



Debugging, Developing, Distributing and Demonstrating Complex Signal Processing Systems with MATLAB

November 3, 2016

Malcolm Slaney

Caveat

I'm currently a Research Scientist in Google's Machine Hearing Group, but today's work was done at:

- Apple Computer's Advanced Technology Group
- Interval Research
- IBM's Almaden Research
- Yahoo! Research

Not

- Google



Outline

Debugging

- CDROM
- Apple ASR via MEX

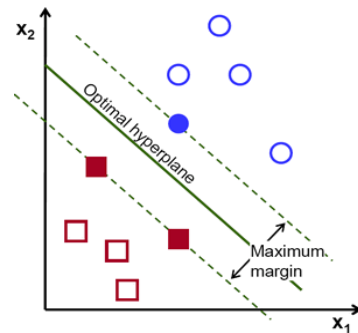
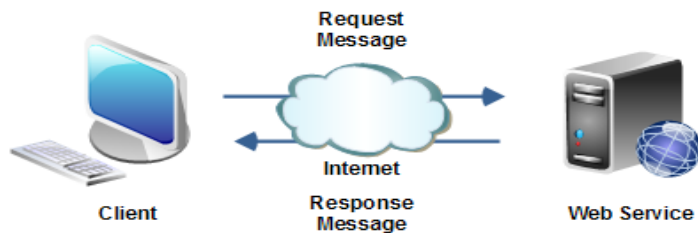
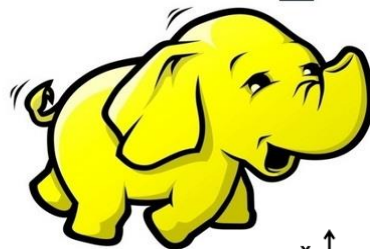
Developing

- Hadoop for Neural Network Grid Search

Documenting and Demonstrating

- Auditory Toolbox
- Telluride Decoding Toolbox
- Web API
- Snakes
- Support Vector Classifiers

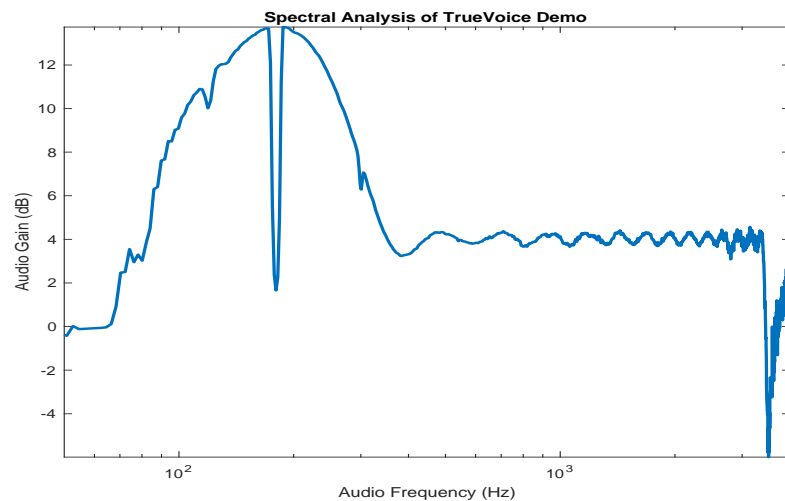
hadoop



Debugging – AT&T TrueVoice

Unknown (magical) processing

Spectral Estimation in MATLAB



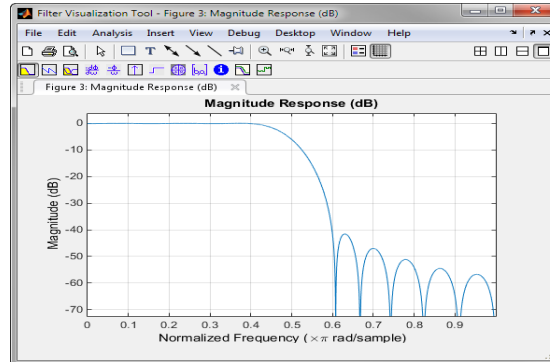
James Kaiser

James: Malcolm, you have to see this operator

Malcolm: Yea, Jim.

James (next year): Malcolm, you have to see this operator.

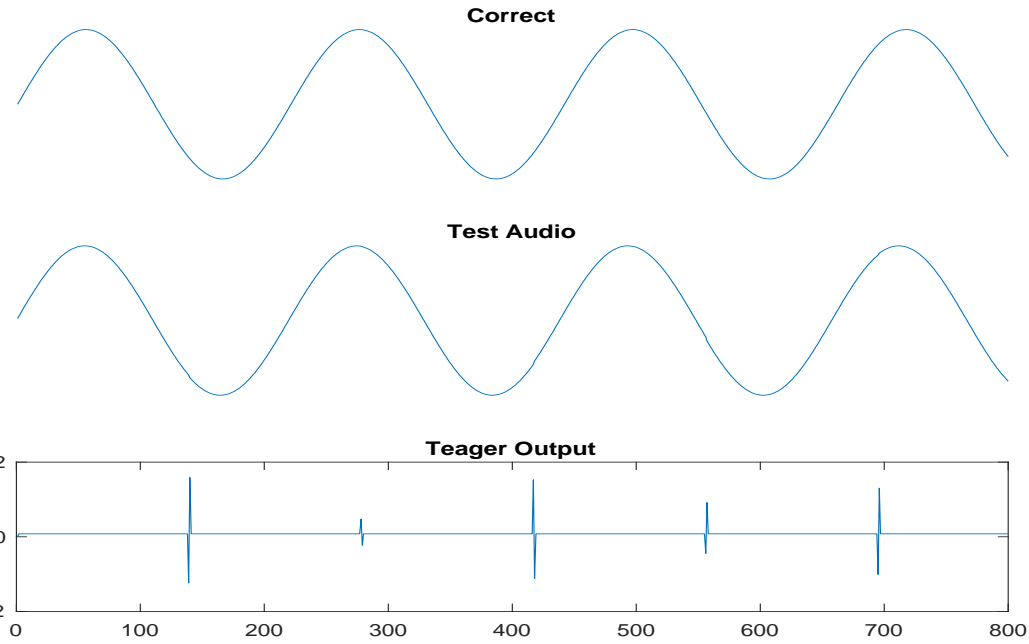
Malcolm: Yea, Jim.



Debugging – CDROM Driver

Dropped samples

- Software engineers disagreed



Teager Energy Operator

Debugging – Automatic Speech Recognition

Debugging Acoustic Models

- Custom MEX
- Put() and Get() memory

MATLAB used to

- Assemble picture of ASR results
- Walk the graph
- (Not possible now due to memory management.)



Developing – Network Grid Search

Subplate Neurons

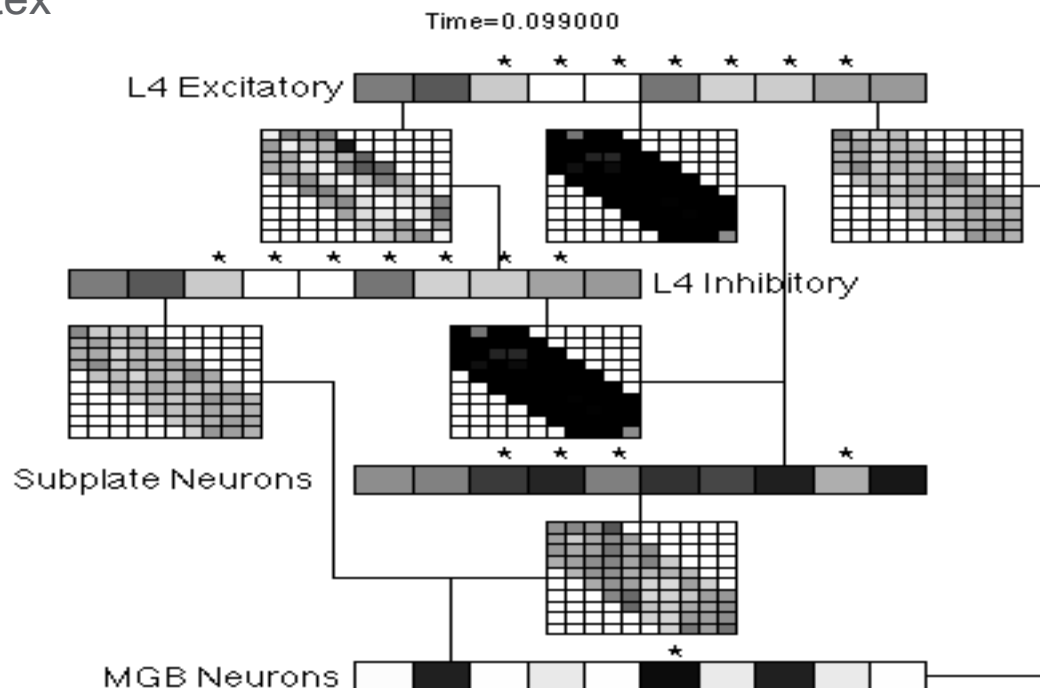
- Structural lattice for developing cortex
- Implicated in language learning
- Disappear post development

Question

- Develop tonotopic distribution?
- Frequency map

Hadoop Test

- Grid search for parameters
- Compiled MATLAB binary
- Command line arguments
- Distribute MSR everywhere
- 8000 CPUs one night



Distributing – Auditory Toolbox

Purpose

- Common models of auditory perception
- Cochlear models
- Reference implementations

Success

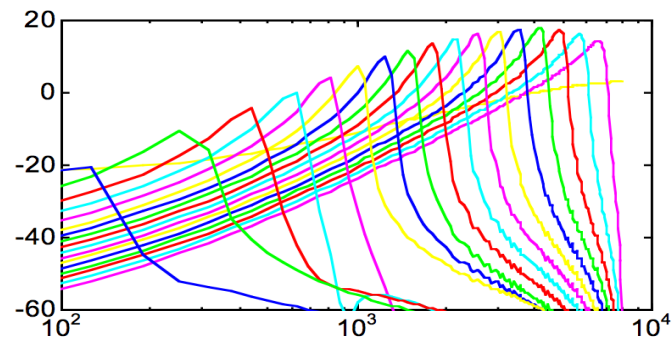
- Most popular toolkit for auditory modeling
- One of my highest cited references
- (a Tech Report!!!)

Auditory Toolbox

Version 2

Malcolm Slaney

Technical Report #1998-010
Interval Research Corporation
malcolm@interval.com



Distributing – Telluride Decoding Toolbox

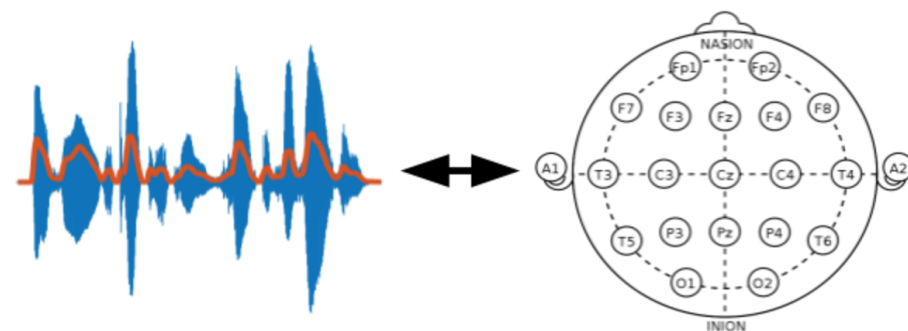
System ID and Modeling

- Audio \leftrightarrow EEG
- Linear and non-linear models

Reason

- Reference implementation
- With data for debugging and testing

Telluride Decoding Toolbox



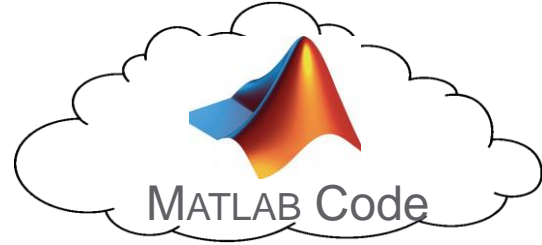
Sahar Akram (UMD), Alain de Cheveigné (ENS), Peter Udo Diehl (ETH), Emily Graber (Stanford), Carina Graversen (Oticon), Jens Hjortkjaer (DTU), Nima Mesgarani (Columbia), Lucas Parra (NYU), Ulrich Pomper (UCL), Shihab Shamma (UMD), Jonathan Simon (UMD), Malcolm Slaney (Google), Daniel Wong (ENS)

Distributing – Web APIs

Want



HTTP REST



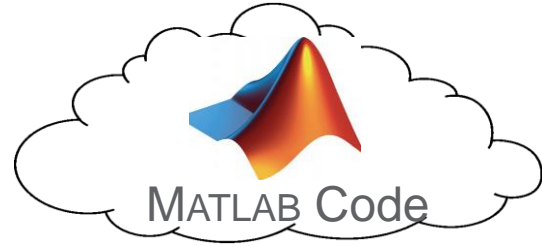
Solution



HTTP
REST



Stdio



Distributing - Snakes

Help

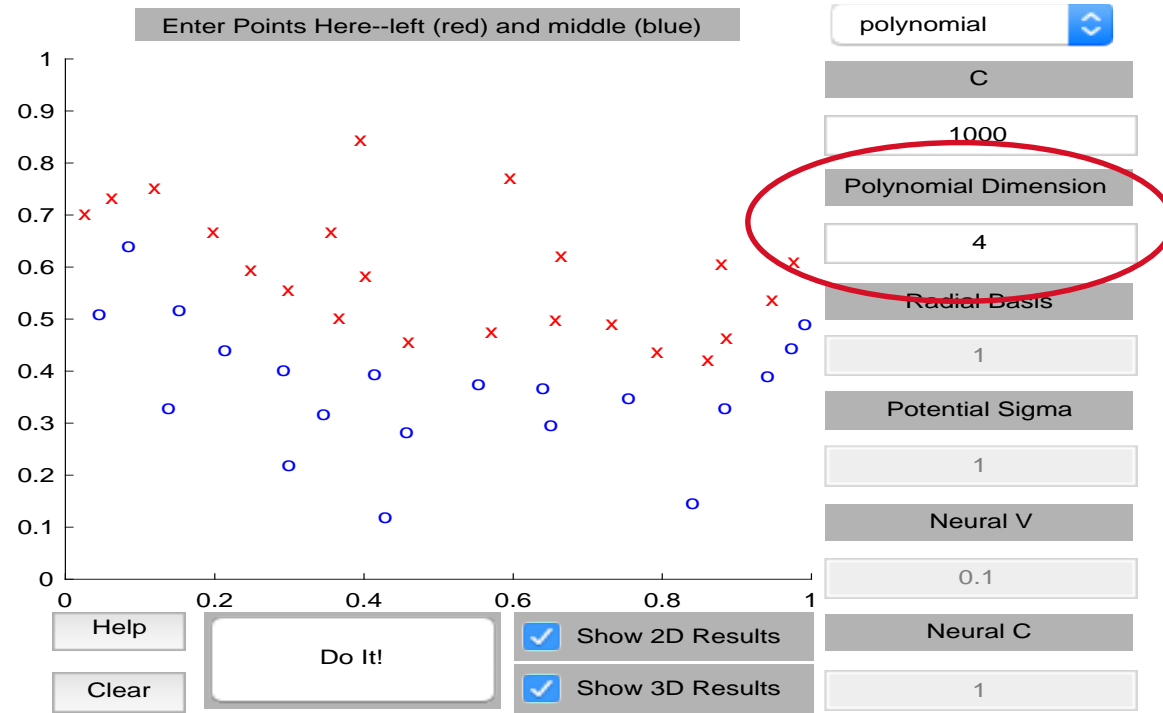
Parameter Help

Parameter Help	
X Resolution	1
X Range	1
Y Resolution	1
Y Range	1
Beta	0.1
Gaussian Sigma	1.5
<input checked="" type="checkbox"/> Fit to Gradient	
<input checked="" type="checkbox"/> Display Gradient	

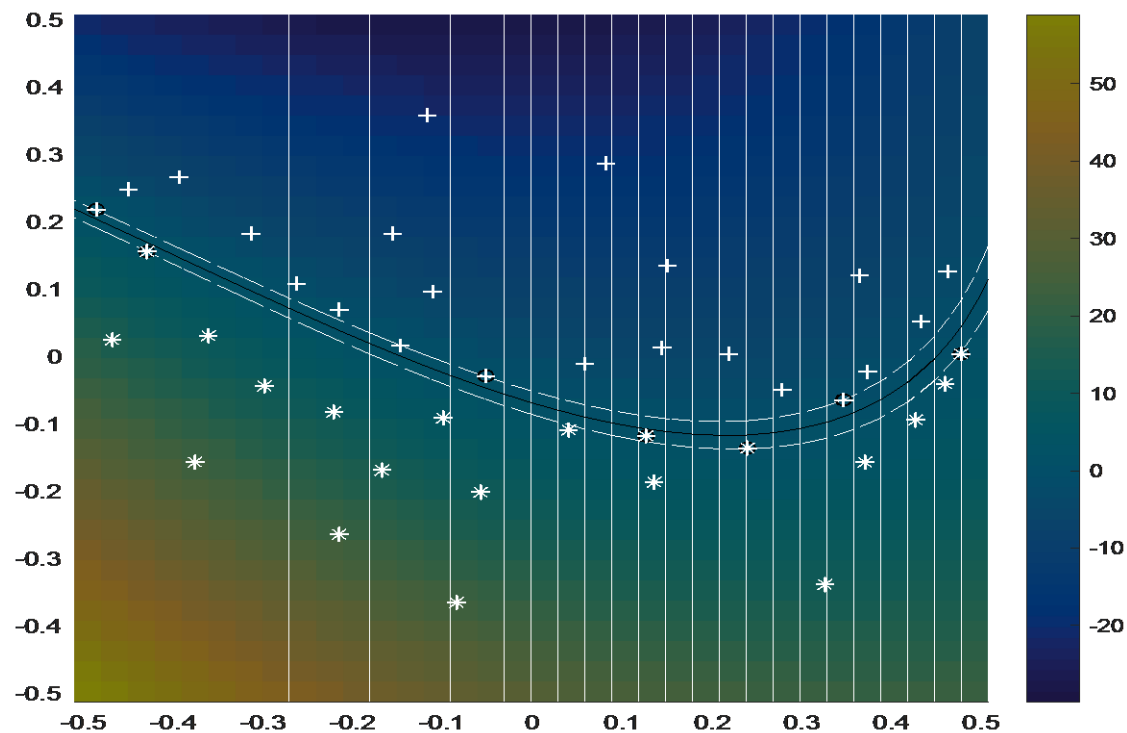
Clear Points

Iterate

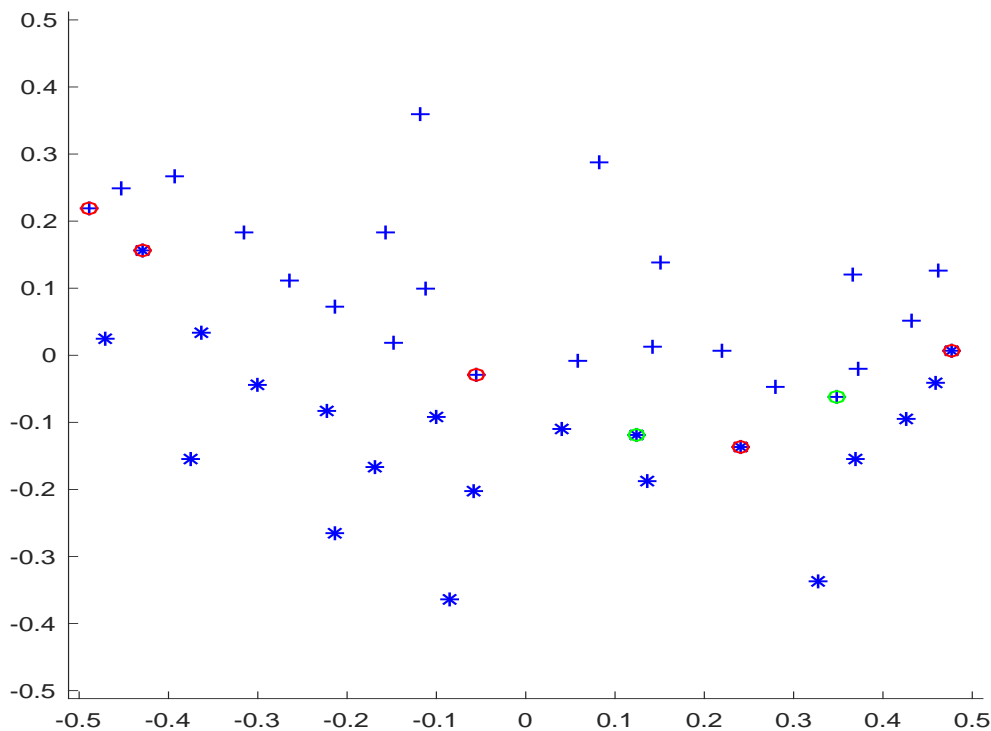
Demonstrating – Polynomial Support Vector Machine



Demonstration – SVM Polynomial Distances



Demonstration – SVM Polynomial Results



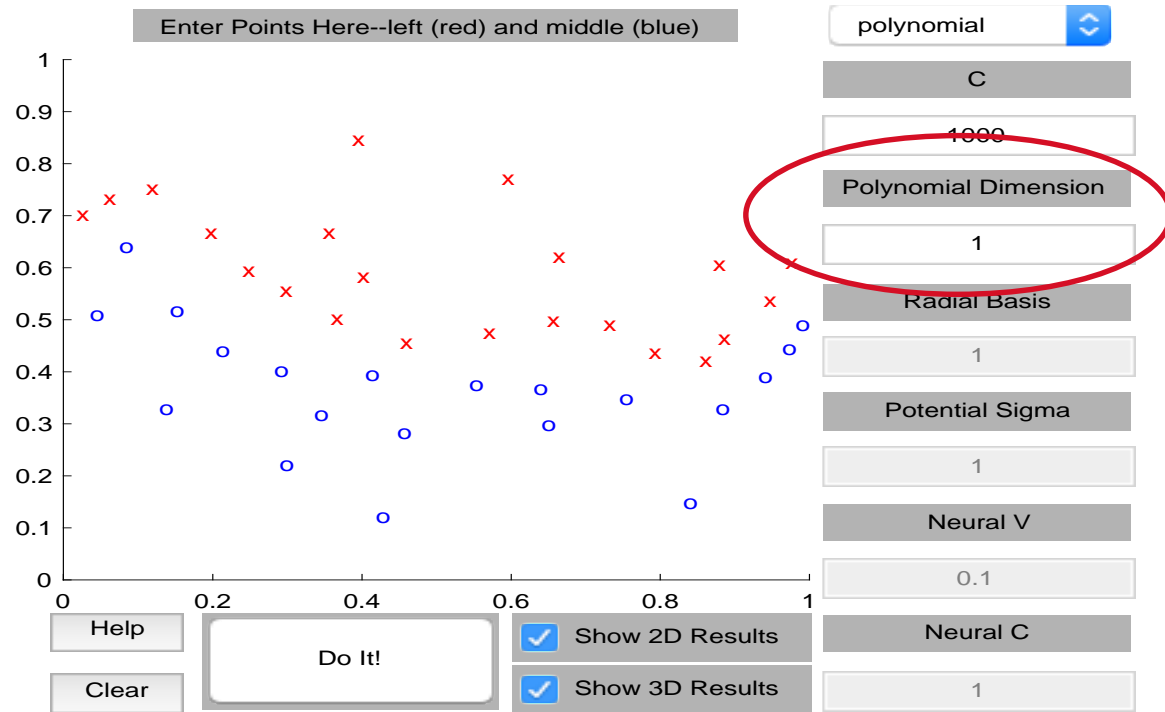
Demonstrating – Linear Support Vector Machine

Matlab GUI

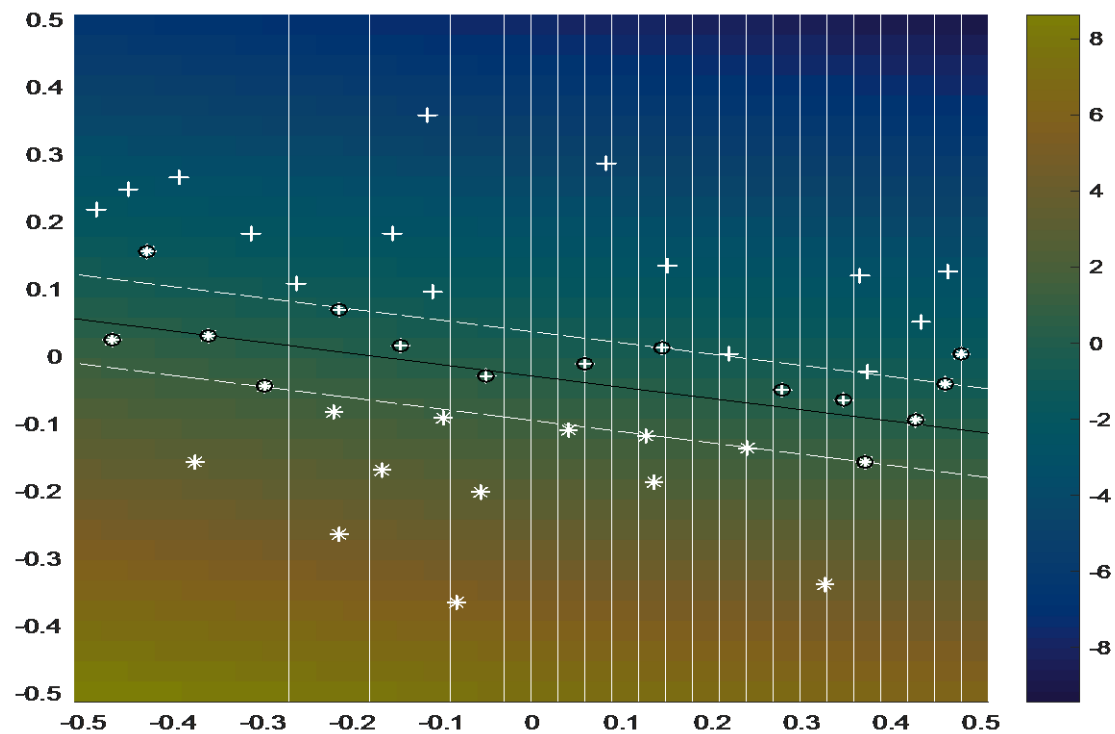
- On top of support vector classifier

Good

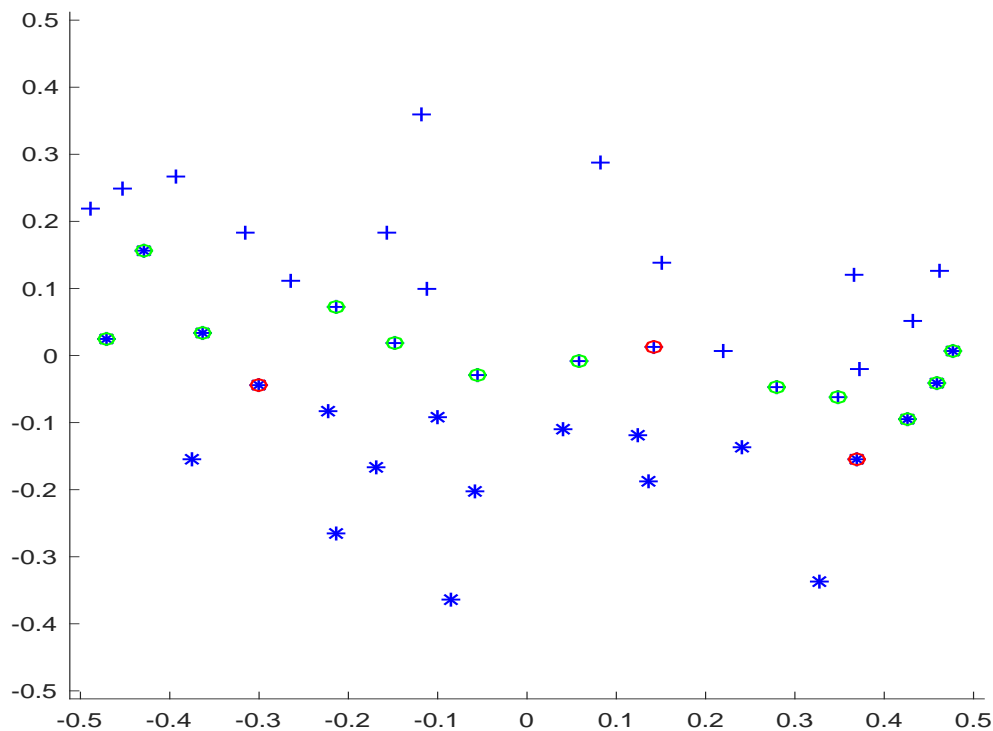
- Exploring parameters
- Understanding performance



Demonstrating – SVM Linear Distance



Demonstrating – SVM Linear Results





Thank You

malcolm@ieee.org

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- Neural network on Hadoop

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hadoop

