Data Structures & Algorithms - Week 1

Subodh Sharma, Rahul Garg {svs,rahulgarg}@iitd.ac.in



IIT Delhi, Computer Science Department

Data Structures & Algorithms -Week 1

Rahul Garg

Course Logistics

Introduction t C++

Variables and Basic

Types Functions and

Loops

Local Scope - Block

Scope - Static Local

C++ Pointers Array Classes

Learning C++: I

- 1 Course Logistics
- 2 Introduction to C++
 - History
 - Variables and Basic Types
 - Functions and Selection
 - Loops
 - Scope Global and Local
 - Scope Block
 - Scope Static Local Variable
 - C++ Pointers
 - Array
 - Classes
- 3 Learning C++: In reality

Data Structures & Algorithms -Week 1

Subodh Sharm Rahul Garg

Course Logistics

ntroduction to

2++

History
Variables and Basic
Types
Functions and
Selection
Loops
Scope - Global and
Local
Scope - Block
Scope - Static Local

Array
Classes

_earning C++:

Learning C++: In reality

- All announcement through the course webpage https://subodhvsharma.github.io/course/col106. So regularly visit and check for updates!
- All content-specific discussions on Piazza. You will be added to COL106's Piazza shortly.
- Course email: 2301-col106@courses.iitd.ac.in
- Subject header must include: [COL106]. Most individual emails will not be entertained
- Lab Venue: LHC 503, LHC 504

Data Structures & Algorithms -Week 1

Course Logistics

• 6 Quizzes (5), 8 Assignments (20), 2 Lab exams (20)

Data Structures & Algorithms -Week 1

Course Logistics

- 6 Quizzes (5), 8 Assignments (20), 2 Lab exams (20)
- Mid-sem (25) and major exam (30)

Data Structures & Algorithms -Week 1

Subodh Sharma Rahul Garg

Course Logistics

Introduction to C++

Variables and Basi

Types

Loops

Scope - Global ai Local

Scope - Block

Variable

Array Classes

Learning C++: In reality

- 6 Quizzes (5), 8 Assignments (20), 2 Lab exams (20)
- Mid-sem (25) and major exam (30)
- Minimum of 30% in Mid-sem+Final+Quizzes

Data Structures & Algorithms -Week 1

Course Logistics

- 6 Quizzes (5), 8 Assignments (20), 2 Lab exams (20)
- Mid-sem (25) and major exam (30)
- Minimum of 30% in Mid-sem+Final+Quizzes
- Minimum of 30% in Lab-exams+Lab-assignments

Data Structures & Algorithms -Week 1

Course Logistics

- 6 Quizzes (5), 8 Assignments (20), 2 Lab exams (20)
- Mid-sem (25) and major exam (30)
- Minimum of 30% in Mid-sem+Final+Quizzes
- Minimum of 30% in Lab-exams+Lab-assignments

Data Structures & Algorithms -Week 1

Course Logistics

- 6 Quizzes (5), 8 Assignments (20), 2 Lab exams (20)
- Mid-sem (25) and major exam (30)
- Minimum of 30% in Mid-sem+Final+Quizzes
- Minimum of 30% in Lab-exams+Lab-assignments

Book References

- Kernighan, Brian W., and Dennis M. Ritchie. "The C programming language." (2002)
- Stroustrup, Bjarne. "The C++ Programming Language Fourth Edition." (2013)
- Goodrich, Michael T., Roberto Tamassia, and David M. Mount. Data structures and algorithms in C++. John Wiley & Sons. 2011
- Mark Allen Weiss. Data Structures and Algorithm Analysis in C++. Fourth edition. Pearson.

Data Structures & Algorithms -Week 1





Data Structures & Algorithms -Week 1

Subodh Sharm Rahul Garg

Course Logistic

C++

History

Variables and Basi

Functions and

Loops

Scope - Global ar

Local

Scope - Block Scope - Static Loc

Variable

Array

Learning C++: In

1978: Kernighan and Ritchie from Bell Labs published "The C Programming Language"







Data Structures & Algorithms -Week 1

Rahul Garg

Course Logistic

Introduction to

C++ History

Variables and Basic Types Functions and Selection

Scope - Global and Local Scope - Block Scope - Static Local Variable C++ Pointers

Learning C++: I

- 1978: Kernighan and Ritchie from Bell Labs published "The C Programming Language"
- 1983: Barne Stroustrup at Bell Labs introduce C with Classes as C++.







Data Structures & Algorithms -Week 1

Rahul Garg

Course Logistic

Introduction to

C++
History

Functions and Selection Loops Scope - Global and Local Scope - Block Scope - Static Local

C++ Pointe Array Classes

Learning C++: I

- 1978: Kernighan and Ritchie from Bell Labs published "The C Programming Language"
- 1983: Barne Stroustrup at Bell Labs introduce C with Classes as C++.
- 2011: C/C++11 standard introduced with a native support for Concurrency, range-based loops, lambda functions, unique/weak/shared pointers, etc.







Data Structures & Algorithms -Week 1

Subodh Sharm

Course Logistics

C++

Variables and Basic

Types

Functions and

Loops Scope - Global a

Local

Scope - Static Loca

Variable

Array

Learning C++: Ir reality

Variables are symbolic names given to expressions or identifiers

Data Structures & Algorithms -Week 1

Subodh Sharm Rahul Garg

Course Logistics

Introduction t C++

Variables and Basic

Types

Loops

Local

Scope - Block Scope - Static Loca

Variable

Array Classes

Learning C++: In reality

- Variables are symbolic names given to expressions or identifiers
- Variables store data

Data Structures & Algorithms -Week 1

Variables and Basic Types

- Variables are symbolic names given to expressions or identifiers
- Variables store data
- Each variable has a type

```
int inch; // declaration
/*
definition
requires declaration first!
*/
inch = 2;
```

Data Structures & Algorithms -Week 1

Variables and Basic

- Variables are symbolic names given to expressions or identifiers
- Variables store data
- Each variable has a type

```
int inch; // declaration
/*
definition
requires declaration first!
*/
inch = 2;
```

 Types determine the operations that can be performed on variables

Data Structures & Algorithms -Week 1

Variables and Basic

- Variables are symbolic names given to expressions or identifiers
- Variables store data
- Each variable has a type

```
int inch; // declaration
/*
definition
requires declaration first!
*/
inch = 2;
```

- Types determine the operations that can be performed on variables
- Basic types: bool, char, int, float, double

Functions and Selection

```
& Algorithms -
Week 1
Subodh Sharma,
Rahul Garg
```

Data Structures

U++ History Variables and Basic Types

Functions and Selection

Scope - Global and Local Scope - Block Scope - Static Local

Variable
C++ Pointers
Array

Learning C++: In reality

```
// Func declaration
int someFunc(char i);
// Func definition
int someFunc(char input) {
  if (input == 'y') return 1;
  else return 0;
}
```

- Function name: someFunc
- Function return type: int
- Formal parameters: char input
- Function declaration: int someFunc(char input);

Loops

```
Data Structures
& Algorithms -
    Week 1
Loops
```

```
bool accept() {
  int tries = 1;
  while (tries < 4) {</pre>
    std::cout << ``Proceed (y/n)?\n'';</pre>
    char answer=0;
    std::cin >> answer;
    switch (answer) {
      case 'v':
             return true;
      case 'n':
             return false;
      default:
             std::cout >> ``Unknown option\n'';
             tries++; //tries = tries +1
```

LoopsContinued

```
Data Structures
& Algorithms -
   Week 1
```

Loops

```
#include <iostream>
int main() {
  int sum =0;
  for (int i = 1; i <= 10; i++) {
    sum += i;
  std::cout << sum << std::endl;</pre>
return 0;
```

Scope - Global and Local

```
Data Structures
& Algorithms -
   Week 1
```

Scope - Global and

```
int globalVar; // global variable
void someFunction() {
  globalVar = 10; // accessible here
  int localVar =5; // not accessible outside
```

Scope - Block

```
Data Structures
& Algorithms -
Week 1
```

Subodh Sharma Rahul Garg

Course Logisti

Introduction to

Variables and Basic

Types

Loops

Scope - Global a

Scope - Block

Variable C++ Pointers

Array Classes

Learning C++: Ir

Scope - Static Local Variable

```
Data Structures
& Algorithms -
    Week 1
```

Scope - Static Local Variable

```
void someFnc() {
  static int x = 30; // Static local variable
  X++;
  // ...
// x is not accesssible here
// but when some Fnc is called again, x = 31
```

Other keywords relating to scope and visibility: extern, const, public, private, protected, namespace, volatile, mutable Home Reading, Try it out in lab sessions!

Data Structures & Algorithms -Week 1

ubodh Sharma Rahul Garg

ourse Logistic

Introduction to

History

Types

Loops

Local Scope - Block

Scope - Static Loca Variable

C++ Pointers
Array
Classes

Learning C++: In

Pointers

In C++, a pointer is a variable that stores the memory address of another variable.

Declaration:

int *p; // p points to an int val

Data Structures & Algorithms -Week 1

C++ Pointers

Pointers

In C++, a pointer is a variable that stores the memory address of another variable.

Declaration:

Definition:

Data Structures & Algorithms -Week 1

Subodh Sharm Rahul Garg

Course Logistic

Introduction to C++

Variables and Basi Types

Selection Loops Scope - Global a

Scope - Block Scope - Static Local

C++ Pointers Array

Learning C++: In

Pointers

In C++, a pointer is a variable that stores the memory address of another variable.

Declaration:

Definition:

Dereference:

Data Structures & Algorithms -Week 1

Subodh Sharm Rahul Garg

Course Logistic

Introduction t

Variables and Basi Types Functions and

Loops
Scope - Global and
Local

Scope - Static Local Variable C++ Pointers

Array Classes

Learning C++: I

Pointers

In C++, a pointer is a variable that stores the memory address of another variable.

Declaration:

Definition:

Dereference:

Value modification through pointers:

$$*p = 20;$$
// y has the same value as x

Array

Data Structures & Algorithms -Week 1

Array

Homogeneous container; Contiguous

```
char v[10]; // array of 10 chars
int num[] = \{1, 2, 3, 4\};
char *p;
p = &v[3];
```

Arrays are passed to functions as pointers

```
void someFnc(int *num, int size) {
  for (int i = 0; i < size; i++) {
    std::cout << num[i];
```

Reading Assignment:

- Pass by value vs Pass by reference
- Pointers vs Reference
- Use of const with pointers
- Unique and Shared pointers

Classes

Data Structures & Algorithms -Week 1

Rahul Garg

Course Logistics

Introduction to

Variables and Basi

Types
Functions and

Loops

Local Scope - Block

Scope - Static Local Variable

Array Classes

Learning C++: I

Classes are user defined datatypes which encapsulated data and functions into a single unit.

```
class Node{
  private:
    int val;
    Node * next;
  public:
    Node (int value, Node *n=nullptr) {
      val = value;
      next = n;
};
Node *n1 = new Node(1);
Node *n2 = new Node(2, n1);
```

Classes:Visibity

Data Structures & Algorithms -Week 1

Subodh Sharm Rahul Garg

Course Logistic

Introduction t C++

Variables and Basic

Types

Loops

Scope - Global ar Local

Scope - Block Scope - Static Loca

Variable

Array Classes

Learning C++: In reality

Public, Private, Protected: Access specifiers that specify the visibility of variables and functions.

Classes:Visibity

Data Structures & Algorithms -Week 1

Subodh Sharm Rahul Garg

ourse Logisti

Introduction t C++

Variables and Basic

Types
Functions and
Selection

Loops Scope - Global an Local

Scope - Block Scope - Static Local Variable

Variable C++ Pointers

Classes

Learning C++: In reality

- Public, Private, Protected: Access specifiers that specify the visibility of variables and functions.
- Public: The entity is accessible from anywhere outside the class definition

Classes: Visibity

Data Structures & Algorithms -Week 1

Classes

- Public, Private, Protected: Access specifiers that specify the visibility of variables and functions.
- Public: The entity is accessible from anywhere outside the class definition
- Private: These members are only accessible from within the class itself through member functions or the **friend** functions.

Classes:Visibity

Data Structures & Algorithms -Week 1

Subodh Sharm Rahul Garg

Course Logisti

Introduction t C++

History
Variables and Basic
Types
Functions and
Selection

Loops
Scope - Global and
Local
Scope - Block
Scope - Static Local
Variable
C++ Pointers
Array

Learning C++: In

Classes

- Public, Private, Protected: Access specifiers that specify the visibility of variables and functions.
- Public: The entity is accessible from anywhere outside the class definition
- Private: These members are only accessible from within the class itself through member functions or the friend functions.
- Protected: These members are accessible from within the class and its derived classes.

Classes:Example

```
Data Structures
          #include <iostream>
& Algorithms -
 Week 1
          #include <string>
          class Person {
          private:
               std::string aadhaar;
          public:
               std::string name;
               void setAadhaar(std::string s) {
                    aadhaar = s;
Classes
               std::string getAadhaar() const {
                    return aadhaar;
```

Classes:Inheritance

```
Data Structures
& Algorithms -
Week 1
```

Introduction to

Variables and Basic

Types
Functions and
Selection

Loops
Scope - Global and

Scope - Block Scope - Static Local Variable

Array Classes

Learning C++: In reality

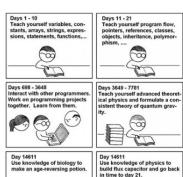
```
class Base {
public:
virtual void foo() {
  std::cout << "Base::foo()\n";</pre>
} } ;
class Derived : public Base {
public:
void foo() {
  std::cout << "Derived::foo()\n";</pre>
void bar() { Base::foo(); }
};
```

Keyword **virtual** is *necessary* for method overriding.

Learning C++: In reality

Data Structures & Algorithms -Week 1

Learning C++: In reality



Days 22 - 697 Do a lot of recreational programming. Have fun hacking but remember to learn from your mis-Days 7782 - 14611 Teach yourself biochemistry, molecular biology, genetics,... Day 21 Replace younger self.

As far as I know, this is the easiest way to "Teach Yourself C++ in 21 Days".

Figure: Learning C++ in 21 days!