

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

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

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