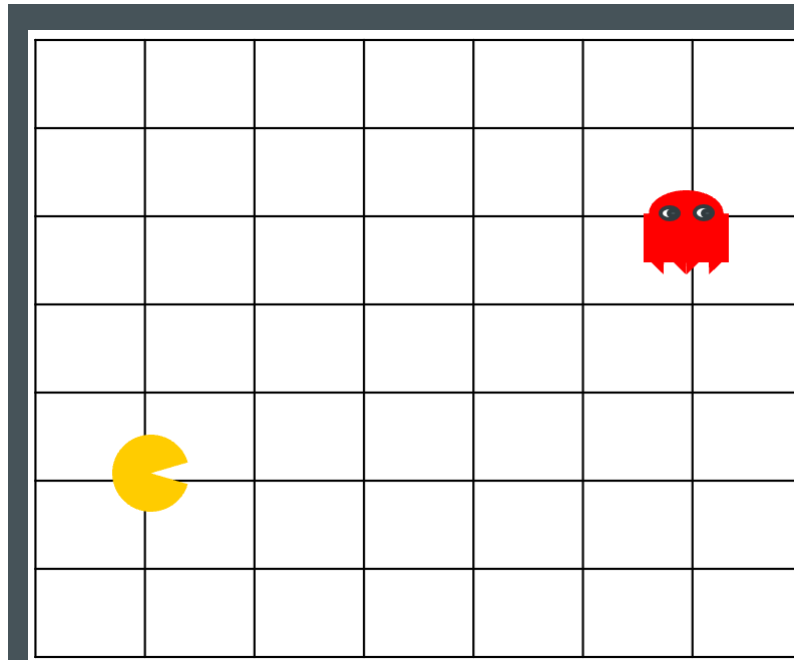
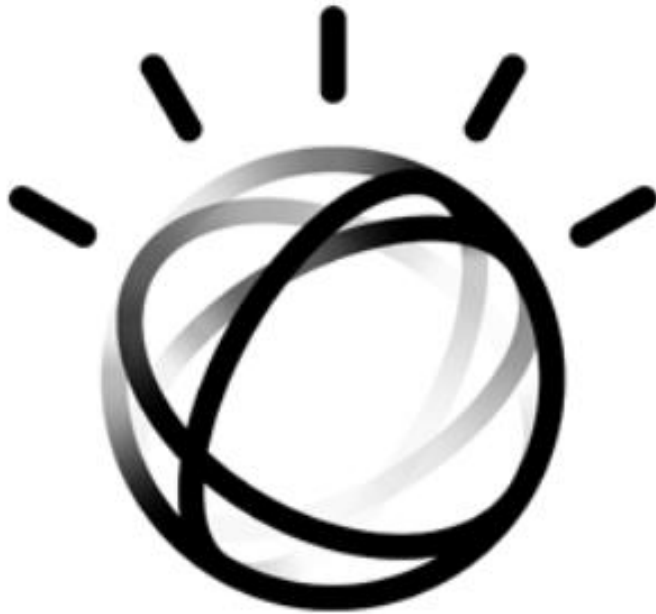


TRAIN YOUR COMPUTER WITH MACHINE LEARNING

CREATE A PAC-MAN GAME

AN IBM VOLUNTEERS ACTIVITY



DEE

@STEMDEEP

DEEPSTEM.WORDPRESS.COM

JAN 30 2020

MARSHALL MIDDLE SCHOOL

LET'S GET TO
KNOW EACH
OTHER!

Your
Name



Your
Grade




Coolest
Technology



QUICK SURVEY


Programming

- Who has attended a previous machine learning session?
 - What computer languages have you coded?
- 



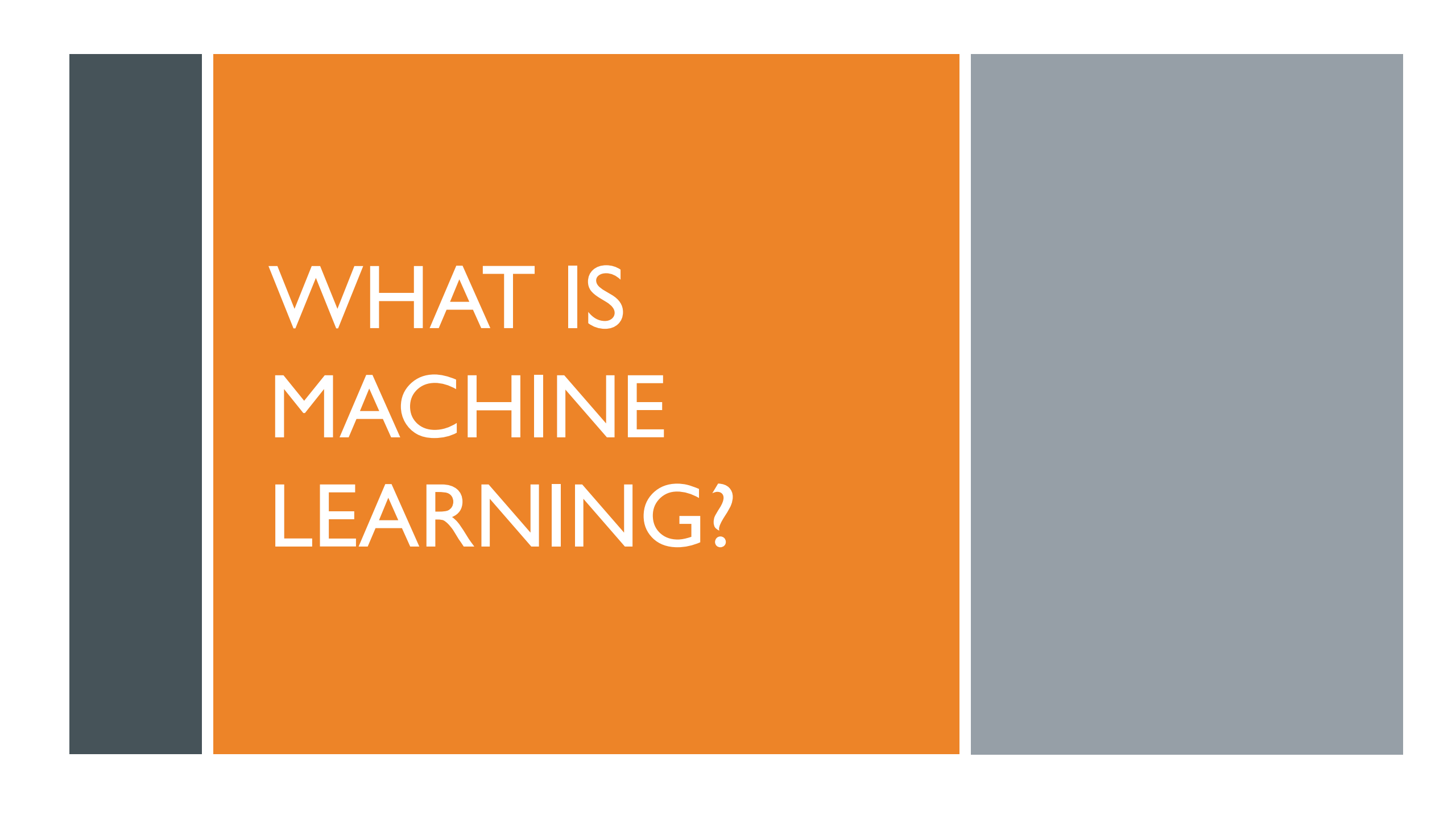
QUICK SURVEY

Scratch

- Who has used SCRATCH before?
 - What did you build?
- 

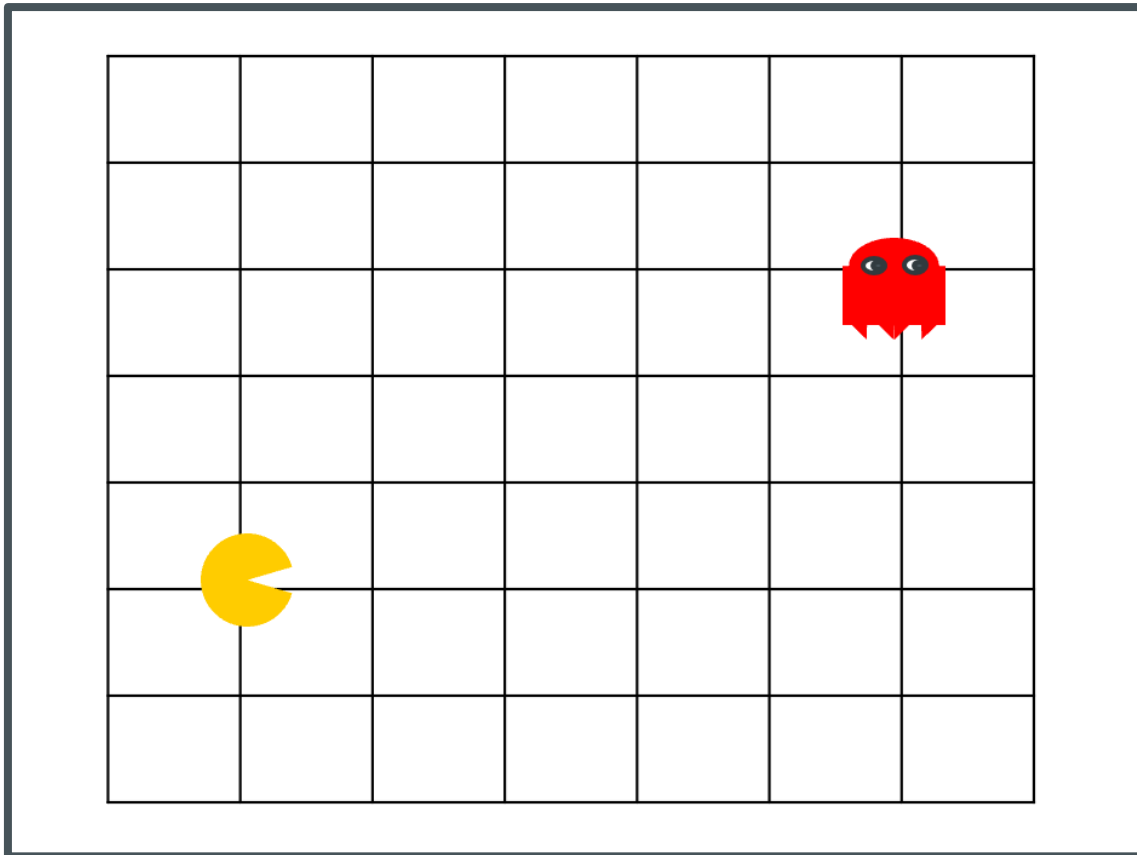


WHAT IS ARTIFICIAL INTELLIGENCE?



WHAT IS MACHINE LEARNING?

PLAN FOR TODAY



- Programming vs. Machine Learning
- Hands-on activity: Create a Pac-Man game in SCRATCH and train a machine learning model to play the game. You won't give instructions to play but will show examples of how you play the game.

PROGRAMMING

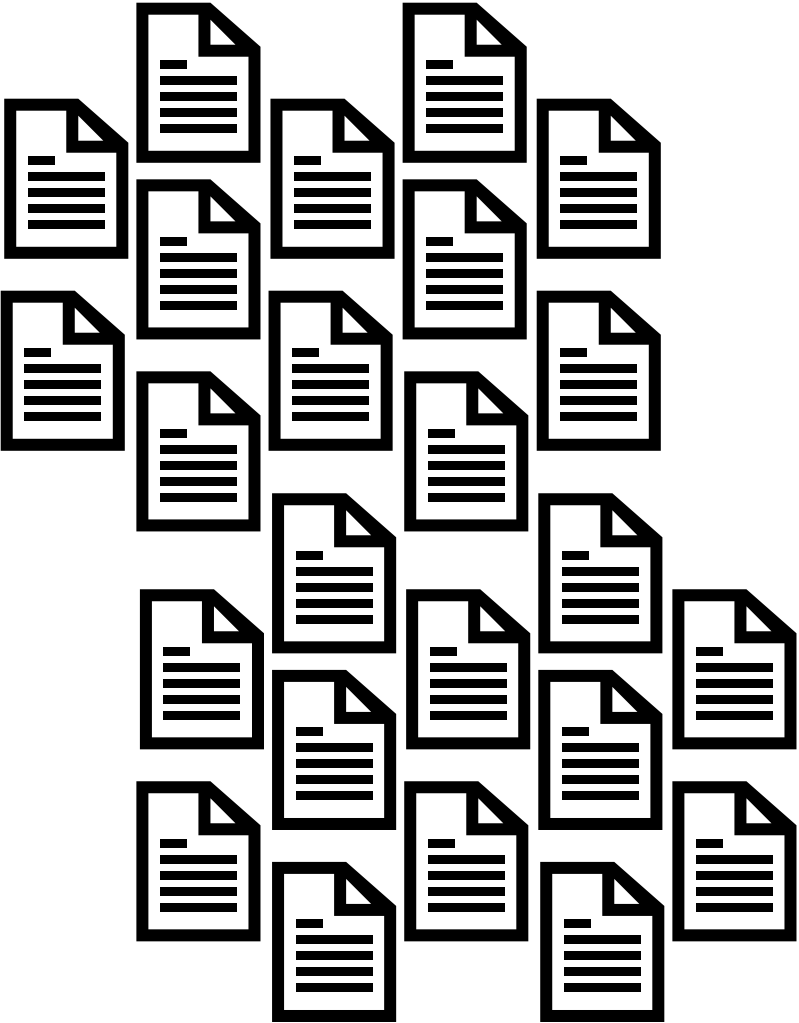
BREAKING
DOWN A
TASK INTO A
SERIES OF
STEPS THAT
CAN BE
FOLLOWED

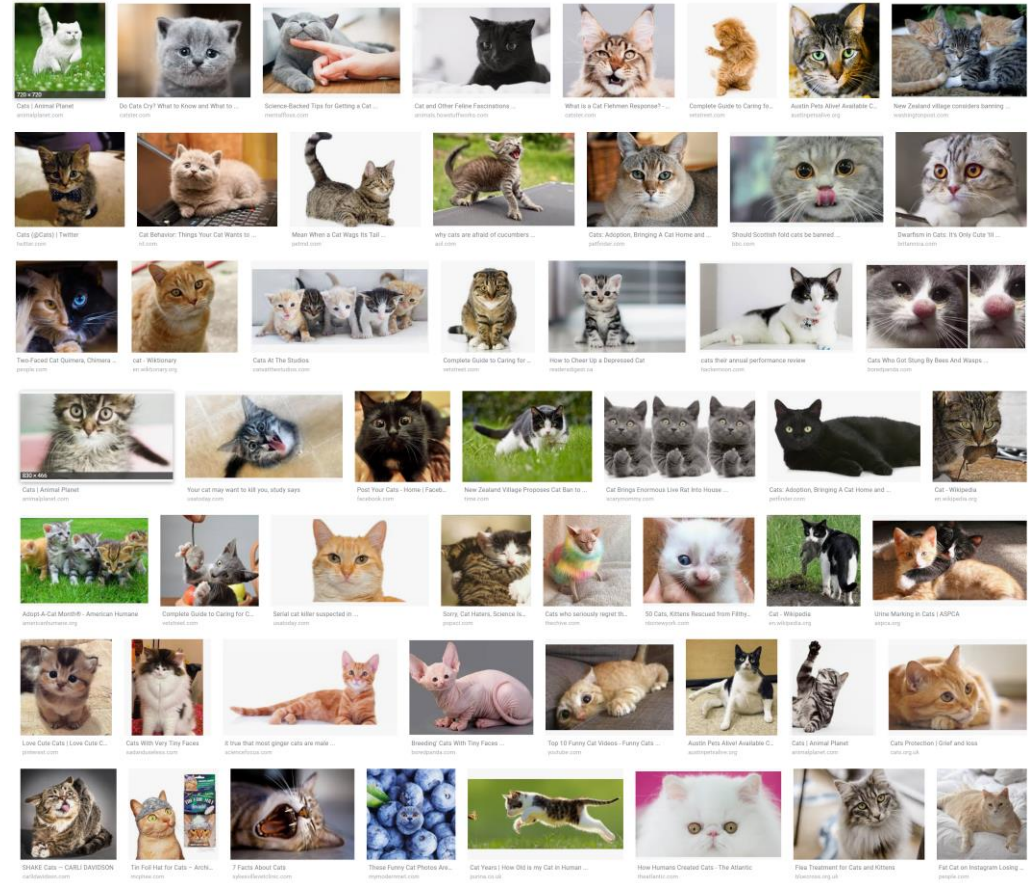

```
when clicked
go to x: 0 y: 90
delete all of Players
delete all of Player ID
forever
  if screen = title then
    show
  else
    hide
```

```
when clicked
set frame to 0
forever
  point in direction 90 + sin of frame * 20
  change frame by 15
```

MACHINE LEARNING

LEARNING
HOW TO
PERFORM A
TASK FROM A
COLLECTION
OF EXAMPLES





Images from Google Search for "cats"



Watson Assistant

IBM

Watson Assistant lets you build conversational interfaces into any application, device, or channel.

AI



Watson Studio

IBM

Embed AI and machine learning into your business. Create custom models using your own data.

AI



Compare and Comply

IBM

Process governing documents to convert, identify, classify, and compare important elements

AI



Discovery

IBM

Add a cognitive search and content analytics engine to applications.

AI



Knowledge Catalog

IBM

Discover, catalog, and securely share enterprise data.

AI



Knowledge Studio

IBM

Teach Watson the language of your domain.

AI



Language Translator

IBM

Translate text, documents, and websites from one language to another. Create industry or region-specific translations via the service's ...

AI



Machine Learning

IBM

IBM Watson Machine Learning - make smarter decisions, solve tough problems, and improve user outcomes.

AI



Natural Language Classifier

IBM

Natural Language Classifier uses advanced natural language processing and machine learning techniques to create custom ...

AI



Natural Language Understanding

IBM

Analyze text to extract meta-data from content such as concepts, entities, emotion, relations, sentiment and more.

AI



Personality Insights

IBM

The Watson Personality Insights derives insights from transactional and social media data to identify psychological traits.

AI



Speech to Text

IBM

Low-latency, streaming transcription

AI



Text to Speech

IBM

Synthesizes natural-sounding speech from text.

AI



Tone Analyzer

IBM

Tone Analyzer uses linguistic analysis to detect three types of tones from communications: emotion, social, and language. This insight can...

AI



Visual Recognition

IBM

Find meaning in visual content! Analyze images for scenes, objects, and other content. Choose a default model off the shelf, or create your own...

AI




Watson OpenScale

IBM

IBM Watson® OpenScale™ tracks and measures outcomes from AI throughout it's lifecycle, and adapts and governs AI in changing business ...

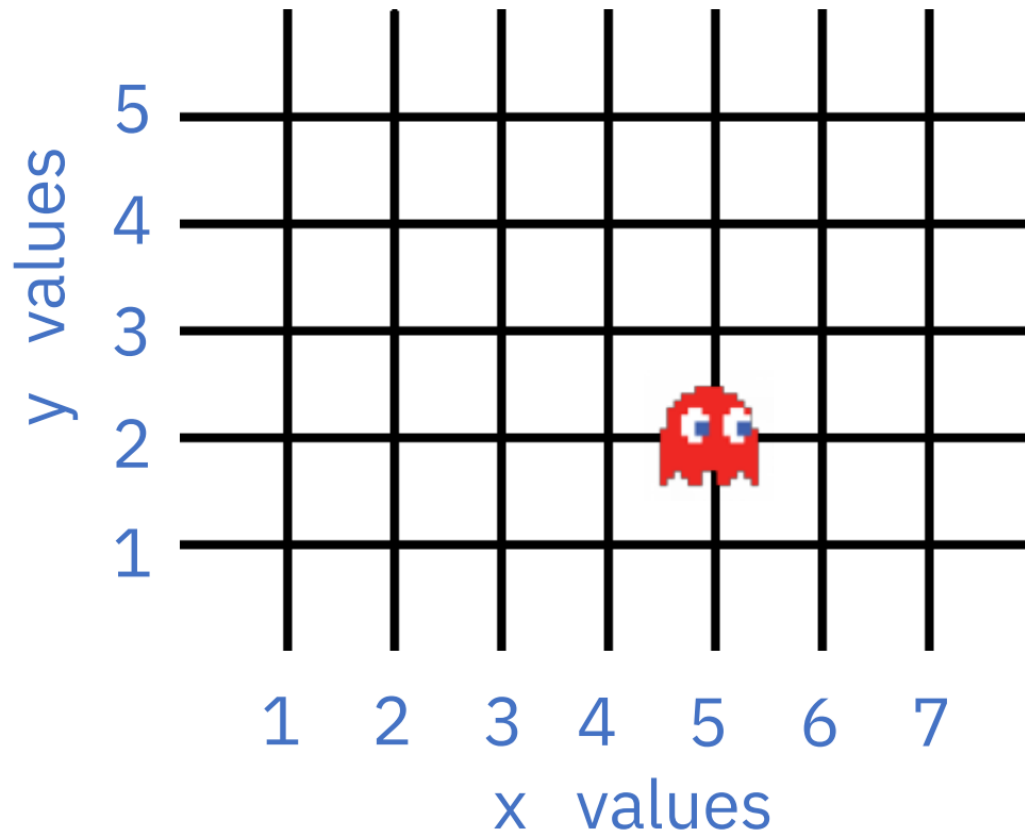
AI



GOAL: CREATE A PAC-
MAN GAME IN SCRATCH
AND TRAIN A MACHINE
LEARNING MODEL TO
PLAY THE GAME.

GAME GRID

Representing Pac-Man in Scratch



The game board is a graph.
Pac-Man and the ghost can only travel along lines.

The location of each character is stored as:

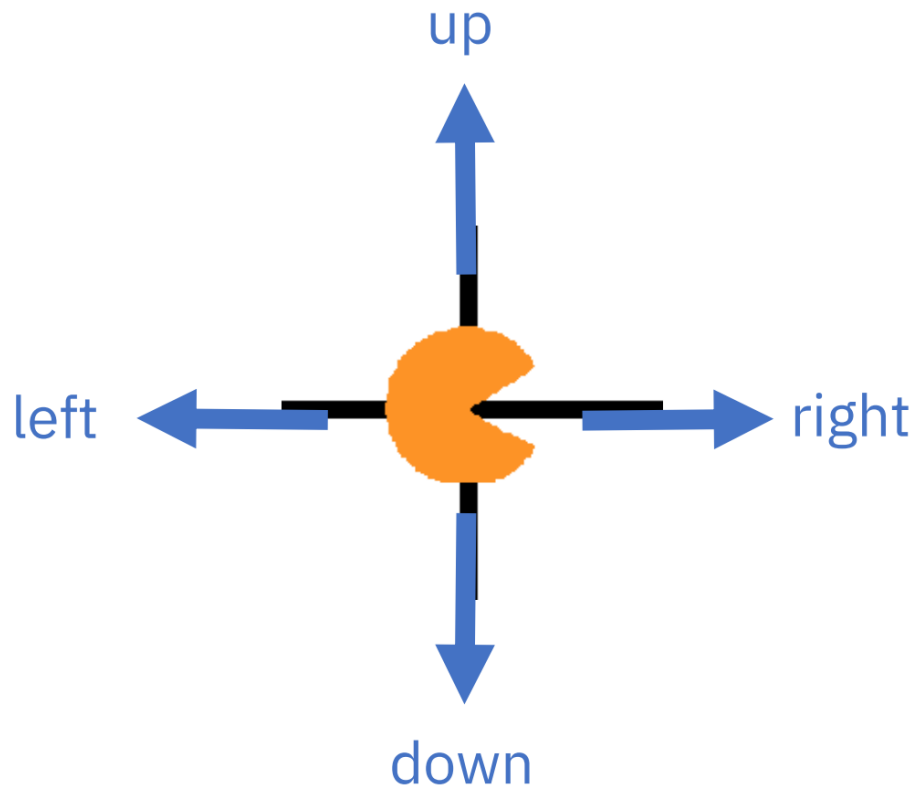
- * an x-value (a number from 1 to 7)
- * a y-value (a number from 1 to 5)

For example, the ghost on the left is at:

$$X = 5$$
$$Y = 2$$

At each turn, each character has to choose between four moves: up, down, left, right.

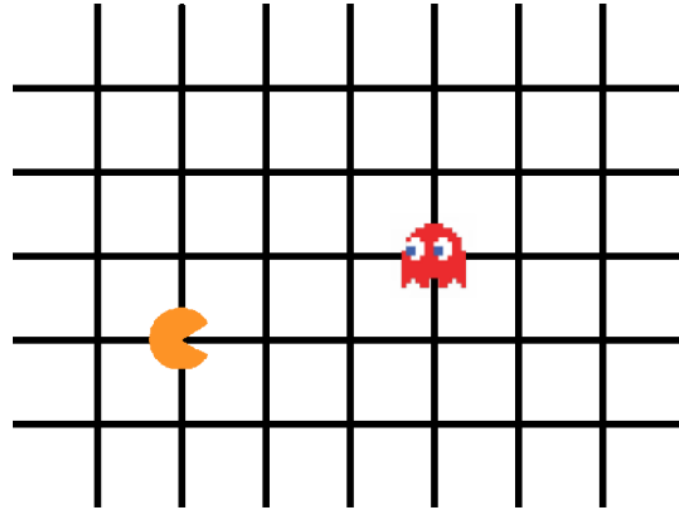
(There are no diagonal moves.)



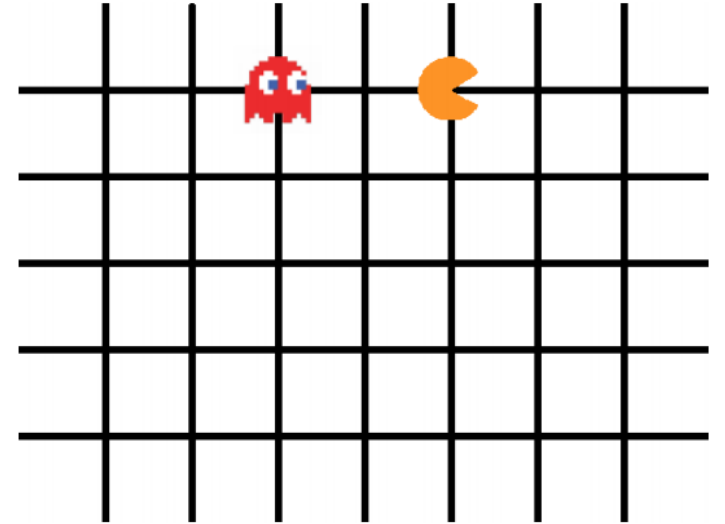
PAC-MAN MOVES

EXAMPLE MOVES

Imagine the board looks like this:



Imagine the board looks like this:



Imagine you decide to go up:

pacman x	2
pacman y	2
ghost x	5
ghost y	3

choice: up

Imagine you decide to go down:

pacman x	5
pacman y	5
ghost x	2
ghost y	5

choice: down

Recognising **numbers** as **left, right or 2 other classes**

[Back to project](#)

+ Add new label

left

pacman x 3 pacman y 4 ghost x 4 ghost y 4	pacman x 2 pacman y 4 ghost x 3 ghost y 4
pacman x 1 pacman y 4 ghost x 2 ghost y 4	pacman x 6 pacman y 3 ghost x 7 ghost y 4
pacman x 5 pacman y 3 ghost x 7 ghost y 3	pacman x 4 pacman y 3 ghost x 6 ghost y 3
pacman x 3 pacman y 3 ghost x 5 ghost y 3	pacman x 7 pacman y 1 ghost x 7 ghost y 3
pacman x 6 pacman y 1 ghost x 7 ghost y 2	pacman x 5 pacman y 1 ghost x 6 ghost y 2
pacman x 4 pacman y 1 ghost x 5 ghost y 2	pacman x 3 pacman y 1 ghost x 5 ghost y 1
pacman x 2 pacman y 1 ghost x 4 ghost y 1	pacman x 7 pacman y 1 ghost x 7 ghost y 3

+ Add example

50

right

pacman x 1 pacman y 5 ghost x 3 ghost y 3	pacman x 2 pacman y 5 ghost x 2 ghost y 3
pacman x 3 pacman y 5 ghost x 2 ghost y 4	pacman x 4 pacman y 5 ghost x 3 ghost y 4
pacman x 5 pacman y 5 ghost x 4 ghost y 4	pacman x 6 pacman y 5 ghost x 4 ghost y 5
pacman x 3 pacman y 5 ghost x 2 ghost y 4	pacman x 4 pacman y 5 ghost x 2 ghost y 5
pacman x 5 pacman y 5 ghost x 5 ghost y 5	pacman x 6 pacman y 5 ghost x 4 ghost y 5
pacman x 1 pacman y 5 ghost x 1 ghost y 3	pacman x 2 pacman y 5 ghost x 1 ghost y 4
pacman x 3 pacman y 5 ghost x 2 ghost y 4	pacman x 4 pacman y 5 ghost x 3 ghost y 4

+ Add example

59

up

pacman x 1 pacman y 3 ghost x 5 ghost y 3	pacman x 1 pacman y 4 ghost x 4 ghost y 3
pacman x 2 pacman y 3 ghost x 4 ghost y 3	pacman x 2 pacman y 4 ghost x 3 ghost y 3
pacman x 2 pacman y 5 ghost x 2 ghost y 3	pacman x 1 pacman y 1 ghost x 3 ghost y 1
pacman x 1 pacman y 2 ghost x 2 ghost y 1	pacman x 1 pacman y 3 ghost x 2 ghost y 2
pacman x 1 pacman y 4 ghost x 1 ghost y 2	pacman x 5 pacman y 1 ghost x 7 ghost y 1
pacman x 5 pacman y 2 ghost x 6 ghost y 1	pacman x 5 pacman y 3 ghost x 5 ghost y 1
pacman x 5 pacman y 4 ghost x 5 ghost y 2	pacman x 3 pacman y 5 ghost x 4 ghost y 4

+ Add example

58

down

pacman x 7 pacman y 5 ghost x 5 ghost y 5	pacman x 7 pacman y 4 ghost x 6 ghost y 5
pacman x 7 pacman y 3 ghost x 7 ghost y 5	pacman x 7 pacman y 5 ghost x 5 ghost y 5
pacman x 7 pacman y 4 ghost x 6 ghost y 5	pacman x 7 pacman y 3 ghost x 6 ghost y 4
pacman x 7 pacman y 2 ghost x 7 ghost y 4	pacman x 7 pacman y 5 ghost x 5 ghost y 5
pacman x 7 pacman y 4 ghost x 6 ghost y 5	pacman x 7 pacman y 3 ghost x 7 ghost y 5
pacman x 7 pacman y 2 ghost x 7 ghost y 4	pacman x 3 pacman y 4 ghost x 3 ghost y 5
pacman x 3 pacman y 3 ghost x 3 ghost y 4	pacman x 3 pacman y 2 ghost x 3 ghost y 3

+ Add example

55

TRAINING EXAMPLES

HANDS-ON ACTIVITY

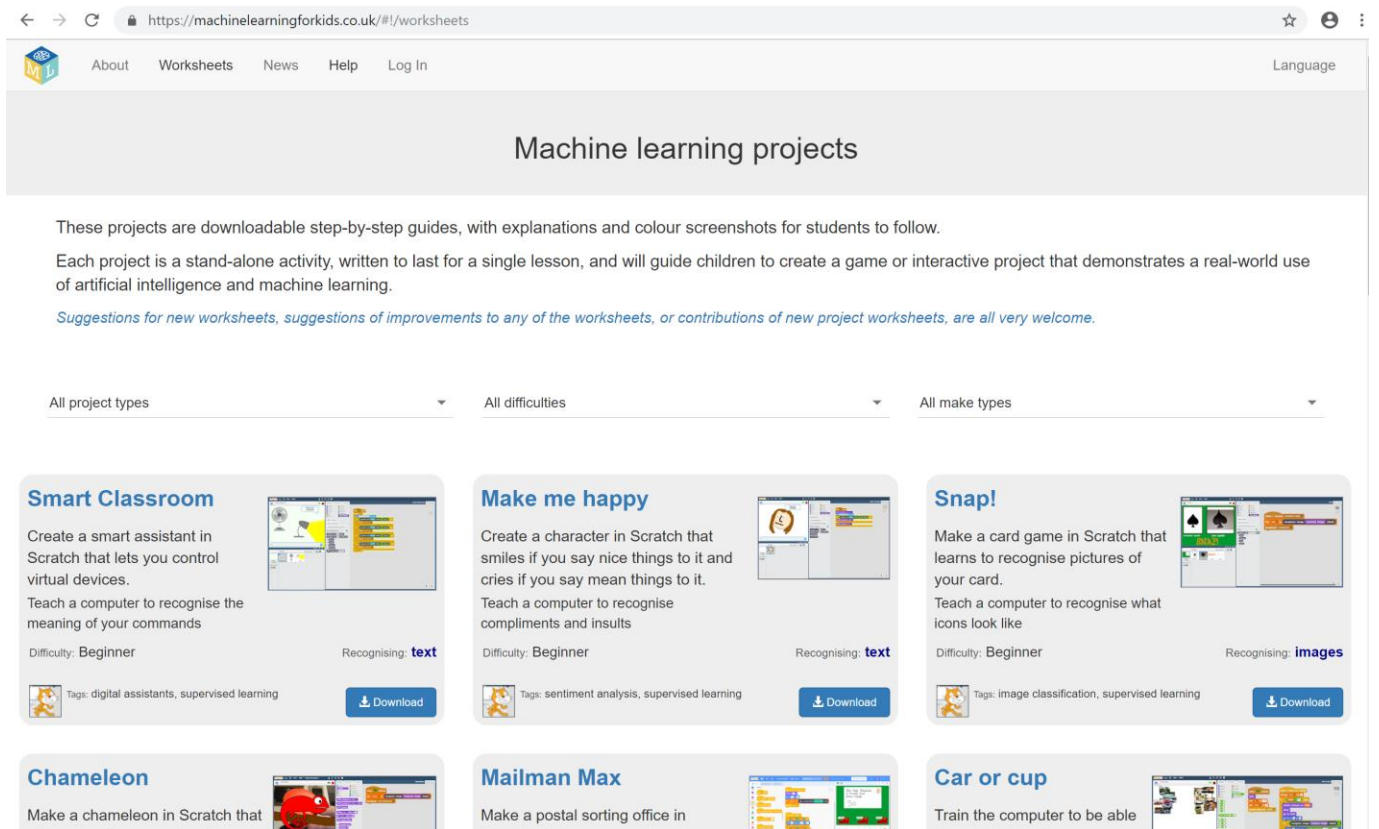
- Play Pac-Man in SCRATCH and review the project code
- Create a machine learning project to recognize numbers
 - Four values representing x,y coordinates for pacman and ghost: pacman_x, pacman_y, ghost_x, ghost_y
 - Four labels representing the directions in which pac-man and ghost move: Left, Right, Up, Down
- Train the model by playing the game
 - Create examples of how to avoid the ghost
- Save the project as pacman-learn
- Modify the project as pacman-play (computer plays the game)
- Test your model
- Improve with more examples

CREDENTIALS

- Username:
- Password:

LET'S GET STARTED!

<https://machinelearningforkids.co.uk>



The screenshot shows a web browser at the URL <https://machinelearningforkids.co.uk/#/worksheets>. The page has a navigation bar with links for 'About', 'Worksheets', 'News', 'Help', and 'Log In', and a 'Language' dropdown. The main heading is 'Machine learning projects'. Below this, there is an introductory paragraph: 'These projects are downloadable step-by-step guides, with explanations and colour screenshots for students to follow. Each project is a stand-alone activity, written to last for a single lesson, and will guide children to create a game or interactive project that demonstrates a real-world use of artificial intelligence and machine learning.' A blue italicized line of text follows: 'Suggestions for new worksheets, suggestions of improvements to any of the worksheets, or contributions of new project worksheets, are all very welcome.' There are three dropdown menus: 'All project types', 'All difficulties', and 'All make types'. The main content area displays six project cards in a 2x3 grid. Each card includes a title, a brief description, a difficulty level, a 'Recognising' category, and a 'Download' button. The projects shown are: 'Smart Classroom' (Recognising: text), 'Make me happy' (Recognising: text), 'Snap!' (Recognising: images), 'Chameleon' (Recognising: images), 'Mailman Max' (Recognising: images), and 'Car or cup' (Recognising: images).

Machine learning projects

These projects are downloadable step-by-step guides, with explanations and colour screenshots for students to follow. Each project is a stand-alone activity, written to last for a single lesson, and will guide children to create a game or interactive project that demonstrates a real-world use of artificial intelligence and machine learning.

Suggestions for new worksheets, suggestions of improvements to any of the worksheets, or contributions of new project worksheets, are all very welcome.

All project types All difficulties All make types

Smart Classroom
Create a smart assistant in Scratch that lets you control virtual devices.
Teach a computer to recognise the meaning of your commands
Difficulty: Beginner
Recognising: **text**
Tags: digital assistants, supervised learning
Download

Make me happy
Create a character in Scratch that smiles if you say nice things to it and cries if you say mean things to it.
Teach a computer to recognise compliments and insults
Difficulty: Beginner
Recognising: **text**
Tags: sentiment analysis, supervised learning
Download

Snap!
Make a card game in Scratch that learns to recognise pictures of your card.
Teach a computer to recognise what icons look like
Difficulty: Beginner
Recognising: **images**
Tags: image classification, supervised learning
Download

Chameleon
Make a chameleon in Scratch that

Mailman Max
Make a postal sorting office in

Car or cup
Train the computer to be able

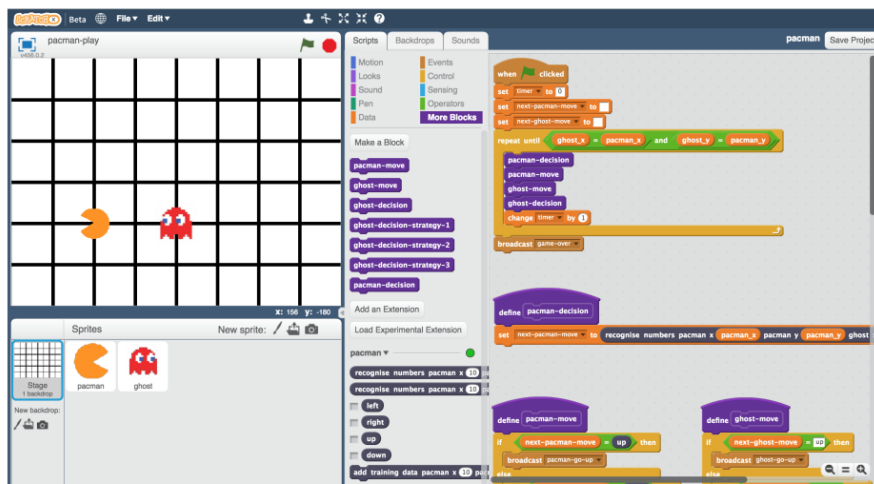
Pac-Man

In this project you will create a Pac-Man game in Scratch that is able to learn from how you play.

You won't give it instructions for how to play, or tell it what the objective or rules of the game are.

Instead, you'll show it examples of you playing the game.

FOLLOW
ALONG ON
THE
WORKSHEET



EXTRA CREDIT

Check out Ideas and Extensions

Pick another project @

<https://machinelearningforkids.co.uk>

Ideas and Extensions

Now that you've finished, why not give one of these ideas a try?

Or come up with one of your own?

Add another ghost

The game is beatable with only one ghost – Pac-Man can just carry on avoiding the ghost forever.

But with a second ghost chasing after Pac-Man, it will get really hard.

Change the game board

Try making the game board bigger.

Or add obstacles that Pac-Man and the ghost will need to go around.

Make your own game

This doesn't only work with Pac-Man.

Why not make your own game in Scratch, and then train a machine learning model to be able to play it?

Tips

Getting stuck in a loop

Sometimes the computer can get lucky, and find a circular route around the board that gets into a never-ending loop.

When this happens, Pac-Man will never lose!

You can press the red stop button if you need to stop though.

Don't be kind!

You might be tempted to go easy on the ghost when you're playing against it.

Don't. It is learning from the way that you play. If you don't play well, it can't learn how to play well.

If you want it to get better quickly, **play as well as you can.**

Keep training

The more examples the computer has to learn from, the better it will get. If you have time, play a lot of games and train a new model again.

**What did
you learn?**

**Will you
come back?**

QUICK SURVEY