Engaging KS3/4 students with AI and Python Code

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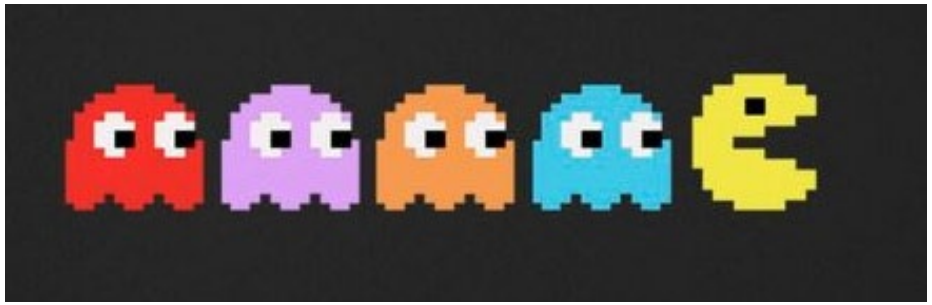
This presentation is available today at
www.weddell.co.uk

My first AI experiences



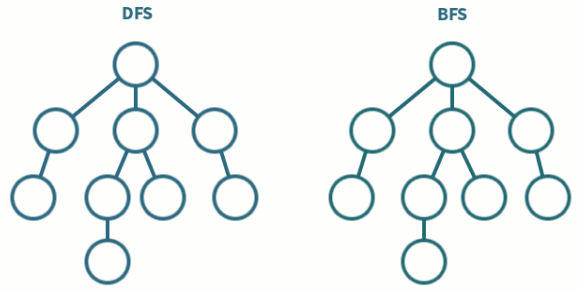
Early Teaching AI experiences

Gather, Train, Use…

Machine Learning for Kids

Teachable Machine

AQA 4.3 - Graph Traversal and Optimisation Algorithms



Inspiration – CAS Conference 2024

```
from nltk import bigrams, trigrams
from collections import Counter, defaultdict

# Create a placeholder for model
model = defaultdict(lambda: defaultdict(lambda: 0))

# Count frequency of co-occurance
for sentence in text:
    for w1, w2, w3 in trigrams(sentence, pad_right=True, pad_left=True):
        model[(w1, w2)][w3] += 1


# Let's transform the counts to probabilities
for w1_w2 in model:
    total_count = float(sum(model[w1_w2].values()))
    for w3 in model[w1_w2]:
        model[w1_w2][w3] /= total_count
```

Miles Berry - 3 July 2024 AI and Computing Education, workshop for Computing At School conference, ADA College.

Why with KS3/4?

Most AI experiences remove the coded complexity of “reasoning” from students.

Algorithms for GCSE are fairly basic and seem far removed from equipping …

“… pupils to use computational thinking and creativity to understand and change the world.”

UK Teacher Standards encourage us to …

“Set high expectations which inspire, motivate and challenge pupils”

Your setting…

My Three Examples

- Algorithmic AI - Rule-based Systems

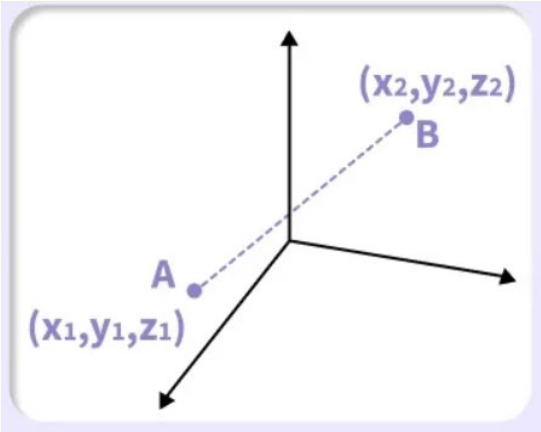
- Data Driven AI – Human in the Loop (HITL)

- Data Driven AI - Automated Playtesting

Colour Matching – Near Neighbour - Algorithmic AI

Distance AB = $\sqrt{(x1 - x2)^2 + (y1 - y2)^2 + (z1 - z2)^2}$

The difference between two colours could be calculated (represented) using the change in R, G and B values.



https://trinket.io/pygame/cace981cbd91

The Code

A ‘minimum’ in list function
combined with 3D Pythagoras calculation

```
def checkColourProximity(red,green,blue):
  #Initial values
  colourProximity = 1000
  closestColourPosition = 0

  #Check against all 16 colours
  for index in range(16):

    # Calculate proximity
    thisProx = ((red-colourPalette[index][0])**2 + (green-colourPalette[index][1])**2 + (blue-colourPalette[index][2])**2) **0.5

    #Is this closer in colour
    if thisProx < colourProximity:
      colourProximity = thisProx
      closestColourPosition = index

  return closestColourPosition
```

Check each colour in the list.
Work out proximity of this colour.
If the proximity is less than current colourProximity…
Set new colourProximity and closestColourPosition

https://trinket.io/pygame/cace981cbd91

Tasks

Ideas…

- As they are lists in Python, you can add a name as a string to each colour list.

  Print the name of the nearest colour.

- Find the nearest two colours, so the user can choose the closest.

- Imagine the numbers represent other values on a scale, such as musical tastes, personality traits, etc.

  How could you adapt the concept? Instead of 3 values, perhaps 4?

Think …

- Are there limitations with this algorithm of near neighbour algorithm?
- When would you use it, and when not?
- Could this develop to K-Near Neighbour and K –Means Clustering ?

https://trinket.io/pygame/cace981cbd91

Multiplication Tables – HITL - Machine Learning AI

The idea that a computer can learn and become more accurate as millions of users attempt to answer questions.


```
What is 12 x 9?: 108

The most common answer so far is 108
You gave the answer most frequently given to this question



2 user(s) have answered this question.
The answer(s) they gave: 108, 108,

The most common answer was given 100.0 % of the time
Confidence in this answer is low,
as few people have answered this question
```

Instead of correct answers, users might receive a reward or gain feedback about their answer...

https://trinket.io/python3/775333af4d6d

The Code

```
## Multiplication Quiz

for i in range (20):
  x = randrange(1, n+1)
  y = randrange(1, n+1)

  question = "What is " + str(x) + " x " + str(y) + ("?:")
  guess = int(input(question))


  ## Add answer given to data
  data[x-1][y-1].append(guess)

  ## Save data to file

  save_data_to_file(data)

  ## Save data to file

  giveFeedback(data, guess, x, y)
```

```
What is 12 x 9?: 108
```

```
The most common answer so far is 108
You gave the answer most frequently given to this question



2 user(s) have answered this question.
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```

Ask Question
Get answer from User
Add to data and save
Feedback about answers to same question

https://trinket.io/python3/775333af4d6d

Tasks

Ideas...

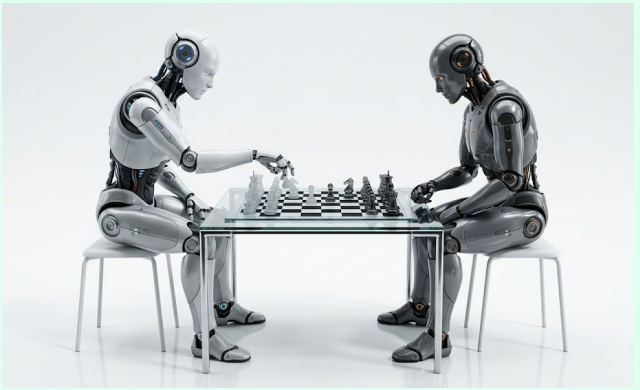
- The data is currently mostly correct.
  Investigate what happens when you get an answer wrong. How does the data change?
- Change the feedback.
- What other questions could you ask people to gather data about?
  Would this work for a country / capital quiz?

Think ...

- How could you ensure that people aren't entering malicious answers?
- What sort of data does this work for? Bias?
  Is there a difference between the data that can and cannot be collected in this way?

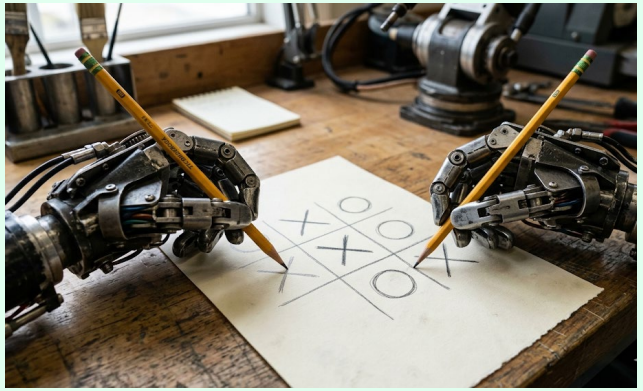
https://trinket.io/python3/775333af4d6d

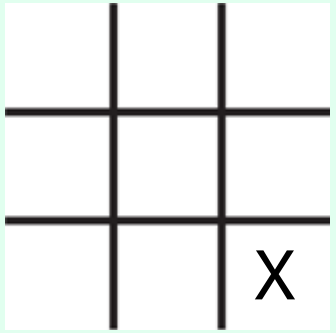
Tic Tac Toe – Computer Generated Data - Machine Learning AI

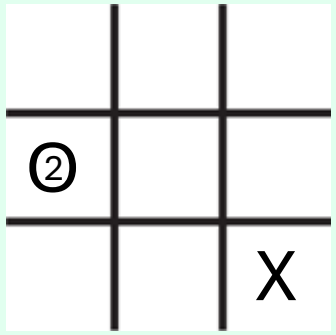


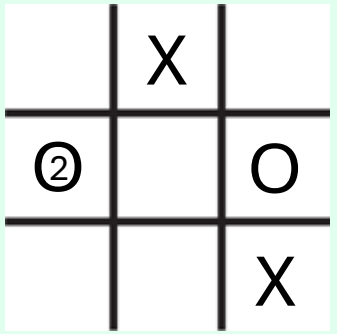
Given a set of rules as to how to play, a computer can play thousands or millions of times.

By analysing moves, can the computer predict good choices?









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Tic Tac Toe – Computer Generated Data - Machine Learning AI

```
firstCell = int(input("Enter the number (0 - 8) of the cell where X went: "))

for i in range(100000):              # Play 100,000 random games of Tic Tac Toe

  game = playTicTacToe(firstCell)

  outcome = game[1]                  # outcome is "win", "loss" or "draw"
  gameBoard = game[0]                # gameBoard is a list showing order of moves

  if outcome =="win":                 # Make a list of games won by "O"
    Win.append(gameBoard)

  if outcome =="draw":                 # Make a list of drawn games
    Draw.append(gameBoard)

  if outcome =="lose":                 # Make a list of games lost by "O"
    Loss.append(gameBoard)
```

- Ask for a starting move from your opponent
- Play thousands of games from that point
- For each game…
  - Record whether ‘O’ won, lost or drew
  - Record the order of moves made
  - Add the order of moves to an array of wins, of draws or losses
- Produce statistics of how many games won and lost for each next move.

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Tic Tac Toe – Computer Generated Data - Machine Learning AI

Ideas…

- Investigate different starting positions for X
- Produce the analysis of the “Loss” list to see bad places to go.
- Instead of just one first move, keep entering moves until number 9 is entered, to allow analysis from different positions.
- Improve the game playing engine. At present, moves are made completely randomly. If the algorithm could spot winning or losing moves, do the stats change?

Think …

- What sort of situations apart from games could this work for?
- What are the pitfalls of this approach?

https://trinket.io/library/trinkets/21ac43e94c79

Would you use these ideas with students?

How? When?

Why? Why not?

Is this useful?

What would you change?

Thank you

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