Terms which significant research is needed

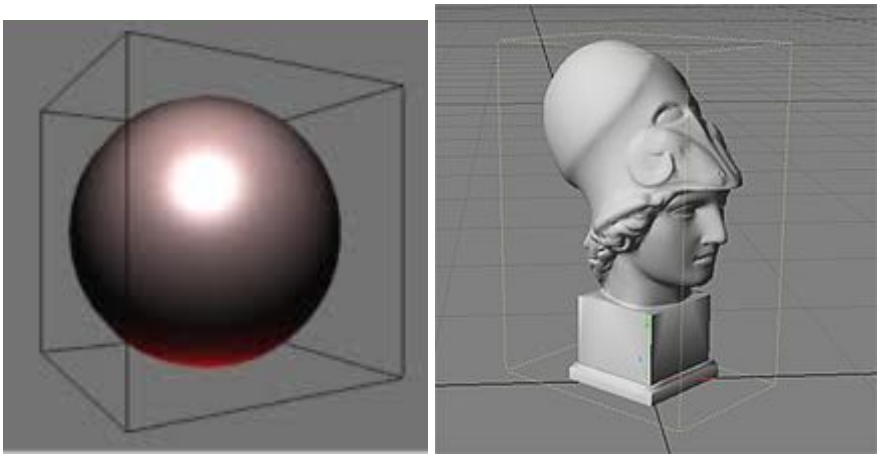
- **Autonomous**: Having the freedom to act independently. In this case, transport (cars and buses) have the technology to move independently (accelerate, decelerate, steer) to the location the user chooses.

- **Backpropagation**: Short for ***backward propagation of errors***. A method of optimising an artificial neural network. Works by calculating the gradient of the loss function(cost function) of the ANN.
  More reading on:https://brilliant.org/wiki/backpropagation/

- **Big O notation**: A mathematical notation to find the time required to run an algorithm as the input increases. Ex: O(n) = grows linearly as input grows.

- **Bounding boxes**: A volume that contains a set of objects inside it. Allows for better efficiency by containing complex volumes inside a simpler one.

examples of a bounding box:



An example of a bounding box in image/text recognition.

- **Brute-force**: A trial and error method in mathematics to try and eliminate all other possibilities and find the correct answer. Also called proof by exhaustion. Brute force in algorithms include brute force attacks and brute force searches. BF attacks try and decrypt a code by simply trying all the possibilities. BF searches are essentially the same, but it try to solve a problem by comparing all the possible solutions.

- **Convolutional neural networks (CNNs)**: Similar to normal Neural Networks in that they include neurons that have learnable weights and biases. A CNN is different from an ANN since it assumes that the input is an image. Also, it arranges its neurons in 3D.
  More thorough explanation: http://cs231n.github.io/convolutional-networks/

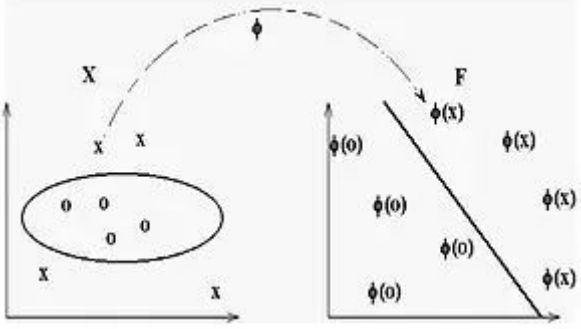
- **Cost function(Loss function)**: A function that maps an an event or values of one or more variables onto a real number that shows the “cost” of the event.

- **Deep learning**: A type of machine learning that has to do with the learning tasks of ANNs. Looks a bit like nervous systems.

- **Dijkstra’s algorithm**: An algorithm that finds the fastest path from one node to another in a graph. A solution to the travelling salesman problem.

- **End-to-end learning**: idea of outputting complex data types from raw features, for example, audio transcripts, image captures, or steering for self-driving cars. Often has better performance than traditional deep learning. However, it cannot be used for every problem as it requires a lot of labeled data to work optimally.

- **Feature maps (Activation maps)**: A function that maps the data vector to a feature space, which makes it presentable to the algorithm. It makes it linearly separable, like in the image.



- **Filters (Kernels)**: Matrices that basically filter a pixel. Certain numbers can be put for a 3x3 matrix which then multiplies it for the centre pixel and the 8 pixels around it, which then creates another centre pixel by summing all the multiplied values for the 3x3 matrix. For example, a normal image would be the 3x3 below, where the 0s show that the centre pixel is not affected by any other pixels around it, since the values are multiplied by 0.

0	0	0
0	1	0
0	0	0

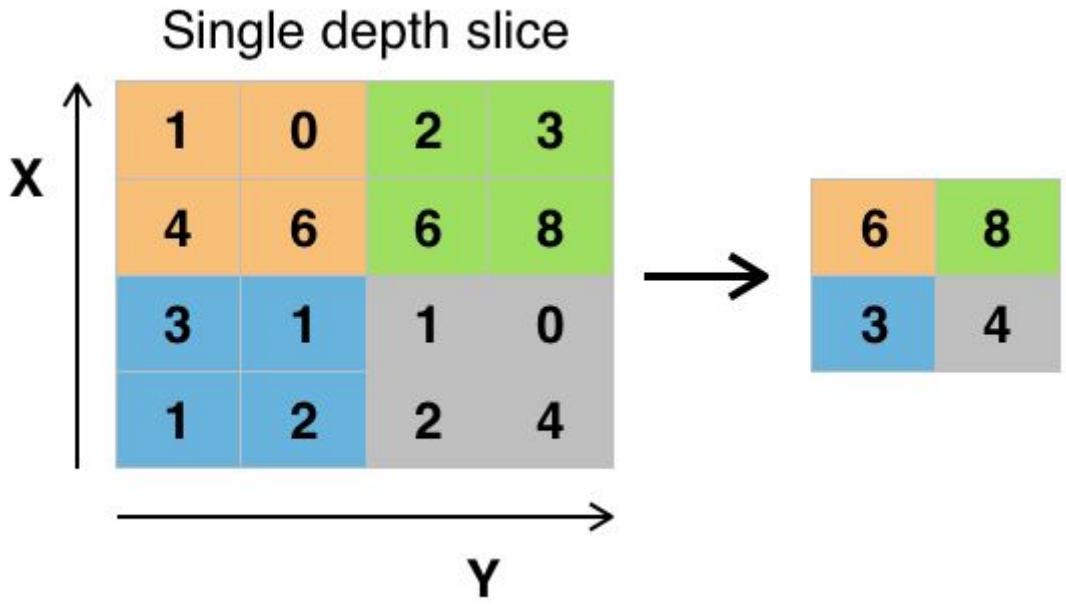
Example of a matrix that shows a normal pixel

- **Filter stride**: https://adeshpande3.github.io/A-Beginner%27s-Guide-To-Understanding-Convolutional-Neural-Networks-Part-2/ A filter stride is when the kernel moves through the image to process it. The kernel might start from (3,3) from the first pixel on the image, or start from the centre matrix (2,2) from the first pixel.

- **Greedy algorithm**: In an algorithm, there can not be an “universal” answer that fits all problems. The greedy algorithm is a technique from many other that is used for specific solutions. This algorithm chooses the best-looking solution at every moment. In a nutshell, it tries to choose the most logically optimal choice in hopes of finding the globally optimal solution.

- **Machine learning**: subfield of computer science that allows computers to learn without having information explicitly programmed into it. Basically learning by itself. It bases itself on the construction of algorithms to make predictions and learn from sets of data rather than sticking to only static program instructions.

- **Max-pooling / Pooling**:

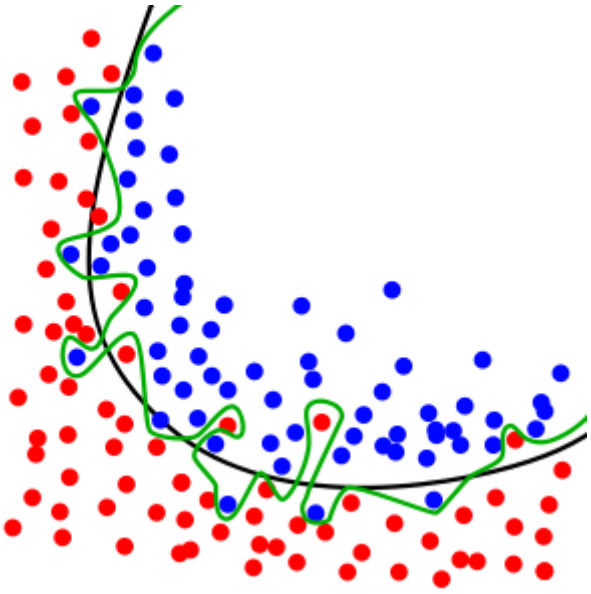


Max-pooling is when you add a pooling layer, causing an image is separated into non-overlapping rectangles, with each sub-region's maximum being outputted afterwards. This reduces the spatial size of the image, controlling overfitting by reducing the parameters and computation needed to interpret the image.

- **Multi-layer perceptron (MLP)**: It is a type of artificial neural network. An MLP consists of at least three layers of nodes. Except for the input nodes, each node is a neuron that uses a nonlinear activation function. Its multiple layers and non-linear activation distinguish MLP from a linear perceptron. It can distinguish data that is not linearly separable.

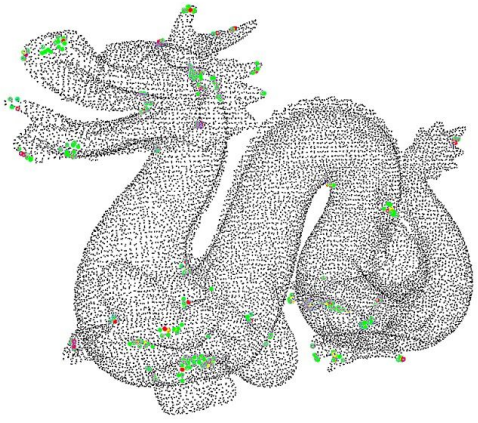
- **Nearest neighbour algorithm**: An algorithm to solve the travelling salesman problem. Finds the closest neighbour, and visits it. If it's used to give a solution to the travelling salesman problem, it will give a short tour, but won't give a nice optimised solution.

- **Overfitting**: Overfitting is when you train an algorithm too much, making it behave quite strangely. When you fit an algorithm, it tries to model the data provided; over time, if an algorithm is overfitted, the error will increase if another set of data is given.

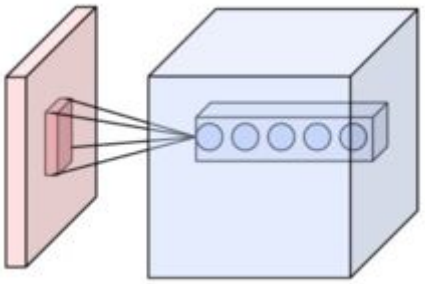


An example of overfitted data. The black line is nicely fitted, while the green line tried too hard to be 100% accurate. But if other data will be inputted, the error will increase.

- **Point clouds**: A set of data points in a coordinate system often used to represent the external surface of an object

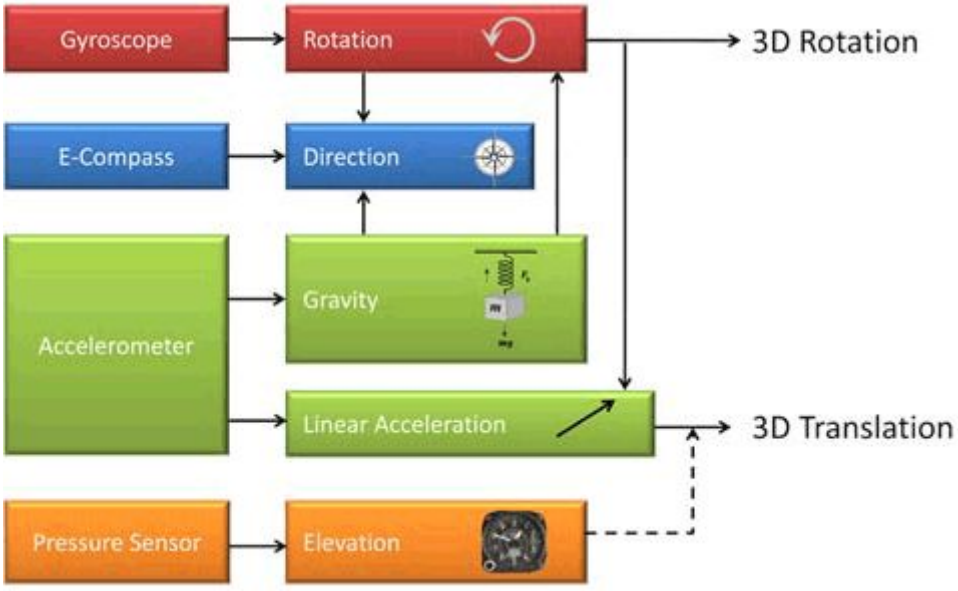


- **Receptive field**: Like a receptive field you'd think about in biology, it is the feed that is given to a given cell in the nervous system. But in a machine learning algorithm, the receptive field refers to what the artificial neurons represent in the original image in a CNN.



neurons of a convolutional layer (blue) receptive field (red)

- **Sensor Fusion**: Software that combines data from several different sensors to improve performance in a program. By combining the data, the deficiencies of each sensors are cancelled out.



- **Society of Automotive Engineers**: SAE International is a global association of more than 128,000 engineers and related technical experts in the aerospace, automotive and commercial-vehicle industries.

- **Shift invariance** **(Spatial invariance**): An invariant is a value that can be assured that it will stay true while the program runs. In an invariant system, If y(n) is the response of the system to x(n), then y(n–k) is the response of the system to x(n–k). In a shift invariant system, the k would respond to the shift of space, while in a time invariant system, time would be responsible of k.

- **Vehicle-to-vehicle (VTV) protocol**: Technology designed for vehicles to communicate with each other. The communication is wireless, many of these protocols rely on simple comm protocols, which can be used to detect the car near your car to send out a signal. If all cars will be connected to each other using this, we might not need street lights for cars.

- **Vehicle-to-infrastructure (VTI) protocol**: Communication model that allows the vehicle to share information with infrastructure meant for road control (traffic lights, lane markers, streetlights, signage and parking meters). It is wireless and bidirectional. Can be used to give the user information about parking availability, accidents, roadblocks, traffic, etc.