OPRE 4393: AI in Supply Chain Management
Syllabus - Last updated December 29, 2024

Course Overview

This undergraduate course provides an introduction to the applications of Artificial Intelligence (AI) in supply chain management (SCM) across various business contexts and domains. Students will learn about different types of AI algorithms used in SCM, understand how AI is implemented in supply chain processes, explore the effects and implications of AI implementations for various stakeholders, consider ethical implications and potential biases of AI in SCM, and discuss the future of AI in supply chain management and its potential impact on the field. Through case studies, readings, discussions, and a semester-long group project, students will gain practical insights into how AI is transforming the supply chain landscape.

No background knowledge of supply chain management or data science is required; we welcome students from across all academic programs.

This is a project-based and discussion-based course and will therefore require you to come prepared to each class having completed the assigned readings and be fully prepared to share your thoughts during the class discussions. The course materials will include a combination of mainstream media articles, blog posts, podcasts, videos, along with the occasional academic research paper. Some readings will be more technical than others and those I encourage you to skim to get a general understanding but you do not need to fully understand all the technical details of an AI implementation.

The course is broadly divided into 5 modules:

1. AI within the warehouse
2. Using AI appropriately in SCM
3. Upstream and downstream uses of AI in the supply chain
4. AI in SCM across various contexts
5. Future of AI in SCM and final presentations

Instructor

Prof. Maya Balakrishnan
Assistant Professor - Operations Management
maya.balakrishnan@utdallas.edu

Class time:
Wednesday 4:00pm – 6:45pm
JSOM 12.210

Office hours:
Wednesday 10:30am – 12:30pm
Or by appointment

Course Materials

This course will use materials from a wide variety of sources including news articles, short videos, blog posts, and podcasts. The materials are pulled from a range of academic disciplines to provide you with an interdisciplinary understanding of this topic, including pulling from management research on operations and supply chain management, psychology literature, computer science, and human-computer interaction research.

Each week we will have a set of assigned materials that you are expected to engage with before class. ***We will make all course materials freely available online.*** For each class, there may be materials which we recommend you come prepared with a thorough understanding of, as well as materials you may skim.

Assignments and Grades

5%	In-class Participation: All students are expected to attend and participate in every class discussion by making contributions that demonstrate they have thoughtfully engaged with the course materials. Students are expected to make connections and inferences that go beyond the presented materials by drawing on their personal experiences, knowledge from other classes, as well as any sources they may have also engaged with. If a student has an excused absence for a class, they are expected to send the discussion leaders for that class 1 discussion question along with a 1 paragraph response for that question by the start of class with the instructors copied on the email.
10%	Class Discussion Lead: Each student is expected to sign up to lead one class discussion. The student in charge of leading a class discussion should come prepared having thoroughly engaged with the course materials for that class. They are expected to prepare a 10 minute presentation summarizing the readings including the key takeaways. They should also source additional materials (including practitioner articles, blog posts, recent news articles, research papers, etc.) that connect with the readings and summarize how these materials relate to the current class topic, to previous class topics, and to recent and historical AI implementations in SCM. Each discussion leader is also expected to prepare 2 discussion questions that stem from the readings and write 1 paragraph responses for each of their discussion questions. The discussion questions should be shared at the end of the presentation to kick off the class discussion portion. The discussion questions should be sent to the instructor by 5pm the day before class.
10%	Reading Reflections: Students are expected to write 3/4 page (single-spaced) reading reflections for 10 of the lecture-based classes. Each reading reflection is worth 1%. The reflections should engage with the pre-reading materials for the class, drawing connections between course materials and across other courses and other topics. Each reflection should contain appropriate in-text citations and references to both the pre-reading course materials and any other materials the students reference. Reading

	reflections should be sent to the instructor by midnight the day before class.
20%	Inventory Ordering Simulation: At the midpoint of the class, all students will participate in an inventory ordering simulation. Before the class in which the simulation occurs, students are expected to create and send in their inventory ordering algorithm. They will be expected to upload a description of their algorithm and what their algorithm outputs for a set of inventory ordering decisions, along with a brief explanation of how their algorithm works. Completing this is worth 5% of the grade. If this material is not uploaded prior to the start of the simulation you will not be allowed to participate in the simulation. Students are expected to be present in class and participate during the simulation. This is worth 5% of the grade. One week after the simulation, students will be expected to each upload a 2 page (single-spaced) writeup of their experience during the simulation. This writeup should include how they created their initial inventory ordering AI, an analysis of how it performed, how they used their AI to inform their ordering decisions, how and why they decided to modify their AI, what may have changed over the course of the simulation, when and why their AI performed well vs poorly, what they might have done differently in retrospect, and what they learned from their classmates. This writeup is worth 10% of the grade.
5%	Final Project Proposal: Students are required to create a final project. After choosing an idea, students should submit a 1-page (single-spaced) proposal of what they will do for their final project. Students should be as detailed as possible in these project proposals as they are meant for them to receive feedback. If students are debating multiple ideas they are welcome to submit shorter proposals for each of their ideas.
5%	Final Project Midpoint Draft: Students should submit a 4-page (single-spaced) draft of the writeup for their final project. Students should also submit sketches or diagrams details the workings of their project prototype. Students should be as detailed as possible in this midpoint drafts as they are meant for them to keep on track with finishing their projects as well as receive peer feedback.
10%	Final Project Peer Feedback: Each student will be assigned to provide peer comments on two other students' final project midpoint drafts. Students will be asked to submit a 1 page writeup (single-spaced) of peer feedback including what the peer's proposal did well, what the peer could do a better job of addressing in the final submission, any sources or materials the peer should include or cite in their final project, and any questions that were left unanswered by the proposal that may be interesting to explore in the final project. Each peer feedback is worth 5% of the grade.
35%	Final Project: Students are expected to complete a final project pitching a particular AI algorithm or implementation that will reshape supply chain management. Students can complete this final project individually or as a team of 2 students.

	As part of the final project, each group will be required to give a 20 minute presentation in class (worth 20% of their grade). Each group will also submit a final project writeup of 8-12 pages excluding references (worth 15% of their grade). As part of your project and presentation, you will choose a "persona" and pitch a SCM AI implementation to a group of judges who will decide whether or not to fund your project. Some examples of personas are a startup founder, a manager of a retail company, a city council member, a non-profit leader, or a government/policy advisor. Within the presentation and writeup, you are expected to discuss what your AI technology is, high level details of how it may work including any data it will be trained on, how it will be developed, and ideas for what type of underlying algorithm it might leverage. You will be required to explain what inputs the technology will take in and what it will output. You should consider all the stakeholders involved and how this technology will affect each of them with a discussion of whether this technology is meant to augment or replace human workers. You should discuss how the technology will be evaluated and what its metrics for success will be. Please also touch on any ethical considerations for this technology including how it may be measured for bias and how that bias can be mitigated. Within your project writeup please state the contributions of each team member. No late submissions will be accepted.

Expectations

Students are expected to attend all class sessions on time, stay for the duration of the session, complete all assigned readings and assignments by the due date, and come prepared ready to participate. Students may use resources like generative AI to assist them with their final project and simulation work but if they do so must document how generative AI was used. Generative AI is not to be used for reading reflections. The goal of the reading reflections is for you to engage with the material and be prepared to discuss it in class.

Course Overview

Week	Class	Topics	Assignments	Date
Module 1: AI within the warehouse				
1	1	Introduction Overview of AI in Supply Chain Management Managing Workers		Jan 24
2	2	Demand Forecasting		Jan 31

		Job Scheduling		
3	3	Predictive Maintenance Product Pricing		Feb 7
Module 2: Using AI appropriately in SCM				
4	4	Human-AI Interaction and Behavioral Biases Human-in-the-loop AI		Feb 14
5	5	Final Project Introduction and In-Class Prep Time		Feb 21
6	6	Inventory Ordering Simulation	Simulation pre-work due (before class)	Feb 28
7	7	AI Ethics AI Transparency and Explainability	Simulation reflection due	Mar 7
Module 3: Upstream and downstream uses of AI in the supply chain				
8	8	Product Assortment Selection Personalized Product Recommendations	Project proposals due	Mar 14
9		Spring Break		Mar 21
10	9	Network Optimization Sourcing Suppliers		Mar 28
11	10	New Product Creation	Project midpoint draft due	Apr 4
Module 4: AI in SCM across various contexts				
12	11	Healthcare Operations	Project peer feedback due	Apr 11
13	12	Humanitarian Operations Food Operations		Apr 18

14	13	Supply Chains for Creating AI		Apr 25
Module 5: Future of AI in SCM and final presentations				
15	14	Generative AI in SCM		May 2
16	15	Final Presentations		May 9

Course Outline and Schedule

MODULE 1: AI WITHIN THE WAREHOUSE

Class 1:
Introduction
Overview of AI in SCM
Managing Workers

Introduction
This first class will introduce the course, the instructor, and expectations from the students. We will provide an overview of the course and go over the syllabus including the 5 modules of the course and our goals and expectations. Students will also be expected to sign up as discussion leaders for each of the remaining classes.

Overview of AI in SCM
What do people really mean when they talk about "AI" versus "algorithms"? We'll break down these terms and see how they're used in supply chains. Through real-world examples, we'll explore different types of AI (like supervised and reinforcement learning) and understand what they're good at - whether that's predicting future sales, optimizing delivery routes, or finding patterns in customer behavior. We'll look at how AI works at a basic level: what information goes in, what comes out, and how we know if it's doing a good job.

Managing Workers
Companies like Amazon and Walmart are increasingly using AI to manage their warehouse workers - but is this good or bad? We'll explore how AI helps schedule shifts, track performance, and assign tasks in warehouses and distribution centers. We'll discuss the benefits (like improved efficiency) and challenges (like worker privacy and fairness) of using AI to manage people.

Class 2:
Demand Forecasting
Job Scheduling

Demand Forecasting
How can companies use AI to predict how many products they will sell next month? We'll look at how companies have moved from simple spreadsheet predictions and heuristic rules to

sophisticated AI systems that can spot patterns in everything from weather data to social media trends. Through hands-on examples, we'll see how these systems work and why they sometimes get it wrong.

Job Scheduling
How does a factory decide which products to manufacture first and on which machines? We'll explore how AI helps manufacturing plants schedule their production efficiently. We'll see how AI juggles complex constraints like machine capabilities, order deadlines, setup times, and maintenance schedules to create efficient production plans. We'll also look at how AI can quickly reschedule operations when unexpected events occur, like machine breakdowns or rush orders.

Class 3:
Predictive Maintenance
Product Pricing

Predictive Maintenance
Breaking machines cost companies billions - but what if we could predict when equipment will fail? We'll explore how companies use AI and sensor data to spot potential breakdowns before they happen. We'll see how predictive maintenance works in practice and calculate the potential savings from preventing equipment failures.

Product Pricing
Why do prices on Amazon change so frequently? We'll dive into how companies use AI to set prices dynamically based on factors like competitor prices, inventory levels, and customer demand. Through real examples from retail and e-commerce, we'll explore how these systems work and discuss whether they're fair to customers. We'll also look at some cases where AI pricing went wrong and caused PR disasters.

MODULE 2: USING AI APPROPRIATELY WITHIN SCM

Class 4:
Human-AI Interaction and Behavioral Biases
Human-in-the-loop AI

Human-AI Interaction and Behavioral Biases
When do people trust AI too much or too little? Through interactive exercises, we'll explore how human psychology affects our interaction with AI systems. We'll look at real cases where warehouse workers, planners, and managers work alongside AI, and discuss what makes these partnerships successful or problematic.

Human-in-the-loop AI
Sometimes AI needs human help to make better decisions. We'll explore real examples where companies combine human expertise with AI capabilities to get better results than either could achieve alone. We'll see different ways of designing these partnerships to understand how humans and AI can work together effectively.

Class 5:
Final Project Introduction and In-Class Prep Time

Students will be introduced to the final project. They will form teams in class and discuss ideas for potential projects. By the end of the class students should have chosen a team, discussed several project ideas, chosen 3-5 project ideas to research further, and made a plan to meet with their team for the duration of the semester to complete their project.

Class 6:
Inventory Ordering Simulation

This class will involve a hands-on simulation of AI-driven inventory ordering. Students will create their own inventory ordering AI algorithms and participate in a real-time simulation in class. Please make sure to come to class prepared having submitted your pre-work for the simulation or you will not be able to participate in class.

Class 7:
AI Ethics
AI Transparency and Explainability

AI Ethics
When companies implement AI in their supply chains, who benefits and who might be harmed? Through real case studies, we'll explore key ethical challenges like algorithmic bias in hiring, worker surveillance concerns, and the impact of automation on jobs. We'll see how biased training data can lead to unfair decisions, examine how different companies have addressed these challenges, and discuss what responsibilities companies have when implementing AI. =

AI Transparency and Explainability
Why did the AI make that decision? We'll explore why being able to understand and explain AI decisions is crucial in supply chain management. Through practical examples, we'll look at different tools and techniques that help make AI systems more transparent - from simple decision trees to more complex explanation methods like LIME and SHAP. We'll see how companies explain AI decisions to different stakeholders (like workers, managers, and customers) and discuss when AI systems need to be explainable versus when they can be "black boxes."

MODULE 3: UPSTREAM AND DOWNSTREAM USES OF AI IN THE SUPPLY CHAIN

Class 8:
Product Assortment Selection
Personalized Product Recommendations

Product Assortment Selection
How does Target decide which products to stock in each store? We'll explore how retailers use AI to choose their product mix, predict trends, and personalize selections for different locations.

Through examples from major retailers, we'll see how AI helps balance variety against complexity.

Personalized Product Recommendations
"Customers who bought this also bought..." - sound familiar? We'll dive into how online companies use AI to make personalized recommendations. We'll explore how these systems work, why they sometimes make weird suggestions, and how companies balance customer experience with inventory costs.

Class 9:
Network Optimization
Sourcing Suppliers

Network Optimization
Where should we put our warehouses? Which delivery route is best? We'll see how companies use AI to design and optimize their supply chain networks. We'll explore how AI helps companies adapt their networks to changing conditions.

Sourcing Suppliers
How do companies choose and monitor their suppliers? We'll explore how AI helps evaluate supplier risk, track performance, and even read contracts automatically. Through recent examples like supply chain disruptions during COVID-19, we'll see how AI helps companies build more resilient supplier networks.

Class 10:
New Product Creation

How do fast fashion brands create new products so quickly? We'll explore how companies use AI to spot trends, design products, and test them virtually. Through examples from fast fashion and other industries, we'll see how AI is speeding up product development while discussing the impact on sustainability and quality.

MODULE 4: AI IN SCM ACROSS VARIOUS CONTEXTS

Class 11:
Healthcare Operations

How do hospitals manage their supplies and staff? We'll explore how AI helps healthcare organizations manage everything from medical supplies to operating room schedules. Through recent examples from the COVID-19 pandemic, we'll see how AI helps hospitals adapt to changing demands while ensuring patient care.

Class 12:
Humanitarian Operations
Food Operations

Humanitarian Operations
When disaster strikes, how do relief organizations respond? We'll explore how AI helps coordinate disaster response and humanitarian aid. Through recent examples from natural disasters and humanitarian crises, we'll see how AI helps organizations deliver aid more effectively.

Food Operations
From farm to table, how does food reach your plate? We'll explore how AI is transforming food supply chains, helping reduce waste, ensure food safety, and get fresher food to consumers. Through examples from grocery stores, restaurants, and delivery services, we'll see how AI is changing how we get our food.

Class 13:
Supply Chains for Creating AI

What does it take to create and maintain AI systems? We'll explore the "supply chain of AI" - from collecting data to training models to keeping systems running. Through examples from major tech companies, we'll see what it takes to build and maintain AI systems at scale.

MODULE 5: FUTURE OF AI IN SCM + PRESENTATIONS

Class 14:
Generative AI in SCM

ChatGPT, DALL-E, and beyond - how will generative AI change supply chains? We'll explore how these new AI technologies might transform supply chain planning, documentation, and decision-making. Through demonstrations and examples, we'll see both the potential and limitations of these emerging technologies.

Class 15:
Final Presentations

This class will be dedicated to student presentations of their final projects. Each group will pitch and demo their AI implementation, followed by Q&A. Students will evaluate and score each of their peers' pitches and the final scores will be tallied and presented at the end of the last class.