Cognitive Stragegy List for Preventing Software Vulnerabilities Version 1

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*Note: This is the initial version and is subject to change as future studies progress. The candidate vulnerability examples in the 5th column of the table below are based on the empirical study described in the article, "An Approach to Cognitive Root Cause Analysis of Software Vulnerabilities." Future studies on cognitive training may select some of these examples and add more as needed.

Cognitive Stage: Problem Representation

Cognitive Strategy	When to use (Error-prone situations)	How to use	Why to use (Targeted Cognitive Modes)	Candidate vulnerabily examples (CWE #)
Slow down	When information seems especially important.	Stop, read, and think about information.	Enhance focus of one's attention to logically significant information, preventing **Selectivity** errors	425, 1041
Retrospectively reason	When solution is generated automatically and quickly.	Ask oneself how the solution was produced, what schema was used in previous experiences.	Enhance one's attention in rule-based performance, preventing "**Strong-but-Now Wrong**" errors.	188, 201, 609, 308, 1113
Searching countersigns	The task in hand seems extremely familiar.	Check if some information indicates the condition in hand is different from previous experiences.	Focus one's attention on exceptional conditions, preventing "**Rule Encoding Deficiencies**" errors.	362, 476, 303, 427, 272, 346, 909, 354, 562, 358, 135, 369, 468, 1082, 486, 1221

Cognitive Stage: Solution Generation

Strategy	When to use (Error-prone situations)	How to use	Why to use (Targeted Cognitive Modes)	Candidate vulnerabily examples (CWE #)
Decomposition	The problem is complex.	Decompose the problem into sub-problems and work on	Prevent errors caused by working memory overload	**1109, 1119, 276, 131**

		them in the top-down hierarchical way.	and **Problems with Complexity**.	
Mental integration	Learn complex information or require deeper understanding of a problem.	Relate main ideas. Use these to construct a theme or conclusion.	Prevent errors caused by **Lack of Knowledge**.	287, 918, 378, 277, 1087, 1100, 663, 331, 319, 407, 414, 335, 549, 565, 487, 328, 698, 586, 363, 732, 1102, 1079, 603, 532, 785, 634, 242, 564
Making notes or draw diagrams	When there is a lot of interrelated information.	Identify main ideas, connect them, and list supporting details under main ideas, connecting supporting details.	Extend working memory capacity, preventing errors caused by working memory overload and **Problems with Complexity**.	**1109, 1119, 276, 131**
Increase mental effort to the change rates between variables	When there are causality or correlations between multiple varialbes/factors	Pay special mental effort to think whether the correlations are exponential rather than linear	Prevent errors caused by **Difficulties with Exponential Development**	1333

Cognitive Stage: Solution Evaluation

Cognitive Strategy	**When to use (Error-prone situations)**	**How to use**	**Why to use (Targeted error modes)**	**Candidate vulnerabily examples (CWE #)**
Hierarchically tracking	The problem is complex and is decomposed into hierarchical sub-goals.	Check if all the goals have been achieved in the hierarchical way.	Prevent sub-goal omission errors (PCE) and errors caused by inattention	212, 766, 489, 170, 617, 460
Examine special cases	The problem is complex, or interactive with many other functions.	Examine if some special cases or boundary conditions are lack of consideration.	Prevent errors caused by Biased Review.	400, 787, 60, 770, 89, 209, 94, 184, 186, 606, 79, 182, 119, 120, 138, 204, 805,

Falsification	Perform unit test by oneself.	Try to search evidences to reject the solution. Design falsification test cases to check the solution.	Prevent errors caused by Confirmation Bias.	59, 129, 795, 352, 34, 862, 502, 78, 524, 426, 268, 301, 477, 605, 233, 1320
Exchanging review	One thinks the solution is completed and there is no any other problem detected by himself or herself.	Find someone else to check the program, conduct an exchanged review with a partner, or independent test.	Prevent errors caused by biased review and confirmation bias.	

Cognitive Stage: any of the above cognitive stage

Cognitive Strategy	**When to use** **(Error-prone situations)**	**How to use**	**Why to use** **(Targeted error modes)**	**Candidate vulnerabily examples (CWE #)**
Allocating attention to some special places requiring visual perception	When there are letters, symbols, function names, directories that look similar or closely located, do double check.	Check if your mixed the similar things	Prevent vulnerabilities caused by Perceptual Confusions	416, 783, 192, 480, 482