

### ASSECT Model for Computational Thinking in IT (NSF CCF 0939089)

Criteria	Definition	Measures	Beginning	Developing	Accomplished
<b>Logical Thinking</b>	Creatively develop, select and test relevant hypotheses	<ul style="list-style-type: none"> <li>○ Asks probing questions to uncover details of the problem</li> <li>○ Clearly defines the problem</li> <li>○ Defines clear success criteria for the project including measurable objectives</li> </ul>	<ul style="list-style-type: none"> <li>◆ No or limited logical connection of ideas.</li> <li>◆ Few questions formulated. Expects others to define the questions. Does not seem to understand the central problem.</li> <li>◆ Problem is defined incorrectly or too narrowly. Key information is missing or incorrect.</li> <li>◆ Fails to formulate hypotheses to test.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Most information and ideas are presented in a logical and effective manner.</li> <li>◆ All questions may not be relevant. May have some difficulty formulating questions to move toward better understanding of the problem.</li> <li>◆ Problem statement has some ambiguity or misses some important issues.</li> <li>◆ Formulates and relates hypotheses to test.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Logical connection of ideas.</li> <li>◆ Questions are probing and help clarify facts, concepts, and relationships in regard to problem. Follow-up questions are gleaned from appropriate sources.</li> <li>◆ Clearly defines the problem and outlines necessary objectives in an efficient manner</li> <li>◆ Formulates and relates hypotheses to test as well as relating them to previous knowledge.</li> </ul>
<b>Strategizing</b>	Ability to anticipate and evaluate potential outcomes	<ul style="list-style-type: none"> <li>○ Anticipates and evaluates the effects of various design options</li> <li>○ Makes design decisions based on rational criteria</li> </ul>	<ul style="list-style-type: none"> <li>◆ Not clear as to what is needed. Waits to be told. Does not seek information sources.</li> <li>◆ No evidence of search, selection or source evaluation skills.</li> <li>◆ Does not express possible outcomes or describe planned experiments.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Relies on a few sources only. Does not gather extensive information.</li> <li>◆ Sources selected adequately meet the information need, though little evidence of more than routine exploration.</li> <li>◆ Description of planned experiments, relation of hypotheses, identification of steps and timeline, can be accomplished by joint effort of the whole team but not by each team member.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Identifies several sources of information and individuals for support.</li> <li>◆ Evidence of search, selection, and source evaluation skills; notable identification of uniquely salient resources.</li> <li>◆ Each team member can describe planned experiments and how they relate to the problem and previous knowledge; identify necessary steps and timeline for project.</li> </ul>
<b>Abstract Thinking</b>	Ability to visualize the whole and identify the relevant parts and relationships of those parts in order to solve a problem	<ul style="list-style-type: none"> <li>○ "Sees the big picture"</li> <li>○ Deconstructs the problem into component parts</li> <li>○ Correlates the relationships between components and prior knowledge</li> </ul>	<ul style="list-style-type: none"> <li>◆ Unable to make connection to previous knowledge.</li> <li>◆ Unable to make connections between information gathered and the problem.</li> <li>◆ Unwilling to review summaries of prior knowledge for useful information.</li> <li>◆ Fails to gather information, or obtains it from limited or inappropriate sources.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Applies limited amount of prior knowledge to current problem. Does not consistently apply information effectively.</li> <li>◆ Information gathered may not be extensive, or may have occasional difficulty using information effectively in problem solving.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Effectively applies previous knowledge to the current problem. Integrates with new information to assist the problem solving process.</li> <li>◆ Consistently gathers a broad spectrum of resources and information and integrates it with prior knowledge and problem-solving strategies.</li> </ul>

For more information or if you have questions, contact Deborah Boisvert at [deborah.boisvert@umb.edu](mailto:deborah.boisvert@umb.edu)

Criteria	Definition	Measures	Beginning	Developing	Accomplished
<i>Procedural Thinking</i>	Ability to select and execute appropriate steps to solve a complex problem	<ul style="list-style-type: none"> <li>○ Identifies the steps required to solve a problem</li> <li>○ Identifies the sequence of steps including possible decisions and branching</li> <li>○ Identifies normal and exceptional behavior of a solution</li> </ul>	<ul style="list-style-type: none"> <li>◆ Does not break down the problem into steps, or steps do not result in a solution</li> <li>◆ Addresses the solution as a sequence of steps without identifying opportunities for collaboration (parallelism), or without understanding dependencies (sequence).</li> <li>◆ Solution is obtainable for specific cases, but a robust procedure for solving the general case is slow to emerge.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Begins to highlight opportunities for delegation and parallelism while continuing to preserve and respect dependencies and the requirement for sequencing.</li> <li>◆ Provides solutions which lack efficiency, and are fragile in their handling of unexpected inputs or behaviors.</li> <li>◆ Provides solutions robust enough to successfully handle a modest number of test cases, but fails to stand up to rigorous test case, fails to scale within acceptable parameters, or experiences a wide variation in performance characteristics</li> </ul>	<ul style="list-style-type: none"> <li>◆ Creates, and documents a well defined methodology (e.g. diagram, flowcharts, algorithms) throughout the process and revises it as necessary.</li> <li>◆ Designs and develops a scalable solution, which maximizes the opportunity for delegation and parallelism, complete with a testing/ evaluation plan, metrics to define adequate performance, and robust handling for inconsistent input variables, or exceptional behavior characteristics</li> <li>◆ Verifies the solution with a methodical testing strategy and a wide range of test cases.</li> </ul>
<i>Optimizing</i>	Ability to analyze processes for optimal efficiency and use of resources	<ul style="list-style-type: none"> <li>○ Identifies available resources</li> <li>○ Develops a solution that uses only available resources</li> <li>○ Measures and adapts the solution to optimize resource utilization</li> </ul>	<ul style="list-style-type: none"> <li>◆ Quantitative or qualitative analysis conducted is inappropriate, inaccurate, and superficial (or nonexistent).</li> <li>◆ Analysis doesn't help clarify the issues or facilitate decision-making.</li> <li>◆ Errors made in analytical methods, but sources of error aren't found.</li> <li>◆ Appropriate control or replicate experiments not run.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Quantitative or qualitative analysis is appropriate and accurate, but rather superficial.</li> <li>◆ Analysis has limited ability to help clarify the issues and facilitate decision-making.</li> <li>◆ Uses new methods and tools, but may not always be successful.</li> <li>◆ May not accurately explain rationale.</li> <li>◆ Does not fully run appropriate controls and replicate experiments.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Quantitative or qualitative analysis is appropriate, accurate, and thorough.</li> <li>◆ Analysis is used to clarify the issues and facilitate decision-making.</li> <li>◆ Consistently uses new procedures and tools successfully, and can describe rationale for them.</li> <li>◆ Runs appropriate control and replicate experiments.</li> </ul>
<i>Iterative Refinement</i>	Process refinement with the goal of improving quality or precision.	<ul style="list-style-type: none"> <li>○ Measures and evaluates solutions against the success criteria</li> <li>○ Adjusts the design and implementation as needed</li> </ul>	<ul style="list-style-type: none"> <li>◆ States conclusions without justification.</li> <li>◆ Does not consider internal consistency of results. Cannot compare control or replicate results.</li> <li>◆ Does not recognize that results do not conform to original hypothesis.</li> <li>◆ Cannot suggest alternative interpretation.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Draws correct conclusions from results, but may not relate them well to original hypothesis or current theory.</li> <li>◆ Recognizes results that don't fit hypothesis but may not readily come up with alternative interpretations.</li> </ul>	<ul style="list-style-type: none"> <li>◆ Able to describe results and conclusions clearly and concisely.</li> <li>◆ Relates results to hypothesis and to currently accepted theory.</li> <li>◆ Can account for un-explained results.</li> <li>◆ Recognizes limitations of current hypothesis and proposes alternative interpretations.</li> </ul>