

Machine Learning SPICE - Gate4SPICE Budapest

P.Svimbersky

Intacs certified Trainer – ML SPICE

Artificial Intelligence: Winters & Major Milestones

Key Milestones:

- **1943** The artificial neuron network invented in 1943 by Warren McCulloch and Walter Pitts
- **1956:** Dartmouth Conference — Birth of AI as a field. Frank Rosenblat introduce Perceptron
- **1966–1973:** Early successes in symbolic AI and SHRDLU.
- **1980s:** Rise of expert systems in industry.
- **1997:** IBM Deep Blue defeats chess champion Garry Kasparov.
- **2012:** Deep learning breakthrough — AlexNet wins ImageNet.
- **2013:** Tomas Mikolov opens way in NLP by word2vec algorithm
- **2022–Now:** Generative AI boom (e.g., ChatGPT, DALL·E).

AI Winters (Setbacks):

- **1974–1980 (1st AI Winter):** unmet expectations, failure of early expert systems, Perceptron XOR problem...
- **1987–1993 (2nd AI Winter):** Collapse of commercial AI tools (e.g., Lisp machines) and loss of interest after hype.

 **Pattern:** Hype → Disillusionment → Winter → Breakthrough → Renewed Hype

More than only LLM / generative AI

Neural Networks

Architecture: Layers of neurons with activation functions (e.g., ReLU, sigmoid)

Training: Backpropagation + gradient descent

Use Cases: Image classification (CNNs), language modeling (RNNs, Transformers), autonomous driving (sensor fusion)

Pattern Recognition

Methods: Template matching, statistical classifiers (e.g., k-NN, SVM), feature extraction

Applications: OCR (Optical Character Recognition), biometric ID, defect detection in manufacturing

PCA (Principal Component Analysis)

Goal: Reduce dimensionality while preserving maximum variance

Math: Eigenvalue decomposition of the covariance matrix

Use Cases: Preprocessing for ML pipelines, noise filtering, gene expression analysis

Self-Adjusting Regulators (SARs)

Type: Adaptive control systems (e.g., Model Reference Adaptive Control - MRAC)

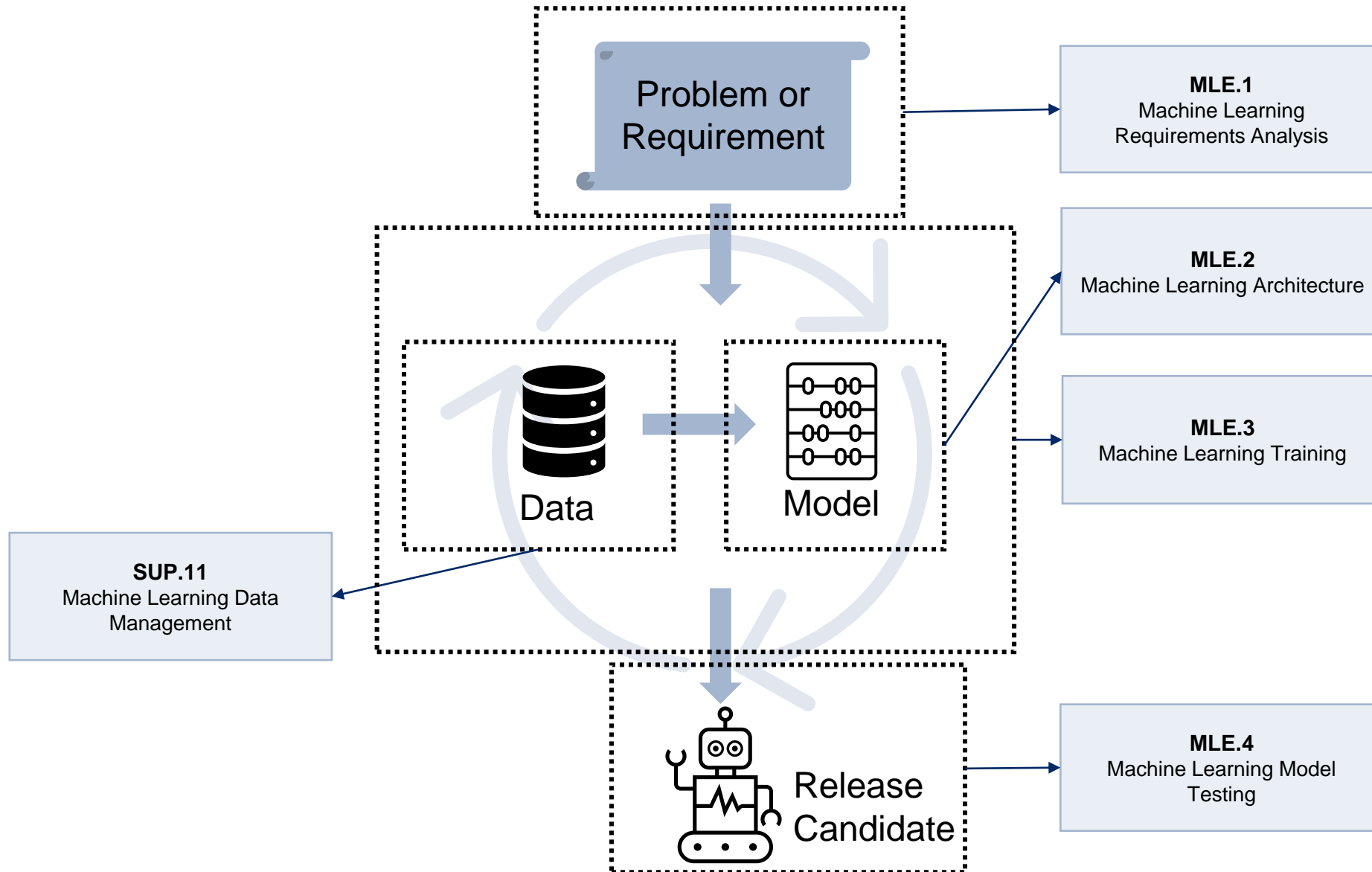
Behavior: Adjust control parameters in real-time based on system feedback

Applications: Engine control units, adaptive cruise control, industrial process automation

Basic steps for ML component creation

- **Define Requirements** - Clarify performance goals, success criteria, and the statistical characteristics of the dataset. Formulate the ML problem clearly.
- **Select Model Architecture** - Choose a suitable model type and define the required hyperparameters and training strategy.
- **Prepare Datasets** - Split the data into training, validation, and test sets.
- **Validate Approach** - Experiment with model architectures and hyperparameters using the validation set.
- **Train the Model** - Execute training with the selected configuration.
- **Evaluate Performance** - Test the trained model against defined requirements using the test dataset.
- **Deploy and Verify** - Deploy the model to the target environment and validate its behavior post-deployment.
- **Celebrate Success — or Iterate**
If requirements are met, you're done. If not, refine and repeat as needed.

Mapping of ML development phases to ML processes in PAM



Why dedicated ML processes are needed in the PAM

- Machine Learning is different to “classical” development of Automotive software-driven systems
- You can consider it a **different technology** and for different technologies there are different SPICE processes e.g., HWE vs. SWE
- Since it is a different technology, it comes with its own risks (see “Machine Learning Introduction”-module for some examples) that need to be addressed by **systematic processes**

→ Indication that dedicated processes are needed

- Nonetheless, Machine Learning ultimately produces SW, so maybe the SWE processes may fit after all?

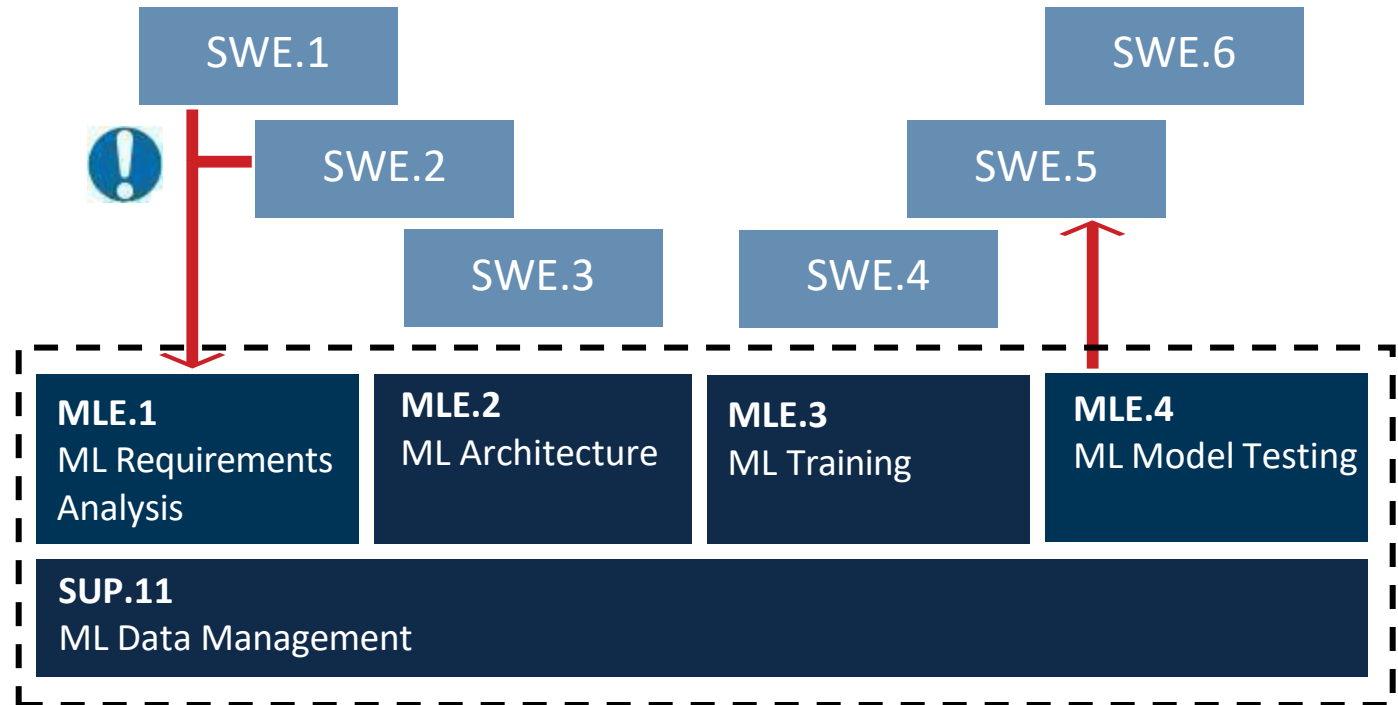
→ Let's check!


Starting point for ML development and interaction with SWE Processes

An important aspect is to check the suitability of the problem/requirement for ML in the first place.


Criteria to check include:

- Could the problem also be solved with “classical” software?
- Is sufficient data over the entire operating range available or can it be made available in time?
- Is the intended hardware suitable for ML?
- Etc.



 **Be careful!** Make a conscious decision whether the problem really requires an ML .

It is already here

 Advanced Driver Assistance Systems (ADAS) - Example: Tesla Autopilot / Mercedes Drive Pilot


AI Role: Computer vision and deep learning detect lanes, vehicles, pedestrians, and traffic signs.

Impact: Enables adaptive cruise control, automatic emergency braking, and lane keeping.

 Predictive Maintenance - Example: BMW & Rolls-Royce (part of BMW Group)


AI Role: ML algorithms analyze sensor data to predict component failures (e.g., engine, brakes).

Impact: Reduces downtime, improves safety, and optimizes maintenance schedules.

 Driver Behavior Monitoring - Example: Subaru DriverFocus

AI Role: Computer vision monitors driver attention and fatigue using facial recognition and eye-tracking.

Impact: Enhances safety by issuing warnings or intervening if driver is distracted or drowsy.

 In-Vehicle Voice Assistants - Example: Mercedes-Benz MBUX (with NVIDIA AI)

AI Role: Natural language processing (NLP) and speech recognition adapt to driver speech and preferences.

Impact: Provides hands-free control and enhances user experience.

European authorities have played a major role in AI Regulations

European Commission (EC) published the seminal ***Ethics guidelines for trustworthy AI*** in April 2019.

German Federal Ministry for Justice and Consumer Protection followed suit, with ***Opinion of the Data Ethics Commission*** in October 2019.

A draft of ***Regulation 2019/2144*** governing “*modern technologies used in vehicles, including specific requirements for automated and fully automated (‘driverless’) vehicles and the systems they employ, to ensure that they are safe to use*”, was published on **27 November 2019** (final regulation adopted on 06 July 2022).

A proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on “*adapting non-contractual civil liability rules to artificial intelligence*” (AI Liability Directive) was published on **28 September 2022** (in discussion).

....and especially now we have the world-famous ***EU AI Act***:

- Proposal by EC on 21/4/2021; Approved by EU Parliament on 09/12/2023; Final text on 13/03/2024
- Official name: ***REGULATION LAYING DOWN HARMONISED RULES ON ARTIFICIAL INTELLIGENCE***
- Final text: *459 pages, 180 Whereases, 68 Definitions, 113 Articles*



The ISO effort for standardization of AI-related disciplines

The ISO Joint Technical Committee **ISO/IEC JTC 1/SC 42** is entirely dedicated to **Artificial Intelligence**.

Its webpage:

<https://www.iso.org/committee/6794475.html>

reports more than **60 standards** under development or recently published.

In spite of this huge number, many **other ISO JTCs are covering AI** for applications in other sectors, e.g. **“ISO PAS 8800 - Road Vehicles - Safety and artificial intelligence”**



Reference ↑	Title	Type
ISO/IEC JTC 1/SC 42/AHG 4 ⓘ	Liaison with SC 27	Working group
ISO/IEC JTC 1/SC 42/AHG 7 ⓘ	JTC1 joint development review	Working group
ISO/IEC JTC 1/SC 42/JAG ⓘ	Joint Advisory Group on AI and sustainability with ISO/IEC JTC1/SC 39 and JTC1/SC 42	Working group
ISO/IEC JTC 1/SC 42/JWG 2 ⓘ	Joint Working Group ISO/IEC JTC1/SC 42 - ISO/IEC JTC1/SC 7 : Testing of AI-based systems	Working group
ISO/IEC JTC 1/SC 42/JWG 3 ⓘ	Joint Working Group ISO/IEC JTC1/SC42 - ISO/TC 215 WG : AI enabled health informatics	Working group
ISO/IEC JTC 1/SC 42/JWG 4 ⓘ	Joint Working Group ISO/IEC JTC1/SC42 - IEC TC65/SC65A: Functional safety and AI systems	Working group
ISO/IEC JTC 1/SC 42/JWG 5 ⓘ	Joint Working Group ISO/IEC JTC1/SC42 - ISO/TC 37 WG: Natural language processing	Working group
ISO/IEC JTC 1/SC 42/WG 1 ⓘ	Foundational standards	Working group
ISO/IEC JTC 1/SC 42/WG 2 ⓘ	Data	Working group
ISO/IEC JTC 1/SC 42/WG 3 ⓘ	Trustworthiness	Working group
ISO/IEC JTC 1/SC 42/WG 4 ⓘ	Use cases and applications	Working group
ISO/IEC JTC 1/SC 42/WG 5 ⓘ	Computational approaches and computational characteristics of AI systems	Working group



DO YOU HAVE ANY QUESTIONS?

© iNTACS e.V. All rights reserved. The copying, use, distribution or disclosure of the confidential and proprietary information contained in this document is strictly prohibited without prior written consent. Any breach shall subject the infringing party to remedies.

Icons: <http://www.1001FreeDownloads.com> Photos: www.unsplash.com, © Fotolia.de, kasko