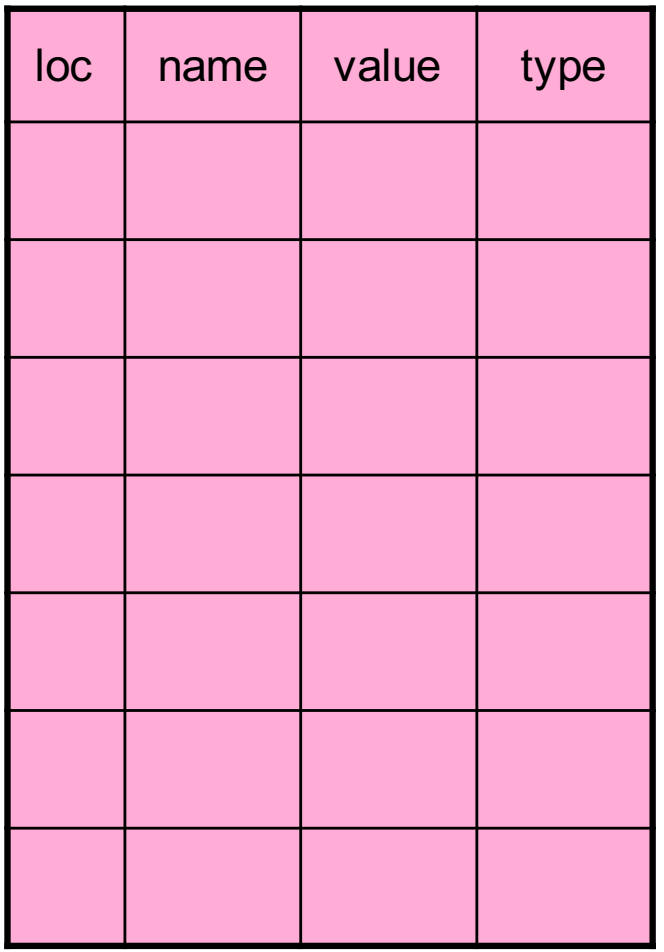
Announcements

MP1 available, due 9/1, 11:59p.

Variables and memory in C++

Stack memory



Pointers - Intro

```
int x;
int * p;
```

How do we assign to p?

```
p =
```

```
p =
```

_____ operator: &

_____ operator: *

Stack memory

loc	name	value	type
a20	x	5	int
a40	p		int *

Pointer variables and dynamic memory allocation:

```
int * p;
```

Stack memory

loc	name	type	value
a40	p	int *	

Heap memory

loc	name	type	value

Youtube: pointer binky c++

Fun and games with pointers: (warm-up)

```
int * p, q;
```

What type is q?_____

```
int *p;
int x;
p = &x;
*p = 6;
cout << x;
cout << p;
```

What is output?_____

What is output?_____

Write a statement whose output is the value of `x`, using variable `p`: _____

```
int *p, *q;
p = new int;
q = p;
*q = 8;
cout << *p;
q = new int;
*q = 9;
p = NULL;
delete q;
q = NULL;
```

What is output?_____

Do you like this?_____

Do you like this?_____

Memory leak:

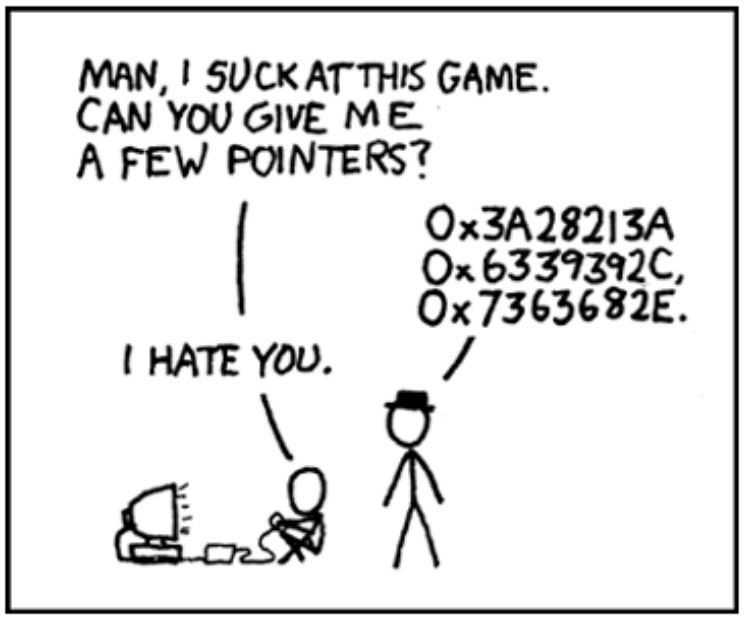
Deleting a null pointer:

Dereferencing a null pointer:

Fun and games with pointers:

```
int * p, * q;
p = new int;
q = p;
delete p;
… // some random stuff
cout << *q;
```

Do you like this?_____



Fun and games with pointers:

```
int * p; int x;

p = x;
```

Do you like this?_____

What kind of error?

Compiler Runtime

```
int * p;  int x;
```

Variable `p` can be given a target (pointee) in two ways. Write an example of each.

Use the letters S and H in a meaningful way to tell where the pointee exists in memory.

```
int * p;

*p = 37;

p = NULL;

*p = 73;
```

Do you like this?_____

What kind of error?

Compiler Runtime

```
int * p, * q;

p = new int;

q = p;

delete p;

… // some random stuff

cout << *q;
```

Do you like this?_____

Stack vs. Heap memory:

```
void fun() {
  string s = "hello!";
  cout << s << endl;
}
int main() {
  fun();
  return 0;
}
```

System allocates space for s and takes care of freeing it when s goes out of scope.

Data can be accessed directly, rather than via a pointer.

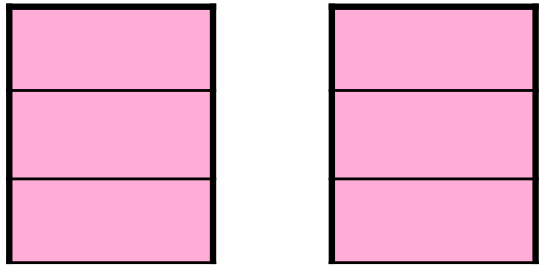
```
void fun() {
  string * s = new string;
  *s = "hello?";
  cout << *s << endl;
  delete s;
}
int main() {
  fun();
  return 0;
}
```

Allocated memory must be deleted programmatically.

Data must be accessed by a pointer.

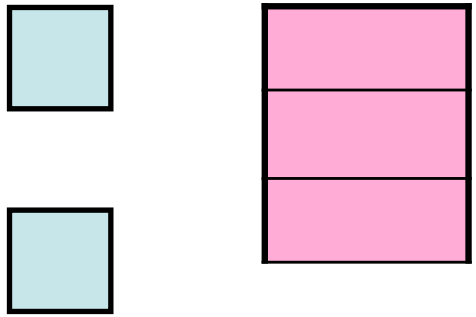
Pointers and objects:

```
face a, b;
… // init b
a = b;
a.setName("ann");
b.getName();
```



```
class face {
public:
     void setName(string n);
     string getName();
     …
private:
     string name;
     PNG pic;
     boolean done;
};
```

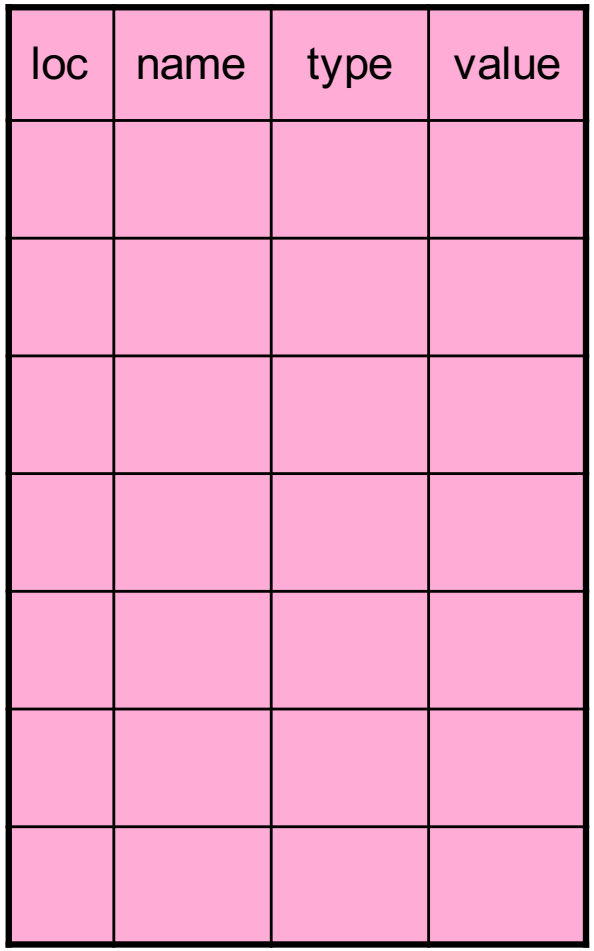
```
face * c, * d;
… // init *d
c = d;
c->setName("carlos");
(*d).getName();
```



Arrays: static (stackic)

```
int x[5];
```

Stack memory



Arrays: dynamic (heap)

```
int * x;


int size = 3;
x = new int[size];


for(int i=0, i<size, i++)
    x[i] = i + 3;


delete [] x;
```