CMKL: AI for Teachers Workshop
Building AI through Hands-on Learning

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Introduction

My goal today:

- To give you a "beginners-friendly" AI system
- Basic overview of how this can be delivered to high-school students

Software

Python. Why?

- Runs everywhere, few concerns with technical aspects of compatibility, etc.

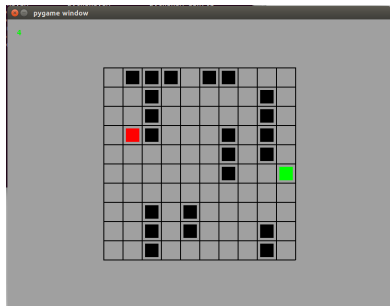- Quite popular at the moment, so if students have programming expertise, it's probably in Python

Structure

- I'll deliver an example class
- Then we'll turn this into discussion of issues and challenges
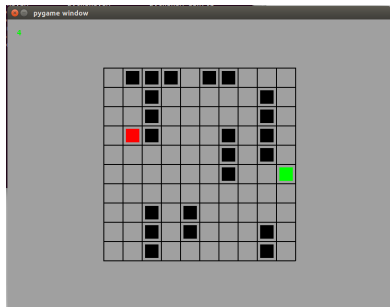
Example: Introduction

- Let's look at a game
- Figure out a way to automate it (so it plays itself)
- Then develop an AI to do the same thing

Example: Game

- Hero is the red piece
- Black blocks are walls (hero cannot cross walls)
- Green piece is the monster

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Example: Game

- Every time hero moves to a new position, gets a point
- Monster chases hero: game over if it catches hero
- Arrow keys to move hero around (not a very hard game...)

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Example: Game

See the game in action:

- python game.py (command line)
- Or whatever Python interpreter you're using

CMKL - AI

Example: Algorithm

- Not everything a computer does is AI....
- We can specify rules for the hero to follow
- In other words, we can precisely define what the hero should do

Example: Algorithm

```
def moveHero():
...
#if can move in same direction, keep doing it
#otherwise, turn right
if canMoveHero(herodirection) and noMonster(herodirection):
    moveHeroTo(herodirection)
    score = score + 1
else:
    turnHeroRight()
    if canMoveHero(herodirection) and
        noMonster(herodirection):
        moveHeroTo(herodirection)
        score = score + 1
```

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Example: Algorithm

See the algorithm in action:

- python game_algorithm.py

Example: Algorithm

This is an **algorithm**

- A precise sequence of steps to achieve a goal
- It's not a very good algorithm....
- (**homework:** come up with an algorithm that never loses.)

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Example: Algorithm

Important lesson to remember:

- Artificial Intelligence should never replace Human Intelligence
- If we know how to do it, then we should do it
- AI is useful to complement human intelligence: when we don't know how to do it

Example: Algorithm

A computer can make "smart" decisions, specified by humans

- Being able to decide does not make it intelligent
- "Asking whether a computer can think is like asking whether a submarine can swim"

Example: AI

What is "AI" then?

- Computer programs that **learn by experience**
- The program tries and improves its decisions by trial and error
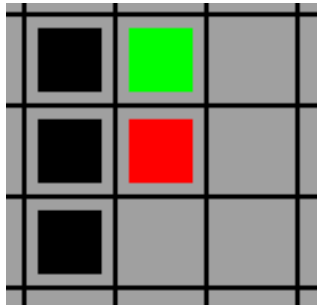
Example: AI

How does it learn?

- **That's an algorithm :)**
- Humans specify how the program learns
- Many different algorithms....

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Example: AI

Our game doesn't "need" AI (we can write an algorithm to beat it)

- But it's a good practice place to learn AI
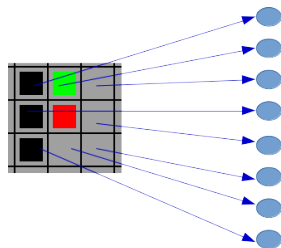- Let's implement a learning algorithm: **a neural network**

Example: AI

Let's have the hero look around itself

- See, for each square around it, whether it's vacant, a wall, or the monster
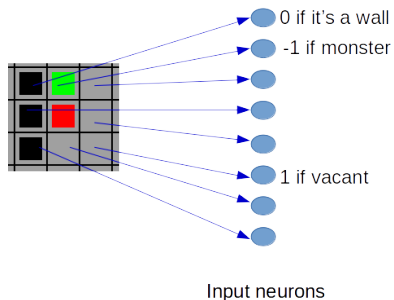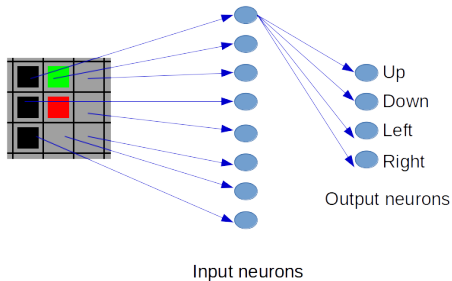
Example: AI

Input neurons

- We connect each square to a *neuron*
- (these are called input neurons, as they receive input from the world)

Example: AI

0 if it's a wall

-1 if monster

1 if vacant

Input neurons

- We give a number to each type of square

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Example: AI

Output neurons

Input neurons

- We create output neurons for UP, DOWN, LEFT, RIGHT
- And connect every input to every output

Example: AI

Input neurons
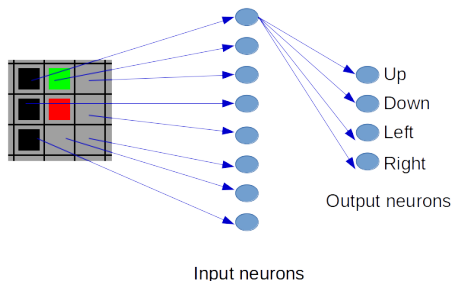
Output neurons

- Each connection has a weight (a number)
- The value of each output neuron is the sum of inputs, each multiplied by the weight
- E.g., $Output = weight_1 \times input_1 + weight_2 \times input_2 + ...$

Example: AI Learning

Hero moves towards the direction specified by the biggest output neuron

- If the weights are all random, our results will mostly be bad....

Example: AI Learning

But if we modify the weights every time we make a decision....

- Make an output neuron more likely, when the decision was good...
- Less likely, when the decision was bad....
- Maybe, just maybe, it will "learn" the right weights to do what we want

Example: AI Learning

```
def moveHero():
...
    update_input_neurons()
    update_output_neurons()
    direction = choose_biggest()
    if canMoveHero(direction):
        moveHeroTo(direction)
        update_weights_good(direction)
        score = score + 1
    else:
        update_weights_bad(direction)
    if Dead():
        update_weights_bad(direction)
```

Example: AI Learning

See the AI in action:

- python game_AI.py

Example: AI Learning

Important lesson to remember:

- AIs tend to do things their creators did not expect
- Thus, the importance of ethical, explainable and responsible AI

Example: AI Learning

This is the simplest neural network ever, and the simplest training algorithm ever. **Your homework**:

- Come up with a better training algorithm (google "back propagation")
- Implement a better neural network (google "neural network hidden layers")
- Implement different types of AI! ("Genetic Algorithms" are a really good start)

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Reflection

That concludes the example lesson

- Important: I've never taught at the high-school level
- This is available to you, to modify as you see fit
- And we're here to help

Reflection

- Is this useful to you?
- What else would be useful?
- Challenges?

Let's work it out.

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