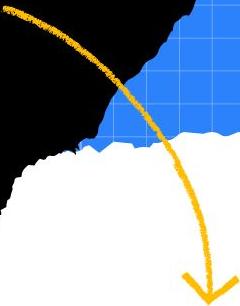


# devfest

2022

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dden="" fixed="" aria-label='Hide  
 Hide side navigation'



## Introduction to Computer Vision and Image Processing

 Google Developer Groups  
Beja



Nourchene Ferchichi  
ML Google Developer Expert  
NVIDIA DLI Ambassador

# The goals of this workshop

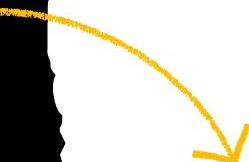
1. Get you up and on your feet quickly after this workshop.
2. Build a foundation to tackle a Computer Vision project right away.
3. We won't cover the whole field, but we'll get a great head start.
4. Foundation from which to read articles, follow tutorials, take further classes.

# What will be discussed today:

- 1 An Introduction to Deep Learning and Computer Vision
- 2 How a Neural Network Trains
- 3 Convolutional Neural Networks
- 4 Bring it all Together!

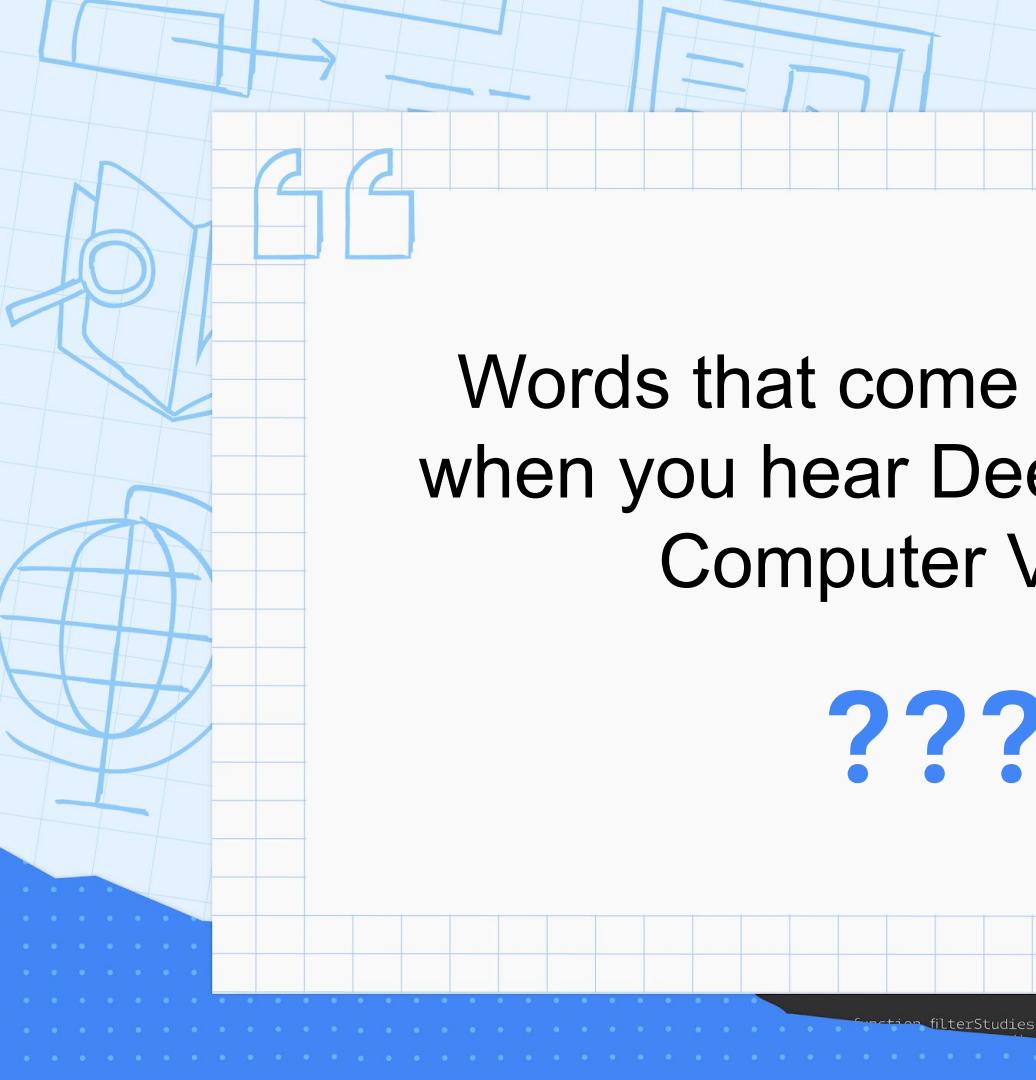
devfest  
2022

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# 1. An Introduction to Deep Learning and Computer Vision

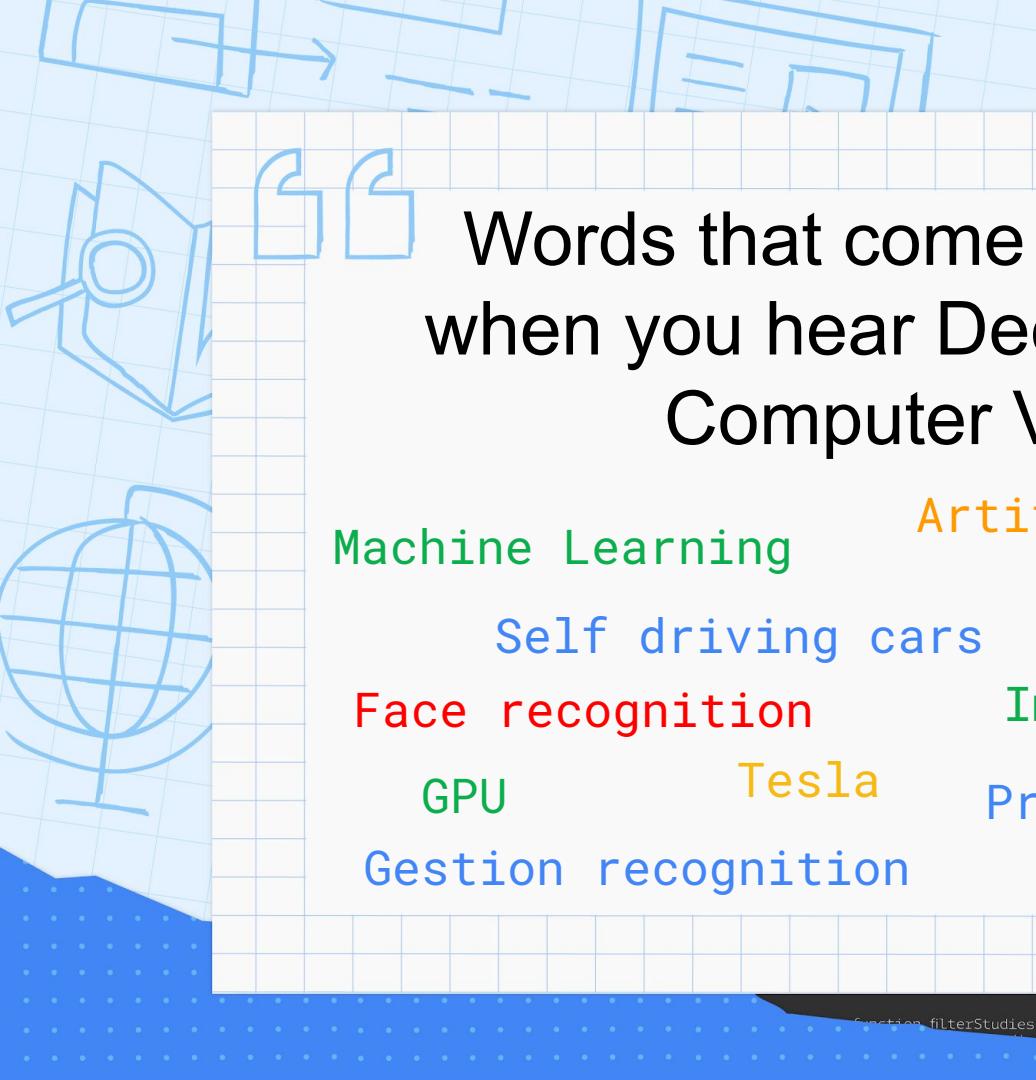




Words that come to your mind  
when you hear Deep Learning &  
Computer Vision?

???





# Words that come to your mind when you hear Deep Learning & Computer Vision?

Machine Learning

Artificial Intelligence  
Robots

Self driving cars

Face recognition

Image classification

GPU

Tesla

Programming

Gestion recognition

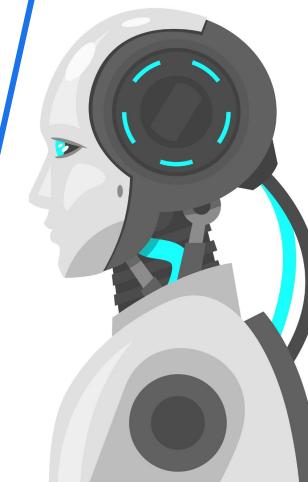
Python



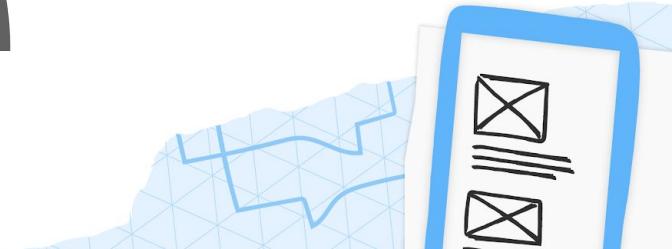
# A Simple Definition

The simulation of **Human Intelligence processes** by **Machines**

???



???



# A Simple Definition

The simulation of **Human Intelligence processes** by **Machines**

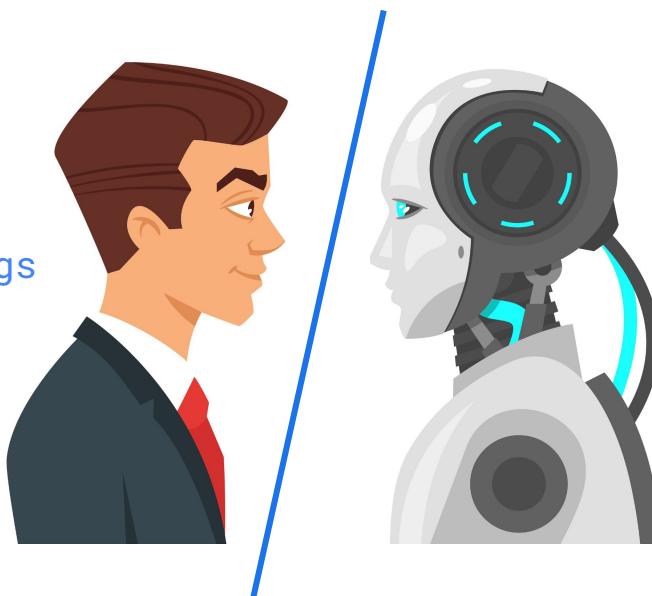
Human Brain

Recognize people

Creativity: Art, paintings

Solving math equations

Detect and name objects



GPU, neuromorphic computing

Face recognition

Generate images

Super calculus capabilities

Object detection and classification



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2022

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" class="time talk-ended single">  
' class="talk-name"><h3>  
class="description">
```

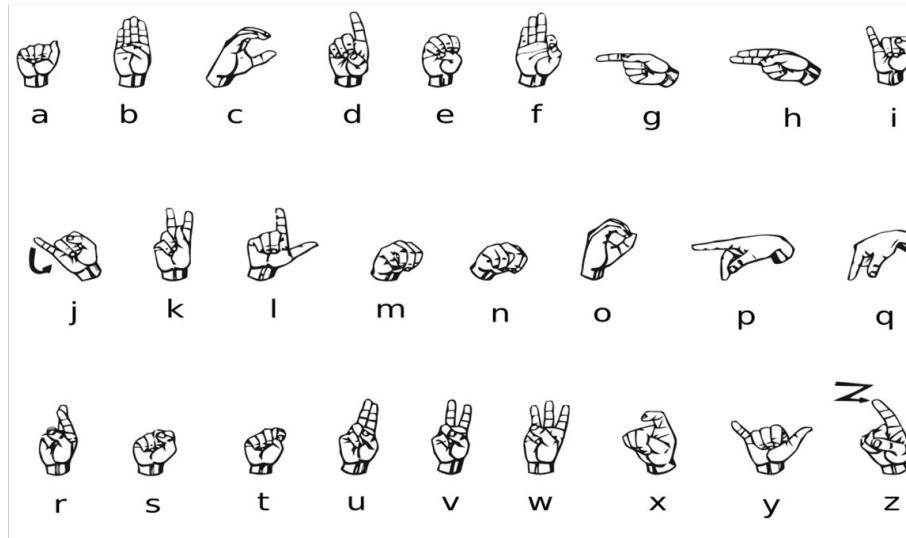


## 2. How a Neural Network Trains



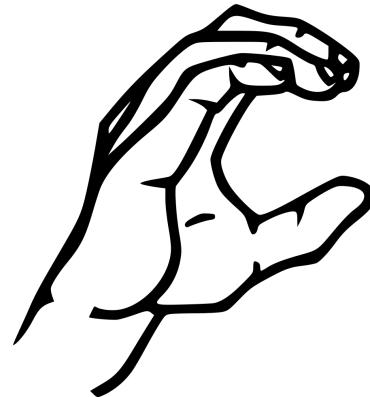
# What if you were the Neural Network?

## The American Sign Language Alphabet



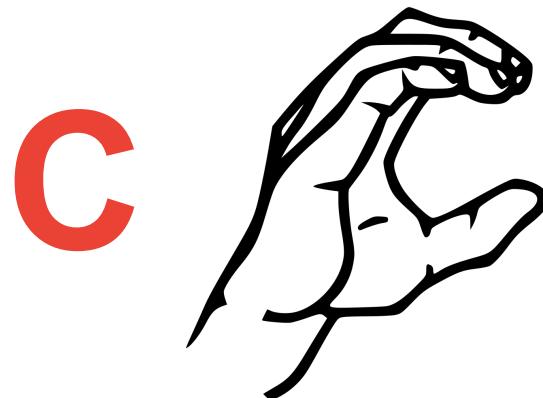
# What if you were the Neural Network?

Which sign letter is this? Make a guess!



# What if you were the Neural Network?

Which sign letter is this? Make a guess!

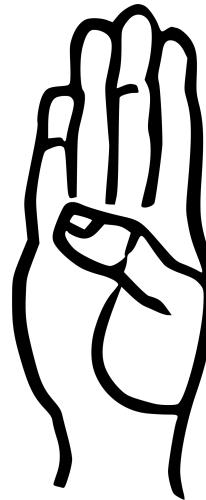


C



# What if you were the Neural Network?

Which sign letter is this? Make a guess!



# What if you were the Neural Network?

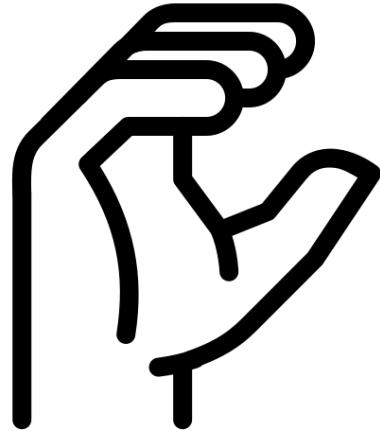
Which sign letter is this? Make a guess!

B



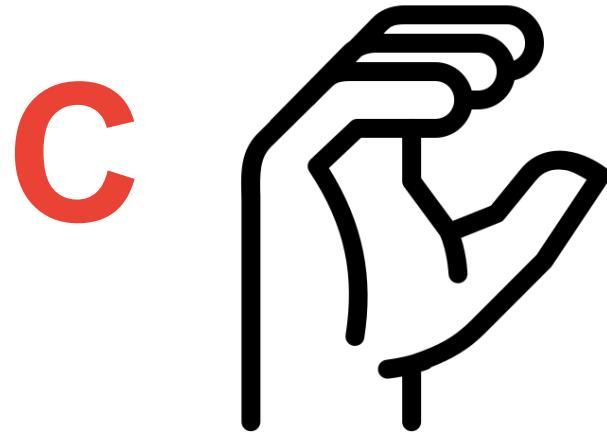
# What if you were the Neural Network?

Which sign letter is this? Make a guess!



# What if you were the Neural Network?

Which sign letter is this? Make a guess!



# What if you were the Neural Network?

Which sign letter is this? Make a guess!



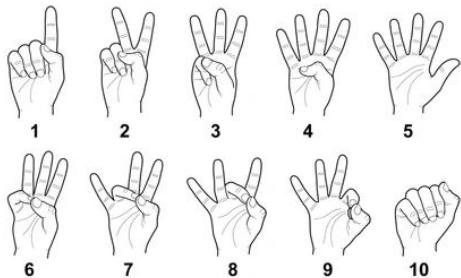
# What if you were the Neural Network?

Which sign letter is this? Make a guess!

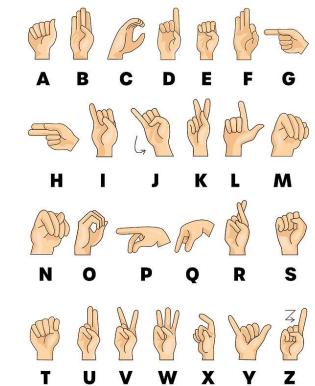
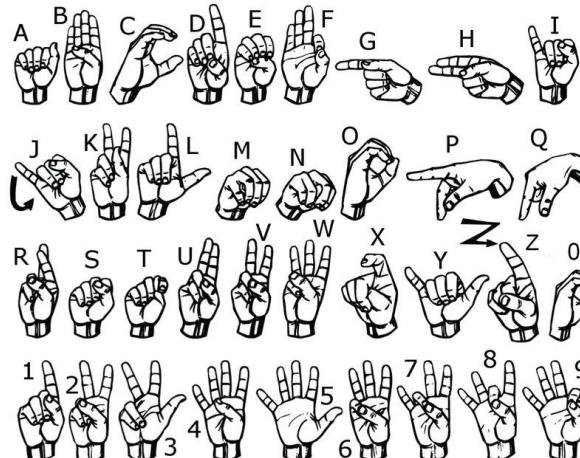
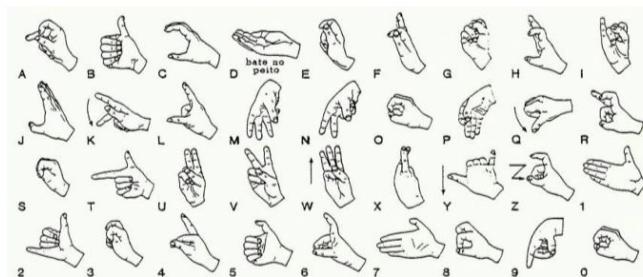
B



# What if you were the Neural Network?

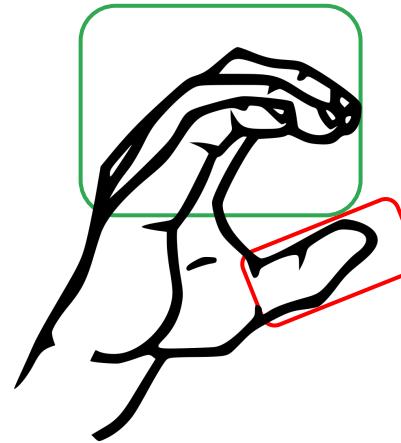
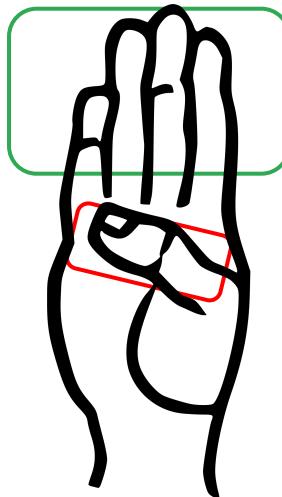


Machines learns by **Making Guesses** based on a lot of **Examples!**



# What if you were the Neural Network?

Which sign letter is this? Make a guess!



Neural Networks learn based on **Patterns**!



# What makes a machine a machine?

What things do Neural Network need?

**1. A lot of Data**

**3. Compute power**

**2. Algorithms**

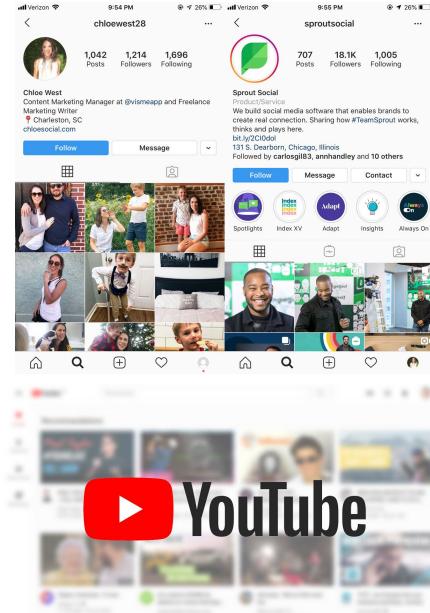


# What makes a machine a machine?

What other things do machines need?

## 1. A lot of Data

1. Images
2. Videos
3. ( .... )



# What makes a machine a machine?

What other things do machines need?

## 2. Algorithms

a process or set of rules to be followed in calculations or other problem-solving operations

```
1    this.validate(a); return b; destroy:function(){return new this.constructor(this.a);
2    this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
3    this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
4    this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
5    this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
6    this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
7    this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
8    this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
9    this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
10   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
11   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
12   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
13   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
14   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
15   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
16   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
17   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
18   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
19   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
20   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
21   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
22   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
23   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
24   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
25   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
26   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
27   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
28   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
29   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
30   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
31   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
32   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
33   this._changedCount=0; this._changed=false; this._changedCount++; this._changedCount>=this.options.maxChangedCount?this._changedCount=0:0;
```

```
19  tempLevel = 0;
20  unsigned int len1 = s1.size(), len2 = s2.size();
21  const size_t colLen = len1 + len2 + 1;
22  vector<unsigned int> prevCol(len1 + len2 + 1);
23  for (unsigned int i = 0; i < len1; i++) {
24      prevCol[i] = i;
25  }
26  for (unsigned int i = 0; i < len2; i++) {
27      col[0] = i;
28      for (unsigned int j = 0; j < len2; j++) {
29          col[j + 1] = std::min( std::min( prevCol[i] + j + 1, col[j] ),
30                                prevCol[i] + s1[i] == s2[j] ? 0 : 1 );
31      }
32  }
33  return prevCol[0];
    }  
    static void  
    sameT( const char* table,  
           T* v1, size_t k, size_t l, size_t r );
```

# What makes a machine a machine?

What other things do machines need?

## 3. Compute power

How fast a machine can perform an operation  
CPUs, GPUs, Neuromorphic computing



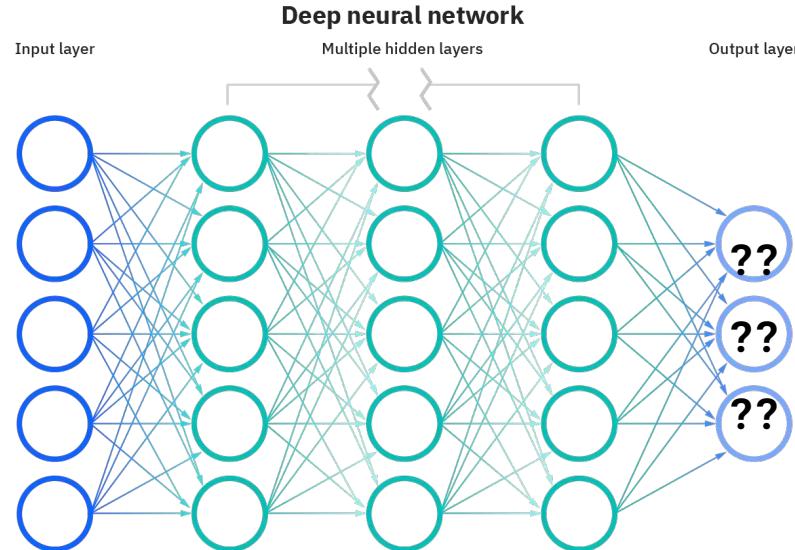
# Putting it All together

[1, [0, [0,  
0, 1, 0,  
0] 0] 1]



1. A lot of Data

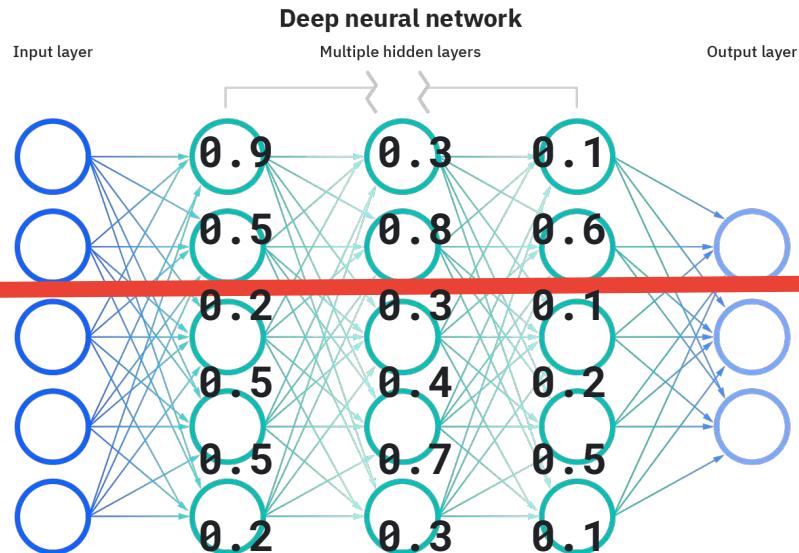
## 2. Algorithms



3. Compute power

# Making Guesses & Learning Weights

## 2. Algorithms



1. A lot of Data

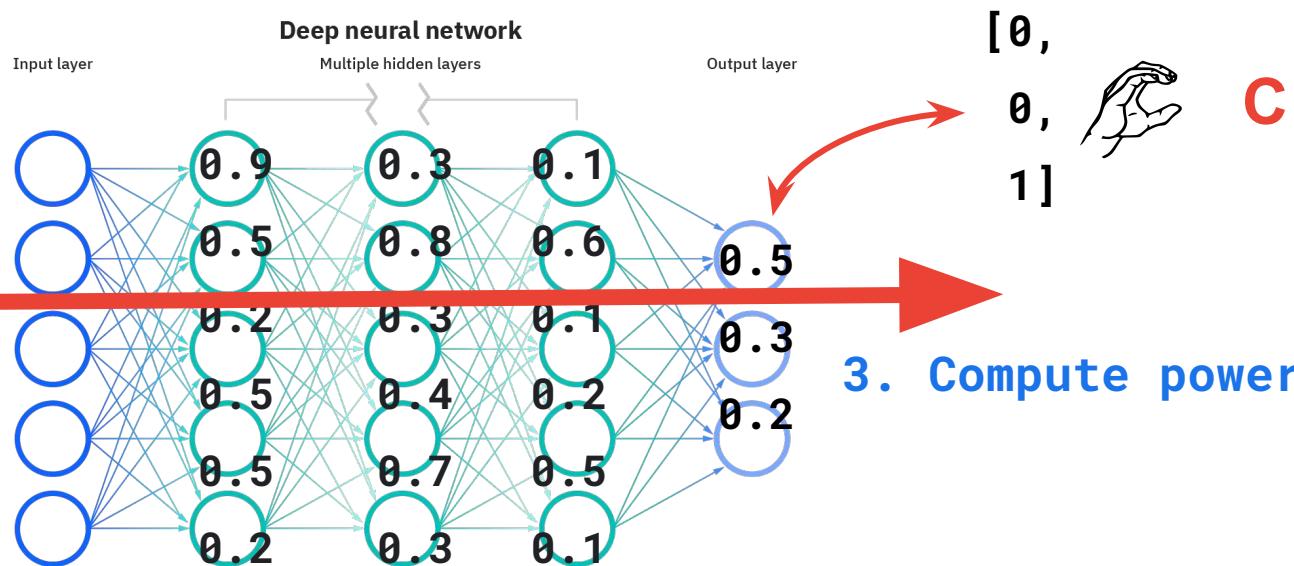
3. Compute power

Comparing the guesses  
with the correct results

## 2. Algorithms



1. A lot of Data

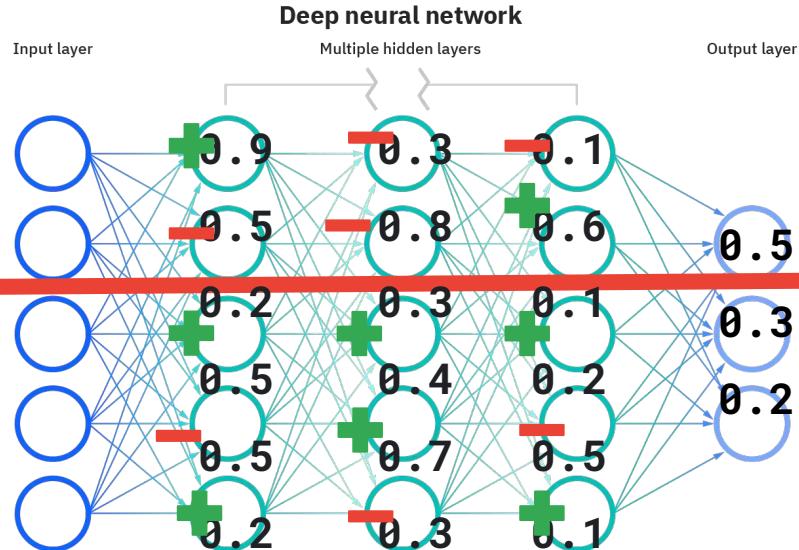


3. Compute power

## Correcting Errors & Updating weights

### 2. Algorithms

1. A lot of Data



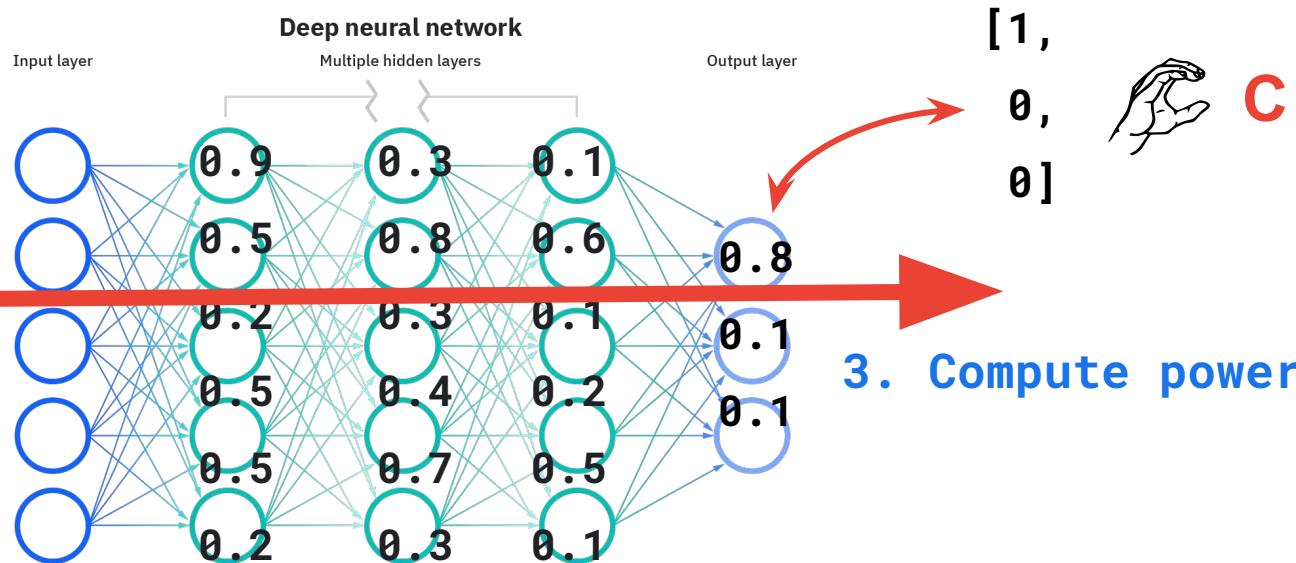
3. Compute power

Comparing the guesses  
with the correct results

## 2. Algorithms



1. A lot of Data



3. Compute power

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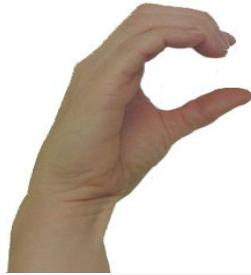
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' class="talk-name">< />  
lass="description">



### 3. Convolutional Neural Networks



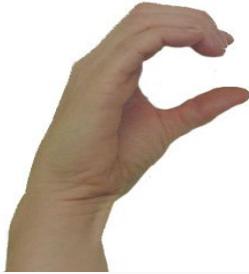
# Kernels and Convolution



Google Developer Student Clubs



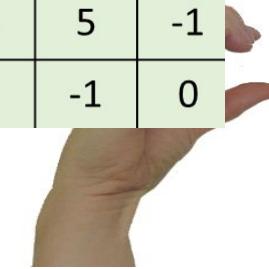
# Kernels and Convolution



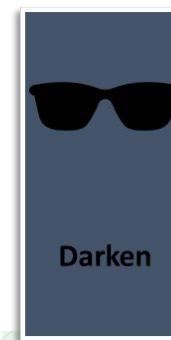
.06	.13	.06
.13	.25	.13
.06	.13	.06



0	-1	0
-1	5	-1
0	-1	0



0	0	0
0	1.5	0
0	0	0



0	0	0
0	0.5	0
0	0	0

## Blur Kernel

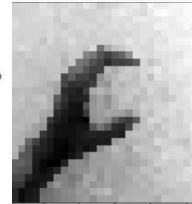
.06	.13	.06
.13	.25	.13
.06	.13	.06



## Original Image

1	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	1	0
0	1	1	1	1	0
1	0	1	1	0	1
1	1	0	0	1	1

## Convolved Image

## Blur Kernel

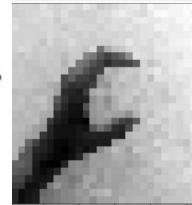
.06	.13	.06
.13	.25	.13
.06	.13	.06



## Original Image

1	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	1	0
0	1	1	1	1	0
1	0	1	1	0	1
1	1	0	0	1	1

## Convolved Image

## Blur Kernel

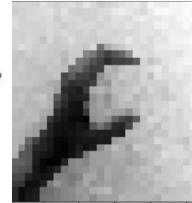
.06	.13	.06
.13	.25	.13
.06	.13	.06



## Original Image

1	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	1	0
0	1	1	1	1	0
1	0	1	1	0	1
1	1	0	0	1	1

## Convolved Image

# Kernels and Convolution

Blur Kernel

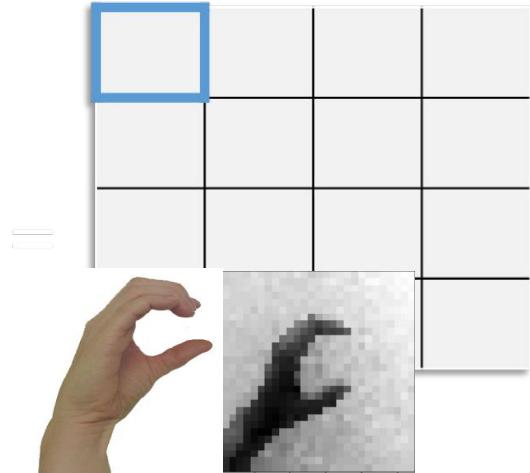
Multiply

.06	0	.06			
0	.25	0			
.06	.13	.06			
.13	.25	.13			
.06	.13	.06			

Original Image

.06	0	.06	1	0	1
0	.25	0	0	1	0
.06	.13	.06	1	1	0
.13	.25	.13	0	1	1
.06	.13	.06	1	0	1
0	1	1	1	1	0
1	0	1	1	0	1
1	1	0	0	1	1

Convolved Image



# Kernels and Convolution

Blur Kernel

.06	.13	.06
.13	.25	.13
.06	.13	.06

Original Image

.06	0	.06	1	0	1
0	.25	0	0	1	0
0	.13	.06	1	1	0
0	1	1	1	1	0
1	0	1	1	0	1
1	1	0	0	1	1

Convolved Image

.56



## Blur Kernel

.06	.13	.06
.13	.25	.13
.06	.13	.06

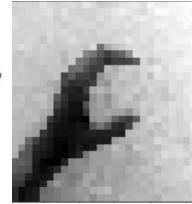


## Original Image

1	0	.13	.06	0	1
0	.13	0	0	1	0
0	.06	.13	.06	1	0
0	1	1	1	1	0
1	0	1	1	0	1
1	1	0	0	1	1

## Convolved Image

56	.57	



## Blur Kernel

.06	.13	.06
.13	.25	.13
.06	.13	.06

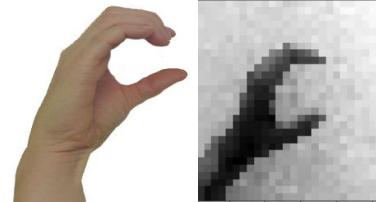
\*

## Original Image

1	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	1	0
0	1	1	1	1	0
1	0	1	1	0	1
1	1	0	0	1	1

=

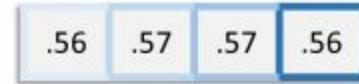
.56	.57	.57	.56
.7	.82	.82	.7
.69	.95	.95	.69
.64	.69	.69	.64



# STRIDE

Stride 1

1	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	1	0



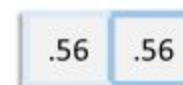
Stride 2

1	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	1	0



Stride 3

1	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	1	0



## Original Image

1	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	1	0
0	1	1	1	1	0
1	0	1	1	0	1
1	1	0	0	1	1

## Zero Padding

0	0	0	0	0	0	0	0
0	1	0	1	1	0	1	0
0	0	1	0	0	1	0	0
0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	1	0	1	1	0	1	0
0	1	1	0	0	1	1	0
0	0	0	0	0	0	0	0

# PADDING

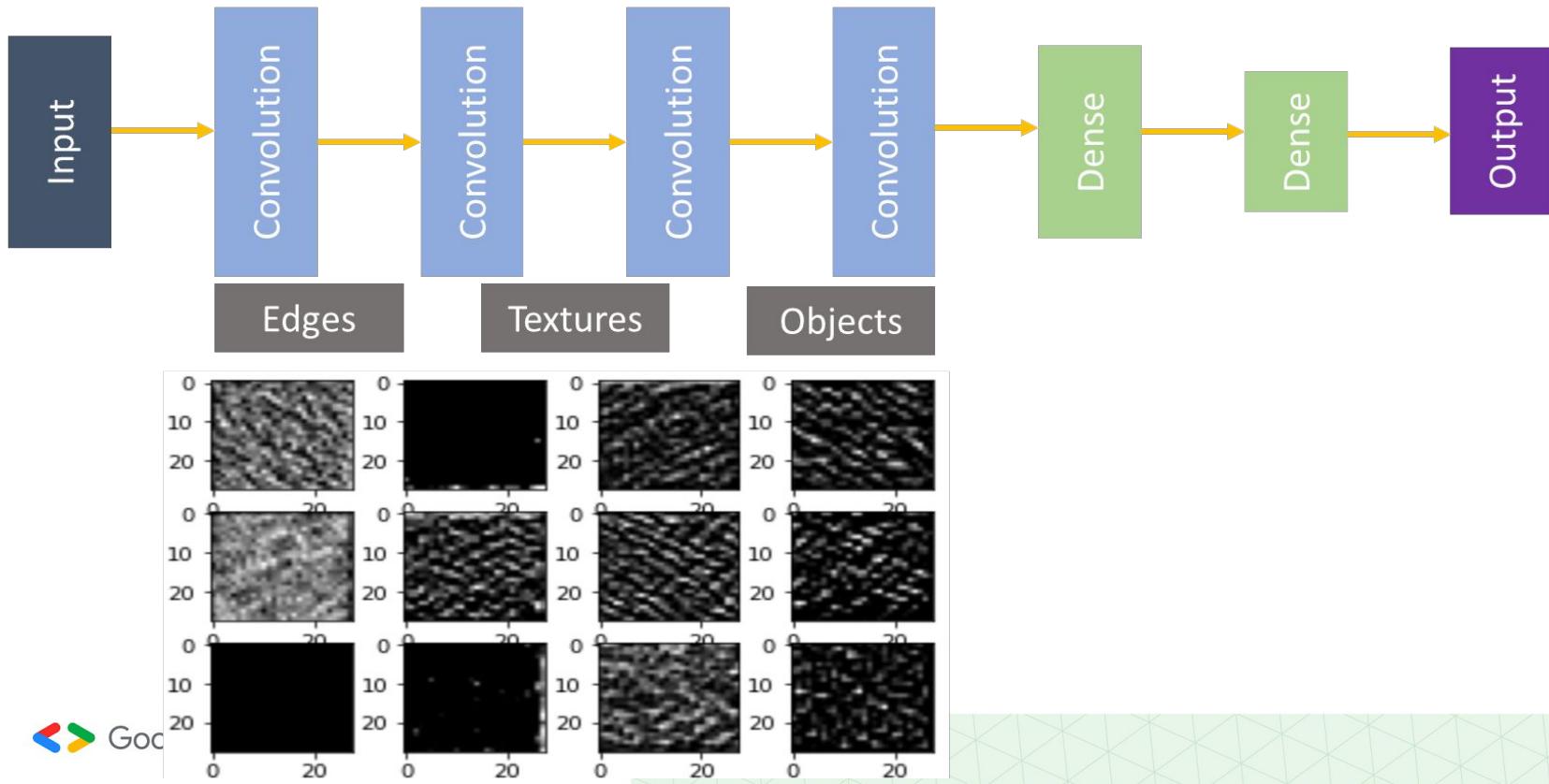
Original Image

1	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	1	0
0	1	1	1	1	0
1	0	1	1	0	1
1	1	0	0	1	1

Mirror Padding

1	1	0	1	1	0	1	1
1	1	0	1	1	0	1	1
0	0	1	0	0	1	0	0
0	0	1	0	0	1	0	0
0	0	1	0	0	1	0	0
1	1	0	1	1	0	1	1
1	1	1	0	0	1	1	1
1	1	1	0	0	1	1	1

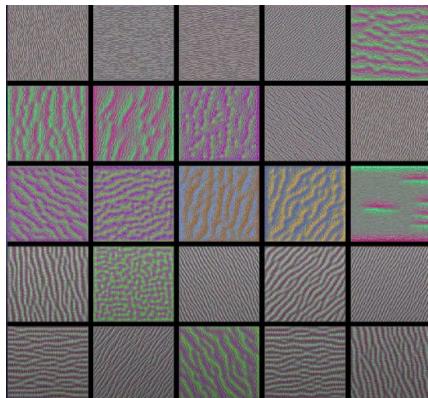
# Neural Network Perception



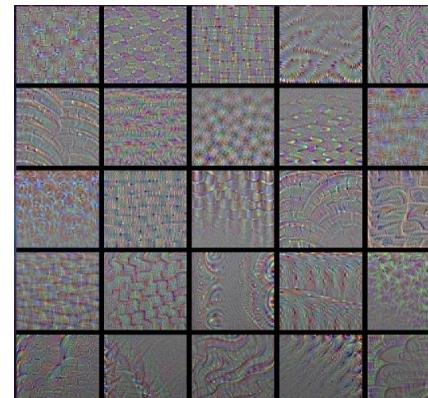
Convolution block 1



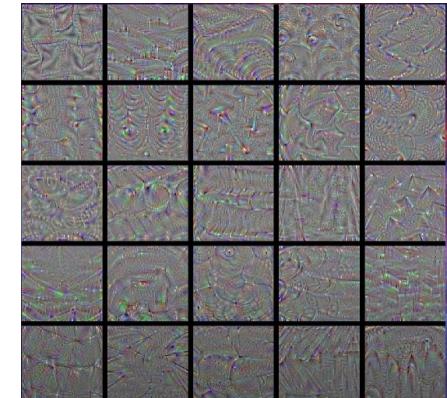
Convolution block 2



Convolution block 3



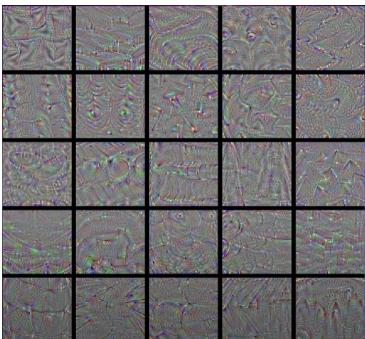
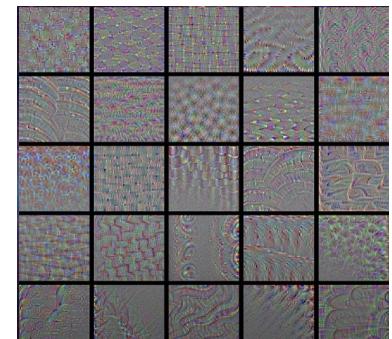
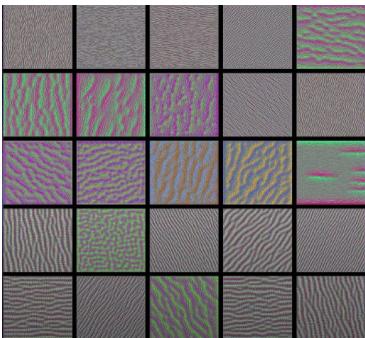
Convolution block 4



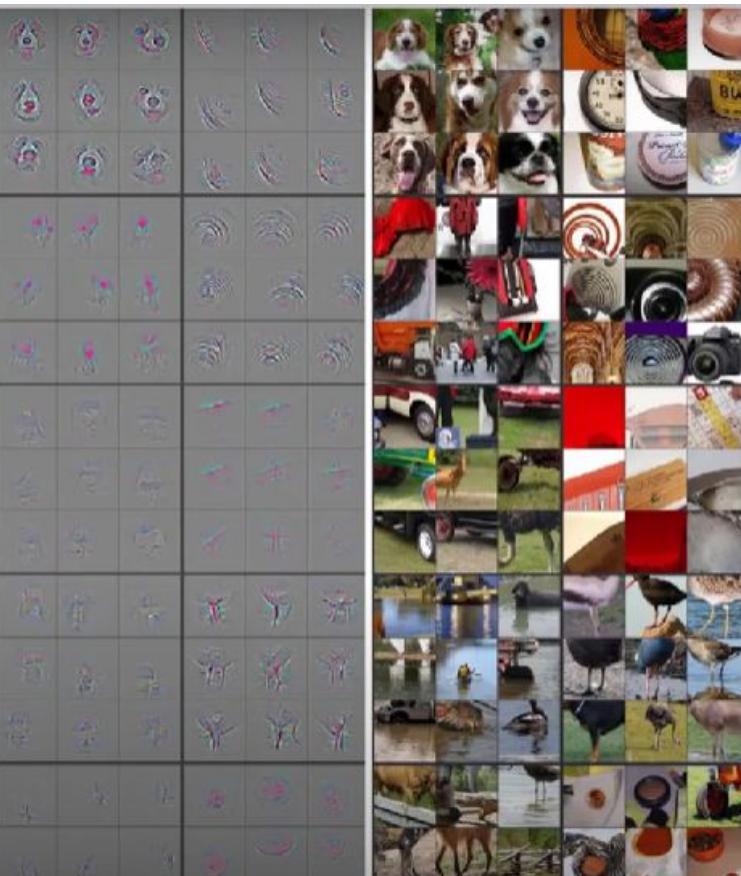
Convolution block 1



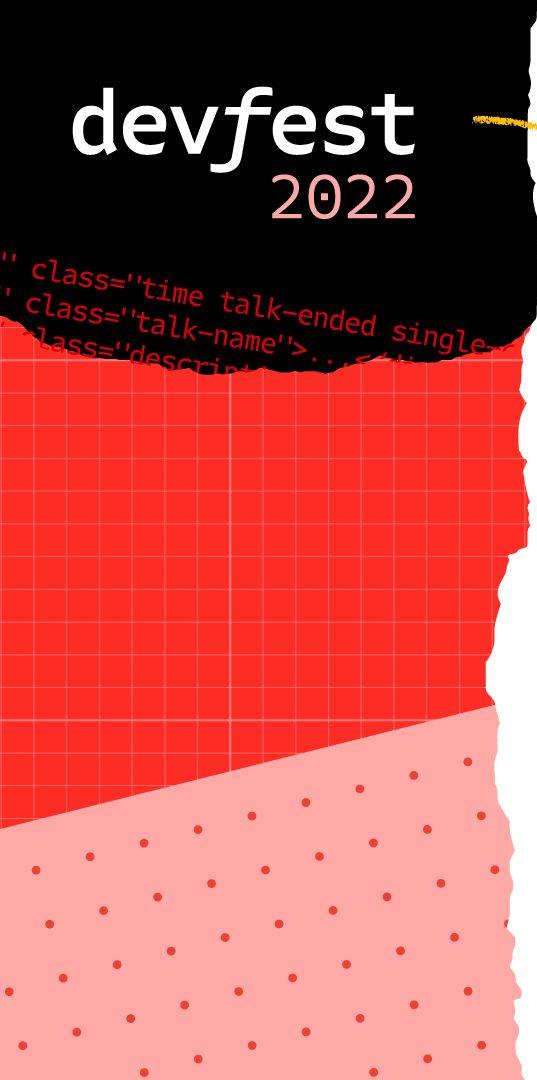
Convolution block 2



Convolution block 3



Convolution block 4

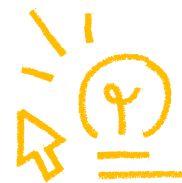


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' class="talk-name'>...  
lass="descriptio...
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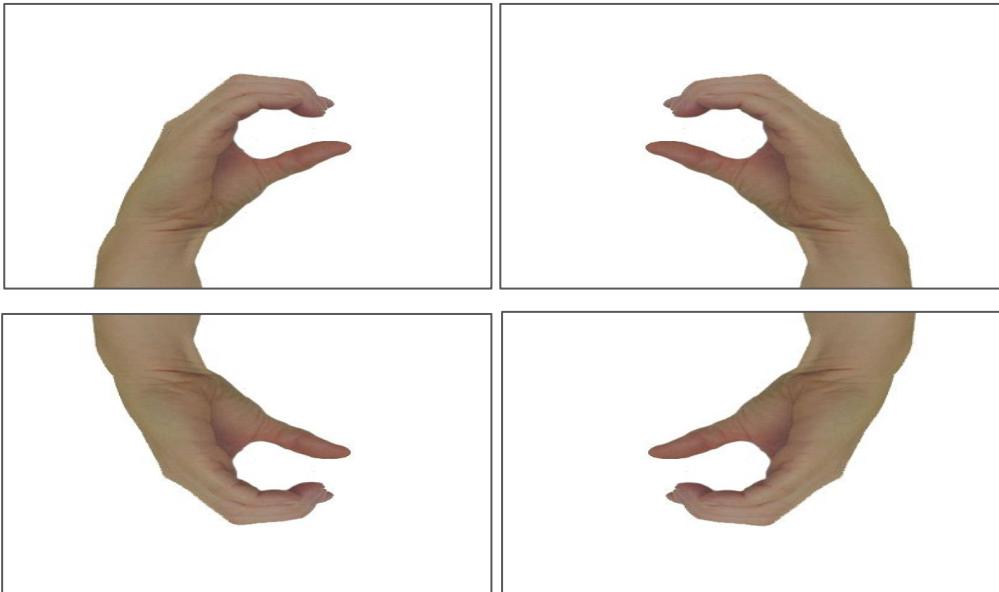
## 4. Image Data Augmentation



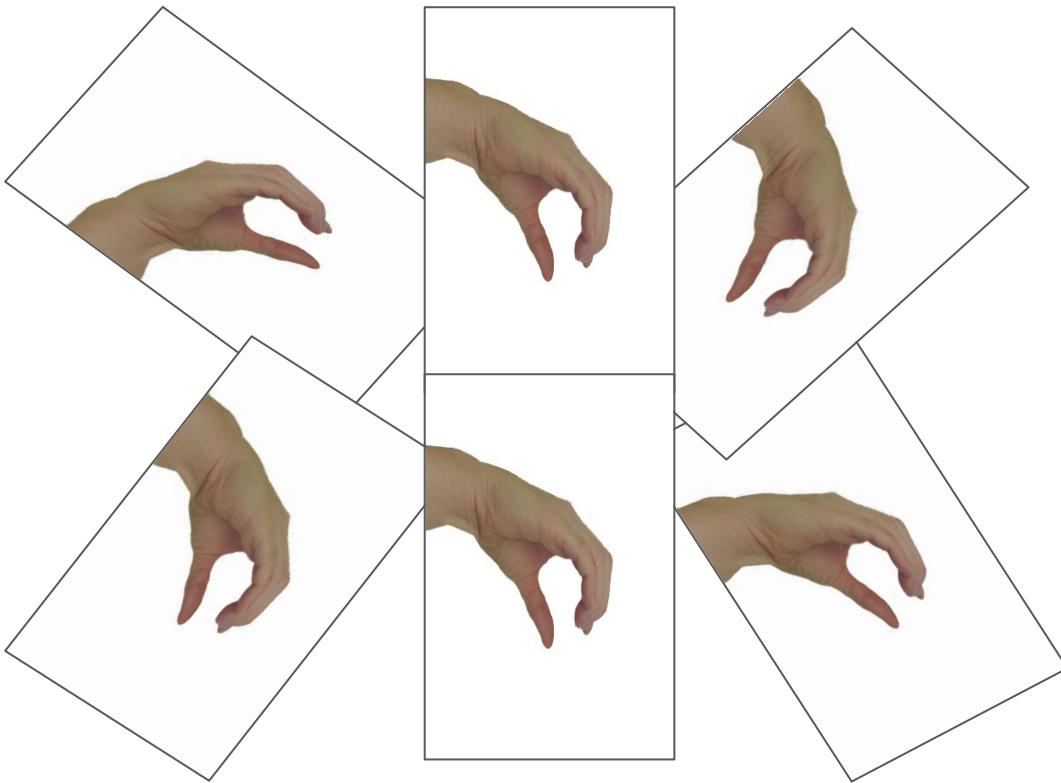
# Image Flipping

Vertical Flipping

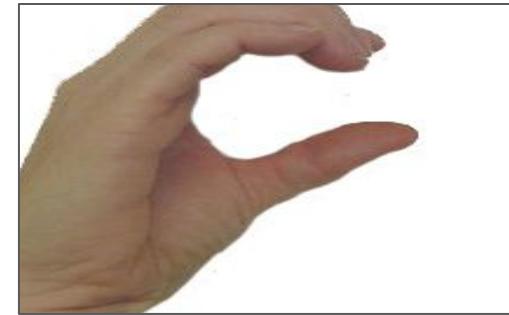
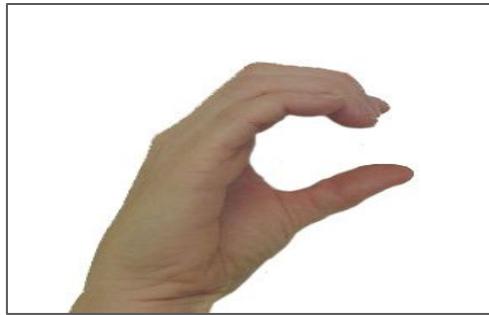
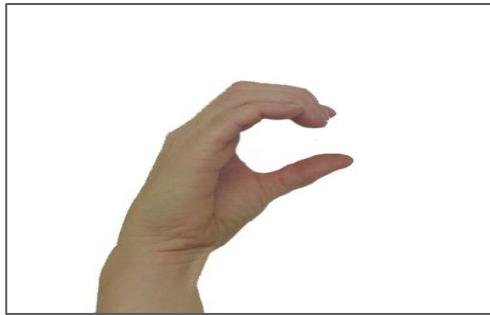
Horizontal Flipping



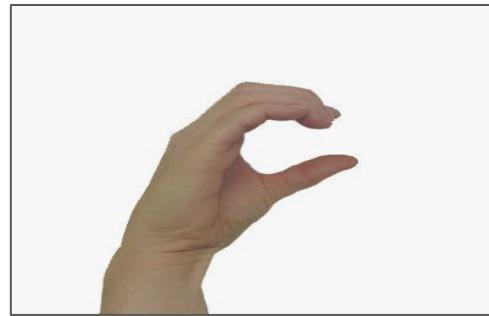
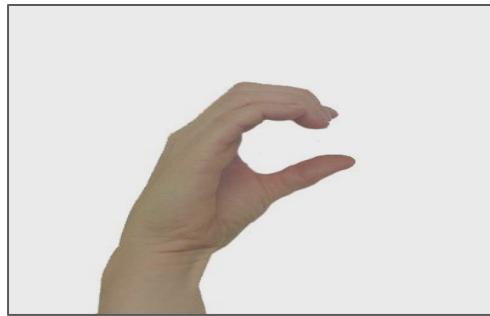
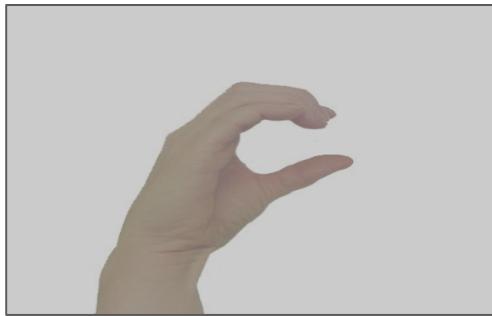
# Rotation



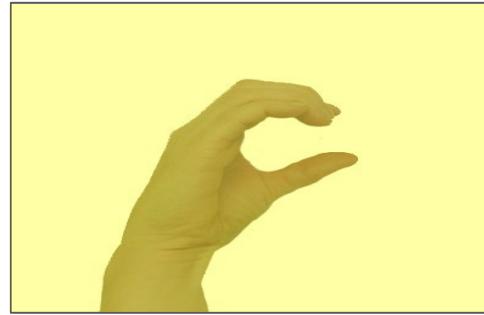
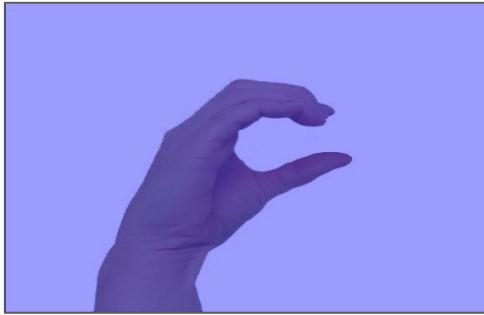
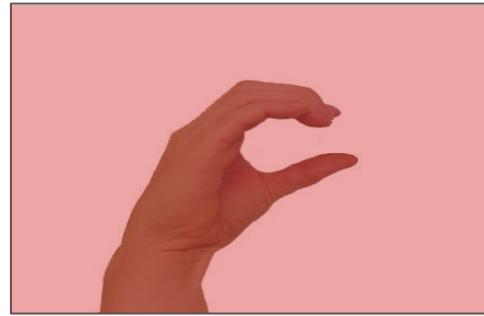
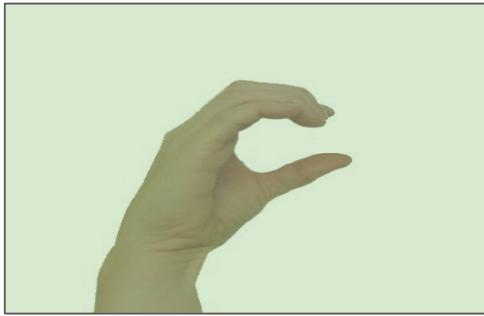
# Zooming



# Brightness



# Channel shifting



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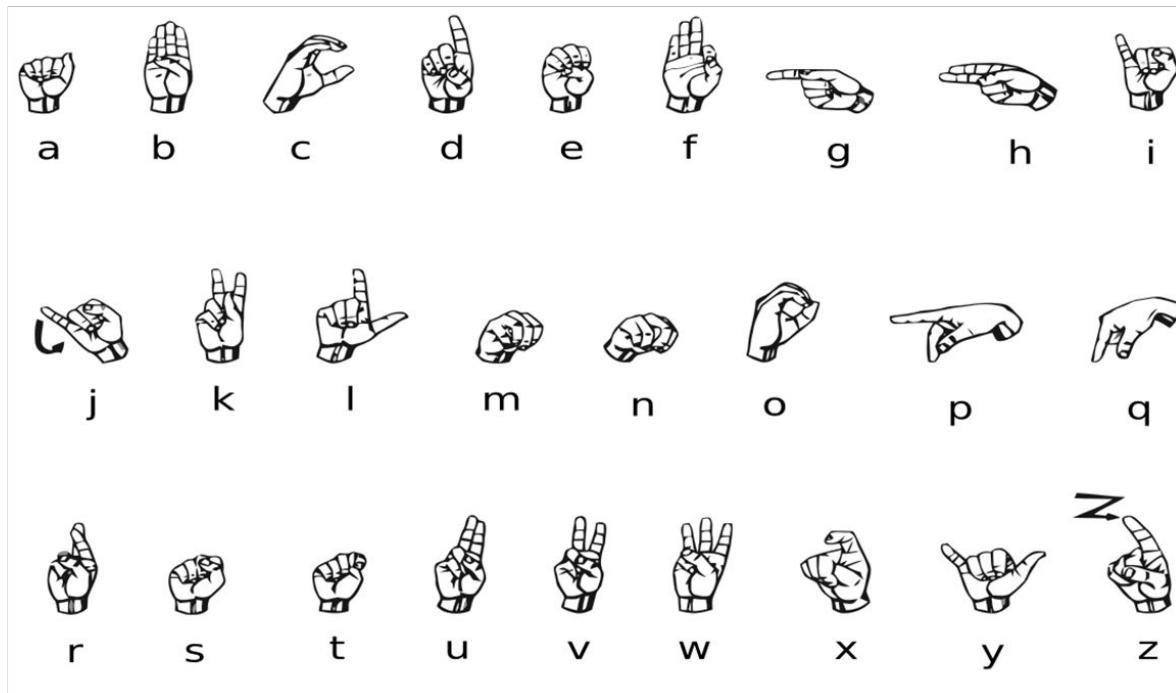
```
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' class="talk-name"><h3>  
lass="descriptio
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## 4. Bring it all Together!

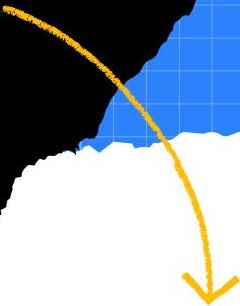


# The American Sign Language Alphabet



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## Introduction to Computer Vision and Image Processing

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Nourchene Ferchichi  
ML Google Developer Expert  
NVIDIA DLI Ambassador