How to program?

- Syntax Error vs. Semantic Error

Example	Syntax Error	Semantic Error
How are you?	No	No
How ar yu?	Yes	No
Are you how?	No	Yes
Ar yu how?	Yes	Yes

Note:

  - Syntax Error can be detected automatically, but not Semantic Error.

- There are two perspectives on computer programming:
  - Syntax ==> depend on programming language
  - Semantics ==> independent of programming language
- Type of Computational Thinking (semantics)

Types of Computational Thinking	Programming Languages	Comments / How to teach
Procedure-Oriented	Shell Script, C, R, Perl, Fortran, Pascal	◦ Logic 1. Basic Concepts (source) - 1st milstone ▪ Declaration, Output & Input, Arithmetic Operators ▪ Flow Chart ==> Trace Table ==> Program 2. Control Flow and Loop ▪ Control Flow (source) - 2nd ▪ Loop (source) - 3rd milestones 3. Function (source) - 4th milestone 4. 1D Array (source) - 5th milestone
Object-Oriented	Javascript, Python, Java, C++, Scala, C#, Swift, Objective-C ▪ Note: Javascript is Object-Based and is not a true Object-Oriented programming language.	◦ Most modern programming languages are object-oriented. ◦ Must 1. Basic Object-Oriented Concepts 2. A simplified OO Process 3. 4 types of member functions 4. Simple class ==> Aggregation 5. Inheritance ==> Inheritance + Aggregation 6. Exception Handling ◦ Want 1. Generic Programming 2. UML 3. Design Patterns (more)

Recursive-Oriented	Lisp	◦ Lisp is used to implement Artificial Intelligence algorithms.
		◦ Recursive functions
		Example 1
		`void f() { f(); }`
		`void main()`
		Example 2: coroutine
		`void f() { g(); }`
		`void g() { f(); }`
		`void main()`

			`{ f(); }`	`{ f(); }`
Hardware-Oriented	Assembly Language		◦ Assembly program is procedure-oriented, but hardware knowledge is required to program. ◦ Little Man Computer (LMC). ▪ Online LMC Simulator ▪ Alternative LMC Simulator	
Distributed Computing	MapReduce, Spark		◦ Learning by first drawing MapReduce Tables ◦ MapReduce is a framework which requires the concept of parallel programming. ◦ Several languages can be used to implement MapReduce algorithms, such as Java, Python.	

- Which programming language you should learn in each type of Computational Thinking depends on the industry and education trends:
  - Top 10 In-Demand programming languages to learn in 2020
  - 5 Reasons JavaScript is Still Better Than Python
  - Programming Languages - Trends in Education (local copy)
  - Is Python an Appropriate Programming Language for Teaching Programming in Secondary Schools? (local copy)
  - Programming Languages You Should Learn in 2020
  - Programming language popularity: Python overtakes Java – as Rust reaches top 20
  - Programming Language Trends In 2020
  - An education for the 21st century means teaching coding in schools
  - Python Is Now the Most Popular Introductory Teaching Language at Top U.S. Universities

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