Data Structures

```
Declaring a struct:
        typedef struct {
               int x;
               int y;
       } point;
Declaring a variable and
accessing members:
        point first;
        first.x = 1;
        first.y = 4;
        pri ntf ("(%d, %d) \n",
first.x, first.y);
```

Point is name of struct.

Omega

	lower (Ω)	upper (O)
insertion into a hash table with separate chaining	1	1
insertion into a trie	1	1
insertion into a sorted linked list	1	n
deletion from a sorted linked list	1	n
deletion from an unsorted linked list	1	n

Common Structs

Hashtable:

```
        typedef struct _node
       {
               char word[50]; //
50-char word
                struct _node
*next;
       }
        node;
```

Tree:

```
        typedef struct _tree3 {
               bool valid; //
exists or not
                struct _tree3
*child1;
                struct _tree3
*child2;
                struct _tree3
*child3;
       }
        tree3;
```

Trie:

```
        typedef struct _btrie {
               bool valid;
                struct _btrie
*child ren[2];
       }
        btrie;
```

Stacks

Pop:

```
int pop(void)
{
       if (stack.size == 0)
                return -1;
        return stack.n um ber -
s[- -st ack.size];
```

Stacks (cont)

```
> }
```

Push:

```
bool push(int n)
{
   if (stack.size == CAPACITY || n < 0)
      return false;
   stack.numbers[stack.size++] = n;
   return true;
}
```

Pointers

```
Declaration and initialization:
       int a = 14;
       int b = 15;
       int * iPtr;
       iPtr = &a;
       int * anotherPtr = &b;
Accessing pointers and values:
// assign an address to another
pointer
        ano therPtr = iPtr;
// change the value stored in
the memory
// location being pointed to
        *iPtr = 3;
// print the address held be a
pointer
        pri ntf ("%x \n", iPtr);
// print the value being pointed
to
        pri ntf ("%d \n",
*iPtr);
```

&b = "address of" operator
*iPtr = dereference operator
iPtr -> a = 14; //shortcut

Definitions

Valgrind: used for detecting memory leaks from forgetting to fclose() and free()
- syntax: valgrind –v --leak–check=full <executable file>

Bitwise Operators – see table to the right. Find if a number is odd: if (num & 1) print(“Odd”);

Hashtable - has 2 main parts: (1) a hash function, and (2) an array the hash function maps to. Often times, each index of the array will be a linked list to store the values that are hashed to a specific index. Struct of a hashtable node is below at left:

Tree - a data structure made up of nodes that have the following 2 rules: (1) A tree node can point at its children or at NULL, and (2) A tree node may not point at any other node other than those listed in (1), including itself. Struct of a 3-child tree is above right. In the diagram, black (top) is the root node and grey (point to NULL) are leave nodes. A binary tree is a special kind of tree that has 2 children left and right.

Trie – Just like tree but can have arbitrary number of children. Below are examples of binary trie and 6-child trie.

File Input / Output

```
Declaring a FILE pointer:
       FILE * inputFile;
       FILE * output File;
Opening a file:
        inp utFile = fopen( " -
fil e1.t xt ", " r");
        out putFile = fopen( " -
fil e2.t xt ", " w");
Input / Output:
        fsc anf (in put File,
" %d", &x);
        fpr int f(o utp utFile,
"%f \n", 3.14);
Closing a file:
        fcl ose (in put File);
        fcl ose (ou tpu tFile);
```

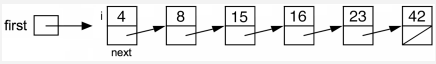
"r" for read
"w" for write
"a" for append

Operators

increment, decrement	++, --
multiply, divide, modulus	*, /, %
add, subtract	+, -
relational comparisons	>, >=, <, <=
equality comparisons	==, !=
and	&&
or	||
assignment	=, +=, -=, *=, /=, %=

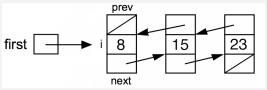
Grouped by precedence.

Linked Lists



Linked list is sorted with NULL pointer after 42.

Doubly Linked List




```
typedef struct node
{
struct node* prev;
unsigned int i;
struct node* next;
}
node;
```