

*Based on requirements, always pick the right tool for the job. — DrewMarsh*

Data structure is a particular way of organizing data in a computer. The developer must choose the appropriate data structure for better performance. If the developer chooses bad data structure, the system does not perform well. This article explains the each data structure advantages and usage.

Linked List

Linked list is a data structure which links each node to the next node. The developer can use linked list in the following use cases.

* When the developer needs constant time for insertion and deletion.
* When the data dynamically grows.
* Do not access random elements from the linked list.
* Insert the element in any position of the list.

Circular Linked List

A circular linked list is a linked list which the link field of the tail node link to the head node. The developer can use circular linked list in the following use cases.

* Develop the buffer memory.
* Represent a deck of cards in a game.
* Browser cache which allows to hit the BACK button.
* Implement Most Recently Used (MRU) list.
* Undo functionality in Photoshop or Word.

Doubly Linked List

Doubly linked is a data structure which each node contain data and two links. One link point to previous node and another link point to next node. The developer can use doubly linked list in the following uses cases.

* Easier to delete the node from doubly linked list.
* Can be iterated in reverse order without recursion implementation.
* Insert or remove from double-linked lists faster.

Stack

The stack is a last in, first out data structure. The developer can use the stack in the following use cases.

* Expression evaluation and syntax parsing.
* Finding the correct path in a maze using backtracking.
* Runtime memory management.
* Recursion function.

Queue

The queue is a first in, first out (FIFO) data structure. The developer can use Queue in the following use cases.

* Use queue when the developer wants an order.
* Processed in First In First Out order.
* If the developer wants to add or remove both ends, they can use the queue or a double-ended queue.

Binary Tree

A binary tree is a tree data structure in which each node has at most two child nodes. The developer can use Binary Tree in the following use cases.

* Find name in the phone book.
* Sorted traversal of the tree.
* Find the next closest element.
* Find all elements less than or greater than a certain value.

Binary Search Tree

A binary search tree is a tree data structure in which root node is less than or equal to left subtree and greater than or equal to right subtree. The developer can use Binary Search Tree in the following use cases.

* Binary Search Trees are memory-efficient.
* Use when the data need to be sorted.
* Search can be done for a range of values.
* Height balancing helps to reduce the running time.

Heap

A heap is a specialized tree-based abstract data type that satisfies the heap property. The developer can use Heap in the following use cases.

* Implement Priority Queue.
* whenever the developer want quick access to the largest (or smallest) item.
* Good for selection algorithms (finding the min or max).
* Operations tend to be faster than for a binary tree.
* Heap sort sorting methods being in-place and with no quadratic worst-case scenarios.
* Graph algorithms are using heaps as internal traversal data structures, run time will be reduced by polynomial order.

Hashing

Hash table is a data structure used to implement an associative array, a structure that can map keys to values. The developer can use Hash table in the following use cases.

* Constant time operation.
* Inserts are generally slow, reads are faster than trees.
* Hashing is used so that searching a database can be done more efficiently.
* Internet routers use hash tables to route the data from one computer to another.
* Internet search engine uses hash function effectively.

Graph

The graph is an abstract data type that is meant to implement the graph and directed graph concepts from mathematics. The developer can use Graph in the following use cases.

* Networks have many uses in the practical side of graph theory.
* Finding the shortest path between the cities.
* Solve maze game.
* Find the optimized route between the cities.

Red-Black Tree

Red–black tree is a binary search tree with an extra bit of data per node, its color, which can be either red or black. The developer can use Red-Black Tree in the following use cases.

* Java Tree Map and C++ map implemented using Red Block Tree.
* Computational Geometry Data structures.
* Scheduler applications.

Array

The array is a data structure to store the same type of elements continuously. The developer can use an array in the following use cases.

* Need access the elements using the index.
* Know the size of the array before defining the memory.
* Speed when iterating through all the elements in the sequence.
* Array takes less memory compare than linked list.

Matrix

Matrix is a data structure which store the data using rows and columns. The developer can use Matrix in the following use cases.

* Matrix arithmetic in graphic processing algorithms.
* Represent the graph.
* Represent quadratic forms and linear algebra solution.

B-Tree

B-tree is a tree data structure that keeps data sorted and allows searches, sequential access, insertions, and deletions in logarithmic time. The developer can use B-Tree in the following use cases.

* File systems.
* Database operations.

Splay Tree

A splay tree is a self-adjusting binary search tree with the additional property that recently accessed elements are quick to access again. The developer can use Splay Tree in the following use cases.

* When the developer wants access the recent data easily.
* Allow duplicate items.
* Simple implementation and take less memory.
* When the application deals with a lot of data, use the splay tree.

AVL Tree

AVL tree, the shape of the tree is constrained at all times such that the tree shape is balanced. The height of the tree never exceeds O(log n). The developer can use AVL Tree in the following use cases.

* When the developer wants to control the tree height outside -1 to 1 range.
* Fast looking element.

Trie

A Trie (digital tree and sometimes radix tree or prefix tree), is an ordered tree data structure that is used to store a dynamic set or associative array where the keys are usually strings. The developer can use Trie in the following use cases.

* Fixed dictionary and want to look up quickly.
* Require less storage for a large dictionary.
* Matching sentences during string matching.
* Predictable O(k) lookup time where k is the size of the key.
* Lookup can take less than k time if it’s not there.
* Supports ordered traversal.
* No need for a hash function.
* Deletion is straightforward.

Minimum Spanning Tree

A spanning tree of that graph is a subgraph that is a tree and connects all the vertices together. A minimum spanning tree (MST) or minimum weight spanning tree is then a spanning tree with weight less than or equal to the weight of every other spanning tree. The developer can use Minimum Spanning Tree in the following use cases.

* Describe financial markets.
* Handwriting recognition of mathematical expressions.
* Image registration and segmentation.
* Constructing trees for broadcasting in computer networks.

We discussed different data structure and uses cases to choose the appropriate data structure. When the candidate attends the technical coding interview or uses the application programming interface in software development, the candidate must choose the correct data structure. If the candidate uses the incorrect data structure, it may work. But the programs may fail with more data or with different use case.

Reference

1. [How to choose the data structure](http://i.stack.imgur.com/HNMy4.png)
2. [HOW TO ACE AN ALGORITHMS INTERVIEW](https://www.palantir.com/2011/09/how-to-ace-an-algorithms-interview/)
3. [Get that job at Google](http://steve-yegge.blogspot.in/2008/03/get-that-job-at-google.html)
4. [How to Pass a Silicon Valley Software Engineering Interview](http://paultyma.blogspot.ca/2007/03/howto-pass-silicon-valley-software.html)
5. [Choosing the Right Data Structures](https://mathieularose.com/choosing-the-right-data-structures/)
6. [Use the Right Algorithm and Data Structure](http://programmer.97things.oreilly.com/wiki/index.php/Use_the_Right_Algorithm_and_Data_Structure)

رررر