



**Prize Winner**

**Models & Inventions**

**Year 5-6**

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PRIZE WINNER

AI. 0447-006  
Ismail

## “Hey AI, what fruit is this?”

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Report

### How does our Brain learn?

Our brain learns through experience, trial and error and through education. In our brain there are about 86 billion neurons (nerve cells).



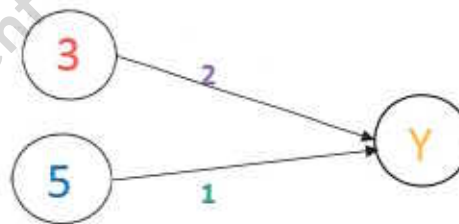
The image above shows three neurons connected to each other. During the learning process the neurons connect to each other at different strengths. Signals are carried by these connections and all are added at the neurons to make decisions.

### What is AI?

AI stands for artificial intelligence. AI models imitate how our brain learns using mathematical algorithms.

### My AI model

I made an AI model for deciding the type of fruits using the following three features: 1. texture (Rough or smooth) , 2.shape (round or cylindrical) and 3.hardness (hard or soft). AI models can be programmed on a computer to automatically detect fruit types in factories.



$$Y = (3 \times 2) + (5 \times 1) = 11$$

In my AI model neurons are shown as circles. The strength of the connections between neurons is given by a number shown at each connection. The diagram shown on the left is an AI model containing three neurons. All the signals entering Y are combined as shown in the equation.

The AI model I made is shown on the right. This is a fully learned AI model, because the connection strength values are found. The connection values were found by trying for many strength numbers and finding the output values G, A and P. These numbers are found by first finding H1, H2, H3, H4 and then G, A, P. These equations combines the signals entering each neuron (as explained before).

$$H1 = (I1 \times 1) + (I2 \times 1) + (I3 \times 1); \quad H2 = (I1 \times 0) + (I2 \times 0) + (I3 \times 1);$$

$$H3 = (I1 \times 1) + (I2 \times 0) + (I3 \times 1); \quad H4 = (I1 \times 1) + (I2 \times 1) + (I3 \times 0);$$

$$G = (H1 \times 0) + (H2 \times -1) + (H3 \times 0) + (H4 \times 1);$$

$$A = (H1 \times 1) + (H2 \times 1) + (H3 \times -1) + (H4 \times -1);$$

$$P = (H1 \times 0) + (H2 \times -1) + (H3 \times 1) + (H4 \times 0);$$

I1, I2, I3 are input feature numbers. For a correctly learned connection strength values, the model should output following values and for all other input feature values the model should not output the values shown.

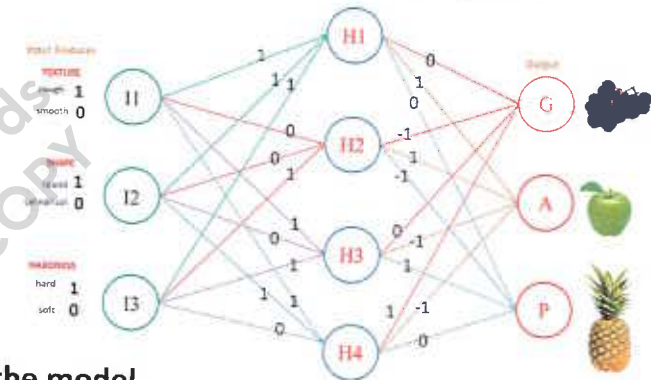
Grape(G): smooth (I1=0); round (I2=1); soft (I3=0). G=1, A=0, P=0.

Apple(A): smooth (I1=0); round (I2=1); hard (I3=1). G=0, A=1, P=0.

Pineapple(P): rough (I1=1); cylindrical (I2=0); hard (I3=1). G=0, A=0, P=1.

Finding the connection strength values were the most hard and time consuming part of the project. Different sets of values were tried until a good set were found. My dad helped me to find these values.

Artificial Intelligence (AI) Model



### Operating the model

To operate this model, first we need to choose input features (of any of the three fruits shown) and then using the equations shown on the right to find G, A and P values.

For example, for Apple, I1=0, I2=1, I3=1. Using these,

$$H1 = (0 \times 1) + (1 \times 1) + (1 \times 1) = 2; \quad H2 = (0 \times 0) + (1 \times 0) + (1 \times 1) = 1;$$

$$H3 = (0 \times 1) + (1 \times 0) + (1 \times 1) = 1; \quad H4 = (0 \times 1) + (1 \times 1) + (1 \times 0) = 1;$$

$$G = (2 \times 0) + (1 \times -1) + (1 \times 0) + (1 \times 1) = 0; \text{ Not a Grape}$$

$$A = (2 \times 1) + (1 \times 1) + (1 \times -1) + (1 \times -1) = 1; \text{ Is an Apple}$$

$$P = (2 \times 0) + (1 \times -1) + (1 \times 1) + (1 \times 0) = 0; \text{ Not a Pineapple}$$

Therefore it is an Apple.

I1	0	0	0	0	1	1	1	1
I2	0	0	1	1	0	0	1	1
I3	0	1	0	1	0	1	0	1
G	0	1	1	0	1	0	2	1
A	0	1	0	1	1	0	-1	0
P	0	0	0	0	1	1	1	1

All other combinations are shown on the right.

### Making the model operate interactively

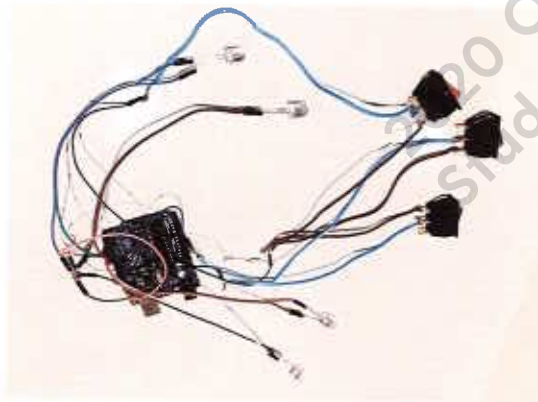
To make the model interactive, I coded the equations on an Arduino UNO mini-computer. Three switches are used to select the features of the fruit. When the user selects the features, the computer automatically calculates the values of G, A and P and then it turns on the LED to show the type of the fruit. Three LEDs are connected for the three fruits and one other LED if it cannot find the type of fruit correctly.

Step 1: Turn on power switch.

Step 2: Select three features using the three switches.

Step 3: See the LED to find what fruit it is.

The program written for the Arduino UNO is shown on the right. Switches and LEDs are connected as shown below. Arduino board is powered by a 9V battery. My dad helped me to solder the switches, LEDs and improve my Arduino program.



```
int switch_out = 0; int switch_in1 = 0; int switch_in2 = 0; int switch_in3 = 0;
```

```
void setup() {  
  pinMode(9, INPUT_PULLUP); pinMode(10, INPUT_PULLUP); pinMode(11, INPUT_PULLUP);  
  pinMode(2, OUTPUT); pinMode(3, OUTPUT); pinMode(4, OUTPUT); pinMode(5, OUTPUT);  
}
```

```
void loop() {
```

```
  int I1; int I2; int I3;  
  int H1; int H2; int H3; int H4;  
  int G; int A; int P;
```

```
  switch_in1 = digitalRead(9);  
  switch_in2 = digitalRead(10);  
  switch_in3 = digitalRead(11);
```

```
  I1 = 1-switch_in1;  
  I2 = 1-switch_in2;  
  I3 = 1-switch_in3;
```

```
  H1 = (I1*1)+(I2*1)+(I3*1);  
  H2 = (I1*0)+(I2*0)+(I3*1);  
  H3 = (I1*1)+(I2*0)+(I3*1);  
  H4 = (I1*1)+(I2*1)+(I3*0);
```

```
  G = (H1*0)+(H2*-1)+(H3*0)+(H4*1);  
  A = (H1*1)+(H2*1)+(H3*-1)+(H4*-1);  
  P = (H1*0)+(H2*-1)+(H3*1)+(H4*0);
```

```
  if (G==1 & A==0 & P==0){  
    digitalWrite(2, HIGH); digitalWrite(3, LOW); digitalWrite(4, LOW); digitalWrite(5, LOW);  
  } else if (G==0 & A==1 & P==0){  
    digitalWrite(3, HIGH); digitalWrite(2, LOW); digitalWrite(4, LOW); digitalWrite(5, LOW);  
  } else if (G==0 & A==0 & P==1){  
    digitalWrite(4, HIGH); digitalWrite(2, LOW); digitalWrite(3, LOW); digitalWrite(5, LOW);  
  } else {  
    digitalWrite(5, HIGH); digitalWrite(2, LOW); digitalWrite(3, LOW); digitalWrite(4, LOW);  
  }  
}
```