

CS481 - Object-Oriented Programming

Exception Handling

A variety of philosophical approaches

- ❖ Exceptions can't happen!?
- Don't worry about impossible (?) conditions

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Exception Handling

A variety of philosophical approaches

- ❖ Exceptions can't happen!?
- ❖ Laissez-faire
 - Propagate error conditions so they cause someone else's code to break

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Exception Handling

A variety of philosophical approaches

- ❖ Exceptions can't happen!?
- ❖ Laissez-faire
- ❖ Exceptions are normal?
 - Build exception code in everywhere
 - Pass and check status every time
 - ◆ Return value or global variable?

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Exception Handling

A variety of philosophical approaches

- ❖ Exceptions can't happen!?
- ❖ Laissez-faire
- ❖ Exceptions are normal?
- ❖ Exceptions are exceptional?
 - Optimize normal; cope with errors!

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Exception Handling

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- ❖ Exceptions are normal?
- ❖ Exceptions are exceptional?

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Bailing Out



- ❖ If exceptions are exceptional
 - Don't occur in "normal" operation
 - No recovery at point of exception
- ❖ Stop what we're doing
 - Clean up (destructors) & give up
- ❖ Ask for higher-level help

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C++ Exceptions

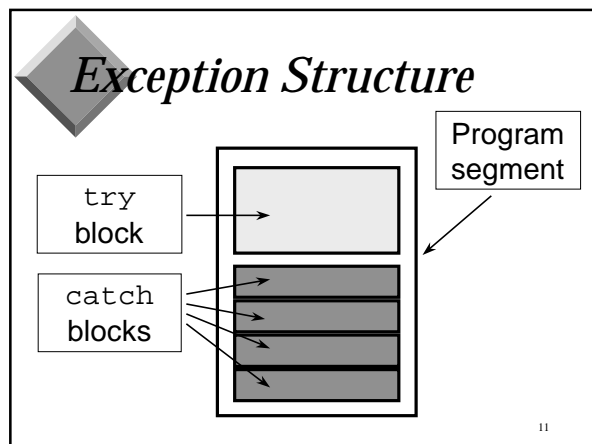
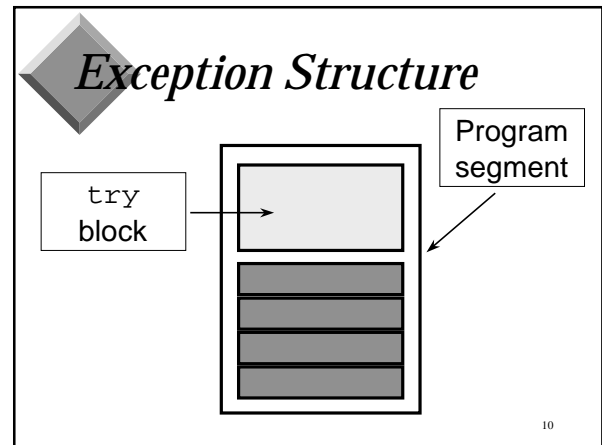
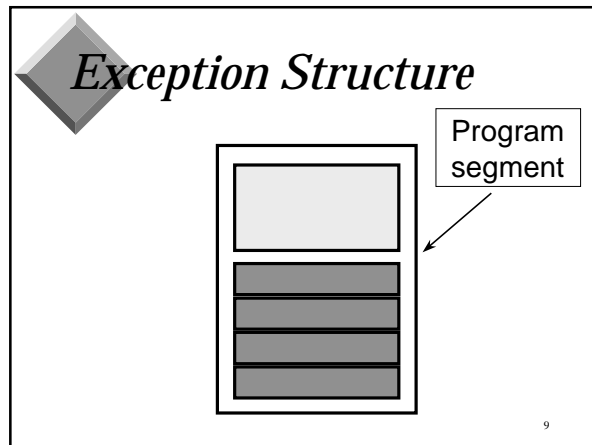
- ❖ At point of exception
 - Create object representing exception
 - ◆ Often of an exception class
- ❖ Throw exception
 - Leave current context (local destructors)
 - Passing exception object to ... ???

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Exception Handler

- ❖ Defined area of responsibility
 - Section of code
 - ◆ Including any called routines
 - Unless lower-level handler intervenes
- ❖ Catches thrown exceptions
 - By type of exception object

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Exception Example

```

try {
    cout << "Ready ..." << endl;
    throw "Test"; ...
}
catch (char* e) {
    cout<<"Caught { "<<e<< "}"<<endl;
}...
    
```

Ready ...
Caught {Test}

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Catch Options

Catch blocks are tried in order until a type match (including derived) is found.

```
try { /* code */ }
catch (char* e)
{cout<<"Caught {"<<e<< "}"<<endl;}
catch (int i)
{cout<<"Caught int "<< i <<endl;}
//Default: any type, last catch!!
catch (...)
{cout<<"Caught ??? " <<endl;}
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```

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```

Uncaught Exceptions

- ❖ If no matching catch block
- ❖ Or, if exception re-thrown
 - throw with no argument (in catch block)
- ❖ Exception passed to next level
 - Enclosing try block
 - If none, terminate() aborts program

Destructors

- ❖ Exception exits from "middle"
 - Some block objects have been created
 - Some have not (yet) been created
- ❖ Destructors are called
 - All created objects (constructor completed)
 - What about pointers to heap objects?

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Destructor Exceptions

- ❖ **throw from destructor?**
 - If another exception in progress, then `terminate()` is called (bad idea!)
- ❖ **Allow no exceptions to escape**
 - Use `try/catch` block in destructor
 - Handle all exceptions locally

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Constructors??

- ❖ **Constructor exceptions**
 - Constructor not completed
 - So destructor not called
- ❖ **What to do?**
 - Avoid if possible
 - Otherwise, do needed cleanup

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Exception Specs

Controversial feature?

- ❖ **Part of function declaration**
 - `void f() throw (domain_error);`
 - `void g() throw(); // none`
 - `void h(); // any`
- ❖ **Specifies possible exceptions**
 - Others, if any, are “unexpected”

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Unexpected Exceptions

- ❖ **Not propagated from function**
 - Handled in function (no re-throw)
 - Or, guaranteed (?) not to occur at all
- ❖ **But, what if ... ?**
 - Function `unexpected()` is invoked
 - Default is to call `terminate()`

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Termination`terminate()`

- ❖ **Handler cannot be found**
- ❖ **Execution stack corrupted**
- ❖ **Destructor throws exception**
 - During object cleanup (1st exception)
 - Can't handle two at once - give up
 - Difficult to debug

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Program Hooks

- ❖ **Function `set_terminate()`**
 - Caller provides new routine
 - Must still exit the program!! (no return)
- ❖ **Function `set_unexpected()`**
 - Re-throw, or throw another exception
 - May (need not) exit program

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A Distinction**Caution**

❖ Mechanism

- Provides a way to do something
 - ◆ E.g., exceptions in C++ language

❖ Policy

- Specifies how things should be done
 - ◆ E.g., exceptions in standard library

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Standard Exceptions

❖ Defined by draft standard

- But standard keeps changing!?

❖ Class hierarchy

- Base class: `exception`
 - ◆ Used to be `xmsg`
- Use existing or derive a class

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Standard Exceptions

```
exception (xmsg)
  logic_error (xlogic)
    domain_error  invalid_argument
    length_error  out_of_range
    bad_cast      bad_typeid
  runtime_error (xruntime)
    range_error  overflow_error
    bad_alloc
ios::failure
```

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Standard ExceptionsWhat about `raise()`?

```
exception (xmsg)
  logic_error (xlogic)
    domain_error  invalid_argument
    length_error  out_of_range
    bad_cast      bad_typeid
  runtime_error (xruntime)
    range_error  overflow_error
    bad_alloc
ios::failure
```

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Exception Uses

❖ Meant for error conditions

- Where local recovery not possible
- Relatively infrequent events
 - ◆ Overhead?

❖ Synchronous events only

❖ Not to replace `switch/case`

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