

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

Criteria	Definition	Measures	Emerging	Developing	Mastering
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 find appropriate level of detail to define and solve a problem	<ul style="list-style-type: none"> ○ Decomposes a problem into component parts ○ Understands the relationships between components 	<ul style="list-style-type: none"> ◆ Unable to make connection to previous knowledge. ◆ Unwilling to review summaries of prior knowledge for useful information. ◆ Fails to gather information, or obtains it from limited or inappropriate sources. ◆ Can't make connection between information gathered and the problem. 	<ul style="list-style-type: none"> ◆ Applies limited amount of prior knowledge to current problem. Does not consistently use 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 current problem. Integrates with new information to assist problem solving process. ◆ Consistently gathers a broad spectrum of resources and information and integrates it with prior knowledge and problem-solving strategies.

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Procedural Thinking	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"> ◆ Creates a vague framework that doesn't move the problem-solving process along. ◆ Doesn't seek help from others. ◆ Team spends time on tasks that interfere with the problem-solving process. ◆ Team members don't know who is responsible for which task. 	<ul style="list-style-type: none"> ◆ Can create a framework but may not use it consistently in an effective manner, or revise it as needed. ◆ All team members generally cooperate and prioritize tasks, but may not consistently rotate responsibilities or work out most effective strategies for success. 	<ul style="list-style-type: none"> ◆ Creates and applies a framework (e.g. diagram, flowcharts, algorithms) throughout the process and revises it as necessary. ◆ Team takes the initiative to define tasks, match assignments to expertise, rotate responsibilities, maintain open communication, and develop strategies to enhance group success.
Optimizing	Ability to analyze processes for optimal efficiency and use of resources	<ul style="list-style-type: none"> ○ Understands 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.
Iterative Refinement	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.

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