INFO213: Lecture 1

Object-Oriented Systems Development

Course Introduction

Kia Ora and Welcome to INFO213!

- The plan for today:
  - Housekeeping: lectures, tutorials, assessment, resources
  - Course content and goals
  - The JADE prize!
  - The OO (Object Orientated) development paradigm introduction
  - JADE demonstration and introduction

The INFO213 Teaching Team

- Lecturer: Timothy Aitchison
  - Software Engineer at Jade
  - Works on the JADE product
  - Instructor for the JADE Developer's Course
- Course coordinator: Constantine Zakkaroff
- Tutor: Thilini Bhagya

Teaching Arrangements

- Lectures, labs:
  - One two-hour lecture followed by a two-hour tutorial/lab per week
  - Theory and examples in lectures, programming exercises in tutorials
- All About ACIS Assessments, Marking, Special Considerations and Cheating
  - Academic Integrity Guidance for Staff and Students (canterbury.ac.nz)
  - Special Consideration | University of Canterbury

Assessments: Dates to Be Posted on UC Learn

1. Online quiz: 10%
2. Course project: 40%
3. Final exam, two hours: 50%

Course Objectives

- Learn OO (Object Orientated) analysis and design
- Understand the benefits and challenges of OO development
- Learn how to use UML (Unified Modelling Language) for design and documentation
- Learn a bit of advanced OO: software design patterns
- Learn JADE programming
- Gain experience with OO databases

Course Resources

- Optional textbook:
  - *Introduction to object-oriented systems development with JADE*, 6th Edition, B. J. Clarke
    - Covers most topics discussed in lectures
    - Excellent JADE examples and exercises
    - https://www.amazon.com/Introduction-Object-Oriented-Systems-Development-JADE/dp/1539106667/
- The INFO213 page on UC Learn:
  - Further readings (book chapters, articles)
  - Lecture slides, tutorial handouts, exercises, code, solutions
  - Forums related to course material and course assessment

The JADE Prize

- Top student $2000 award from JADE Software Corporation

1997—Simon Munro
1998—Daniel Flitcroft
1999—Matthew Smith
2000—Alan Creek
2001—Jeremy Dodgson
2002—James Mitchell
2003—Alex Wong
2004—Steve Sarjeant
2005—Kim Oorschot
2006—Benjamin Marsh
2007—James Ashford
2008—Craig Paterson
2009—Brigette Martin
2010—Michael Suttie
2011—Edward Robinson
2012—Josh Lovell-Smith
2013 – Michael Dewar
2014 – Daniel Bathurst
2015 – Mark McKitterick
2016 – Mathew Hylkema
2017 – Sam Green
2018 – Lewis Garton
2019—Benjamin Crozier
2020—Gabriel Burnett
2021—Cancelled due to COVID ☹
2022—You??

Why JADE?

- Accessible to beginners
- Easy-to-learn programming environment
- Low-effort database programming
- Scalable for large systems
- Massive international projects:
  - https://www.jadeworld.com/our-work
- JADE hires graduates to work overseas:
  - https://www.jadeworld.com/contact-us
- First, a brief tour of JADE history:
  - https://www.jadeworld.com/who-we-are

What Does JADE Provide?

- OO language - Makes complex problems more simple!
- Integrated development environment (IDE)
  - Compiler
  - Debugger
  - Profiler
- Application server
- Database server
- Testing framework
- Graphic user interface (GUI) tools
- Version control tools
- … and much more

Complexity of Software Development

- Complexity: inherent property of software
  - Complexity of the problem domain
  - Difficulties of the development process management
    - Unclear or changing requirement
    - Multiple decisions and solution paths
    - Communication difficulties
  - Desired flexibility of software
- *"The more complex the system, the more open it is to total breakdown."* – Laurence J Peter
  - Humans struggle with complexity
    - The 7±2 rule
    - Slow processing speed
  - Incomprehensible complexity: chaos

OO Development to the Rescue! *Maybe…?*

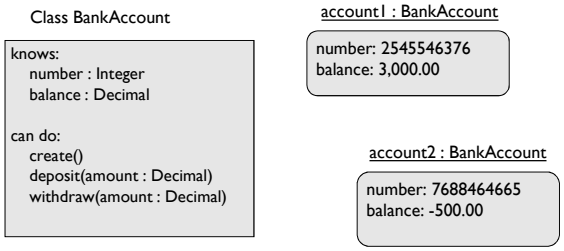
- OO reduces complexity with:
  - Abstraction
  - Encapsulation and data hiding
  - Decomposition

  (We will examine these topics in detail later)
- OO paradigm is better suited for the average human
- OO paradigm: a blend of engineering, science and art
- OO development is not perfect and is not the only solution.

Key OO Terms and Concepts

- **OO definition:** Object-oriented programming (OOP) is a programming language model organized around objects rather than "actions" and data rather than logic. Historically, a program has been viewed as a logical procedure that takes input data, processes it, and produces output data.
- **Class – I am a … (Lecturer? Engineer? Human?)**
- **Property – I have a … (name? course? arm?)**
- **Method – I can do … (speak? code? drink coffee?)**
- **Object – Specific instance of a class.**

Classes vs. Objects



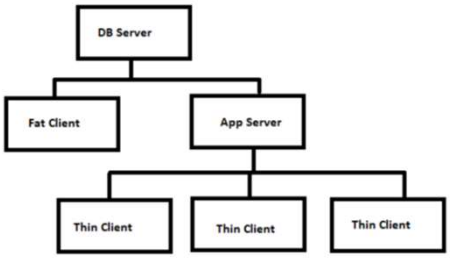
Properties - Public, Protected and Read Only

- **Public** – Anyone can read, anyone can modify
- **Protected** – Only the object itself can read, only the object can modify
- **Read only** access is a JADE-specific access modifier – Anyone can read, but only the object itself can modify.

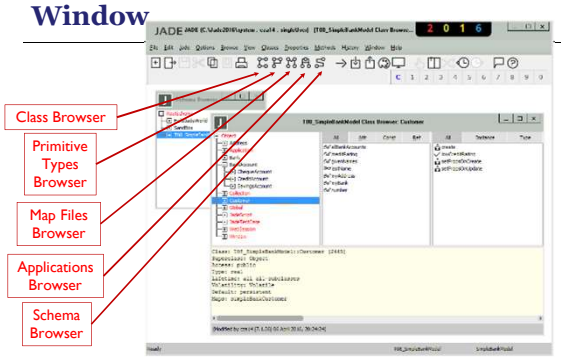
Running JADE the First Time

- Running JADE
  - Single user mode vs. client/server mode
- Tour of the JADE IDE
  - Schema, class, application browsers
- Creating a new JADE "Hello World" schema
- Loading an existing JADE schema

Client/Server Mode



JADE IDE Introduction: Main Window

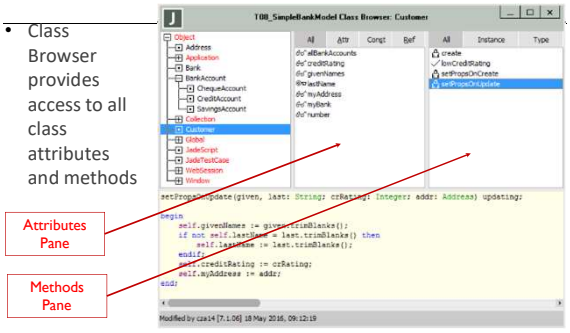


JADE IDE: Schema Browser

- **RootSchema** contains all system classes
- All other schemas inherit system classes from the **RootSchema**
- BTW, what is meant under the term "schema" in JADE?
  - How would we go about finding out an answer to this question?

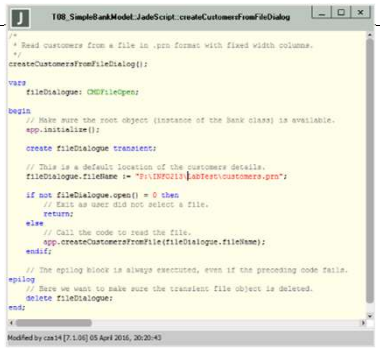
JADE IDE: Class Browser

- Class Browser provides access to all class attributes and methods



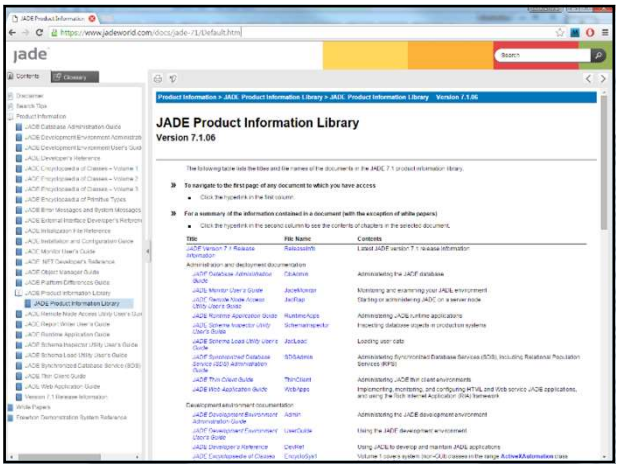
JADE IDE: Code Editor

- Code editor offers syntax highlighting, code completion, contextual help and much more



JADE's Help System

- Reading application program interface (API) docs is a skill and a means of … self-*empowerment*
- Context-sensitive help in the JADE IDE (F1)
  - https://forums.jadeworld.com/search.php?keywords=adobe+reader+context+help
- Online help at the JADE Developer Centre
  - https://www.jadeworld.com/docs/jade-2018/Default.htm
- Other sources of self-empowerment:
  - Peers, class forms, JADE forums, examples…



Level 1 OO Concepts (Revision)

- **Class** – **Persistent** vs. **Transient**
  - Persistent is saved to the database
  - Transient is use-then-throw-away
- **Attribute** – "I have a..."
- **Method** – "I can do..."
- **Object** – "an Instance of a Class"
- **Primitive type** vs. **object type** attributes
  - "I have a name" is different to "I have a cat"

Level 2 OO Concepts

- **Public** attribute – Read and write
- **Protected** attribute – No read, no write
- **Read only** attribute – Read but not write
  - JADE-specific access modifier
- **Class interfaces –** what others see (Not protected!)

Level 3 OO Concepts

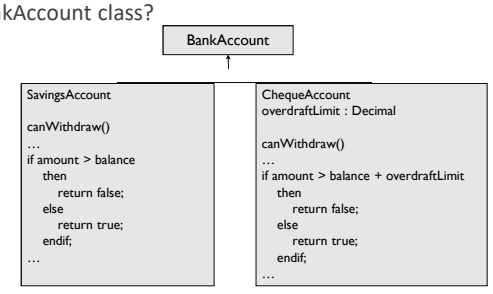
- Special methods in the interface of each class:
  - **Constructor** –
  - **Destructor** –
  - **Getters, Setters** –
- **Superclass** and **subclasses –**
  - Inheritance: generalisation vs. specialisation

Questions are coming … Collect the answers!

- **What is Inheritance and Polymorphism in OO?**
- **What is the difference between an Abstract class and a Real class?**
- How is the data in a JADE database stored on disk?
- What can you do in the Primitives Browser?
- Name three kinds of Node in a JADE database.
- Why is it important to delete Transients when done with them?

Polymorphism, Generalisation vs. Specialisation

- What methods/attributes should be in the in the BankAccount class?



Have we answered the first questions?

- What is Inheritance?
- What is Polymorphism?
- What is an Abstract Class?
- What is a Real Class?

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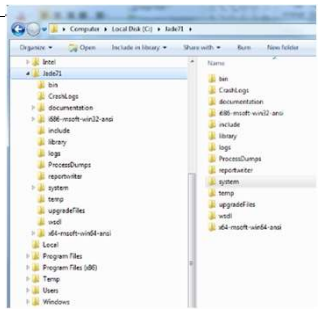
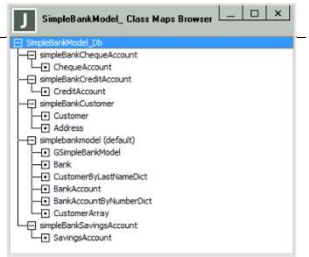
Schemas, Database Files on Disk

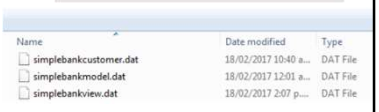
- **Schema** –
- **Map File** –
- Map files are stored in the system folder
- Map files are to be created before class instantiations



JADE IDE: Map File Browser

- Common practice is to create a map file for each persistent class with many instances - Why?
- Small number of instances of various types are OK in one (default) schema map file
- Map file renaming is complicated





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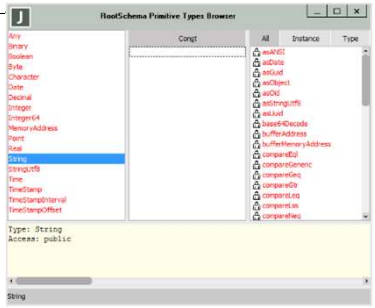
JADE IDE: Primitive Types Browser

- Convenient place for defining new functionality for specific primitive types, e.g. adding some custom operations on Date type
- Convenient place to examine available methods



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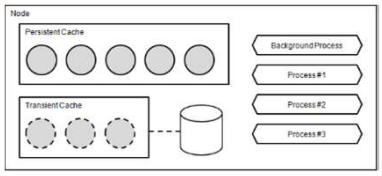
Persistent vs Transient Cache Rules

- PC: A node fetches persistent objects from the server automatically
- PC: After committed transaction modified objects are copied to the server
- PC: Objects discarded when cache fills up
- TC: Shared by all processes on the node
  - (1) Process vs. (2) Shared transient objects
  - (1) Accessible by the creator process
  - (2) Accessible by all processes on the node
- TC: Objects are stored on disk when cache fills up

JADE Nodes and Caches

- Node
  - Where application code is executed and where objects are processed
    - Standard client
    - Database server
    - Application server
- Cache
  - Complex rules for cache management (retention and discarding)
    - Persistent: automatic fetching from database
    - Transient: shared on the node only



Installing JADE at Home

- Access to JADE on your home machine:
  - Free JADE developer package 2020 available online:
    - https://www.jadeworld.com/developer-center/jade-download/
  - Request free developer license:
    - https://secure.jadeworld.com/devlicense
  - Documentation (PDF, optional) to be downloaded and installed separately (Can use online help instead):
    - https://www.jadeworld.com/developer-center/resource-library
- Further installation instructions to be posted on UC Learn