



FALMOUTH
UNIVERSITY

Lecture 1: Module Introduction

COMP704: Machine Learning
MSc Artificial Intelligence for Games

- Today's session:
 - Introduction to the module
 - Introduction to the assignments

- Introduction to the module

- Introduction to the module
 - ‘Machine Learning’ is an inaccurate title for the module
 - When we planned it we had two modules:
 - Symbolic AI
 - Non-symbolic AI
 - This reflects what AI is. Marketing made us change them to:
 - ‘Classical AI’ & ‘Machine Learning’ for sales reasons

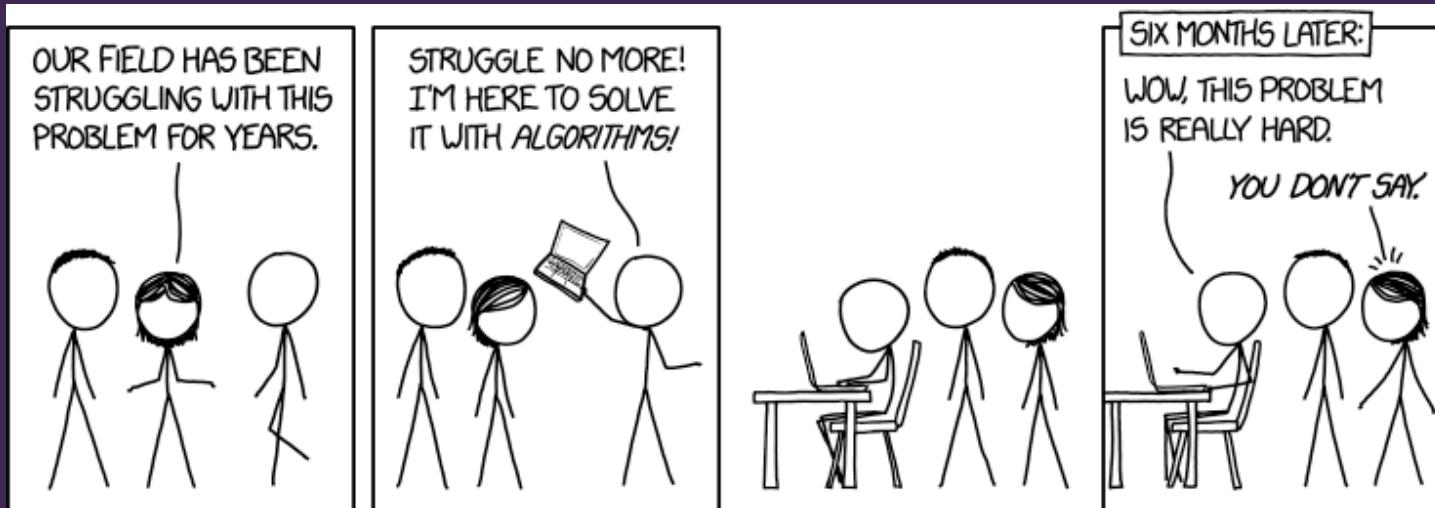
- Introduction to the module
 - ‘Machine Learning’ is an inaccurate title for the module
 - Symbolic AI
 - Describes a programming-centric approach to AI
 - Where you look to analyse and deconstruct problems into solutions that are programs
 - Non-symbolic AI
 - Describes a data-centric approach to AI
 - » Hence data science, but data science isn’t ‘all’ of non-symbolic AI
 - Where you write software to look for patterns in data

- Introduction to the module
 - ‘Machine Learning’ is an inaccurate title for the module



- Symbolic vs. non-symbolic AI has lead to some interesting issues

- Introduction to the module
 - ‘Machine Learning’ is an inaccurate title for the module



- Symbolic AI can't really solve a lot of issues
 - Tacit / heuristic knowledge & expert systems
 - Describe how you:
 - » Work out if you know someone from their face
 - » Where to stand to catch a ball
 - » How to drive a car / bike

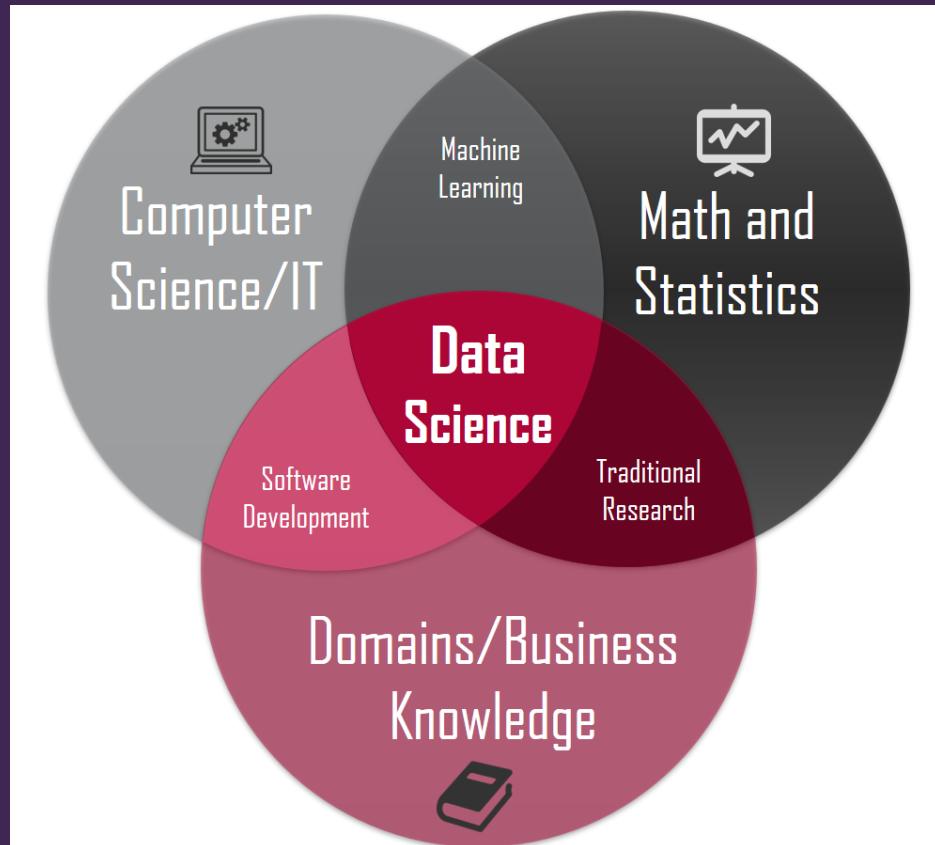
- Introduction to the module

Week 1	Week 2	Week 3	Week 4	Week 5	Reading Week
	Data Science				
Introduction	Foundations of Data Science	Intro to ML	ML: Regression	ML: Classification	
	Workshop	Workshop	Workshop	Workshop	
	Paper Club		Paper Club		Paper Club
Week 7	Week 8	Week 9	Week 10	Week 11	Week 12
Genetic Algorithms		PCG		Genetic Programming	
Genetic Algorithms 1	Genetic Algorithms 2	Procedural Content Generation 1	Procedural Content Generation 2	Genetic Programming 1	Genetic Programming 2
Workshop	Workshop	Workshop	Workshop	Workshop	Workshop
	Paper Club		Paper Club	Peer Review	Individual Review

Week 13

VIVA OF DOOM

- Introduction to the module
 - Data Science (& machine learning)



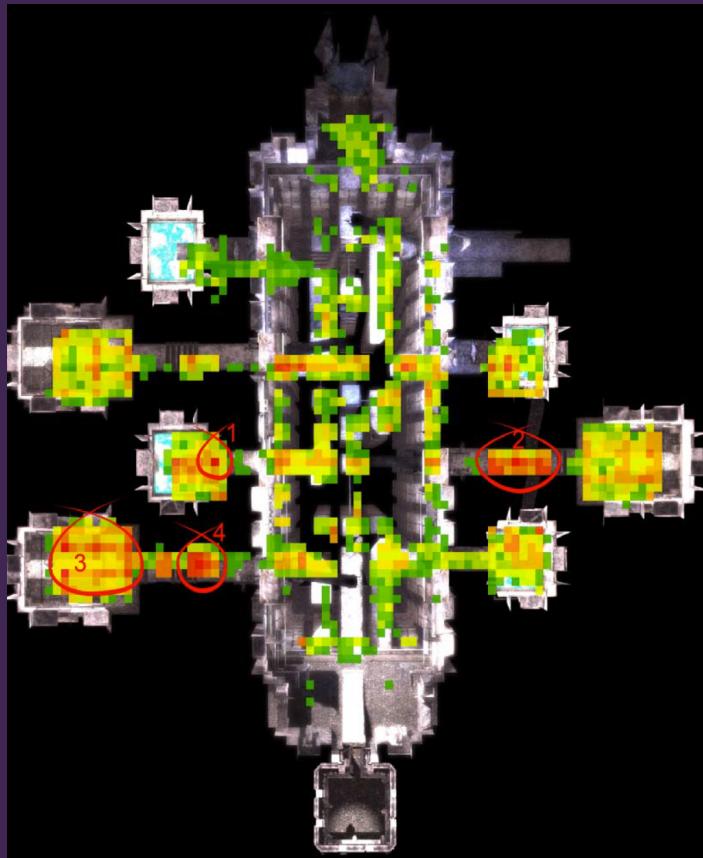
Russel & Norvig:

18. learning from examples
19. Knowledge in learning
20. Learning probabilistic models
21. Reinforcement learning.

- Introduction to the module
 - Data Science (& machine learning)
 - Effectively, using computer science and ‘maths’ to address domain / business problems through the use of data
 - ML describes a suite of techniques between CS & maths to analyse data
 - Therefore, it’s clearly data-driven / data-centric
 - Analytics / metrics (collecting & analysing data)
 - Relies on
 - Big data & big processing (not in all cases)
 - This is why it’s a big thing now

- Introduction to the module
 - Data Science (& machine learning)
 - A lot of games orgs will use DS for marketing insights (cf. free-to-play, GaaS, casual games)
 - Analytics:
 - » Collect user data from players during game play
 - » Upload to a server / AWS
 - » Grind through data looking for ‘business insights’
 - Where do we lose players?
 - How can we get players to spend more
 - What in-game items can we create that players will engage with / buy
 - How can we make predictions about players & personalise their experiences?

- Introduction to the module
 - Data Science (& machine learning)
 - <https://medium.com/@t2thompson/tombraider-60682f8fe36f>



- Where are players dying?
 - Is there an issues with level design?
 - Heatmaps (from analytic data) can show this

Frequently bought together

Total price: £115.88

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This item: Crucial MX500 CT1000MX500SSD1 (Z) 1 TB (3D NAND, SATA, 2.5 inch, Internal SSD) £101.90

Inateck SSD Mounting Bracket 2.5 to 3.5 £7.99

USB 3.0 to SATA Adapter Cable for 2.5" SSD/HDD Drives - SATA to USB 3.0 External Converter and Cable... £5.99

Customers who viewed this item also viewed

Samsung 860 QVO 1 TB SATA 2.5" Internal SSD

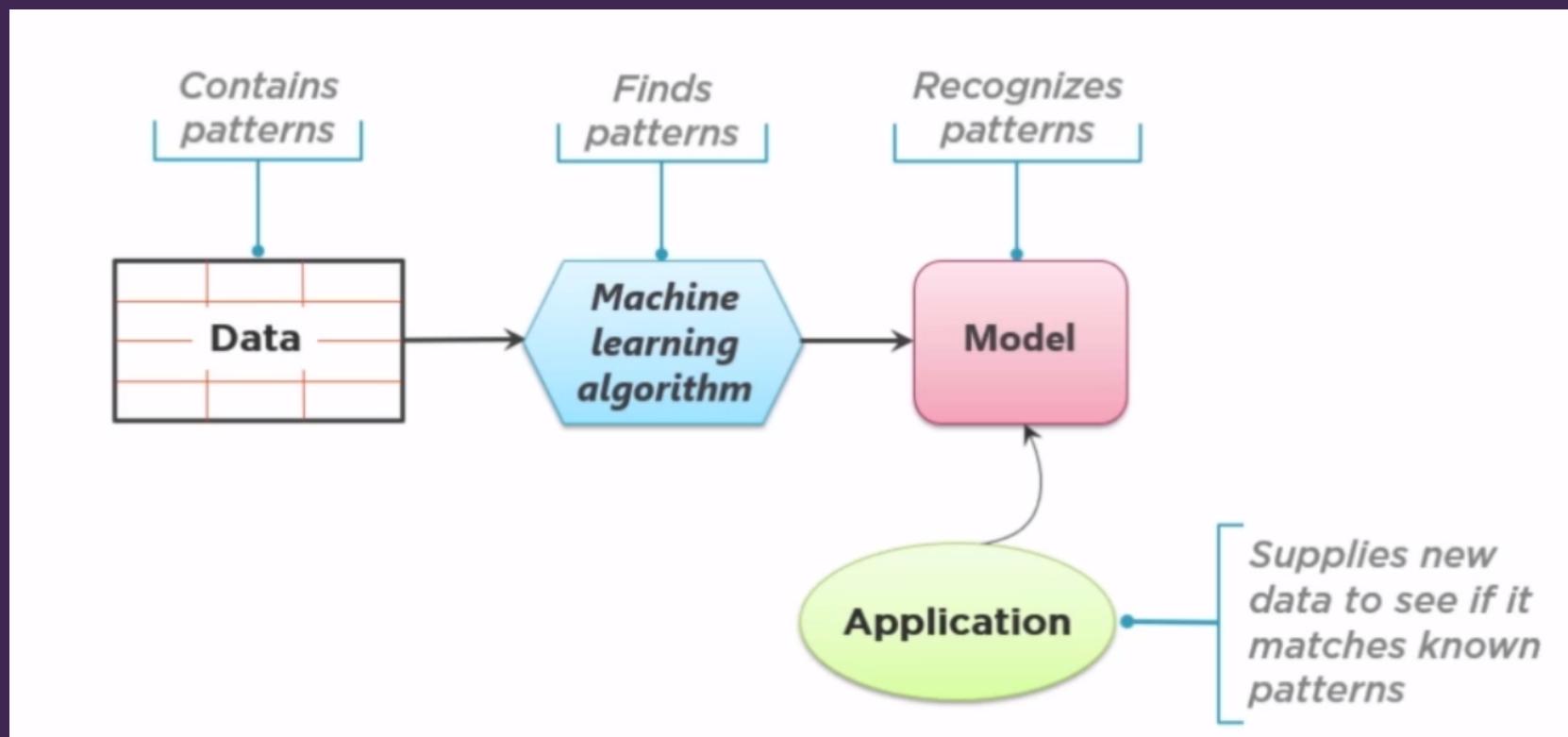
SanDisk SSD PLUS 1 TB Sata II 2.5 Inch Internal SSD Up to 535 MB/s

Samsung 860 EVO 1 TB SATA 2.5" Internal SSD

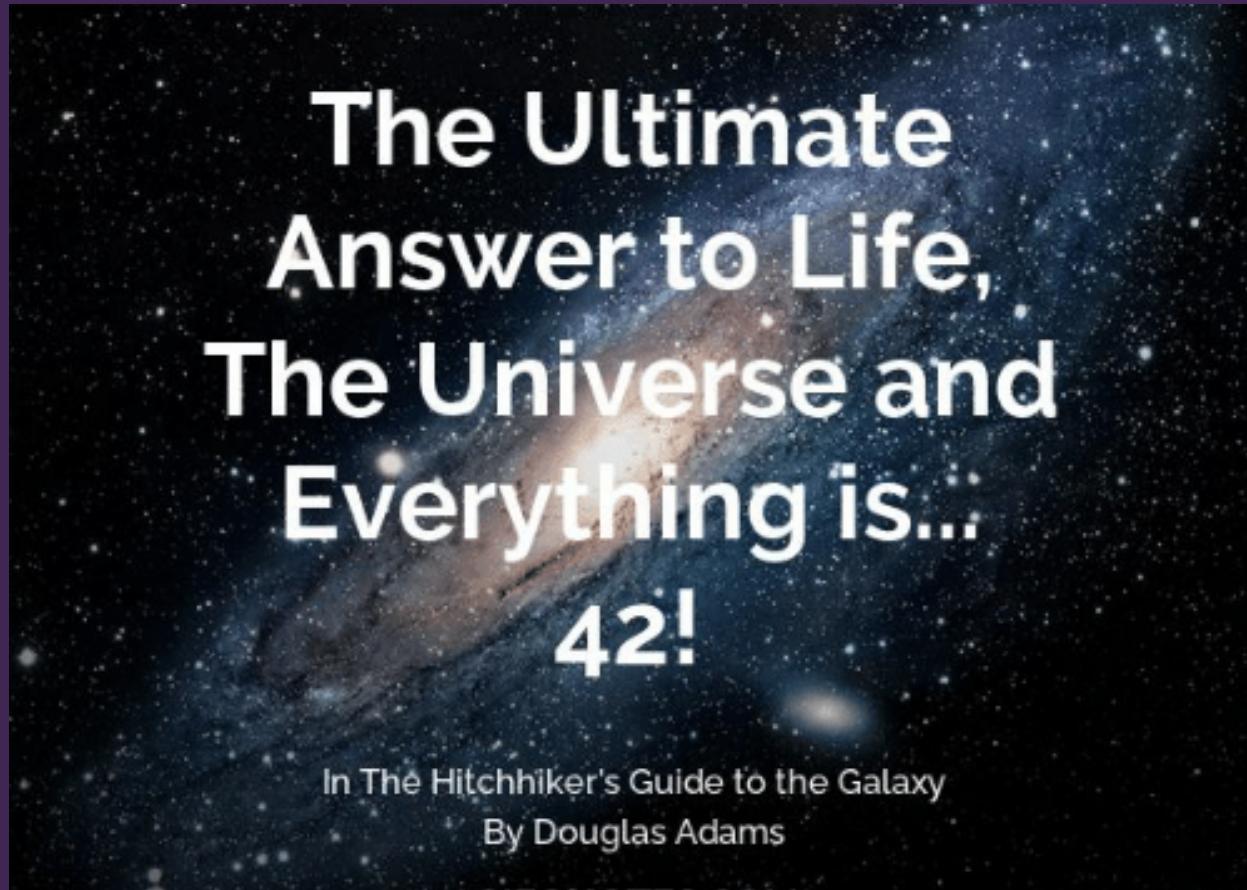
WD Blue 3D NAND Internal SSD 2.5 Inch SATA - 1 TB

Crucial BX500 CT1000BX500SSD1 1 TB Internal SSD (3D NAND, SATA, 2.5 inch)

- Introduction to the module
 - Data Science (& machine learning)
 - As the name suggests, DS is all about data



- Introduction to the module
 - Data Science (& machine learning)
 - Important to remember that ML is just about statistics, we get to define what is good or bad (DS)

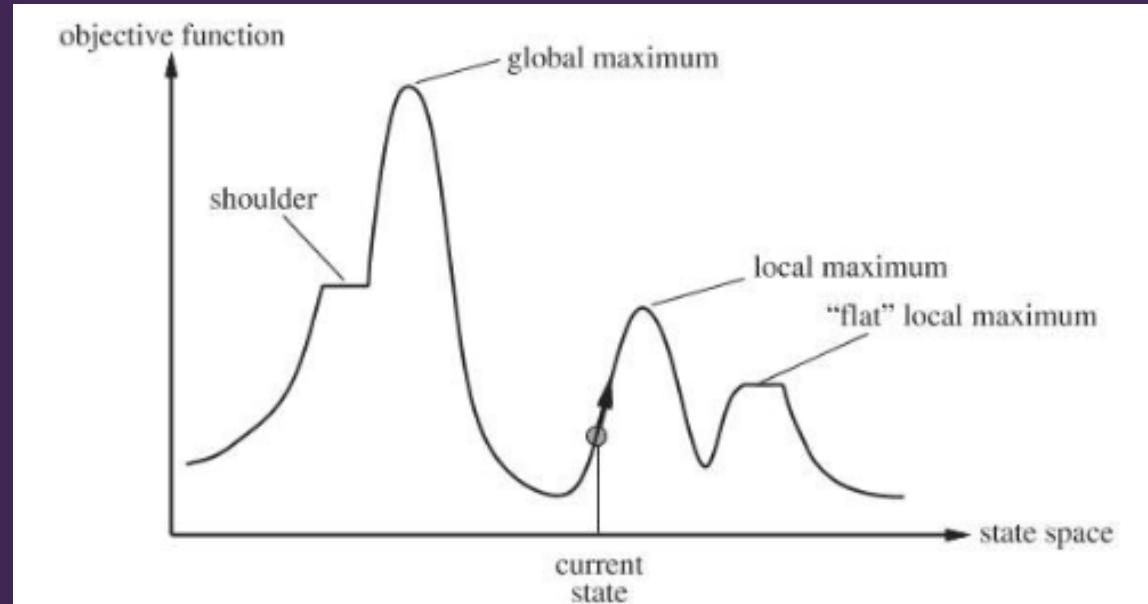


- Introduction to the module
 - Data Science (& machine learning)
 - Important to remember that ML is just about statistics, we get to define what is good or bad (DS)



- DS & ML are not magic bullets
 - Easy to concentrate on the wrong data

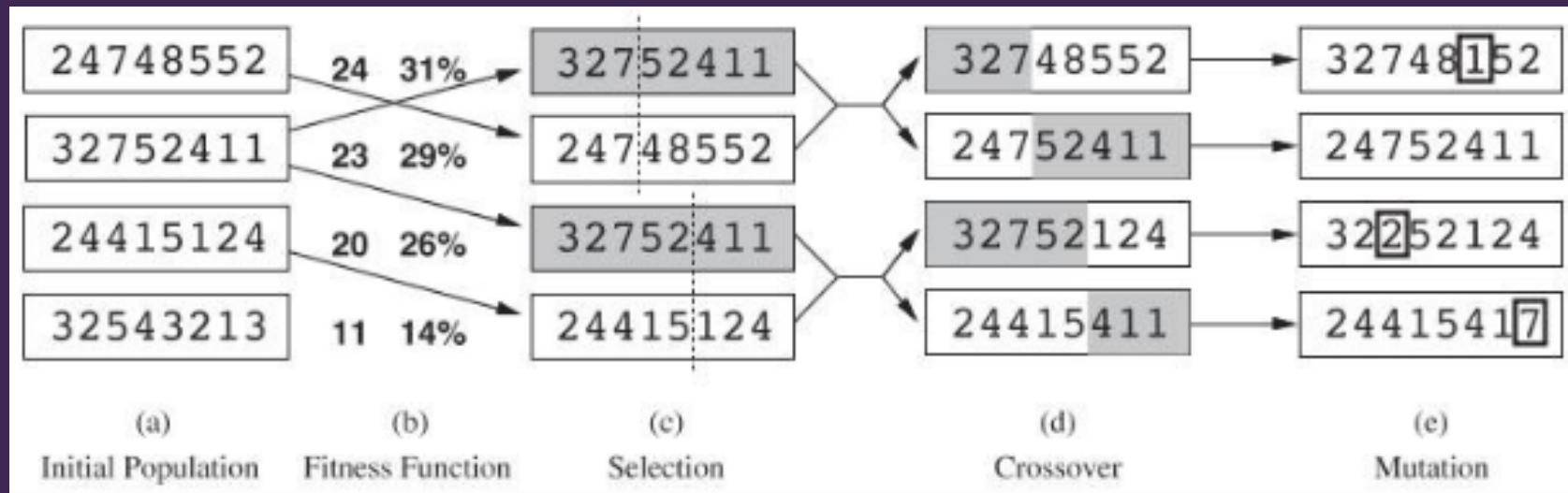
- Introduction to the module
 - Genetic Algorithms
 - Use Darwinian evolution to perform search space analysis



Russel & Norvig: 4, Beyond classical search

<https://www.dawsonera.com/abstract/9781292153971>

- Introduction to the module
 - Genetic Algorithms
 - Q: How do we find global maxima for multi-dimensional quantitative problem spaces?
 - A: Obviously, make a population of solutions and breed them based on survival of the fittest



- Introduction to the module
 - Genetic Algorithms
 - Typically:
 - Store solution attributes as genes in a binary array to simulate a genome
 - Use the fitness function to evaluate their quality, mate population based on that
 - Mutate some of the binary bits
 - Repeat until solution found (best possible or ‘good enough’)

- Introduction to the module
 - Genetic Algorithms
 - Quantitative assessment is usually key
 - Input to a complex simulation
 - Often used to optimise ML & PCG solutions
 - Can use ‘artist as gardener’ qualitative approach where users can pick or rank population
 - Particularly useful for qualitative (aesthetic) problems

- Introduction to the module
 - Procedural Content Generation
 - PCG has a bad name in games as it's associated with shovel-content
 - Endless levels for Roguelikes & indie games
 - No Mans' Sky bazillion planets of tedium
 - However, using code to create content can be extremely useful
 - Asset creation without the need to go to triangle modelling (Probuilder)
 - Automatic generation of 'filler' content for games

- Introduction to the module
 - Procedural Content Generation (Grammar models)

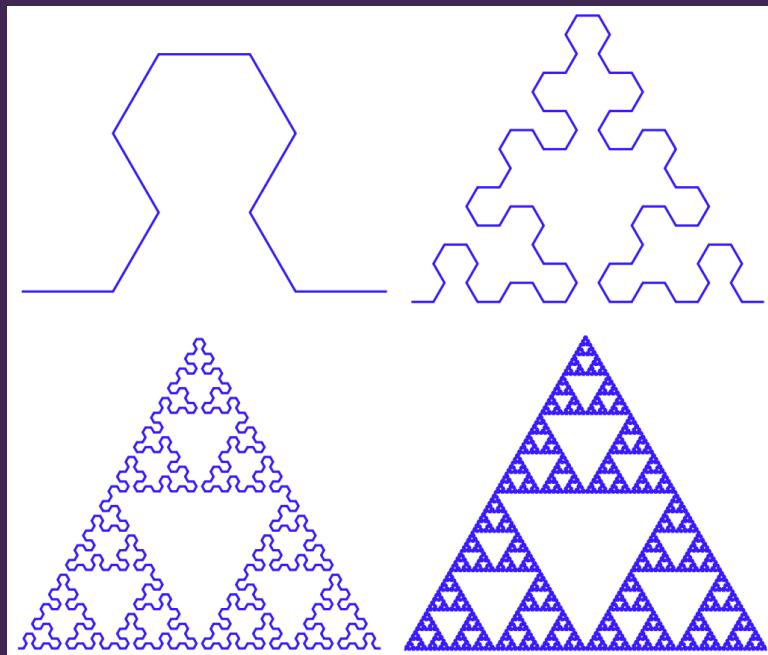


<https://www.youtube.com/watch?v=5jBi4KHvnXU>

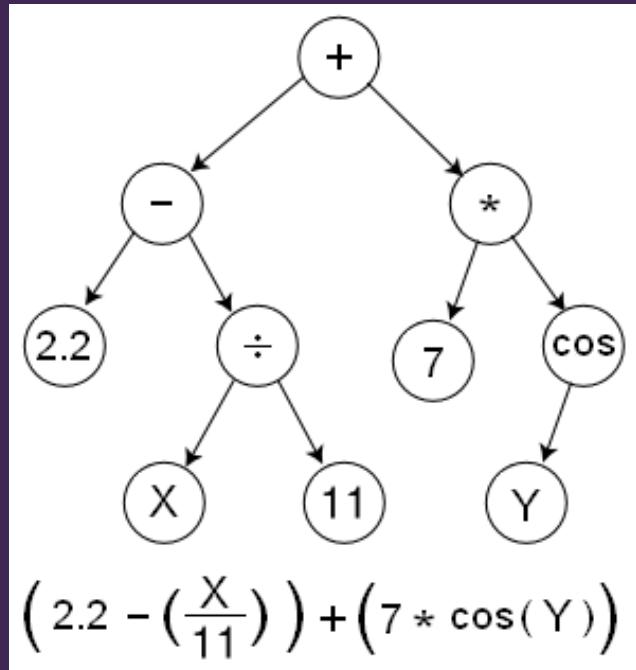
- Introduction to the module
 - Procedural Content Generation
 - Building & city generation through grammars
 - <http://peterwonka.net/>
 - <http://vterrain.org/Culture/BldCity/Proc/>
 - Challenge with this approach is that they are procedural rather than data-driven



- Introduction to the module
 - Procedural Content Generation
 - Lindenmayer system (L-system)
 - Mimic nature to create flora through fractals



- Introduction to the module
 - Genetic Programming
 - John will cover this as the core of his PhD research
 - Effectively, using genetic approaches (like the GA approach) to create solutions to defined problems
 - Uses programming constructs (BNF, syntax trees etc)



<http://www.genetic-programming.org/>

- Assignments

- Assignments
 - Application of Machine Learning (70%)
 - Development Journal (30%)

- Assignments
 - Application of Machine Learning (70%)

Introduction

For this assignment, you will undertake a research project into Machine Learning (ML) for creating video game AI. This will allow you to experiment with the ML frameworks that we will explore in the lecture and workshop sessions to create a small game that uses ML, rather than symbolic AI, to control non-player behaviour.

The choice of game you look to develop is up to you, but it is recommended that you look to minimise the scope of the game to something that you can experiment with in the time available (12 weeks). You will need to look for a game that has fairly limited AI behaviours and scope.

This project seeks to answer two key ML questions for game baddie AI:

Can ML successfully be used to model baddies in a game?

Can ML baddies be ‘tuned’ to respond to player behaviours?

The goal of this assignment is to create an artefact that will demonstrate machine learning based AI within a small video game

- Assignments
 - Development Journal (30%)
 - A week-by-week academic journal of your experiences in creating ML-based AI for a game.
 - Think of it as a collection of reports detailing your development issues and your attempts to find solutions.
 - Problems: description & scope
 - Solutions: synthesis & quality
 - Writing and diagramming
 - Further enquiries
 - Solution reflections

- Assignments
 - We will discuss ideas next week
 - Ideally:
 - We'll use Python for ML
 - scikit learn
 - Look to work in Python / PyGame to build your game
 - Write symbolic AI in python
 - Use it to generate training data
 - Build a solution using ML
 - Evaluate

- Assignments
 - We will discuss ideas next week
 - Ideally:
 - Game
 - Look for something small & simple that you can write in a few hours
 - » Games that you can consider as ‘turn based’ to make it simple to iterate between player and AI, and AI actions
 - Player does nothing is a valid action ;)
 - » Pong, pacman, asteroids, Space invaders, card games, board games, Tetris etc
 - » Don’t spend forever making a game to then realise it’s not good for training ;)
 - Getting training data will be key
 - » What will it look like, how will you process it and how do the ML results feed back into the game
 - Blending results, how to switch between good, bad and indifferent AI play styles



- Assignments
 - We will look at building ML-solutions over the next couple of weeks, in particular pontoon
 - Don't forget, the processes you go through to choose a game and develop it are core parts of your development journal



- Questions