



C++ "Diamond Problem" of Multiple Inheritance

Home

Privacy Policy GDPR

Java

If You Put System.exit(0) on Try or Catch block, Will Finally Block Execute?

JVM platform dependent?

Method overriding vs overloading

Why have a private constructor

Difference between object and class

How copy constructors work

Final modifier

Finally block

Java: Will Finally run after return?

Java Protected Example

Java serializable class example

Multiple Inheritance

How to Create a Thread in Java

Interface vs. Abstract Class

Thread States in Java

Arithmetic Exception

Overridden Method

Dynamic Binding

Can constructors be synchronized in Java?

Does Java pass by reference or by value?

Difference between a primitive type and a class type?

Does Java have pointers?

Downcasting in Java

Java: Diamond Problem

Java: Can an interface extend another interface?

Java: Are objects of the same type as the interface implemented?

What's the difference between a stack and a heap?

The differences between the stack and the heap can be confusing for many people. So, we thought we would have a list of questions and answers about stacks and heaps that we thought would be very helpful.

Where are the stack and heap stored?

They are both stored in the computer's RAM (Random Access Memory). For a refresher on RAM and virtual memory, read this article: [How Virtual Memory Works](#)

How do threads interact with the stack and the heap? How do the stack and heap work in multithreading?

In a multi-threaded application, each thread will have its own stack. But, all the different threads will share the heap. Because the different threads share the heap in a multi-threaded application, this also means that there has to be some coordination between the threads so that they don't try to access and manipulate the same piece(s) of memory in the heap at the same time.

Can an object be stored on the stack instead of the heap?

Yes, an object can be stored on the stack. If you create an object inside a function without using the "new" operator then this will create and store the object on the stack, and not on the heap. Suppose we have a C++ class called Member, for which we want to create an object. We also have a function called somefunction(). Here is what the code would look like:

Code to create an object on the stack:

```
void somefunction( )
{
    /* create an object "m" of class Member
       this will be put on the stack since the
       "new" keyword is not used, and we are
       creating the object inside a function
    */

    Member m;

} //the object "m" is destroyed once the function ends
```

So, the object "m" is destroyed once the function has run to completion – or, in other words, when it "goes out of scope". The memory being used for the object "m" on the stack will be removed once the function is done running.

Java: Can an interface be instantiated?

Find First Nonrepeated Character

Java: What's the difference between equals() and ==?

Find trailing zeros in factorial

Java Reflection Example

Bit Manipulation Interview Questions and Answers

XOR in Java

Java Inner Class Example

When to use inner classes in Java

Inner vs nested class

Java Anonymous Class Example

Anonymous Class Interface

Argument Defined Anonymous Inner Class

C/C++

Introduction

Function Overloading

How to Read Complex C Declarations

C++ abstract keyword

Pure Virtual Function

Lvalues and Rvalues in C

Inline vs. Macro

Diamond Problem

How Vtables Work

Virtual Destructors

Friend Classes in C++

How do you call C functions from C++?

What is a memory leak in C++?

What is the difference between delete and delete[]?

What's the difference between a class variable and an instance variable?

Can static function access non-static members of class?

Execution order of constructor and destructor in inheritance

Does C++ support multiple inheritance?

Can you change the "this" pointer?

Function Templates in C++ example

C++: The compiler and function templates

C++: Function template with

If we want to create an object on the heap inside a function, then this is what the code would look like:

Code to create an object on the heap:

```
void somefunction( )
{
    /* create an object "m" of class Member
       this will be put on the heap since the
       "new" keyword is used, and we are
       creating the object inside a function
    */

    Member* m = new Member( ) ;

    /* the object "m" must be deleted
       otherwise a memory leak occurs
    */

    delete m;
}
```

In the code above, you can see that the "m" object is created inside a function using the "new" keyword. This means that "m" will be created on the heap. But, since "m" is created using the "new" keyword, that also means that we must delete the "m" object on our own as well – otherwise we will end up with a [memory leak](#).

How long does memory on the stack last versus memory on the heap?

Once a function call runs to completion, any data on the stack created specifically for that function call will automatically be deleted. Any data on the heap will remain there until it's manually deleted by the programmer.

Can the stack grow in size? Can the heap grow in size?

The stack is set to a fixed size, and can not grow past it's fixed size (although some languages have extensions that do allow this). So, if there is **not** enough room on the stack to handle the memory being assigned to it, a **stack overflow** occurs. This often happens when a lot of nested functions are being called, or if there is an infinite recursive call.

If the current size of the heap is too small to accommodate new memory, then more memory can be added to the heap by the operating system. This is one of the big differences between the heap and the stack.

How are the stack and heap implemented?

The implementation really depends on the language, compiler, and run-time – the **small** details of the implementation for a stack and a heap will always be different depending on what language and compiler are being used. But, in the big picture, the stacks and heaps in one language are used to accomplish the same things as stacks and heaps in another language.

Which is faster – the stack or the heap? And why?

The stack is much faster than the heap. This is because of the way that memory is allocated on the stack. Allocating memory on the stack is as simple as moving the stack pointer up.

How is memory deallocated on the stack and heap?

more than one type parameter

C++: #include " " vs. #include <>

C++: Name Hiding

C++ Ellipsis Catch Handler

What happens if a thrown exception is not handled?

C++ namespace example

C++ const pointer examples

Databases/SQL

SQL Interview Questions

UNION vs. UNION ALL

Inner vs. Outer joins

SQL Key Definition

Differences between Primary and Foreign Keys

Natural Key In Database

Secondary Key

Simple key in SQL

Superkey Example

What is Referential Integrity

Having vs. Where clause

How do database indexes work?

What is a self join?

Example of DISTINCT in SQL

Retrieve unique rows without DISTINCT

Practice Interview Question 1

Practice Interview Question 1 continued

Practice Interview Question 1 continued

Practice Interview Question 2

Advanced SQL Interview Questions and Answers

Advanced SQL Interview Questions and Answers Part 2

Practice Interview Question 2 continued

Data Mining vs. Data Warehousing

Ternary/Three-valued Logic in SQL

Find Maximum Value Without Using Aggregate

SQL Injection Example and Tutorial

SQL Injection Prevention

Blind SQL Injection Example

Parameterized Queries vs Prepared Statements

Prepared Statement Example

Data on the stack is **automatically** deallocated when variables go out of scope. However, in languages like C and C++, data stored on the heap has to be deleted **manually** by the programmer using one of the built in keywords like **free**, **delete**, or **delete[]**. **Other languages like Java and .NET use garbage collection to automatically delete memory from the heap, without the programmer having to do anything..**

What can go wrong with the stack and the heap?

If the stack runs out of memory, then this is called a *stack overflow* – and could cause the program to crash. The heap could have the problem of *fragmentation*, which occurs when the available memory on the heap is being stored as noncontiguous (or disconnected) blocks – because *used* blocks of memory are in between the *unused* memory blocks. When excessive fragmentation occurs, allocating new memory may be impossible because of the fact that even though there is enough memory for the desired allocation, there may not be enough memory in one big block for the desired amount of memory.

Which one should I use – the stack or the heap?

For people new to programming, it's probably a good idea to use the stack since it's easier. Because the stack is small, you would want to use it when you know exactly how much memory you will need for your data, or if you know the size of your data is very small. It's better to use the heap when you know that you will need a lot of memory for your data, or you just are not sure how much memory you will need (like with a dynamic array).

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Previous...

Next...

38 thoughts on “Difference between stack and heap”

There has been a critical error on your website.

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Difference between a full join and an inner join?
Difference between a left outer join and right outer join?
Difference between a left join and a left outer join?
SQL: Having vs Group By
SQL: Group By with multiple columns
SQL – Select Distinct and Order By
SQL – Order By default sort order
Derived table vs subquery
Correlated vs Uncorrelated Subquery
Find nth highest salary – SQL
Cardinality in SQL
Selectivity in SQL Databases
Cardinality versus Selectivity
Clustered vs. Non Clustered Index
Page versus block
Database Locking
Lock Escalation
Database Deadlock Example
What is a database transaction?
SQL Server Transaction
Oracle Transaction
MySQL Transaction
DB2 Transaction
Concurrent Update Problem
How to Tune Database Performance
Database Full Table Scan
What is cost based optimization?
How to tune SQL queries
SQL Index Performance
What is a bitmap index?
Oracle Indexes Examples
System privileges vs. object privileges
SQL Grant
SQL Revoke
SQL Create User
Database Roles
SQL CASE Statement
SQL Searched CASE Statement
SQL Inline View
RANK() versus DENSE_RANK()

Javascript

[Javascript Interview Questions](#)

[Javascript Outside the Browser](#)

[JavaScript Strict Mode](#)

[Javascript: What is ECMAScript?](#)

[How to print a Javascript object](#)

[Javascript: how "var" works](#)

[Javascript: Block scope](#)

[Javascript Function Scope](#)

[Javascript: Example of Hoisting](#)

[What is Javascript minification?](#)

[Minification vs Obfuscation](#)

[Falsy values in Javascript](#)

[Javascript Method Chaining](#)

[Javascript Nested Function Example](#)

[Javascript Global Object](#)

[Wrapper Objects in Javascript](#)

PHP

[Find a Client IP Address](#)

[PHP Interview Questions](#)

[Difference between == and === in PHP?](#)

[How would you parse HTML in PHP?](#)

[PHP: What are magic methods?](#)

[PHP: Example of the __autoload function](#)

[PHP: self vs \\$this](#)

[PHP: self vs. static](#)

[Find if string contains another string – php](#)

[How to delete an element from an array in php?](#)

[PHP toString](#)

[Return JSON from PHP](#)

[How to remove warnings in PHP?](#)

[Advanced PHP Interview Questions And Answers](#)

[Advanced PHP Interview Questions And Answers Part 2](#)

[Advanced PHP Interview Questions And Answers Part 3](#)

[How to return an array from a PHP function](#)

[How to delete cookies in PHP](#)

[PHP cookie versus session](#)

[Can sessions work without cookies?](#)

Data Structures

Data Structure Interview
Questions and Answers

Big O Notation

Big O versus Big Omega
notations

DFS vs. BFS

Hash Tables versus Binary
Search Trees

How to find if a linked list is
circular has a cycle or ends

Preorder Traversal Algorithm

Inorder Traversal

Postorder Traversal

**Difference between stack and
heap**

Find nth to last element in a
linked list

Delete a node in the middle of a
singly linked list

Reverse a linked list

Design Pattern Questions

Design Pattern Interview
Questions and Answers

What Is GOF?

Design Pattern Interview
Question 1

Design Pattern Interview
Question Part 2

Design Pattern Interview
Question part 3

Decorator pattern versus
Inheritance

Thread Safety in Singleton

Excel Interview Questions

Excel Interview Questions

Cut and paste versus copy and
paste in Excel

How to link cells in Excel

Absolute references in Excel

Excel Range Formula

Excel Entire Column

How to move an entire column
in excel?

How to add a dropdown list to
Excel

HTML5

HTML5 Interview Questions and
Answers

What is a CSS Box Model?

History of HTML5

Void elements HTML5

New Features in HTML5 Forms

HTML5 email form field

HTML5 Polyfill Example

What is a shiv in HTML5?

HTML5 Video Codecs

Containers versus codecs

Codec Hardware Support

Networking

Networking Interview Questions

Why Use Mesh Topology for My Network?

Baud rate vs bit rate

What is a MAC address?

What happens when you visit a website?

Operating Systems

Operating System Interview Questions

How Virtual Memory Works

Paging and Page Faults

Purpose of Swapping

Thread vs. Process

Swapping Versus Paging

Vmware Fusion come with Windows?

Does Parallels Desktop come with Windows?

Monitors vs Semaphores

Example of Threading and Synchronization

User Threads vs. System Threads

Recursion

Recursion Interview Questions

Explanation of Recursion

Can every recursive function be made iterative?

Recursion Versus Iteration

Permutations of A String

Factorial Iterative and Non Recursive

Find nth Fibonacci number

Tail Recursion

Tail Call Optimization

Apache Interview Questions

Introduction

Purpose of ASF's DocumentRoot Directive

Is a restart to Apache required after a change to .htaccess file?

How to password protect a file in .htaccess

How to disable password protection in .htaccess

How to password protect a directory using .htaccess

Directory directive in .htaccess

Does .htaccess slow site down?

What is an Apache module?

General/Miscellaneous

Introduction

What is Ascii?

HTML GET vs. POST

Black vs White Box Testing

Postfix vs. Prefix

Is String A Palindrome Function?

CSS id vs. Class

CSS Sprite Example

Recursion Interview Question

Is array access in Java expensive compared to C++?

Java Method – Calculate Factorial

Web vs. application server

Why Manhole Covers Are Round

Logarithm in HTML

Exponents in HTML

Less than sign in HTML

Tracking Open Emails

Tracking Opens Plain Text Emails

Click tracking in emails

How To Send an HTML email from Gmail

Network Performance 2 Major Issues

Symmetric vs. Public key Cryptography

Why don't C# and Java support multiple inheritance?

FTP command to transfer a directory

What's the difference between a compiled and an interpreted language?

Swap numbers without temp

Find Max Without Comparison

Find continuous sequence with largest sum

URL Size Limit

How to find the number of downloads for an app – iTunes

How does iTunes rank apps?

How to find your WordPress version

Rank Sets in order of their intersections

Non-Technical Questions

Introduction

Why work here?

Five years?

Why leave?

Interviewing in India

India – Introduction

India – Recruiters

Working As a Software Engineer

Working life – Big Company Part 1

Working life – Big Company Part 2

Financial Analyst Questions

Financial Analyst Interview Questions

Financial Analyst interview questions and answers

Financial Analyst interview Questions and Answers Part 2

Job Advice For Programmers

How to Ace an Interview

How to prepare for a software engineering interview

Introduction

Job Offer Negotiations

Skype Interview Tips

So You Want to Be a Programmer?

Should my resume be only one page?

Should I Expect Less Salary After Not Working

Does how I dress matter in an interview?

Does the Company I work for matter?

Should I bring copies of my resume to an interview?

Negotiating an offer for a new job

Puzzles

Cutting a cake into 8 pieces

Puzzles Interview Questions And Answers

Minimum guesses to find a #
from 1 to 1000

three-switches-three-bulbs

100 Lockers Puzzle

8 Pennies Find Lightest 7 equal

Measure weight of an elephant
with no scale

Measure 4 liters

25 horses 5 tracks 3 fastest
puzzle

Same national champion 65
year span

Rope Bridge Puzzle Four People
One Flashlight

8 marbles puzzle find heaviest

8 marbles riddle generalize
solution

2 Fuses Problem Measure 45
Minutes

Train Escape Puzzle 2 boys

Prisoner Hat Riddle

2 Eggs 100 Floors Puzzle

3 Ants Triangle Puzzle

Find number of squares
chessboard

Assortment of Knowledge

Introduction

Web Listings Inc. Scam

WordPress url http error

FTP from Mac Terminal

Mput to FTP from Mac Terminal

Does websense block adsense?

What country are Danish people
from?

What country are Dutch people
from?

Is Donald Trump a Republican?

Is the Vatican in Rome?

What is a "topper"?

How does India feed all it's
people?

Does India give foreign aid?

Does Britain have a space
program?

Why is Blackberry also called
Crackberry?

Does Google return different
results for phones?

Can Google recognize faces?

Can Facebook recognize faces?

Does Google own Yelp?

What countries have Yelp?

Is Yelp in India?
How to make a restricted call from a cell phone?
Is Google auto-complete based on past queries?
Does Yahoo use Bing?
Does Yahoo use Google?
Yahoo Google Antitrust
What share does Mark Zuckerberg own of Facebook?
Who is George Costanza based on?
How to get the radio code for an Acura TSX?
NBA Players that went broke
How much is Zuckerberg worth?
Do airlines x ray checked baggage?
Do airlines charge for infants?
Whats the difference between a nonstop and direct flight?
Do airlines charge for car seats?
Do Airplanes have power outlets?
Do airlines charge for pets?
Do airlines charge for wheelchairs?
Does Prague use the Euro?
Does the Czech Republic use the Euro?
Does Switzerland use the Euro?
How expensive is Switzerland?
How expensive is Paris?
Eiffel Tower Light Show
How much does the Paris Metro cost for one ticket?
Are there roads in Venice?
Are Bank of America debit cards insured?
Is Venice an island?
Review of the Danubius Hotel in London, Regents Park
Should you use your debit card when traveling?
What is Bank Of America's international phone number?
What is the cost of a 5 day Oyster card pass in London's underground tube?
Where is the best place to exchange dollars to pounds in London?
Do they give free tapas in Granada, Spain?

Where is the best place to exchange money in Cordoba, Spain?

Where is the best place to exchange money in Granada, Spain?

Where is the best place to exchange money in Madrid, Spain?

Review of the NH Victoria Hotel in Granada Spain

How to get to Malaga from Granada

How to get to Cordoba from Malaga

Cheapest Airport Shuttle in Honolulu

Cost of taxi Honolulu Airport to Waikiki

How expensive is Honolulu?

Is Terminal 1 at SFO International?

Review of Iberia Flight 6275 from Madrid to Chicago

Vegetarian food in Waikiki

Dish Network Scam

Fedex Stolen iPhone

Fee for ending eBay auction early

PayPal Email Scam Example

Send email address through eBay

How to connect Dish Network remote to a new TV?

Do Tennis Players Get Paid for Davis Cup?

What is a gazetted holiday?

American Vocabulary

Introduction

What is a pop quiz?

What does back burner mean?

What is a "pissing contest"?

What does "let's play it by ear" mean?

Earns The Big Bucks?

What does shady mean?

It all boils down to?

What is crunch time?

Game Time Decision?

Catch Off Guard?

What is an alpha male?

What is a hard stop?

Take Conversation Off Line?

What is hump day?
Putting Lipstick On a Pig?
Picking somebody's brain?
What is a pow wow?
Pushing the Envelope?
6 to one half dozen to the other
Reinvent the Wheel?
What does "in a row" mean?
What is a "stones throw away"?
What is a red flag?
What is a "fire drill"?
Meaning of "where there's smoke there's fire"
Meaning of "et al"
Meaning of out of commission?
Meaning of "fly by night"?
What does "flight risk" mean?
What does "catch wind" mean?
What is a brain fart?
What does "make a killing" mean?
In tennis what's a bagel?
What is a "bounced check"?
What does "shortchange" mean?
What does it mean to "clock out"?
What is shock value?
What does "be the bigger man" mean?
What does "rube" mean?
What is "careerism"?
What is a "haunt"?
Meaning of "get feet wet"?
Meaning of "changing of the guard"?
What is a "hard copy"?
What does "brush with death" mean?
In tennis, what is a pusher?
What does "OTE" mean in sales?
What does "pay lip service" mean?
What does "tip of the iceberg" mean?
What is an advert?
In the 11th hour meaning
Gentleman's C meaning
Meaning of teetotalar

Hala Madrid Meaning
Make your mark meaning
Shameless Plug Meaning
Low Hanging Fruit Meaning
Successism meaning
See eye to eye meaning
Rob Peter to Pay Paul meaning
Case in point meaning
Bait and Switch Meaning
Pardon My French Meaning
Throw him under the bus meaning
Wrong line of work meaning
My cue to leave meaning
What is a buzzkill?
Coined the Term Meaning
Elephant in the room meaning
Winging it meaning
Touch and go meaning
Hold my own meaning
Throw a line meaning
Skin in the game meaning
Brain dump meaning
He had the last laugh meaning
Call it a night Meaning
Speak off the cuff meaning
He has a chip on his shoulder meaning
Touch base meaning
On the house meaning
What are meeting minutes?
What is a low life?
What are brownie points?
Show True Colors Meaning
What does legit mean?
Just a heads up meaning
On the line meaning
Cream of the Crop meaning
Right as Rain Meaning
Hat in hand meaning
What is a cake eater?
What is a second wind?
Bush league move meaning
Skating on thin ice meaning
Last straw meaning
At my wit's end meaning
At the end of my rope meaning

At Large Meaning

What is tunnel vision in slang?

Do me a solid meaning

In a pig's eye meaning

Wear emotions on sleeve meaning

Keep plugging away definition

He is toast meaning

What is smart money?

On the lam meaning

Living large meaning

What is the Difference Between an Array and Linked List?

Hold the fort down meaning

Lay low meaning

Over the hill meaning

Out of the question meaning

Runs a tight ship meaning

Around the corner meaning

Technical Vocabulary

Introduction

What is a soft launch in software?

What is a software generalist?

What is a staging environment?

What is deprecated code?

What is syntactic sugar?

What is a turnkey solution?

What is a White hat hacker?

What is web root?

What is the LAMP stack?

What is GoF in design patterns?

What is a "hack" in software?

What is hard coding in Java?

Science Questions

Science Questions Introduction

What is the longest earthquake ever?

Are all volcanoes made of lava?

Why do rivers wind?

What makes rivers run?

Does the Mississippi River form a delta?

Do glaciers ever melt?

What is an ephemeral river?

What is the snout of a glacier?

Are there any rivers in the desert?

How much of the world's land is covered by desert?
Do Caves Last Forever?
What are gallery caves?
What is the world's longest cave?
What is the name for an expert on caves?
Who first realized earth circles the sun?
Why does the Moon look the same size as the Sun?
How do rockets work in space?
How many satellites are launched each year?
Does Pentagon know where every satellite is?
What planets have been visited by spacecrafts?
What tree is the symbol of Canada?
Why don't all trees lose their leaves?
Do all plants grow from seeds?
Are fruits seeds?
Are any vegetables also fruits?
Why do flowers have pretty colors?
Problems with the green revolution?
What are the largest seeds?
Do any flowers bloom for just a day?
How many plants are edible?
Has any woman ever run a 4 minute mile?
Did women ever put deadly nightshade in their eyes?
How can a willow tree cure a headache?
Does Coca Cola come from same plant as cocaine?
What plant has two different flowers?
What trees make wood?
What trees are used to make cricket bats?
What is the world's worst smelling flower?
Is there a plant that eats frogs?
What plant did the Egyptians use for writing?
How do plants find water in the desert?
How often does it rain in Chile's Atacama desert?

Is the snow pink in Antarctica?

What frog makes arrows
poisonous?

Do reindeers really pull sleighs?

What's the difference between a
moose and an elk?

What's the difference between a
reindeer and a caribou?

Why is a grizzly bear grizzly?

Do wolves really howl at the
moon?

Do all penguins live in the
Antarctic?

What bird never sees the
sunset?

Do zebras neigh like horses?

What's the difference between a
male lion and a female?

Can crocodiles climb trees?

Does a mother crocodile carry
babies between her teeth?

Are crocodiles like dinosaurs?

What animal can jump the
highest?

Do vultures hunt?

Difference between a buffalo
and a bison?

Who first wore trousers?

Which parts of the body are
most sensitive to heat?

What country has the most
arable land?

How long can a cheetah run?

Find a Job

What:

Where:



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