AWS re:Invent

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How Amazon.com transforms customer experiences through AI/ML

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"We intend to build the world's most customer-centric company. But there is no rest for the weary. I constantly remind our employees to be afraid, to wake up every morning terrified. Not of our competition, but of our customers.

We consider customers to be loyal to us – right up until the second that someone else offers them a better service."

Jeff Bezos

1998 letter to shareholders

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Customer promise: Prime One-Day | Prime Now



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What powers the customer promise



400 million products forecast every day

300+ fulfillment centers, 200K+ robots, 19K trailers, and 30K+ delivery vans

Accurate delivery promise

(1 billion+ packages shipped to Prime customers last year)

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How does Amazon.com get the right items in the right place… even before the customer clicks the **Buy** button?

Obvious





Not so obvious



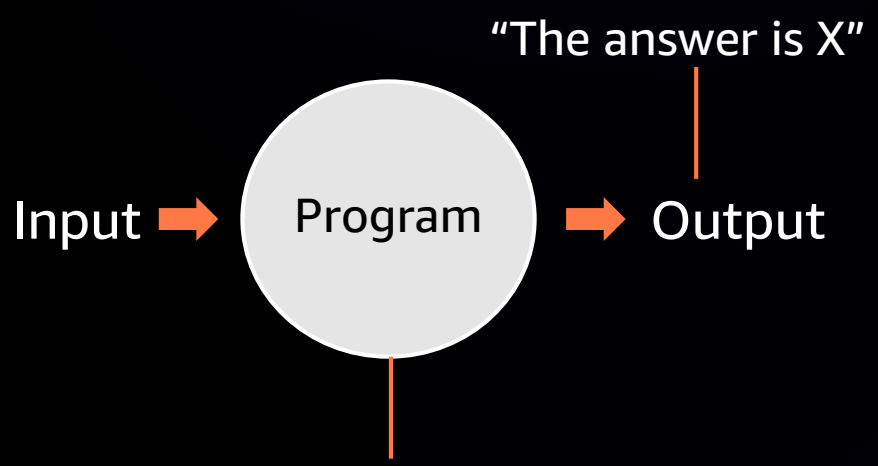




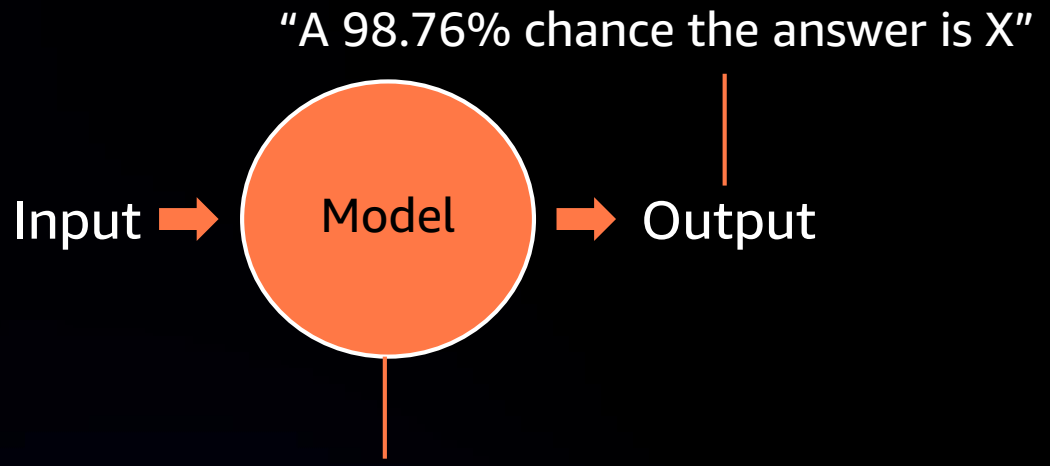
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Forecasting models that learn from data

Traditional approach



Machine learning

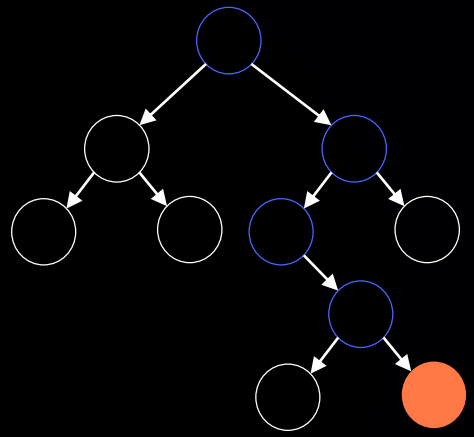


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Forecasting models that learn from data

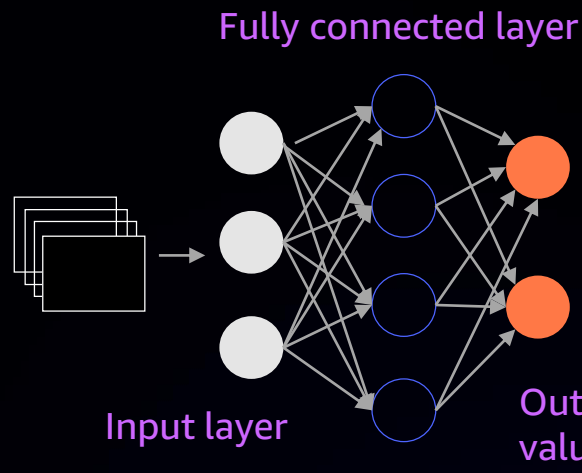
Circa 2007

Decision tree algorithm-driven model



Today

Convoluted neural networks



Billions of training data points

Powerful nonlinear relationships

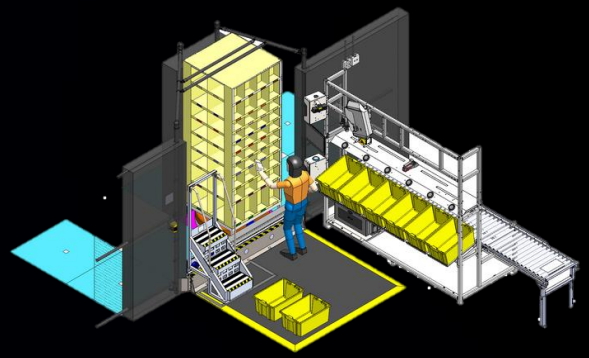
Automated feature engineering

Forecast 400M+ items every day

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Package delivery: A symphony of humans and robots







- Computer tracks millions of **randomly stowed items**
- A fleet of **robots bring storage mods** to humans
- Guided stow/pick activities through **bin vision system**

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What other customer experiences are transformed through ML (at scale)?

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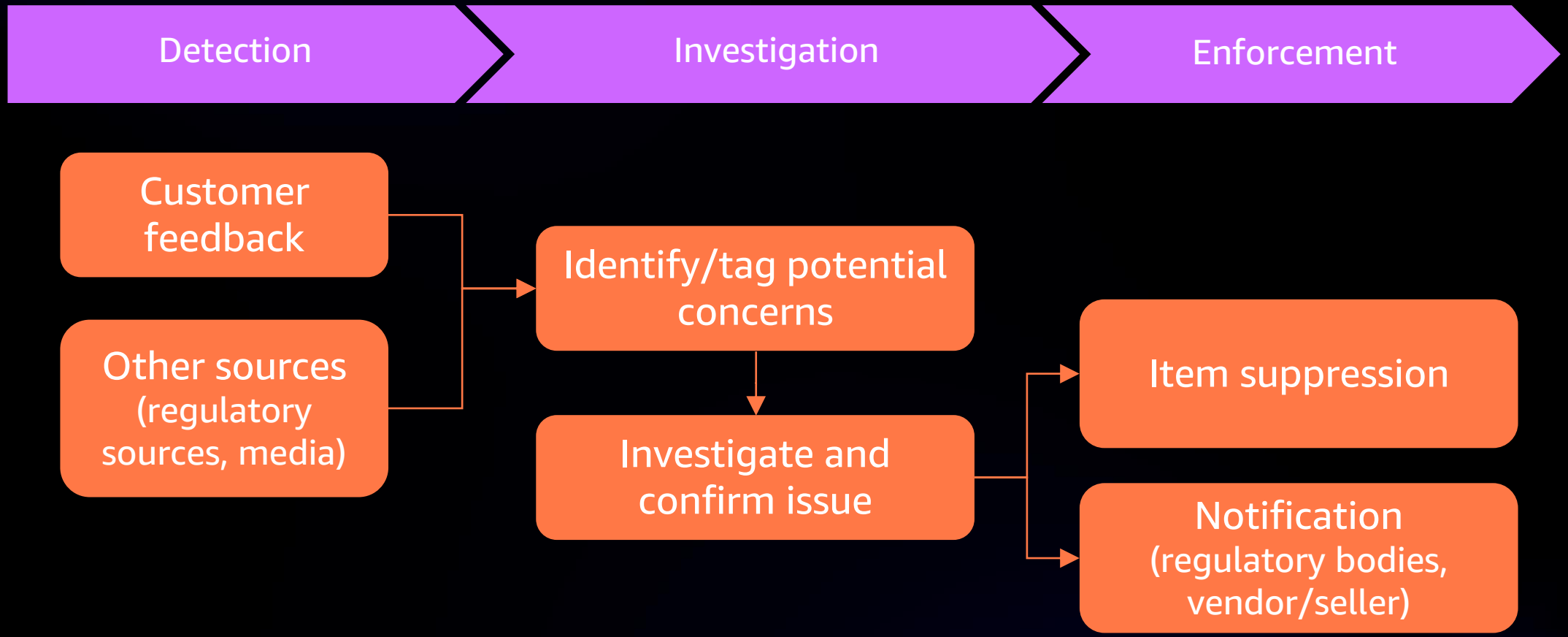
A delicious treat… or a medical risk?





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What are the limitations of this approach?



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Predicting safety risk before products ship



Billions of product and sales data updates

Hundreds of thousands of concerns a year

Predictive and highly accurate models

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Why does shipping packaging matter?

Less of this



And (a lot) more of that



75% lighter
than similarly sized boxes

40% less space
during shipping

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ML model changing the game

Basic decision-making rules

+

Visual inspection of (only) top products

Handle small fraction of products

Untapped data

Limits to what an individual can observe



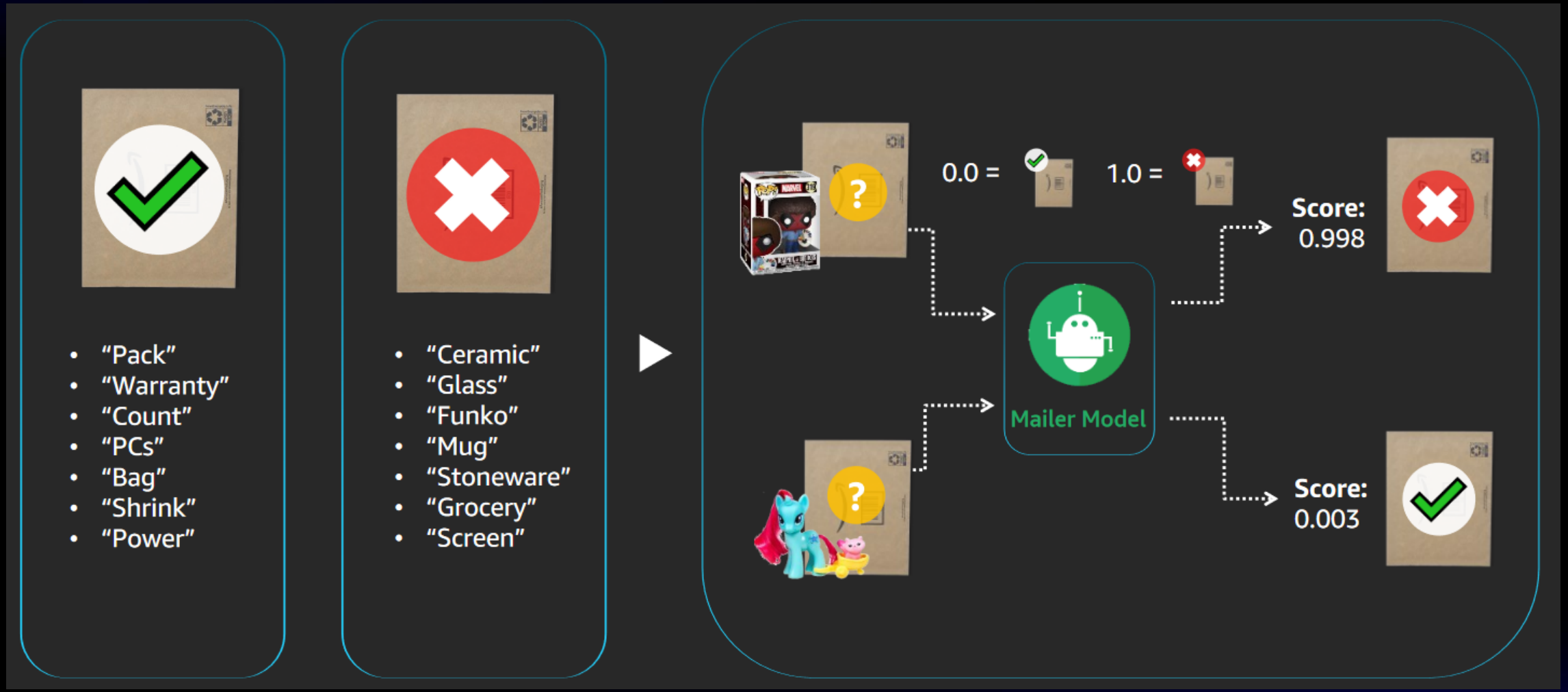
Ability to process all products Amazon sells

Apply complete set of intelligence generated in the delivery process

Handle nonobvious use cases (e.g., collectible)

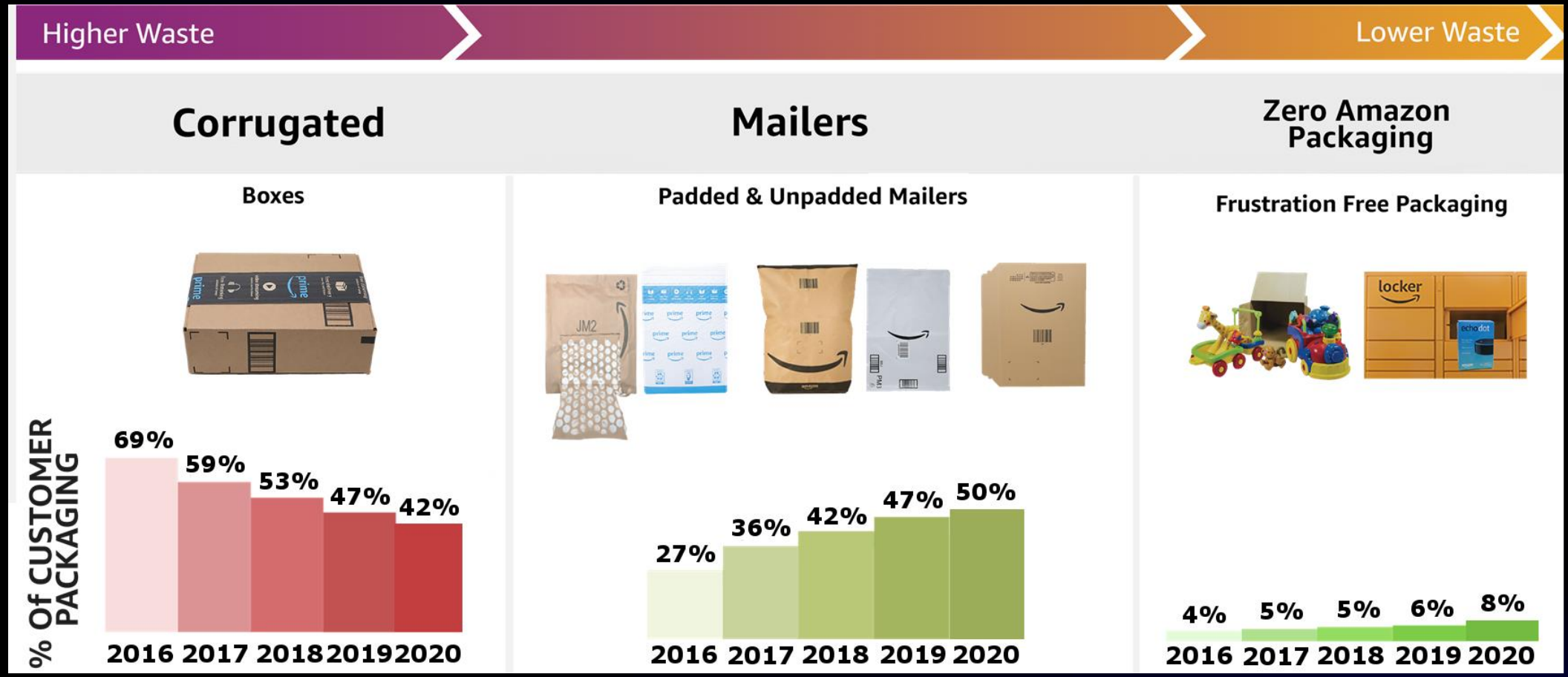
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What is a collectible?



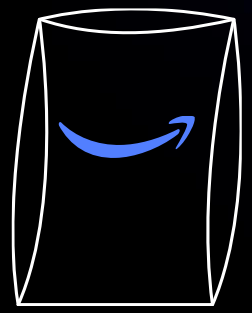
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>50% of Amazon's shipments in mailers in 2020

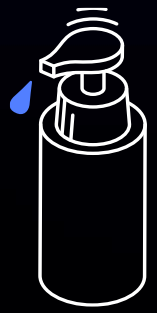


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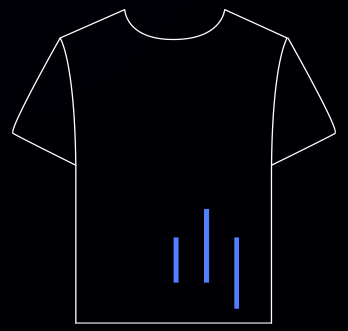
Team can launch new models in weeks



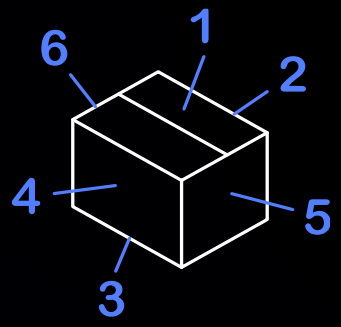
Suitable for paper bag?



Might leak?



Foldable?



No Amazon package needed?



Prone to damage?

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Team can launch new models in weeks

Automation

Better, cheaper, and faster

Augmentation

Smarter, more convenient

Enrichment

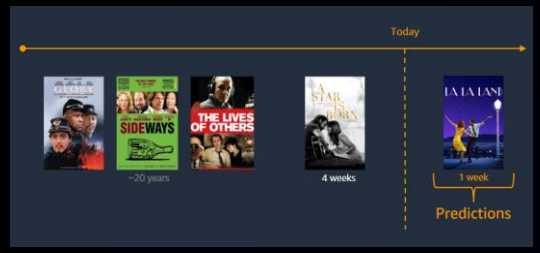
New features/services

Invention

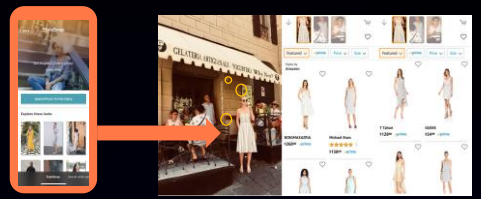
New products and categories



Supply chain automation and operations



Personalized Amazon Video recommendation



"Style Snap" – find that style in the picture



No check out lines. Ever.

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What did Amazon learn was most important to get right in the ML journey?

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It’s (always) the basics

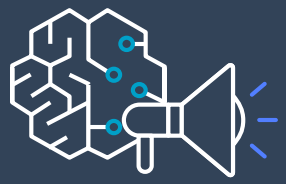
What are the most common challenges with AI/ML adoption?

Challenge	% of Respondents
Skills of staff	56%
Understanding AI benefits and uses	42%
Data scope and quality	34%
Finding use cases	26%
Integration complexity	26%
Defining the strategy	25%
Security or privacy concerns	20%
Measuring the value	17%
Governance issues or concerns	13%
Finding funding	12%

Source: Gartner Research Circle members survey, July 2019

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Solve for a system of enablers



ML-first mindset & culture



Enabling teams for the mission



Powerful data platform



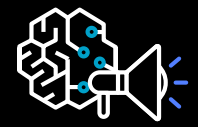
Choosing the right first project



Scaling

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Start with one question



ML-first mindset & culture

How will you use machine learning?

("We won't" is not an acceptable answer)

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Break down the silos

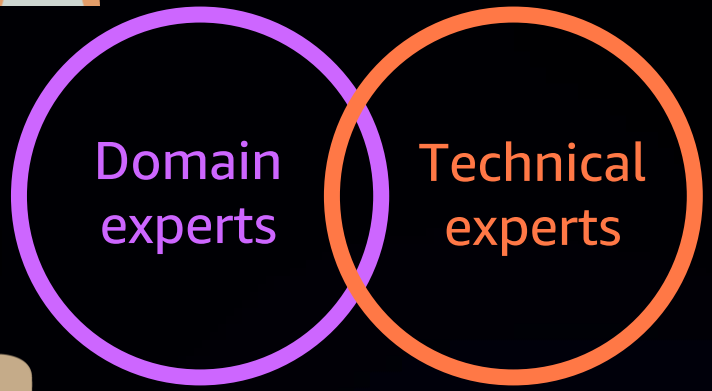




Product manager
Requirements/validations



Data scientist
Model development and testing





Data engineer
ML data foundation and performance



Research scientist
Cutting-edge theories and applications



ML platform engineer
Model production and optimization

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Evolve the teams as you grow and scale



Enabling teams for the mission

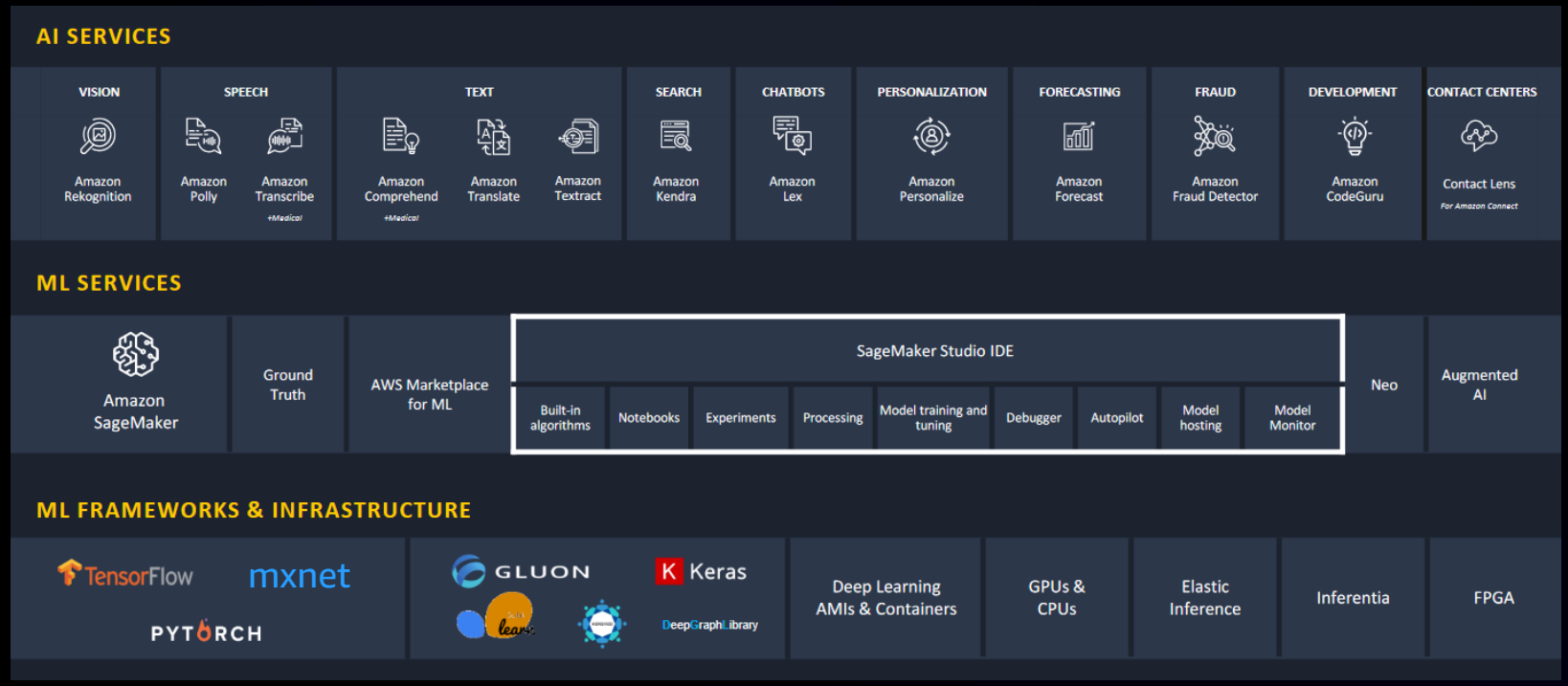
	How teams might start	Scaling within teams	Scaling across teams
Team level	Product manager	Product manager, Data scientist	Product manager, Data scientist
Function/ LoB level	Data engineer	Data engineer	Research scientist, Platform engineer, Data engineers
Enterprise level/ consultants	Data scientist	Platform engineer	Other specialist

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Apply the right tool for the job

Enabling teams for the mission

Example: AWS AI/ML service stacks



Simple, powerful, and ready to use

Control and flexibility at the most granular levels

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Data fuels ML-driven innovations



Amazon.com's big data marketplace

- Innovation happens at the edge
- Self-service discovery and subscription
- Bring your own clusters/queries

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Speed and substance is critical



1. Does it solve a real and significant problem for your customer?
2. Where/how does machine learning unlock new capabilities?
3. Are there places where we already have a lot of untapped data?
4. Can we achieve success in the 6–10 months?
5. Is it important enough to get sustained attention and support ?

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Remove that bottleneck

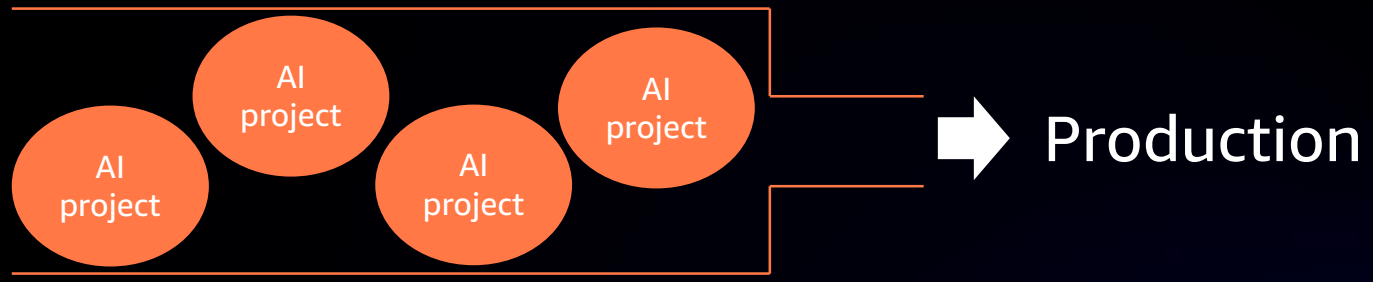
Scaling

# of AI projects next year

x2

Plan to actually deploy solutions

40%



Source: Gartner 2020 CIO Agenda survey

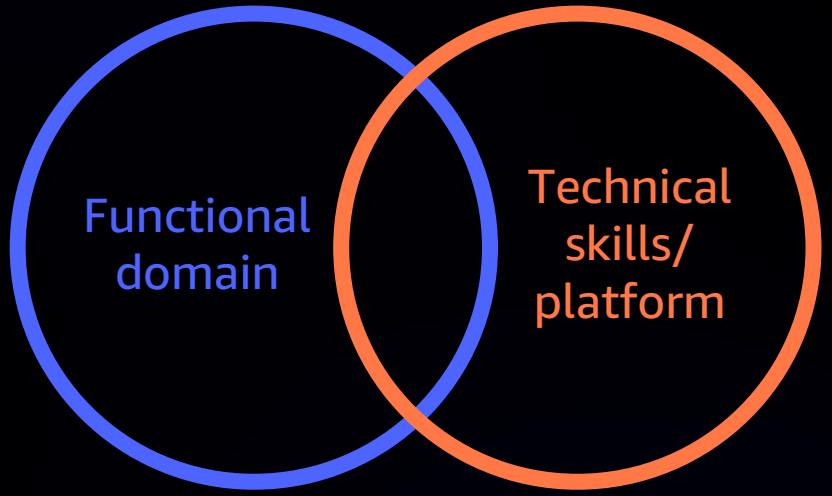
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Remove that bottleneck



1. Lack of common mentality/priorities
2. Teams in silos, not cross-functional

3. Inability to define and measure actual/ differentiated business outcome



6. Lack of integrated complete data pipeline and production platform

4. Unique aspects of ML delivery methods
5. Governance, compliance, and security

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Eliminate undifferentiated heavy lifting



Legacy ML platforms	Increasing use of AWS ML toolset
• Homegrown platform, tools, and assets • Multiple different ML platforms and pervasive one-time ML practices • Perception of custom platforms are cheaper to run	• Standardizing model development lifecycle and data pipeline infrastructure • Tools are automating model tuning, retraining, and optimization; traditionally hard-to-find skills • Deployment and maintenance done with “clicks”
“Hidden costs” blocking speed and scale • Significant ongoing manual effort to maintain, retrain, and optimize models • Additional IT/engineering expertise needed to set up and deploy ML solutions • Business impact from increasing cost of poor quality	**Nonlinear growth in speed and scale** • Significantly improve the developer-scientist ratio • Retraining time decreasing from days to just hours: better models, free up team • 10x+ model coverage without incremental head count increase

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Summary

1. Amazon sees AI/ML as a **table stake** toward **delivering better services**
2. ML delivers a **differentiated impact** and **nonlinear scaling** for Amazon
3. Building and scaling ML usage at enterprise need requires clear strategies across the **"system of enablers"**
4. Creating the **right way of working** and providing teams with the **right tools for the job** are critical toward building and scaling ML-driven innovation engine
5. Identify and remove the blockers to **path to production**

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Thank you!

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