COMP2511

Tutorial 1

Introduction

- Hello! I’m James (he/him)
- 4th year Computer Science/Maths student, briefly did Psychology initially
- Third term tutoring this course!
- Loves playing video games, pandas and similar animals like raccoons
- Very short (evidently)
- I’m very happy to be interrupted if you have any questions during the tutorial or if you’d like me to re-clarify anything!
  - I do have a tendency of losing track of time and occasionally going on tangents or trying to over-explain things. I’ll try to be much more wary of this, but don’t be afraid to call me out on this if it happens!

Icebreakers

- Please introduce yourselves and your year/degree, and if you'd like, anything you would like to share!
    - fun facts about yourself
    - anything cool you did during the holidays (doing nothing counts!)
    - your go-to food/drink spot on campus
    - how many hours of sleep you got last night

Welcome to COMP2511!

- In previous courses, you became more proficient and confident in your abilities as **programmers**.
  - COMP1531: Working on large-scale projects as a team, web-based programming
  - COMP2521: Exploring various data structures and solving a range of algorithmic problems
- In this course, the focus is on developing your ability as **designers**, in the context of programming.

Assessments

- **Labs (15%)** - 7 labs, each *manually marked* out of 10. Your overall lab mark is out of 60 (take sum of all marks), leaving a buffer for 10 marks.
- **Assignment 1 (15%)** - *individual* assignment where you will build a system from the ground up, assessing your understanding and application of the initial (yet extremely important) topics of the course.
- **Assignment 2 (20%)** - *pair* assignment. Will be assessing the newly introduced software architecture topics in the second half of the course.
- **Final Exam (50%)** - *40% hurdle*, approximately 50% of the exam will be very similar in style to lab exercises and tutorial examples.

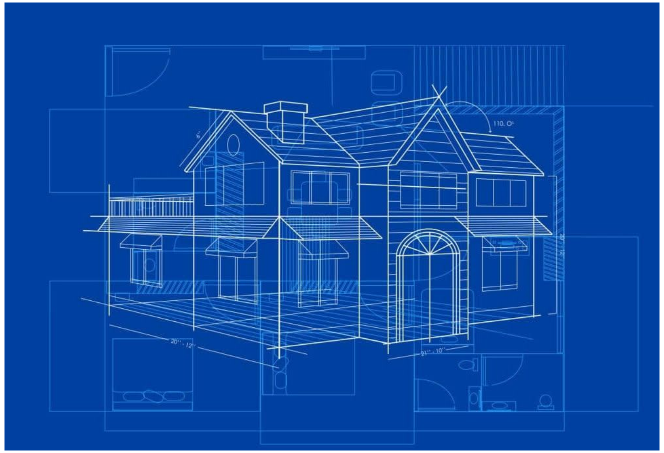
What is ‘good’ design?

- Design is inherently a subjective topic, so what do we necessarily mean by ‘well-designed code’ or ‘good design’?
- What are some things that we can all agree are desirable in code?
    - At the text level, code that adheres to widely used **conventions** and stylistic **patterns** for readability.
    - Logic that is **correct**, yet **simple** enough to read and understand.
    - Being able to focus on how things operate at a **high level**, rather than having to worry about concrete implementation details (e.g. ADTS in 2521).
    - Having responsibilities and logic be **separated** into different parts that work together as a whole to form a **cohesive** program (e.g. hopefully your COMP1531 project!).
    - Being easily **adaptable** in order to account for changes in requirements.
- These are ideas that we will carry throughout the entire course!

Object-Oriented Programming

- During this first half of the term, we will be focusing on **object-oriented programming** (formerly the entire focus of the course!).
- Object-oriented programming (OOP) is a programming paradigm (i.e. style/model) which dictates that logic should be organised around user-defined types called **classes** and the interactions between them.
- A class is a structure which holds its own data (like structs in C or interfaces in TypeScript) **and** methods (i.e. functions) that act on that data and potentially interact with other classes.
- A concrete *instance* of a class is referred to as an **object**.

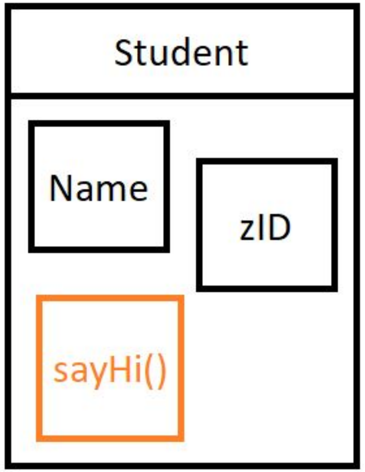
Blueprint vs. Product

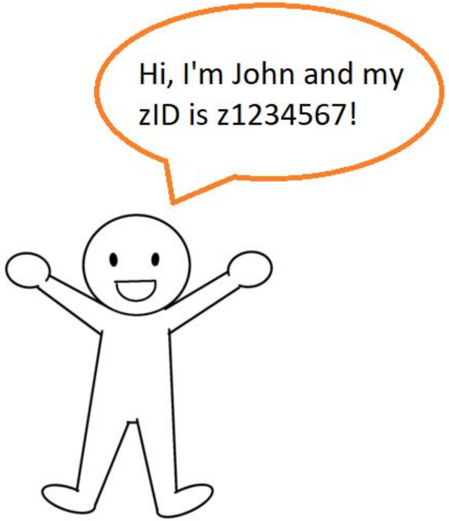


A blueprint of a house; the *idea* that informs what components the house will have and how it will be structured.

A house; the physical *realisation* of the blueprint (Sorry, I couldn't find the exact house shown in the blueprint!)

Class vs. Object





A class; the template/blueprint to create an object. Name/zID are **fields**, sayHi() is a **method**.

An object; an **instantiation** of the Student class. This object has its own name, zID and method to introduce itself.

(Some) Key Tenets of Object-Oriented Programming

- We will be exploring how we can apply OOP to design larger-scale **extensible**, **flexible**, **maintainable** and **reusable** systems (buzzwords!).
- Object-Oriented Programming is most commonly associated with the principles of **encapsulation**, **abstraction**, **inheritance** and **polymorphism**:
    - **Encapsulation** - grouping data and the mechanisms that act on that data together; this is facilitated through the use of classes. The fields and methods of a class should be very closely tied together.
    - **Abstraction** - hiding away unnecessary details of how things are implemented and only exposing the essential features or functionalities to users, i.e. you just need to know the *what*, and not the *how*.
    - We will look at **inheritance** and **polymorphism** next week, and more principles that guide 'good' applications of OOP in Week 4!

Cons of Object-Oriented Programming

- If a system has a lot of moving pieces that need to interact together, an object-oriented approach may be very suitable! However, OOP **isn't** something that you can just apply in every single scenario without consideration.
- Some potential drawbacks and pitfalls of OOP include:
  - Object-oriented languages (e.g. Java, Python) are mostly high-level languages, where the overhead and memory cost of managing objects could get very large and simply not sufficient over a highly performant language like C (however, C++ does exist!).
  - Misuse of the paradigm could make programs even **more** complicated unnecessarily. A program that only has one main component *most likely* doesn't need to be separated into 20 different classes! More when we touch on design patterns in Week 4/5.

Java and Gradle

- We will use **Java** for all code in this course (specifically, Java 17).
- Java is a friendly entry-point for programmers getting started with OOP.
- Java shares similar syntax with C in its static typing and variable declarations.
- All code in Java has to exist within a class.
- Unlike C, Java has automatic **memory management**!
    - This means that you won't have to deal with things like memory leaks in *almost* all cases.
- **Gradle** is a tool used for dependency and build management.
    - You shouldn't have to interact with Gradle outside of using some commands - it should be making your experience in this course easier, not more complicated. Treat it as a black-box to compile your projects!

Important Terminology

- **Access modifiers**
  - Keywords that dictate what can access and use particular class fields/methods.
  - **public** - *all* files and classes can access this field/method
  - **private** - *no* files and classes can access this field/method outside of the class in which it belongs
  - there are a couple more, but you will only need to use these in most cases!
- **Constructors**
  - You can think of these as functions/methods that return an instance of your class, given a list of parameters.
  - They are declared like typical methods, with the method being the name of the class itself.
  - e.g. a constructor for a class named Student with fields name and zID can be declared as public Student(String name, String zID) { ... }
- **Instance fields/methods**
  - In the Student example again, each concrete student should have their own name and zID, i.e. each Student instance has its own 'copy' of the field, making name and zID **instance fields**.
  - **Instance methods** are methods that belong to individual concrete objects and can be invoked/called from the object. For example, s.sayHi() if sayHi is a method that all Students have.

Important Keywords

- **static**
  - In contrast to instance fields/methods, the **static** keyword declares that a field or method *belongs to a class itself*, rather than being tied to concrete instances of the class.
  - If sayHi() was a static method of Student, it could be invoked by doing Student.sayHi() [but if sayHi() should include a student's name and zID, does this actually make sense?].
  - Can you think of instances where a static field or method makes sense?
- **this**
  - When used in an instance method, **this** refers to the actual instance in which the method was invoked from.
  - Useful for when the instance has a field that shares the same name as a local variable, as without this keyword the local variable is prioritised.
- **new**
  - You can think of this as the Java equivalent of malloc. This keyword is followed by the constructor for a certain object, and allocates memory to instantiate the class.
  - Student s = new Student("John", z1234567);

Live Coding

- HelloWorld.java
    - Write a program with a main method that prints out “Hello World!” to the terminal and run it, then push the code onto git.
    - [KEY TAKEAWAYS] Java output, writing and running the main method, git revision
- Sum.java
    - Write a program that uses the Scanner class which reads in a line of numbers separated by spaces, and sums them.
    - [KEY TAKEAWAYS] Java input, control flow, importing classes, using a static method
- Shouter.java
    - Inside a new file Shouter.java, write a class that stores a message and has methods for getting the message, updating the message and printing it out in all caps. Write a main() method for testing this class.
    - [KEY TAKEAWAYS] Declaring class fields and methods, constructors, encapsulation