

# Cracking the Coding Interview – STUDY GUIDE

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## Programming Paradigms

### Object Oriented

In object oriented languages **data and methods of manipulating the data are kept as a single unit called an object**. The only way a user can access the data is via object's methods. Therefore the inner workings of an object may be changed without affecting any code that uses the object.

### Polymorphism

Providing or supplying a single interface to be used with entities of different types.

### Declarative

In declarative languages the computer is told **what the problem is, not how to solve the problem** –the program is structured as a collection of properties to find in the expected result, not as a procedure to follow. It's a style of expressing the logic of a computation without describing its control flow. This is in **contrast with imperative programming**, which implements algorithms in explicit steps. *Given a database or a set of rules, the computer tries to find a solution matching all the desired properties., e.g. SQL*

### Imperative

Imperative programming focuses on **how a program operates**, consisting of commands for the computer to perform. This **contrasts declarative programming**.

### Functional

Functional programming is a **subset of declarative programming**. Programs are written using functions, *blocks of code intended to behave like mathematical functions*. Functional languages discourage changes in the value of variables through assignment.

## Arrays & Strings

### 1. Determine if string has unique characters; without additional data structures.

- split up characters from string `chars[] = str.toCharArray();`
- get single character from string `char c = str.charAt(i);`
- cast char to int, `int value = str.charAt(i);` , (this is because the primitive char datatype is a 16 bit unsigned integer)
- shift 1 by the int casted from the char && with a checker 0, if result isn't 0 then not unique, if it is checker |= result

### 2. Reverse a String

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code input sample

```
public class isUnique {
    public static boolean isUnique(String s) {
        // hello world
        HashMap <Character, Boolean> charMap = new HashMap<Character,
            Boolean>();
        return true;
    }
}
```

### Properties of supremum and infimum

Let  $h$  be a given positive number and let  $S$  be a set of real numbers.

- (a) If  $S$  has a supremum, then for some  $x$  in  $S$  we have  $x > \sup S - h$ .
- (b) If  $S$  has an infimum, then for some  $x$  in  $S$  we have  $x < \inf S + h$ .

### Well-ordering principle

Every nonempty set of positive integers contains a smallest member.

### Triangle inequality

For arbitrary real numbers  $x$  and  $y$ ,  $|x + y| \leq |x| + |y|$ . More generally, for arbitrary real numbers  $a_1, a_2, \dots, a_n$ , we have  $|\sum_{k=1}^n a_k| \leq \sum_{k=1}^n |a_k|$ .

### The Cauchy-Schwarz inequality

If  $a_1, \dots, a_n$  and  $b_1, \dots, b_n$  are arbitrary real numbers, we have  $(\sum_{k=1}^n a_k b_k)^2 \leq (\sum_{k=1}^n a_k^2) (\sum_{k=1}^n b_k^2)$ . The equality sign holds if and only if there is a real number  $x$  such that  $a_k x + b_k = 0$  for each  $k = 1, 2, \dots, n$ .

## Complex Field

### Field properties

$(a, b) = (c, d)$  means  $a = c$  and  $b = d$

$(a, b) + (c, d) = (a + c, b + d)$

$(a, b)(c, d) = (ac - bd, ad + bc)$   $x + y = y + x$

$x + (y + z) = (z + y) + z$

$x(y + z) = xy + xz$

$e^{z+2n\pi i} = e^z$

### Polar coordinates

$x = r \cos \theta$   $y = r \sin \theta$

$r$  is the modulus or absolute value of  $(x, y)$ , equal to  $\sqrt{x^2 + y^2}$ .

$\theta$  is the angle between  $(x, y)$  and the x-axis, and is called the argument of  $(x, y)$ , or the principal argument if  $-\pi < \theta \leq \pi$ .

Polar form of  $z$ : Every complex number  $z \neq 0$  can be expressed as  $z = re^{i\theta}$ .

### Complex exponential

If  $z = (x, y)$ , then  $e^z = e^x(\cos y + i \sin y)$

$e^a e^b = e^{a+b}$

**Derivatives and integrals**

If  $f = u + iv$ , then  $f'(x) = u'(x) + iv'(x)$

$$\int_a^b f(x) dx = \int_a^b u(x) dx + i \int_a^b v(x) dx$$

$$(e^{tx})' = te^{tx}$$

$$\int e^{tx} dx = \frac{e^{tx}}{t}$$