

A Set of CS 1 Labs Utilizing Graphical Objects and Inheritance

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Overview

- Cohoon & Davidson: *C++ Program Design*
- Math 2170 — CS 1
- Multi-part Weekly Labs
- Graphics
- Themes
- Object-Oriented

Cohoon & Davidson

C++ Program Design: An Introduction to Programming and Object-Oriented Design

Graphics Package: EzWindows

- Object-Oriented
- Engaging
- Allows Animation
- Provides Immediate Feedback

Background

- EIU: A regional university
- Department of Mathematics
- Students: Pre-Engineering, Math, Math Ed, and CS
- Teaching Team

Math 2170 — CS 1

- Lab-based
- Uses C++
- Two 50-minute lectures per week
- One 100-minute lab per week
- Co-requisite: Calc I

Lab Components

- Reference to Reading (text and handouts)
- Preview Exercises, Submission Sheet
- Lab Exercises
- Makefile
- Lab Check-off Sheet
- Gradesheet
- Follow-up Programming Exercise

Example—Week 5 Lab

Laboratory 5 Key Concepts

- EzWindows graphics
- Classes: RandomInt, Position, SimpleWindow, RectangleShape, RaySegment, and CircleShape
- Using messages with classes

Week 5 Lab

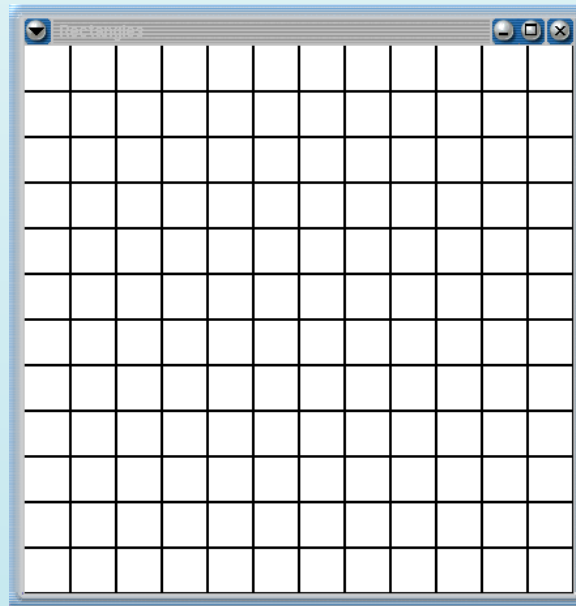
Lab Preview Reading

- Class and Library Descriptions manual
(written by team)
- §3.9
- All program listings in appendix

Week 5 Lab

Lab Preview Exercises

- ★ 1. Locating RectangleShapes on a grid



Week 5 Lab

Lab Preview

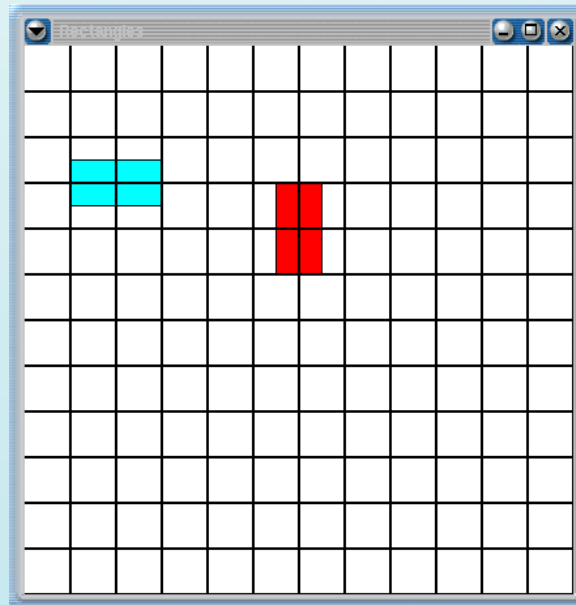
Exercises—continued

- ★ 2. How to declare a specific `RectangleShape`
- ★ 3. How to display that `RectangleShape` in a graphics window
- 4. Various position displacement expressions (★ parts b & c) needed for lab exercises

Week 5 Lab

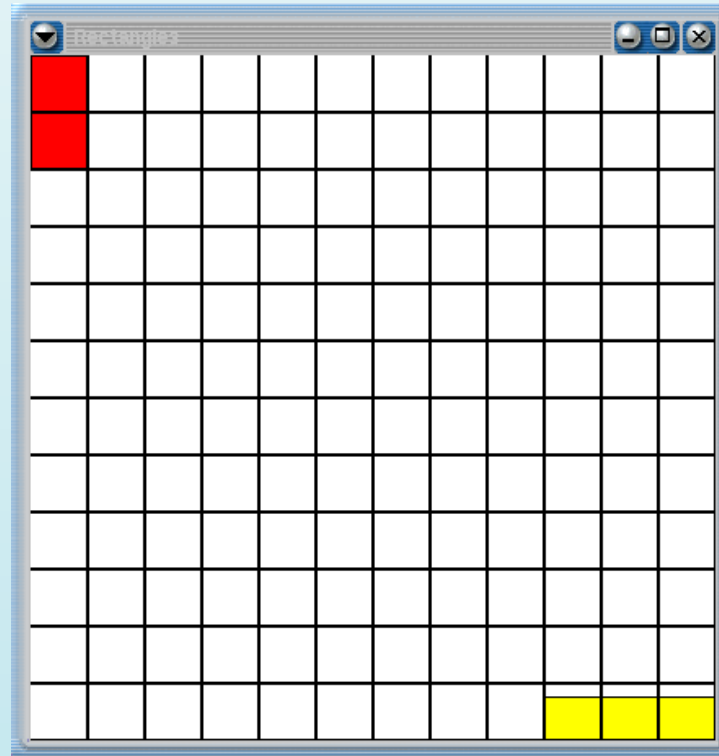
Lab Exercises

1. Download, uncompress lab files
2. Compile, execute **lab5a.cpp**



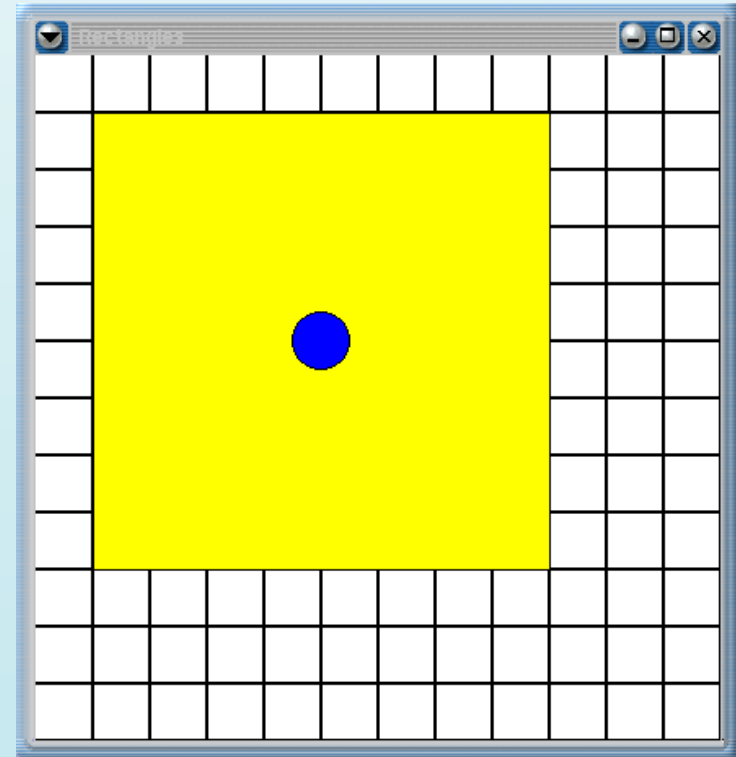
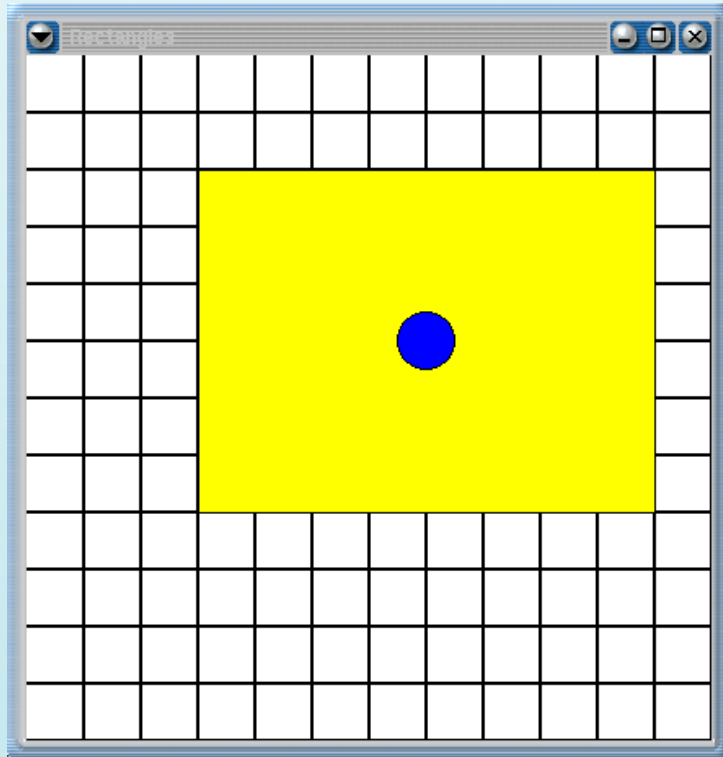
Week 5 Lab

- ✓ 3. Add RectangleShapes in corners, change window size



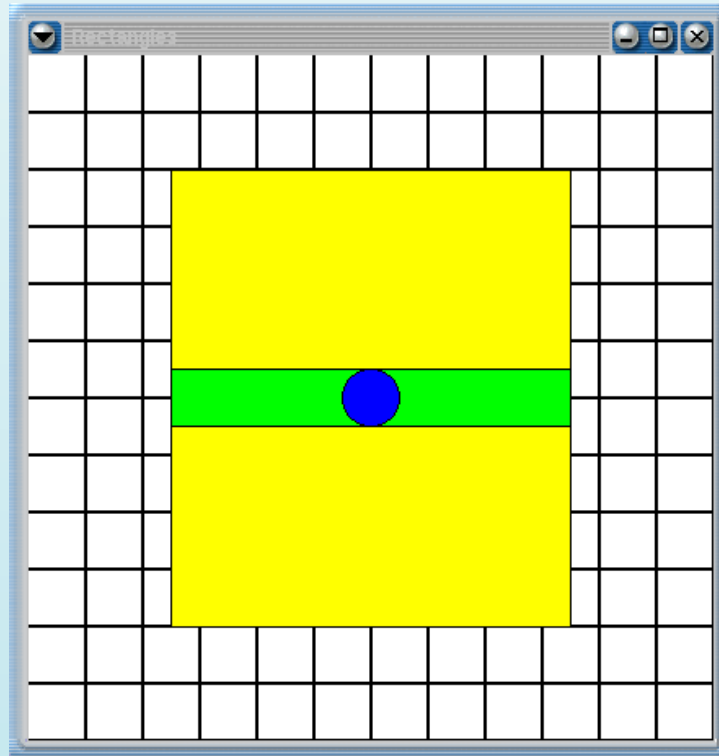
Week 5 Lab

4. **lab5b.cpp**: Compile, Execute, Observe...



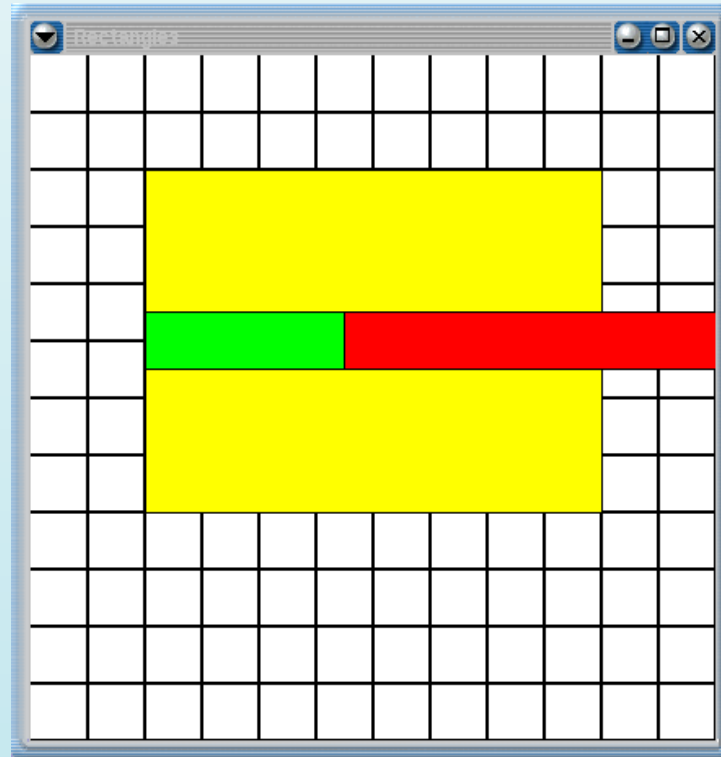
Week 5 Lab

5. Add a green bar behind circle



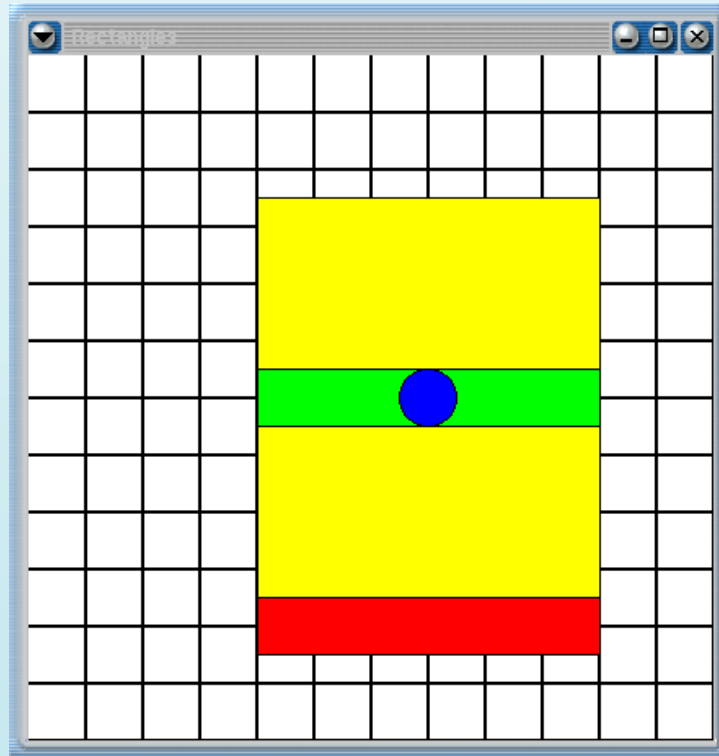
Week 5 Lab

6. Add a red bar below the box... Oops



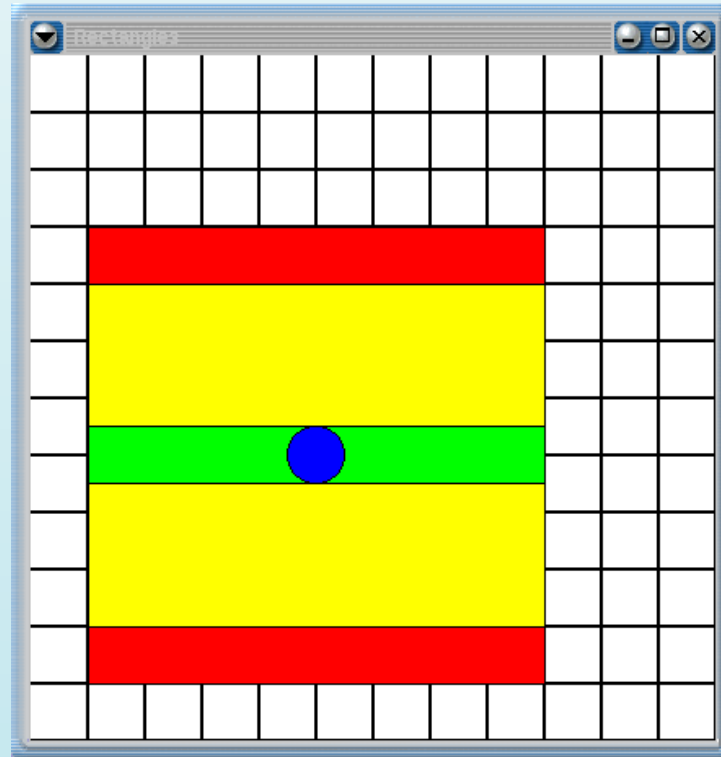
Week 5 Lab

- ✓ 6. Add a red bar below the box...



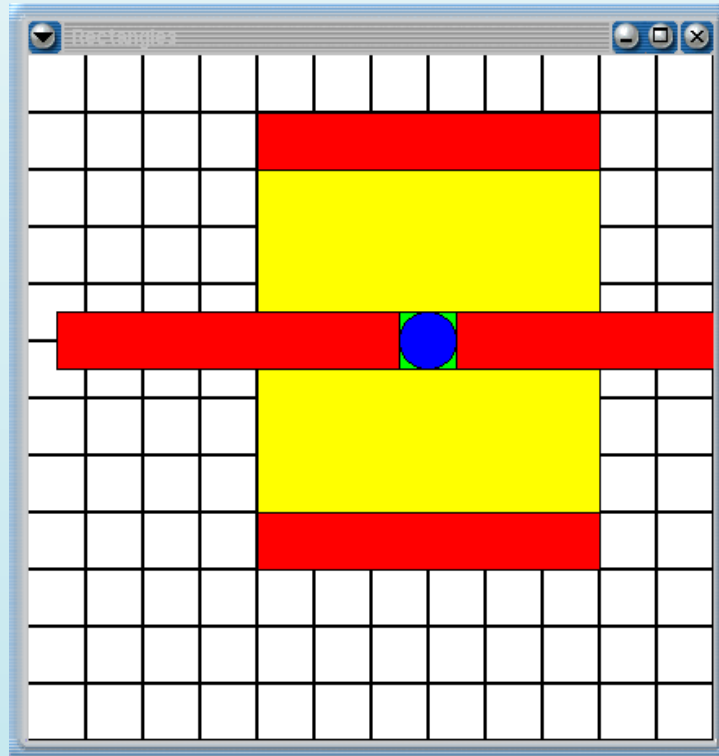
Week 5 Lab

7. Complete the red frame around the box...



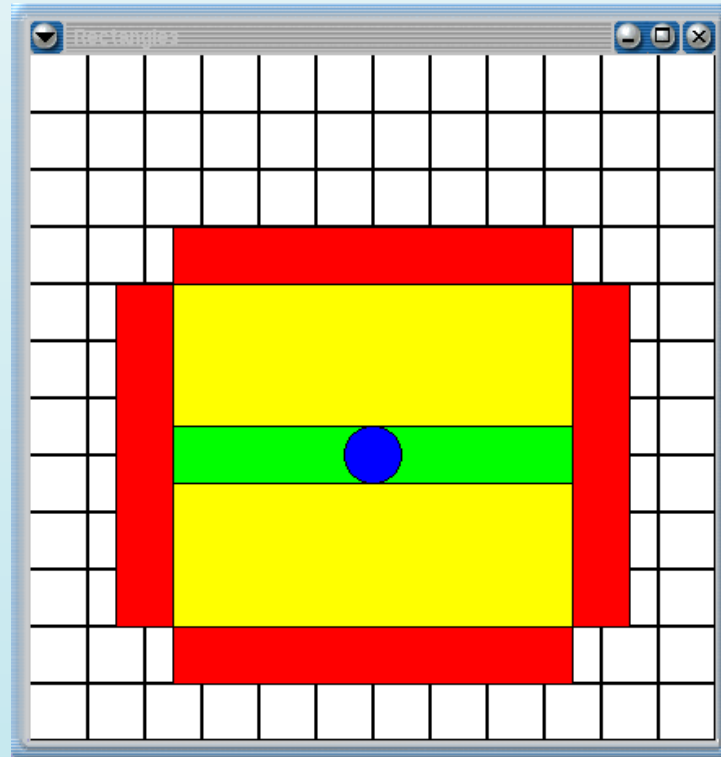
Week 5 Lab

7. Now the sides... Oops



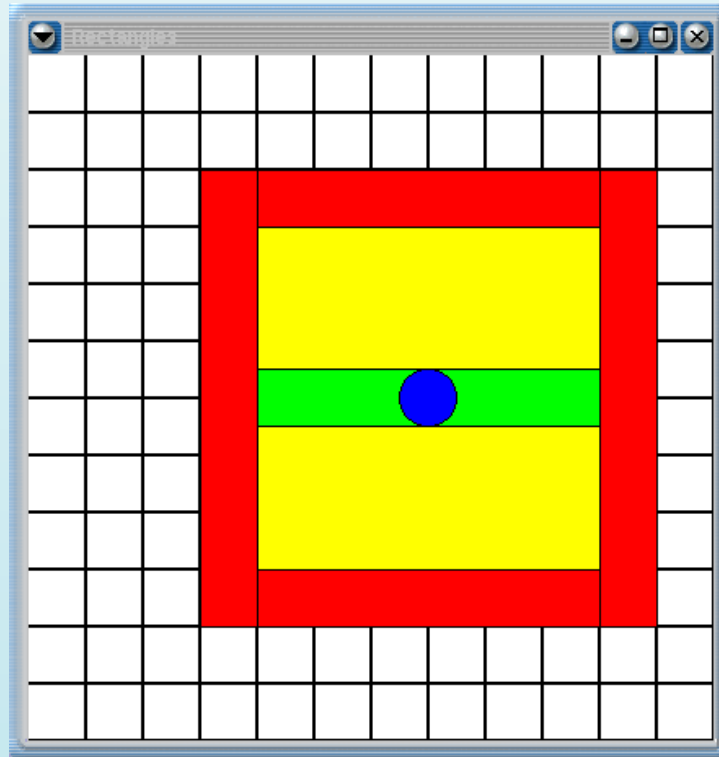
Week 5 Lab

7. Try again... Oops



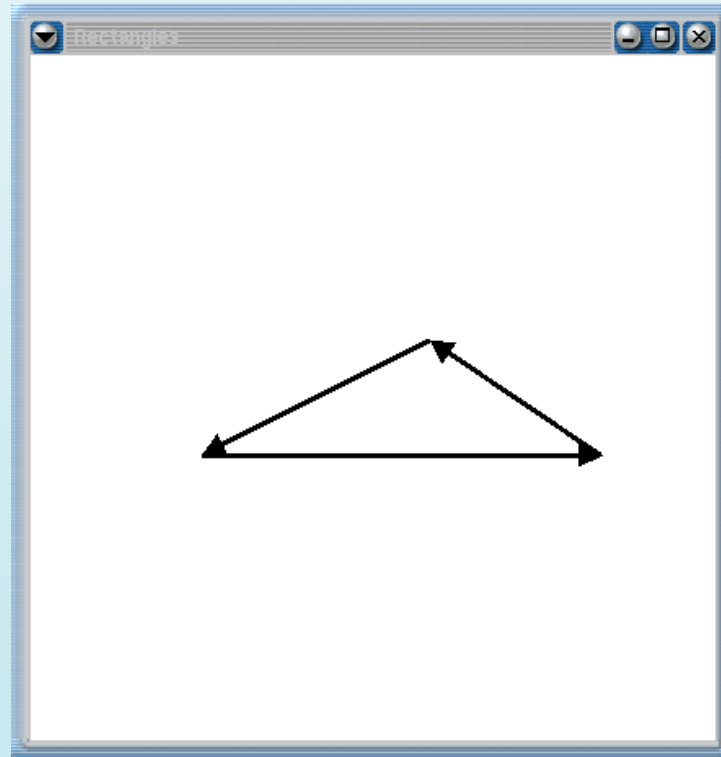
Week 5 Lab

✓ 7. Voilá, the framed box



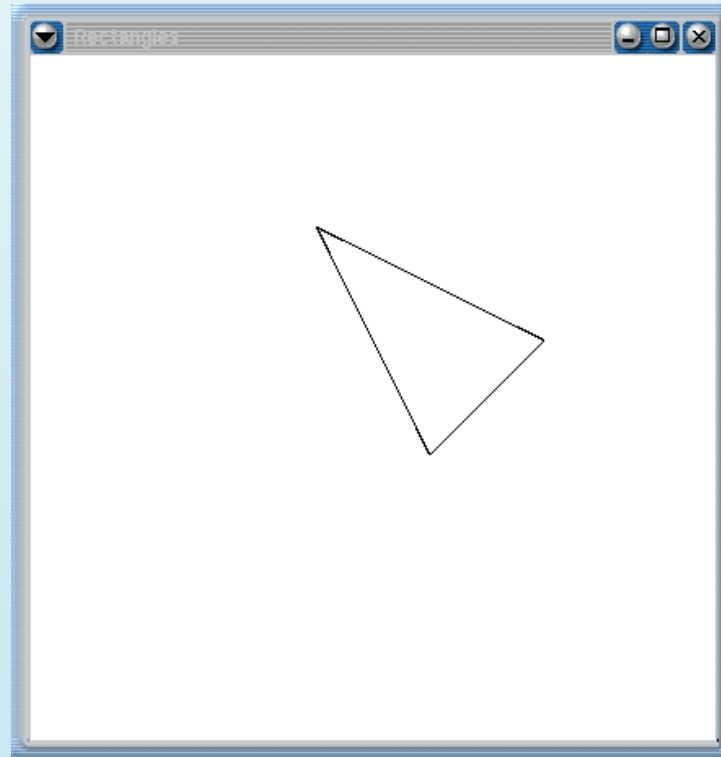
Week 5 Lab

8. **lab5c.cpp**: Compile, Execute, Observe...



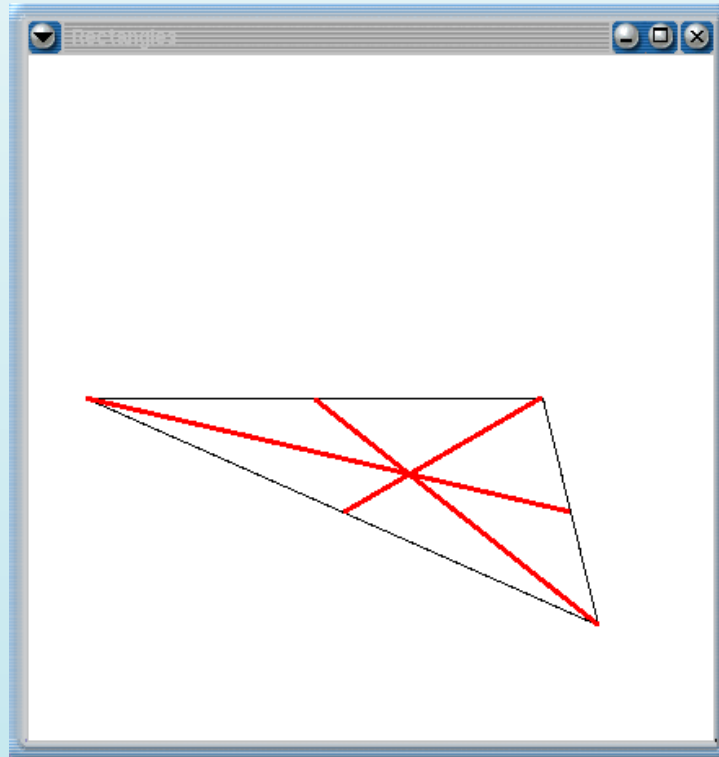
Week 5 Lab

9. Delete arrowheads, modify width



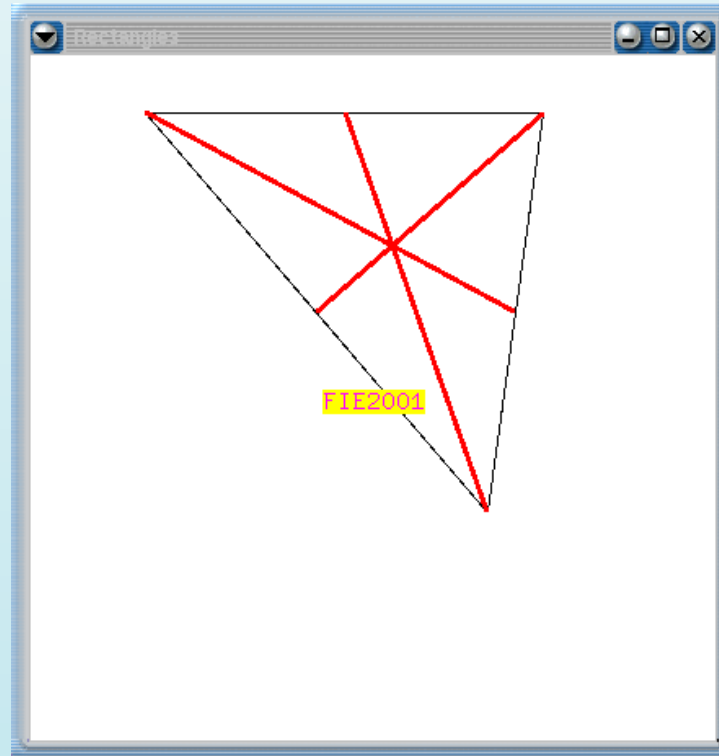
Week 5 Lab

✓ 10. Add bisecting lines



Week 5 Lab

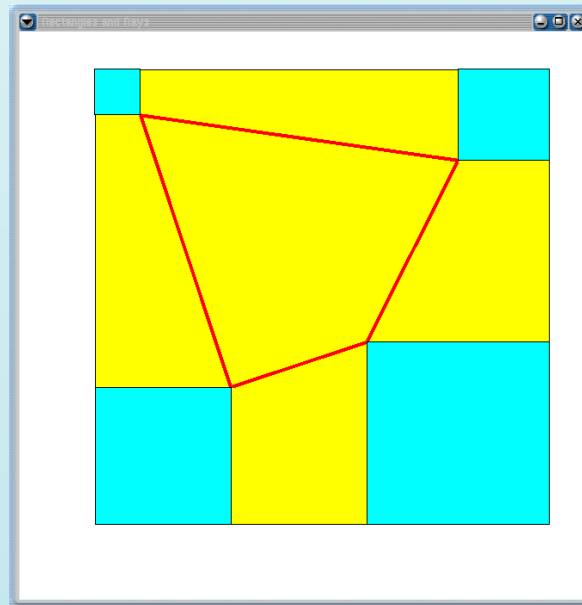
✓ 11. Add Label in window center



Week 5 Lab

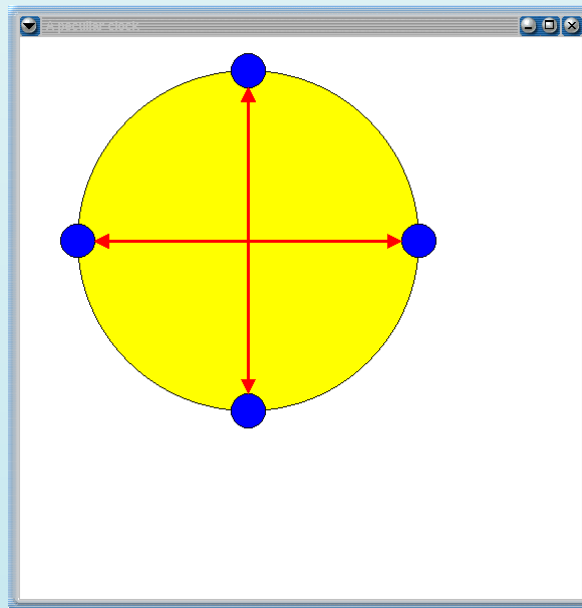
Lab Followup—given skeleton program...

Get four percentages, declare and draw four corner squares, declare and draw connecting ray segments



Week 5 Homework

Create the figure shown below—get center and diameter of large circle from user:



Themes

Concepts are:

- Introduced in lecture and lab (already coded)
- Expanded upon following week (need to modify)
- Significant student involvement by third week
- Use in new context; from “scratch”

Input File Theme

1. Present concept

- “hardcoded” file name
- code already present in lab exercise(s)
- loop to read file contents (`int`, `string`) in place

2. Expand on concept

- code present in lab exercise(s)
- modify to obtain filename from user
- modify to get character at a time

3. Follow-up requires code from “scratch”

Function Theme

1. Practice—Predefined functions—Messages to objects
2. Practice
 - EzWindows classes and messages
 - sleep function (delay execution for animation)
3. Practice—library functions: math, ctype, iomanip
4. Practice—header files, pre-compiled implementation
 - focus on interface
 - testing

Function Theme—Continued

5. Completing function implementations
6. Writing functions with reference parameters, function templates
7. Completing/Writing member functions

File Processing–Bar Chart–Scaling Themes

Follow-up 6: statistics about text file, bar chart scaled to window

Follow-up 7: scale a Lissajous curve to fit background `RectangleShape`

Follow-up 10: two-pass processing of file of integers, represent as bar chart scaled to window

Follow-up 12: approximating the area under a curve, display as `RectangleShapes` scaled to window

Inheritance Theme

Week 3: window coordinates, spiral coordinates
(no graphics)

Week 5: EzWindows classes RectangleShape,
RaySegment

Week 6: graphing a spiral, drawing a checkerboard

Week 9: completing class messages for:
SmartSquareShape and MovingSquareShape

Week 10: completing class messages for:
FramedRectangleShape, Board, GameBoard,
and Piece

- Follow-up: interactive Tic-Tac-Toe
- Project: FractalBoard — using JuliaColor to rewrite
GetBlockColor()

Graphics Theme

Week 3: Window coordinate system

Week 5: Introduction to EzWindows classes
RectangleShape, RaySegment

Week 6: Checkerboard using nested loops

Week 7: Bar Chart, string file statistics; first animation

Week 8: Lissajous Curve—animated

Week 9: Derived SquareShape classes, animation

Week 10: Derived Board classes

Week 11: Derived Grid class

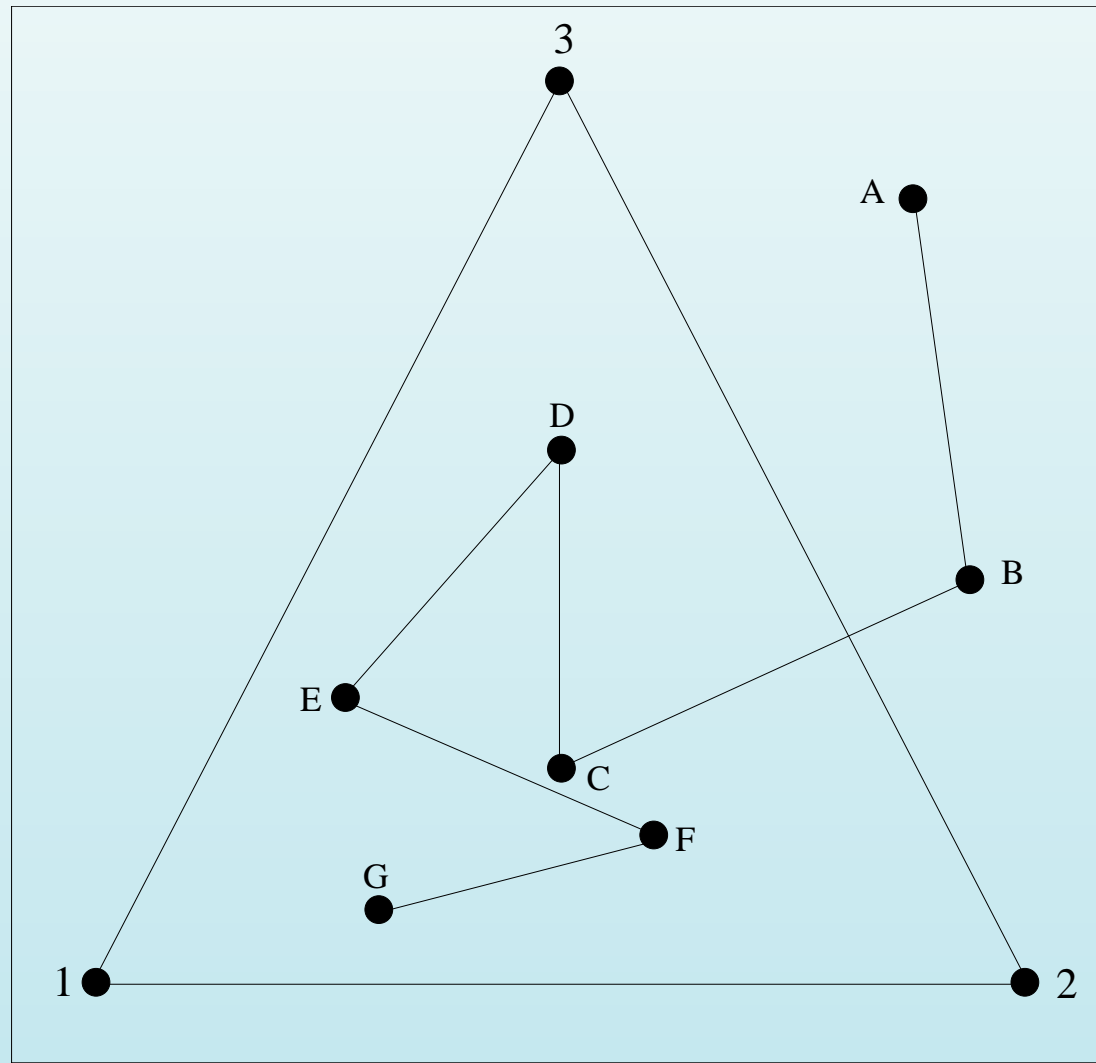
Week 12: Bar Chart, int file statistics

Week 13: Area Under a Curve

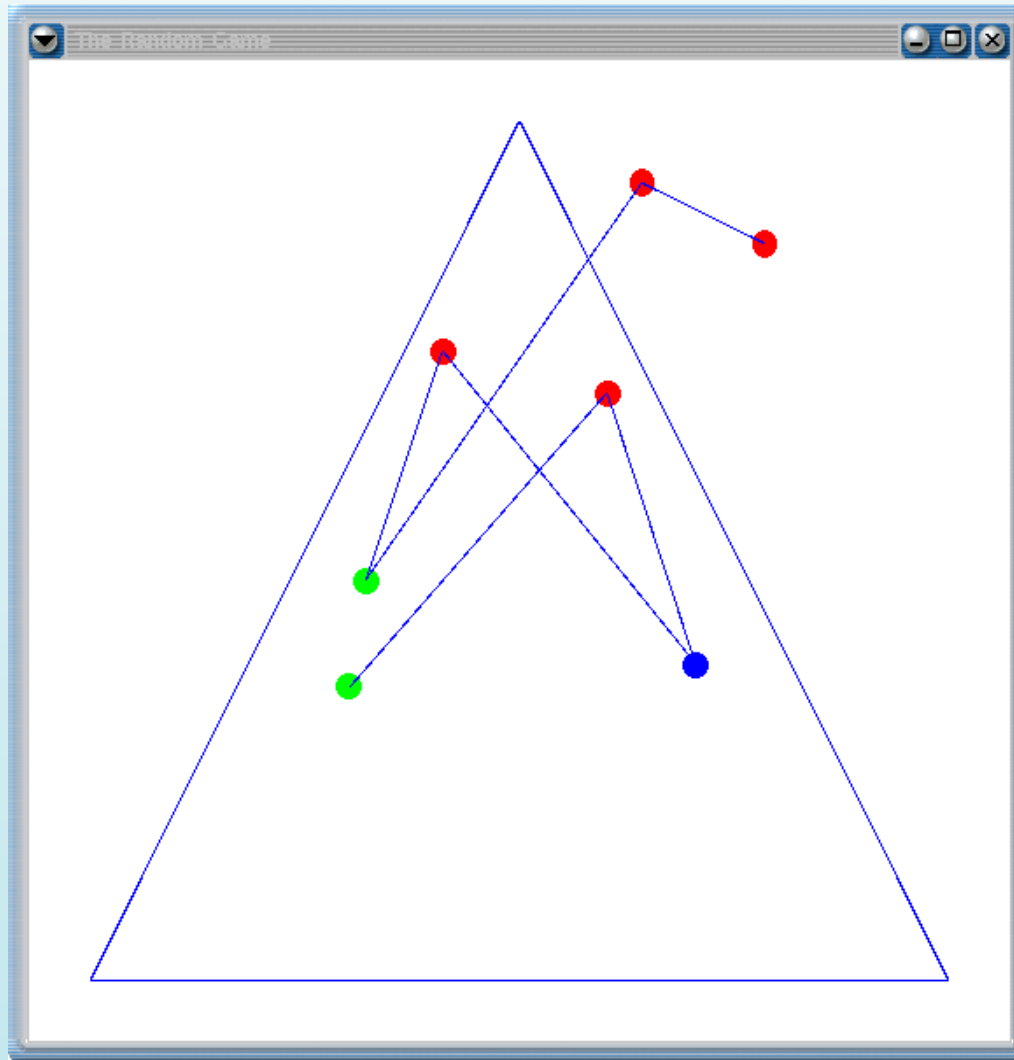
Conclusion

- Cohesive and comprehensive
- Basic concepts of C++, reinforced by themes
- Incorporates object-oriented aspects of C++
- Graphics—good for visual learners; interesting

Homework 7 – Chaos Game



Homework 7 – Chaos Game



Homework 7 – Final Results

