Lecture 16

Cognitive System Engineering

Course Revision

Cognitive systems (CogSys) are software-hardware systems that have their structure and functionality based on principles of information processing in the human brain. They are part of AI, but AI includes also other systems that manifest cognitive behaviour, such as speech and image recognition, learning and reasoning, but using other methods, such as statistical, empirical, abstract logic, etc.

The course is by research papers.
Every topic will include:

1. Topic/task/problem specification
2. Previously published methods for solving the problem
3. Description of the method and in the paper under discussion
4. Experimental results and discoveries
5. Future work to be done for this problem
6. Questions for individual work for those interested

Impact of my Lectures on the Cognitive System Engineering Course

Introducing advanced concepts and methodologies that enhance students' understanding and application of cognitive systems.

Specifically:

Impact of my Lectures on the Cognitive System Engineering Course

Deep Learning and Deep Knowledge Representation in the Human Brain (*Lecture 2-summary notes*)

- Provides knowledge on how the human brain processes information through deep learning mechanisms and spatio-temporal dynamics.
- Inspires the development of brain-inspired cognitive systems, illustrating the integration of spatial and temporal structures in learning and memory, and highlighting the holistic nature of neural processing.

Impact of my Lectures on the Cognitive System Engineering Course

Dynamic Evolving Neural-Fuzzy Inference System - DENFIS (*Lecture 5*)

- Covers adaptive learning strategies for dynamic time-series prediction in both online and offline environments.
- By integrating neural networks and fuzzy systems, it demonstrates the ability to handle complex, nonlinear data and adapt in real-time, which is crucial for cognitive system engineering.

Impact of my Lectures on the Cognitive System Engineering Course

Integrated Learning Systems - NeuDen
(*Lecture 8*)

- Focusing on integrating evolving spiking neural networks (eSNN) with Dynamic Evolving Neuro-Fuzzy Systems (deNFS) for predictive and explainable modeling.
- By enhancing eSNN explainability and addressing the limitations of deNFS in modeling multiple streaming time series interactions, it contributes significantly to the cognitive system engineering field.

Impact of my Lectures on the Cognitive System Engineering Course

Predictive Associative Memories for Time Series (ePAMeT)
(*Lecture 12*)

- Introducing ePAMeT, a method for evolving predictive associative memory based on Brain-Inspired Spiking Neural Networks (BI-SNN).
- It is an associative memory method that effectively recall financial time series with reduced input features, maintaining prediction accuracy and explainability.
- It is also a Life Long Learning method that adapts to new financial time series variables and data without retraining on old data.

Significant Contributions to the Cognitive System Engineering Field

- Emphasizing the importance of adaptive learning strategies and associative memory, which are critical for developing robust and intelligent cognitive systems.
- Introducing innovative evolving models like ePAMeT that adapt to new data in real-time, offering practical solutions for dynamic and complex environments.
- Applying brain-inspired techniques to develop advanced cognitive systems that mimic human neural processing, by integrating eSNN and deNFS enhancing both prediction accuracy and system explainability.

New Advancements Introduced to the Cognitive System Engineering

- **ePAMeT Framework**: A pioneering model for creating evolving predictive associative memories for time series, which excels in functioning efficiently with reduced input features during recall and integrating new input features seamlessly.
- **NeuDen Framework**: Combines the strengths of evolving spiking neural networks and neuro-fuzzy systems, enhancing the predictive power and explainability of models applied to multiple time series data.
- **Deep Learning**: Providing a comprehensive understanding of deep learning mechanisms and spatio-temporal processing in the human brain, inspiring the development of sophisticated computational models.

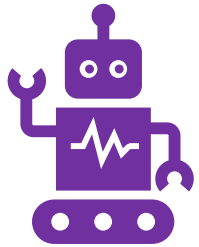
Encouraging Student Engagement to the Cognitive System Engineering

- Encourage students to apply these innovative models in their projects and research to explore the practical applications and benefits of adaptive learning systems and neuro-inspired techniques.
- Conduct workshops where students can further learn to implement and experiment with my models. This practical experience will deepen their understanding of cognitive system engineering principles.
- Promote research opportunities where students can work on real-world problems using my models.

Encouraging Student Engagement to the Cognitive System Engineering

- My research work and active engagement of students will accelerate the advancement of cognitive system engineering.
- Will also foster a community of researchers and practitioners dedicated to exploring the full potential of these innovative approaches.

Thank you
for your attention



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感谢你们的关注

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