MATLAB EXPO 2019

Beyond the “I” in AI

Loren Dean
Artificial intelligence is a transformative technology

Notes from the AI frontier: Modeling the impact of AI on the world economy

September 2018 | Discussion Paper

AI will create $13 trillion in value by 2030

based on McKinsey’s latest AI forecast – September 2018
AI has tremendous potential to increase productivity

McKinsey Global Institute, September 2018
Yet AI is struggling

**DigitalTonto**
Most AI Projects Fail. Here’s How to Make Yours Successful.
July, 2018

**DataRobot**
Why Most AI Projects Fail
Oct, 2017

**CMS Wire**
3 Common Reasons Artificial Intelligence Projects Fail
May, 2018
Google Photos AI fail goes viral

AI's intelligence and stupidity in one photo stitch fail

I can’t stop looking at this wonderfully bad Google Photos panorama stitch

By Natt Garun | @nattgarun | Jan 18, 2018, 6:51pm EST
There are many ways Artificial Intelligence can fail

- No data scientists
- Beyond the skill of the team
- Can’t interact with other systems
- Too much data
- Incomplete tools
- Problem is a poor fit for AI
- Not enough data
- Poor ROI
- Problem is unsolvable
AI is more than just the intelligence of the algorithm.
Intelligence

Interaction

Operate within their environment

Insights

Apply domain expertise

Implementation

Span the entire design workflow
Bring human insights into AI

1. Select data
2. Make tradeoffs
3. Evaluate results

AI
Bring human insights into AI

- We are the domain experts
- Shortage of data scientists
- We need the right tools
Improving New Zealand Dairy Processing

University of Auckland

Auckland University of Technology
Wanted to detect a bad product earlier

Raw Milk → Continuous Plant Process → Powdered Milk

Days later
Wanted to detect a bad product earlier

Data

- Raw Milk
- Plant Process
- Powdered Milk

AI model

Predict Results

Near real-time
They had **lots** of data

- Millions of data points
- 6 years
- 3 plants

Data

- Raw Milk
- Plant Process
- Powdered Milk
But…

Data

- Raw Milk
- Plant Process
- Powdered Milk

AI model

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They made several key insights

1. Results were wrong
They made several key insights

1. Results were wrong

2. Need to build a separate model for each plant

Plants behaved differently from each another
They made several key insights

1. Results were wrong

2. Need to build a separate model for each plant

3. Plant’s operating state changes each year

Each year was like a completely different plant
Bulk density prediction results were inaccurate

- Many false positives
- Unused classes
They made several key insights

1. Results were wrong
2. Need to build a separate model for each plant
3. Plant’s operating state changes each year
4. Training data was biased
Resampling data resulted in higher predictive accuracy

- Resampled data
- Reduced the number of bins
“It’s great to sit down with our industry partners and watch their jaws drop when they see how productive we are with MATLAB and how quickly we can analyze and plot data. Our results have enabled them to confirm hypotheses for which they lacked evidence, and have sparked new ideas for process improvement.”

- David Wilson, Industrial Information and Control Centre
To be successful with AI, we must …

Combine AI model building with scientific and engineering insights

Along with tools that span both the science and engineering and the data science
Intelligence

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- Operate within their environment

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Implementation
- Span the entire design workflow
Intelligence

Interaction
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Insights
- Apply domain expertise

Implementation
- Span the entire design workflow
Implementation is about designing the solution

**Research**
- Testing
- Data analysis
- Reporting

**Manufacturing**
- Developing concept
- Prototyping
- Deployment

**Autonomous System**
- Requirements building
- Modeling and simulation
- Verification and validation
“Deliver on the promise of self-driving cars today.”
Voyage’s goal was to quickly get to market

1. Target retirement communities
Voyage’s goal was to quickly get to market

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2. Use off-the-shelf components wherever possible
Voyage’s goal was to quickly get to market

1. Target retirement communities

2. Use off-the-shelf components wherever possible

3. Bring in the right software tools across the entire workflow
Voyage completed their AI system first
But they needed to connect the AI to the rest of the system.
Started with Simulink example that they could build upon

Adaptive Cruise Control with Sensor Fusion

This example shows how to implement a sensor fusion-based automotive adaptive cruise controller for a vehicle traveling on a curved road using sensor fusion.

In this example, you will:

1. Review a control system that combines sensor fusion and an adaptive cruise controller (ACC). Two variants of ACC are provided: a classical controller and an Adaptive Cruise Control System block from Model Predictive Control Toolbox.

2. Test the control system in a closed-loop Simulink model using synthetic data generated by the Automated Driving System Toolbox.

3. Configure the code generation settings for software-in-the-loop simulation and automatically generate code for the control algorithm.
Injected simulated vehicles to interact with while driving
Deployed controller as ROS node and generated code

Robotics System Toolbox
Embedded Coder

Robot Operating System
Train your AI faster with tight simulation loops
One example of leveraging simulation for data synthesis

**Traditional deep learning workflow**
- Record
- Label
- AI model

**Simulation-based workflow**
- Simulate
- Auto-label
“Simulink + ROS allowed us to deploy a Level 3 autonomous vehicle in less than 3 months.”

– Alan Mond, Voyage
To be successful with AI, we must …

Use tool chains that span the entire design workflow
Interaction

Intelligence

Insights

Apply domain expertise

Operate within their environment

Implementation

Span the entire design workflow
Intelligence

Interaction
Operate within their environment

Insights
Apply domain expertise

Implementation
Span the entire design workflow
Interaction within complex environments
What was the larger system the vehicle had to operate in?
“Proactive patient care”
Statistics and Machine Learning Toolbox
Signal Processing Toolbox
MATLAB Coder
Embedded Coder
EarlySense’s AI can **predict critical events** before they happen

- Continuous Monitoring
- Early Detection
- Early Intervention
- Better Outcomes
Dashboards at nurses’ stations and on hallway monitors
Alerts on hand-held devices carried by staff
Address problems before they become emergencies
To be successful with AI, we must …

Design how our systems will integrate and interact within their environment
Success requires **more than just intelligence**

**AI is a transformative technology**

**But AI projects can and do fail**

- **DigitalTonto**
  - Most AI Projects Fail. Here's How to Make Yours Successful.
  - July 2015

- **DataRobot**
  - Why Most AI Projects Fail
  - Oct. 2017

- **CMS WiRE**
  - 3 Common Reasons Artificial Intelligence Projects Fail
  - May 2018
Intelligence

Interaction
Operate within their environment

Insights
Apply domain expertise

Implementation
Span the entire design workflow
How will you apply AI to your projects?

- **Interaction**: Operate within their environment
- **Intelligence**: Span the entire design workflow
- **Insights**: Apply domain expertise
- **Implementation**
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Go Beyond the “I” in AI