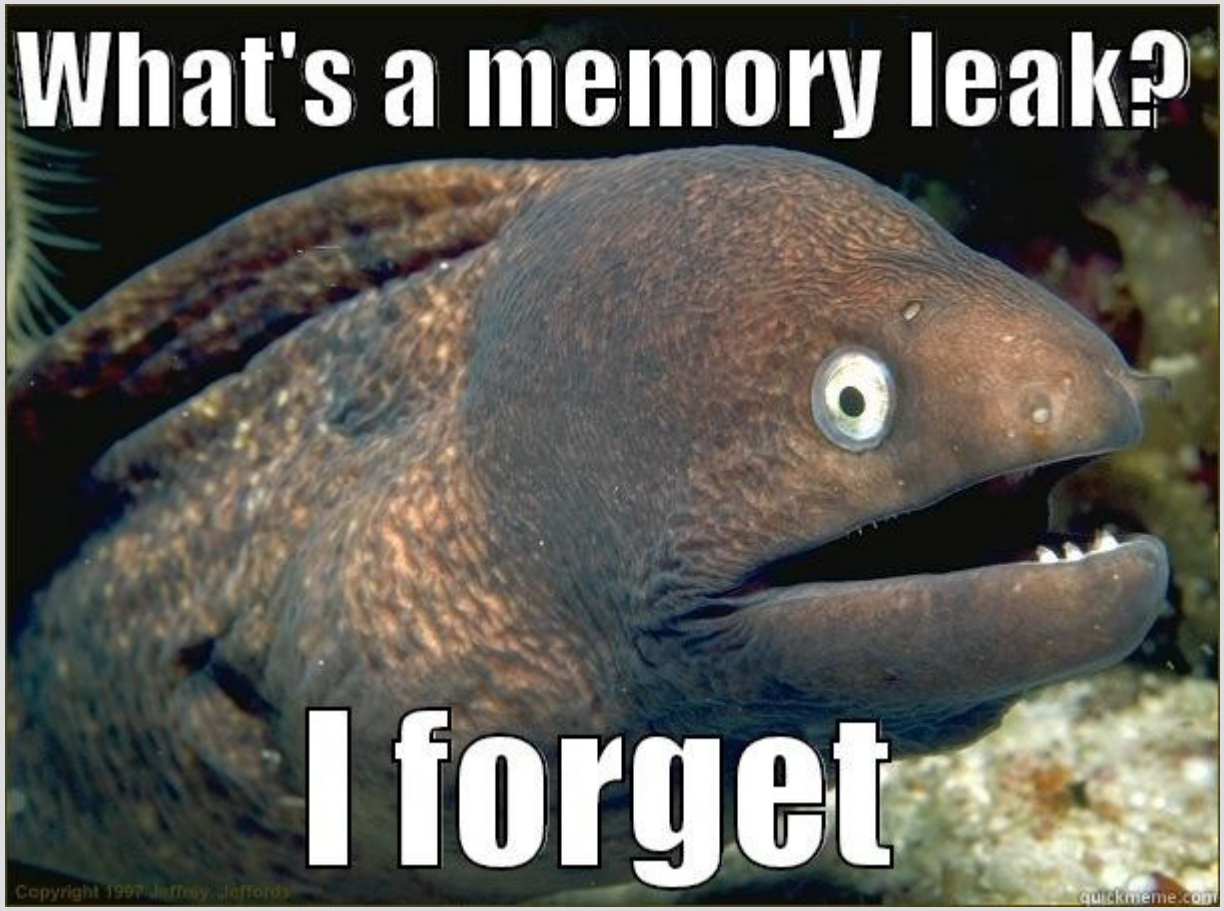
Dynamic memory in class

Ch 9, 11.4, 13.1 & Appendix F



Dynamic arrays

Arrays are memory addresses (if you pass them into function you can modify original)

So we can actually make a dynamic array in a very similar fashion

```
int x;
cin >> x;
int *list; // pointer to array
list = new int[x];
// arrays are just memory addresses
```

(this memory spot better to store large stuff)

Dynamic arrays

One important difference to normal pointers

When you delete an array you must do:

```
int *list; // pointer to array
list = new int[x];
delete [] list;
```

need empty square brackets

If you do the normal one, you will only delete a single index (list[0]) and not the whole thing

```
int *list; // pointer to array
list = new int[x];
delete list; // BAD BAD BAD BAD BAD
```

(See: dynamicArrays.cpp)

Dynamic 2D arrays

Since pointers can act like arrays...
(i.e. int* acts like int [])

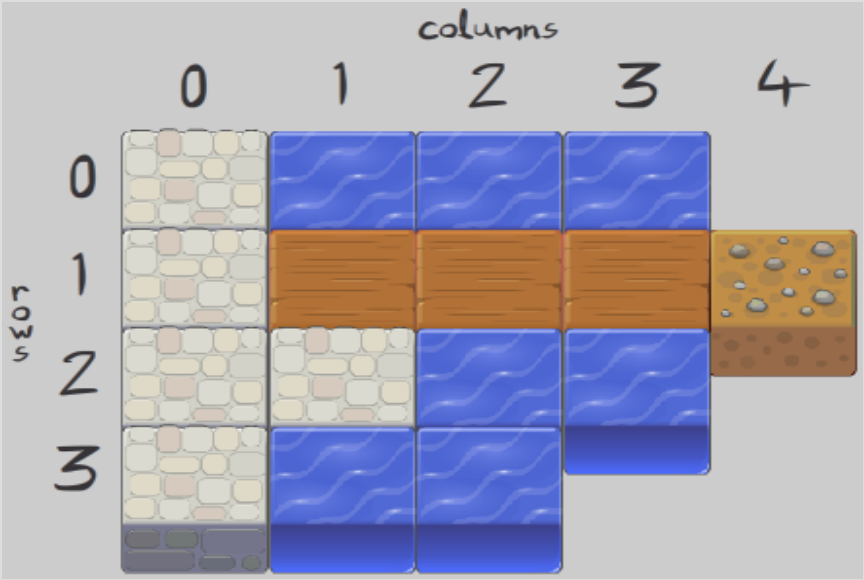
... int** can act like a two dimensional array

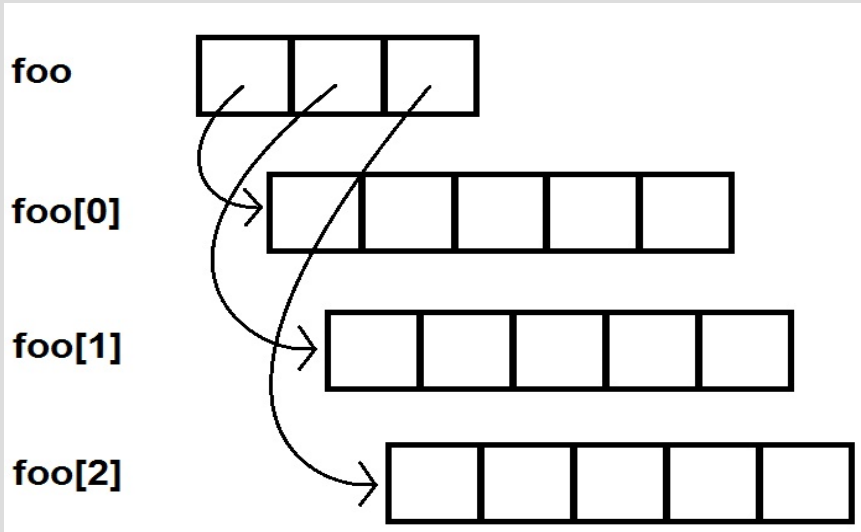
But need to use new to create each column individually (but can change the size of them)

When deleting, same structure but backwards (delete each column, then rows)

Dynamic 2D arrays

```
int** arr;
arr = new int*[4]; // 4 rows (of pointers)
arr[0] = new int[4];// 1st row = 4 cols
arr[1] = new int[5];// 2nd row = 5 cols
arr[2] = new int[4];// 3rd row = 4 cols
arr[3] = new int[3];// 4th row = 3 cols
```





(See: raggedArray.cpp)

Dynamic 2D arrays

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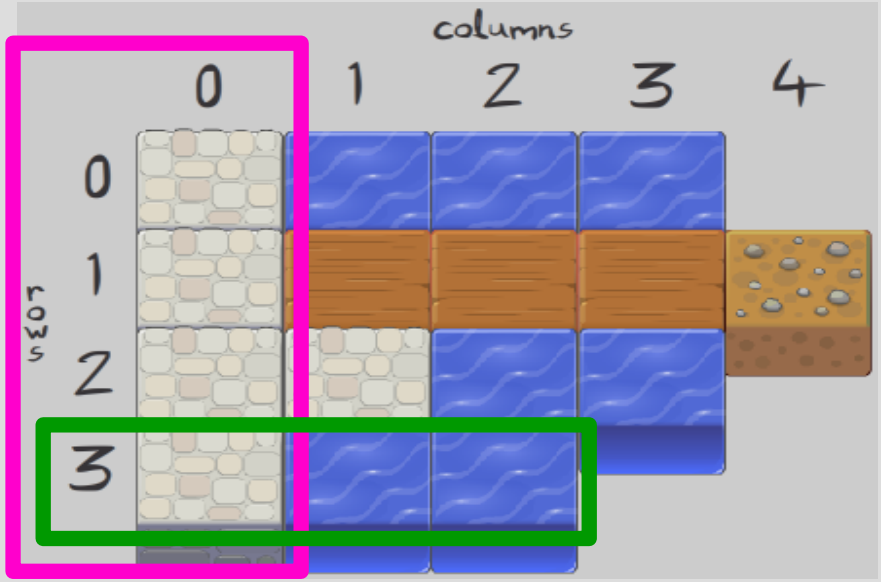

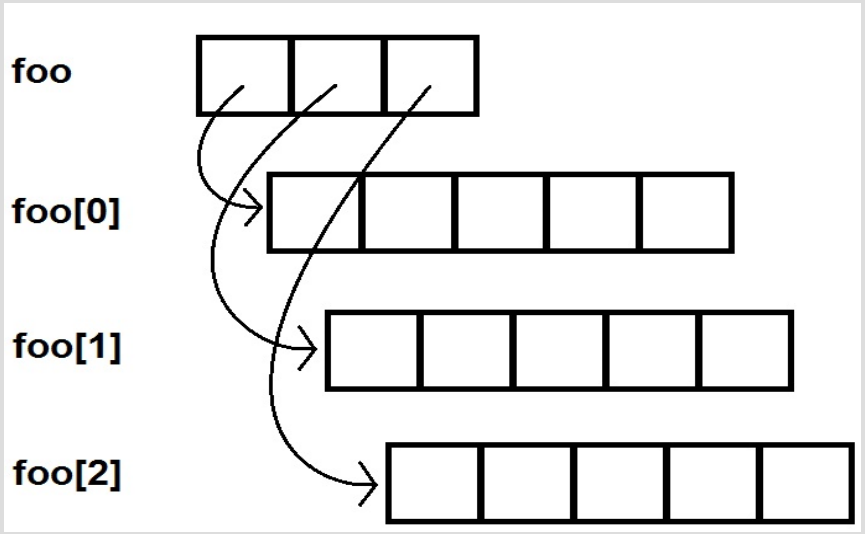

(See: raggedArray.cpp)

Highlights

- Destructors

```
class simple{
public:
    int x;
    simple(); // constructor (default)
    ~simple(); // deconstructor (cannot overload)
};
```

Review: constructors

Constructors are special functions that have the same name as the class

Use a constructor to create an instance of the class (i.e. an object of the blueprint)

```
// all three the same
string a = string("one way");
string b("another way");
string c = "overloaded operator way";
```

Constructors + dynamic

What if we have a variable inside a class that uses dynamic memory?

```
simple::simple()
{
    xArray = new int[3];
}
```

```
class simple{
public:
    int* xArray;
    simple();
};
```

When do we stop using this class?
What do we do if the int* was private?

(See: classMemoryLeak.cpp)

Constructors + dynamic

Often, we might want a class to retain its information until the instance is deleted

This means either:

1. Variable's scope ends (automatically deleted)

```
while(true)
{
        Leaky oops;
}
```

oops out of scope = gone

2. You manually delete a dynamically created class with the delete command

Destructors

Just as a constructor **must** run when a class is created...
A destructor will always run when a class object/instance/variable is deleted

Destructors (like constructors) must have the same name as the class, but with a ~:

```
public:
    Unleaky();
    ~Unleaky();
```

constructor

destructor

(See: classMemoryLeakFixed.cpp)

Destructors

A good analogy is file I/O, as there are 3 steps:

1. Open the file (read or write)
2. Use the file
3. Close the file

The constructor is basically requiring step 1 to happen

Do you want #3 to be automatic or explicit?

Destructors

The benefit of destructors is the computer will run them for you when a variable ends

This means you do not need to explicitly tell it when to delete the dynamic memory, simply how it should be done

This fits better with classes as a blueprint that is used in other parts of the program (see: destructor.cpp)