



# ARTIFICIAL INTELLIGENCE 501

Lesson 3

AI in the Enterprise

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# Learning Objectives

You will be able to:

- Identify the steps in the data science workflow
- Identify the key roles and skill sets within the field of AI
- Describe the different ways to structure an AI team
- Identify common data science misconceptions
- Identify the components of model maintenance after deployment



# DATA SCIENCE WORKFLOW

# Data Science Workflow

**Problem Statement**

What problem are you trying to solve?

**Data Collection**

What data do you need to solve it?

**Data Exploration  
& Preprocessing**

How should you clean your data so your model can use it?

**Modeling**

Build a model to solve your problem?

**Validation**

Did I solve the problem?

**Decision Making  
& Deployment**

Communicate to stakeholders or put into production?

# Problem Statement

What problem are you trying to solve?

- Data scientists first need to identify the problem to solve.
- Knowledge of the business is needed to identify impactful opportunities.
- Technical knowledge is needed to ask the right questions, and to know what is possible.

# Data Collection

What data do you need to solve your problem?

- The data required to solve the problem needs to be identified and collected.
- Data and engineering skills are needed to collect and consolidate data from multiple sources.

# Data Exploration and Preprocessing

How should you clean your data so your model can use it?

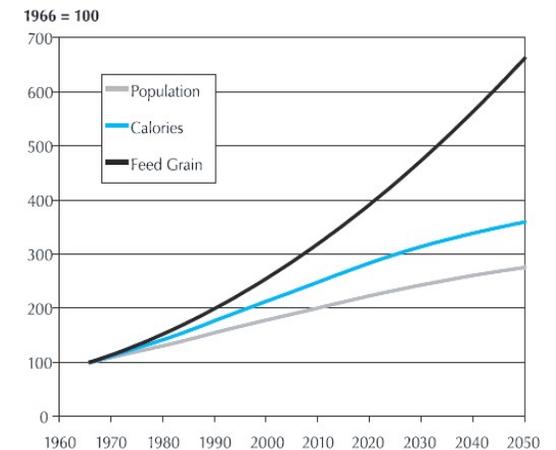
- Data needs to be cleaned and processed so that it's in a usable format for modeling.
- Exploration is required to identify important elements within the data and to identify any data quality issues.
- Data, engineering, and statistics skills are needed to appropriately process the data and make inferences.



# Modeling

What model needs to be built to solve your problem?

- Several factors go into modeling such as complexity, required data, speed, and performance.
- This step requires skills in engineering, modeling, and statistics.



# Validation

Did the problem get sufficiently solved?

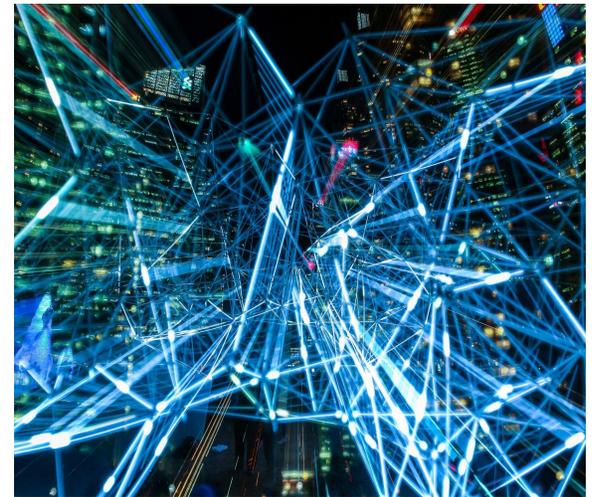
- Validation is required to ensure the original problem was solved.
- Model performance needs to be accurately measured.
- Statistics and modeling skills, as well as domain knowledge, are needed to make sure the results align with the business problem.



# Decision Making and Deployment

Communicate to stakeholders or put into production.

- A business decision needs to be made, or a product needs to be put into production, so the business can see value from the project.
- This requires domain knowledge, as well as communication and storytelling skills.
- Engineering skills are needed to integrate code into back-end software systems.





# DATA SCIENCE SKILL SET

# Data Science Skill Sets

Data science teams need a variety of skills to be successful.



# Data Science Team Skills

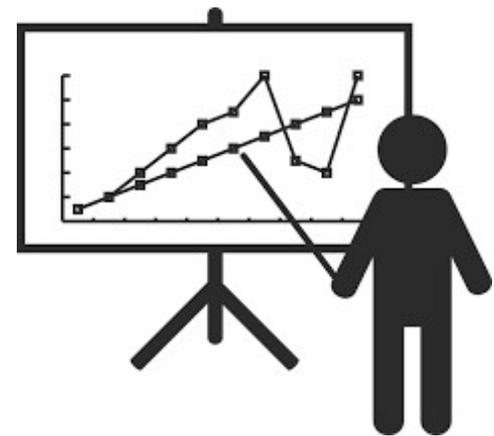
Data science teams need a variety of skills to be successful.



# Communication, Storytelling, Domain Expertise

Understand the business needs and communicate how to address them.

- Domain expertise to understand the process and business problem to help their business.
- Persuade decision makers to support their idea.
- Communicate complicated concepts clearly, and tell stories.



# Modeling and Statistics

Use data to make predictions via models, and using statistics to assess the validity of those predictions.

- Work with a variety of modeling techniques, from regression to DL.
- Use statistics to assess the performance of one model vs. another.
- Design experiments and perform A/B testing.



# Data Munging/Software Engineering

Transform messy data into clean, usable data, as well as building software systems to deploy their models.

- Raw data can be messy and unstructured.
- Data must be manipulated and stored in databases before it can be used.
- Models need to be deployed.

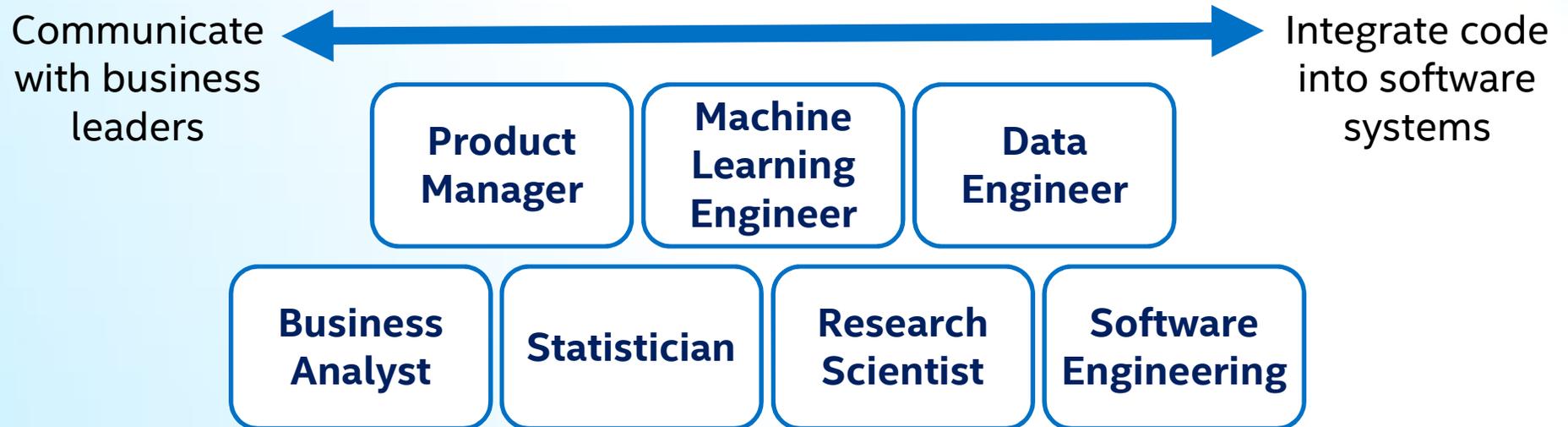




# DATA SCIENCE ROLES

# Roles on Data Science Teams

Roles have evolved that fit on different places on this spectrum.



# Business Analysts

Business analysts interact with decision-makers.

- Create reports and provide insights.
- Create dashboards displaying key product KPIs.
- Perform analysis to determine business impact of a new product/feature.
- Excel\*, PowerBI\* and Tableau\* are examples of tools used.



# Product Managers

Product Managers get requirements from business.

- Translate business ideas into product ideas.
- Determine feasibility of solving business problems.
- Consider impact of new product or model on key business metrics.
- Prioritize projects and tasks.
- Examples of tools used: Microsoft Project\*, Trello\*, and JIRA\*.



# Statisticians

Statisticians determine the validity of models.

- Applies statistical concepts to determine amount of data required.
- Explores outliers and trends.
- Determines if results are statistically significant.
- Examples of tools used: R\*, SAS\*, Python\*.



# Machine Learning Engineers

Machine learning engineers solve problems involving large amounts of high-dimensional data.

- Apply machine learning techniques.
- Focused on the engineering that makes models accurate and fast.
- Examples of tools used: Python\*, R\*, and MATLAB\*.



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# Research Scientists

Research scientists work on problems in bleeding-edge fields.

- Work on the toughest problems in big data and machine learning.
- Expert at a particular sub-discipline.
- Understand how algorithms work under the hood.
- Can be part of a separate research team, interfacing with data science team when necessary.
- Examples of tools used: Python\*, MATLAB\*, R\*, C++, and Java\*.



# Data Engineers

Data engineers build data ingestion, storage, and infrastructure.

- Databases experts.
- Know the tradeoffs between speed, reliability, and size.
- Automate data cleaning.
- Build ETL (extract, transform, load) pipelines to make data available on a regular cadence.
- Examples of tools used: Java\*, SQL, and noSQL.



# Software Engineers

Software engineers are responsible for optimizing code and deploying.

- Get code into production.
- Write tests to detect code breaking and bugs.
- Ensure model code is maintainable.
- Examples of tools used: Python\*, Ruby\*, C++, and Java\*.



# Skills and Roles

	Business Analyst	Product Manager	Statistician	Machine Learning Engineer	Research Scientist	Data Engineer	Software Engineer
Communication/Story	X	X					
Domain Expertise	X	X					
Modeling		X	X	X	X		
Statistics			X	X	X	X	
Data Munging				X	X	X	X
Software Engineering							X



# STAFFING STRUCTURE

# Data Science Organizational Structure

There are multiple ways to organize data science teams.

- Centralized teams where all data scientists report to the same head.
- Distributed teams where individual data scientists work with a business team.
- Teams embedded within functional business units.

# Centralized Teams

All the data scientists report to the same group head.

- Usually within a technology or IT team.
- Pros:
  - Standardization of skills and tools
  - Reduction of redundant roles
  - Closer collaboration amongst scientists
- Cons:
  - Further removed from the business units
  - Tendency to be more reactive to problems



# Distributed Teams

Distributed teams are where individual data scientists sit within a particular team within a business unit.

- Pros:
  - Closer access to the business, domain experts, and end users
  - More likely to come up with solutions to immediate business problems
- Cons:
  - Destandardization of tools and skills throughout the organization
  - Less communication and collaboration between data scientists

# Additional Team Structures

There are multiple hybrid ways to organize data science teams.

- Some examples include:
  - Full data science teams can be embedded within a business function.
  - Data science centers of excellence can be created for the company.





# COMMON MISCONCEPTIONS

# Misconception #1: Data Science “Unicorn”

Data Scientists who are experts in all areas are called “unicorns”.

- Successful teams contain people with a diverse array of skillsets and backgrounds.
- Some excel at communication, while others may excel at statistics.
- Successful teams have experts in the three main areas: business, science, and engineering.

## Misconception #2: Research and Algorithms Focus

Data science teams cannot just focus on research and algorithms.

- Effective teams have mechanisms to:
  - Identify problems
  - Communicate findings
  - Work with engineering to understand how to put their models into production



## Misconception #3: Complex and Advanced Systems

The most complicated solution isn't always the best.

- Teams tend to be more successful when they start simple and then move on to more complex modeling techniques.
- Complex models may be more accurate, but are less interpretable, more likely to fail in unpredictable ways, and harder to maintain.
- Starting simple also ensures that what the team is building aligns with business needs.

## Misconception #4: Industry Differences

The underlying modeling and data analysis techniques are largely transferable between industries.

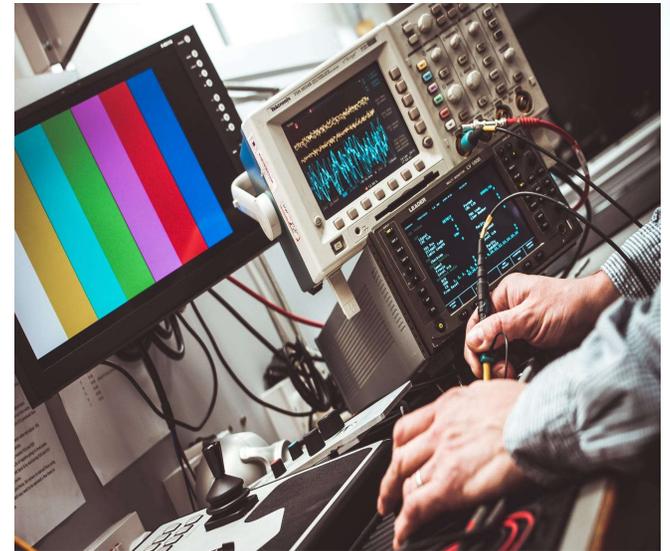
- Domain expertise is required to understand which data is relevant and which problems are most important to solve.
- The techniques used to clean data, store it, and extract useful insights and modeling remain very similar.



# Misconception #5: Projects Begin Well-Defined

Data Science projects are often exploratory and experimental in nature.

- It may not be clear how hard the problem is to solve until investing time exploring the data.
- Product Managers must actively work with both the team and the business stakeholders to manage expectations.



# Misconception #6: Best Prediction Models are Best

There are more challenges involved when selecting a model than its predictive abilities.

- Some models may be too slow or complicated to include in production.
- Some models may not be interpretable, and would have a tough sell with decision makers.





**AFTER DEPLOYMENT**

## After Deploying a Model

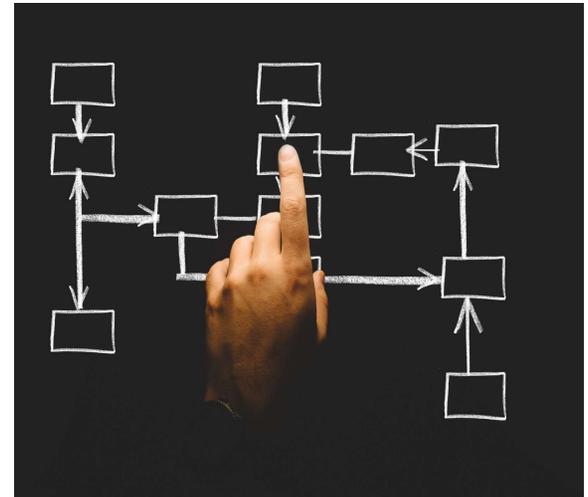
Once a model is deployed, relevant teams must monitor and manage the model for it to be useful.

- **Business Intelligence teams** should build reports/dashboards displaying model results.
- **Business teams** (e.g. operations, merchandising) or customers should use model outputs.
- **Data Science teams** must update model at appropriate cadence (for example, monthly).

# Business Intelligence Team

The business intelligence team monitors how model predictions are changing over time.

- Monitor model usage and output.
- Develop key performance indicators and dashboards.
- Visualizations should align with the needs of the functional teams (for example, operations) that will be using the model.



# Functional Business Team

Use dashboards to improve decision making.

- For example: marketing team could use churn model to decide when to reach out to groups of customers.
- For example: operations team could use model to predict shipping/logistics times.



# Data Science Team

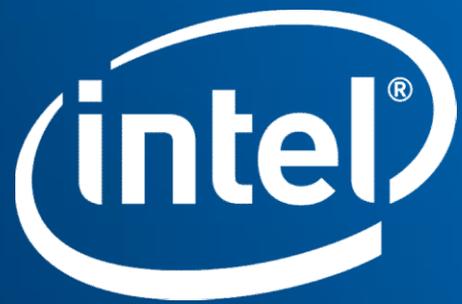
Monitor model to ensure continued validity and usefulness.

- For example: changes in marketing may lead to different types of customers coming in the door, making the old model of customer behavior less accurate.
- Depending on how fast the business conditions are changing, the data science team should update model with appropriate frequency.
- Retraining models with new data.

# Learning Objectives Recap

In this lesson, we worked to:

- Identify the steps in the data science workflow
- Identify the key roles and skill sets within the field of AI
- Describe the different ways to structure an AI team
- Identify common data science misconceptions
- Identify the components of model maintenance after deployment



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