Programming for Regional and City Planning

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About

Let's Get to Know Each Other

- Ph.D from DTETI - UGM
- Lecturer at STMIK Akakom, head of Magister Teknologi Informasi
- Programming since 18 years old - it's been 30 years!
- More in industry than in university, my latest tech position is Senior Software Architect.
- CEO at PT Wabi Teknologi Indonesia, a software engineering company
- Community involvement:
  - Founded Rust Indonesia - and still maintains it.
  - Founded Arch Linux Indonesia - and still maintians it
  - KPLI, Ruby Indonesia: no longer active.
- Certified in Blockchain from Corda, LSP digital assessor.
- I'm happiest when I'm coding

It’s A Sharing Session

I may know something you don’t know, you may know something I don’t know.

The Big Picture

Software Taxonomy

- Operating System
- Development Tools
- Application Program
- Utilities

Engineering a Software

It’s the domain of Software Engineering body of knowledge. Programming is substantial part but not the most important part. In fact, every part is important, lack of them will result in software defects.

Programming: Coding, Algorithm, and Data Structure

What is Programming?

Programming: using a language to instruct the computer to do various tasks—a specific task.

Normally, machine can only read binary (1-0), so human need to understand 1-0. From the closeness of instruction to machine, we have:

- High-level language: understood by human, translated to machine understandble format (Python, Ruby, Java).
- Middle-level language: understood by human, hava a capability to embed machine code (C, Rust).
- Low-level language: very close to machine, using mnemonic (Assembly).

How do I Program?

You need programming language(s) and development tools

Programming Languages and Development Tools

- **Programming Languages (PL)**: formal language that specifies a set of instructions for computer to do something.
- PL should be seen from 2 points: specification and implementation (reference implementation and vendor implementation).
- **Development Tools (DT)**: a set of tools to help software developer in doing their tasks to create software product:
  - IDE (Integrated Development Environment)
  - Compiler / Interpreter
  - Profiler
  - Debugger
  - Editor
  - Package Management
  - Programming Environemnt (discussed later)

What is Algorithm?

An algorithm is a finite sequence of well-defined, computer-implementable instructions, typically to solve a class of problems or to perform a computation.

Example

Problem: Given a list of positive numbers, return the largest number on the list.

```
 Set max to 0.
 For each number x in the list L, compare it to max.
 If x is larger, set max to x.
max is now set to the largest number in the list.
```

Python implementation:

```
max = 0
for x in L:
    if x > max:
        max = x
```

Data Structure

A data structure is a data organization, management, and storage format that enables efficient access and modification

Niklaus Wirth: Algorithms + Data Structures = Programs.

Programming Paradigms

What is Programming Paradigms?

Programming Paradigm: related with the way programmers solve programming problem. PP are implemented as programming language features.

Some Programming Paradigms

- **Imperative**: allow side effects, sequential, there are constructs to control order. Ex: Perl, Python, JavaScript, PHP
- **Functional Programming**: disallow side effects, treats computation as the evaluation of mathematical functions, avoids changing state and mutable data. Ex: Haskell, OCaml
- **Declarative**: order is not important, declare something and have computer do the work. Ex: SQL
- **Object Oriented Programming**: treat class as an encapsulation of executrable code and let the objects from the class to collaborate. Ex: Java, C++
- And many others

Current: multi paradigms.

Programming Environment

Programming Environment

- Programming is not the only thing to consider when we want to build software product.
- Programming environment are other things related to programming and DT, important for successful delivery of software products although may not be technically related.
- It is the answer of: “I can program, I can do programming tasks, now how should I begin and how do I manage it so that I can deliver software product?”

List of Programming Environment

Programming environment usually consists of:

- Software development methodology: waterfall, prototyping, agile.
- Cloud-enabled DT (platform as a service): Docker, Kubernetes, rkt, unikernel
- Distributed Computing: Data serialization: XML (OBSOLETE), JSON, msgpack, protocol buffer, etc.
- Testing and Continous Integration
- Online tools: workflow management (ex: trello), communication (Slack)
- Project Management: Github, Gitlab
- Product Development: Aha (aha.io)

Domain Problems

- Frontend: GUI, TUI, and Web
- Mobile
- Backend - Distributed System: low latency Programming Language
- Programming Language - Compiler and libraries: microservices.
- Data Technology: Big Data, SQL, NOSQL, NewSQL
- Big Data
- Artificial Intelligence: Machine Learning and Data Mining (ex: TensorFlow), Deep Learning: see Julia and R.
- Embedded System: Raspberry Pi etc: need specific OS and specific development tools: Python, Node.js, Rust, Go, C

Applying Programming for Regional and City Planning

Some Notes on Sofware Engineering and Regional-City Planning

- I know almost nothing about regional - city planning, so, let's collaborate.
- Some papers - articles mention *xxxxxxx algorithm* in regional-city planning related, but to have a fully functional solution, we should not neglect other IT things beside algorithm.

Some Ideas

- Open Urban Planning Toolbox: `https://blogs.iadb.org/conocimiento-abierto/en/open-urban-planning-toolbox/`
- Regional Road Network Shortest Path Algorithm in Vehicle Navigation Systems: `https://link.springer.com/chapter/10.1007/978-3-642-53703-5_36`
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- And many more.