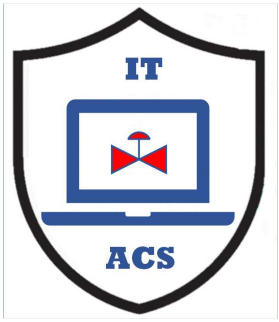
MLM EXAMPLE TEMPLATE

An Engineer's View of AI in Process Industries

MLM-090-A

Industry	– Process Industry
Principal Role	– All
Professional Role	– Control Engineer + IT Specialists
Enterprise Phase	– All



Turn on your audio and click start to begin video

START

This MLM provides an introduction to the use of Artificial Intelligence in Process Industry plants. It is intended for design engineers and plant engineers who will encounter these systems today and probably use them or develop them in the future.

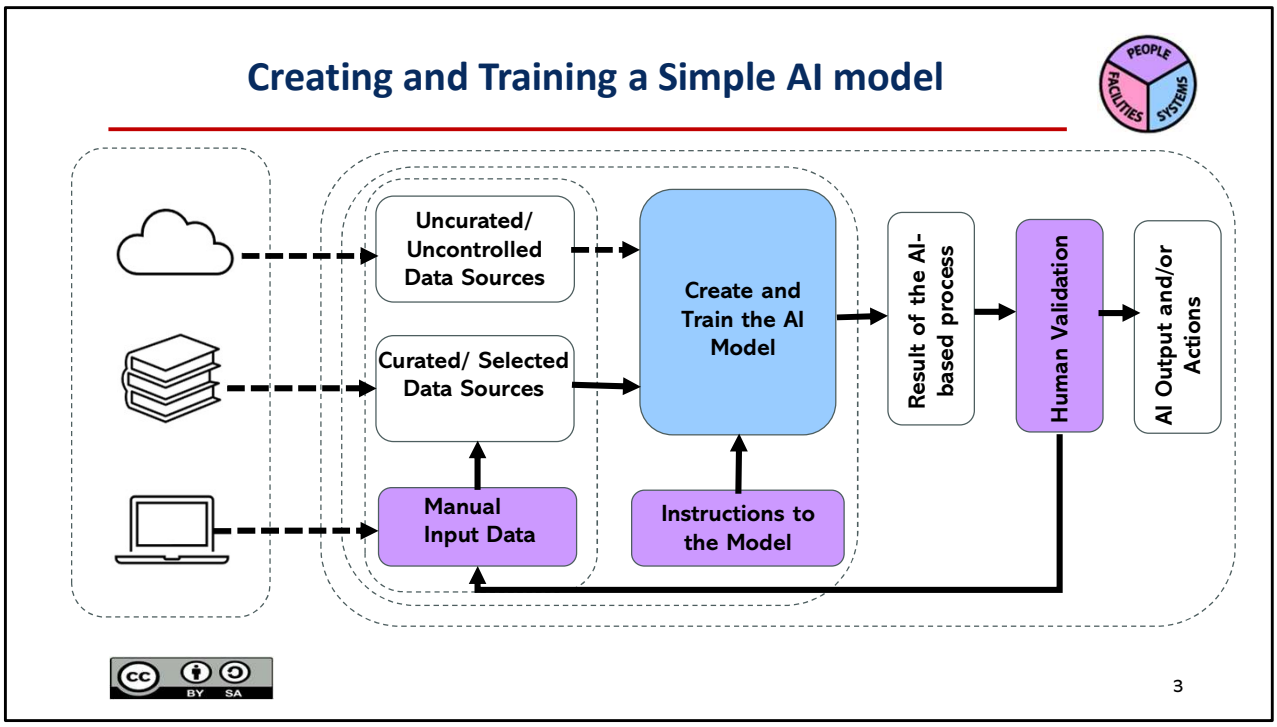
Click the START button when you are ready to advance to the next slide.

What is the Definition of AI ?

Artificial intelligence (**AI**) is the capability of computational systems to perform tasks typically associated with human intelligence, such as learning, reasoning, problem-solving, perception, and decision-making.

Source: Wikipedia

AI was founded as an academic discipline in 1956, and the field went through multiple cycles of optimism followed by periods of disappointment. Funding increased after 2012 when graphics processing units (GPUs) were used to accelerate neural networks, and deep learning outperformed previous AI techniques. This growth accelerated further after 2017 with the transformer architecture. In the 2020s, the period of rapid progress marked by advanced generative AI became known as the AI boom. Recently, generative AI's ability to create and modify content has raised ethical concerns about copyright.



Creation of the Model is usually done using standardized development packages like Llama and service bureaus with specialized processors.

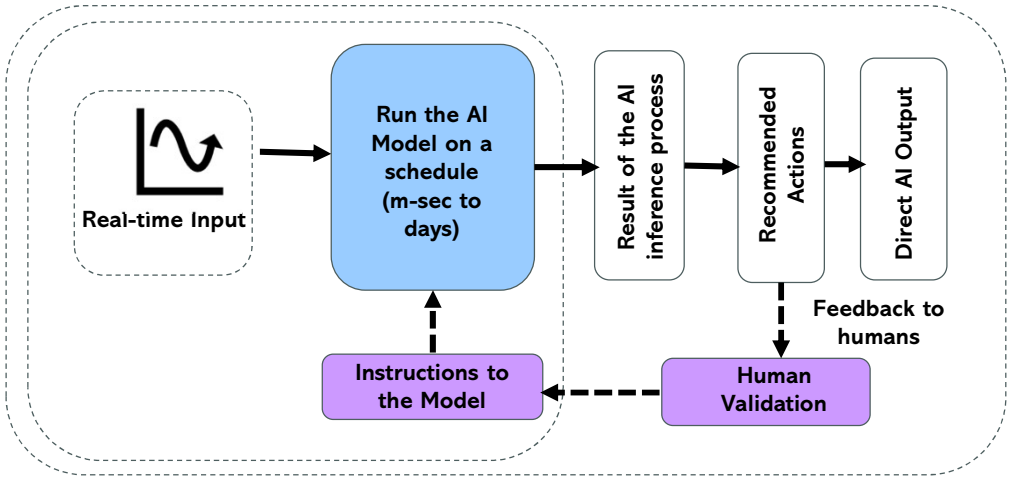
Inputs may include uncurated data sources (e.g., internet pages), curated data sources (like company practices or operating manuals), or manual input

Training requires large amounts of data. In general, the more data, the better the model.

Once a model is developed and trained, Instructions (or "prompts") are used to examine the results of the AI Model. These are then validated by a human, and additional data is submitted to improve the model. This process is repeated until the AI output and/or actions are satisfactory.

For simple "single-shot" models, a human may provide "instructions" (sometimes called "Prompts") that result in a response, which is then reviewed and validated before being released as reports or real-world actions.

Using a Trained AI Model in Real-time



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Once trained, the model requires much less hardware to execute.

Trained and evaluated models may be used in real-time to “read” plant data and recommend actions based on the AI model’s results.

Once confidence in the model is established, it may be allowed to directly adjust plant parameters, particularly where the process “time constant” is short or the model is very complex. In this case, it is common to limit the range of adjustment that the model may make without human confirmation.

Human validation of AI results is typically done “after the fact,” and if necessary, instructions may be provided to the model (e.g., constraining the range of actions it can take).

If the Plant Facilities or work processes being modelled have changed, it may be necessary to return to the previous development step and retrain the model.

Some AI Technologies Found in Process Plants

1. Large Language Models (e.g., GPT-4 or GROK) to interface technical manuals
2. Real-world Navigation (e.g., for anthropomorphic robots, or to guide service vehicles to remote installations)
3. Vision (e.g. for image analysis of flares or infrared plant images)
4. Text-to-Speech (to deliver maintenance instructions to field workers)
5. Cybersecurity monitoring and penetration testing increasingly involve AI “agents”.
6. Text-to-image AI (to create graphics for training and maintenance materials)
7. Computation & numerical analysis (e.g. Wolfram’s Alpha AI for process modelling or Fast Fourier curve fitting)
8. Generative AI (for optimization algorithms or Expert Systems for troubleshooting)
9. AI-Powered Engineering (to accelerate and enrich design practices)

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Some of these AI technologies include:

1. Large Language Models (e.g., GPT-4 or GROK to interface technical manuals).
2. Real-world Navigation (e.g., for anthropomorphic robots, or to guide service vehicles to remote installations).
3. Vision (for image analysis of flares or infrared plant images).
4. Speech-to-text AI (to deliver maintenance instructions to field workers).
5. Cybersecurity monitoring and penetration testing increasingly involve AI “agents”.
6. Text-to-image AI (to create graphics to improve training and maintenance materials).
7. Computation & numerical analysis (e.g., Wolfram’s Alpha AI for process modelling or Fast Fourier curve fitting).
8. Generative AI (for optimization algorithms or Expert Systems for troubleshooting).
9. AI-Powered Engineering may be used to accelerate and enrich design practices.

Key “Take-away” Messages

- Public “Search” and “Chat” bots are rarely used in plants as they are often trained on poorly curated information, so results may be wildly biased or just plain wrong.
- Even models created and trained with curated data may “hallucinate,” so human validation and supervision are required. Control actions may be “bounded”.
- Reliability can be improved with more extensive training and validation, but this is expensive, so it should only be used when economic benefits are very large.
- Once developed and validated, AI models can run on much smaller AI computers that may execute at very high speeds for real-time response (e.g., self-driving cars).
- Any changes in the Facilities or Work Processes that were modelled will require review and perhaps retraining of the model.

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The following are Key Messages to “take away”

Public “Search” and “Chat” bots are usually trained on poorly-curated information so results may be wildly biased or just plain wrong.

With the current state of AI technology, even models created and trained with curated data may “hallucinate,” so human validation is required. It is common to limit real-time actions within safe “boundaries”.

Reliability can be improved with more extensive training and validation; however, this is expensive, so it should only be used when the economic benefits are substantial.

Once developed and validated, AI models can run on much smaller AI computers that may execute at very high speeds for real-time response, such as self-driving cars.

Any changes to the Facilities or Work Processes that were modeled will require review and, possibly, retraining of the model.

More Reading

Related MLMs:

- MLM-090-B AI Applications in Process Industry.
- MLM-091-A Plant AI and Human Interfaces.

References

- ISA 18 Management of Alarms Standard
- Fareed Khan offers an extensive library describing the development of AI applications on the Medium.com publishing platform.

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Author

Gary has more than 40 years of experience with enterprise integration and optimization projects, including PERA master planning and project management.

As one of the initial authors of the PERA Handbook of Master Planning, he has used PERA Enterprise Architecture and Master Planning methodologies throughout his career including control and information systems for oil production, pipelines, refining and marine loading, petrochemicals, coal, gas, and oil-fired power plants, polyethylene, ammonia, explosives, paint, pulp and paper, food and beverage, and pharmaceuticals. LNG facilities included world-scale arctic, European, and US Gulf coast complexes.

infrastructure facilities included Fire, Police, and Emergency Response systems for major US cities, as well as emissions reporting and trading systems for more than 100 US Power Plants,