2025 Summer School of the N3BG Group

FROM NEUROSCIENCE AND NEURAL NETWORKS TO AI MACHINE CONSCIOUSNESS WITH APPLICATIONS

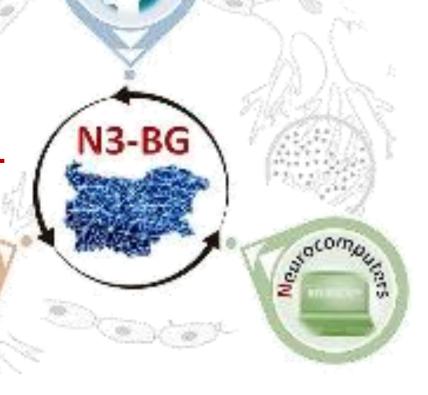
N3BG (Neuroinformatics, Neural networks and Neurocomputers Bulgarian Group) https://www.knowledgeengineering.ai

Assoc. Prof. Galina Momcheva
Institute of Mathematics and Informatics
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KNOWLEDGE

ENGINEERING •

BIOINSPIRED NEURAL NETWORKS +++



WITH OPEN HEART TO SUSTAINABLE INNOVATION SPACES THROUGH NETWORKING &&

INTERDISCIPLINARY RESEARCH



Assoc. Prof., Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Sofia

Est. Res (R3), Research Institute, Medical University - Varna

Chair, BioMed-Varna Foundation, Varna

Expert, BG Ministry of Education, Sofia



+359 888 793785 (viber, whatsapp, telegram)

EXPERT GROUP for the development of guidelines on high-quality informatics

ORCID https://orcid.org/0000-0003-0726-2022

ResearchGate https://www.researchgate.net/profile/Galina-Momcheva

Google Scholar https://scholar.google.com/citations?hl=en&user=vRPT-IcAAAAJ

in https://www.linkedin.com/in/galina-momcheva-1a612817



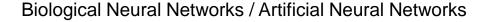


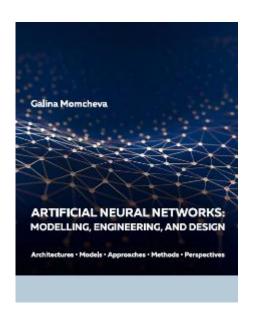




BULGARIAN ACADEMY OF SCIENCES

Momcheva, G., Transdisciplinary Design in Neural Network Architectures, IMI-BAS, 2024





ALGORITHMIC DESIGN APPROACHES TO ANN Combinatorial Approach in ANN Design

Graph-based Approach to ANN

Bio-inspired metaheuristics and ANN

Fuzzy-based ANN

CONTEMPORARY RESEARCH IN NEUROSCIENCE

Connectom perspective

Cortical connectivity cortical coding

Neural Plasticity

Dendritic Computing

Spike-Based Approaches

MODELING, ENGINEERING, AND DESIGN

Design. Modelling. Engineering

Mathematical Modeling

Computational Topology

Rhythm, Vibrations, Audio

Quantum approaches in modeling, engineering, and design

Photonic Neural Networks

Fractals

Cosmology





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Fuzzy U-Net Neural Network Architecture

Fuzzy U-Net Neural Network Design for Image Segmentation

Mark Kirichev , Todor Slavov , and Galina Momcheva (□) (□)

Fuzzy U-Net Neural Network Architecture Optimization for Image Segmentation





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DOI: 10.2478/cait-2023-0030

Multi-Activation Dendritic Neural Network (MA-DNN) Working Example of Dendritic-Based Artificial Neural Network

Konstantin Tomov¹, Galina Momcheva²

¹High School of Mathematics "Dr Petar Beron", 9009 Varna, Bulgaria

E-mails: kosio.tomov@gmail.com gmomcheva@math.bas.bg

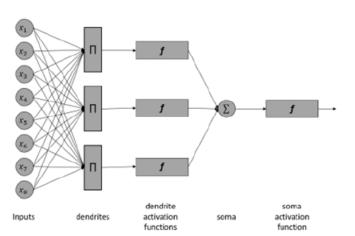


Fig. 6. A representation of the multi-activation dendritic neuron model with eight inputs and three dendrites. Note that all of the activation functions can be the same, different, and some can be the same while others are different

²Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria





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CONTEXT <-> DATA DRIVEN

DATA CAN BE MODELED IN CONTEXT

FUNDAMENTAL SCIENCE CAN BE DEVELOPED IN CONTEXT

water e

energy

health

TRANSDICIPLINARY RESEARCH

BRAIN

HEART

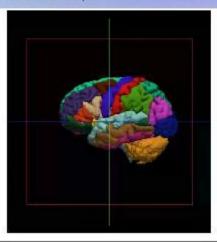
symmetry

rhythm

WAVEs, LIGHT, phonics, string theory, quantum computing

Brain atlases

Desikan-Killiany











Saftis SUMMER CAMP

AM 22-25 SIN- harve Scalefocus

Ponel: Brain/Name: Session

Interdisciplinary Research && Innovation

July 24; 2024; 10:30 h



In-Silico Investigation of Human Brain Using Spike Time Neural Network Models

Prof. Petya Koprinkova, PhD

Institute of Information and Communication Technologies
Bulgarian Academy of Sciences





Prof. Nikola Kasabov



Auckland University of Technology, New Zealand https://scademics.aut.ac.or/nkarabov

applications



FROM NEUROSCIENCE AND NEURAL NETWORKS TO AI MACHINE CONSCIOUSNESS WITH APPLICATIONS

Assoc. Prof. Galina Momcheva IMI-BAS, BIOINSPIRED Neural Networks *



Methods | Systems | Applications for SUSTAINABLE AI

Deadline: August 15, 2024





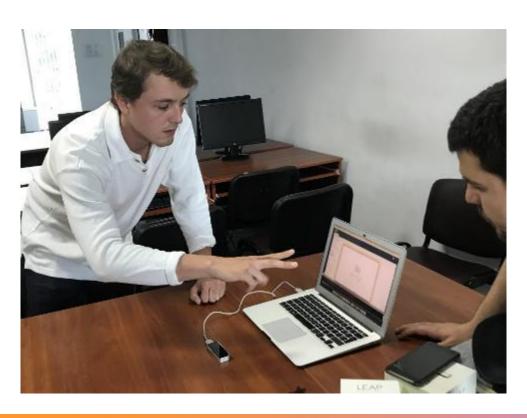




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NUI (Natural User Interfaces)











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Assoc. Prof. Galina Momcheva IMI-BAS, BIOINSPIRED Neural Networks *

Much like the insulation around the wires in electrical systems, **glial cells** form a membraneous sheath surrounding axons called myelin, thereby insulating the axon. This myelination, as it is called, can greatly increase the speed of signals transmitted between neurons (known as action potentials).



Myelin: A Specialized Membrane for Cell Communication

Glial cells of the (a) central nervous system include oligodendrocytes, astrocytes, ependymal cells, and microglial cells.



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. doi: <u>10.3389/fncel.2014.00378</u>

frontiers

Cell and Developmental Biology

Sections ~

Articles

Research Topics

Editorial b

more closely associated with synapses (Markey et al., 2023). Synaptic pruning involves direct phagocytosis of neuronal synapses (Schafer and Stevens, 2013; Wilton et al., 2019), as well as engulfment of extracellular matrix (ECM) maintaining synapse stability (Nguyen et al., 2020; Crapser et al., 2021). Our focus here is on neuron-to-glia signals and glia-to-glia signals directing experience-dependent glial synapse pruning, a process by which glial cells selectively eliminate unnecessary synapses. However, emerging understanding is guided by more general mechanisms of glial phagocytosis.

► EMBO Rep. 2024 Mar 28;25(5):2162–2167. doi: 10.1038/s44319-024-00127-4 🖸

Cell consciousness: a dissenting opinion

The cellular basis of consciousness theory lacks empirical evidence for its claims that all cells have consciousness

<u>David G Robinson</u> ^{1,⊠}, <u>Jon Mallatt</u> ², <u>Wendy Ann Peer</u> ³, <u>Victor Sourjik</u> ⁴, <u>Lincoln Taiz</u> ⁵

► Author information ► Article notes ► Copyright and License information

PMCID: PMC11094104 PMID: 38548972

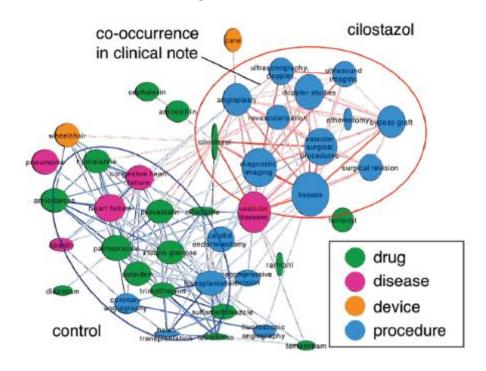


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(Araque et al., 1999; Perea et al., 2009). Accordingly, novel concepts in brain physiology have been coined, such as "tripartite synapse", to highlight the direct involvement of astrocytes in synaptic function, gliotransmitters, to generically name neuroactive substances released by astrocytes, or gliotransmission, to define the active signaling between astrocytes and neurons (Volterra and Bezzi, 2002).



Multimodal network

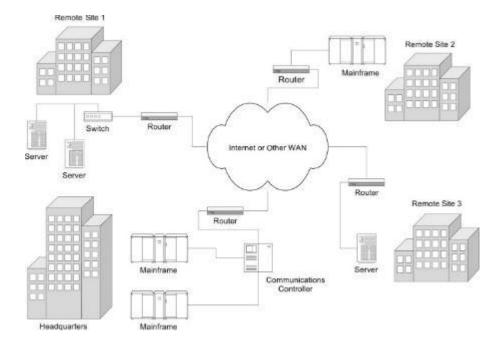
https://eye2data.blogspot.com/2015/10 /an-overview-of-multi-modalnetworks.html



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Distributed Architecture0

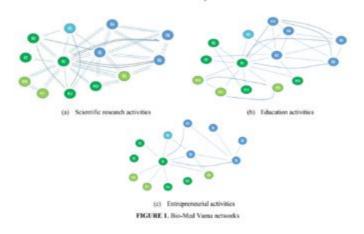


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Sustainability of Research-based Ecosystem

Antonina Ivanova^{1, a)}, Galina Momcheva^{1, b)}, Ralitsa Zhekova^{1, c)}, Eleonora Tankova^{1, d)} and Stoyan Pavlov^{2, e)}





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https://www.quantamagazine.org/these-cells-spark-electricity-in-the-brain-theyre-not-neurons-20231018/

https://pubmed.ncbi.nlm.nih.gov/36481974/

Garbage collector (Java)



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Eduardo Rodriguez Calzado Collective Consciousness 2018 19.7 in. x 27.6 in. Oil on canvas

https://shop.artlegacytx.com/product/collective-consciousness/



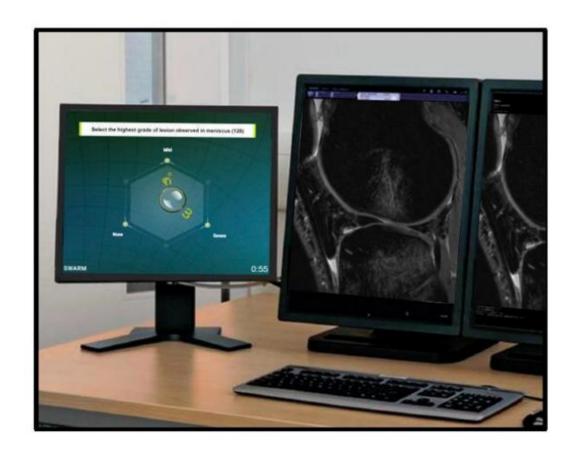
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Artificial Swarm Intelligence FRAMEWORKS && PLATFORMS

#swarm intelligence



https://unanimous.ai/swarm/#



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Frameworks for Collective Intelligence: A Systematic Literature Review

Supplementary Material for: Frameworks for Collective Intelligence: A Systematic Literature Review

SHWETA SURAN, VISHWAJEET PATTANAIK, and DIRK DRAHEIM, Tallinn University of Technology, Estonia

A SUPPLEMENTARY MATERIAL

A.1 Details of Selected CI Platforms

Table 1 presents the short name, full name, URL, types of related publications, and organizations of the examined CI platforms.

Table 1. Details of Examined CI Platforms

Platform	Full name	URL	Resources*	Organization
CAPSELLA	Collective Awareness Platform	capsella.eu	TR, CP	CORDIS
	for Environmentally Sound			(H2020)
	Land Management based on			
	Data Technologies and			
	Agrobiodiversity			
hackAIR	Collective awareness platform	hackair.eu	TR, CP	CORDIS
	for outdoor air pollution			(H2020)
openIDEO	Collaborative platform for the	openideo.com	CP	IDEO
	design process			
Climate CoLab	Climate CoLab	climatecolab.org	CP	MIT CCI
WikiCrimes	WikiCrimes	wikicrimes.org	CP	CNPq
Threadless	Threadless	threadless.com	CP	SkinnyCorp
				LLC

^{*} TR: Technical Reports. CP: Conference Papers.



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PROPOSAL

for conducting a full-time doctoral study

under Article 21, Paragraph 7 of the Higher Education Act

at the Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences

Doctoral Program "Informatics"

Scientific Supervisor: Assoc. prof. Galina Momcheva, PhD

Topic of the Doctoral Study: Design of New Computational Models for Data Mining from Biomedical Images

Expected results

New computational models for data mining from images, and more especially for biomedical images, such as neural network designs, metrics, etc., as well as their validation, are anticipated as a result of the work on the subject. A particular outcome on the subject is also anticipated in relation to the scientific group's work on computational models for multimodal analyses, which includes sonification of biomedical images, tensor methods, or the combination of scientific techniques with computational topology tools.

Impact

The work on this topic will also include participation in initiatives of the already established scientific interdisciplinary ecosystem BioMed-Varna, the scientific group Advanced Computational Bioimaging at the Scientific Institute of Medical University-Varna and international partners. As a result of this development, its commercialization for innovations in medical research and the biotechnology industry is also possible.



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14 students Math Schools Varna && Burgas

- Bioinspired Computing
- ANN
- Sound/Vibration/Audio Anal.
- Computational Topology



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IMI-BAS ISTI-CNR







Topological Data Analysis, TDA, Point Set Topology, Topological Point Cloud Clustering, Topological Neural Networks









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Softis Summer Camp

13.06.2025 г.

15:15	Opening Session	
	(programme, challenges, guests, participants)	
16:00 – 17:45	Panel A: Al-focused Research and Software Development	
17:45 – 18:00	Coffee Break	
18:00 - 19:00	Discussions on Panel A.	
	(collaborations, projects, initiatives, practices)	
19:00	Free Dinner	
21:00	Varna Summer Social Panel	



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Softis Summer Camp

14.06.2025 г.

9:00 – 10:15	Panel B: Business-Academia-Citizens Research-Based Perspectives
10:15 - 11:00	Discussions on Panel B.
	PhD Students from Industry - Discussion
11:00 - 11:15	Coffee Break
11:15 - 12:15	Panel C: Commercialization of Research
12:15 - 13:00	Discussions on Panel C.
	(collaborations, projects, initiatives, practices)
13:00 - 14:00	Free Lunch

14.06.2025 г.

14:00 - 15:15	Panel D: Domain-Specific Research and RaaS	
15:15 - 16:00	Discussions on Panel D.	
	(collaborations, projects, initiatives, practices)	
16:00 - 16:15	Coffee Break	
17:00 - 18:30	Panel E: Emerging Technologies in Software Development	
	Discussions on Panel E.	
	(collaborations, projects, initiatives, practices)	



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Softis Summer Camp

15.06.2025 г.

9:00 – 10:15	Panel F: Firefly Panel
10:15 - 11:00	Firefly Software EXPO
11:00 - 11:15	Coffee Break
11:15 - 12:00	Panel G: Green Software Development
12:00 - 13:00	Green Software Development Challenges Presentations
13:00 - 14:00	Closing Session

Assoc. Prof. Galina Momcheva IMI-BAS, BIOINSPIRED Neural Networks *

BIOLOGICAL SYSTEMS living things — evolve, learn, grow, and change purposely

PROBLEM-SOLVING AS AN ENVIRONMENT RESPONSE

(internal or external)

MODELLING - DESIGN

life-forms are aware and conscious

HIGHEST LEVEL ANALYTICAL THINKING

CREATIVITY AND CRITICAL THINKING TOGETHER



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#values

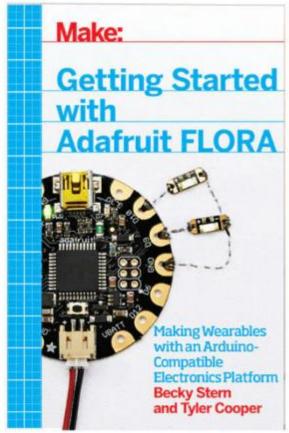






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STEAM Inspiration HUB

15.04.2025 18.00 - 19.00

31.05.2025 11.00 - 12.00

www.streamit-project.eu

www.linkedin.com/company/projectstreamit/

www.facebook.com/profile.php?id=61558486186687

www.instagram.com/projectstreamit/

www.youtube.com/@projectstreamit



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European Researchers' Night and Researchers at Schools 2026-2027 HORIZON-MSCA-2025-CITIZENS-01-01



European Commission EU Funding & Tenders Portal



Budget overview

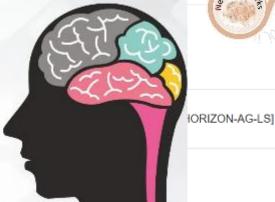
Conditions and documents

Destination

past nine years, commemorating the awareness of brain diseases. This day emphasises the increasing awareness

World Brain Day is a global healthcare event observed on the 22[™] of July every year for the

This day emphasises the increasing awareness and advocacy about health care, education and research of neurological conditions.



Forthcoming

Deadline date 22 October 2025 17:00:00 Bru





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Sectoral digital skills academies: Quantum Skills Digital Academy DIGITAL-2025-SKILLS-08-QUANTUM-ACADEMY-STEP

https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/DIGITAL-2025-SKILLS-08-QUANTUM-ACADEMY-STEP

Deadline date

02 September 2025 17:00:00 Brussels time

The Quantum Digital Academy will offer tailored training opportunities at different levels that bridge the gap between traditional disciplines and quantum technologies.

https://digital-strategy.ec.europa.eu/en/library/european-declaration-quantum-technologies



https://qt.eu/news/2023/2023-04-14_update-for-the-european-competence-framework-for-quantum-technologies-version-2-0

WITH OPEN HEART TO SUSTAINABLE INNOVATION SPACES THROUGH NETWORKING &&

INTERDISCIPLINARY RESEARCH



Assoc. Prof., Institute of Mathematics and Informatics, Bulgarian Academy of Sciences, Sofia

Est. Res (R3), Research Institute, Medical University - Varna Chair, BioMed-Varna Foundation, Varna

Expert, BG Ministry of Education, Sofia

Assoc. Prof. Galina Momcheva, PhD gmomcheva@math.bas.bg; gmomcheva@gmail.com +359 888 793785 (viber, whatsapp, telegram)

EXPERT GROUP for the development of guidelines on high-quality informatics

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ResearchGate https://www.researchgate.net/profile/Galina-Momcheva

Google Scholar https://scholar.google.com/citations?hl=en&user=vRPT-IcAAAAJ

in https://www.linkedin.com/in/galina-momcheva-1a612817



