

# Programming in Real Bioinformatics

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# Outline

- 1 Five Programming Languages?
- 2 Software Development Process
- 3 Final Examination

# Next

1 Five Programming Languages?

2 Software Development Process

3 Final Examination

# Why do we need five programming languages?

## Why do we have to learn languages?

- 廣東話
- 普通话
- 客家话
- 上海话
- English
  - England, Scotland, Wales, North Ireland
  - United States
  - Hong Kong
- Hinglish
- ...

# Programming Languages

- C: Embedded device, high performance system software
- C++: Embedded device, large-scale software, GUI applications
- Java: Large-scale system, Enterprise systems, cross-platform applications
- Perl: Text processing, biological sequence processing, CGI-programming
- Python: System administration, desktop applications, web development
- R: Data analysis and visualization
- Objective-C: applications on iOS and Mac OS
- Swift: a future programming languages for Apple products
- Go: Google's system programming languages
- Ruby, Scala, Julia, JavaScript, LaTeX ...

The  
Pragmatic  
Programmers

# Seven Languages in Seven Weeks

A Pragmatic  
Guide to  
Learning  
Programming  
Languages

Bruce A. Tate

*Edited by Jacquelyn Carter*



香港中文大學

The Chinese University of Hong Kong

# Seven More Languages in Seven Weeks

Languages That Are  
Shaping the Future



Bruce A. Tate, Fred Daoud,  
Ian Dees, and Jack Moffitt

Foreword by José Valim

*Edited by Jacquelyn Carter*



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# Programming in Real Bioinformatics

## Five Programming Languages?



### Seven Databases in Seven Weeks

A Guide to Modern Databases  
and the NoSQL Movement



Eric Redmond  
and Jim R. Wilson

Series editor: Bruce A. Tate  
Development editor: Jacquelyn Carter



### Seven Concurrency Models in Seven Weeks

When Threads Unravel



Paul Butcher

Series editor: Bruce A. Tate  
Development editor: Jacquelyn Carter



### Seven Web Frameworks in Seven Weeks

Adventures in Better Web Apps



Jack Moffitt  
and Fred Daoud

Series editor: Bruce A. Tate  
Development editor: Jacquelyn Carter

# Interaction between Programming Languages

- C-based: C, C++, Go, R, Perl, Python ...
- Virtual Machine based:
  - JVM: Java, Scalar, JPython, Perl 6 ...
  - CLI: C++/CLI, C#, IronPython, F#, VB.NET, PowerShell ...
- Interface: web service, file, database, container ...

- Java and R: rJava
- Perl and R: RSPerl
- Python and R: rpy2
- C/C++ and R: Rcpp
- C and Perl: perl.h
- Java and C/C++: JNI

Example: Integration of R and C++  
see rcpp directory.

# Next

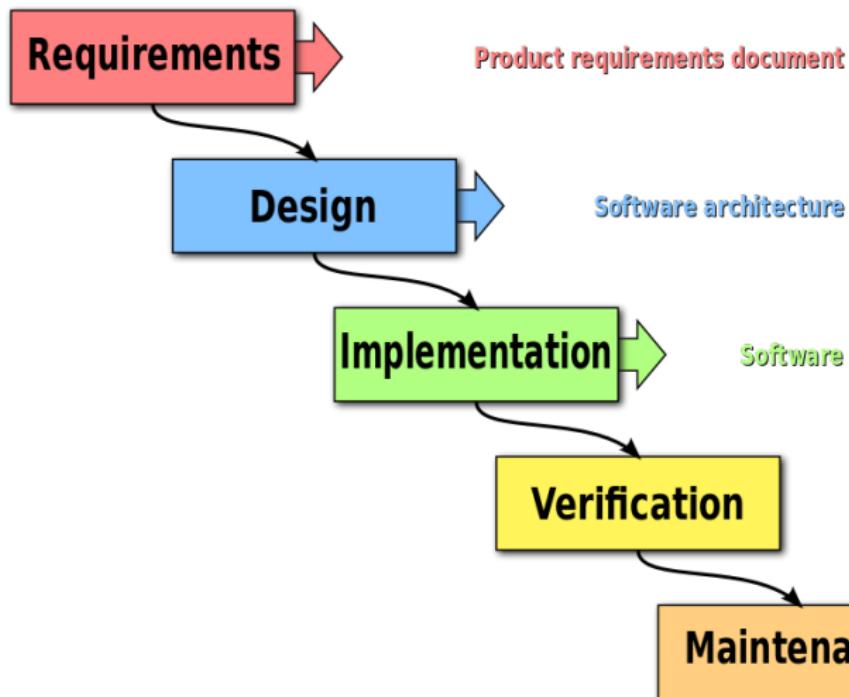
1 Five Programming Languages?

2 Software Development Process

- Waterfall
- Agile Software Development
- Reference

3 Final Examination

# Waterfall



# Case: Fibonacci Sequence Generator

- Requirements: What is the input? Web based or Command line application?
- Design: technology stack, architecture, user experience ...
- Implementation: only coding? Construction
- Verification: testing, alpha, beta
- Maintenance:

# Agile Software Development

## Agile Software Development

Agile software development is a group of software development methods in which requirements and solutions evolve through collaboration between self-organizing, cross-functional teams. It promotes adaptive planning, evolutionary development, early delivery, continuous improvement and encourages rapid and flexible response to change.

# 12 principles of agile software development

- Customer satisfaction by rapid delivery of useful software
- Welcome changing requirements, even late in development
- Working software is delivered frequently (weeks rather than months)
- Close, daily cooperation between business people and developers
- Projects are built around motivated individuals, who should be trusted
- Face-to-face conversation is the best form of communication (co-location)
- Working software is the principal measure of progress
- Sustainable development, able to maintain a constant pace
- Continuous attention to technical excellence and good design
- Simplicity—the art of maximizing the amount of work not done—is essential
- Self-organizing teams
- Regular adaptation to changing circumstances

# Why do we need agile software development?

- Stock trading system, military, bank ...
- Desktop softwares ship as floppy disk, CD or DVD ...
- Internet helps us update our software every minutes ...

## Agile Methods

- Extreme Programming
- Test Driven Programming
- Scrum
- ...

## Agile Practices

- Pair programming
- test-driven
- story-driven modeling
- Iterative and incremental development
- Cross-functional team
- Refactoring
- ...

# Practice: Pair Programming

## Pair Programming

An agile software development technique in which two programmers work together at one workstation

- Driver: writes codes
- Observer: reviews each line of code as it is typed in.

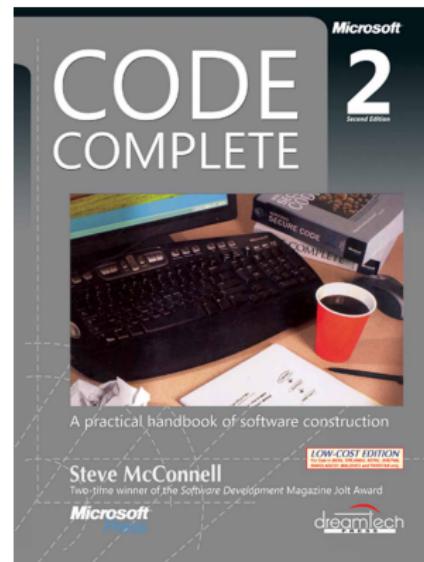
# Practice: Pair Programming

## Fibonacci Sequence Generator

- Input from command line argument
- Output to screen
- What will happen if the input is less than 1?
- What will happen if the input is more than 2000?
- Who is driver? Who is observer?

# Reference

- Code Complete, Second Edition
- <http://www.cc2e.com/>



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# Scope

- Basic knowledge of the five programming language
- How to choose a programming language for your work
- Basic knowledge of software engineering

# Question Sample

Is it possible to implement object-oriented programming using Perl?

- Yes
- No

# Question Sample

Which one is not a OOP system in R?

- S3
- S4
- ROOP
- RC

# Question Sample

Assume that your customer needs a website to provide genome annotation service. Choose a programming language for this work and explain the reason.

# Tips

- Don't leave blank on your answer sheet.
- Review the slides of this course before exam.
- Finish all assignments as required.

# Thanks!