CREATE Lab Arts&Bots

Talent Definitions Summary

Computational Thinking Talent

Computational thinking (CT) is a set of problem solving skills and techniques which incorporate attitudes and skills that allow real world problems to be solved with methods from computing and computer science.

We define ***exceptional computational thinking talent*** as demonstrating above average abilities:

- thinking through different levels of abstraction
- formulating logical data organizations and algorithmic processes
- comparing the efficiency and effectiveness of feasible solutions

PS	Problem-Solving
Problem Breakdown	Take a large problem and divide it into smaller problems that are each more manageable and, when each is solved, the complex problem becomes easier.
Redefine problems	Recognize that a given problem cannot be solved with available resources. Take the problem and express it in a different way so that available tools (such as the available motors and sensors) are more applicable.
Strategic decision-making	Compare and weigh possible strategies and solutions, and make a justifiable decision concerning how to proceed.

AB	Abstraction
Modelling	Create a model or simulation to represent a complex system in order to better understand the system. Represent key elements of the system while ignoring superfluous details.
Pattern Recognition	Consider multiple tasks and recognize the common features that the tasks share.
Modularity	Recognize which components may be useful for reuse and create solutions that are generalizable for multiple tasks.

AT	Algorithmic Thinking
Algorithm Design	Identify the sequence of simpler steps that must be created and combined in order to create a more complex behavior. Beyond using *expressions* to make *sequences*, an exceptional student will combine *subsequences* to create larger and more elaborate final *sequences*.
Incremental development and evaluation	Solve complex challenges by breaking the problem down and implementing simple, manageable parts. Test and perfect each part one-by-one and eventually combine them into the full solution.

Engineering Design Talent

Engineering design is the process of developing a concrete solution for an ill-defined problem within technical feasibility constraints.

We define ***exceptional engineering design talent*** as demonstrating above average abilities:

- transforming ambiguous and complex problem spaces into concrete design goals
- developing new concepts and creative solutions for solving design problems
- communicating design concepts using graphical representations and other nonverbal means
- actualizing designs into real-world prototypes, devices or systems

DP	Defining the Problem
Defining the Problem	Identify criteria for success, constraints and resource limits for a given problem.

ID	Intentional Design
Deliberate Planning	First develop a complete plan for constructing and programming the intended robot based on the criteria and constraints. Then consider how to follow this plan before beginning construction and programming.
Following a Plan	Work to follow a design for creating a robot despite challenges, rather than changing plans haphazardly while building.

IN	Innovating
Generating Multiple Solutions	Brainstorm two or more possible solutions for each challenge or need instead of just beginning to create the first solution that comes to mind.
Solution Evaluation	Carefully consider the strengths and weaknesses of multiple potential solutions and describe the reason for making a choice. Use success criteria, and project and resource constraints to select the best solution.
"Outside the Box"	Come up with possibly risky, very novel solutions to problems. These solutions might incorporate innovative uses of materials, creative mechanisms, or a solution unlike any examples shown in class.

RT	Refining and Testing
Systematic Diagnosis	Utilize a methodical process of elimination to determine the source of a problem.
Trade-offs Consideration	Recognize when important goals of the robot are at risk of not being accomplished due to resource limitations. Prioritize the success criteria and reduce or eliminate low priority features in order to reach high priority goals.
Thorough Testing	Carefully test each subcomponent of robot or program, in addition to the whole system, and compare test results to the success criteria.

PR	Prototyping

Design for Construction	During design and construction, carefully consider how each component will be constructed. Consider the strengths and weaknesses of available materials to avoid issues that commonly occur in Arts & Bots projects.
Making It Real	Take an idea and create a physical model which accurately reflects the original idea. The model is carefully crafted, constructed with attention to detail, and successfully and elegantly meets the initial design criteria.

CO	Communicating Design
Clear Communication of Ideas	Clearly communicate design ideas to teammates, teachers, and others.

Complementary Student Dispositions

Confidence Dealing with Complexity	Faces complex challenges with confidence and formulates a plan of action for how to proceed.
Persistence in Working on Difficult Problems	Tolerance for early failure. Willingness and excitement to try again.
Flexibility	Adapts to unforeseen complications and discoveries throughout the project.
Tolerance for Ambiguity	Successfully defines and follow her own plan when the presented challenge is ambiguous or goals are ill-defined.