BUCKINGHAMSHIRE
NEW UNIVERSITY
EST. 1891

School of Creative and Digital Industries

Module Scheme Semester One 2022-23

Module Name:	Algorithms and Data Structures		
Module Code:	CO536	Academic Year:	2022-23
Tutor(s):	Nicholas Day		
Tutor's Email:	nicholas.day@bnu.ac.uk	Tutor's Telephone:	ND: Ext. 3181 & contact via MS Teams

Learning Outcomes:

1. Identify in intelligent systems requirements and criteria that are appropriate for reducing algorithmic complexity leading to efficient specifications to be used in the solution of specific AI problems.
2. Understand the importance of algorithmic complexity and demonstrate this in an implementation language when deploying AI solutions.
3. Employ analytical techniques and design tools in the development of AI software and Intelligent system artefacts.

Assessment Summary:

Assessment Task	Key Dates
CW1 Logbook (Logbook exercises) (50%)	Submission: W10: Friday 2 December 2022
CW2 Report (1500 words) (50%)	Submission: U19: Friday 3 February 2023

Indicative Weekly Content

Week by Week Guide:	Teaching details
1. Week beginning: 26/09/2022 (Timetabling Week 1) 2. Week beginning: 03/10/2022 (Timetabling Week 2)	Introduction to the basics of Python and set up IDEs ***Lesson Plan (weeks 1 & 2):*** [1] Presentation – Introduction to Python and Anaconda *Lesson Practical:* [2] Logbook Activity 1 – Python 1 – Variables and Lists [3] Logbook Activity 2 – Python 2 – List Manipulation [4] Logbook Activity 3 – Python 3 – Sets and Dictionaries

3. Week beginning: 10/10/2022 (Timetabling Week 3)	Revisit principles of good OO, Selection and Iteration ***<u>Lesson Plan:</u>*** [1] Presentation – Revisit OOP, Selection and Iteration *<u>Lesson Practical:</u>* [2] Logbook Activity 4 – Python 4 – Conditionals (selection, iteration & functions) [3] Logbook Activity 5 – Python 5 – Object Orientation (classes, objects, inheritance)
4: Week beginning: 17/10/2022 (Timetabling Week 4)	Nodes and LinkedLists ***<u>Lesson Plan:</u>*** [1] Presentation – Nodes and Linked Lists *<u>Lesson Practical:</u>* [2] Logbook Activity 6 – Linked List
5: Week beginning: 24/10/2022 (Timetabling Week 5)	Computational Complexity, Search and Sort ***<u>Lesson Plan:</u>*** [1] Presentation – Computational Complexity *<u>Lesson Practical:</u>* [2] Logbook Activity 7 – Search and Sort
6. Week beginning: 31/10/2022 (Timetabling Week 6)	Stack, Queue, and HashMap ***<u>Lesson Plan:</u>*** [1] Presentation – Stack, Queue, HashMap *<u>Lesson Practical:</u>* [2] Logbook Activity 8 – Stacks and Queues [3] Logbook Activity 9 – HashMap
7. Week beginning: 07/11/2022 (Timetabling Week 7)	Trees, Binary Search Trees, Recursion ***<u>Lesson Plan:</u>*** [1] Presentation – Trees, BSTs and Recursion *<u>Lesson Practical:</u>* [2] Logbook Activity 10 – BST navigation via Recursion
8. Week beginning: 14/11/2022 (Timetabling Week 8)	Tree Search: BFS, DFS ***<u>Lesson Plan:</u>*** [1] Presentation – BFS and DFS *<u>Lesson Practical:</u>* [2] Logbook Activity 11 – BFS and DFS
9. Week beginning: 21/11/2022 (Timetabling Week 9)	Graph Theory ***<u>Lesson Plan:</u>*** [1] Presentation – Graph Theory *<u>Lesson Practical:</u>* [2] Logbook Activity 12 – Set up a Graph
10. Week beginning: 28/11/2022 (Timetabling Week 10)	Graph Search + Heuristics ***<u>Lesson Plan:</u>*** [1] Presentation – Graph Search Algorithms *<u>Lesson Practical:</u>* [2] Logbook Activity 13 – Djikstra [3] Logbook Activity 14 – A* Algorithm

11. Week beginning: 05/12/2022 (Timetabling Week 11)	Artificial Neural Networks (ANNs) ***Lesson Plan:*** [1] Presentation – Artificial Neural Networks (ANNs) *Lesson Practical:* [2] Logbook Activity 15 – Simulate a Neural Network
13. Week beginning: 12/12/2022 (Timetabling Week 12)	Module and Assignment Review
Timetabling Weeks 13-15	**Winter Break (3 weeks)**
13. Week beginning: 09/01/2023 (Timetabling Week 16)	Assignment Workshop
14. Week beginning: 16/01/2023 (Timetabling Week 17)	Assignment Workshop
15. Week beginning: 23/01/2023 (Timetabling Week 18)	Jupyter Logbook presentation tutorials
15. Week beginning: 30/01/2023 (Timetabling Week 19)	**Assignment submission – Thursday 2 February**

Reading List

Link to Reading list in Keylinks:

https://bucks-new.keylinks.org/#/list/1894

Module Text

- Lee, K.D., Hubbard, S. (2015). Data Structures and Algorithms in Python. Springer.
- Weiss, R. (2014). 4th Ed. Data Structures and Algorithms in C++. Pearson.
- Cormen, T.H. Leiserson, C.E. Rivest, R.L., Clifford, S. (2022). 4th ed. Introduction to Algorithms. MIT Press.
- Gamma E, Helm R, Johnson R and Vlissides J (1995). Design Patterns: Elements of Reusable Object-Oriented Software. Addison-Wesley. (***NOTE: This is the key academic and authoritative texts on DPs***)

Other useful sources

- Downey AB (2012) Think Python: How to Think Like a Computer Scientist, O'Reilly. (***NOTE: …. or free at http://www.greenteapress.com/thinkpython/thinkpython.pdf***).
- Phillips D (2015) Python 3 Object-Oriented Programming. Packt Publishing. (***NOTE: Good OO Python with comprehensive cover of design patterns***)
- Shalloway A and Trott JR (2004) Design Patterns Explained: A New Perspective on Object-Oriented Design (Software Patterns). Addison Wesley. (***NOTE: An accessible interpretation of applied DPs***)

- Anon (2015) PyQGIS Developer Cookbook. Available at http://docs.qgis.org/2.6/pdf/en/.
- Burris E (2012) Programming in the Large with Design Patterns. Pretty Print Press.
- Freeman, E., Robson, E., Bates, B., & Sierra, K. (2004). Head-first design patterns. " O'Reilly Media, Inc.".
- Ryoo (2015) Design Patterns with Python. Lynda.com.
- Stone B (2014) Python GUI Development with Tkinter. Lynda.com.
- Weinman W (2010) Python 3 Essential Training. Lynda.com
- Zlobin, G. (2013). Learning Python Design Patterns. Packt Publishing Ltd

- Dataquest (2019) Jupyter Notebook for Beginners: A Tutorial. https://www.dataquest.io/blog/jupyter-notebook-tutorial/
- Inge Halilovic (2017) Markdown for Jupyter notebooks cheatsheet. https://medium.com/ibm-data-science-experience
- Jupyter Notebook Tutorial - https://www.javatpoint.com/jupyter-notebook /markdown-for-jupyter-notebooks-cheatsheet-386c05aeebed
- Karlijn Willems (2017) Jupyter Notebook Cheat Sheet. https://www.datacamp.com/community/blog/jupyter-notebook-cheat-sheet
- https://www.learnpython.org/
- Python - https://www.python.org/tutorial
- Python tutorial – the 'official' one - https://docs.python.org/3/tutorial/
- Python tutorial – free and mobile - https://www.sololearn.com/
- W3Schools - Python tutorial at https://www.w3schools.com/python/