

**SUMMER
SCHOOL
2026**
Let's Shape!

**ARTIFICIAL INTELLIGENCE
AND PARAMETRIC DESIGN FOR
SHELLS AND SPATIAL STRUCTURES**

September 19-23, 2026

PROGRAM

SUMMER SCHOOL 2026 *Let's Shape!*

Let's Shape!
Artificial Intelligence and Parametric Design
for Shells and Spatial Structures

Summer School

Shaping Intelligent Structures:
Where AI Meets Shells and Spatial Innovation

In collaboration with:
CSP/IAS \ Institute for Advanced Study
ARTiStE International Association
4S-Italian Association for the Studies on Shells and Spatial Structures

Endorsed by:
The Italian Institute of Artificial Intelligence (AI4I)
Politecnico di Torino

Let's Shape! Artificial Intelligence and Parametric Design for Shells and Spatial Structures

BASIC INFORMATION		
Organizers: • ARTiStE research team and Association • IAS (Institute for Advanced Study) Endorsed by: • AI4I • IAS Association • PoliTo Scientific Direction: Prof. Giuseppe Carlo Marano Dr. Marco Maurizi Prof. Amedeo Manuello Bertetto Prof. Stefano Gabriele Prof. Francesco Marmo Prof. Andrea Micheletti Dr. Federica Joe Gardella Dr. Raffaele Cucuzza Dr. Valeria Morra	Name of the School:	Summer School Let's Shape!
	Website:	IAS – the Institute for Advanced Study of AI4I WEB ↗
	Dates:	September 19–23, 2026
	Venue:	OGR - Officine Grandi Riparazioni WEB ↗ Corso Castelfidardo, 22, Turin, Italy MAP ↗
	Duration:	5 Intensive Days 50 hours of lectures and studio work
	Schedule:	2 daily blocks (Morning/Afternoon) of 3 hours each
	Modules:	20 daily modules (1h30' each) with dedicated breaks
	Tech. Tour:	1 Guided visit to OGR Tech innovation hub

SHAPING INTELLIGENT STRUCTURES: WHERE AI MEETS SHELLS AND SPATIAL INNOVATION

Let's Shape! is a five-day Summer School exploring how artificial intelligence, computational design and structural engineering can inform the design of shells and spatial structures. Through lectures, coding sessions, applied workshops and collaborative studio work, participants will investigate machine learning, generative modelling, evolutionary optimization and AI-driven parametric workflows for advanced architectural and engineering applications.

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Sept. 19 th		AI for SHELL AND SPATIAL STRUCTURES	
DAY 1 / OPENING MORNING 9:00 -09:30		Introduction to the Summer School Prof. Giuseppe Carlo Marano ArtIStE Prof. Amedeo Manuello – ArtIStE Dr. Federica Joe Gardella – AIDAD Dr. Marco Maurizi -AI4I	
DAY 1 / MODULE 1 MORNING 9:30 -11:00		Keynote 1 AI, AUTOMATION AND CONSTRUCTABILITY Prof. Mark Tam, <i>The Univ. of Hong Kong</i>	
<i>Break 11:00 - 11:30</i>		- Generative inverse design - Knowledge-informed, physics-inspired ML - Versatile graph-based representations - Joint learning of differentiable objectives (structural, geometric, constructability, design-space quality, etc)	
DAY 1 / MODULE 2 MORNING 11:30 -13:00		Keynote 2 COMPUTATIONAL STRUCTURAL DESIGN FOR ADVANCED MANUFACTURING Prof. Pierluigi D'Acunto, <i>TUM</i>	
<i>Lunch 13:00 - 14:30</i>		- Conceptual structural design with discrete equilibrium models - Machine-learning-enhanced structural design - Structural geometry as a driver of fabrication and assembly - Integration of computation, material behavior, and construction	
DAY 1 / MODULE 3 AFTERNOON 14:30 -16:00		Keynote 3 AI AND STRUCTURAL INTELLIGENCE Prof. Sigrid Adriaenssens, <i>Princeton</i>	
<i>Break 16:00 - 16:30</i>		- Form finding and structural morphology - Integration of architectural design and structural performance - Physics-driven and data-informed design - Shells and spatial structures as adaptive structural systems	
DAY 1 / MODULE 4 AFTERNOON 16:30 -18:00		Keynote 4 OPTIMIZATION AND MULTI-OBJECTIVE STRATEGIES Eng. Robert Otani, <i>Thornton Tomasetti</i>	
SOCIAL DINNER <i>Ramo d'Oro</i> <i>Galleria Umberto I, Turin</i>		- Multi-objective optimization for lightweight systems - Surrogate modeling - Trade-offs: stiffness, mass, constructability - Decision-support systems	

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Sept. 20 th		COMPUTATIONAL FOUNDATIONS
DAY 2 / MODULE 1 MORNING 9:30 -11:00	<i>Lecture 1</i> PYTHON FOR ENGINEERS Dr. Sebastiano Panichella, <i>AI4I</i>	• Introduction to python for Engineers (Colab) • Utilizing Google Colab for scientific computing. • Basic syntax • Arrays and matrices (NumPy) • Visualization (Matplotlib) • Simple structural examples • Plotting and visualization of structural results.
<i>Break 11:00 - 11:30</i>		
DAY 2 / MODULE 2 MORNING 11:30 -13:00	<i>Lecture 2</i> INTRO TO MACHINE LEARNING Prof. Giuseppe Marano, <i>ArtStE</i>	Supervised and unsupervised learning. Data Handling for Structural Problems • Structural datasets • Feature engineering • Normalization and scaling
<i>Lunch 13:00 - 14:30</i>		
DAY 2 / MODULE 3 AFTERNOON 14:30 -16:00	<i>Lecture 3</i> INTRO TO MACHINE LEARNING Prof. Giuseppe Marano, <i>ArtStE</i>	• Supervised vs. Unsupervised Learning • Regression vs. Classification • Overfitting and Bias-Variance Trade off
<i>Break 16:00 - 16:30</i>		
DAY 2 / MODULE 4 AFTERNOON 16:30 -18:00	<i>Lecture 4</i> INTRO TO MACHINE LEARNING REGRESSION BAYESIAN STATISTICS Prof. Daniel Bichara, NP-AI	• Cross-Validation • Polynomial Interpolation • Radial Basis Functions (RBF) • Gaussian Processes (overview) • Application: Surrogate Models for Structural Response

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Sept. 21 st		STAT. AND LEARNING –NN and ANN	
DAY 3 / MODULE 1 MORNING 9:30 -11:00		<i>Lecture 5</i> BAYESIAN STATISTICS FOR STRUCTURAL MODELING Prof. Giuseppe Marano, <i>Art/StE</i>	
<i>Break 11:00 - 11:30</i>		· Bayes' Theorem · Likelihood and Posterior Distribution · Bayesian Parameter Updating	
DAY 3 / MODULE 2 MORNING 11:30 -13:00		<i>Lecture 6</i> NEURAL NETWORKS Dr. Simone Betteti, <i>AI4I</i>	
<i>Lunch 13:00 - 14:30</i>		· Fundamentals · Perceptron · Backpropagation · Functions of activations · Structural regression with NN	
DAY 3 / MODULE 3 AFTERNOON 14:30 -16:00		<i>Lecture 8</i> ADVANCED NEURAL NETWORKS Dr. Marco Maurizi, <i>AI4I</i>	
<i>Break 16:00 - 16:30</i>		· Convolutional Neural Networks (geometries and stress fields) · Recurrent Neural Networks (structural sequences) · Introduction to Graph Neural Networks Application Examples in Engineering	
DAY 3 / MODULE 4 AFTERNOON 16:30 -18:00		<i>Lecture 7</i> GENERATIVE MODELING Dr. Leonel Roza, <i>AI4I</i>	
		· Introduction to Generative Modeling · Physical-geometric structures in generative models · Generative AI for simulation, data augmentation, and structural design OR Uncertainty Quantification in generative models (but not both)	

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Sept. 22 nd		EVOLUTIONARY & METAHEURISTIC OPTIMIZATION	
DAY 4 / MODULE 1 MORNING 9:30 -11:00		Lecture 9 GENETIC ALGORITHMS (GA) Dr. Sebastiano Panichella, AI4I	
		- Chromosome Encoding - Structural Fitness Function - Selection, Crossover, and Mutation - Constraint Handling	
Break 11:00 - 11:30			
DAY 4 / MODULE 2 MORNING 11:30 -13:00		Lecture 10 POPULATION-BASED, METAHEURISTIC OPTIMIZATION Dr. Raffaele Cucuzza, UCL	
		- Particle Swarm Optimization (PSO) - Particle Dynamics-Control - Parameters-Convergence	
Lunch 13:00 - 14:30			
DAY 4 / MODULE 3 AFTERNOON 14:30 -16:00		Lecture 11 CONSTRAINT HANDLING IN STRUCTURAL OPTIMIZATION Dr. Raffaele Cucuzza, UCL	
		- Penalization methods - Repair strategies - Multi-objective optimization - Pareto front	
Break 16:00 - 16:30			
DAY 4 / TECH TOUR AFTERNOON 16:30 -18:00		Guided Visit SUMMER SCHOOL TECH TOUR	
		- Guided visit to OGR Tech innovation hub - Overview of AI, aerospace, and deep-tech ecosystem - Presentation of resident startups Insights into technology transfer and industry collaboration	
DAY 4 / MODULE 4 AFTERNOON 18:00 -19:30		Lecture 12 IMPLEMENTATION IN PYTHON Dr. Raffaele Cucuzza, UCL	
		- GA/PSO Applied to a Simple Structural Problem - Weight Minimization with Displacement Constraints	
19:30 APERITIVO AT OGR TECH			

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Sept. 23 rd		AI-DRIVEN PARAMETRIC OPTIMIZATION
DAY 5 / MODULE 1 MORNING 9:30 -11:00	Lecture 13 FROM PARAMETRIC MODEL TO OPTIMIZATION LOOP Prof. Giuseppe Marano, <i>ArtiStE</i>	
	- Extracting design parameters - Connecting Python to Grasshopper - Building the iterative loop	
<i>Break 11:00 - 11:30</i>		
DAY 5 / MODULE 2 MORNING 11:30 -13:00	Lecture 14 SURROGATE-ASSISTED OPTIMIZATION Prof. Amedeo Manuello, <i>ArtiStE</i> Eng. Paolo Pagliuca, <i>CNR Rome</i>	
	- Computational cost reduction - Neural networks as metamodels - Hybrid FEM + ML workflow	
<i>Lunch 13:00 - 14:30</i>		
DAY 5 / MODULE 3 AFTERNOON 14:30 -16:00	Lecture 15 AI-AUGMENTED STRUCTURAL FORM FINDING AND IMPOSSIBLE ARCHITECTURES Dr. Federica Joe Gardella, <i>AIDAD</i> , Prof. Amedeo Manuello, <i>ArtiStE</i>	
	- Generative exploration - Performance-based morphing - Shell case study	
<i>Break 16:00 - 16:30</i>		
DAY 5 / MODULE 4 AFTERNOON 16:30 -18:00	Lecture 16 AI-GENERATED IMPOSSIBLE ARCHITECTURES: FORWARD AND INVERSE DESIGN IN ENGINEERING Dr. Marco Maurizi, <i>AI4I</i>	
	- Forward and Inverse Design in Engineering - Forward Modeling for Structural - Response Prediction - Inverse Design and Parameter - Identification - Surrogate Models for Fast Approximation	

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The Italian Institute of
Artificial Intelligence



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*Italian Association
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