CARTE-Enbridge Bootcamp

Digital Transformation

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING
Centre for Analytics and Artificial Intelligence Engineering

Introduction to AI in Digital Transformation

- Objectives of this lecture:
  - Understand what digital transformation is and why it's crucial
  - Learn how AI acts as a catalyst in digital transformation
  - Understand the risks around using AI in the real world, and how to mitigate them

What is Digital Transformation?

- Digital transformation is the integration of digital technology into all aspects of business, fundamentally changing how you operate and deliver value to customers.
- Involves changes to business operations, customer experiences, and organizational culture.
- It's not just about implementing new technology but about changing the entire way an organization operates and delivers value.

Key AI Technologies

- **Time Series Analysis**
  - Enables systems to predict sequential data
  - Useful for demand forecasting
- **Natural Language Processing (NLP)**
  - Helps machines understand human language
  - Applications in chatbots, sentiment analysis
- **Computer Vision**
  - Allows machines to interpret visual data
  - Used in facial recognition, autonomous vehicles

AI Maturity Model

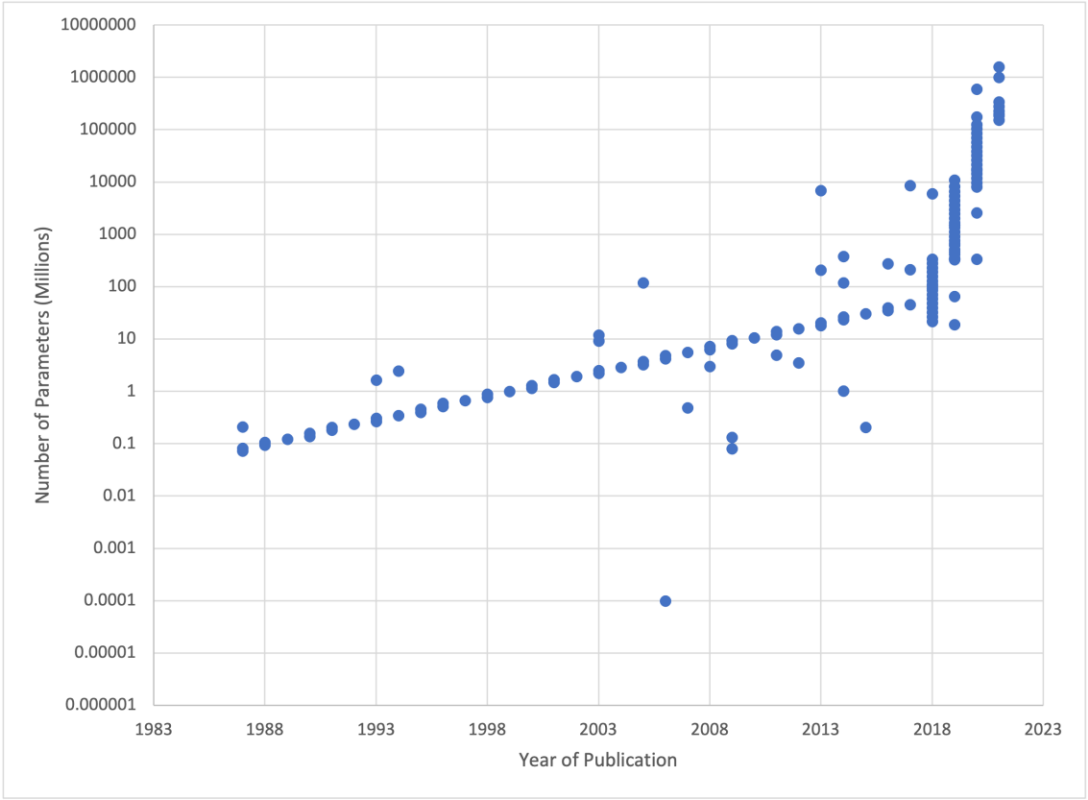
Reactive	Problem-solving focused Limited data utilization
Organized	Centralized data management Initial AI projects
Integrated	AI embedded in multiple business functions Advanced analytics capabilities
Transformative	AI at the core of business strategy Continuous innovation and adaptation

Impact on industries

- Healthcare
  - Drug discovery: Insilico Medicine found new treatments for fibrosis using AI in just 21 days
- Finance
  - Fraud detection: a global bank reduced fraudulent transactions by 50% using AI
- Manufacturing
  - Quality control: Noodle.ai collaborated with a steel mill to deploy an AI application for quality control, reducing suboptimal coil production from 50% to less than 1%

Why now?

- **Data Availability**
  - Explosion of Big Data
  - Improved Data Storage and Management
- **Computational Power**
  - Advances in GPU Technology
  - Cloud Computing Resources
- **Advanced Algorithms**
  - Breakthroughs in Machine Learning Models
  - Accessibility of Pre-trained Models



Case Study

Customer Service: Amtrak

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Customer Service: Amtrak

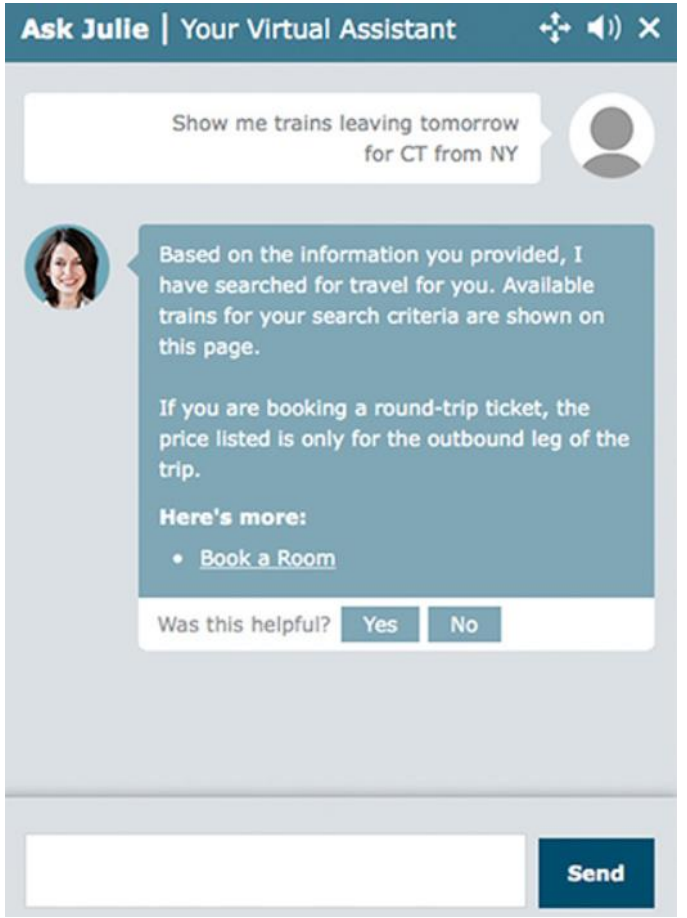
- **Passenger Downturn**
  - Dropped 47.4% in 2020
  - Recovered to 22.9M in 2022, still not peak
- **Limited Workforce**
  - Only 20,000 employees
  - Struggle with customer service calls
- **Slower Service**
  - Not as fast as bullet trains or as extensive as European railways
- **Customer Preferences**
  - Preference for planes and personal vehicles over trains

Implementation

- Use existing customer service data
  - Amtrak receives more than 5 million online queries per year
- Leverage pre-training
  - Existing customer service model can be further trained on specific data
- Chatbot interacts with existing web forms
  - Allows for a mix of working with the chatbot and with the page directly

Results

- Adapts, learns, refines based on queries
- 30% more revenue than other booking methods
- Always on, no waiting times
- Multi-Language Support
- Contextualized responses, akin to a personal concierge



Challenges in Digital Transformation

- Data Privacy and Security
  - Protecting sensitive information
- Cost and Complexity
  - Initial investment in technology
  - Complexity of integrating new systems
  - Ongoing maintenance costs

Data Privacy and Security

- Changing legislative landscape
  - AI is a quickly-changing area with no global (or even provincial!) consensus on best practices
- Generative AI: danger of reproducing sensitive data
  - ChatGPT can reproduce copyrighted material on occasion!
- Customer perception
  - AI is treated with suspicion by the public

Data Privacy and Security

- Netflix Prize (2006)
- Netflix releases a data set of 100 million *anonymized* user ratings
- Challenge: correctly predict how these users rate other movies
- Prize: $1m for the first team 10% better than Netflix
- Front-runners included ML@UToronto, led by Geoffrey Hinton

Data Privacy and Security

- In 2008, researchers showed that just from the *anonymized* ratings in the Netflix data, they could identify individuals!
- By comparing the Netflix data with public sites (like IMDb), users could be matched to their public ratings
- If you rate enough films, the likelihood of someone else having the exact same taste is very small

Robust De-anonymization of Large Datasets
(How to Break Anonymity of the Netflix Prize Dataset)

Arvind Narayanan and Vitaly Shmatikov

The University of Texas at Austin

February 5, 2008

Mitigating Privacy Risks

- Redacting private data is just the first step
- Need to train models that are designed to protect against leaks
- Adversarial approach: build a second model which attempts to predict sensitive information from the first model
- For example, can the decisions of a CV reading model be used to predict the race of candidates?

Data Privacy and Security

- OpenAI approach: give the model all the data we possibly can
  - This is why they are being sued for copyright infringement!
- Careful selection of appropriate data is better in every way
  - Many models perform better when only provided with the most relevant data
  - If we understand what the model has seen, we understand what it might reproduce
  - Much easier to show clients that we are taking risks seriously

Cost and Complexity

- Startup costs to develop in-house AI platforms is high
  - High demand for computing resources that are being used for crypto, consumer use, and more
  - Microchip shortage is ongoing
- System design requires new expertise
- Maintenance includes regular upgrades
  - Computing resource demand for AI is growing rapidly

Cost and Complexity

- Enterprise-scale solutions from Microsoft, Amazon, IBM and more allow for more time spent on developing models and less on procuring resources
- Cloud AI platforms allow for low- or no-code AI usage
- Data security and regulatory compliance built-in

Regulatory Landscape

- Understanding regulatory oversight is crucial for AI deployment in digital transformation.
- Key Regulatory Frameworks:
  - General Data Protection Regulation (GDPR) in the EU
  - Personal Information Protection and Electronic Documents Act (PIPEDA) in Canada
  - California Consumer Privacy Act (CCPA) in the U.S.

GDPR and PIPEDA

- GDPR in the EU and PIPEDA in Canada are key frameworks affecting AI.
- GPDR Highlights:
  - Data Subject Rights: Includes the right to explanation for AI decisions
  - Data Minimization: Collect only necessary data
- Key Points for PIPEDA:
  - Consent: Explicit consent required for data collection
  - Accountability: Organizations responsible for data protection
- AI-specific Challenges:
  - Ensuring explainability
  - Anonymizing training data effectively

CCPA and Future Canadian Legislation

- CCPA in the U.S. and emerging frameworks in Canada.
- Key Points for CCPA:
  - Consumer Rights: Right to opt-out, right to delete data
  - Business Obligations: Transparency in data usage
- Future Canadian Trends:
  - Discussion on modernizing PIPEDA for AI
  - Provincial regulations like Québec's Bill 64

Measuring ROI

- Measuring Return on Investment is critical for evaluating the success of digital transformation initiatives.
- Key Metrics:
  - Cost Savings
  - Revenue Generation
  - Customer Satisfaction
  - Operational Efficiency
- Why Measure ROI:
  - Justify investment in digital technologies
  - Align digital strategies with business objectives

ROI Calculation Methods

- Common methods to calculate ROI in the context of digital transformation:
  - Payback Period: Time required to recoup the initial investment
  - Net Present Value (NPV): Future value of the investment adjusted for time
  - Internal Rate of Return (IRR): Annualized rate of growth expected from the investment
- Challenges:
  - Intangible benefits like customer satisfaction are hard to quantify
  - Digital transformation often requires long-term investment

Key Takeaways

- Digital transformation is integral for modern businesses.
- AI accelerates transformation but comes with challenges like data privacy and regulatory compliance.
- ROI metrics are essential for gauging the success of digital initiatives.
- Regulatory frameworks like GDPR and PIPEDA are key to responsible AI deployment.

Final Thoughts

- Digital transformation is a long-term strategy, not a one-time project.
- The landscape is ever-changing, requiring continual adaptation and learning.
- Organizations must balance innovation with ethical considerations and compliance.
- Investing wisely in AI and other digital technologies can provide a competitive edge.