40.317 Course Description

Basic Information

Title:	Financial Systems Design
Pillar/Cluster:	ESD
Academic Year and Term:	2020, Term 8
Elective or Core:	Elective
Subject Credits:	12

Instructors

- For the first half: Jon Freeman, Adjunct Lecturer.
- For the second half: Chung-I Lu, Adjunct Lecturer.
- There will be no Teaching Assistant.

Summary

This is a course in Computational Finance in which students learn the tools for delivering financial services and the algorithms used to price complex financial instruments (derivatives). It also abstracts the design of financial services, focusing on interface design, which reduces to language design. There will be weekly coding exercises (in Python 3), however only moderate coding proficiency is required. There will be a mid-course project to design the interfaces used within a distributed multi-player trading game.

The main topics are:

- Price discovery via an interactive, distributed trading game
- Distributed computing
- Blockchains for distributed consensus and storage
- Interfaces described as domain-specific "little languages"
- System design viewed as interface design, and hence as language design
- Introductory topics in Computational Finance:
    - Computation of derivatives via finite difference
    - Numerical solution of ODEs
    - Numerical solution of PDEs
    - Monte Carlo simulation for option pricing
    - Monte Carlo variance reduction techniques
    - Pricing of American options

Learning Objectives

On successful completion of this course, students should be able to:

- Recognise and apply the tools of financial systems design in distributed environments.
- Create a systems level design by designing the system interfaces, viewing each interface as a "little language."
- Recognise and implement algorithms for pricing financial instruments (derivatives).

Texts

There are three recommended texts:

- Hilpisch, Yves. Python for Finance, 2nd Edition. O'Reilly, 2018.
- Newman, Mark. Computational Physics. CreateSpace, 2013 revised edition.
- Wilmott, Paul. Paul Wilmott on Quantitative Finance, 2nd Edition. (Volume 3 only.)

All other required or recommended materials will be provided via eDimension.

Pre-Requisites and Expectations

- 40.242 Derivative Pricing and Risk Management.
- At least one course beyond 10.009 The Digital World requiring the use of Python. Alternatively by instructor permission.

Students will be required to use Python 3. Resources will be provided listing the differences between Python 2 and 3. Moderate coding proficiency is assumed; the weekly coding assignments will often involve completing supplied code fragments.

Assessments

Students will receive a letter grade, and will be assessed on the following:

- Weekly homework assignments
- A mid-course design project
- Class attendance and participation

There will be no quizzes or final exam.

Students will be permitted to complete most of the homework assignments in pairs, and to complete the mid-course design project in teams of up to three.

Assessment Weights

Assessment Item	Percentage	Period
Homework assignments	40%	Throughout the term
Design project	25%	Weeks 6-8
Case study	10%	Weeks 4-5
Class participation	25%	Throughout the term

These weights are exclusive of a 2% weight earned for completing the course surveys.