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
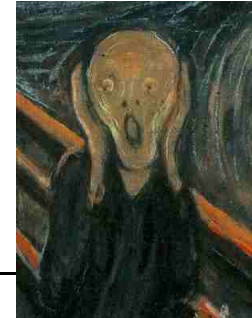
1. Online quiz: 10%

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

INFO213: Lecture 1

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

INFO213: Lecture 1

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

Class BankAccount

```
knows:
    number : Integer
    balance : Decimal

can do:
    create()
    deposit(amount : Decimal)
    withdraw(amount : Decimal)
```

account1 : BankAccount

number: 2545546376
balance: 3,000.00

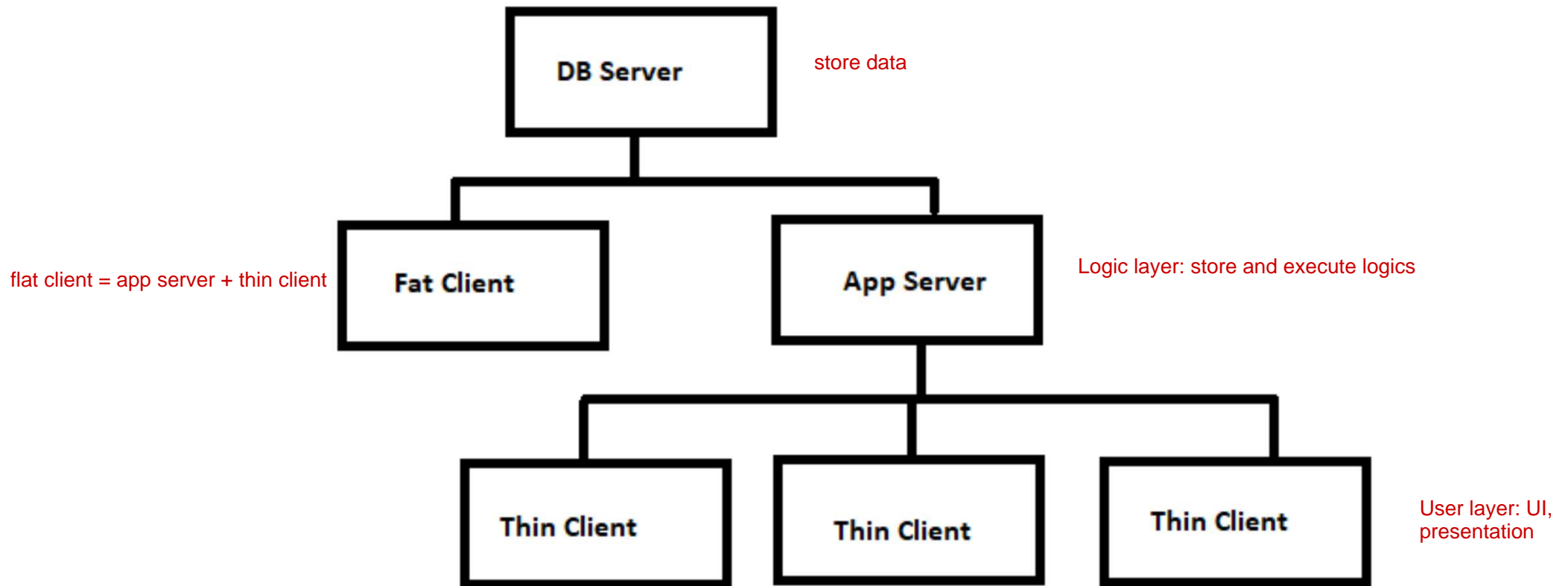account2 : BankAccount

number: 7688464665
balance: -500.00

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.
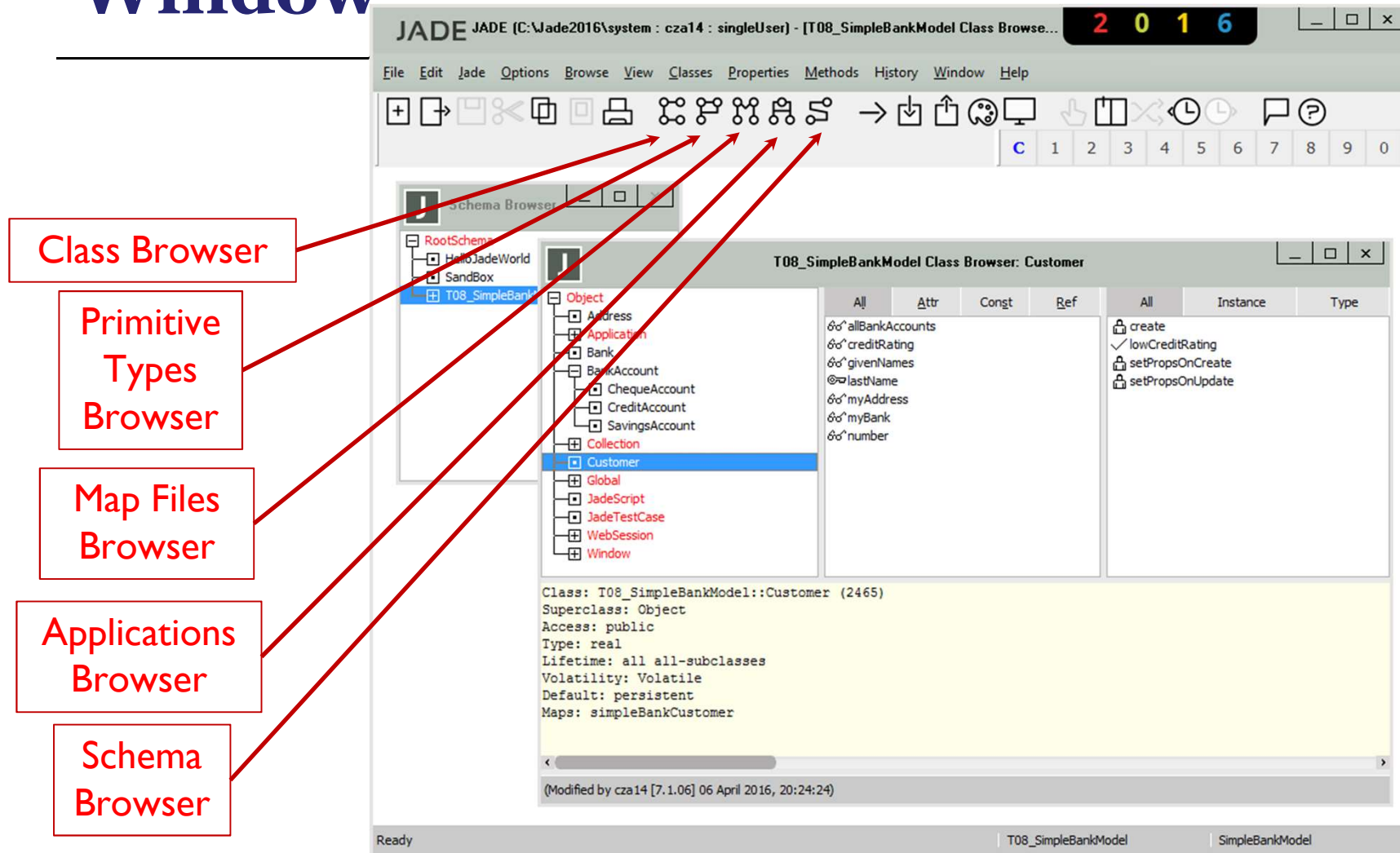
Running JADE the First Time

- 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

store data

flat client = app server + thin client

Logic layer: store and execute logics

User layer: UI, presentation

JADE IDE Introduction: Main Window

Class Browser

Primitive Types Browser

Map Files Browser

Applications Browser

Schema Browser

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?
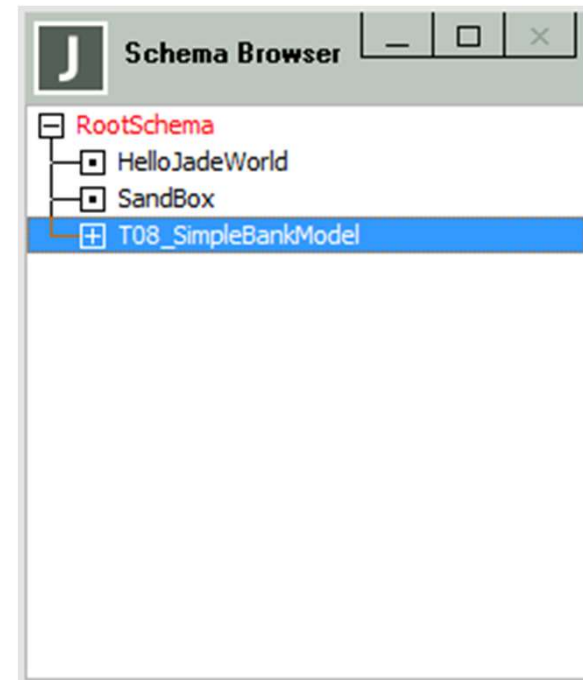
JADE IDE: Class Browser

- Class Browser provides access to all class attributes and methods

Attributes Pane

Methods Pane

JADE IDE: Code Editor
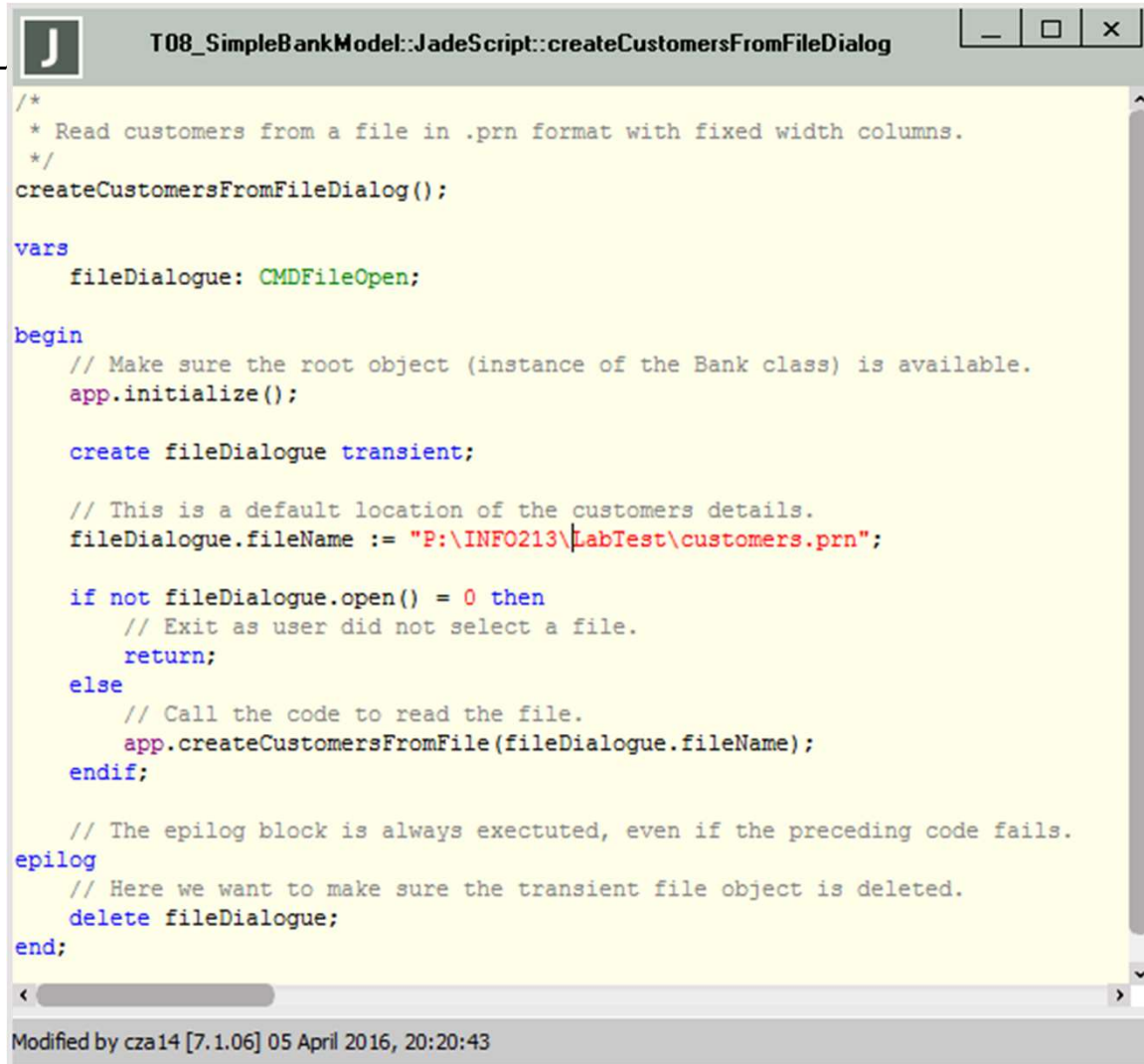
- Code editor offers syntax highlighting, code completion, contextual help and much more


```
T08_SimpleBankModel::JadeScript::createCustomersFromFileDialog

/*
 * Read customers from a file in .prn format with fixed width columns.
 */
createCustomersFromFileDialog();

vars
    fileDialogue: CMDFileOpen;

begin
    // Make sure the root object (instance of the Bank class) is available.
    app.initialize();

    create fileDialogue transient;

    // This is a default location of the customers details.
    fileDialogue.fileName := "P:\INFO213\LabTest\customers.prn";

    if not fileDialogue.open() = 0 then
        // Exit as user did not select a file.
        return;
    else
        // Call the code to read the file.
        app.createCustomersFromFile(fileDialogue.fileName);
    endif;

    // The epilog block is always exectuted, even if the preceding code fails.
epilog
    // Here we want to make sure the transient file object is deleted.
    delete fileDialogue;
end;
```

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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…

jade

Search

Contents panel:

- Disclaimer
- Search Tips
- Product Information
  - JADE Database Administration Guide
  - JADE Development Environment Administrati
  - JADE Development Environment User's Guide
  - JADE Developer's Reference
  - JADE Encyclopaedia of Classes – Volume 1
  - JADE Encyclopaedia of Classes – Volume 2
  - JADE Encyclopaedia of Classes – Volume 3
  - JADE Encyclopaedia of Primitive Types
  - JADE Error Messages and System Messages
  - JADE External Interface Developer's Referen
  - JADE Initialization File Reference
  - JADE Installation and Configuration Guide
  - JADE Monitor User's Guide
  - JADE .NET Developer's Reference
  - JADE Object Manager Guide
  - JADE Platform Differences Guide
  - JADE Product Information Library
    - JADE Product Information Library
  - JADE Remote Node Access Utility User's Guide
  - JADE Report Writer User's Guide
  - JADE Runtime Application Guide
  - JADE Schema Inspector Utility User's Guide
  - JADE Schema Load Utility User's Guide
  - JADE Synchronized Database Service (SDS)
  - JADE Thin Client Guide
  - JADE Web Application Guide
  - Version 7.1 Release Information
- White Papers
- Erewhon Demonstration System Reference

JADE Product Information Library

Version 7.1.06

The following table lists the titles and file names of the documents in the JADE 7.1 product information library.

» **To navigate to the first page of any document to which you have access**

- Click the hyperlink in the first column.

» **For a summary of the information contained in a document (with the exception of white papers)**

- Click the hyperlink in the second column to see the contents of chapters in the selected document.

Title	File Name	Contents
JADE Version 7.1 Release Information	ReleaseInfo	Latest JADE version 7.1 release information
Administration and deployment documentation		
JADE Database Administration Guide	DbAdmin	Administering the JADE database
JADE Monitor User's Guide	JadeMonitor	Monitoring and examining your JADE environment
JADE Remote Node Access Utility User's Guide	JadRap	Starting or administering JADE on a server node
JADE Runtime Application Guide	RuntimeApps	Administering JADE runtime applications
JADE Schema Inspector Utility User's Guide	SchemaInspector	Inspecting database objects in production systems
JADE Schema Load Utility User's Guide	JadLoad	Loading user data
JADE Synchronized Database Service (SDS) Administration Guide	SDSAdmin	Administering Synchronized Database Services (SDS), including Relational Population Services (RPS)
JADE Thin Client Guide	ThinClient	Administering JADE thin client environments
JADE Web Application Guide	WebApps	Implementing, monitoring, and configuring HTML and Web service JADE applications, and using the Rich Internet Application (RIA) framework
Development environment documentation		
JADE Development Environment Administration Guide	Admin	Administering the JADE development environment
JADE Development Environment User's Guide	UserGuide	Using the JADE development environment
JADE Developer's Reference	DevRef	Using JADE to develop and maintain JADE applications
JADE Encyclopaedia of Classes	EncycloSys1	Volume 1 covers system (non-GUI) classes in the range **ActiveXAutomation** class

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** – special kind of method to instantiate an object of a class (if class is defined bank account, then the method create account is constructor; delete account would be destructor)

  - **Destructor** –

  - **Getters, Setters** –

- **Superclass** and **subclasses** –
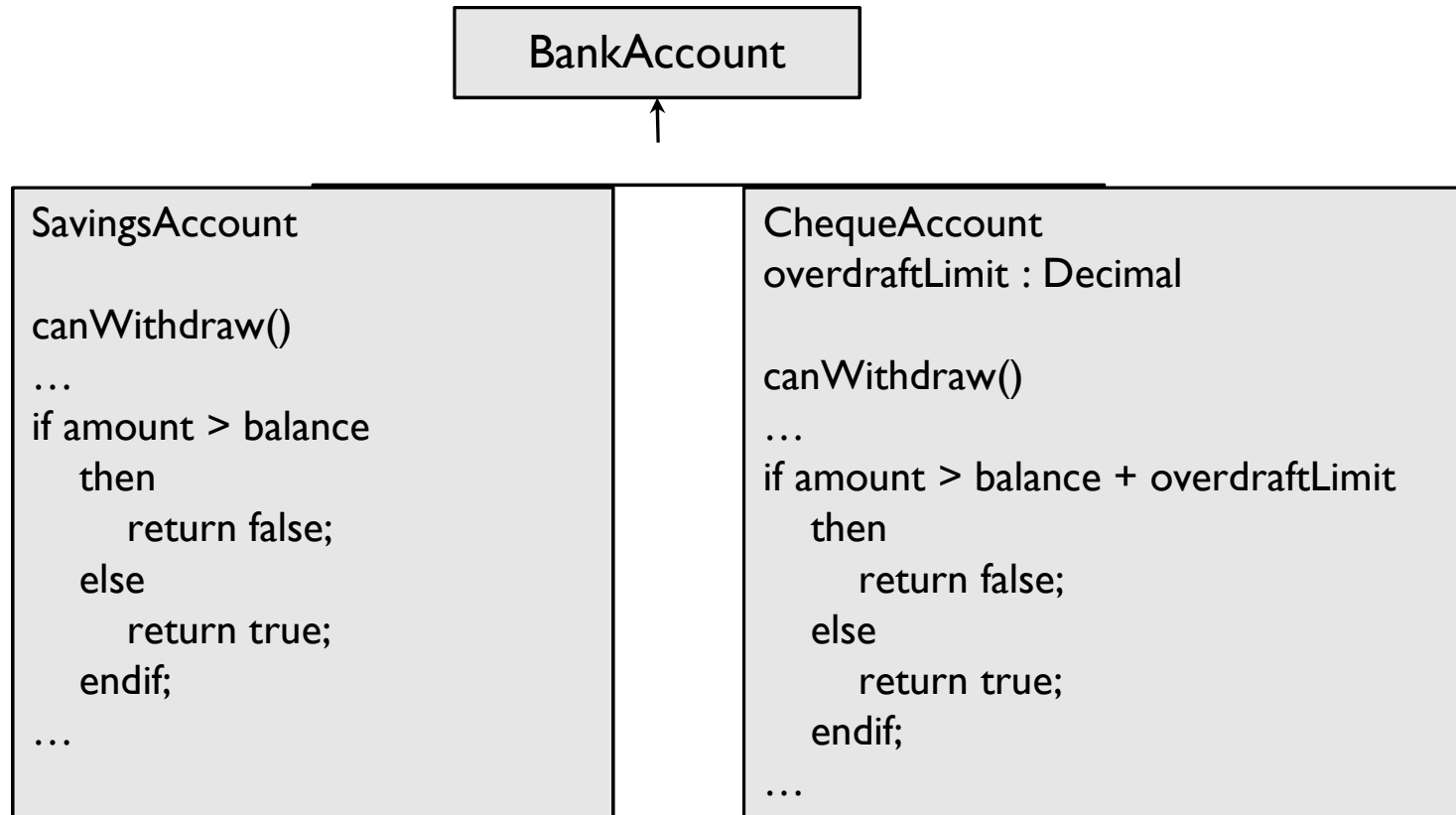
  - Inheritance: generalisation vs. specialisation

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?

```
                          BankAccount
```

SavingsAccount	ChequeAccount
	overdraftLimit : Decimal
canWithdraw()	canWithdraw()
…	…
if amount > balance	if amount > balance + overdraftLimit
then	then
return false;	return false;
else	else
return true;	return true;
endif;	endif;
…	…

Have we answered the first questions?

- What is Inheritance?

- What is Polymorphism?

- What is an Abstract Class?

  Almost all of classes are real class. Abstract class is only used by superclass like BankAccount. You are not allowed to instantiate an abstract class. You have to subclass it first. But with an abstract class you are allowed to put a method on it and have no codes of the method. The subclass will implement that method later. For example, BankAccount can have a 'withdraw' but BankAccount doesn't know how to do it itself and have to subclass with SavingsAccount and ChequeAccount.

- What is a Real Class?

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?**
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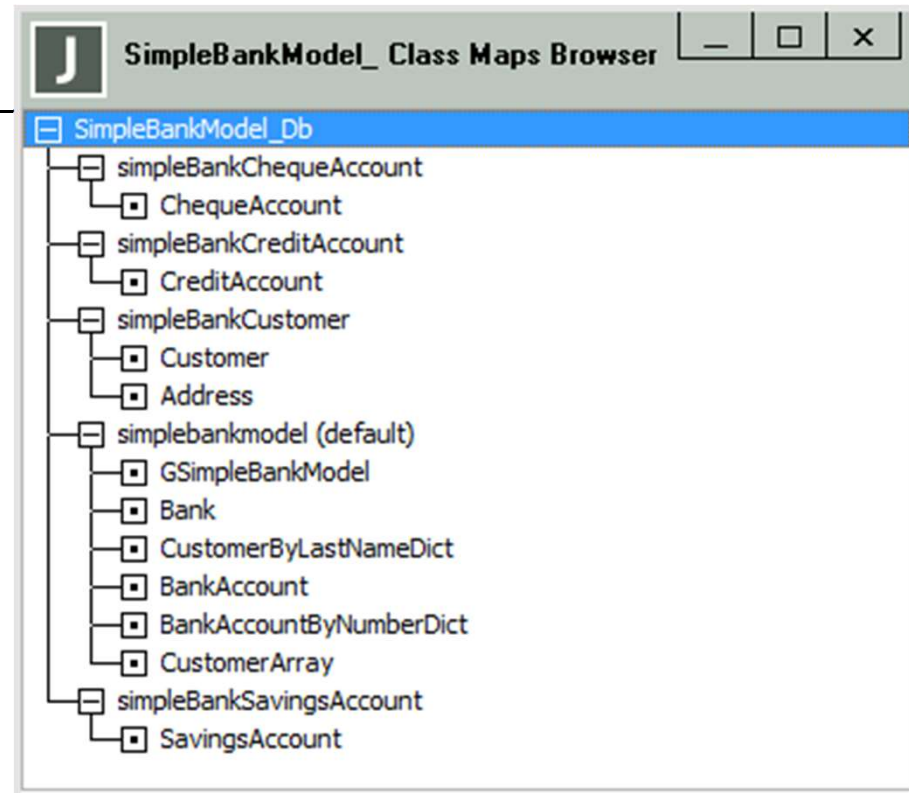- Why is it important to delete Transients when done with them?

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
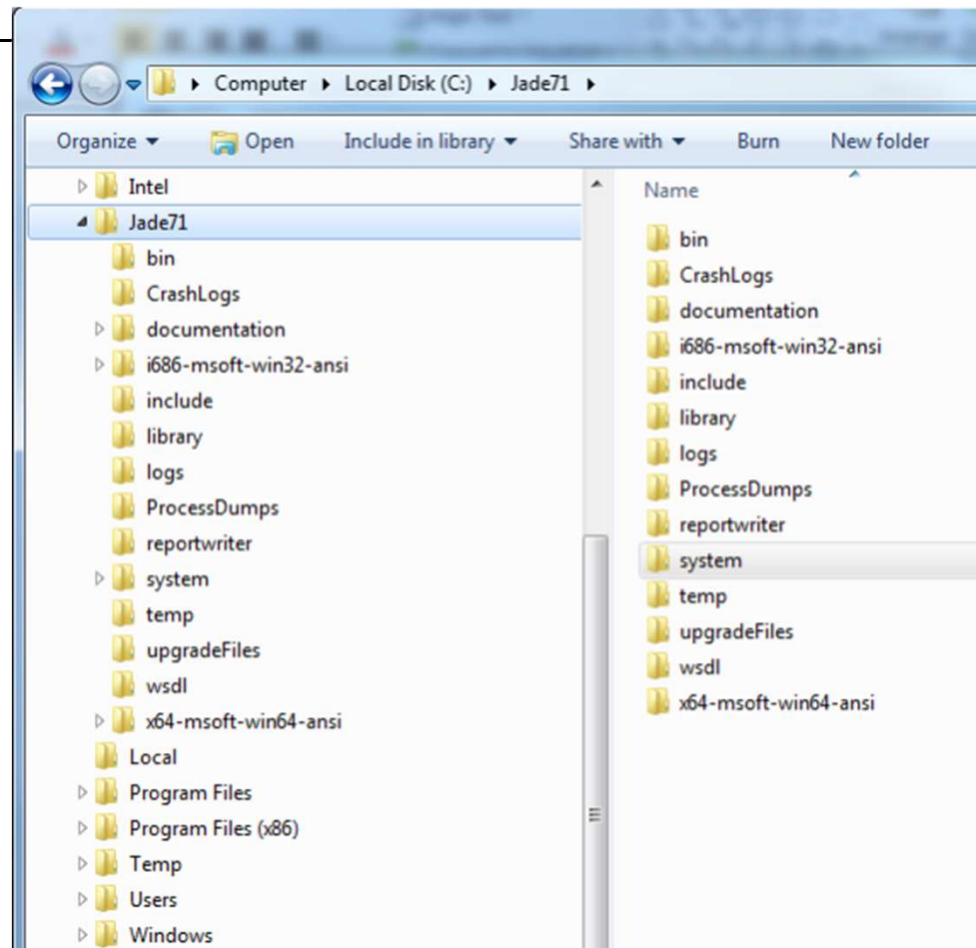
JADE IDE: Map File Browser

- 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
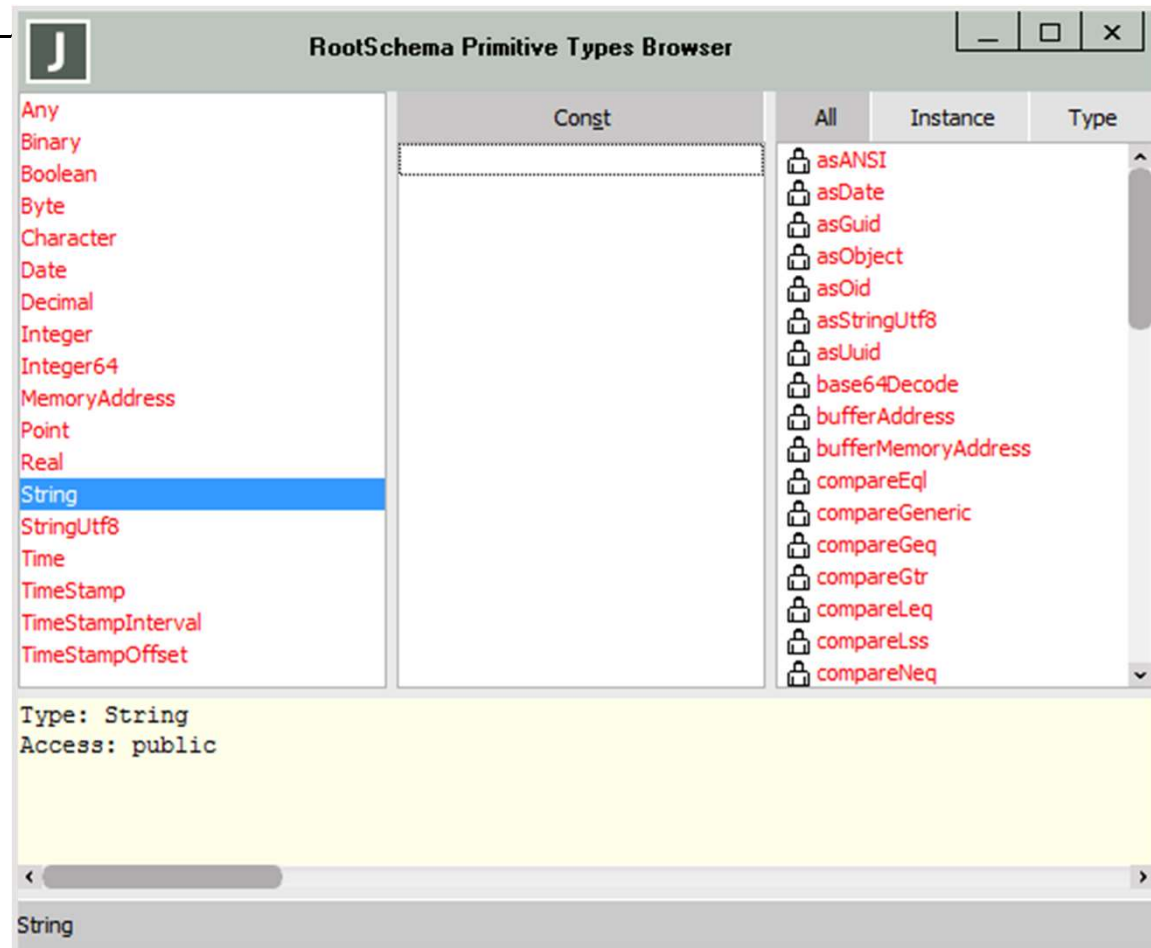
- Map file renaming is complicated

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?

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==

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.**

DB server, fat client, app server are nodes. Thin client can't do any thinking but just a presentation so it is not node

- **Why is it important to delete Transients when done with them?**

while the system object is doing on the disk the transient object is doing in the computer memory. If don't delete the transients will stay in the memory (take up space). When run out of space the computer runs slower. This is called transient cache overflow.

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
  - <mark>Where application code is executed and where objects are processed</mark>
    - Standard client
    - Database server
    - Application server


```
Node

  ┌─────────────────────────────────────┐
  │ Persistent Cache                    │
  │   ◯   ◯   ◯   ◯   ◯                 │
  └─────────────────────────────────────┘

  ┌──────────────────────┐
  │ Transient Cache      │        ▭
  │   ◌   ◌   ◌          │────── (database)
  └──────────────────────┘
```

Background Process

Process #1

Process #2

Process #3

- Cache
  - Complex
    rules for cache management (retention and discarding)
    - Persistent: automatic fetching from database
    - Transient: shared on the node only
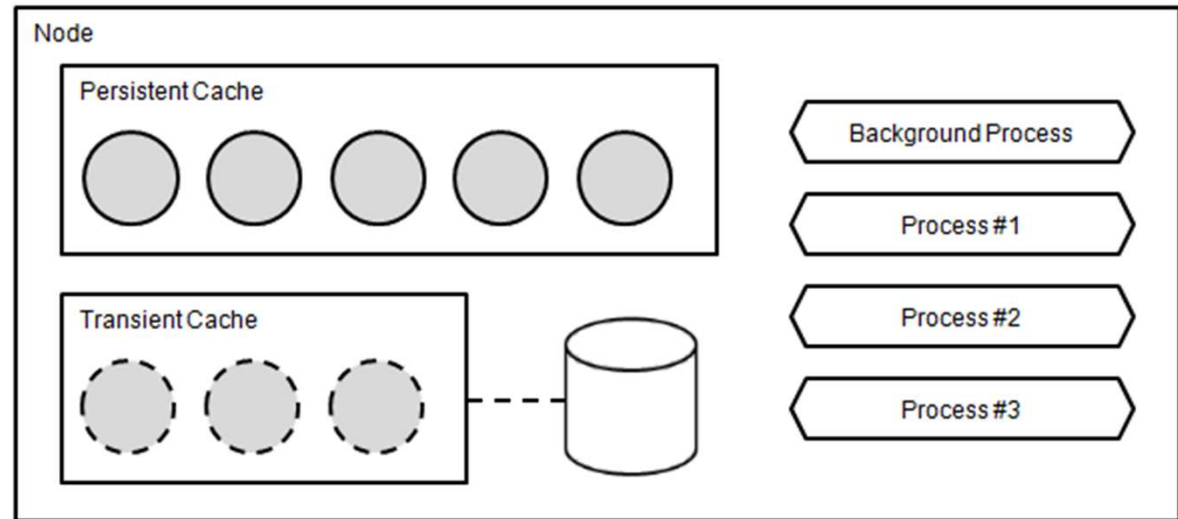
Installing JADE at Home

- 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