Programming Languages
and
Programming Language Families

Purposes

- Instructing machines.
- Communicating between programmers.
- Expressing high-level designs.
- Notation for algorithms.
- Tool for experimentation.
- Preventing human errors.

Can you rate your favorite language?

Programming Style

Procedural: Program consists of procedures that are invoked to change the state of the machine.

Object Oriented: Program consists of objects. Methods on objects are invoked to change the state of that object.

Functional: Program consists of functions that return results. These results are then used for future calculations. The function does not otherwise alter the state of the machine.

Language constructs encourage different styles.

Language Families

Imperative: Characterized by procedures that change the state of the system. I.e. have *side-effects*.
- *Procedural*: Fortran, (impure) Lisp/Scheme, Algol, Pascal, C.
- *Object Oriented*: Simula, Smalltalk, C++, CLOS.

Declarative: Describe “what” is wanted, not “how” it is done.
- *Functional*: (pure) Lisp/Scheme, ML, Miranda, Haskell.
- *Logic/Relational*: Prolog, CLP.

Importance

There are many tradeoffs in selecting/creating a language:

- *reusability*
- *maintainability*
- *portability*
- *performance*
- *complexity*
- *expressiveness*
- *libraries*
- *debugging ease*

Scheme

- Allows side-effects, but encourages a functional style.
- Simple syntax, expression oriented.
- Extensively uses lists (Lisp = LISt Processing).
- Heavy use of recursion.
- Dynamically typed.
- Interpreted (or compiled).

Miranda

- Pure functional.
- Lazy evaluation.
- Pattern Matching.
- Heavy use of lists and recursion.
- Statically typed.

Java

- Object oriented.
- Similar syntax to C++.
- Statically & dynamically typed, type-safe.
- Extensive class library.
- Interpreted byte-codes.

CLP($\mathcal{R}$)

- Declarative.
- Pass by constraint.
- Relations work in both directions.
- Relations combine to restrict solutions.
- Constraint solver searches solution space for solution.
- Can solve linear systems of equations.