

Syllabus

For selecting the teams that will represent Romania at the International Olympiad in Artificial Intelligence in 2024

Phase I:

- Artificial Intelligence Basics:
 - Supervised learning: Classification, Regression
 - Unsupervised learning: Clustering, Dimensionality Reduction
 - Metrics: Accuracy, Recall, Precision, F1-score, confusion matrix
 - Loss functions: MSE, MAE, MAPE, logarithmic, cross-entropy
 - Overfitting, Underfitting, Cross-Validation
 - Train, Validation, Test separation
 - Normalization, scaling
 - Data augmentation
 - Feature Engineering
 - Pre-training and fine-tuning
 - Parameter tuning
- Machine Learning:
 - Linear regression / classification, Logistic regression / classification, Decision trees
 - Probabilistic: Naive Bayes, Gaussian mixture model
 - Kernel Trick: Support vector machines (SVM), Ridge, Perceptron
 - Clustering: K-nearest neighbors (kNN), K-Means
 - Dimensionality Reduction: Principal component analysis (PCA), Linear discriminant analysis (LDA), Generalized discriminant analysis (GDA), Uniform manifold approximation and projection (UMAP)
 - Ensemble methods: Random forest, boosting, bagging, voting
- Deep Learning:
 - Architectures: Multi-Layer Perceptron (MLP), Artificial Neural Networks (ANN), Recurrent Neural Networks (RNNs), Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU)
 - Activation Functions: ReLU, ELU, Leaky ReLU, Tanh, Sigmoid, GELU, Softmax
 - Gradient Descent: Backward Propagation, Forward Propagation, Learning Rate, Variations
 - Regularization techniques: L1, L2, Early stopping, Dropout, Weight initialization, Normalization Layers, Skip Connections
 - Network Dynamics: Sparsity, Weight quantization, Compression, Convex vs. Non-Convex Loss, Local Minima, Saddle Points, Expressivity
 - Security and Privacy: Adversarial attacks, Robustness, Differential Privacy (DP)

Phase II:

- Natural Language Processing:
 - Augmentation Techniques
 - Text Processing
 - Encoding Techniques: One hot encoding, Dense vectors
 - Word Embeddings: Bag of Words (BOW), Term Frequency-Inverse Document Frequency (TFIDF), Word2Vec, Contextualized Word Embeddings (BERT)
 - NNs: Sequence-to-sequence (seq2seq), Encoder-Decoder, Attention
 - Architectures: Transformers (BERT, GPT)
 - Language Modeling
 - Prompt engineering
- Computer Vision:
 - Augmentation Techniques
 - Image Processing
 - NNs: VGG, Inception, ResNet, Variational Autoencoders (VAE), UNet
 - Architectures: Generative Adversarial Networks (GAN), Vision Transformer (ViT), Diffusion
 - Multimodal: prompt engineering

Other:

- Societal impact of AI (ethics, fairness)
- AI-search: BFS, DFS, A*, MinMax, Alpha-Beta
- Reinforcement Learning: Markov Decision Processes (MDPs), policy iteration, value iteration, Monte Carlo, Temporal Difference learning, Q-Learning, SARSA, Deep Q-Networks (DQN)