Machine Learning Opens Up New Ways to Help Disabled People

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May 23, 2017

Keywords

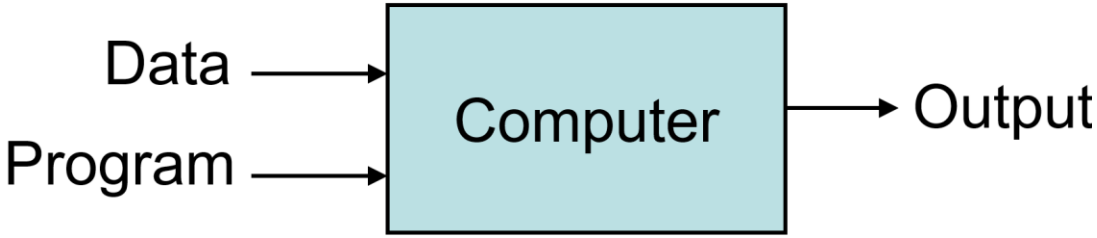
Machine learning

People are taking about it

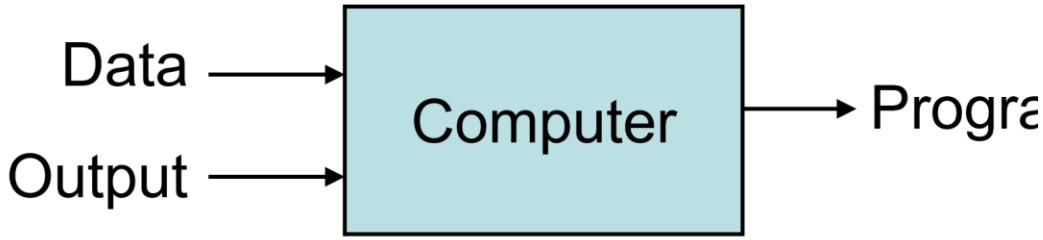
Machine learning gives computers the ability to learn without being explicitly programmed.

-Arthur Samuel, 1959

Traditional Programming



Machine Learning



From Data To Model

Components

- Tens of thousands of machine learning algorithms
- Hundreds new every year
- Every machine learning algorithm has three components:
  - **Representation**
  - **Evaluation**
  - **Optimization**

Representation

- Decision trees
- Sets of rules / Logic programs
- Instances
- Graphical models (Bayes/Markov nets)
- Neural networks
- Support vector machines
- Model ensembles
- Etc.

Evaluation

- Accuracy
- Precision and recall
- Squared error
- Likelihood
- Posterior probability
- Cost / Utility
- Margin
- Entropy
- K-L divergence
- Etc.

Optimization

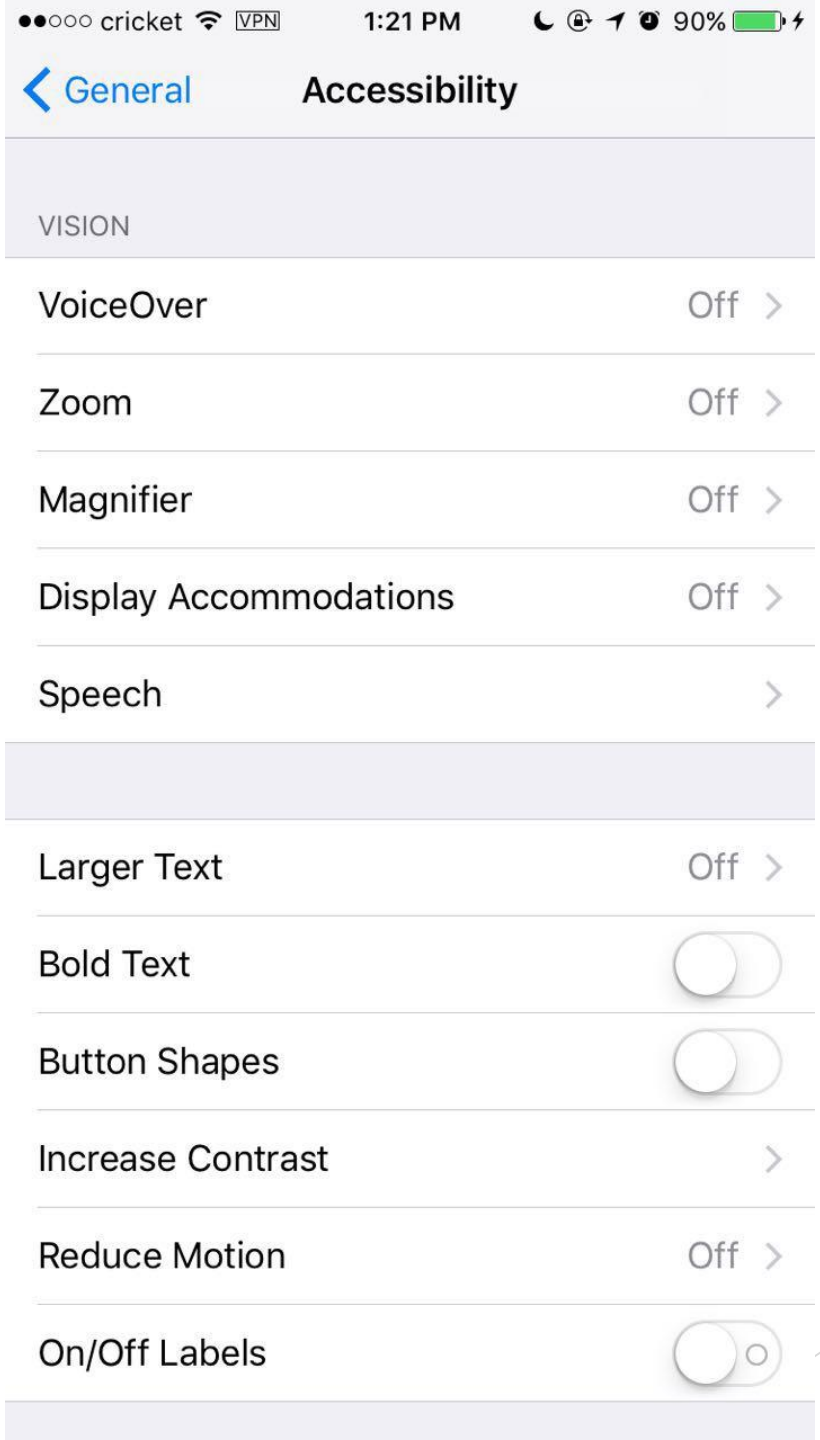
- Combinatorial optimization
  - E.g.: Greedy search
- Convex optimization
  - E.g.: Gradient descent
- Constrained optimization
  - E.g.: Linear programming

Machine Learning

- Representation
- Evaluation
- Optimization

Accessibility

When we have a hammer


●●○○○ cricket VPN
1:21 PM
90%
General
Accessibility
VISION
VoiceOver
Off
Zoom
Off
Magnifier
Off
Display Accommodations
Off
Speech
Larger Text
Off
Bold Text
Button Shapes
Increase Contrast
Reduce Motion
Off
On/Off Labels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1:21 PM
90%
General
Accessibility
On/Off Labels
INTERACTION
Switch Control
Off
AssistiveTouch
On
Touch Accommodations
Off
Keyboard
Shake to Undo
On
Vibration
On
Call Audio Routing
Automatic
Home Button
Reachability
Double-tap the home button to bring the top of the screen into reach.
HEARING


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1:21 PM
90%
General
Accessibility
HEARING
Hearing Devices
TTY
Off
LED Flash for Alerts
Off
Mono Audio
Phone Noise Cancellation
Noise cancellation reduces ambient noise on phone calls when you are holding the receiver to your ear.
L
R
Adjust the audio volume balance between left and right channels.
MEDIA
Subtitles & Captioning
Audio Descriptions
Off

New ways

YouTube, Facebook, IBM …

What do they do?

Visualizing Sound Effects

YouTube

Visualizing Sound Effects

- Captions – Ten years ago
- Then Automated Captions


Je t'aime
Jane

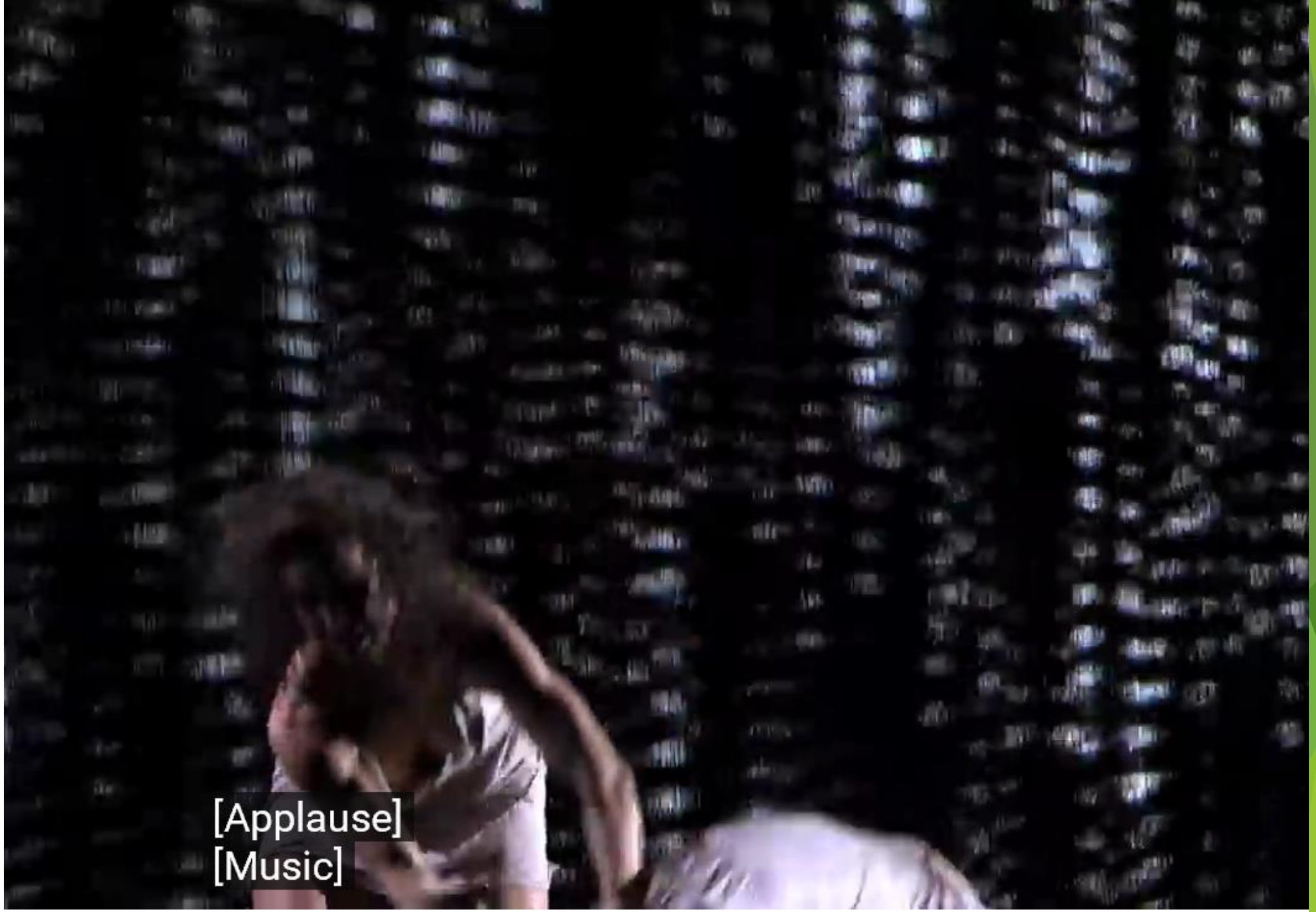
Visualizing Sound Effects

- [APPLAUSE]
- [MUSIC]
- [LAUGHTER]


America's
got Talent
AUDITIONS


[Music]


[Applause]
[Music]


[Applause]
[Music]

“Machine learning is giving people like me that need accommodation in some situations the same independence as others”

-Liat Kaver, a product manager at YouTube who is deaf.

1, 000, 000, 000

accuracy close to human ears

Prospect for YouTube

- Interpreting sound, music, text
- ads, search, cloud computing

Image Recognition

Facebook


Carrier
1:20 PM
77%
Search
Whats on your mind?
Peter Cottle
March 6 at 10:14 PM
We finally made it :)
Image may contain: two people, smiling, sunglasses, sky, outdoor, water
News Feed
Requests
Videos
Notifications
More
Carrier
1:20 PM
77%
Search
Whats on your mind?
Chelsea Kohler
March 6 at 10:14 PM
Sunday night splurge
Image may contain: pizza, food
48 Likes 6 Comments
Like
Comment
Share
Stephanie Hughes
Yesterday at 10:14 PM
News Feed
Requests
Videos
Notifications
More

Search by image

Search Google with an image instead of text. Try dragging an image here.

Paste image URL | **Upload an image**

Browse...


_DSC0669.JPG ×

conifer cone

All | Images | Maps | Shopping | More | Settings | Tools

About 2 results (0.77 seconds)

Image size:
5520 × 3680

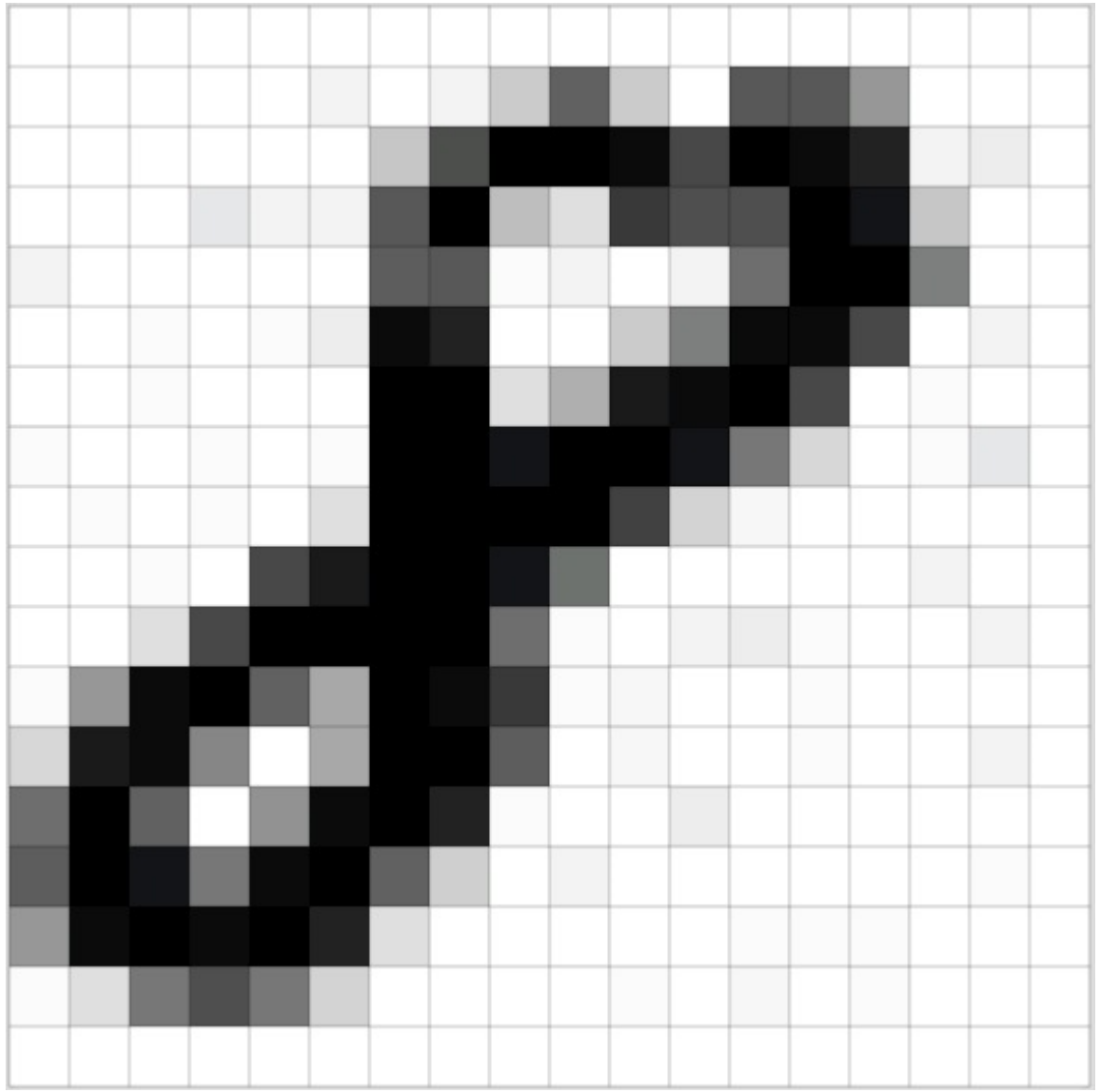
No other sizes of this image found.

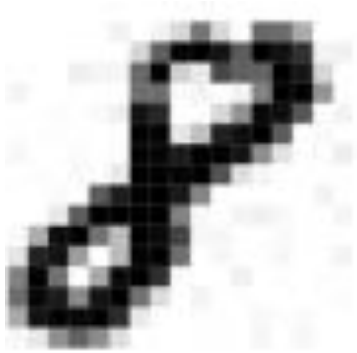
Best guess for this image: ***conifer cone***

Conifer cone - Wikipedia

https://en.wikipedia.org/wiki/Conifer_cone ▼

A **cone** is an organ on plants in the division Pinophyta (conifers) that contains the reproductive structures The familiar woody **cone** is the female **cone**, which ...





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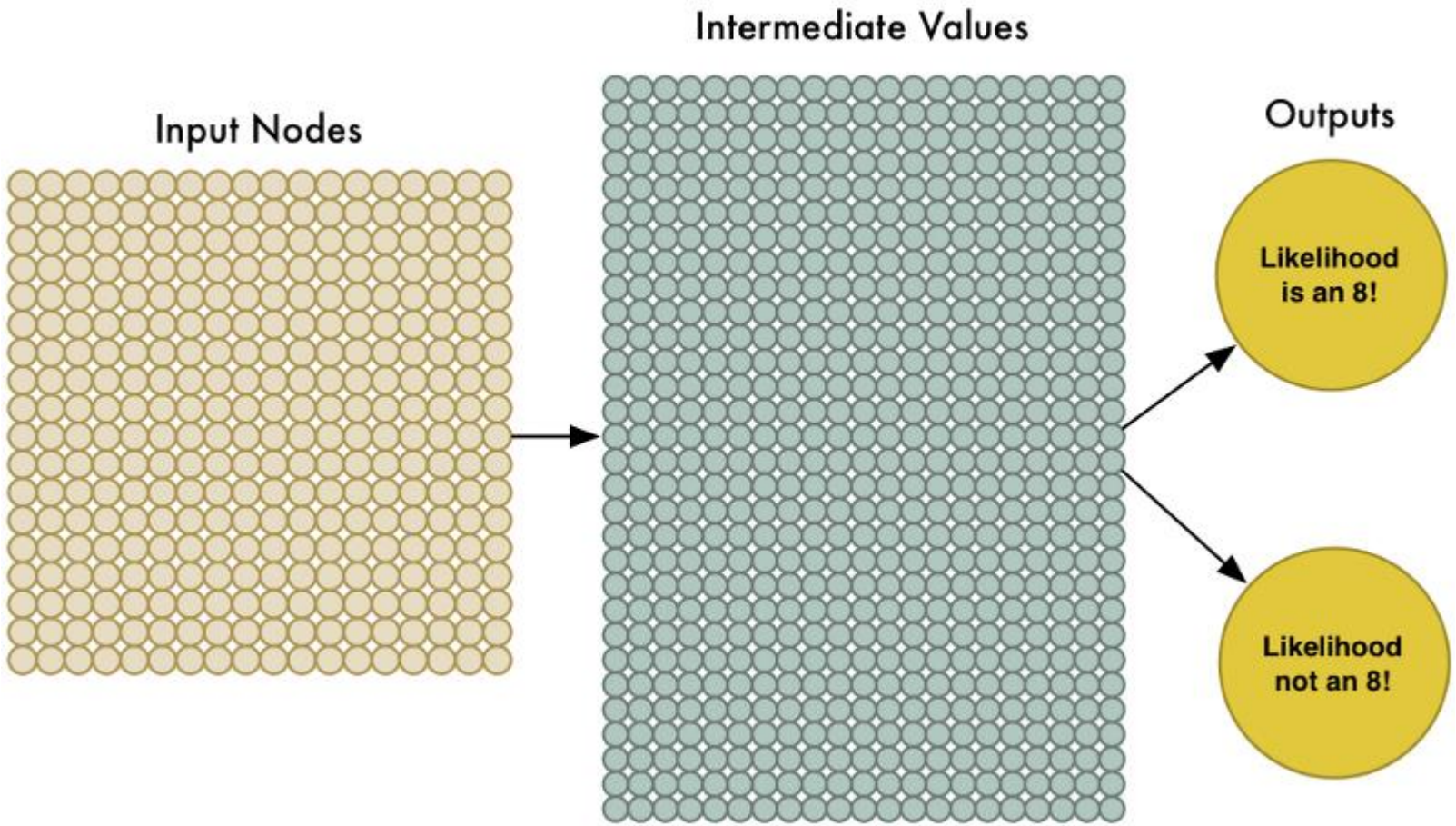

Intermediate Values
Input Nodes
Outputs
Likelihood is an 8!
Likelihood not an 8!

Train data set

Results


Test
Image #1
Prediction from
our network
100% an "8"!
Test
Image #2
Prediction from
our network
100% not an "8"!

Test Image #1

Prediction from our network

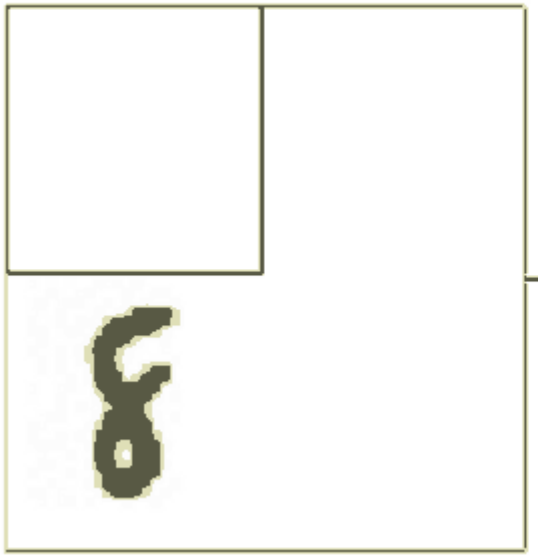
100% an "8"!

Test Image #2

Prediction from our network

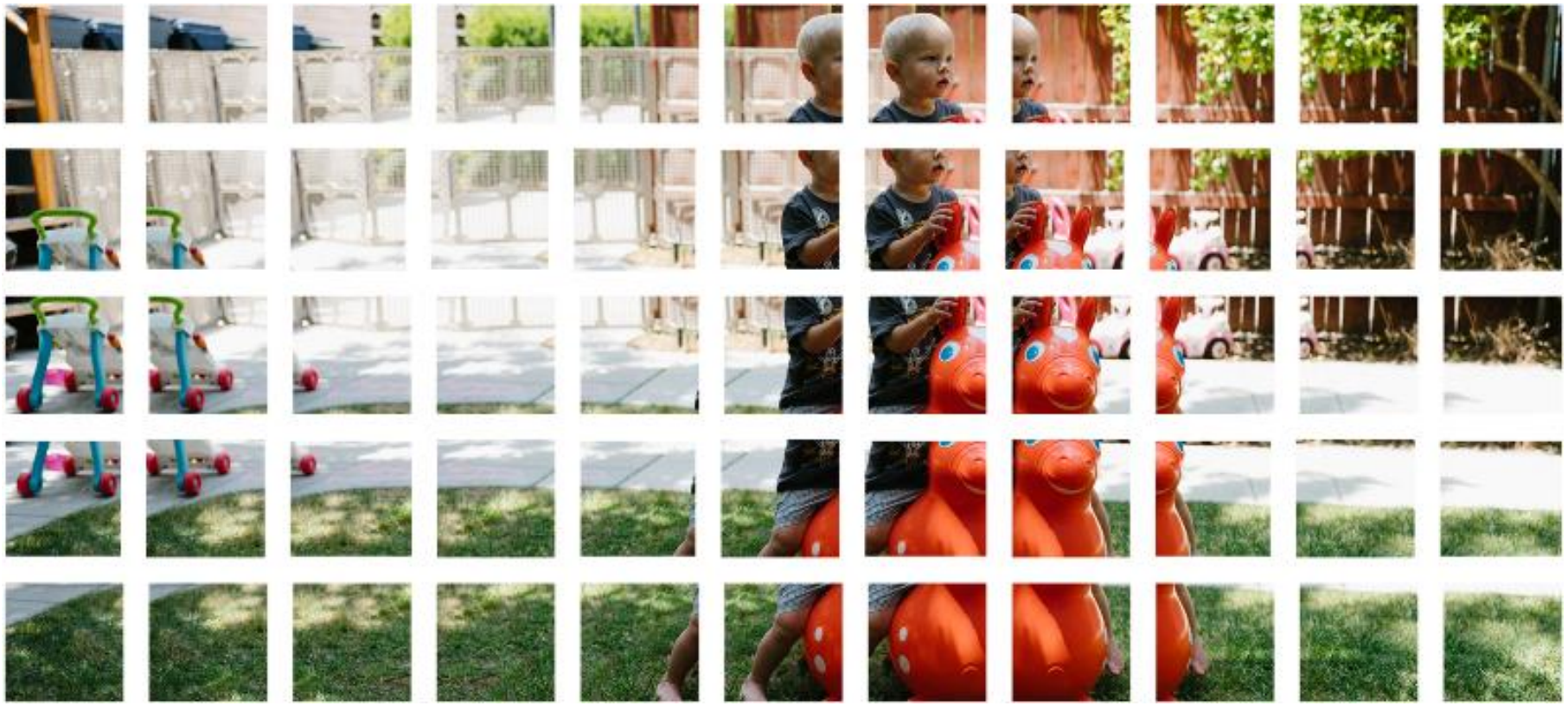
100% not an "8"!

Test Image



Prediction from our network

No idea!?!



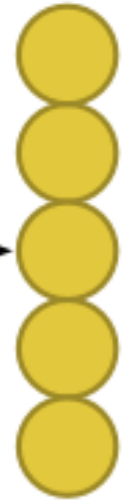
More Generally

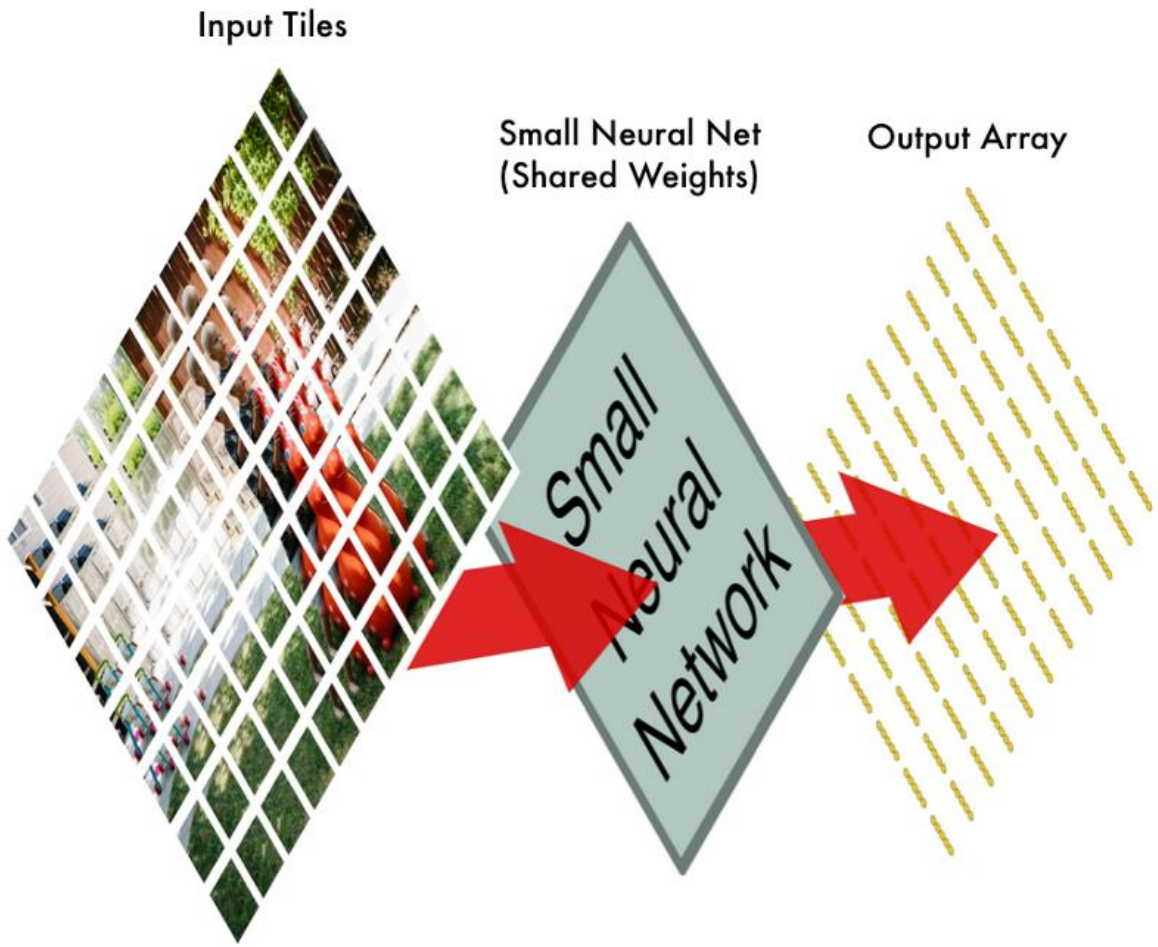
Processing a single tile

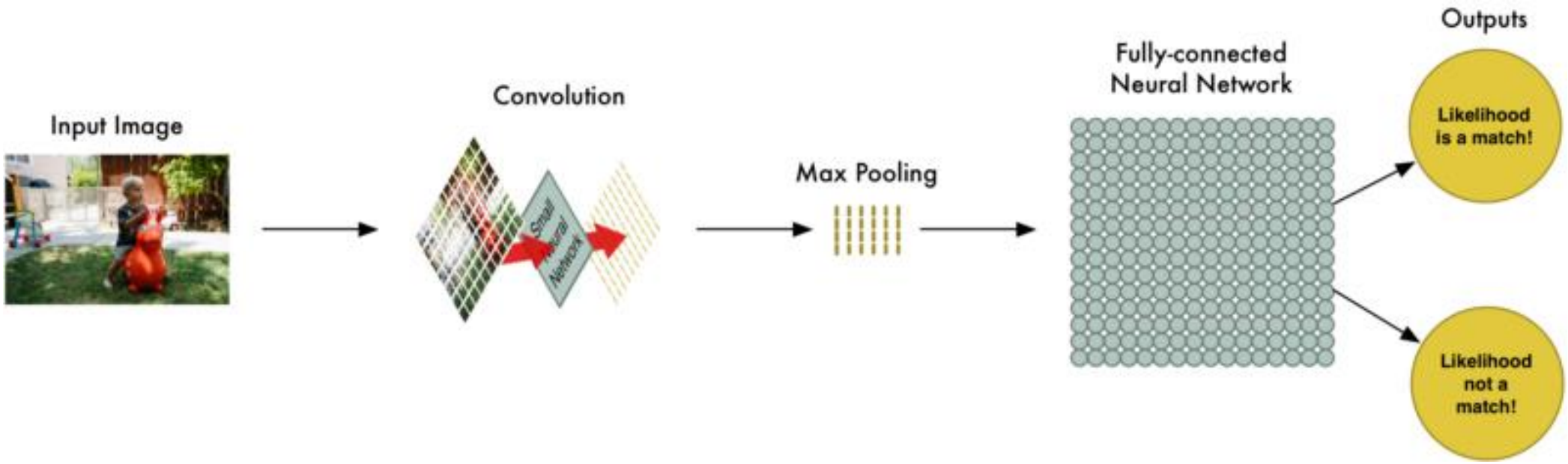
Input Tile

Small Neural Network

Outputs




Input Tiles
Small Neural Net
(Shared Weights)
Output Array
Small Neural Network



Get the result

IBM
EU Project

Text Simplification

Who need it?

- Cognitive and intellectual disabilities
- autism or dementia
  - difficulty in **communicating** and forming relationships with other people and in using **language and abstract concepts**
  - disorder of the mental processes caused by brain disease or injury and marked by **memory disorders, personality changes, and impaired reasoning**.

Raining cats and dogs

IBM & MIT

- helps autistic high schoolers transition to college life
- to prevent some people from being left behind

EU Project

- built into apps that integrate with Gmail and social networks such as Facebook

“People with intellectual disabilities, or any disability, want to do what their friends and sisters and brothers do—use smartphones, tablets, and social networking”

- Ineke Schuurman.

Problem

- A machine-learning algorithm recommending a movie you don’t care for is one thing
- An error that causes you to misunderstand a friend is another.

We build things

Works Cited

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Thank you

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