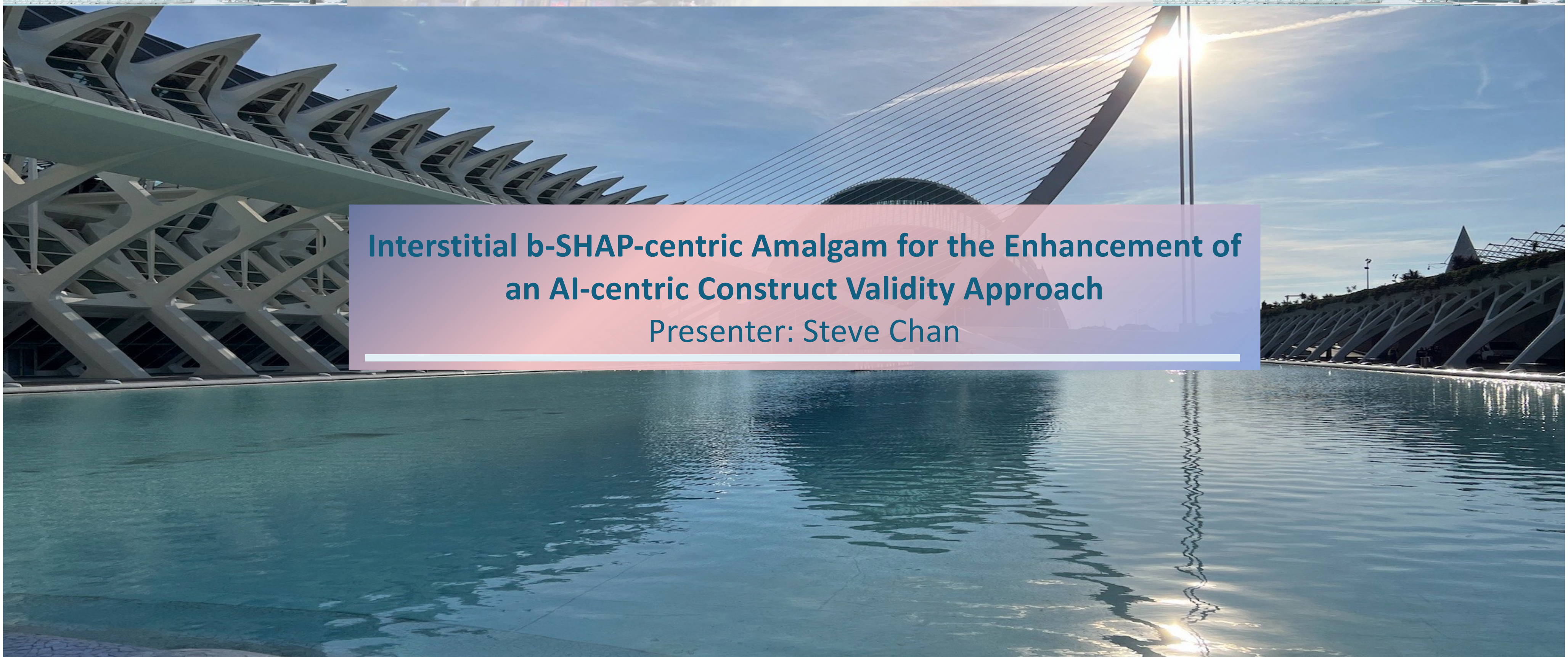
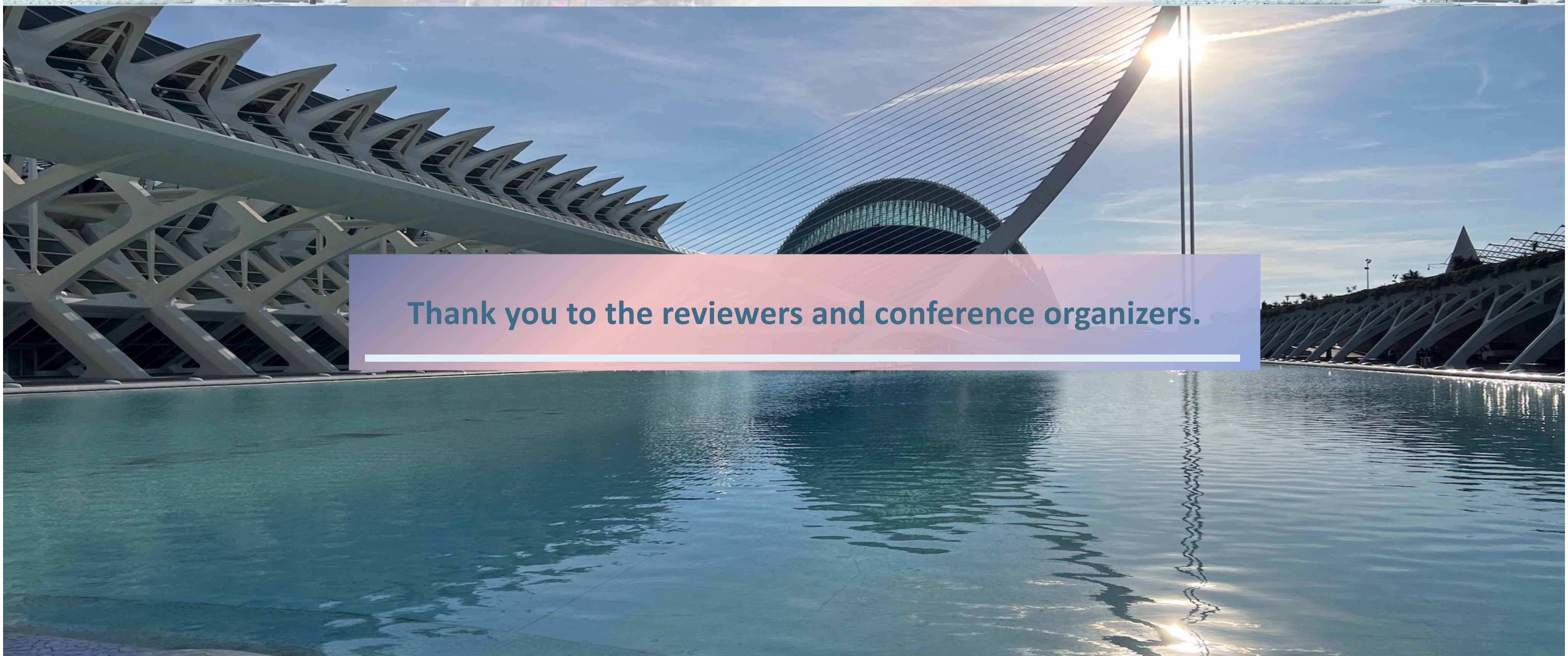
The Seventeenth International Conference on Future Computational Technologies and Applications
FUTURE COMPUTING 2025
April 06, 2025 to April 10, 2025 - Valencia, Spain



Interstitial b-SHAP-centric Amalgam for the Enhancement of an AI-centric Construct Validity Approach

Presenter: Steve Chan



Thank you to the reviewers and conference organizers.

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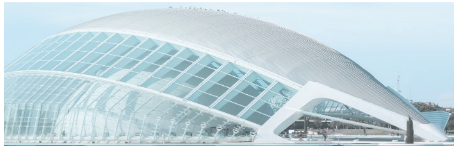
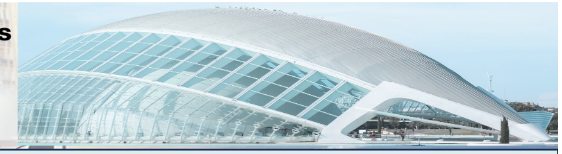
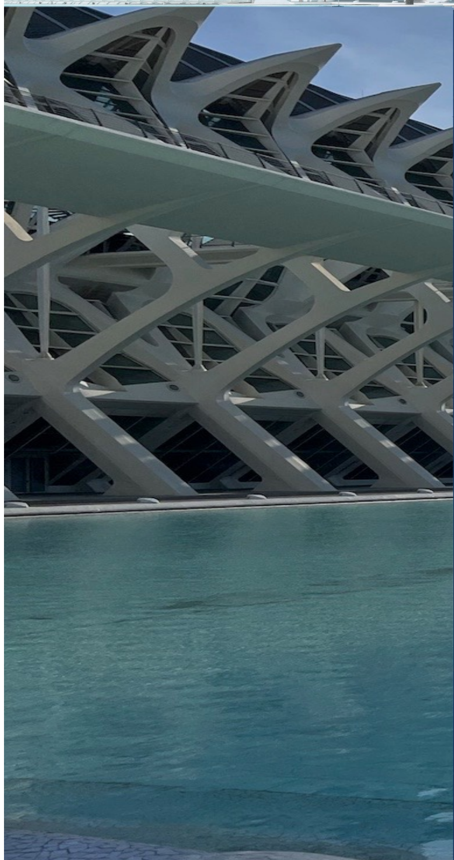
Introduction





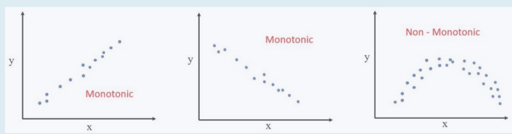


- **Construct Validity Verification Methodology (CVVM)**
- **The Criticality of Construct Validity**
  - For numerous Real-World Scenario (RWS) paradigms, actionable insights from an Artificial Intelligence (AI) System (AIS) is desired. Robust construct validity helps to ensure that the AIS is progressing towards the intended concept.
  - If an AIS is deficient in its construct validity, it might inadvertently focus upon non-pertinent constructs, which could segue to inaccurate and/or misleading results.
- **Transparency, Explainability, and Accountability (TEA) Evaluation & Testing for Enhanced Construct Validity**
  - System TEA (STEA) and Interpretability & Explainability (I&E) can enhance construct validity via insights into how the AIS-related model is measuring and what progress is being made towards the intended concept (rather than focusing upon non-relevant correlations).
  - STEA/I&E can help discern for prospective biases/errors as well as areas for optimization/enhancement, thereby segueing to more accurate results.
- **Enhancing TEA for Enhanced Construct Validity via:**
  - Higher Order Networks (HONs).
  - Finer-tuned Dynamic Assessment and Weighting System (DAWS).
  - Better understanding of the Machine Learning (ML) algorithms and their spawn (e.g., non-monotonic, non-polynomial, or even non-continuous functions)

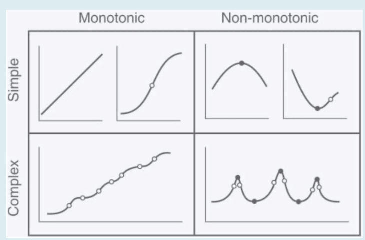
Background

Various Facets of OSNS

	Monotonic	Non-monotonic
Linear		
Non-linear		

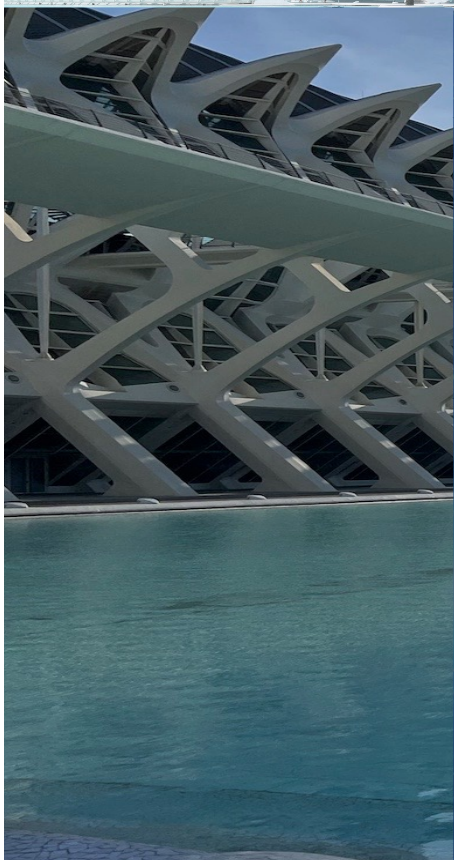


Source: https://datasciencelk.com/correlation-coefficient-interpretation/



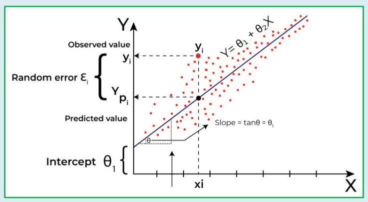
Source: https://europepmc.org/backend/ptpmcrender.fcgi?accid=PMC4883946&blobtype=pdf

- **Descriptors:**
  - Linear Monotonic: wherein the variables progress in the same direction, whether increasing or decreasing, at a constant rate and form a straight line.
  - Linear Non-monotonic: seeming contradiction; N/A
  - Non-linear Monotonic: wherein the variables tend to progress in the same direction, whether increasing or decreasing, but the rate of change between the variables is not constant and a curve is formed.
  - Non-linear Non-monotonic: wherein the complicated relationship of the variables does not result in a straight line, and the direction, such as increasing or decreasing, is not consistent.

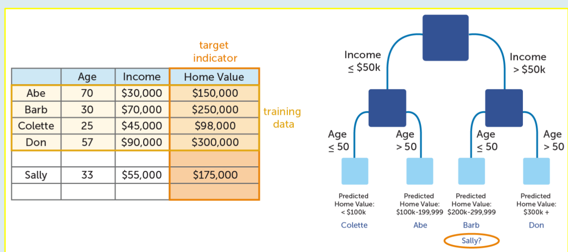


ML Model Types with Exemplar I&E Tools

Model Specific (MS)	Exemplar I&E Tools	Model Agnostic (MA)
Linear Regression (LR)	e.g., InterpretML	e.g., Local Interpretable Model-agnostic Explanations (LIME);
Decision Tree (DT)	e.g., GPTree	
Neural Network (NN)	e.g., Grad-CAM	Shapley Additive explanation (SHAP)
Deep Learning (DL)	e.g., DeepLift	



https://www.geeksforgeeks.org/ml-linear-regression/



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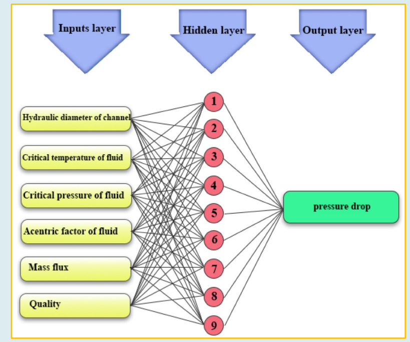

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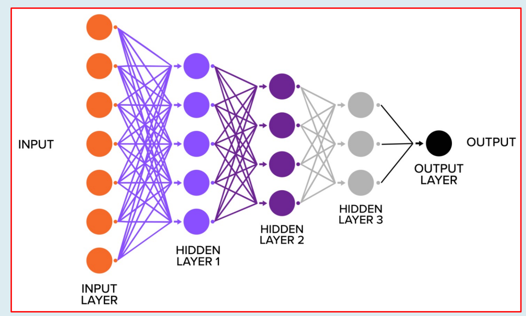
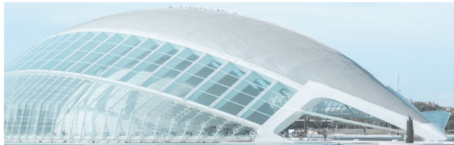
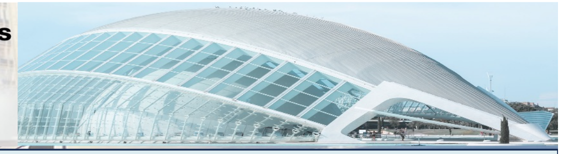
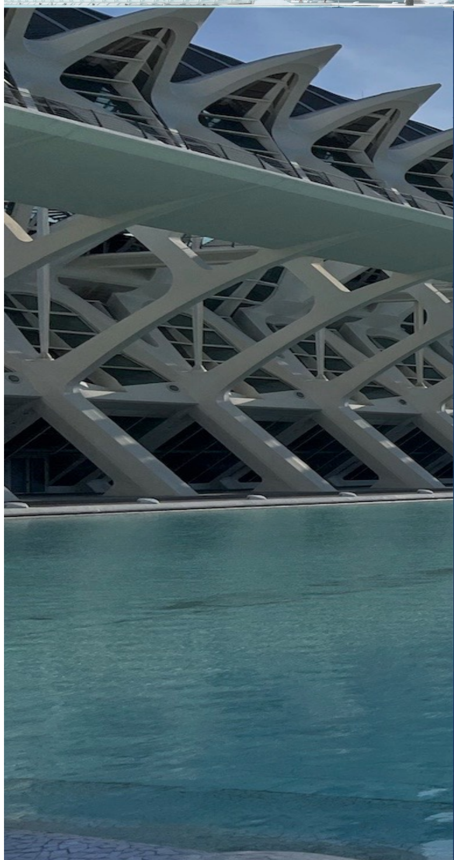


https://www.smartboost.com/blog/deep-learning-vs-neural-network-whats-the-difference/







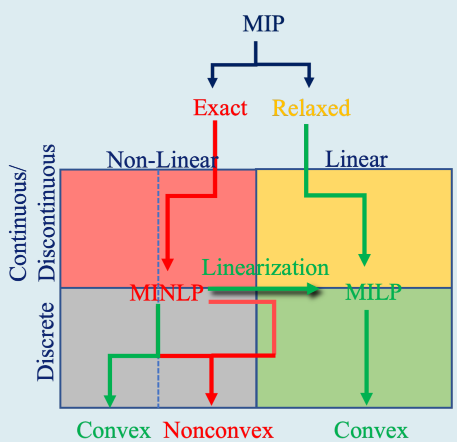
Various Facets of OSNS

OSNS context	Facet
STEA	In general
	HON
	DAWS
	LAHU
STEA-related SOS boundary areas	C2 of C2
	ML of ML

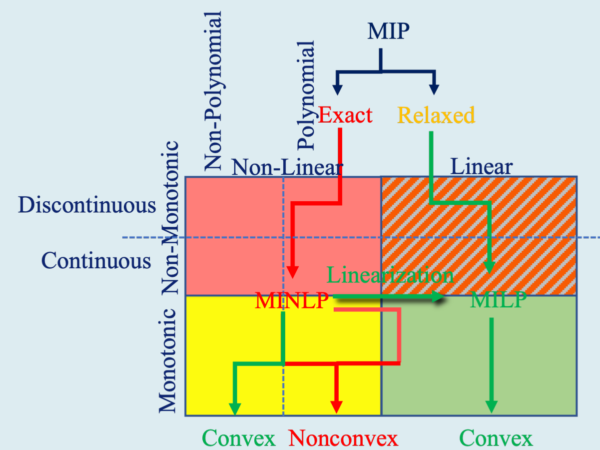
- **Acronyms:**
  - System Transparency, Explainability, and Accountability (STEA)
  - System of System (SOS)
- **Sub-Acronyms:**
  - Higher Order Networks (HON)
  - Dynamic Assessment Weighting Systems (DAWS)
  - Lower Ambiguity Higher Uncertainty Module (LAHU)
  - Command and Control (C2) of C2 (C2 of C2)
  - Machine Learning (ML) of ML (ML of ML)

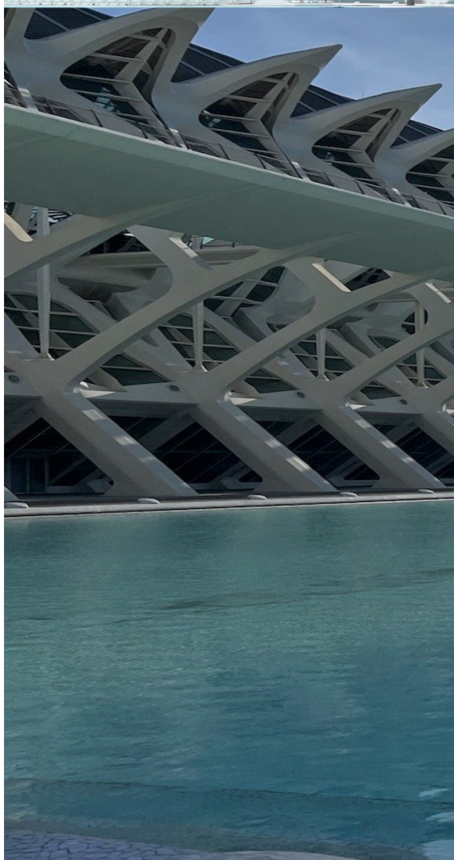
Experimentation

Non-convex to convex Transformation Pathways (e.g., non-convex discontinuous non-linear MINLPs to convex form)



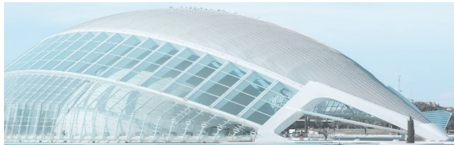
Non-convex to convex Transformation Pathways (e.g., non-convex[non-monotonic, discontinuous] non-polynomial MINLPs to convex form)

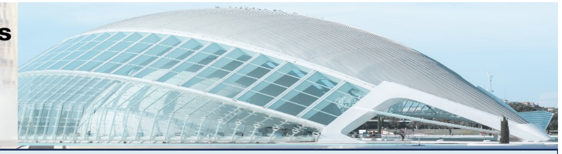


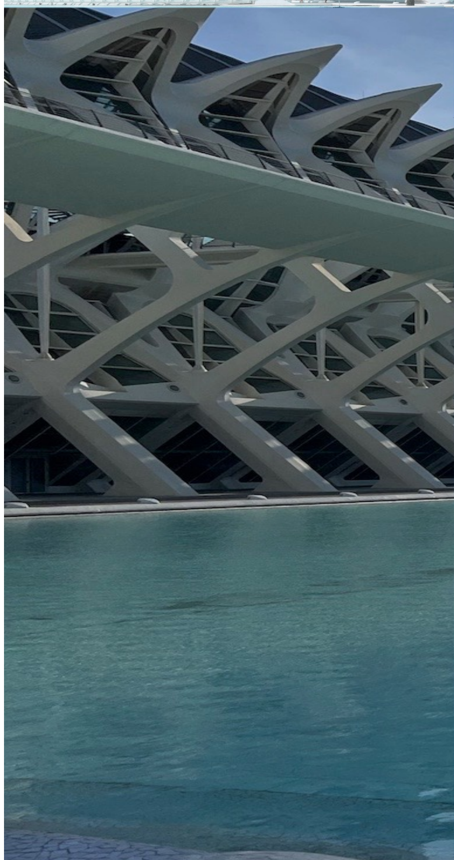


A Useful, Prototypical Latent Variable Model (LVM)

Abstract Concept/ Notion/ Predicted Class/ Unknown Parameter/ Estimated Parameter Class (EPC)	**Unobserved Variables/ Interim Notions/ Hidden Underlying Factors/ Latent Traits/ Interim Latent Variables (ILVs)**	**Observation Variables/ Indicators/ Items/ Measures Characteristics/ Attributes/ Measures/ Measured Variables (MVs)**







CPRLD Architectural Construct with a ML of ML (SR_2 on SR_1) Spawn Reduction Paradigm

Key Solver for Spawn Reduction $(SR)_2$

Key Solver for Spawn Reduction $(SR)_1$

Key Solver for RCR Optimization Problems
DCNN-1

Key Solver for the additional Non-Convex Problems Spawned via the RCR
DCNN-2

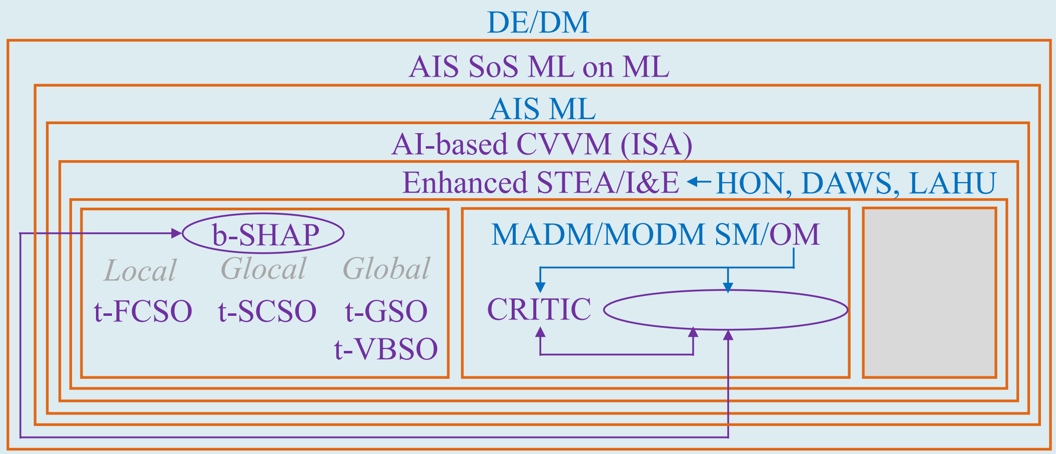
DCNN-3

Maintain Numerical Stability for the Key Solvers and the Construct-at-large
DCNN-4

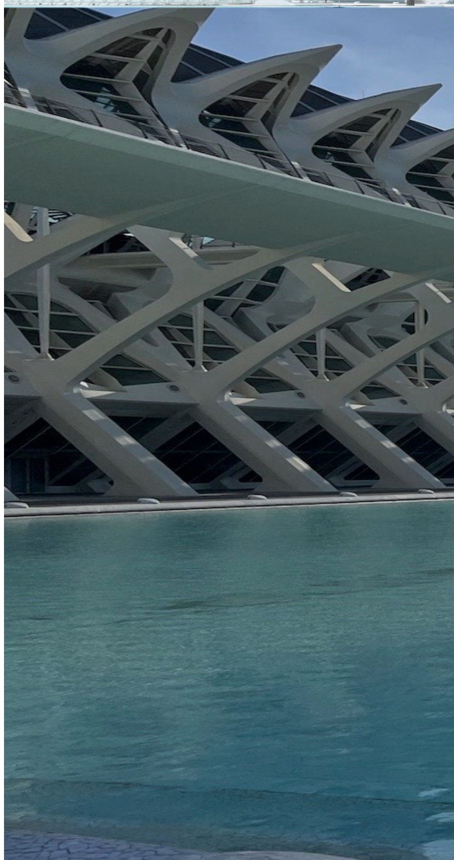
Mitigator Against Mode Failure/ Collapse
DCGAN-1

DCNN-5

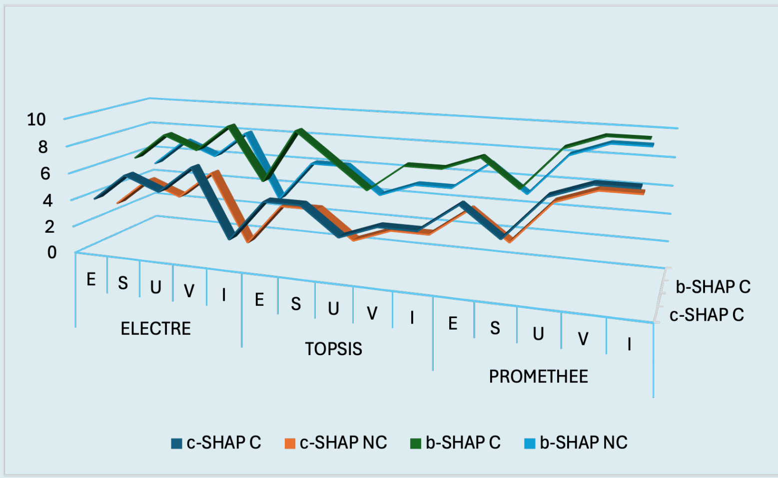
AI-based CVVM (ISA) Experimentation Aspects



- **Key Acronyms:**
  - Bespoke Shapley Additive explanation (b-SHAP)
  - Finite-Change Shapley-Owen (FCSO)
  - Generic Shapley-Owen (GSO)
  - “Squared Cohorts” Shapley-Owen (SCSO)
  - Variance-Based Shapley-Owen (VBSO)
  - CVVM (Construct Validity Verification Methodology)
  - Interstitial SHAP-centric Amalgam (ISA)
  - Higher Order Networks (HON)
  - Dynamic Assessment Weighting Systems (DAWS)
  - Lower Ambiguity Higher Uncertainty Module (LAHU)

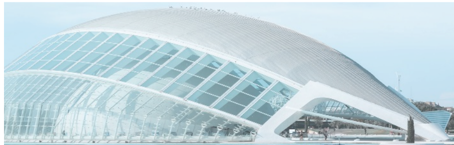


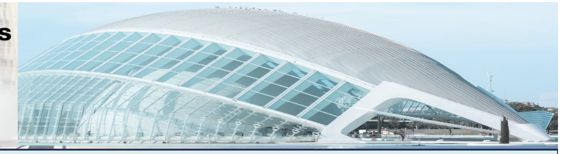
Preliminary Results from b-SHAP/select OM Benchmarking

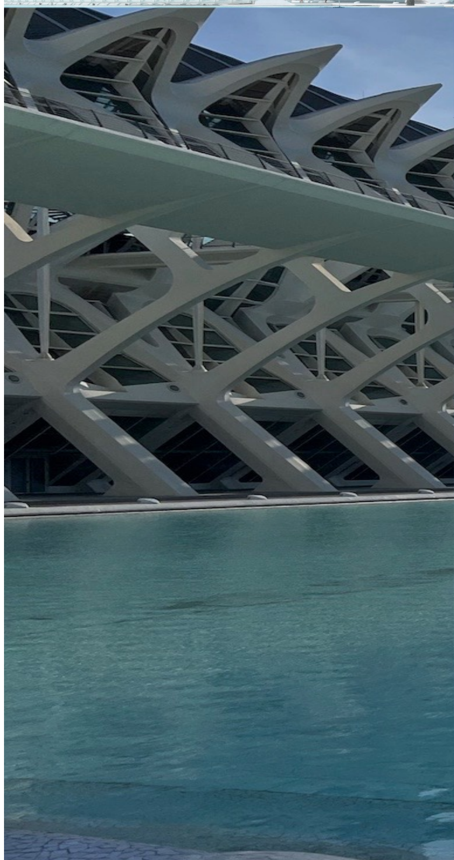


- **Key Acronyms:**
  - Shapley Additive exPlanation (SHAP)
  - Classical (C)
  - Non-classical (NC)
  - ÉLimination Et Choix Traduisant la Realité (ELECTRE)
  - Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)
  - Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE)

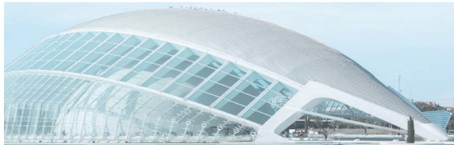
Conclusion

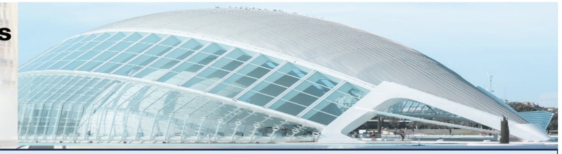


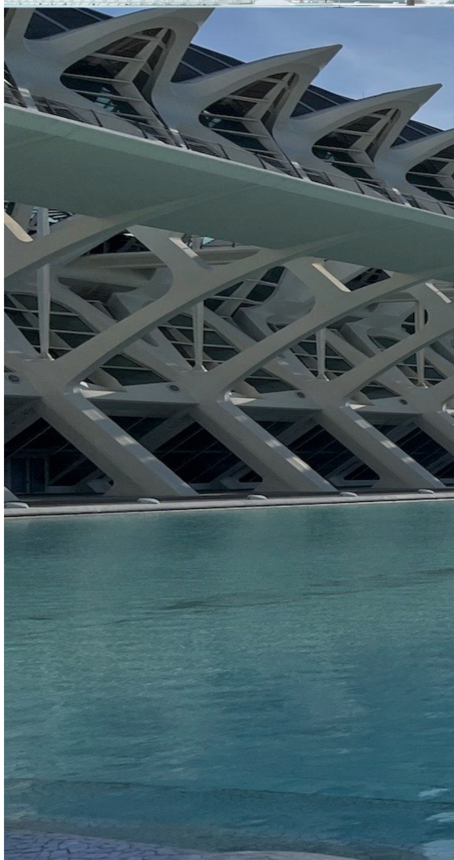




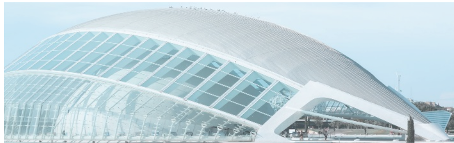
- **The primary impetus:**
- **Enhancing robustness of the testing facet (with more granularity) at the interstices (e.g., interstitial areas between/among individual/amalgam component at the local, glocal, and global levels)**
  - It was posited that the Interstitial SHAP-centric Amalgam (ISA), by better correlating features with each interim intended construct, potentially segues to better Interpretability & Explainability (I&E) and construct validity at the component, interstitial, and overall system level.
- **Better illuminating I&E/STEA DE/DM pathways, and operationalizing AI-based CVVM for the purposes of achieving higher efficacy AI SoS ML on ML for RWS**
  - It was posited that by better understanding the System Transparency, Explainability, and Accountability (STEA) and the accompanying Interpretability & Explainability (I&E) pathways, it would be possible to obtain better insights in the construct validity. After all, Sjoberg depicts construct validity as being "concerned with whether one can justifiably make claims at the conceptual level that are supported by results at the operational level." As the Machine Learning (ML) models for Artificial Intelligence (AI) System of Systems (SoS) (AI SoS) continue to evolve, construct validity becomes particularly important to ensure that the involved progression leads to the intended construct. For example, construct validity can help ensure that the feature set aligns with the intended construct (i.e., feature alignment). Also, given the understood constraints of the Shannon-Weaver model in communications theory, consideration of construct validity can help to avoid misinterpretation of the AI SoS ML model's posits.







- **Some findings:**
- **OSONS >>> OSNS**
  - Optimal Shapley-Owen-Nondominated Solution (OSONS) was found to have greater efficacy than Optimal Shapley-Nondominated Solution (OSNS).
- **b-SHAP/PROMETHEE >> b-SHAP/TOPSIS or b-SHAP/ELECTRE**
  - A bespoke Shapley Additive explanation (SHAP) (b-SHAP) (which involves various temporal-centric SHAP instantiations for local, glocal, and global) and Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) - along with Criteria Importance through Intercriteria Correlation (CRITIC) - amalgam was found to be more robust than the b-SHAP/Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) or b-SHAP/Elimination et Choix Traduisant la Realite (ELECTRE) amalgams on the interpretability front.
- **Key Solver for Spawn Reduction is vital**
  - Spawn reduction turns out to be central, for once in the convex form, a myriad of Semi-Definite Programming (SDP) solvers can be leveraged to handle the involved optimization problems in polynomial time; otherwise, Non-deterministic Polynomial-time Hardness (NP-hard) spawn can congest matters with an indefinite impasse.
- **Enhanced STEA/I&E segues to an enhanced CVVM**
  - The enhanced System Transparency, Explainability, and Accountability (STEA)/Interpretability and Explainability (I&E) discernment seems to segue to more robust feature alignment, robust interpretation, etc., which constitutes an enhanced Construct Validity Verification Methodology (CVVM).



Thank you to the audience and to the organizers for the opportunity to present.