

# AI: Strategy + Marketing (MGT 853)

## Economics of AI & Prediction Problems (Session 4)

Vineet Kumar

Yale School of Management  
Spring 2025

# Agenda for Today's Session

- Reinforcement Learning

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- Reinforcement Learning
- Prediction & Computing Problems

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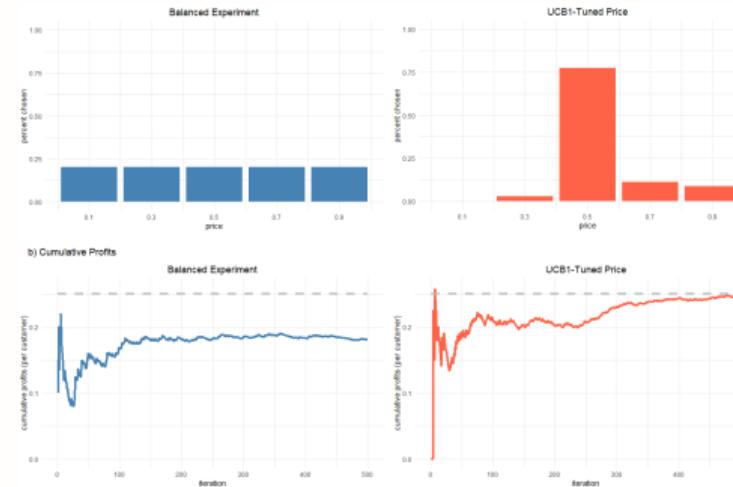
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- Humans also use this mode of learning especially children
- **Critically important to specify the reward function properly**

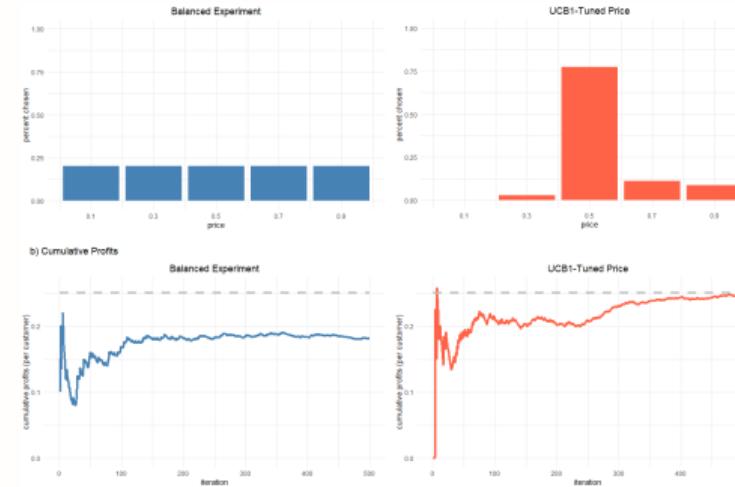
# RL in Dynamic Pricing

- When you have a new zero cost product we don't know demand



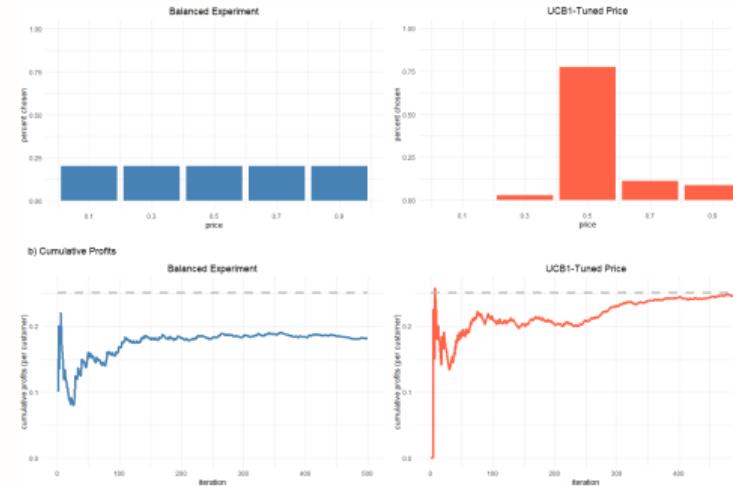
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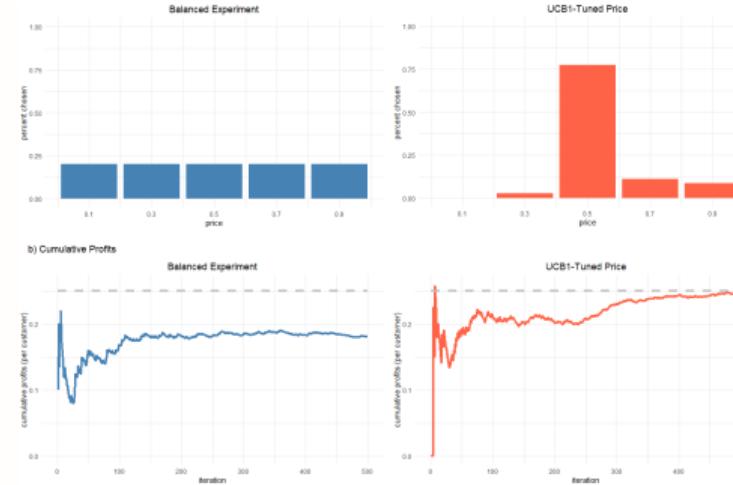
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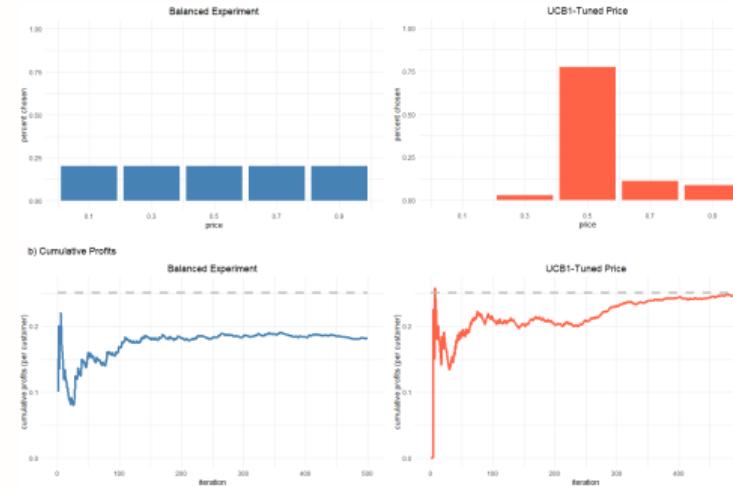
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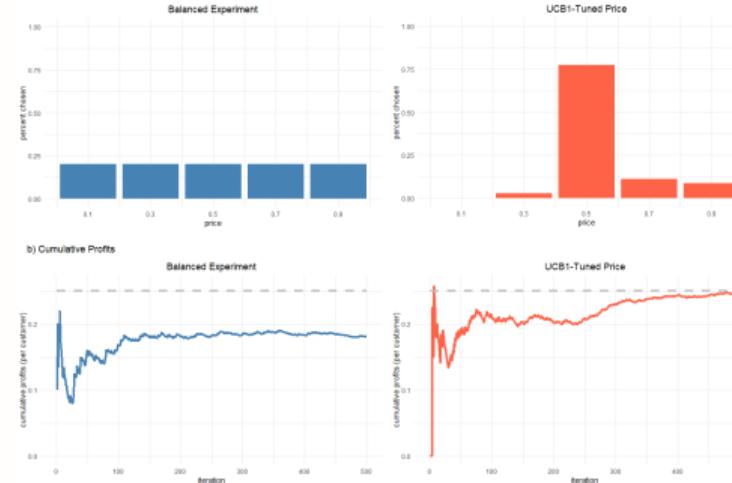
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- Actions, rewards and state?



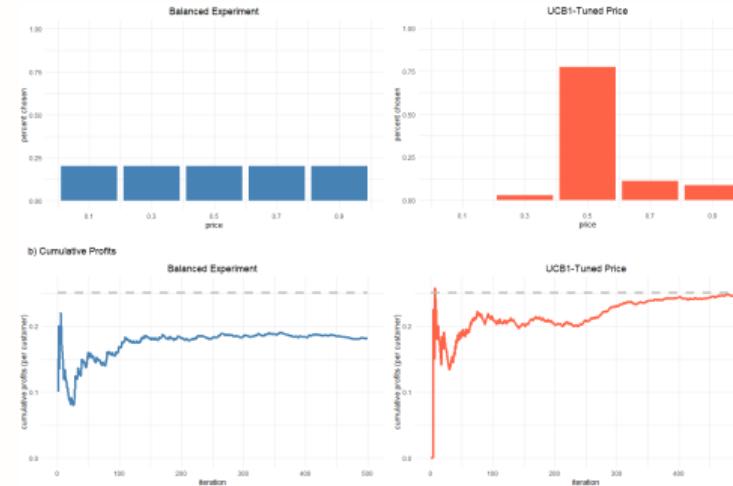
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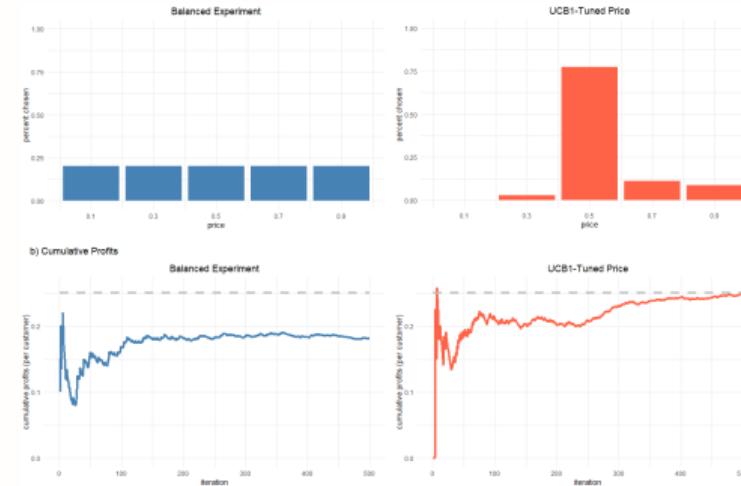
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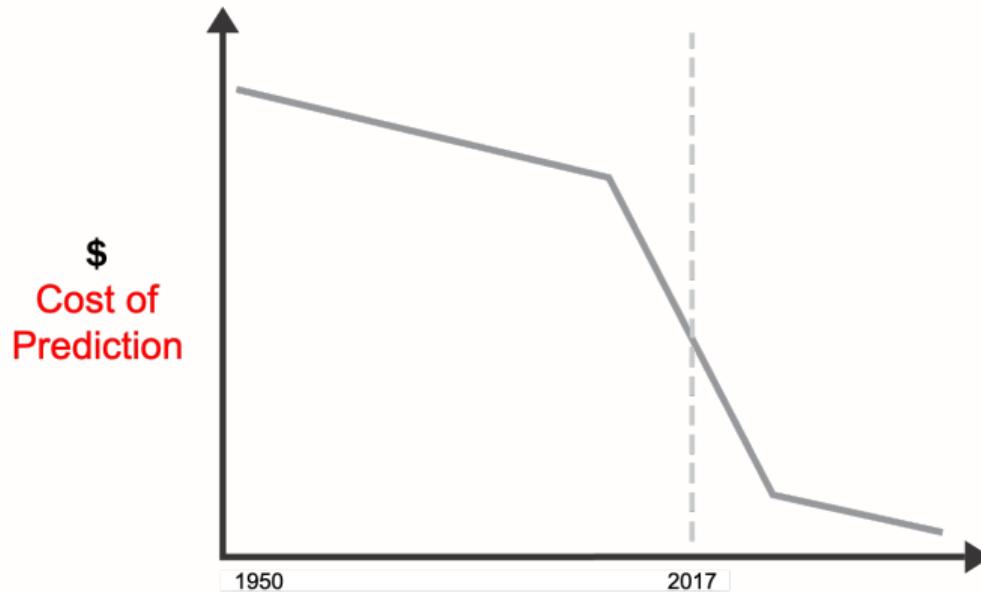
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 $p = 1, 2, \dots, 100$
- Rewards:**  $\Pi = p \times D(p)$
- State:** Sequence of prices tested and quantities sold



# Economic Impact of AI

# Prediction Costs Over Time



Cost of high-quality prediction (accurate, robust) has decreased significantly

# Economics of AI

## Impact of Cheap Prediction

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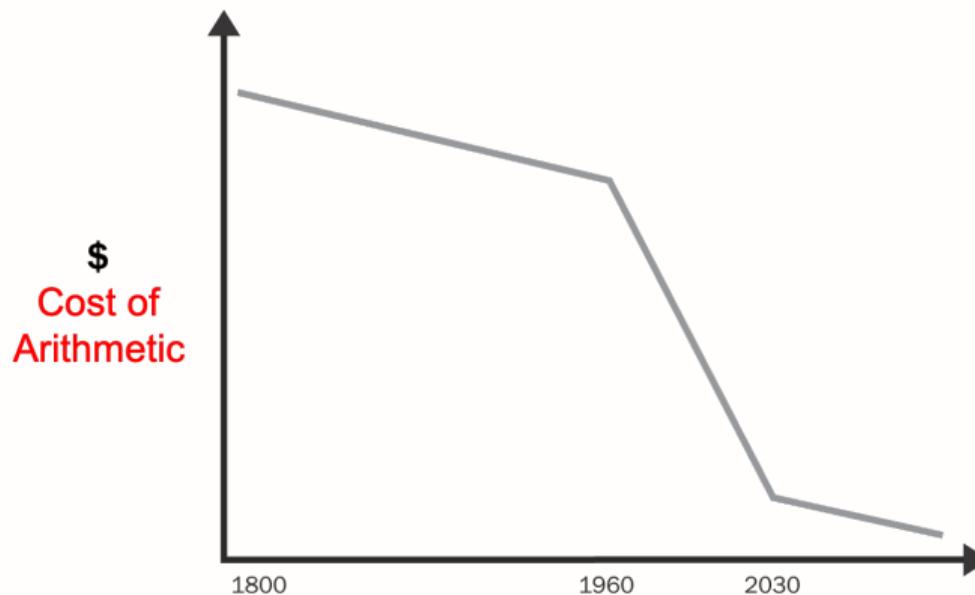
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## Biggest Impact

Convert non-prediction problems to prediction problems

# Computing Costs Over Time



# Converting to a Computing Problem

How has writing become a computing problem?

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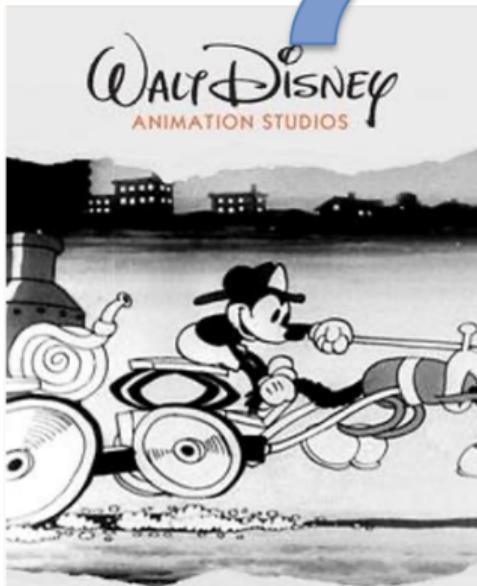
# Converting to a Computing Problem

How has writing become a computing problem?

- Computing has become much cheaper over past few decades.
- Has become a general purpose technology
- Non-computing problems have been converted to computing problems



# Converting to a Computing Problem



**THE FIRE FIGHTERS**

MGT 853 AI: Strategy + Marketing



Computing  
problem

# Converting to a Computing Problem



How has photography become a computing problem?

# Converting to a Prediction Problem

# What is a Prediction Problem?

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Using information that you *do have*  
to  
generate information that you *don't have*

# Converting to a Prediction Problem?



With Smartphones, can we think of a prediction problem here?

# Converting to a Prediction Problem?

## How Apple Uses AI To Produce Better Photos

By Paul Mah on November 03, 2021



# Converting to a Prediction Problem?



# From Prediction Performance to Business Impact

# AI Drives Change in Firm Strategy

Google Products and Services Artificial Intelligence Companies Google (company)

**What does it mean for Google to become an "AI-first" (quoting Sundar) company? How will this affect prioritization and product development?**

🔗 <https://googleblog.blogspot.com/2016/04>this-years-founders-letter.html>

**Google sees huge value in moving from 80% accuracy in search to 99.x% accuracy**

**Willing to de-prioritize everything else (before this, Google was "Mobile First")**



Peter Norvig, Research Director at Google

Answered May 16 2016 · Upvoted by Pål Bergerskogen, M.Sc Artificial Intelligence, Norwegian University of Science and Technology (2018) and Ken Fishkin, former Software Engineering Manager at Google (2013-2018)

"Classic" Google was an information retrieval company: you give a query, we quickly respond with ten suggestions of relevant pages, and it is your job to make sense of the suggestions. "Modern" Google, as Sundar has set out the vision, is based not just on suggestions of relevant information, but on informing and assisting. Informing, meaning that we give you the information you need, when you need it. For example, Google Now telling you it is time to leave for an appointment, or that you are now at the grocery store and previously you asked to be reminded to buy milk. And assisting means helping you to actually carry out actions—planning a trip, booking reservations; anything you can do on the internet, Google should be able to assist you in doing.

With information retrieval, anything over 80% recall and precision is pretty good—not every suggestion has to be perfect, since the user can ignore the bad suggestions.

With assistance, there is a much higher barrier. You wouldn't use a service that booked the wrong reservation 20% of the time, or even 2% of the time. So an assistant needs to be much more accurate, and thus more intelligent, more aware of the situation. That's what we call "AI-first."

# Preparing for the Future

## Science Fictioning?

- What if we can turn the dial to 100% on prediction accuracy?

Would you consider this an incremental change or disruptive change?



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US008615473B2

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Specifications  
Claims  
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Front Page  
Drawings  
Specifications  
Claims

(12) United States Patent  
Spiegel et al.

(10) Patent No.: US 8,615,473 B2  
(45) Date of Patent: Dec. 24, 2013

(54) METHOD AND SYSTEM FOR  
ANTICIPATORY PACKAGE SHIPPING

(75) Inventor: Joel R. Spiegel, Woodinville, WA (US); Michael T. McKenna, Bellevue, WA (US); Girish S. Lakshman, Issaquah, WA (US); Paul G. Nordstrom, Seattle, WA (US)

(73) Assignee: Amazon Technologies, Inc., Reno, NV (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 13/894,195  
(22) Filed: Aug. 24, 2012

(65) Prior Publication Data  
US 2012/0323645 A1 Dec. 20, 2012

Related U.S. Application Data  
(62) Division of application No. 13/005,611, filed on Nov. 28, 2011, now Pat. No. 8,271,308, which is a division of application No. 11/015,288, filed on Dec. 17, 2004, now Pat. No. 8,086,546.

(51) Int. Cl.  
**G06Q 99/00** (2006.01)  
(52) U.S. Cl.  
USPC ..... 705/332; 705/330; 705/333; 705/336; 705/337

(58) Field of Classification Search  
USPC ..... 705/332, 330, 333, 336, 337

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Primary Examiner — Akiba Allen  
(74) Attorney, Agent, or Firm — Robert C. Kowert; Meyerton, Flood, Kivlin, Kowert & Goetzl, PC

**ABSTRACT**

A method and system for anticipatory package shipping are disclosed. According to one embodiment, a method may include packaging one or more items as a package for eventual shipment to a delivery address, selecting a destination geographical area to which to ship the package, shipping the package to the destination geographical area without completely specifying the delivery address at time of shipment, and while the package is in transit, completely specifying the delivery address for the package.

# Is Prediction Sufficient?

# The Impact of Prediction

A Wartime example from WWII

- We have the images from 100s of planes showing bullet holes

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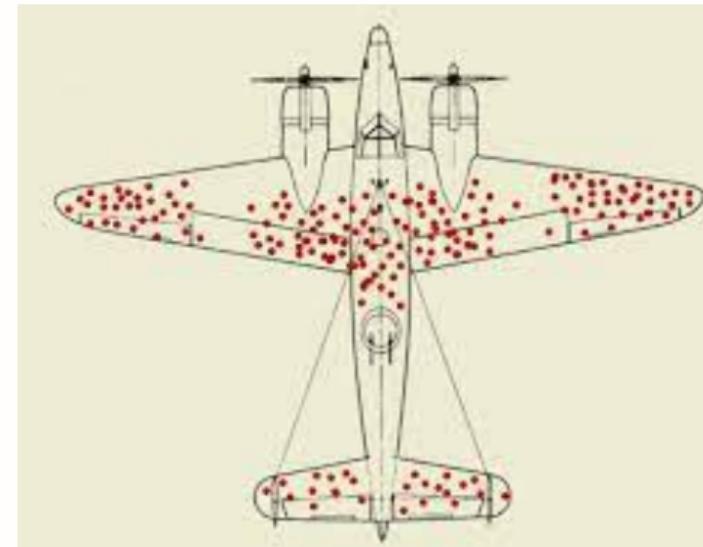
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# AI Decision Making Framework (Prediction $\neq$ Decision)

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## What is Judgment?

“The ability to make considered decisions or come to sensible conclusions” – Oxford

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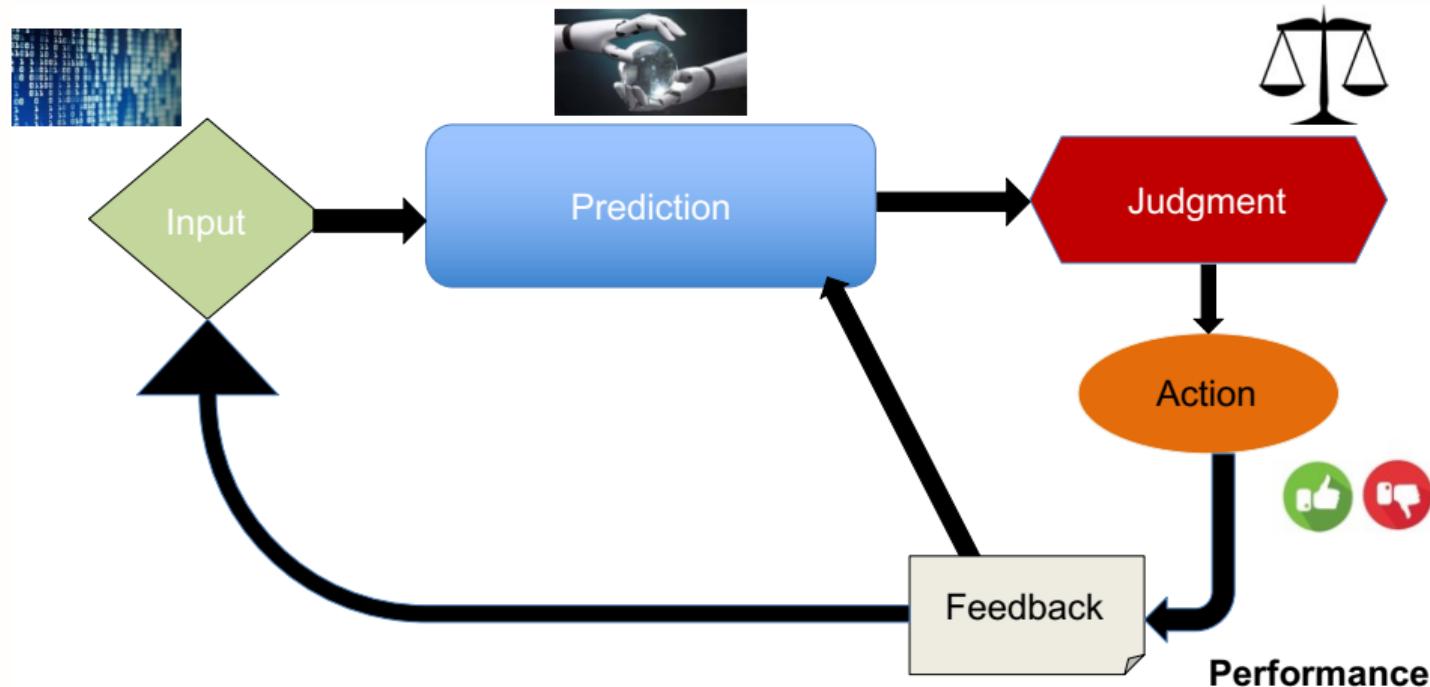
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# AI Decision-Making Framework



Does Feedback also inform Judgment?

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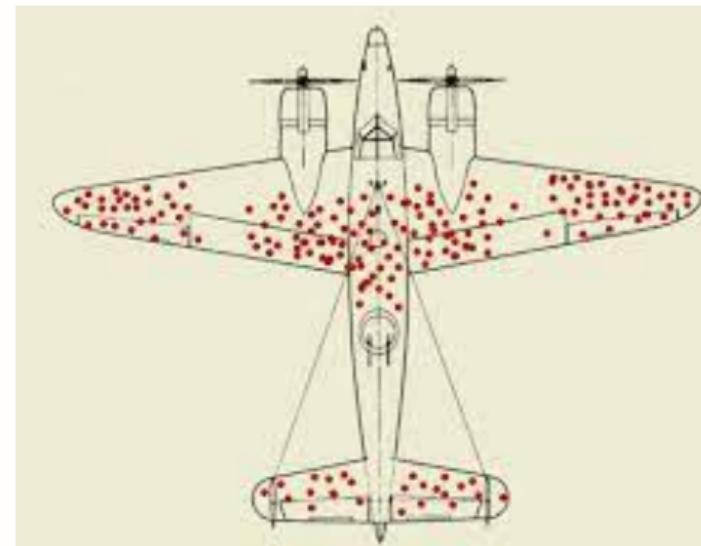
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Source: An Except from How not to be Wrong

# The Confusion Matrix

## Understanding Performance and Consequences

- Two class problem:  $y = Y (1)$  or  $N (0)$

Judgment: Now we need to assign values (utilities) to each cell



# Converting to Prediction Problems (In class exercise)

# Let's try this in Groups

- Choose one of the applications. Tell the class what you have chosen before you get started.  
 $\geq 2$  groups for each.

## 3 Cases – Choose ONE

- A) Social media (Instagram) – increase engagement
- B) Content firm (Spotify) – recommend new content to its users
- C) Restaurant – improve product assortment
- D) Auto Insurance – improve customer service

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- **What metric would you use to measure improvement?**

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- Complements to Prediction: Value increases as use of prediction becomes more widespread

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# Autonomous Vehicles



# Autonomous Vehicles

## Three Waves

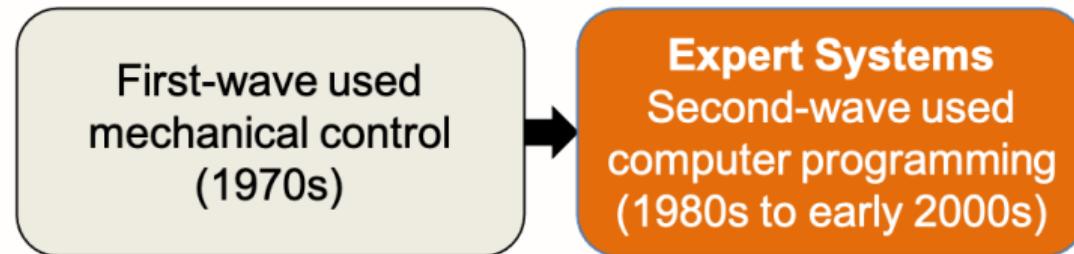
First-wave used  
mechanical control  
(1970s)

### Mechanical Control

- Works in very limited way
- No flexibility if environment is changed even a bit

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# Converting to Prediction Problem (In class exercise)

# Autonomous Vehicles

- Consider the role of prediction in autonomous driving
- Let's walk through the AI Decision Framework

## Questions to Ponder

- 0) What sources of data should the system use?
- 1) What are the possible predictive problems one might encounter?
- 2) How should we measure performance?
- 3) What are appropriate ML algorithms in our toolbox to solve them?
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# Autonomous Vehicles

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# Autonomous Vehicles

## Three Waves

First-wave used mechanical control (1970s)

**Expert Systems**  
Second-wave used computer programming (1980s to early 2000s)

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