Week 1 | Lecture 1

ED6008: An Introduction

Instructor
Athulan Vijayaraghavan, Ph.D

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About Me

Graduated in 2009 from UC Berkeley

Co-Founded VIMANA, software for manufacturing data analytics

Executive Director at IM Gears, precision manufacturer

Welcome to ED6008

- Name
- Interests
- What do you want to get out of this class?

Conduct

- Professional
- Punctual
- Ethical

Industry *4.0*

"Industry 4.0 is the realization of the digital transformation of the field, delivering real-time decision making, enhanced productivity, flexibility and agility"
IBM (https://www.ibm.com/in-en/topics/industry-4-0)

"a name for the current trend of automation and data exchange in manufacturing technologies, including cyber-physical systems, the Internet of things, cloud computing and cognitive computing and creating the smart factory"
iScoop (https://www.i-scoop.eu/industry-4-0/)

"application of the IoT, cloud computing, cyber-physical systems (CPS), and cognitive computing into the manufacturing and service environment"
Tibco (https://www.tibco.com/reference-center/what-is-industry-40)

Smart **Manufacturing**

a.k.a: “Digital manufacturing” “cyber manufacturing” “data driven manufacturing”, “intelligent manufacturing”

“orchestrating physical and digital processes within factories and across other supply chain functions to optimize current and future supply and demand requirements”

Gartner (https://www.gartner.com/en/information-technology/glossary/smart-manufacturing)

“use of emerging, advanced technologies to increase the efficiency of traditional manufacturing processes”

Texas A&M (https://engineering.tamu.edu/news/2022/03/what-is-smart-manufacturing-and-how-is-it-changing-the-industry.html)

Why is it a *revolution*?

Why not 3.1?

New Tech + New Decision Making ➡ New Decisions ➡ New Outcomes

What is it, really?

- Buzzword
- Can rename this class to “A Survey of Recent Advances in Manufacturing Technology with Applications in The Field Thereof” – but its boring
- Think of it as: “the state of the art in manufacturing”
- Core principles
  - Connected
  - Automated
  - Systemic

Administrivia

- Instructor: Athulan Vijayaraghavan
- Office Hours: TBD + By Appointment
- Text: Assigned in the Lectures

Course Structure

- Lectures (and guest lectures)
- Homework assignments / Pop quizzes
- Literature Review / Project [presentation, report]
- Final Exam

- Notes:
  - Exceptional Class Participation bonus points
  - Grading rubric will be shared soon.

What this class is about

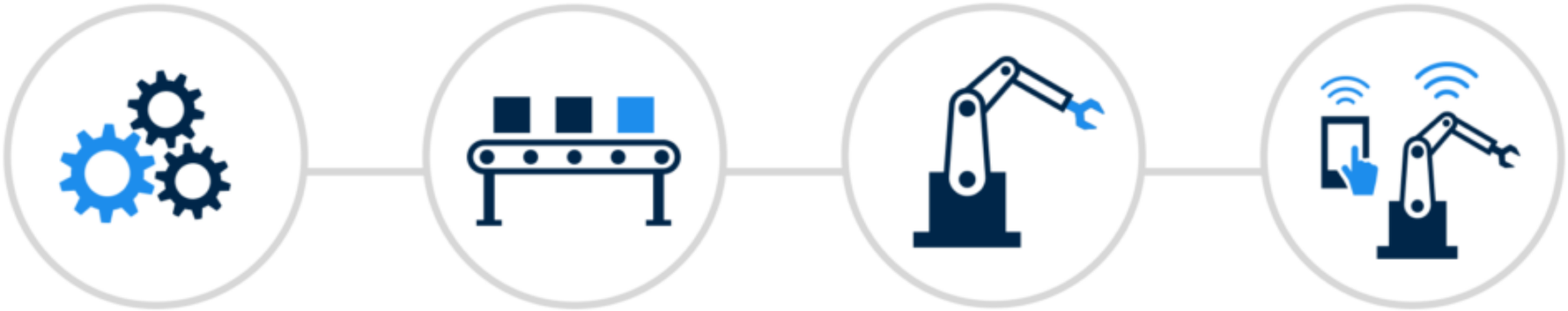
What is Industry 4.0 / Smart Manufacturing and what makes it so great?

What are the fundamentals of Manufacturing?

How do you make it Smart?

How can we learn from the mistakes (and successes) of others?

Section 1: Transformations, an Introduction



Industry 1.0

Mechanization and the introduction of steam and water power

Industry 2.0

Mass production assembly lines using electrical power

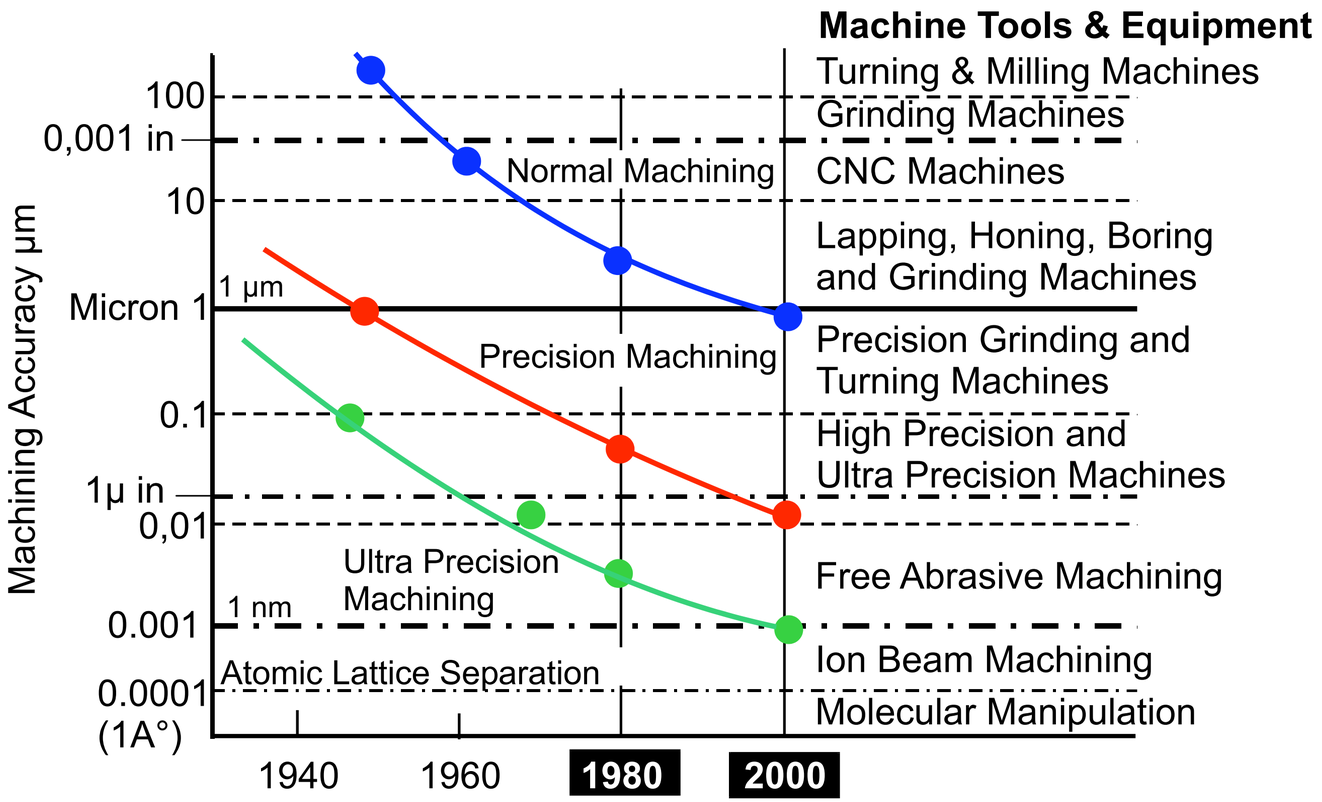
Industry 3.0

Automated production, computers, IT-systems and robotics

Industry 4.0

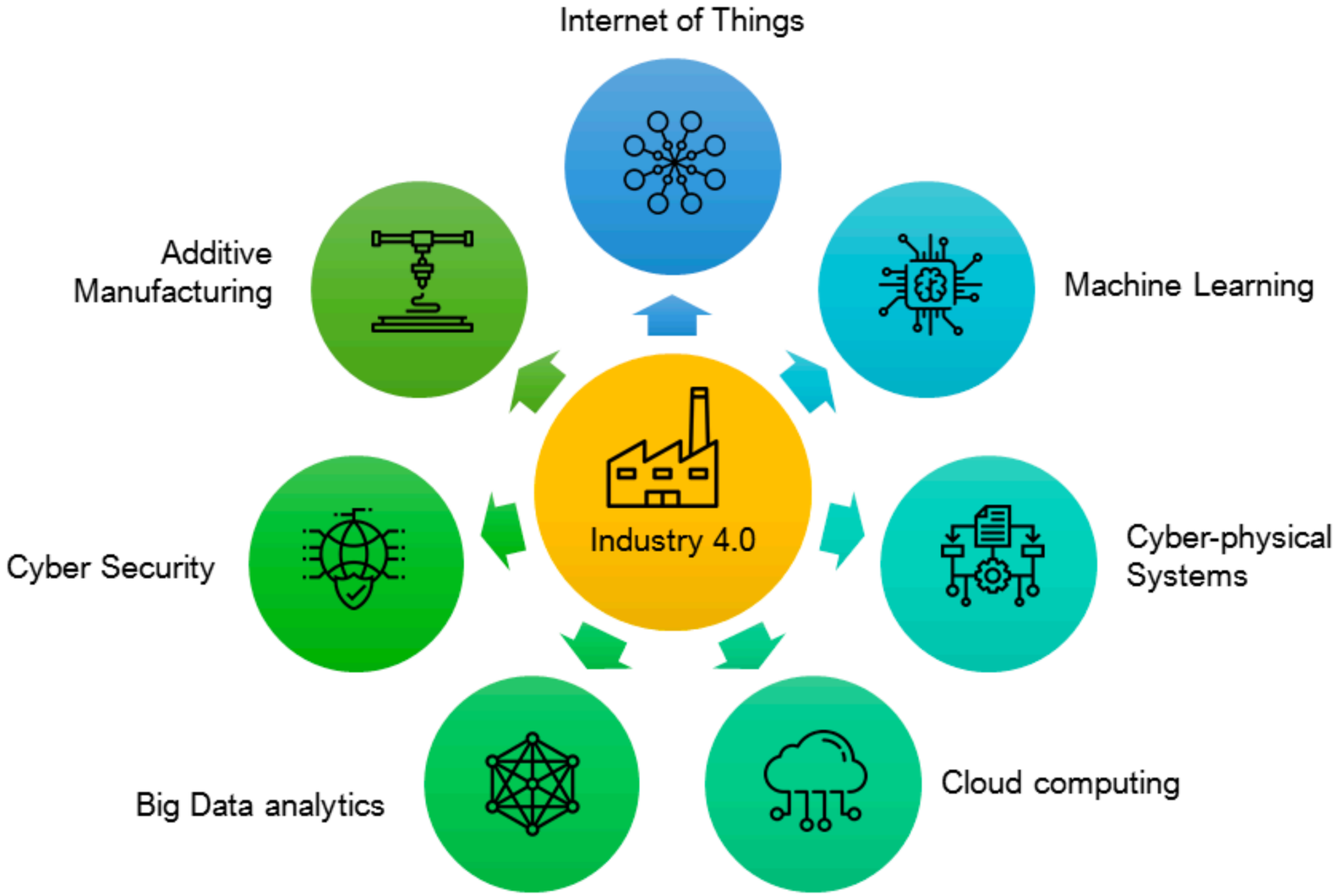
The Smart Factory. Autonomous systems, IoT, machine learning

Section 2: Fundamentals



source: McKeown after Taniguchi

Section 3: Enablers



https://www.mistralsolutions.com/blog/industry-4-0-implications-process-industry/

Section 4: Case Studies

TESLA

DMG MORI

Course Outline

Introduction

- Course Introduction
- Industrial Transformations

Fundamentals

- Manufacturing Processes
- Measurement
- Machine Design
- Metrology
- Manufacturing Systems
- Factory Dynamics

Enablers

- Connectivity / Interoperability
- Additive
- Automation + Robotics
- Sensors + Data Collection
- Industrial IoT
- ML/AI
- Design
- LCA / Energy / Environment

Case Studies

- Smart Factory
- Connected Vehicles
- Predictive Maintenance
- Predictive Quality
- …

What do you want to learn more?

What can you do with this class

You are in Manufacturing

- Starting point to dig deeper
- Survey of key technologies

You are in Engineering

- How tech drives mfg
- Systemic perspective

Anything Else

- Broad trends
- Business impacts

This is a SURVEY course – what you get from it depends on what you want from it

My Biases

- **mechanical discrete manufacturing** vs continuous/ hybrid; electronics/semicon/ chemicals/…
- **Industrial IoT** vs Consumer IoT
- **SW + analytics** vs HW + robotics

Industry 4.0 is MUCH (much) larger than this course

Next Time

Section 1: Overview of Transformations