ECE 3574: Composition

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Administrivia

- **Class survey: due tonight**
- **Semester project milestones**
  - Milestone 0: lexing
  - Milestone 1: + parsing (due 2/26)
  - Milestone 2: + virtual machine (simulating MIPS assembly)
  - Milestone 3: + Qt GUI
  - Milestone 4: + multi-threaded Qt GUI
- **Milestone 1: your use own lexer not my reference implementation**

Composition

- Today we will learn how to build up complex concepts and models from simple parts
  - Composition models "has-a"
  - Examples
  - Composition and the Law of Demeter
  - Composition and Qt
  - Exercise

Composition is a major way of modeling has-a relationships

- A composite type has member variables that correspond to its components

```
class Foo
{
    ComponentType component;
}
```

- `Foo` *has a* `component`

Classic Example: People, Employees, and Customers

- A Person has-a
  - name
  - age
  - address
- An Employee is-a Person and has-a
  - id
  - role
  - salary

Classic Example: People, Employees, and Customers

- A Person has-a
  - name (first/last?)
  - age (possible unknown?)
  - address (format?)
- An Employee is-a Person and has-a
  - id (unique?)
  - role (static or dynamic?)
  - salary (currency?)

Prefer Composition to Inheritance

- Inheritance is overused and leads to tight coupling.
- Composition
  - gives the most flexibility with least coupling
  - shorter compile times, a member can be a pointer, thus only declared
  - less error prone, no private/protected/public
- Use inheritance only when you need to implement is-a relationships that require polymorphism.

Sometimes has-a is just as good as is-a

- Consider the Employee is-a Person.
- A Person could also have-a Job.

Ontology

- Ontology is the name used for defining objects and their relationships.
- Composition and Inheritance in C++ gives us the primary means to model the world.
- Each problem domains have their own ontologies

Composition is very useful in GUI design

- For example, a window has-a
  - menu
  - controls
  - view
- A menu has-a ...
- A control has-a ...
- A view has-a ...

Design tips for C++

1. Describe the specification in plain English
2. Find **nouns** as candidates of class
3. Find **is-a** relationship among nouns (inheritance)
4. Find **has-a** relationship among nouns (composition)
5. Try to substitute an **is-a** relationsip to a **has-a** relationship (prefer composition to inheritance)
6. Find **verbs** of a class as candidates of public methods
7. Go to step 1 until you feel comfortable to write the code

Exercise

- See website
- Line Edits Example
- Let's explore Qt code examples!

Useful Qt links

- Overview of Qt
- Qt for Beginners
- Qt Examples And Tutorials
- Qt API documentation
- Qt Event System
- Qt Signals and Slots
- Lambda expression in C++: Link 1, Link 2

Next Actions and Reminders

- Read about Qt Event System
- Reminder: Milestone 1 is due next Monday.