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# COMP2511

Tutorial 1

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# Introduction

- Hello! I'm James (he/him)
- (Graduated) Computer Science last term, but pivoting to....??
- Fifth 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. 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 you did during the holidays (doing nothing counts!)
  - any recent obsessions (music, games, hobbies)?!
  - 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%)** - 8 labs, each *manually marked* out of 10. Your overall lab mark is out of 70 (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%)** - *individual (!)* assignment, where you will be using some more advanced applications of OOP, and be presented with a scenario to assess your understanding of software architecture.
- **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 (**abstraction**).
  - Having responsibilities and logic be **separated** into different parts that work together as a whole to form a **cohesive** unit (e.g. hopefully, your COMP1531 project!).
  - Having the ability to easily **adapt** to account for changes in requirements.
- These are key ideas that we will carry throughout the entire course!

# Object-Oriented Programming

- During the 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



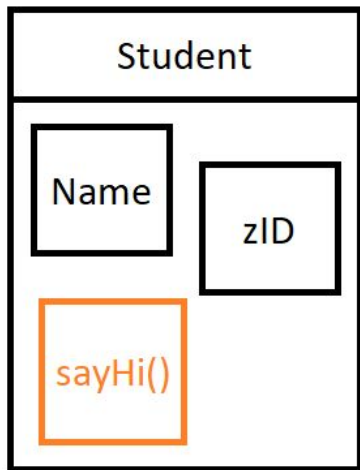
A blueprint of a house; the *idea* that informs what components the house will have and how it will be structured.



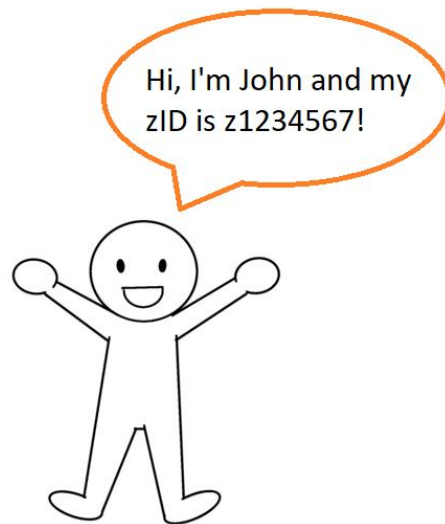
The actual house; the physical *realisation* of the blueprint.



# 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**, **maintainable** and **reusable** systems.
- 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 'better' 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:
  - Languages that support OOP (e.g. Java, Python) are (typically) high-level languages, where the overhead and memory cost of managing objects could get very large. An object-oriented approach may not be suitable if you need a very performant/speedy program.
  - It's fairly easy to misuse the paradigm, actually making programs **more** complicated unnecessarily. If you are considering an O-O approach, you should always consider whether it's *actually* applicable to the scenario.

# Java and Gradle

- We will use **Java** for all code in this course (specifically, Java 21).
- 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 (except for the class itself) can access this field/method
- **protected** and **default** are the other access modifiers - next week if we have time!

- **Constructors**

- Think of these as methods that create an instance of your class, given a list of parameters.
- They are declared like typical methods, with the method name 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 student has their own name and zID; conversely, each name and zID belongs to a specific student, making them **instance fields**.
- **Instance methods** are methods that are invoked (called) from objects. For example, if `st` is of type Student and `sayHi()` is a method for Students, you can invoke it by doing `st.sayHi()`.

# 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.
- You can think of these as being “global” across all instances of a specific class.
- An example where this would make sense is a constant value (e.g. pi) that wouldn’t need to be changed across different instances of a class.

- **this**

- When used in an instance method, **this** refers to the actual instance in which the method was invoked from.
- This is useful for when you need to make reference to a class field that **shares the same name as a local variable** (e.g. name stored in a class, and name as a method parameter). Without **this**, Java will prioritise the variable that is **local** in scope.

- **new**

- Think of this as the Java equivalent of **malloc** (from C). 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 to read 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
  - 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, defining constructors