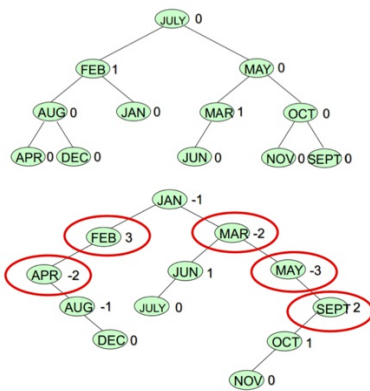


1. AVL trees/Splay trees

AVL Balance Factors

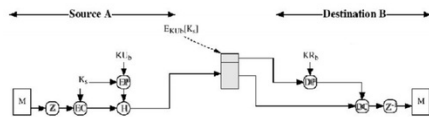


To make searches faster and also need sorted order (e.g., subscriber table, OSPF neighbor table)

2. BSP tree

3D computer graphics

3. Cryptographic algorithms



Security is extremely important for networking devices

They are full of cryptography algorithms
Security Aspects: Confidentiality; Integrity
SSH instead of Telnet: Supports authentication using cryptography; Uses DES etc

IPSEC instead of bare-bones IP: Supports encryption (e.g., AES)
OSPF uses MD5 hash for integrity

Almost every protocol has to deal with security aspects!

4. Dynamic Programming

Route Name	Default Distance Values
Connected interface	0
Static route	1
Intermediate System to Intermediate System (IS-IS)	10
OSPF Summary route	1
External Border Gateway Protocol (BGP)	20
Internal OSPF	60
OSPF	100
OSPF	110
Intermediate System to Intermediate System (IS-IS)	115
Routing Information Protocol (RIP)	120
External Gateway Protocol (EGP)	140
On Demand Routing (ODR)	160
External BGP	170
Internal BGP	200
Unknown	255

A method for solving complex problems by breaking them down into simpler sub-problems (e.g. Used in the routing protocols)

5. Graph Algorithms

function GRAPH-SEARCH(problem) returns a solution, or failure
initialize the frontier using the initial state of problem
initialize the explored set to be empty
loop do
if the frontier is empty then return failure
choose a leaf node and remove it from the frontier
if the node contains a goal state then return the corresponding solution
add the node to the explored set
expand the chosen node, adding each child to the frontier
but only if the child is not already in the frontier or explored set

A network is a graph

Spanning Trees are used in...

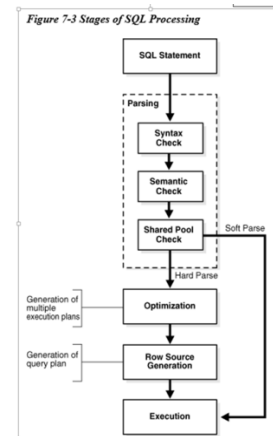
STP:

Stands for "spanning tree protocol";
For avoiding loops

6. Graphs

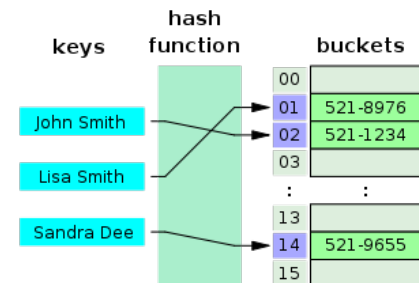
Connections/relations in social networking sites, Routing, networks of communication, data organization etc.

7. Hashing



Used when order is not important but lookup needs to be fast (e.g. Hashing for MAC table)

8. Hash Table

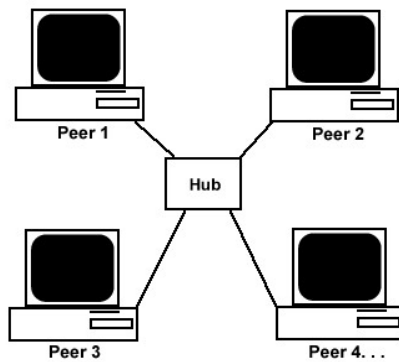


Used for fast data lookup - symbol table for compilers, database indexing, caches, Unique data representation.

9. Heap

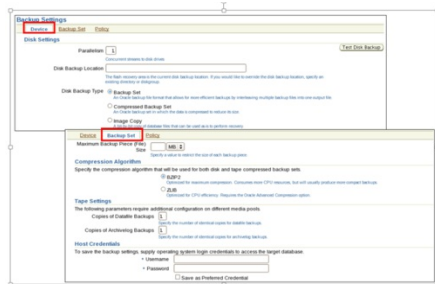
Dynamic memory allocation in lisp

10. Linear Data Structures in the Networking Industry



Stacks, queues, singly linked lists, doubly linked lists are very commonly used.

11. Parallel Algorithms



Multi-cores are getting important for networking

Two ways:

- 1.) Each processor will run a set of processes
- 2.) Split a process so that we can make it faster

GP-GPUs use hundreds of processors

- 1.) They need parallel algorithms
- 2.) Many cryptography algorithms are implemented in parallel fashion on GP-GPUs

12. Priority queues



Process scheduling in the kernel

13. Queues



Transport and operations research where various entities are stored and held to be processed later i.e. the queue performs the function of a buffer.

14. Queues



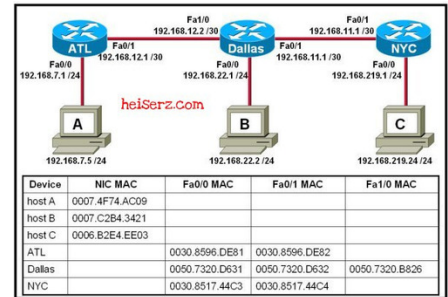
Continues until all data transferred

e.g. Managing IDs

15. Radix tree

IP routing table

16. Searching Techniques



Lot of lists are maintained: List of users, MAC addresses, List of neighbors, etc

Searching: e.g. When someone logs out

Linear search is common/Binary search is rarely used

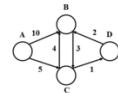
17. Shortest Path algorithms

Dijkstra's Algorithm

```

Dijkstra(G)
for each v in V
    d[v] = ∞;
d[s] = 0; S = ∅; Q = V;
while (Q ≠ ∅)
    u = ExtractMin(Q);
    S = S ∪ {u};
    for each v in u->Adj[]
        if (d[v] > d[u] + w(u,v))
            d[v] = d[u] + w(u,v);

```



Shortest path algorithms are common in networking

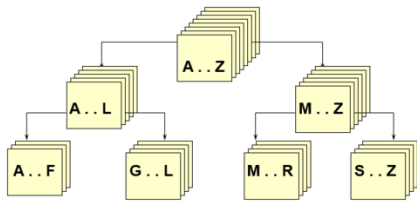
Shortest path algorithms used in...

OSPF: Name itself includes the algorithm name; open shortest path first

IS-IS: Yet another routing protocol based on Dijkstra's shortest path

18. **Sorting Techniques**

Using quick sort algorithm



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Sorting:

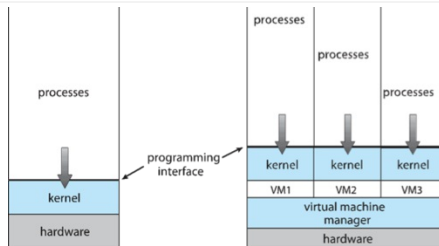
E.g., to display list of users in a show command
E.g., to show the forwarding table used for

Quick sort is sometimes used

In general, it is common to use the sorting data structure (e.g., tree) rather than sorting on the fly

Sometimes a structure is kept under multiple data structures

19. **Stack**



Undo\redo operation in word processors,
Expression evaluation and syntax parsing, many
virtual machines like JVM are stack oriented.

20. **Stacks**

```
void SetJumpOrder(const shared_ptr<PostingListNode>& L) {  
    int order = 0;  
    SetJumpOrderHelper(L, &order);  
}  
  
void SetJumpOrderHelper(const shared_ptr<PostingListNode>& L, int* order) {  
    if (L && L->order == -1) {  
        L->order = (*order)++;  
        SetJumpOrderHelper(L->jump, order);  
        SetJumpOrderHelper(L->next, order);  
    }  
}  
  
void SetJumpOrder(const shared_ptr<PostingListNode>& L) {  
    stack<shared_ptr<PostingListNode>> s;  
    int order = 0;  
    s.emplace(L);  
    while (!s.empty()) {  
        auto curr = s.top();  
        s.pop();  
        if (curr->order == -1) {  
            curr->order = order++;  
            // Stack is last-in, first-out, and we want to process  
            // the jump node first, so push next, then push jump.  
            s.emplace(curr->next);  
            s.emplace(curr->jump);  
        }  
    }  
}
```

e.g. Conversion of recursive routines to non-
recursion

21. **String matching algorithms**

`zip.matches("\\d{5}");`

Networking devices deal with strings

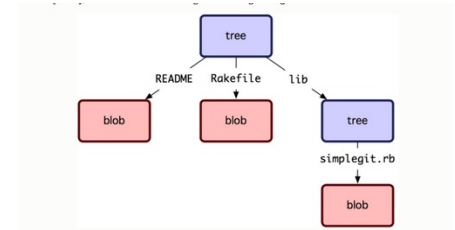
They support regular expressions
The commands support grep operation
Many debugging tools use string matching
(e.g., log file analysis looking for patterns)

22. **Suffix tree**



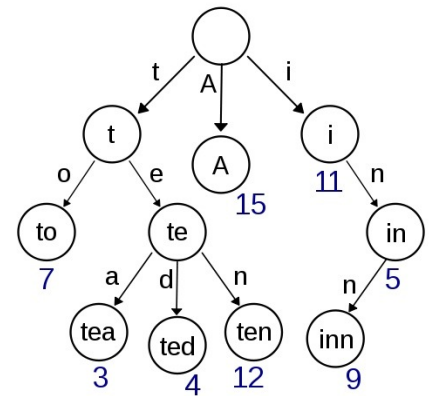
Fast full text searches used in most word processors.

23. **Trees**



Parsers, Filesystem

24. **Trie**



Dictionary, such as one found on a mobile telephone for
autocompletion and spell-checking.

25. **Tries**

☆ Add and Search Word

☐ Description ☐ Notes ☐ Testcase ☐ Judge

Design a data structure that supports the following two operations:
addWord(word) and **search(word)**
search(word) can search a literal word or a regular expression string containing only letters **a-z** or **.**.
A . means it can represent any one letter.

Notice
You may assume that all words consist of lowercase letters a-z.

Have you met this question in a real interview? Yes

Example

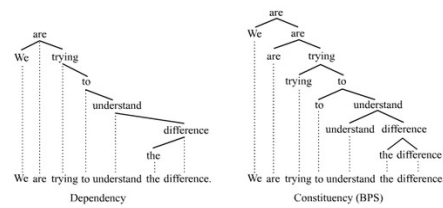
```
addWord("bad")  
addWord("dad")  
addWord("mad")  
search("pad") // return false  
search("bad") // return true  
search(".ad") // return true  
search("b..") // return true
```

Used in radix trees for maintaining routing table
(e.g. Longest prefix match)

26. **Use of libraries in the industry**

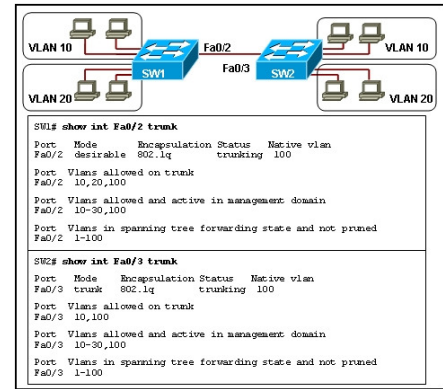
Libraries are common for data structures and algorithms
(e.g. CDT
<http://www2.research.att.com/~gsf/download/ref/cdt/cdtps>)

27. What is a parser?



A software component that takes input data (frequently text) and builds a data structure - often some kind of parse tree, abstract syntax tree or other hierarchical structure - giving a structural representation of the input, checking for correct syntax in the process.

28. Why are linked lists more common than arrays to maintain stacks or queues?



To have flexibility in the number of entries and for memory efficiency