

PHY 410-505 Computational Physics I

Chapter 1: A First Numerical Problem

Lecture 2

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Programming Concepts

Following is a list of concepts useful for understanding the codes decay.cpp and decay.m

Useful References

C++: Quickstart for newbies:

- Check out the C++ Language Tutorial
- Look up concepts in C/C++ Reference
- Download Bruce Eckel's Thinking in C++ (free and very good!) or buy a good C++ book

Mathematica: Built-in tutorials, help, and Mathematica Documentation Center

Comments

C++: Compiler ignores comments

- Rest of line starting with `//`
- Multiline starting with `/*` ending with `*/`

Mathematica: Multiline starting with `(*` ending with `*)`

Keywords

C++: Memorize these C/C++ Keywords!

Mathematica: Has more than 1000 built-in functions, starting with a capital letter, and \sim 120 system-related symbols starting with `$`

Libraries

C++: has essentially no built-in functions

- The C++ Standard Library defines many useful functions and objects
 - Definitions are imported by the C++ preprocessor
 - `#include <...> /* includes standard header ... */`
 - `using namespace std; /* imports all symbols into global namespace */`
otherwise they need to be prefixed with `std::`
 - `#include "myheader.h" /* imports user defined library */`

Mathematica: can be extended using Packages, for examples see
MathSource

Types

C++: is strongly typed, every quantity has a type

- Primitive data types `char, int, double, bool, void, ...`
- Objects (composite) types defined by `struct, union, class`
- Arrays of primitive data or objects, index operator `[]`
string constants delimited by `"..."` are `'\0'` terminated arrays of char

Mathematica: is weakly typed, it figures the type of data from context

- Symbolic math (algebra)
- Arbitrary precision arithmetic
- Compiled numerical math similar to C++
- Lists (tables) are delimited by braces `{a, b, c}`

Operators

C++: Memorize operators and precedence

- Common errors:

```
double half = 1 / 2;           // error, integer division gives 0
```

```
double ke = p * p / 2 * m;           // error, associates left to right
if (a = b) { }                       // do you mean a == b ?
```

Mathematica: input syntax is similar to C++ with many more operators and special symbols

Code Structure

C++: is a compiled language

- Each .cpp file is compiled separately
- Preprocessor directives on lines beginning with #
- Function definitions
- Statements are terminated by a semicolon
- Parentheses () used for grouping and function arguments
- Braces { } delimit compound statements

Mathematica: Everything Is an Expression

- Mathematica is an interpreted language
- Expressions are evaluated sequentially
- Semicolon ; used to separate expressions

Programming Tools

Hints on how to get started with some Integrated Development Environment (IDE) tools

Visual C++ 2008 Express Edition

- Download free
- You can use the command line compiler by opening Start->Microsoft Visual Studio 2008 Express Edition->Visual Studio Tools->Visual Studio 2008 Command Prompt

```
C:\ cl decay.cpp  
C:\ decay.exe
```

- To use the GUI open Start— >Microsoft Visual Studio 2008 Express Edition— >Microsoft Visual Studio 2008 Express Edition
- Start a new project File— >New— >Project
- Select Project type: Win32, Templates: Win32 Console Application, and supply Name: Location: Solution Name:

- Application Settings: Uncheck Precompiled header
- Remove stdafx.h and stdafx.cpp
- stdafx template from .cpp file
- Replace with your code using Edit— >Insert File As Text
- Compile and link using Build— >Build decay
- Run using Debug— >Start Without Debugging
- Use Windows Explorer to find output data files

Dev-C++ for Windows

- Download Dev-C++ and install
- Start Dev-C++ IDE using Start menu or shortcut
- Start a new project File— >New— >Project
- Select Console Application, C++ Project, and supply Name:
- Select project directory from file selection menu
- To add decay.cpp use Project— >Add to Project

- Delete the template file (right click and remove file)
- Compile and run using Execute— >Compile & Run
- Use Windows Explorer to find output data files

Xcode for Macintosh

- Register for a free account at <http://developer.apple.com/> (Click on ADC Member Site)
- Download Xcode and follow the installation instructions