CS 161
Intro to CS I

Begin Heap and Arrays
Odds and Ends...

• Last day to demo Assignment 3
• Assignment #4 due Sunday night

```cpp
void fun(string s) {
    if (s.at(0) == s->at(0) && s->at(0) == s->at(s->size()) - 1) {
        out(s)
    }
}
```
Revisit Variables vs. Pointers

• Value Semantics
  – Values stored directly
  – Copy of value is passed
  
  ```c
  int i, j=2;
i=j;
  ```

• Pointer Semantics
  – Address to variable is stored
  – Copy of address is passed
  
  ```c
  int *i, j=2;
i=&j;
  ```
What if we don’t have the j?

• We need to create the address space.
• How do we do this?
  – **new** type;
• For example:
  
  ```
  int *i;
  i = new int;  // new returns an address
  *i = 10;
  ```
Binky Pointer Video

• Watch the C++ Stanford Binky video: http://cslibrary.stanford.edu/104/

... and make sure you don’t blow binky’s head off in the future😊
Stack vs. Heap
• Static vs. Dynamic
Static vs. Dynamic

• **Static Semantics**
  – Assign address of variable
    ```c
    int *i, j=2;
    i=&j;
    ```

• **Dynamic Semantics**
  – Create memory
  – Assign memory to pointer
    ```c
    int *i==NULL;
    i=new int;
    *i=2;
    ```
What About Memory Leaks?

• What happens here...
...
int main () {
    int *i=NULL;  //created in main function
    while(1) {
        i = new int;
    }
}
Fixing Memory Leaks...

• What happens here...

... int main () {
    int *i=NULL; //created in main function
    while(1) {
        i = new int;
        //do some stuff
        delete i; //free memory that i points to, preventing mem leaks
    }
}

No crash

Freeing must always be sensible.
What is an Array?

- **Array (ar-ray) n.** An ordered arrangement of related items.
  - Example: Array of colors in a rainbow.
    - Related items?
    - Ordered arrangement?
  - Class examples?
  - Computer Science
    - Same data type/data structure
    - Contiguous memory locations
Create 1-D Array

```
int student_grades[5];
```

- How do you access each item?
- What does the array name represent?
- Why is the array name the address of 1st element?
- What are the initial values?