VERMONT EPSCOR BREE

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UNIVERSITY OF VERMONT
VERMONT EPSCOR BREE PROJECT

- EPSCOR: ESTABLISHED PROGRAM FOR STIMULATING COMPETITIVE RESEARCH
- BREE: BASIN RESILIENCE TO EXTREME EVENTS
  - 5 YEAR GRANT (ENTERING 5TH YEAR)
  - INVESTIGATING EFFECTS OF CLIMATE CHANGE, WEATHER, AND LANDUSE CHANGES ON THE STRENGTH AND FREQUENCY OF TOXIC ALGAE BLOOMS IN LAKE CHAMPLAIN
  - SCIENCE LEADS, POSTDOCS, AND GRADUATE STUDENTS MODEL GOVERNMENT NETWORKING, ECONOMIC FORECASTS, LANDUSE BEST PRACTICES, CLIMATE PREDICTIONS, WEATHER CYCLES, HYDROLOGY, AND LAKE DYNAMICS
  - WATERSHED INSTRUMENTATION AND NATIONAL DATABASES PROVIDE HISTORICAL DATA FOR USE IN CALIBRATION
  - ALL MODELS COMBINED INTO AN IAM (INTEGRATED ASSESSMENT MODEL) TO EXPLORE THE SCENARIOS DATASPACE
  - IAM RUN ON A COMBINATION OF LOCAL RESOURCES AND THE CHEYENNE PETAFLP HPC COMPLEX
  - OVER 50 PEOPLE INVOLVED IN RESEARCH, SUPPORT, AND ADMINISTRATION

GRANT: NSF OIA 1556770
BREE COMPUTATIONAL COMPONENTS

- Modeled in diverse languages and environments
  - JAVA, C++, R, PYTHON, FORTRAN
  - ANYLOGIC, MASON, FLAME,
  - RHESSYS, SWAT, RCA/EFDC, AEM3D, WRF

- Local development resources
  - LINUX REDHAT WORKSTATION
  - NVIDIA DGX-1 FOR GPU ACCELERATION
  - GITLAB, RSTUDIO, VSCODE

- Workflow executed by framework, data, and queue managers
  - PEGASUS, GLOBUS, HTCONDOR, PBS

- 2 Staff maintain resources, author the workflows, generate data visualizations and run the IAM
BREE AND MACHINE/DEEP LEARNING

MACHINE/DEEP LEARNING PROVIDES POWERFUL TOOLS FOR MODELING COMPLEX SYSTEMS

BREE IS NO EXCEPTION

• SELF ORGANIZING MAPS FOR CLUSTERING DATA CATEGORIES
• PATTERN/IMAGE RECOGNITION FOR IDENTIFYING EVENTS
• AGENT BASED MODELING WITH EXPERIENTIAL LEARNING
• EMULATOR FUNCTION DEVELOPMENT TO ANALYZE COMPLEX IAM
UNAL "ZAK" SAKOGLU
UNIVERSITY OF HOUSTON - CLEAR LAKE
I. INTRODUCTION

- Neuroimaging or brain image research has different techniques to study structural and functional imaging.
- Structural neuroimaging is studying the structure of the nervous system.
- Functional neuroimaging is studying the function of the brain under different conditions. SPECT or PET is a measure of neural activity.
- The aim of this work is to classify healthy controls vs. patients by utilizing the differences in patterns of the MRI brain activation maps, and use better features via adaptive space filling curves.
- MRI images are stored in nifti format. These are acquired in three-dimensional (3D) over time so the MRI has 4 dimensions.
- The basic element in the 3D image is known as a voxel (volume element).

II. 3D TO 1D ORDERING & SPACE FILLING CURVES

(Why? Ordering 3D MRI data need to be converted to 1D for further analyses.)

In this work the following ordering are used:
- Linear ordering (conventional, pre-determined)
- Hilbert ordering (pre-determined)
- Proposed adaptive space filling curve ordering is a modified TSP problem, NP-hard, exponential-time (O*() computation, where O is ~ 10^16 to ~10^26 (Sakoglu et al.)

III. METHODS

- Method 1:
  - The average brain map using all participants is calculated. Then the mean brain map is masked using the mask and the non-brain region is removed. The masked activation maps are zero masked to apply Hilbert curve of f = 64,646,646 which is pre-generated and this pre-determined Hilbert curve is mapped on the mean activation map.
  - Using the Hilbert curve trajectory the 3D activation map are converted to 1D.
  - Using an absolute threshold we remove all the value below the limit from the 1D brain map and also keeping track of the index where the values are removed.
  - The residue as in the average brain map are removed from all the brain maps, which stimulates that all this values in column same region for all the participants.
  - As the number of attributes is too high, a combination is performed. After the 1D conversion, the length of the array is around 251,446, so using different bin sizes the data is downsampled.
  - The t-test is used and with different p values, the important features are selected. These selected features are further used for the classification of the data.

- Method 2:
  - There is no mean activation map calculation.
  - Each participant is masked and then each ordering is applied accordingly and then co-registered to T1.
  - Done using binning and feature selection using statistics and sequential feature selection techniques.
  - Different classification techniques are used and also passed through a deep learning model.

IV. RESULTS

- Hilbert based classification achieved slightly better classification accuracy than that of SFC (approximately 70% vs. 75%) when utilizing sequential forward search.
- When no feature selection was used, the SFC provided a slightly better accuracy for most of the classification algorithms utilized and also is (10% to the best result when applied the cost function.

V. CONCLUSIONS

- Hilbert based classification achieved slightly better classification accuracy than that of SFC (approximately 70% vs. 75%) when utilizing sequential forward search.
- When no feature selection was used, the SFC provided a slightly better accuracy for most of the classification algorithms utilized and also is 10% to the best result when applied the cost function.

REFERENCES


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Possible?
The 1st Industrial Revolution (Mechanization)
- No concrete start date for the 1st Industrial Revolution.
- After 1760 – these changes were noticeable first in England when steam engine was invented by James Watt.
- Then took place in the United States, Belgium, and France.

Changed Noted After 1st Industrial Revolution:

Agricultural Revolution  Development of Factories

The 2nd Industrial Revolution
The second Industrial Revolution took place between about 1870 and 1960. Saw the spread of the Industrial Revolution to places such as Germany, Japan, and Russia.

- Electricity became the primary source of power for factories, farms, and homes.
- Mass production, particularly of consumer goods.
- Use of electrical power. (electric lights, radios, fans.)

The 3rd Industrial Revolution
Nearly a century later, in the second half of the 20th century, a third industrial revolution appeared with the emergence of a new type of energy whose potential surpassed its predecessors: Nuclear energy.

This revolution witnessed the rise of electronics with
- The transistor and microprocessor.
- Telecommunications.
- Computers.
- Development of the Internet, fast communications.

The 4th Industrial Revolution
And we are now starting number 4.0. It is changing...

The way we work, buy and sell things  The way we travel  The way we live

- The Fourth industrial Revolution is unfolding before our eyes where we are. This is the first industrial revolution rooted in a new technological phenomenon – ‘digitalization’ rather than in the emergence of a new type of energy.
- The Fourth Industrial Revolution is being driven by extreme automation and extreme connectivity. The sectors which is taking us towards global “Digitalization” are -
As Baidu and Alibaba fight over the Chinese marketing for smart speakers, Amazon and Google do so in the West and the voice-interface is coming to everything. It’s a more radical shift than many consumers and businesses estimate. The consumer robots will roll out in the 2030s.

**Sweeping Across Industries**

- **Internet Services**
- **Medicine**
- **Security & Defense**
- **Autonomous Machines**

**How big?**

- Bank of America–Merrill Lynch predicts by 2020:
  - $153 billion market for AI-enabled technology, including:
    - $83 billion for robotics
    - $70 billion for AI-based analytics
  - With an estimated $14-33 trillion creative disruption impact annually
    - $8-9 trillion in cost reductions in manufacturing and health care
    - $9 trillion cuts in employment costs due to AI-enabled automation
    - Manufacturing labor costs cut 18-33%
    - $1.9 trillion in efficiency gains due to autonomous drones & cars
    - Productivity boosted 30% in many industries
    - 47% of jobs have the potential to be automated
THE EXPANDING UNIVERSE OF MODERN AI

THE BIG BANG
Big Data
GPU Algorithms

RESEARCH
Berkeley
CMU
Carnegie Mellon
University
Columbia
University
Parsons
University

CORE TECHNOLOGY / FRAMEWORKS
Facebook
Google
IBM
Microsoft
NVIDIA
OpenAI
Pinterest
Quora
Shopify

AI-as-a-SERVICE
api.ai
BlueRiver
Clarifai
Drive.ai
IBM Watson
Microsoft Azure
Nervana
Ondra
ONNX
PolyAI
Salesforce
Sensei
Sudaku
Syntaxs
TensorFlow

START-UPS
nervana
Alibaba
Ford
Target
Tesla
Toshiba
Toyota

INDUSTRY LEADERS
Silicon Valley

1,000+ AI START-UPS
$5B IN FUNDING
Source: Venture Scanner

Examples of Student from UALR Engagement in AI/ML/DL Research


Xinyi Liu, Mariofanna Milanova, Visual attention in deep learning: a review. Volume 4 Issue 3-2018

https://www.researchgate.net/profile/Mariofanna_Milanova
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- TEXT AND E-BOOKS

DLI ONLINE CONTENT CREDIT
SYLLABUS (WITH DLI ONLINE CONTENT INTERLEAVED)

DIFFERENT KITS FOR DIFFERENT COURSES
- MACHINE/DEEP LEARNING (NYU/YANN LECUN PARTNERSHIP)
- ACCELERATED/PARALLEL COMPUTING (UIUC/WEN-MEI HWU PARTNERSHIP)
- ROBOTICS (CALPOLY PARTNERSHIP)

DEVELOPER.NVIDIA.COM/TEACHING-KITS
NVIDIA Deep Learning AI Resources

Jetson Community Projects


AWS Educate Platform, https://www.youtube.com/watch?v=OxQUo3kwTEA

ONLINE TRAINING WITH DLI

Free online Workshops:

- Fundamentals of Deep Learning for Computer Vision
- Fundamentals of Multiple Data Types (MDT)
- Natural Language Processing

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MOHAMMED TANASH
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WHO AM I

• BSC in Computer Science (2005), MSC in Information Technology (2008), MSC in Computer Science (2014).

• Ph.D. candidate at Kansas State University
  • Research Area: High Performance Computing (Improving the Performance of the Slurm Workload Manager)


• A Cyberinfrastructure team member at New Mexico State University (Jan 2017 – Jan 2019)

• XSEDE Student Campus Champion (2017 – Current)
• XSEDE Fellow (2018 – 2019)
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