

Online Workshop: "Performing with a virtual agent: machine learning for live coding"

Day 2

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Music, Technology and Innovation - Institute for Sonic Creativity (MTI²)

De Montfort University

IKLECTIK 9.12.2020



mirlca.dmu.ac.uk

MIRLCAuto: A Virtual Agent for Music Information Retrieval in Live Coding

Partners: IKLECTIK, Leicester Hackspace, L'Ull Cec, Phonos, MTI²

Collaborators: TOPLAP Barcelona, FluCoMa

Awarded with an EPSRC HDI Network Plus Grant

Online Workshop Performing with a virtual agent: machine learning for live coding

London (IKLECTIK) 7/9/11.12.2020 -
19:00-21:00 (GMT)

Barcelona (L'Ull Cec)
11/13/15.1.2021 - 19:00-21:00 (CET)

Leicester (Leicester Hackspace)
25/27/29.1.2021 - 19:00-21.00 (GMT)

More info at:
mirlca.dmu.ac.uk/workshops

Partners



Collaborators



Materials / Working Tools

- **SuperCollider Extensions:** <http://tiny.cc/IKLECTIK-SC-extensions>
- **Working doc:** <https://pad.riseup.net/p/online-workshop-iklektik-keep>
- **Zoom / Zoom chat**
- **GitHub repo (tutorials, tickets):** <https://github.com/mirlca/iklektik-workshop>

An introduction to machine learning in live coding and task 1: Train an agent to assist meaningful querying to [Freesound.org](https://freesound.org)

```
Equinox-22-03-2020-19-30.scd
31
32 // Hello !
33
34
35
36
37
38
39 // Tag
40
41 a.tag("morse"+"two")
42
43
44 b|
45
46
47
48 c
49
50
51 d
52
53
54 e
55
56
:: Anna Xambó ::
```

```
Post window
server 'localhost' already booting
server 'localhost' already booting
server 'localhost' already booting
server 'localhost' already booting
server 'localhost' already booting
server 'localhost' already booting
server 'localhost' already booting
server 'localhost' already booting
-> a MIRCRep2
Booting server 'localhost' on address 127.0.0.1:57110.
Found 0 LADSPA plugins
Number of Devices: 8
0 : "Built-In Microph"
1 : "Built-In Output"
2 : "Scarlett 6i6 USB"
3 : "BlackHole 16ch"
4 : "Soundflower (2ch)"
5 : "Soundflower (64ch)"
6 : "ZoomAudioDevice"
7 : "Multi-Output Device"

"Scarlett 6i6 USB" Input Device
Streams: 1
0 channels 6

"BlackHole 16ch" Output Device
Streams: 1
0 channels 16

SC_AudioDriver: sample rate = 44100.000000, driver's block size = 512
SuperCollider 3 server ready.
Requested notification messages from server 'localhost'
localhost: server process's maxLogins (1) matches with my options.
localhost: keeping clientID (0) as confirmed by server process.
Shared memory server interface initialized
Sounds selected by tag: 1
curl -H 'Authorization: Token 5a837b803eb5a6da25dd3b42346fd6550080b919' 'https://www.free
-> a MIRCRep2
{"count":7,"next":null,"results":[{"id":47487,"name":"sw-13.wav","tags":["electronic","morse","noise"],
found sound by tag, id: 47487name: sw-13.wav
curl -H 'Authorization: Token 5a837b803eb5a6da25dd3b42346fd6550080b919' 'https://www.free
{"id":47487,"url":"https://freesound.org/people/galeku/sounds/47487/","name":"sw-13.wav","tags"
curl -H 'Authorization: Token 5a837b803eb5a6da25dd3b42346fd6550080b919' 'https://freesound
[0]: id: 47487 name: sw-13.wav by: galeku dur: 83.5293

Interpreter: Active Server: 0.22% 0.29% 8u 1s 52g 134d 0.0dB M R
```

“Crowdsourced Eulerisms”. Eulerroom Equinox 2020.
Streaming from Sheffield, UK. March 23, 2020.

MIRCRep 2.0

Unwanted Situations: The Guitar Case

n02-peterMann

from [noiselets](#) by [carpal tunnel](#)



04:13 / 11:10



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Streaming + Download

Includes high-quality download in MP3, FLAC and more. Paying supporters also get unlimited streaming via the free Bandcamp app.

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Buy the Full Digital Album

from [noiselets](#), released January 8, 2018

List of sounds used from [Freesound.org](#) coming soon.

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<https://carpal-tunnel.bandcamp.com/track/n02-petermann> (around 04:26)

Research Question

Can we build a **virtual agent live coder companion** that **learns** from human live coders using **machine learning** algorithms and a **large dataset of sounds** which goes beyond the approach of following live coder actions (also known as the call-response strategy) and creates **legible and negotiable actions**?

How?

1. Identify ML tasks.
2. Implement the ML tasks with suitable tools.
3. Test the implemented ML tasks.

1. Identify ML Tasks

Identify ML Tasks

- **Two tasks identified (supervised learning):**
 1. **NN-1** learns my musical taste when retrieving sounds from Freesound: do I like it or not?
 2. **NN-2** learns to reply (call-response) with another query based on the existing sound and my musical taste. The response can be based on pitch, bmp or similarity.
- **For each NN:**
 - Phase 1. **Training.**
 - Phase 2. **Testing.**

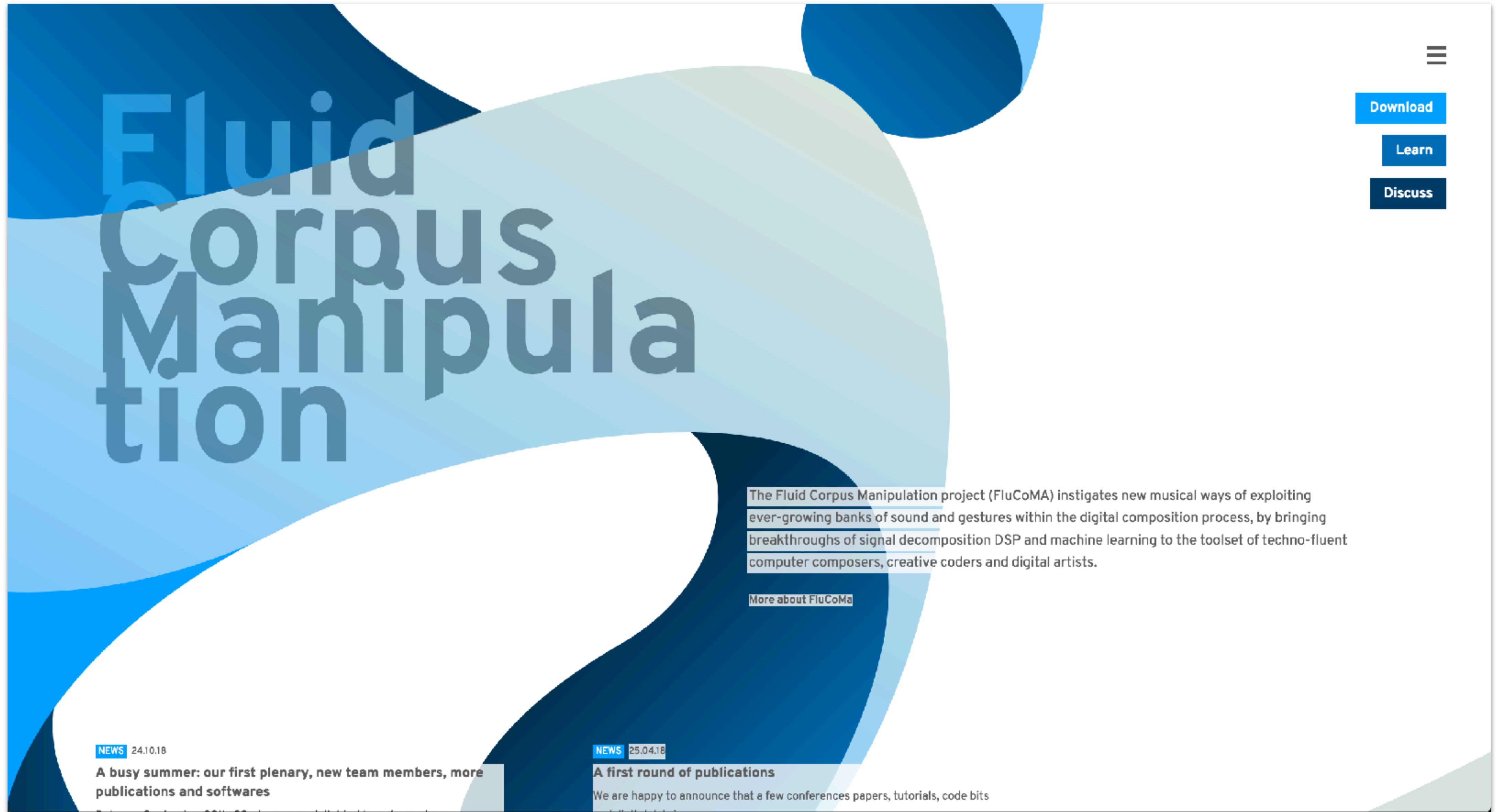
Identify ML Tasks

- **Two tasks identified:**
 1. **NN-1** learns my musical taste when retrieving sounds from Freesound: do I like it or not?
 2. **NN-2** learns to reply (call-response) with another query based on the existing sound and my musical taste. The response can be based on pitch, bmp or similarity.
- **For each NN:**
 - Phase 1. **Training.**
 - Phase 2. **Testing.**

NN-1: Learning my musical taste





1. Choose a set of relevant sound descriptors that characterise the sound samples from Freesound, e.g.:
 - pitch
 - rhythm (bpm)
 - brightness (spectral centroid)
 - noisiness (spectral flatness)
2. Map these sound descriptors to input layers of the NN (encode the information into meaningful numbers).

2. Implement the ML tasks with suitable tools



<https://www.flucoma.org>

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Category	Topics	Latest
Code Sharing This is a place where you can share your proudest code gems, ideally using the toolbox.	97	 ✚ Fluid Corpus Manipulation Toolbox (was Fluid Decomposition) v.1.0.0 Release Candidate 1 is here! Code Sharing 25 May 11
New Ideas This is a place where blue sky ideas of what the toolbox could do for you, how it could be stirred or extended, from an aesthetics/musical and/or a technological and/or a workflow standpoint.	87	 🔒 ✚ Welcome to Discourse 2 Nov '19
Usage Questions This is a place to ask any question from a usage perspective: a task you want to discuss the different ways to achieve.	88	 Francophone members: a superb presentation of Jacob's work on Rodrigo's work, at the Journées d'Informatique Musicale Interesting Links 2 22h
Learning Resources This is a place where you can share any good resource you found out there in the world that explained clearly a concept or a technology linked to corpus manipulation.	29	 Mellite -> Negatum genetic programming of synthetic sounds Interesting Links 0 2d

<https://discourse.flucoma.org>



Fluid Corpus Manipulation

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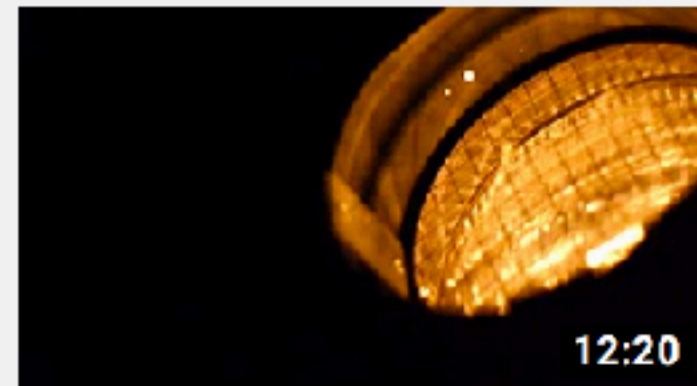
DISCUSSION

ABOUT



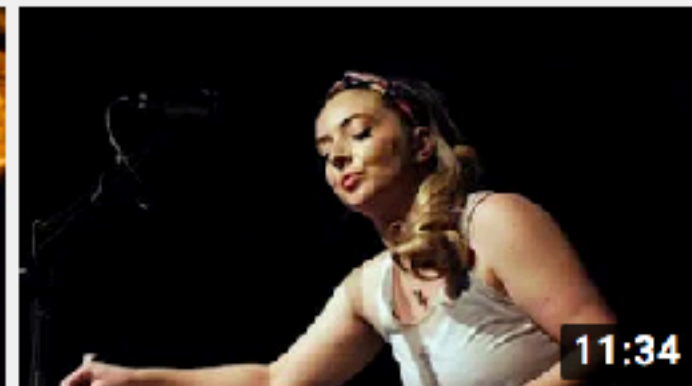
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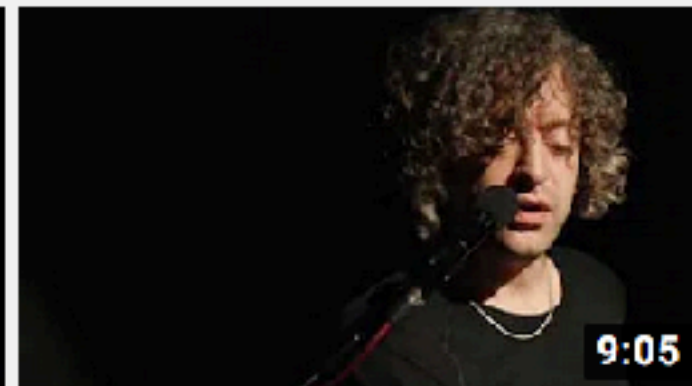
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Lauren Sarah Hayes: Moon via Spirit

723 views • 9 months ago



Owen Green: Race to the Bottom

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Leafcutter John: Line Crossing

250 views • 10 months ago



Rodrigo Constanzo: Kaizo Snare

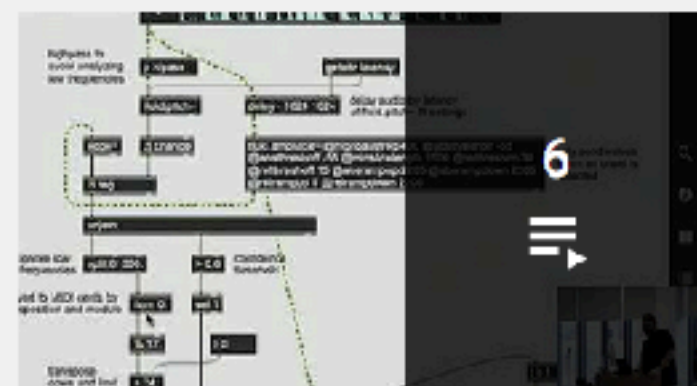
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Reactive Flows - Presentation

286 views • 1 year ago

Created playlists



Plenary 3 Presentations: Traces of Fluid Decomposition

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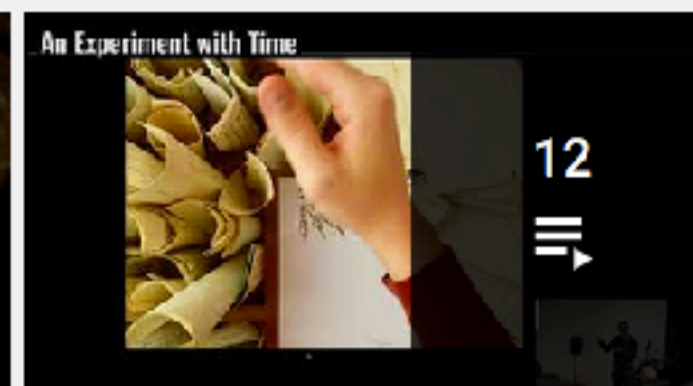
Plenary 3 Presentations: Creative Coding Guests

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Reactive Flows

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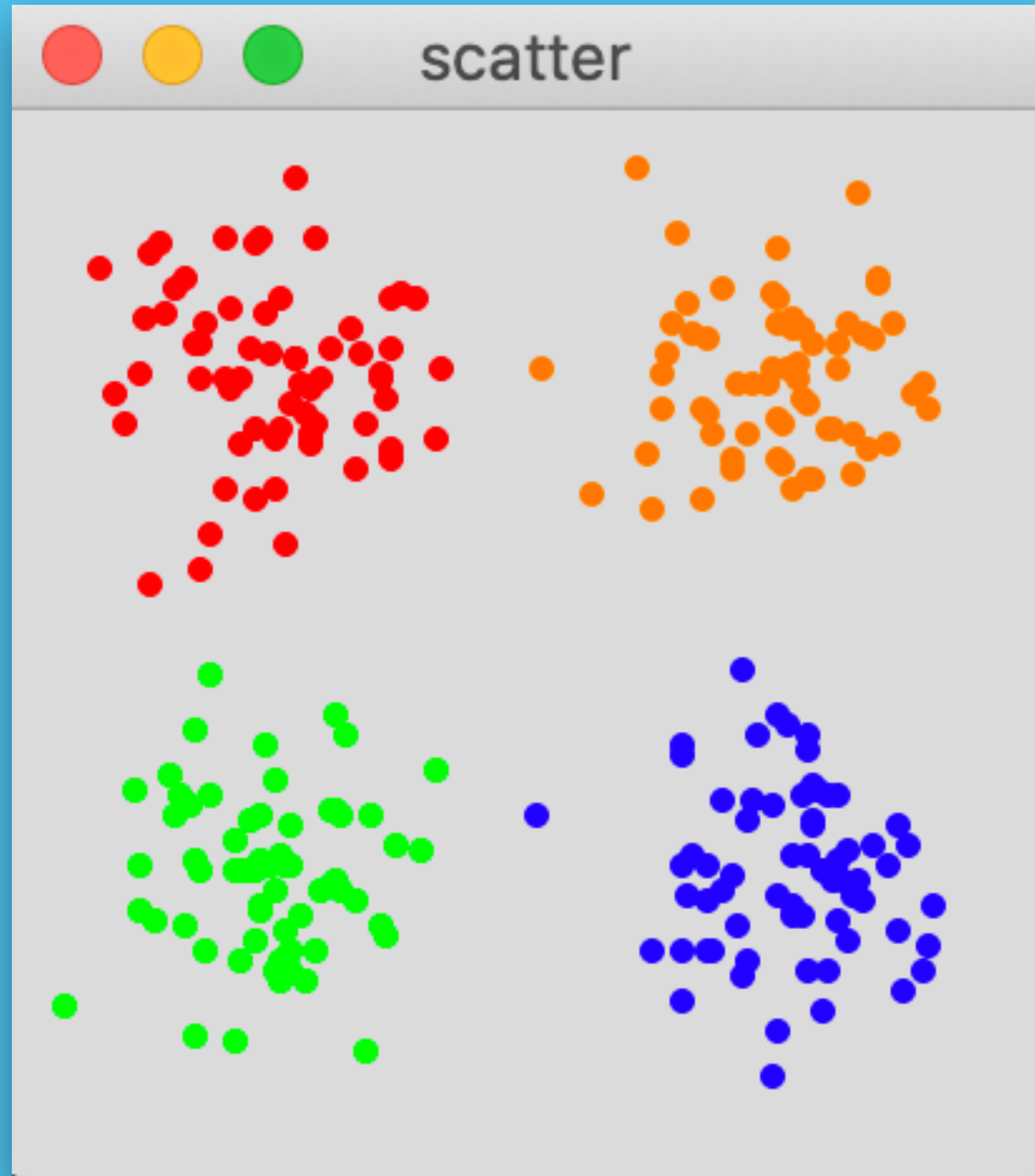


Plenary 1 Presentations: Creative Use of Music Technology

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Fluid Corpus Manipulation YouTube channel:
<https://www.youtube.com/channel/UCw44GjWHPQs0PKnj2OJmWCA>

Flucoma Multilayer Perceptron (MLP) neural network (NN)



- **FluidMLPClassifier:** Perform classification using a MLP NN (NN-1 task).

FluidMLPClassifier

: [FluidRTDataClient](#) : [FluidDataClient](#) :



[FluidManipulationClient](#) : [Object](#)

Classification with a multi-layer perceptron

Source: [FluidMLP.sc](#)

See also: [FluidMLPRegressor](#), [FluidDataSet](#)

Perform classification between a [FluidDataSet](#) and a [FluidLabelSet](#) using a Multi-Layer Perception neural network.

Class Methods

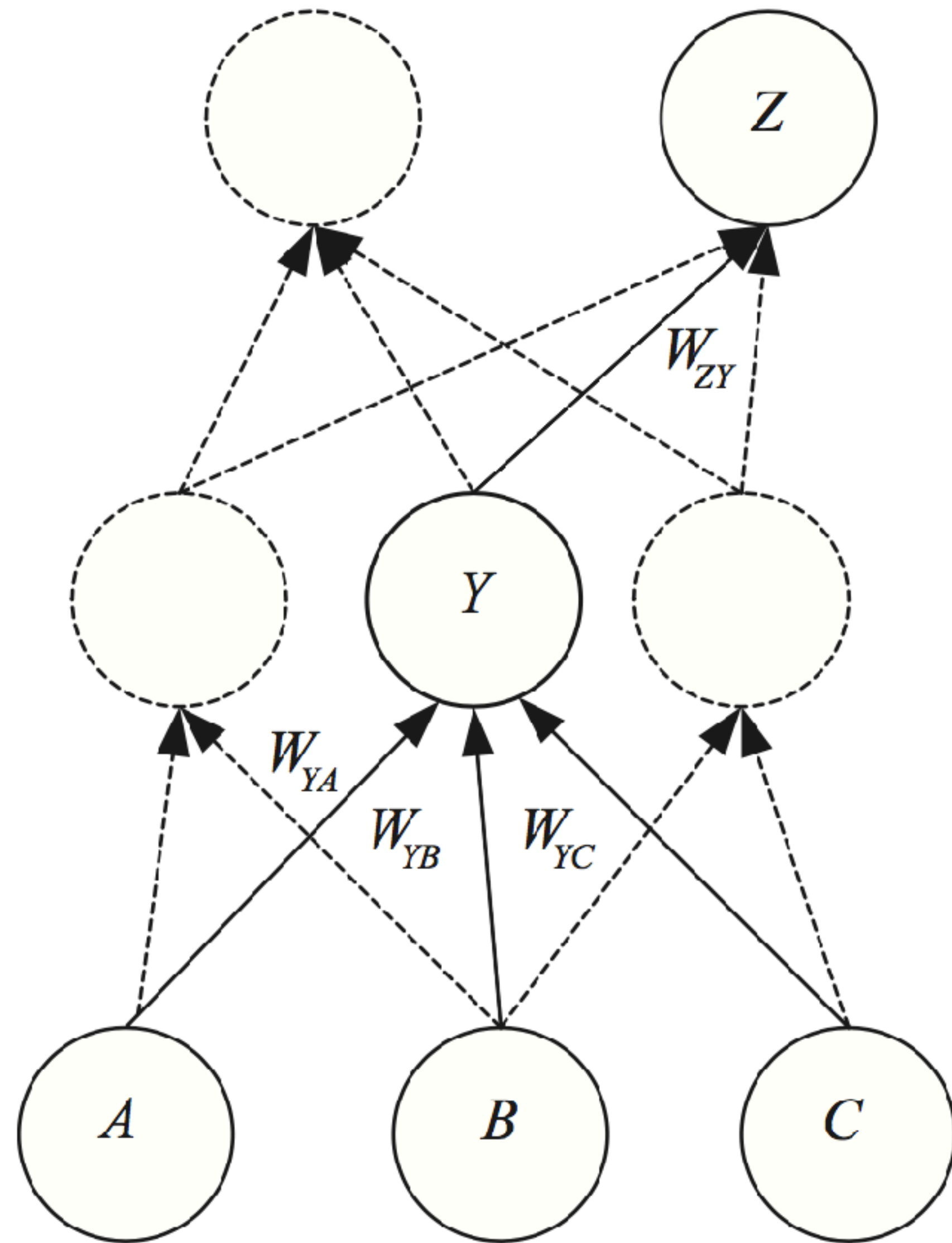
```
FluidMLPClassifier.new(server, hidden: [ 3, 3 ], activation: 2,  
    maxIter: 1000, learnRate: 0.0001, momentum: 0.9, batchSize: 50,  
    validation: 0.2)
```

Creates a new instance on the server.

Arguments:

server	The Server on which to run this model.
hidden	An Array that gives the sizes of any hidden layers in the network (default is two hidden layers of three units each).
activation	The activation function to use for the hidden layer units. Beware of the permitted ranges of each: relu (0->inf), sigmoid (0->1), tanh (-1,1).
maxIter	The maximum number of iterations to use in training.
learnRate	The learning rate of the network. Start small, increase slowly.
momentum	The training momentum, default 0.9
batchSize	The training batch size.
validation	The fraction of the DataSet size to hold back during training to validate the network against.

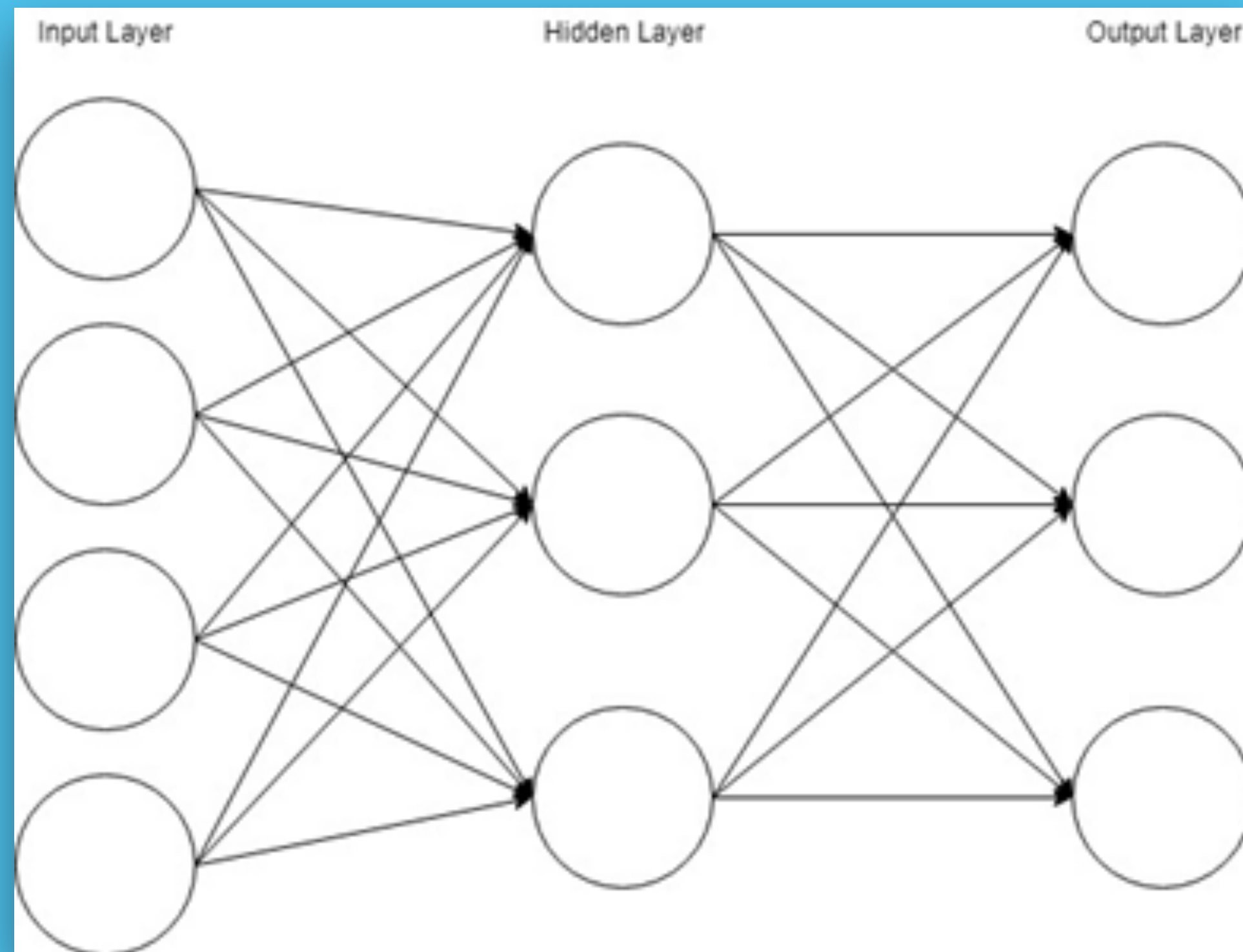
Neural Networks



- Left: example of a neural network (NN) with neurons and synaptic connections.

Alpaydin, Ethem. Machine Learning: The New AI. Cambridge, MA: MIT Press, 2016.

Multilayer Perceptron



- Left: example of a multilayer perceptron (ML), which is a NN with an input layer, output layer, and **may have hidden layers** in between.
- A complex architecture suitable to learn regression and classification models for difficult datasets.

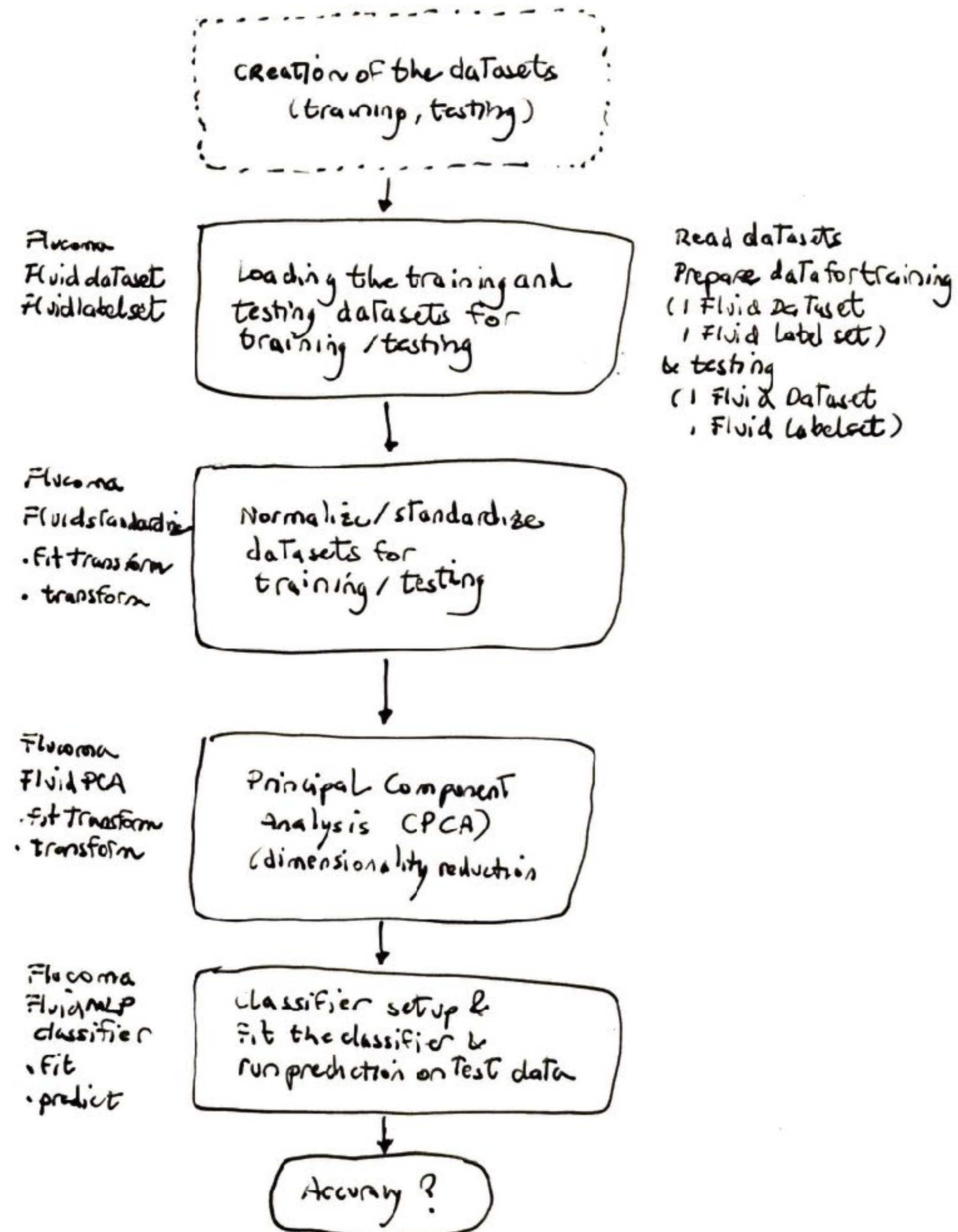
<https://deepai.org/machine-learning-glossary-and-terms/multilayer-perceptron>

3. Test the implemented ML tasks...

NN-1: Learning my musical taste

1. Choose a set of relevant sound descriptors that characterise the sound samples from Freesound, e.g.:
 - pitch
 - rhythm (bpm)
 - brightness (spectral centroid)
 - noisiness (spectral flatness)
2. Map these sound descriptors to input layers of the NN (encode the information into meaningful numbers).

MIRLCA - CREATING A MODEL

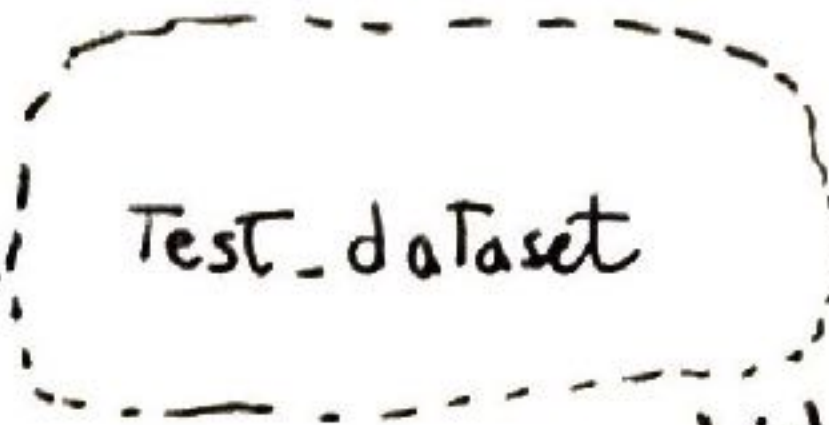


Best Descriptors...

- **First round with 9 descriptors:**
 - pitch, bpm, centroid, flatness, pitch_confidence (mean and variance).
 - **73% accuracy with flatness and pitch_confidence (mean and variance)**
- **Second round with 26 descriptors:**
 - Mel-frequency cepstral coefficients (MFCCs) (mean and variance) + PCA
 - **76%-83% accuracy**

MIRLCA - PERFORMANCE INTERFACE (Loading a model)

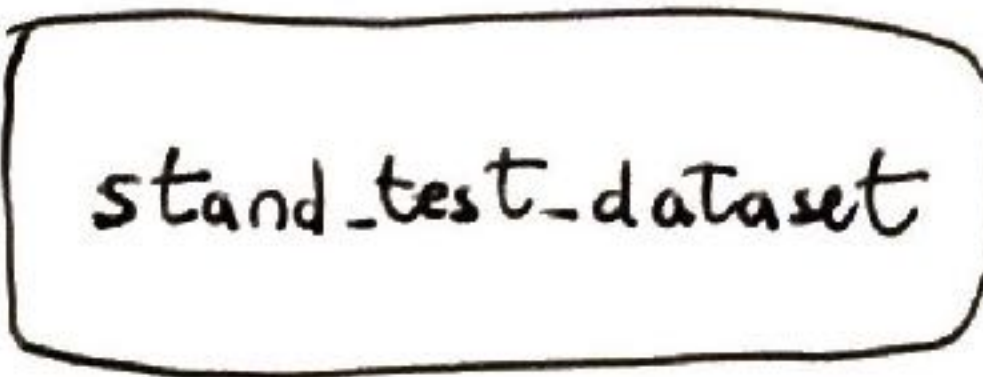
Freesand/
Live coder
queries



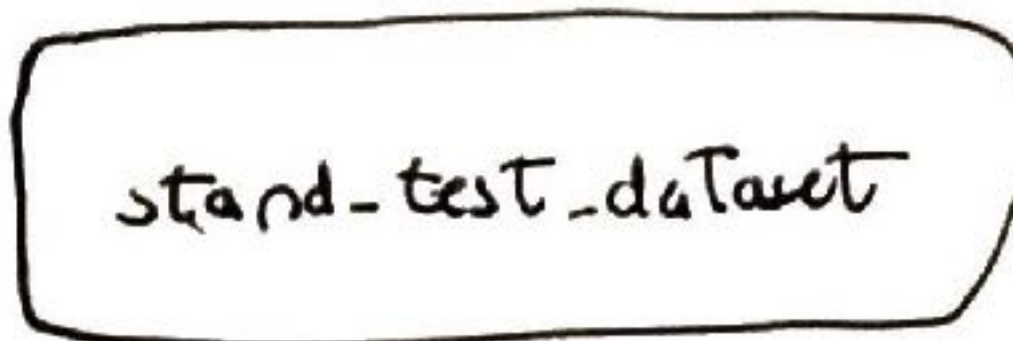
vid
26 MFLLs descriptors



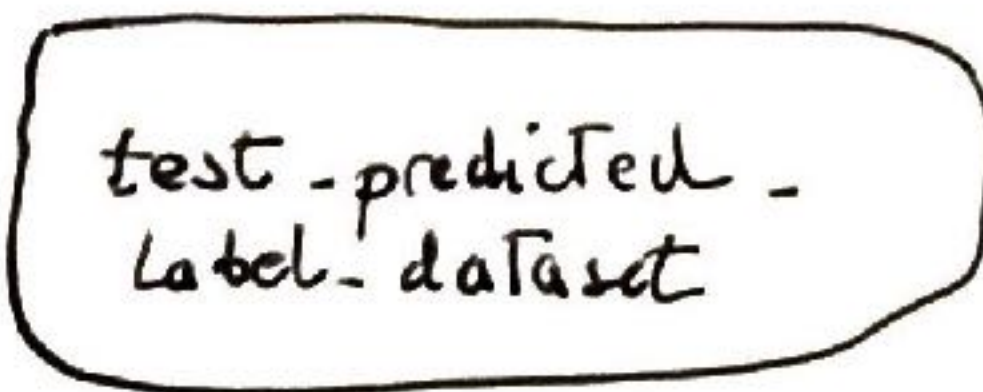
Flscom
FluidStandardize
• transform



Flscom
FluidPCA
• transform



Flscom
FluidMLP
Classifier
• predict



References

- Great blog on ML: <https://machinelearningmastery.com>
- Alpaydin, Ethem. *Machine Learning: The New AI*. Cambridge, MA: MIT Press, 2016.