Templates

Ch 17

POOR DESIGN TEMPLATE

This is an example.
Highlights

- Variable types

```cpp
template <typename T>
void dostuff(T x)
{
    cout << x << endl;
}
```

```cpp
template <typename T>
class holdinStuff {
public:
    T stuff;
};
```
Announcements

Midterm 2 on gradescope (sorry for delay) - 2 weeks from today for regrades
A type is a container for a specific thing.
Review: Types

It is normally not good to mix these up...
Review: Types

C++ is fairly picky about most types, only certain values can be stored in a type

42  'x'  “hello world”
int  char  string

You can convert between types easily (such as from int to double)

But not others (hard to go int to string)
Templates

While C++ has no “I can hold any data” type, it does have a “I can be any type” variables.

That is there is no “magic” type that can be both int and string simultaneously.

Instead, you can specify that “magic” will be some type... you just don't know what yet.

In C++ we call this a template.
Templates

You can think of this not as “a type to hold all values” but as “a box to hold any type”
Templates

You have actually seen templates before, namely static_cast (a function)

You provide the type you wish to convert the data into, but outside of the normal parenthesis

cout << static_cast<char>(100) << endl;

You can put any type you want here!
Templates

You can use a variable-type for both:
1. Functions
2. Classes

This allows you to make more general functions (thus less code)

However, this function should be generalizable (for example, factorial only works for ints...)

NOT DUPLICATING CODE

BECAUSE I KNOW ABOUT TEMPLATES.
Function: templates

To use a variable-type, you put template before the function and specify the type variable

```cpp
template <typename T>
void coutMe(T x)
{
    cout << x << endl;
}
```

This lets you use “T” as a type anywhere in the function
(see: coutMe.cpp) (see: goodSwap.cpp)
Function: templates

You can also use multiple types variables, just separate them with a comma:

```cpp
template <typename T, typename T2>
void mswap(T& a, T2& b);
```

You can have as many different (or similar) types of input as you want

(Although this does not work well for swap) (see: multipleTypes.cpp)
As C++ is rather old, there are a lot of ways to say the same thing (same with templates)

These both mean the same thing (mostly):

```cpp
template <typename T>
template <class T>
```

Some compilers also see these as the same:

```cpp
coutMe<int>(2);
coutMe(2);
```
Bad templates!

Templates are not magic that allow you to do anything with any type!

If an operation does not exist between types and you try and use it, computer will get angry.

You also cannot ignore types completely by making everything a template (main must have real types at the very least) (see: badTemplates.cpp)
Classes: templates

Templates for classes are very similar:

```cpp
template <typename T>
class holdinStuff {
public:
    T stuff;
};
```

After using template, you can use “T” as a type inside the class anywhere

(see: classTemplate.cpp)