Summer School on Fuzzy Cognitive Maps
Methods, Learning Algorithms and Software Tool for Modeling and Decision Making

4-8 July 2015 (5 days)

Organized by Prof. Elpiniki Papageorgiou
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Place: City of Volos, DOMOTEL XENIA VOLOS, Greece

Course Title:
Fuzzy Cognitive Maps: Methods, Learning Algorithms and Software Tools. Applications on case studies

Course Leader: Prof. Elpiniki Papageorgiou, TEI of Central Greece, Lamia

Main Lecturers: Dr. Elpiniki Papageorgiou and Gonzalo Napoles

Structure: 32h course; 5 days; approximately 6h/day

Details of Summer School:

Content
This five-day Summer School deals with the principles, assumptions, models, learning algorithms, convergence issues, strengths, limitations, applications of Fuzzy Cognitive Maps (FCM) and new software tools for them. Fuzzy cognitive maps are fuzzy feedback dynamical systems for modeling causal knowledge. They were introduced by Bart Kosko in 1986 as an extension of cognitive maps. Cognitive maps are a set of nodes linked by directed and signed edges. The nodes represent concepts relevant to a given domain. The causal links between these concepts are represented by the edges which are oriented to show the direction of the influence and are signed to show a promoting or inhibitory effect.

FCMs have emerged as tools for representing and studying the behavior of systems and people. By combining the main aspects of fuzzy logic, neural networks, expert systems, semantic networks, they have gained considerable research interest and are widely used to analyze causal complex systems. From an Artificial Intelligence perspective, FCMs are dynamic networks with learning capabilities, where in more and more data is available to model the problem, the system becomes better at adapting itself and reaching a solution. They gained momentum due to their dynamic characteristics and learning capabilities. These capabilities make them essential for modeling, analysis and decision making tasks as they improve the performance of these tasks. These capabilities make them essential for modeling and decision making tasks as they improve the performance of these tasks.

This summer school is dedicated to providing participants with deep insights on fundamentals, modeling methodologies, learning algorithms, optimization and convergence issues for fuzzy cognitive maps (FCMs), supplemented with hands on real case studies using the software tool.
of FCM Wizard. A diverse number of applications of FCMs in applied sciences and engineering will be investigated.

The FCM software tool, called FCM WIZARD, will be fully presented in practice and the computer experiments will be based on it. A free version of FCM WIZARD will be given to the participants for investigating their problems.

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**Topics and Schedule**

**Monday (4 July)**

9:00-9:10: Welcome – Prof. Elpiniki Papageorgiou (Organizer)


10:30-11:00: Break (Coffee)

11:00-12:00: Construction Methods of FCMs – Part I (Expert-based, Stakeholders, Participatory Modelling) – Prof. Elpiniki Papageorgiou

12:30-14:00: Lunch

14:30-15:30: Presentation of FCM WIZARD Tool for modeling and Inference – Gonzalo Napoles

15:30-16:00: Break (Coffee)

16:00-17:00: Example case studies of the FCM WIZARD Tool for Modeling and Inference – Part I (Gonzalo Napoles)

17:00-18:00: Modeling Complexity using Fuzzy Cognitive Maps – Elpiniki Papageorgiou

**Tuesday (5 July)**

9:00-10:30: Construction Methods of FCMs – Part II (Data-based) – Prof. Elpiniki Papageorgiou

10:30-11:00: Break (Coffee)

11:00-12:30: Supervised learning of FCMs - Part I (Causality estimation) – Gonzalo Napoles and Elpiniki Papageorgiou

12:30-14:00: Lunch

14:00-15:30: Supervised learning of FCMs - Part II (Topology Optimization) – Gonzalo Napoles

15:30-16:00: Break (Coffee)

16:00-17:00: The journey from data to added value in business – FCM in Business Intelligence - Prof. Koen Vanhoof

17:00-18:30: Fuzzy Cognitive Map methods for medical decision making and support – FCM plugin EYE, Prof. Elpiniki Papageorgiou

**Wednesday (6 July)**

9:00-10:30: Unsupervised learning algorithms for FCMs and presentation of selected case studies using the FCM WIZARD TOOL - Prof. Elpiniki Papageorgiou and Gonzalo Napoles

10:30-11:00: Coffee

11:00-12:30: FCM WIZARD TOOL for learning and optimization and its capabilities in decision making – Prof. Elpiniki Papageorgiou and Gonzalo Napoles

12:30-14:00: Lunch

14:00-15:30: FCM for classification, prediction and risk assessment (in Medicine and other domains) – Hands on medical case studies - Prof. Elpiniki Papageorgiou

15:30-16:00: Coffee

16:00-17:30: Convergence issues in FCM-based systems - (analytical methods and heuristic methods) – Gonzalo Napoles
Thursday (7 July)
9:00-10:00: Clustering using Fuzzy Cognitive Maps (Gonzalo Napoles and Elpiniki Papageorgiou)
10:00-11:00: Granular FCMs - Part I (Rough Cognitive Networks) – Gonzalo Napoles
11:00-11:30: Coffee
11:30-12:30: Granular FCMs - Part II (Partitive Cognitive Networks) – Gonzalo Napoles
12:30-14:00: Lunch
14:00-15:30: Learning FCM for Time Series Modeling and Prediction - Katarzyna Poczeta
15:30-16:00- Coffee
16:00-17:00: Selected case studies of the FCM TOOL – I, Hands on the selected case studies - Prof. Elpiniki Papageorgiou and Gonzalo Napoles
17:00-18:30: Selected case studies of the FCM TOOL – II, Hands on the selected case studies - Prof. Elpiniki Papageorgiou and Gonzalo Napoles

GALA DINNER will be held in the evening of July 7, City of Volos

Friday (8 July) -
9:00-10:00: Participatory Modeling and Analysis using Fuzzy Cognitive Maps (Steven Gray and Elpiniki Papageorgiou)
10:00-11:30: Hands on real case studies suggested by participants (Prof. Elpiniki Papageorgiou and Gonzalo Napoles)
11:30-12:00: Break
12:00-13:00: FCM Trends, Extensions and Applications. Comparisons of FCM with other inference Networks (e.g. Bayesian Networks, Artificial Neural Networks) – (Invited speakers with experience in FCMs from different application domains will give short presentations about this subject)
13:00-14:00: Lunch
14:00-15:30: FCM Algorithms for constructing and learning models from time series data – Hands on case studies for time series prediction based on synthetic, real-life and historical data, using a new software tool (Prof. Elpiniki Papageorgiou and Katarzyna Poczeta)
15:30-16:00- Coffee
16:00-17:30: Discussions about FCM research projects and innovations – Presentation of Research programs including FCM for decision support and policy making, e-government, smart cities, environmental modelling and management, climate change. (Coordinator Elpiniki Papageorgiou).
Also discussions about the creation of an International Research Group and Forum on FCMs.
17:30: End of the Summer School

Total: 32 hours  (10 ects credits)

Credits
4 ECTS credits + Certificate of Attendance

Target audience
The ideal number of participants is about 50. The summer school will host: a) young researchers who wish to achieve a thesis on the subject or to carry on a personal work which
uses FCM or to in-depth their knowledge in this discipline in order to complete their training, and b) academics and scientists from research community that have an interest in using FCMs, either as a theoretical framework or as a methodology and tool for applied research, engineering, industrial applications, environmental management, medical decision support, computer science etc.

**Language**

The official language of the School is English. Unfortunately, we cannot provide any simultaneous translation.

### Registration Fees: 560 euro

Registration fees include a free version of the new FCM tool, FCM WIZARD, which will be used for the practical computer exercises and for any real problems that attendees want to solve and make decision with this tool. See [www.fcmwizard.com](http://www.fcmwizard.com)

Registration includes attendance to the summer school, software tool, documents, lunches, dinners and a social activity.

### Computer Exercises:

The computer practice component of the Summer School has a number of very useful hands on real case studies.

**Hands on training includes:**

- FCM construction from experts and stakeholders, participants
- FCM construction from historical data
- Inference and Scenario analysis
- Learning
- Optimization
- Convergence
- Prediction
- Classification
- Clustering
- Decision Support (medical, environmental, business, management etc)

### Website URL

[www.fcmwizard.com/SummerSchool/](http://www.fcmwizard.com/SummerSchool/)

For any queries please contact Elpiniki Papageorgiou, [epapageorgiou@teiste.gr](mailto:epapageorgiou@teiste.gr) and [e.i.papageorgiou75@gmail.com](mailto:e.i.papageorgiou75@gmail.com)

### Expression of Interest

Please send an email to Elpiniki Papageorgiou for expressing your interest to attend the Summer School on Fuzzy Cognitive Maps.
**Contact Details**
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**Important Dates**

The FCM Summer School is a one-week event, taking place on 4th – 8th July, 2016.

- Application submission opening: January 25th, 2016
- Deadline for Application: April 10th, 2016
- Acceptance of Application: April 15th, 2016
- Early registration deadline: April 20th, 2016
- Beginning of the summer school: July 4th, 2016