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High School Course Description: Computer Science

At GISB, students have the opportunity to participate in a rigorous four-year course program in computer science. In this program, students expand their skills to work collaboratively to address real-world issues, to analyze computational work and—of course—to design, write, test, and document program code to solve a variety of problems.

Our students do a deep dive into programming with Python, Java, and the functional programming language Scheme, exploring more and more advanced programming topics over the course of the four years.

By graduation, our students have mastered all topics from *AP Computer Science A* and *AP Computer Science Principles*. For a detailed list of what is covered each year in our intensive Computer Science curriculum, please see below.

Grade 9

- Programming with Scratch
 - Figures and their movement in the coordinate system
 - Messages, sound, and crayon
 - Boolean expressions / conditional instructions: loops, variables and counters, own methods
 - Project: Programming an original game / animation
- Artificial Intelligence & Robotics
 - Definition, characteristics, and application examples of AI: EV3 brick of the LEGO Mindstorms robot and basics of its operation (motors, sensors, connections)
 - Robot graphic programming, algorithm development
 - Project: Design and programming of robots with different tasks
- Basics of Computer Science
 - EVA principle and the dual system: networks, opportunities and risks of the internet, data and data security
 - Coding formats: data volumes and compression methods
 - Different file formats: image rights / copyrights; vector and pixel graphics
 - Project: Solving a real-life problem with the help of microcontroller

Grade 10

- Web pages with HTML, CSS, and JavaScript
 - The most important HTML and CSS commands
 - Concept and usage of TAGs
 - Inserting links, images, and videos with HTML considering copyright regulations
 - Classes and IDs in CSS
 - Positioning with HTML and CSS (DIVs and floating)
 - Changing web page content with JavaScript
 - Project: Designing and publishing web documents
- Spreadsheets
 - Creating graphics
 - First formulas and calculations
 - Representation of data with a spreadsheet program
- Databases
 - Creating and modifying databases (OpenOffice and MySQL)
 - Differences between tables/spreadsheets and databases
 - Normal forms and primary keys
 - Database queries (with aggregate functions, sorting and JOIN)
 - Entity-relationship model and relational data models Designing
- Introduction to Python
 - Variables
 - Data types
 - Lloops (FOR and WHILE)
 - Logical operators, if-statements
 - Project: Programming a mini game

Grade 11

- Object-Oriented Programming (JAVA)
 - Wrapping with the editor BlueJ
 - The most important technical terms (classes, objects, methods, attributes, constructor...)
 - CLASS structure in JAVA
 - UML diagrams
 - Relationships between classes: Inheritance, Aggregation, Composition, Delegation
 - Building in basic structures in JAVA: variables, loops, conditional statements, arrays
 - Polymorphism
- Machine Theory and Formal Language Theory

- Syntax and semantics in natural and formal languages
- Languages and grammars
- Chomsky hierarchy
- Automata models and state-oriented modeling
- Limits of computability
- Distributed systems and communication
 - Network types
 - Addressing (IP addresses)
 - Protocols
 - Layer model and TCP-IP model
 - Client-server model
 - Communication in computer networks
- Cryptology: Data Protection and Data Security
 - Confidentiality, integrity, and authenticity
 - Attack strategies (e.g., brute force)
 - Monoalphabetic and polyalphabetic encryption
 - Symmetric and asymmetric methods
 - RSA methods
 - Algorithms for simple cryptological methods

Grade 12

- Functional Programming (by coding a language translator)
 - Iteration and recursion
 - Sorting and search methods
 - Evaluation of algorithms
 - Use of recursive and end-recursive processes
- Algorithms and data structures (by coding a language translator)
 - Simple and higher data structures
 - Iteration and recursion
 - Sorting and search methods
 - Evaluation of algorithms
 - Use of recursive and end-recursive processes

Textbook / Informational Text Reading Amount

Reading and problems are presented from the following sources:



- Informatik Lehrwerk für die gymnasiale Oberstufe Ausgabe 2021 Schulbuch 1, Westermann
- Informatik Niedersachsen 9/10 Ausgabe für das Gymnasium 2023, Cornelsen
- <https://appcamps.de/>
- <https://inf-schule.de/>

Types of Large Assessments in this Course

Unit tests, quizzes, midterm exam, final exam