

# Programming by Design: Computing, Representation, and Reasoning

9th Grade Computer Science – NYC Museum School

## Course Overview

This yearlong course introduces students to computer science as a discipline of design, logic, and representation. Through structured, inquiry-driven modules, students learn to write programs, model systems, and interpret data. Programming is framed as structured communication between humans and machines.

Students will work across languages—beginning in Racket, transitioning to Pyret, and moving toward Python—building transferable fluency and computational reasoning. Each unit grounds technical skill in social context, particularly through museum-based datasets and themes.

## Units of Study

### Unit 1: The Story of Data

- Communication between humans and machines
- Histories of Ada Lovelace, Grace Hopper, and underrepresented computing figures
- Machine code, abstraction, and the need for high-level languages
- Weekly routines: computing in the news, visual data interpretation

### Unit 2: Programming by Design (Racket)

- Structured problem-solving with design recipes
- Algebraic reasoning, subgoal decomposition, function testing
- Build reusable, interpretable programs from first principles

### Unit 3: Data Science and Representation (Pyret)

- Explore, clean, and transform real datasets (e.g. Met API)
- Model categories, visualize patterns, critique bias in data
- Compare languages: Racket to Pyret transfer

### Unit 4: Systems and Control

- Conditionals, boolean logic, simulations
- Students build interactive systems (e.g., exhibit traffic simulation)

### Unit 5: Interface and Presentation (HTML/CSS)

- Web literacy and front-end structures
- Publish student work with accessible, styled interfaces

### Unit 6: Code in the Wild (APIs + Notebooks)

- Introduction to Jupyter notebooks and literate computing
- Fetching and analyzing data via APIs

- Scaffold toward Python and advanced CS courses

### **Ethics Thread (Interwoven)**

- Algorithmic bias, surveillance, equity in data systems
- Reflection on computing's civic, ethical, and cultural roles

### **Pathways Enabled**

- **AP CS A:** Structural foundations prepare students for Java and OOP
- **Data Science + Capstone:** Jupyter, visualization, and museum data carry into inquiry-based capstone work
- **Algebra 2 + Computing:** Reinforces function structure and modeling as algebraic tools

### **Select Bibliography**

- Felleisen et al., *How to Design Programs*
- Bootstrap: Algebra and Data Science Curriculum
- *Data Feminism* – D'Ignazio and Klein
- Exploring Computer Science (ECS)
- Metropolitan Museum of Art Open Access Data
- NYT Learning Network – *What's Going On In This Graph?*