Computational Intelligence
(Part I, Fall 2021)

Instructor: **Dr. Yanan Sun** (ysun@scu.edu.cn)

Department of Artificial Intelligence

College of Computer Science, Sichuan University

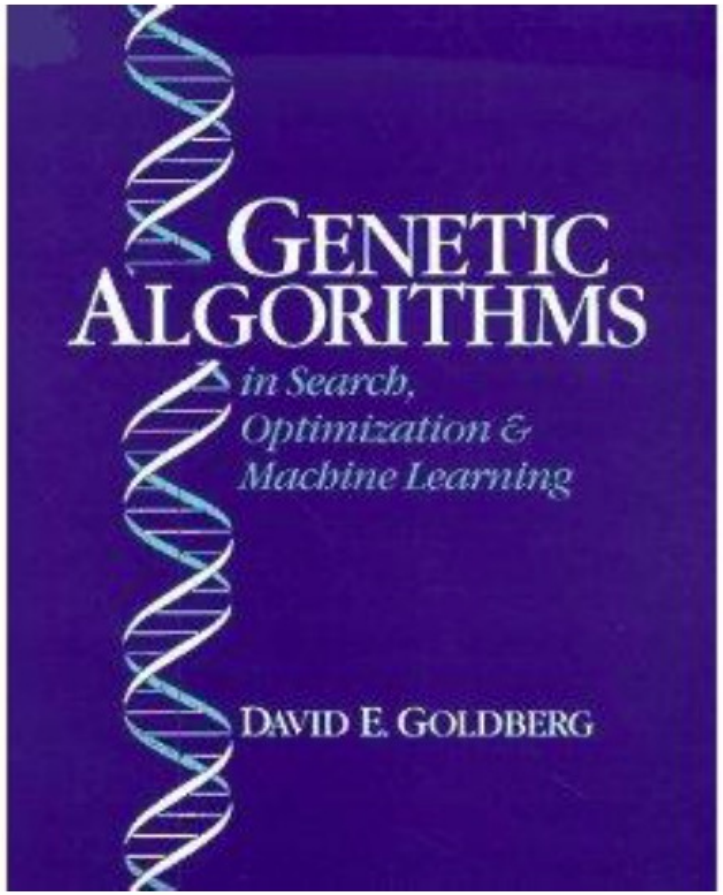
Syllabus

- Course: Computational Intelligence - Part I (计算智能_01), Fall 2021
- Time: Monday 13:50-15:30 (第5-6节课，第四大节)
- Place: A410, No.1 Building, Jiangan Campus (江安一教A座A410)
- Objectives
  - Knowing the computational intelligence (CI), Evolutionary Computation (EC), and their top-ranking journals and conferences.
  - Can solve some traditional optimization problems by using the simulated annealing algorithm, genetic algorithm and particle swarm optimization algorithm.
  - Knowing the multiple and many-objective optimization problems as well as the evolutionary neural architecture search.

Course Policy

- Grading
  - Attendance 5%; Performance 45% (presentation, answering);
  - Final report 50%
- Attendance
  - Attendance record will be sampled randomly and counted toward your grade.
  - Students will be expected to attend class.
  - Habitual failure to do so will result in a reduced grade/score.
  - An incomplete grade will only be given when a student misses a portion of the semester because of illness or accident.

Textbook

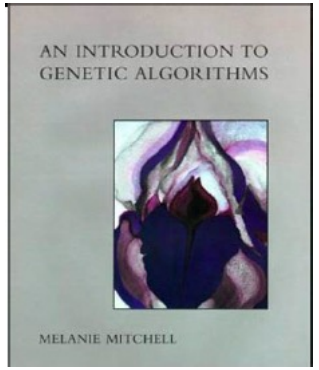


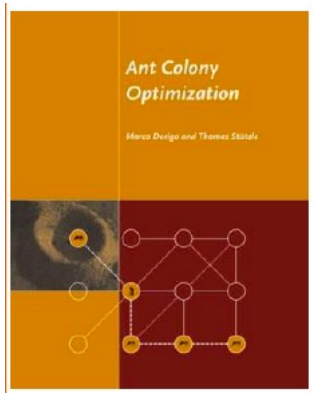
Genetic Algorithms in Search, Optimization & Machine Learning

(ISBN 0-201-15767-5)
by David E. Goldberg
Addison-Wesley, 1989

References

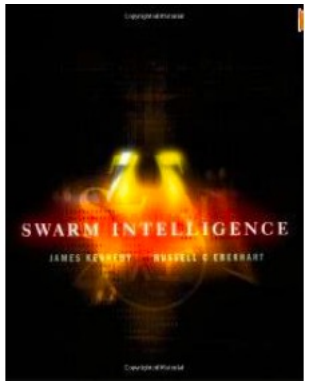
An Introduction to Genetic Algorithms, MIT, 1996
by Melanie Mitchell





Ant Colony Optimization, MIT, 2004
by Marco Dorigoand Thomas Stutzle

Swarm Intelligence, Morgan Kaufmann, 2001
by James Kennedy and Russell C. Eberhart



Instructor

- Professor (Research) Yanan Sun, PhD (孙亚楠、博导、拔尖班指导老师)
- https://cs.scu.edu.cn/info/1288/13623.htm (official)
- https://yn-sun.github.io (personal)
- M: 18011452539, Email: ysun@scu.edu.cn
- B422B, Basic Building, Wangjiang Campus

Research Topics

- Neural Architecture Search (NAS), AutoML(**Effectiveness**, Interpretability, Robustness)
- low-power consumption AI models (Mainly for CV tasks)
- Evolutionary multi- and many-objective optimization

Google Scholar Profile

Yanan Sun

关注

College of Computer Science, Sichuan University
在 scu.edu.cn 的电子邮件经过验证

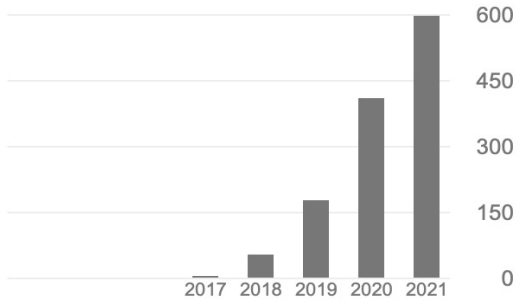
Neural Architecture Search

创建我的个人资料

标题	引用次数	年份
Evolving deep convolutional neural networks for image classification Y Sun, B Xue, M Zhang, GG Yen IEEE Transactions on Evolutionary Computation 24 (2), 394 - 407	212	2020
Automatically designing CNN architectures using genetic algorithm for image classification Y Sun, B Xue, M Zhang, GG Yen IEEE Transactions on Cybernetics	167	2020
IGD indicator-based evolutionary algorithm for many-objective optimization problems Y Sun, GG Yen, Z Yi IEEE Transactions on Evolutionary Computation 23 (2), 173-187	162	2019
Evolving deep convolutional neural networks by variable-length particle swarm optimization for image classification B Wang, Y Sun, B Xue, M Zhang 2018 IEEE Congress on Evolutionary Computation (CEC), 1-8	91	2018
Evolving unsupervised deep neural networks for learning meaningful representations Y Sun, GG Yen, Z Yi IEEE Transactions on Evolutionary Computation 23 (1), 89-103	88	2018
Completely Automated CNN Architecture Design Based on Blocks Y Sun, B Xue, M Zhang, GG Yen IEEE transactions on neural networks and learning systems 31 (4), 1242-1254	70	2019
Surrogate-assisted evolutionary deep learning using an end-to-end random forest-based performance predictor Y Sun, H Wang, B Xue, Y Jin, GG Yen, M Zhang IEEE Transactions on Evolutionary Computation 24 (2), 350 - 364	67	2019

引用次数

	总计	2016 年至今
引用	1267	1260
h 指数	17	17
i10 指数	20	19



可公开访问的出版物数量 查看全部

1 篇文章 14 篇文章

无法查看的文章 可查看的文章

根据资金授权书

合著作者

Supervision@SCU

- 2022 PhD Student
  - Yuqi Feng
- 2021 PhD Students
  - Xiangning Xie (1 Trans. Paper in submit), Shengjia Chen, Zeqiong Lv
- 2021 Master Student
  - Peng Zeng, Xiao Yang, Yuwei Ou, Zixuan Liu
- 2020 Master Student
  - Yuqiao Liu (1 CCF A, 1 Trans.), Siyi Li (1 Patent, 1 Trans. Paper in submit), Jie Wu

Undergraduate Student Thesis

- 2021
  - Computer Science:Yiheng Wang, Wenxin Zhao, Yuesong Feng, Siyi Wu, Youxiang Huang, Guanhong Liu
  - Software Engeering: Xiangning Xie (Best Undergraduate Thesis Award), Jiajun Yan
  - Foreign students: Ahammad Akbar Bin Kabir, Md Ilius Mahfuz， Mahamendige Dakshana Tharinda Mendis, Md Abdul Mazed Siddiki, Pasindu Himantha Kumara Merrennya, Alvin Reuben Walker, K. Gedara Mudiyansela Dulmini Nilushi B.

Undergraduate Student Thesis

- 2020
  - Computer Science: Yuqiao Liu (Best Undergraduate Thesis Award), Yunxiang Song, Weizhen Xu, Siyi Li
  - Software Engeering: Yi Chen, Haoming Wang
  - Foreign students: Preman Dewasiri Ishara Shaminda, Malinda Rukshan, Santosh Ghimire, Rohit Sharma

Supervision@VUW

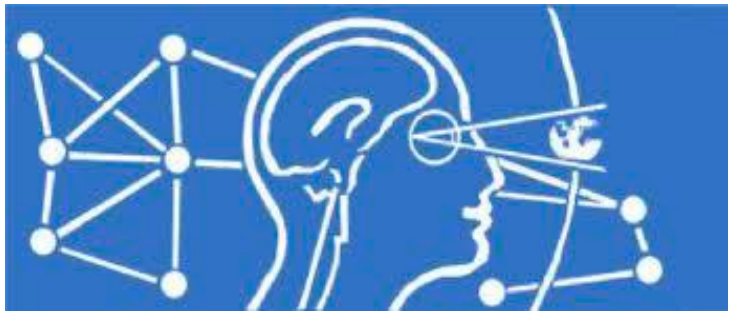
- 2020
  - Phd Student: Junhao Huang (co-supervised with Bing Xue, Mengjie Zhang), “Evolutionary Design of Deep Neural Networks”, 2020-2024
- 2019
  - Summer Scholar: Bin Wang (co-supervised with Bing Xue, Mengjie Zhang), “Evolving deep neural networks by multi-objective particle swarm optimization for image classification Publications”, in this research, Bin has produced two papers that have been accepted by GECCO2019 and PRICAI2019, respectively.
- 2018
  - Honours (Master Student): William Irwin-Harris (co-supervised with Bing Xue, Mengjie Zhang), “Genetic programming for automatic design of convolutional neural network architectures”, In addition to the final report, William has produced two papers including one accepted by CEC2019 and the other submitted to TEVC for review.
  - Honours (Master Student): Bin Wang (co-supervised with Bing Xue, Mengjie Zhang), “Evolving deep neural networks for image classification”, In addition to the final report, Bin has produced one paper accepted by AI2018.
- 2017
  - Summer Scholar: Bin Wang (co-supervised with Bing Xue, Mengjie Zhang), “Evolving deep convolutional neural networks by variable-length particle swarm optimization for image classification”, in this research, Bin has been produced one paper that has been accepted by CEC2018.

Office Hours

- Regular office hours are scheduled each week to meet with any student
  - who needs assistance with this course
  - who needs professional, career, curriculum, or technical advice
- All students are encouraged to make most use of office hours
- The office hours are:
  - Tuesday/Thursday whole day
  - or by appointment only

COMPUTATIONAL INTELLIGENCE

.....



Wikipedia

- CI refers to the ability of a computer to learn a specific task from data or experimental observation (Data-driven?)
- CI is a set of
  - nature-inspired computational methodologies
  - and approaches to address complex real-world problems to which mathematical or traditional modelling can be useless
    - the processes might be too complex for mathematical reasoning
    - it might contain some uncertainties during the process
    - the process might simply be stochastic in nature

A Quote from A Book

"Advances in Computational Intelligence, Theory and Applications," edited by Fei-Yue Wang and Derong Liu.

Computational Intelligence is the study of adaptive mechanisms to enable or facilitate intelligent behaviors in complex and changing environments.

Computational Intelligence is the computational part of the artificial intelligence.

Definition

- Any biologically, naturally, and linguistically motivated computational paradigms include, but not limited to,
  - neural network(basis of deep learning->foundation of today's AI),
  - fuzzy system,
  - evolutionary computation,
  - autonomous mental development
  - and *hybrid intelligent systems* in which these paradigms are contained.

Any nature-inspired computational paradigms for problem solving…

Fuzzy Logic

- This first-prize-winning video was sponsored by the IEEE Computational Intelligence Society (CIS) in its 2011 Fuzzy Logic Video Competition
- The IEEE CIS has free rights to use this video as it sees fit
- The video does not infringe any copyrighted materials

Artificial Neural Network

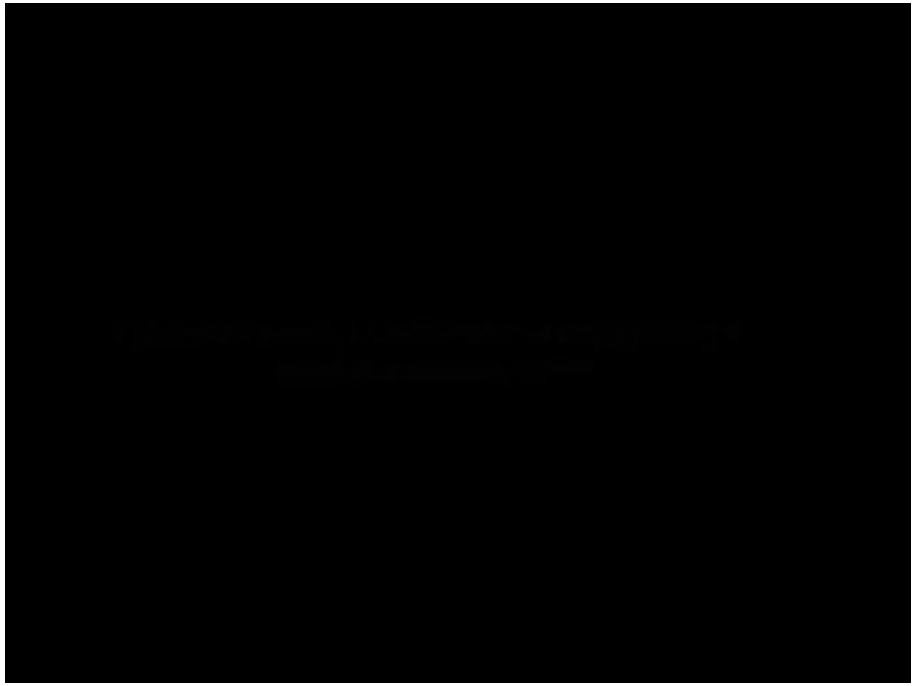
- The EEEE CIS has free rights to use this video as it sees fit
- The video does not infringe any copyrighted materials

Evolutionary Computation

The Origin

- Nearly all inventions have a counterpart in or are an extension of nature.
  - thermonuclear explosions occur in the stars
  - pulse modulation occurs in the human nervous system
  - bats have sonar and dolphin pings serve as a subterranean telephone
- Nature/biology inspires invention
- Engineering uses science and mathematics to emulate and extend nature
- As the bird motivates air flight, so does human/biological intelligence motivates study of advanced computational paradigms.

A Practical Example-Velcro



Common Characteristics

- Biologically motivated behavior such as learning, reasoning, or evolution (in the sense of approximation)
- Parallel, distributed information processing
- Mysterious power under real-world complications

- Lack of qualitative analysis
- Non-repeatable outcomes
- Stochastic nature

Is this a panacea for our modern-day problems?

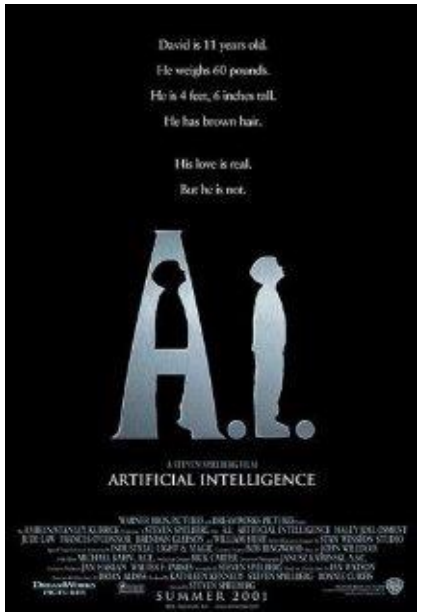
CI vs. Intelligent Systems (IS)

1. IS covers on all aspects of artificial intelligence, focusing on the development of the latest research into practical, fielded applications.

2. CI, on the other hand, is a collective effort in emerging, fundamental computational paradigms.

CI vs. Artificial Intelligence (AI)

1. CI depends upon numerical data supplied by manufacturers and does not rely on “knowledge.”
2. AI, on the other hand, uses “knowledge tidbits” and these knowledge is derived from human expert.
3. The knowledge or intelligence exhibited from CI is self-emerging and spontaneous as opposed to man-made and artificial from AI.



Critical Message Conveyed

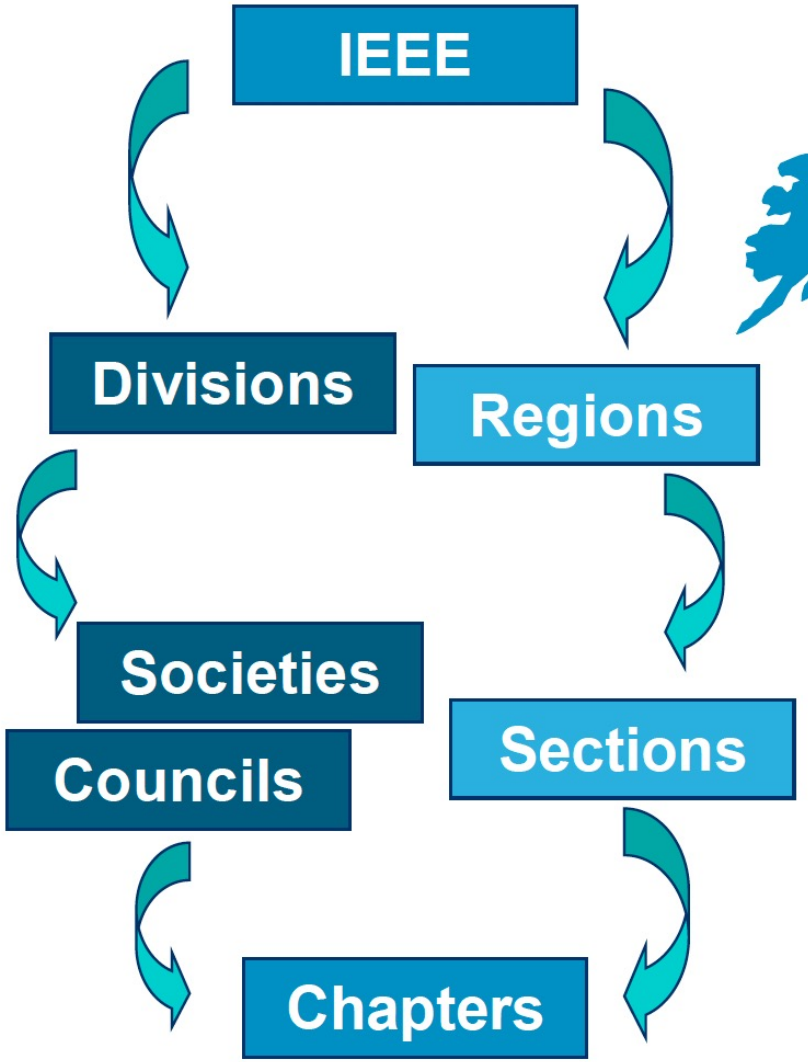
Any nature-inspired computational paradigms
for problem solving…
is

Computational Intelligence

IEEE COMPUTATIONAL INTELLIGENCE SOCEITY

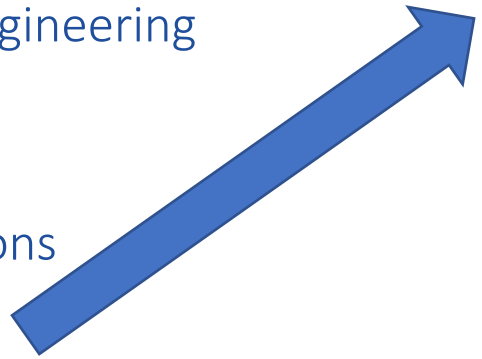
.....

IEEE


IEEE
Divisions
Regions
Societies
Councils
Sections
Chapters

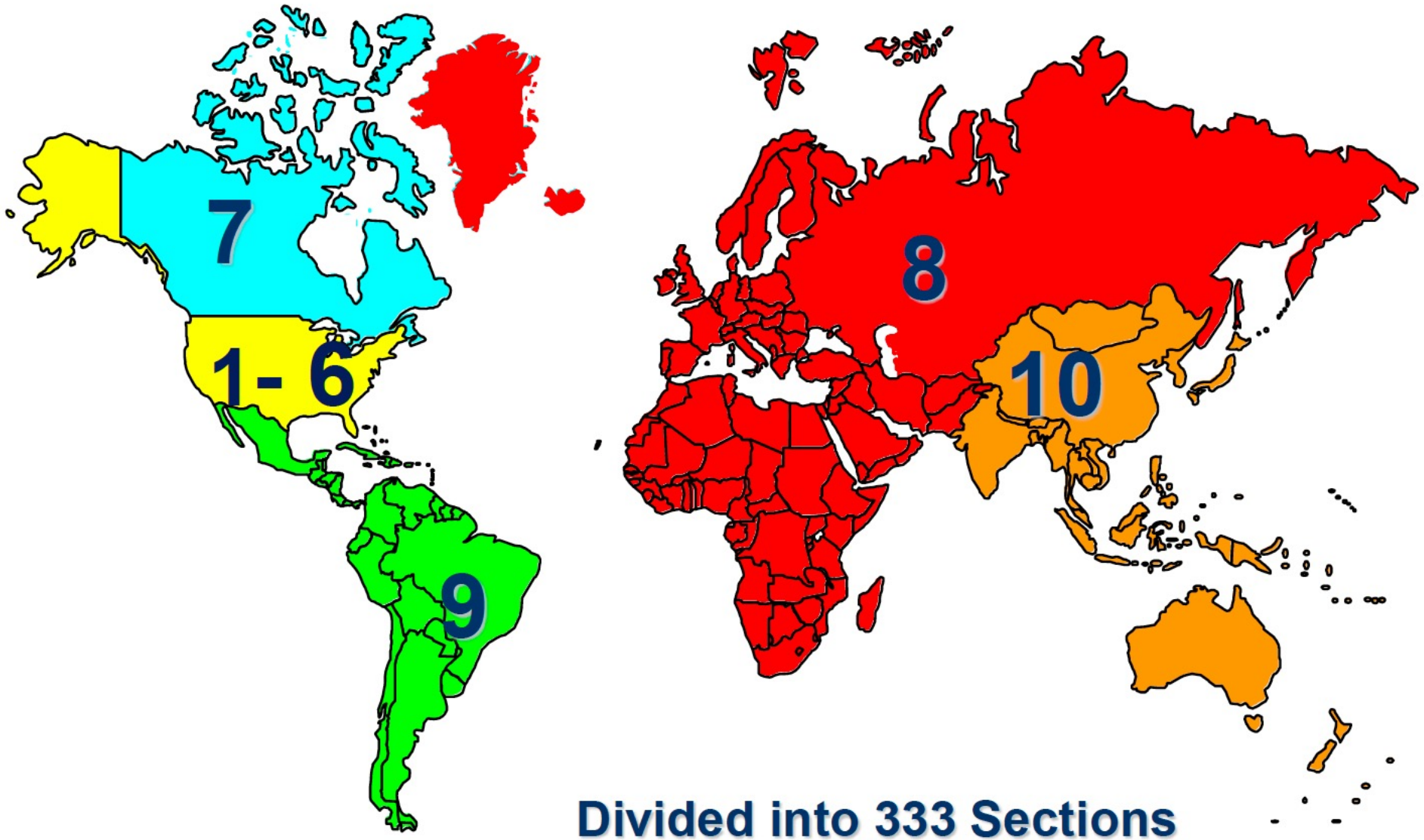
IEEE Divisions

1. Circuits and Devices
2. Industrial Applications
3. Communications Technology
4. Electromagnetics and Radiation
5. Computer
6. Engineering & Human Environment
7. Energy and Power Engineering
8. Computer
9. Signals and Applications
10. Systems and Control



Computational Intelligence Society
Control Systems Society
Engineering in Medicine and Biology Society
Photonics Society
Robotics and Automation Society
Systems, Man and Cybernetics Society
Biometrics Council
Systems Council

IEEE Regions



IEEE CIS

- Neural Network Council was created in 1990
- Transformed into Neural Network Society in 2001
- Name changed to Computational Intelligence Society in 2005
- Currently have 7,000+ members
- $4,000,000 in reserves
- Publish TNNLS (11.683)/TEVC (8.508)/TFS (8.759)//CIM (5.857)/TCIAIG(1.506)/TCDS(2.755)/TETCI
- Hold annual conferences on IJCNN, FUZZ-IEEE, CEC, WCCI, SSCI, ICDL, CIG, CIBCB, CIMSA
- Field of Interest: is the theory, design, application, and development of nature-inspired computational paradigms.

Technical Activities

- Bioinformatics
- Evolutionary Computation
- Computational Finance
- Fuzzy Systems
- Intelligent Systems Applications
- Neural Networks
- Emergent Technologies
- Autonomous Mental Development
- Data Mining
- Computational Games
- Approximate Dynamic Programming & Reinforcement Learning

Applications Task Forces

- Aerospace applications
- Computational Finance and Economics
- Data Mining
- Automotive applications
- Software engineering
- Virtual reality
- Intelligent control and factory automation
- Speech and vision processing
- Telecommunications
- Business Intelligence
- Biometrics
- Intelligent measuring systems
- Homeland security
- and etc

Sponsored Publications

IEEE TRANSACTIONS ON
NEURAL NETWORKS

IEEE TRANSACTIONS ON
FUZZY SYSTEMS

IEEE TRANSACTIONS ON
EVOLUTIONARY COMPUTATION

Technical Committees-1

- Technology-oriented TCs promote CI technologies
  - Neural Networks
  - Fuzzy Systems
  - Evolutionary Computation
  - Cognitive and Developmental Systems
  - Adaptive Dynamic Programming and Reinforcement Learning
- Application-oriented TCs deal with applications of CI technologies
  - Bioinformatics and Bioengineering
  - Computational Finance and Economics
  - Data Mining
  - Games
  - Smart World

Technical Committees-2

- Incubator TCs identify and nurture new CI technologies and new areas for CI applications
  - Emergent Technologies
  - Intelligent System Applications
    - TF1…
    - …
    - TF7: ISATC "Evolutionary Deep Learning and Applications" Task Force, Chair: Yanan Sun
    - …

Professional Development

- Webinars
- Summer Schools
- ...
- Graduate student Research Grants

Simone Ludwig, Chair
North Dakota State University, US

Yanan Sun
Sichuan University, CN

Zhen Ni
Florida Atlantic University, US

Ana Bazzan
Federal University of Rio, BR

Sponsored Conferences

- International Joint Conference on Neural Networks (IJCNN)
- International Conference on Fuzzy Systems (FUZZ-IEEE)
- Congress on Evolutionary Computation (CEC)
- International Symposium on Computational Intelligence in Bioinformatics and Computational Biology (CIBCB)
- International Conference on Computational Intelligence in Games (CIG)
- International Conference on Developmental Learning(ICDL)
- International Symposium on Computational Intelligence for Measurement Systems and Applications(CIMSA)
- International Conference on Computational Intelligence for Homeland Security and Personal Safety(CIHSPS)

WCCI

- 1994, Orlando, Florida
- 1998, Anchorage, Alaska
- 2002, Honolulu, Hawaii
- 2006, Vancouver, Canada
- 2008, Hong Kong, China
- 2010, Barcelona, Spain
- 2012, Brisbane, Australia
- 2014, Beijing, China
- 2016, Vancouver, Canada
- 2018, Rio de Janerio, Brazil
- 2020, Glasgow, UK
- 2022, Padua, Italy

WCCI2020


WCCI2022
IEEE WORLD CONGRESS ON COMPUTATIONAL INTELLIGENCE
World's most influential computational intelligence congress with inspirational speakers
18-23 July, 2022
Centro Congressi
Padova, Italy

SSCI

- IEEE Symposium Series on Computational Intelligence
  - 2007, Honolulu, Hawaii
  - 2009, Nashville, Tennessee
  - 2011, Paris, France
  - 2013, Singapore
  - 2014, Orlando, Florida
  - 2015, Cape Town, South Africa
  - 2016, Athens,Greece
  - 2017, Honolulu, Hawaii
  - 2018, Bengaluru, India
  - 2019, Xiamen, China
  - 2020, Canberra, Australia
  - 2021, Florida, USA

IEEE Membership

- Student Member/Member
- Senior Member
  - Have been in professional practice for at least ten years (including PhD study)
- IEEE Fellow
  - Has significant contribution to some fields
- IEEE Life Fellow
  - Recognize to IEEE Fellows who have been 80 years' old

Critical Message Conveyed

To proactively participate in
professional community
help

to grow your career