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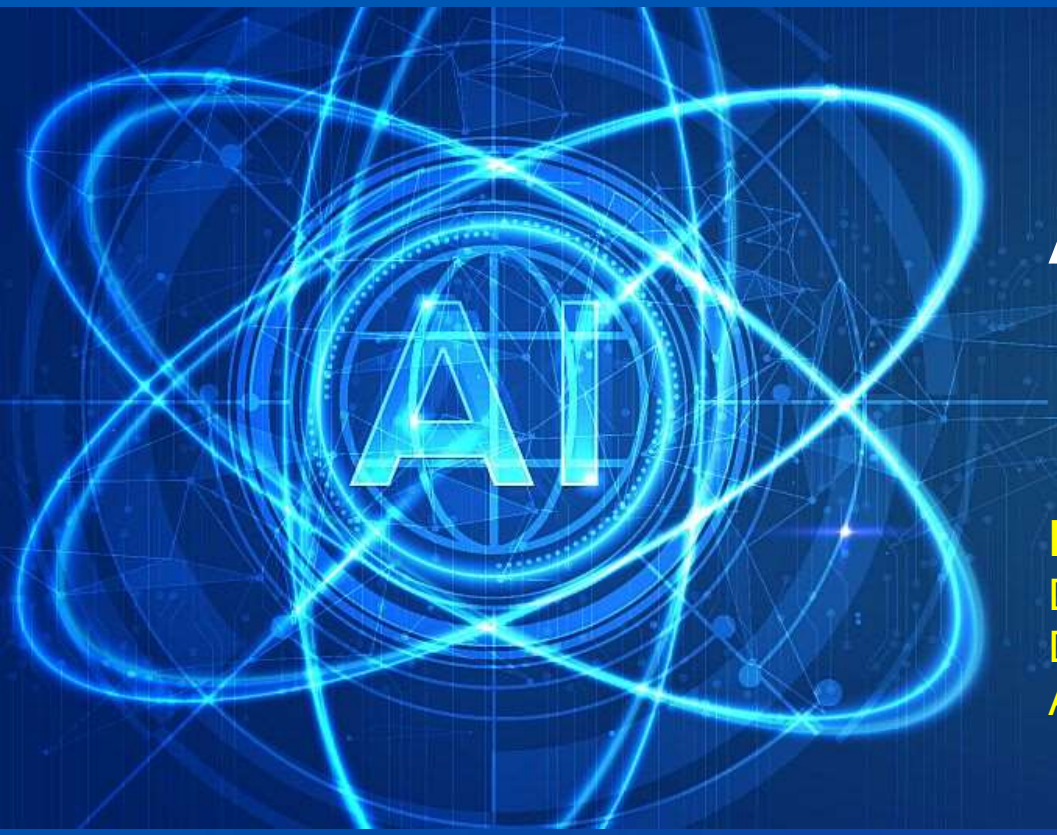
34th Regulatory Information Conference (RIC 2022)
8-10 March 2022



AI for Nuclear Energy

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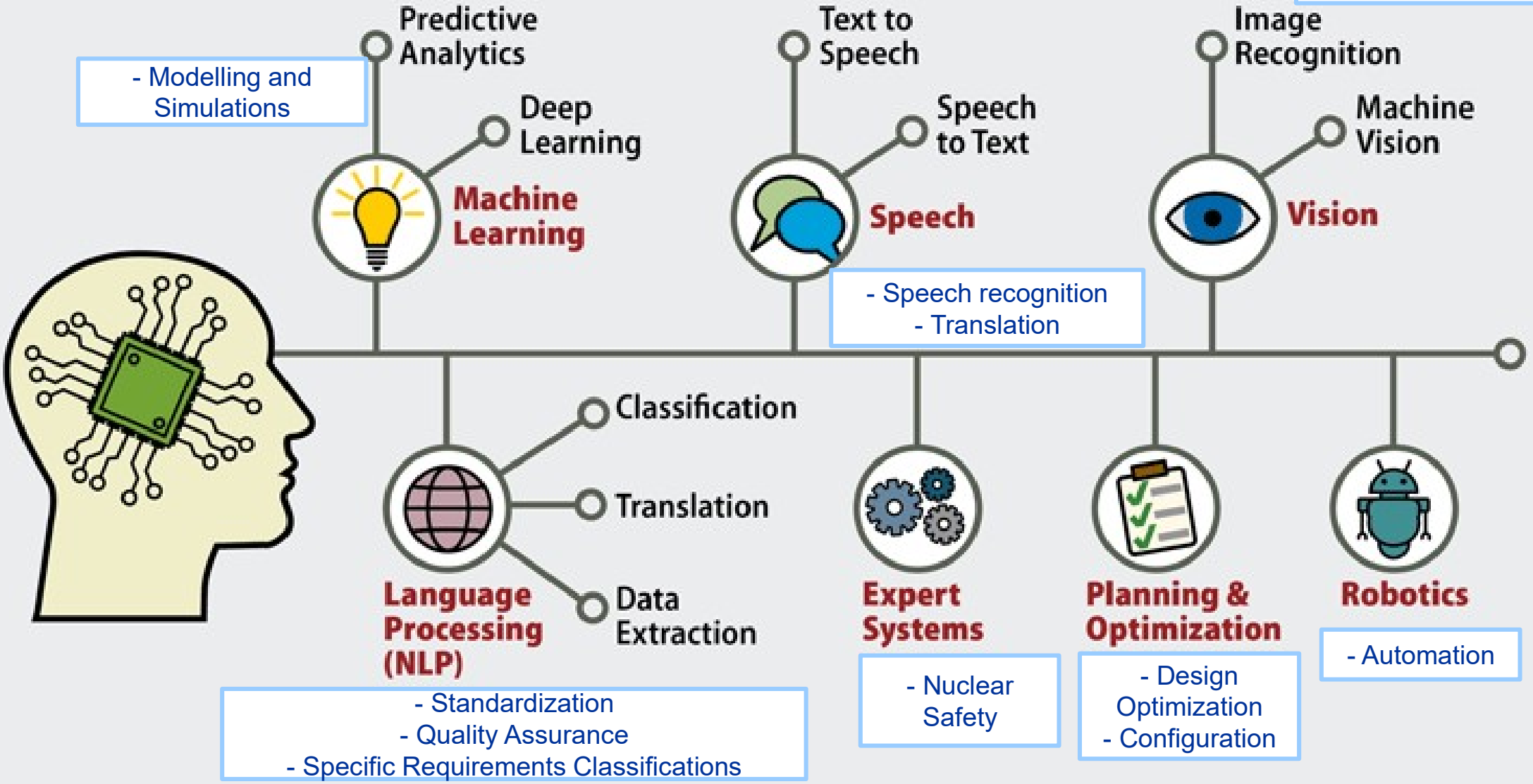
Session T1 – “Am I a Robot? – How Artificial Intelligence and Machine Learning are Impacting the NRC and Nuclear Industry”

What is AI?


Artificial Intelligence
- Fault detection
- Inspections
Predictive Analytics
- Modelling and Simulations
Deep Learning
Machine Learning
Text to Speech
Speech to Text
Speech
- Speech recognition
- Translation
Image Recognition
Machine Vision
Vision
Classification
Translation
Data Extraction
Language Processing (NLP)
- Standardization
- Quality Assurance
- Specific Requirements Classifications
Expert Systems
- Nuclear Safety
Planning & Optimization
- Design Optimization
- Configuration
Robotics
- Automation

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AI for Nuclear

State-of-the-art

Automation

Increase reliability and reduce time of common operations

Optimization

Increase efficiency and design of complex operations

Analytics

Increase the quality of current models and understanding of the used systems

Prediction/ Prognostics

Better inform maintenance activities

Insights

Extract lessons from experiments and operating experience

Deployment Challenges

- Interpretability, confidence, and robustness measures of performance for AI
- Development of AI technologies for safety critical applications could present a challenge to regulators, as many traditional V&V approaches might not be easily applicable
  - Limited transparency of AI/ML
- Demonstration of compliance with standards
  - High level regulatory safety assessment principles and guidance may need to be developed
- Security poses unique challenges through data management and threats of adversarial attacks
- Development of standards is important for the adoption of new technologies

What Next?

Technology Development

- Development of anomaly detection from plant monitoring data
- Core monitoring techniques and experimental validation
- Neural networks to be further leveraged to guide the optimization (e.g. of fuel loading)

Technology Deployment

- Industry has the technological means to start practical adoption of machine learning
- Automated analysis of non-destructive evaluation examination
- Condition monitoring and automation of predictive maintenance procedures

Technology Enabling

- Development of legal regulation for AI application in the design engineering process
- Development of common requirements database
- Development of the requirements that are accessible and understandable to AI (optimization, simplification, specification, etc.)
- Development of design algorithms that are accessible and understandable to AI

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IAEA activities

TM: AI for Nuclear

- Technical Meeting on Artificial Intelligence for Nuclear Technology and Applications: **25-29 October 2021**
- 2 plenary topics and 12 Working Groups.
- All meeting material is freely available and a networking site is established to enhance coordination

Plenary

ENABLING INFRASTRUCTURE

ADVANCED MODELLING AND SIMULATION METHODOLOGIES

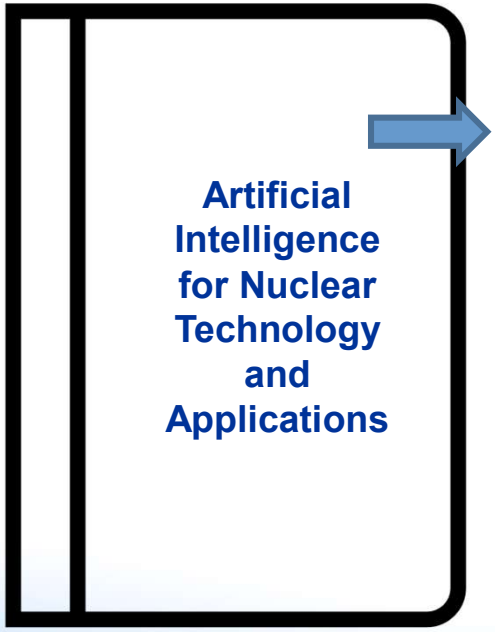
Ethics	Food and Agriculture	Human Health	Nuclear Data
Nuclear Fusion	Nuclear Physics	Nuclear Power	Nuclear Security
Radiation Protection	Radioisotopes and Radiation Technology	Safeguards Verification	Water and Environment

…In collaboration with ITU

- Under the umbrella of AI for good Summit
- **AI for Nuclear Energy** Webinar, ~1200 registrations
  - How do we use digital twins for nuclear plan monitoring?
  - AI for operation and maintenance of nuclear reactors
  - Development of international standards on AI for nuclear energy
  - AI applications for nuclear energy
- One of the most successful event of the summit
- Another webinar on **AI for Atoms**
  - Healthcare, Food and Agriculture, Nuclear Science, Fusion, Ethics

Publications

- Chapter on IAEA activities



Under Preparation

- ***To be published by the end of 2022***
- ***Output of the IAEA Technical Meeting***

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Thank you!