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.

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, $\ldots$, a_n, we have $|\sum_{k=1}^{n} a_k| \leq \sum_{k=1}^{n} |a_k|$.

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

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
$x = r\cos\theta \quad y = r\sin\theta$
r is the modulus or absolute value of (x, y), equal to $\sqrt{x^2 + y^2}$.
θ 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 $f'(x) = u'(x) + iv'(x)$
$\int_a^b f(x)\,dx = \int_a^b u(x)\,dx + i\int_a^b v(x)\,dx$
$(e^{tx})' = te^{tx}$
$\int e^{tx}\,dx = \frac{e^{tx}}{t}$