugs based on behavior or description.
Reproduction	Unable to specify the necessary steps for reliable bug reproduction.	Able to specify necessary steps to reproduce bug reliably in circumstances requiring a single step.	Able to specify necessary steps to reproduce bug reliably in circumstances requiring a sequence of steps.	Able to specify necessary steps to reproduce bug reliably in circumstances requiring a complex set of conditions or environmental factors.
Localization	Unable to localize a bug.	Able to localize through the use of print or trace statement debugging.	Able to localize through the use of breakpoints, stack traces, compilation errors, and trace statements.	Able to localize through the use of breakpoints, watch statements, stack traces, compilation errors and trace statements. Also able to analyze post-mortem through the use of stack traces and memory dumps. Able to localize Heisenbugs.
Test Cases	Unable to independently create test cases	Able to independently create simple test cases for numeric programs	Able to independently create test cases for numeric and text processing programs	Able to independently create test cases for a wide variety of programs
Unit Testing	Unable to write, or define unit tests.	Able to define, and write unit tests for simple	Able to define and write multiple unit tests for	Able to define and write multiple unit tests for

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
		programs.	complex programs that encompasses multiple fail points for a given test.	complex programs encompassing multiple fail points, as well as utilize modern unit test frameworks to automate unit testing.
Correction	Unable to correct errors when located.	Able to correct syntax bugs once located.	Able to correct syntax, logic, and runtime bugs once located.	Able to correct syntax, logic, runtime, thread based, performance, and architectural bugs once located.

Rubric for Student **Outcome 8:** Students will be able to express themselves clearly both verbally and in writing.

Verbal Communications:

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
Organization <i>Organizational pattern (specific introduction and conclusion, sequenced material within the body, and transitions) is clearly and consistently observable.</i>	-Specific introduction and conclusion -No sequence in material	-Specific introduction and conclusion -Sequenced material within the body is inconsistent	-Specific introduction and conclusion -Sequenced material within the body -Cohesive presentation content	-Specific introduction and conclusion -Sequenced material within the body -Cohesive presentation content
Language <i>Language choices enhance the effectiveness of the presentation.</i>	-Unclear -Minimally support the effectiveness of the presentation -Occasional mistakes in grammar -Appropriate to audience	-Not interesting -Partially support the effectiveness of the presentation -Correct grammar -Appropriate to audience	-Support the effectiveness of the presentation -Correct grammar -Appropriate to audience	-Enhance the effectiveness of the presentation -Correct grammar -Appropriate to audience
Delivery <i>Delivery techniques (posture, gesture, eye contact, and vocal expressiveness) make the presentation compelling.</i>	-Poor posture -Seldom eye contact with the audience -Not enough or too much gesture and expression	-Intermittent good posture -Occasional eye contact with the audience -Appropriate gesture and expression	-Good posture -Frequent eye contact with the audience -Appropriate gesture and expression	-Good posture -Eye contact with the audience most of the time -Appropriate gesture and expression -Deliverance with confidence

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
<p>Content <i>A variety of types of supporting materials (explanations, examples, illustrations, statistics, analogies, quotations from relevant authorities) make appropriate reference to information or analysis that significantly supports the presentation.</i></p>	<p>Student does not supply the information asked for in the assignment. Task appears hastily done or incomplete. Details and graphics are badly lacking. Student misconceptions are obvious.</p>	<p>Student may not supply all of the information asked in the assignment. Details, graphics are lacking. Student misconceptions are still seen.</p>	<p>Student supplies the information, but may not have enough details in their explanations. Graphics are relative to the assignment. Students show what they have learned</p>	<p>Student supplies more than the assignment asked. They went over and above to know their country. Fantastic graphics! Student describes in detail about their findings</p>

Written Communications:

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
<p>Context of and Purpose for Writing</p> <p><i>Includes considerations of audience, purpose, and the circumstances surrounding the writing task(s).</i></p>	Demonstrates minimal attention to context, audience, purpose, and to the assigned tasks(s) (e.g., expectation of instructor or self as audience).	Demonstrates awareness of context, audience, purpose, and to the assigned tasks(s) (e.g., begins to show awareness of audience's perceptions and assumptions).	Demonstrates adequate consideration of context, audience, and purpose and a clear focus on the assigned task(s) (e.g., the task aligns with audience, purpose, and context). -Sequenced material within the body -Cohesive presentation content	Demonstrates a thorough understanding of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work.
<p>Content Development</p>	Uses appropriate and relevant content to develop simple ideas in some parts of the work.	Uses appropriate and relevant content to develop and explore ideas through most of the work.	Uses appropriate, relevant, and compelling content to explore ideas within the context of the discipline and shape the whole work.	Uses appropriate, relevant, and compelling content to illustrate mastery of the subject, conveying the writer's understanding, and shaping the whole work.
<p>Genre and Disciplinary Conventions</p> <p><i>Formal and informal rules inherent in the expectations for writing in particular forms and/or academic fields (please see glossary).</i></p>	Attempts to use a consistent system for basic organization and presentation.	Follows expectations appropriate to a specific discipline and/or writing task(s) for basic organization, content, and presentation	Demonstrates consistent use of important conventions particular to a specific discipline and/or writing task(s), including organization, content, presentation, and stylistic choices	Demonstrates detailed attention to and successful execution of a wide range of conventions particular to a specific discipline and/or writing task (s) including organization, content, presentation, formatting, and stylistic

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
				choices
Sources and Evidence	Demonstrates an attempt to use sources to support ideas in the writing.	Demonstrates an attempt to use credible and/or relevant sources to support ideas that are appropriate for the discipline and genre of the writing.	Demonstrates consistent use of credible, relevant sources to support ideas that are situated within the discipline and genre of the writing.	Demonstrates skillful use of high-quality, credible, relevant sources to develop ideas that are appropriate for the discipline and genre of the writing.
Control of Syntax and Mechanics	Uses language that sometimes impedes meaning because of errors in usage.	Uses language that generally conveys meaning to readers with clarity, although writing may include some errors.	Uses straightforward language that generally conveys meaning to readers. The language in the portfolio has few errors.	Uses graceful language that skillfully communicates meaning to readers with clarity and fluency, and is virtually error-free.

Rubric for Student **Outcome 9**: Students will be able to critically evaluate the quality and the features of information from various sources and to make informed decisions about the design of information systems.

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
Knowledge And Comprehension (understanding the basics)	The student demonstrates an inadequate understanding of the relevant facts / data / theories/ terms as well as a limited ability to organize information for application, presentation, documentation, and/or further examination.	The student demonstrates an uneven and shaky understanding of the relevant facts / data / theories/ terms as well as a limited ability to organize the information for application, presentation, documentation, and/or further examination.	The student demonstrates an adequate understanding of the relevant facts / data / theories/ terms as well as the ability to organize information for application, presentation, documentation, and/or further examination	The student consistently demonstrates clear, accurate, detailed and comprehensive understanding of the relevant facts /data / theories/ terms as well as the ability to organize information for application, presentation, documentation, and/or further examination.
Application And Analysis (attaining the concept)	The student demonstrates extremely limited ability to work with the key concepts / information / processes / theory -- applying or extending them with very limited success to new problems or contexts, making predictions, recognizing hidden meanings, drawing inferences, analyzing patterns and component parts,	The student demonstrates uneven and shaky ability to work with the key concepts / information / processes / theory -- applying or extending them with mixed success to new problems or contexts, making predictions, recognizing hidden meanings, drawing inferences, analyzing patterns and component parts,	The student demonstrates adequate ability to work with the key concepts / information / processes / theory -- applying or extending them to a variety of new problems or contexts, making predictions, recognizing hidden meanings, drawing inferences, analyzing patterns and component parts, communicating	The student demonstrates confident ability to work with the key concepts / information / processes / theory -- applying or extending them to a wide variety of new problems or contexts, making predictions, recognizing hidden meanings, drawing inferences, analyzing patterns and component parts, communicating

Scale Performance	1. Novice	2. Intermediate	3. Capable	4. Expert
	communicating insightful contrasts and comparisons.	communicating insightful contrasts and comparisons.	insightful contrasts and comparisons.	insightful contrasts and comparisons.
Synthesizing And Evaluating (going beyond the given)	The student demonstrates little ability to take ideas / theories / processes / principles further into new territory, broader generalizations, hidden meanings and implications – as well as a limited and superficial ability to assess discriminatively the value, credibility and power of these ideas (etc.) in order to decide on well-considered choices and opinions.	The student demonstrates uneven and superficial ability to take ideas / theories / processes / principles further into new territory, broader generalizations, hidden meanings and implications – as well as a limited ability to assess discriminatively the value, credibility and power of these ideas (etc.) in order to decide on well-considered choices and opinions.	The student demonstrates adequate ability to take ideas / theories / processes / principles further into new territory, broader generalizations, hidden meanings and implications – as well as to assess discriminatively the value, credibility and power of these ideas (etc.) in order to decide on well-considered choices and opinions.	The student demonstrates surprising/insightful ability to take ideas / theories / processes / principles further into new territory, broader generalizations, hidden meanings and implications – as well as to assess discriminatively the value, credibility and power of these ideas (etc.) in order to decide on well-considered choices and opinions.