**FE8828**

**Programming Web Applications in Finance**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Academic Year** | : | 2019/2020 | **Mini Term** | : | 2 |
| **Pre-requisites** | : | N/A | | | | |
|  |  |  | | | | |

**Course Description and Scope**

This course aims to teach how to process and analyze data, run statistical and financials model and two threads leading to build application in finance analytics. It includes three parts:

1. How internet works, how to create a website with cloud computing infrastructure like Amazon Web Services.
2. How to use data manipulation and data visualization to carry out exploratory data analysis and reproducible research.
3. How to build data-driven reports and dashboard, interactive rich data visualization.
4. How to build data model and run predictive modeling.
5. How to build finance application which combines data, model and analysis.
6. Latest internet technology in cryptocurrency and payment system like Bitcoin and Blockchain.

Scope

* Students can pick up new programming languages quickly, new programming paradigm (reactive, object-oriented) quickly, new functional libraries quickly.
* Students can tackle problem solving in large and small scales, i.e. from building a derivative valuation model to strategy design.
* Students can use the tool to implement models for finance and data science, it makes them to apply what they learn.
* Student can plan to build application with different input and output to satisfy needs of analytics.
* Students can independently and confidently complete computing projects.

**Course Learning Goals, Objectives & Assessment**

|  |  |  |  |
| --- | --- | --- | --- |
| **Learning Goals¹** | **Course Learning Objective²** | **Assessment Method**³  **(For each learning goal, briefly describe the assignment(s) to be used for assessing the achievement of the stated objectives)** | **NBS Standard Rubrics**4  (For each learning goal, state the actual rubric to be used for grading the assignment(s) described) |
| Use cloud services to host data-driven web application | Understanding how internet and network protocol works. | Assignment:  Learn and use various AWS services cohesively: Route53, EC and S3 to build a website | Use cloud services to host data-driven web application |
| Use programming language to process, manipulate and present data  Build data-driven web-based application | Know how to program R to analyze data and build data-driven interactive applications | * Logic thinking of data processing technical. * Clarity in data visualization * Dealing the complexity of handling user-interaction. | * Use programming to process and present data * Use programming language to build application |
| Build predictive model | Using R makes theory and practical much closer | * Using existing packages and apply insights to feature engineering. | Understand predictive modeling and build practical model. |
| Understand how Blockchain works | Able to prototype Blockchain-based application | 1. Examine the needs for such technology 2. Analyze its current impact and value 3. Deriving ideas for next-generation applications. | Understand how Blockchain works |

|  |  |  |  |
| --- | --- | --- | --- |
| **Learning Goals¹** | **Course Learning Objective²** | **Assessment Method**³  **(For each learning goal, briefly describe the assignment(s) to be used for assessing the achievement of the stated objectives)** | **NBS Standard Rubrics**4  (For each learning goal, state the actual rubric to be used for grading the assignment(s) described) |
| Acquisition of Knowledge | Pick up new knowledge and technology quickly.  Active learning to related  Able to prototype system | Assignment that needs students to interact with 3rd party service provider. Result is open-ended, so students can learn proactively. |  |
| Quantitative Literacy Skills | Know how data and flow of data plays central role in current business world. There are three areas:   * Logic thinking of data processing technical. * Clarity in data visualization * Dealing the complexity of handling user-interaction. | Two stages approach:   1. Step-by-step guided tutorial for the completeness of an application 2. Open-end assignment: given pieces of data, how to prototype a data service around it. |  |
| Ethical Reasoning | Blockchain is an emerging technology that its use is wide-open. Students shall grow independent thinking about the application of such technology.   * Examine the needs for such technology * Analyze its current impact and value | * Able to prototype Blockchain-based application * Deriving ideas for next-generation applications. |  |
| Oral Communication | We are set in a business environment that is fast-paced and demands team works. Students are grouped to form a virtual “bank” at the beginning of the course. Both assignment and final project need the team to rotate their roles (lead, tech, business, sales, etc) and present the result. | I will assess the project based on:   * Overall product * Each member’s role-playing and individual contribution * Oral and written communication in presentation and writing. |  |
| Written Communication |
| Teamwork & Interpersonal Skills |
| Motivation & Development of Self & Others |

**Learning & Teaching Methods**

|  |  |  |
| --- | --- | --- |
| **Stage** | **Objective** | **Teaching Method** |
| Build the foundations | To bring eloquence to languages and tools | Lecture |
| Challenge for application building | To follow instructors’ steps to build own applications | Guided exercise. Group-based.  Presentation. |
| Extend to thought-provoking topics | To present various novel ideas that make Bitcoin and Blockchain working | Lecture and seminar-based.  Group-based. Discussion. |

**Course Assessments**

|  |  |  |
| --- | --- | --- |
| **Components** | **Marks** | **Individual/Group** |
| Assignment (1st to 4th week) | 10 + 10 + 20 + 10 | Individual |
| Class participation | 10 | Individual |
| Final project | 40 | Group |
| **Total** | **100** |  |

**Readings and References**

R for Data Science: Import, Tidy, Transform, Visualize, and Model Data (05 January 2017) by Hadley Wickham, Garrett Grolemund

**Other Resources**

1. Caret package and XGBoost <https://topepo.github.io/caret/index.html> and <https://xgboost.readthedocs.io/en/latest/R-package/xgboostPresentation.html>
2. “Genesis” Nakamoto, Satoshi (24 May 2009). "Bitcoin: A Peer-to-Peer Electronic Cash System"
3. <https://medium.com/@ConsenSys/a-101-noob-intro-to-programming-smart-contracts-on-ethereum-695d15c1dab4#.rahuuy8uh>
4. <https://bitsonblocks.net/2016/02/01/a-gentle-introduction-to-smart-contracts/>
5. Hard fork of Ethereum after a hacker stole tens of millions of dollars worth of digital currency.
6. Bank of England: Staff Working Paper No. 605: The macroeconomics of central bank issued digital currencies - John Barrdear and Michael Kumhof

**Course Instructors**

|  |  |  |  |
| --- | --- | --- | --- |
| **Instructor** | **Office Location** | **Phone** | **Email** |
| Yang Ye |  | +65 9382 6762 | yy@runchee.com |

**\***Please indicate the course coordinator with a “#” next to instructor name (if applicable)

**Proposed Weekly Schedule**

|  |  |  |  |
| --- | --- | --- | --- |
| **Week** | **Topic** | **Learning Objectives** | **Readings/Activity** |
| 1/2 | Foundation for Web-based Application | 1. What’s internet and network protocols 2. Language: HTML/CSS/Markdown/JavaScript/R 3. Development tools and Cloud tools | Lecture/Reading/Hands-on |
| 3/4 | Intermediate R programming  Data Manipulation, Visualization and Exploratory Data analysis | 1. R programming skills 2. Master the use of tidyverse packages to carry out data analysis and visualization. | Lecture/Reading/Hands-on |
| 5 | Applications | 1. Design web-based dashboard and interactive application 2. Build Predictive model | Lecture/Reading/Hands-on |
| 6 | Blockchain and Bitcoin | 1. How Blockchain works. 2. Blockchain’s application | Lecture/Reading/Hands-on |

**Academic Integrity Policy**

NTU’s Student Academic Integrity Policy requires all members of the NTU community to uphold the values of academic integrity in all academic undertakings. The policy defines the following acts as academic dishonesty:

* plagiarism,
* academic fraud and
* facilitating academic dishonesty.

All students are expected to read and observe the policy guidelines detailed at this website: <http://www.ntu.edu.sg/ai/Pages/academic-integrity-policy.aspx> . The academic integrity website also highlights the penalties that will be imposed on students who are found to have violated the policy, and the processes that will be followed when we deal with cases of academic dishonesty.

***Appendix***

***For instructor reference only***

***(Do not print for students)***

***Further description of each Assessment Plan component:***

*¹NBS Learning Goals*

Acquisition of Knowledge | Ethical Reasoning | Quantitative Literacy Skills | Oral Communication | Written Communication | Teamwork & Interpersonal Skills | Motivation & Development of Self & Others

*²Course Learning Objectives*

Related to the expected learning goal(s) | Are observable and measurable

*³Assessment Method*

Assignments specially designed to assess students’ achievement of the stated objectives, e.g., the use of an article critique for assessing critical thinking skills, an analysis of a dilemma for assessing ethical reasoning,  etc.

*4NBS Standard Rubrics*

Criteria in rubrics must relate closely to the stated objectives | Strongly encouraged to use the NBS standard rubrics, and you may add on other criteria relevant to your assessment | NBS Office of Accreditation (AO) can assist you with rubrics that are aligned to the NBS learning goals¹