Objectives

- Analysis and Design
- Introduction to final project

Design Heuristics

- Model real world whenever possible
- Avoid all-powerful (omnipotent) classes
- Distribute system intelligence among classes evenly
  - Top-level classes should share work uniformly
  - More easily understood system
  - More easily communicated design
- Minimize # of messages between class and helper
  - Reduce coupling btw class and helper

Analysis Phase

- Create an abstract model in client’s vocabulary
- Strategy:
  1. Identify classes that model (shape) system as set of abstractions
  2. Determine each class’s purpose, or main responsibility
     - member functions
     - data members
  3. Determine helper classes for each
     - Help complete responsibilities

Analysis Phase Discussion

- Expect to iterate
  - Won’t find all classes at first
    - Especially helpers
  - Won’t know all responsibilities
- Uncertainty in problem statement
  - May be concerns that need to be settled
  - Try to understand requested software system at level of those requesting software
  - Rarely one true correct best design

Identification of Classes

- Potentially model the system
- Usually nouns from problem description or from domain knowledge
- Model real world whenever possible
  - More understandable software
  - Helps during maintenance when someone unfamiliar with system must update/fix code
Identifying Responsibilities

- Responsibilities convey purpose of class, its role in system
- Questions to Ask:
  - What are the other responsibilities needed to model the solution?
  - Which class should take on this particular responsibility?
  - What classes help another class fulfill its responsibility?

Have You Modeled Everything?

- Strategy: Role playing
- Act as different classes: can you do everything you want in various scenarios?
  - Fill in missing classes, responsibilities
  - Methods: parameters, what returned
  - Restructure as necessary
  - No code yet so not actually refactoring
- Example use cases/scenarios:
  - User borrows a video and returns it two days late
  - User tries to borrow book that is already checked out

Discussion

- What else can use cases be used for?

Discussion

- What else can use cases be used for?
  - Test Cases

Project Deliverables Timeline

<table>
<thead>
<tr>
<th>Deliverable</th>
<th>Who</th>
<th>Weight</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>Individual</td>
<td>8%</td>
<td>11/30</td>
</tr>
<tr>
<td>Preliminary Implementation</td>
<td>Team</td>
<td>37%</td>
<td>12/7</td>
</tr>
<tr>
<td>Final Implementation</td>
<td>Team</td>
<td>40%</td>
<td>You decide -&gt;latest 12/18</td>
</tr>
<tr>
<td>Analysis</td>
<td>Individual</td>
<td>15%</td>
<td>12/18</td>
</tr>
</tbody>
</table>

FINAL TEAM PROJECT
Goal: Generate images from expressions

Every pixel gets assigned a color, computed from its x and y coordinate and the given expression.

Colors are RGB values:
- Range [-1, 1]
- Black is [-1, -1, -1]
- Red is [1, -1, -1]
- Yellow is [1, 1, -1]

For all x:
  For all y:
    pixels[x][y] = expression.evaluate(x, y)

What is the resulting image if the expression is:
- [-1, 1, -1]
- x
- x*y

User can enter expressions interactively or from file.
Language is defined in specification.
Lots of possible extensions.

Import an existing project:
/home/courses/cs209/handouts/picasso_init.tar

What questions do you have about the code?
What do you want to find out?
Preparation Analysis

- What are the main parts/steps that need to be completed to complete the project?
  - How much work does each part require? Approximate in terms of time or relative to the other steps.
  - How many people should work on each part?
- How will your program handle the following use case: "The user starts the program, types 'x/y' in the expression window, and sees the image."?
  - From your description, it should be clear which classes/objects are responsible for completing each part of the task.
- What 3 extensions would you like to have in the final application?
- A plan for how you would tackle implementing the project.
  - What parts can be completed independently of the other parts?
  - What parts need to be completed before other parts?
  - The parts of the project you're most interested in working on, in ranked order.
- Any questions about the given specification.