Amazon SageMaker Introduction and Feature Engineering

Immersion Day

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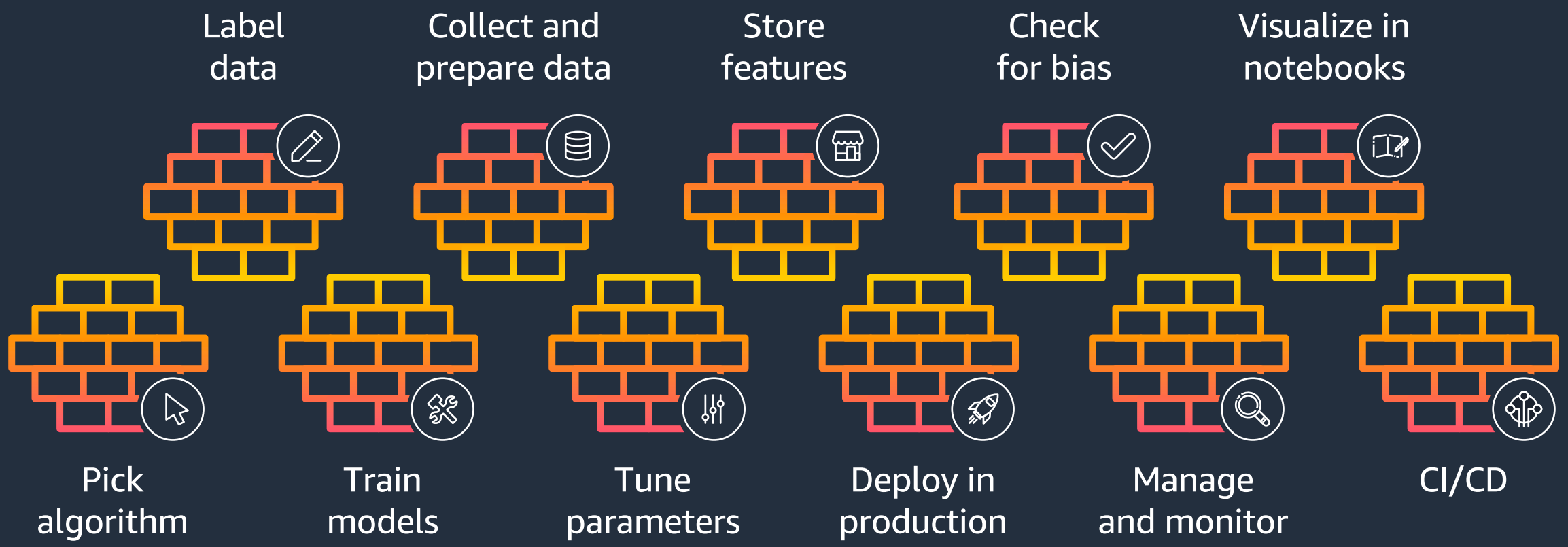
Machine learning development is complex and costly



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What is SageMaker?

Amazon SageMaker feature tour

PREPARE DATA AND BUILD, TRAIN, AND DEPLOY ML MODEL FOR ANY USE CASE

PREPARE

Geospatial
Visualize geospatial data

Ground Truth
Create high quality datasets for ML

Data Wrangler
Aggregate and prepare data for ML

Processing
Built-in Python, BYO R/Spark

Feature Store
Store, catalog, search, and reuse features

Clarify
Detect bias and understand model predictions

BUILD

Studio Notebooks & Notebook Instances
Fully managed Jupyter notebooks with elastic compute

Studio Lab
Free ML development environment

Built-in Algorithms
Integrated tabular, NLP, and vision algorithms

JumpStart
UI based discovery, training, and deployment of models, solutions, and examples

Autopilot
Automatically create ML models with full visibility

Bring Your Own
Bring your own container and algorithms

Local Mode
Test and prototype on your local machine

TRAIN & TUNE

Fully Managed Training
Broad hardware options, easy to setup and scale

Distributed Training Libraries
High performance training for large datasets and models

Training Compiler
Faster deep learning model training

Automatic Model Tuning
Hyperparameter optimization

Managed Spot Training
Reduce training cost by up to 90%

Debugger and Profiler
Debug and profile training runs

Experiments
Track, visualize, and share model artifacts across teams

Customization Support
Integrate with popular open source frameworks and libraries

DEPLOY & MANAGE

Fully Managed Deployment
Ultra low latency, high throughput inference

Real-Time Inference
For steady traffic patterns

Serverless Inference
For intermittent traffic patterns

Asynchronous Inference
For large payloads or long processing times

Batch Transform
For offline inference on batches of large datasets

Multi-Model Endpoints
Reduce cost by hosting multiple models per instance

Multi-Container Endpoints
Reduce cost by hosting multiple containers per instance

Shadow Testing
Validate model performance in production

Inference Recommender
Automatically select compute instance and configuration

Model Monitor
Maintain accuracy of deployed models

Kubernetes Operators & Components
Manage and monitor models on edge devices

Edge Manager
Manage and monitor models on edge devices

MLOps: Pipelines | Projects | Model Registry
Workflow automation, CI/CD for ML, central model catalog

Canvas
Generate accurate machine learning predictions—no code required

Studio | RStudio
Integrated development environment (IDE) for ML

Governance
Model Cards | Dashboard | Permissions

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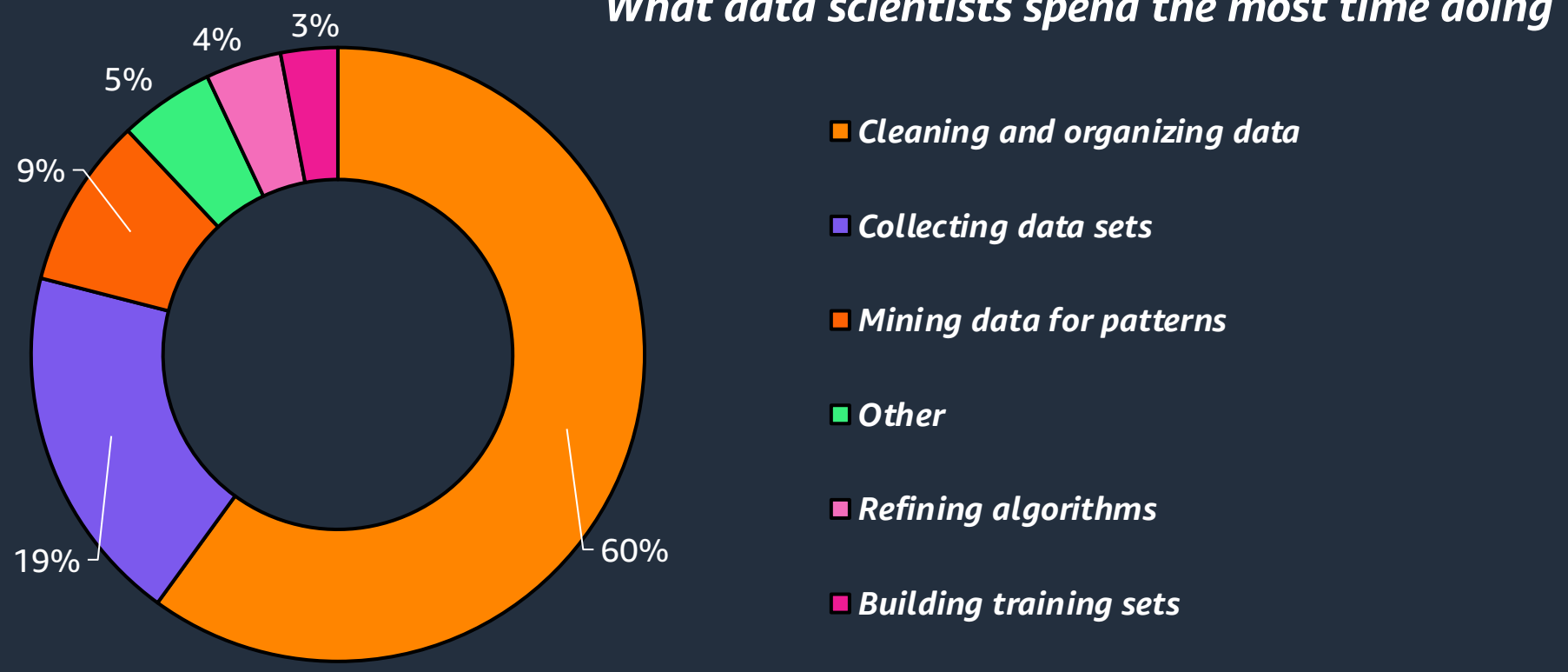
Data Exploration & Feature Engineering

80% of time spent on data prep



Source: Forbes survey of 80 data scientists, March 2016

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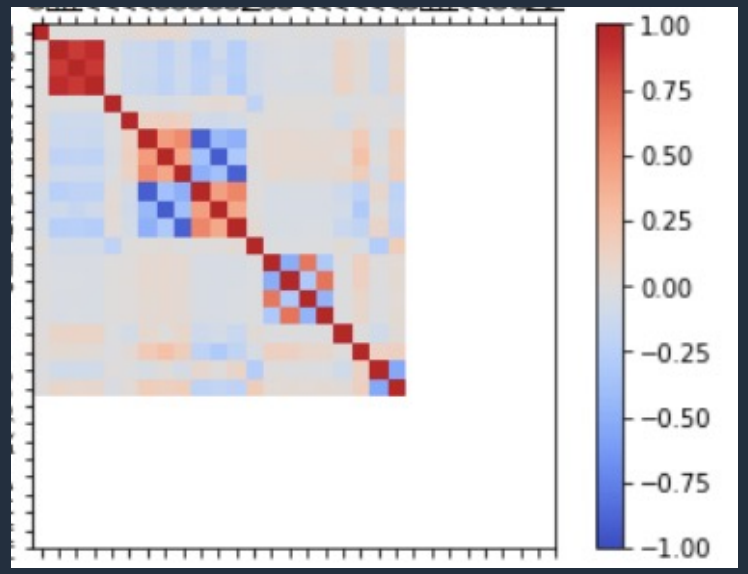
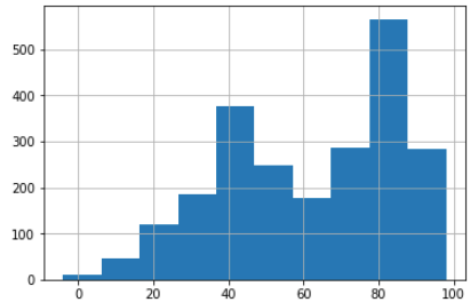
Are My X's correlated with my Y's? With other X's?

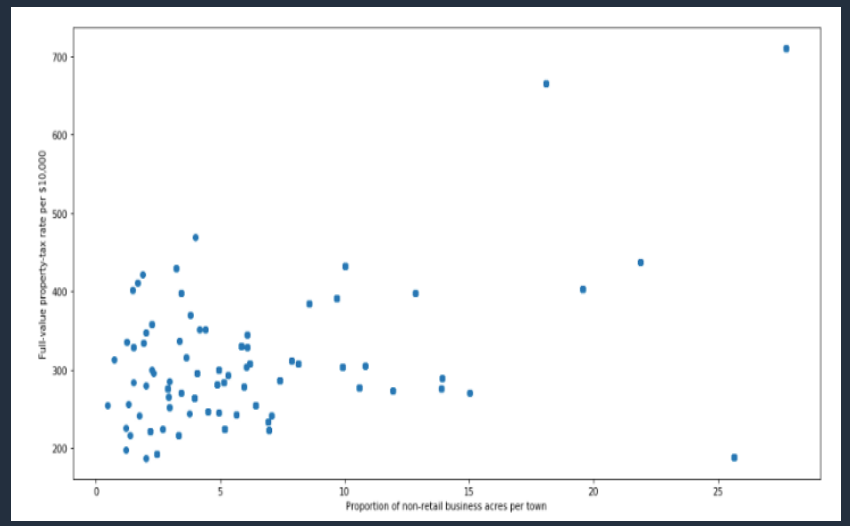


Do they represent the real world?

```
In [39]: %matplotlib inline
         reduced_df["TMAX"].hist()
Out[39]: <matplotlib.axes._subplots.AxesSubplot at 0x7f5a35a8fa90>
```



Do I need to remove outliers?



What rows and columns are in my data set?

```
In [3]: df.head()
Out[3]:
```

	ID	Case Number	Date	Block	IUCR	Primary Type	Description	Location Description	Arrest	Domestic	...
0	24170	JB429040	09/09/2018 10:30:00 PM	019XX E 74TH ST	0110	HOMICIDE	FIRST DEGREE MURDER	STREET	False	False	...
1	11447764	JB437679	09/09/2018 12:00:00 PM	085XX W HIGGINS RD	1210	DECEPTIVE PRACTICE	THEFT OF LABOR/SERVICES	HOTEL/MOTEL	False	False	...

Do I need to combine columns?

```
]: data['no_previous_contact'] = np.where(data['pdays'] == 999, 1, 0)
   # Indicator variable to capture when pdays takes a value of 999
   data['not_working'] = np.where(np.in1d(data['job'], ['student', 'retired', 'unemployed']), 1, 0)
```

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How do I handle strings? One Hot Encoding

One hot encoding is a process by which categorical variables are converted into a form that could be provided to ML algorithms to do a better job in prediction.

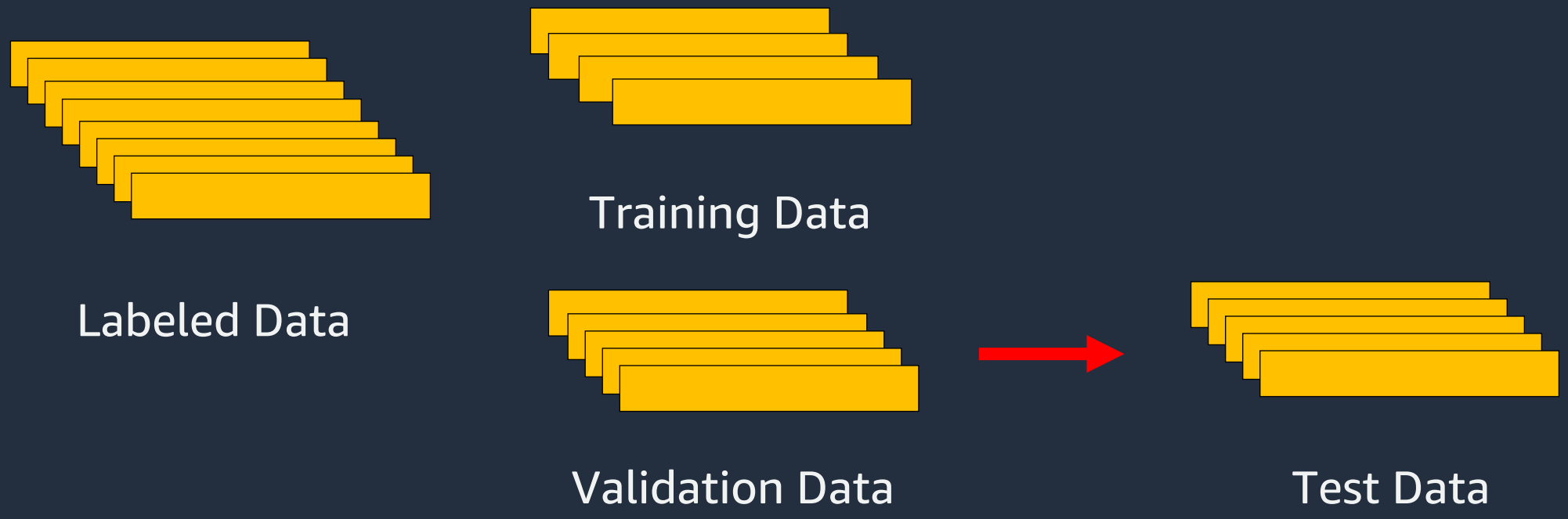
CompanyName	Categoricalvalue	Price
VW	1	20000
Acura	2	10011
Honda	3	50000
Honda	3	10000

VW	Acura	Honda	Price
1	0	0	20000
0	1	0	10011
0	0	1	50000
0	0	1	10000

```
In [64]: model_df = pd.get_dummies(model_df, columns = ["Block"])
```

Source https://hackernoon.com/what-is-one-hot-encoding-why-and-when-do-you-have-to-use-it-e3c6186d008f

Splitting Data for Machine Learning



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SageMaker-Purpose- built data preparation tools

Amazon SageMaker Data Wrangler

EXPLORE, PREPARE, AND PROCESS DATA WITH LITTLE TO NO CODE

Import data from multiple sources

Get insights on data and data quality

Visually explore, analyze, and prepare data

Quickly perform feature engineering

Automate ML data preparation workflows

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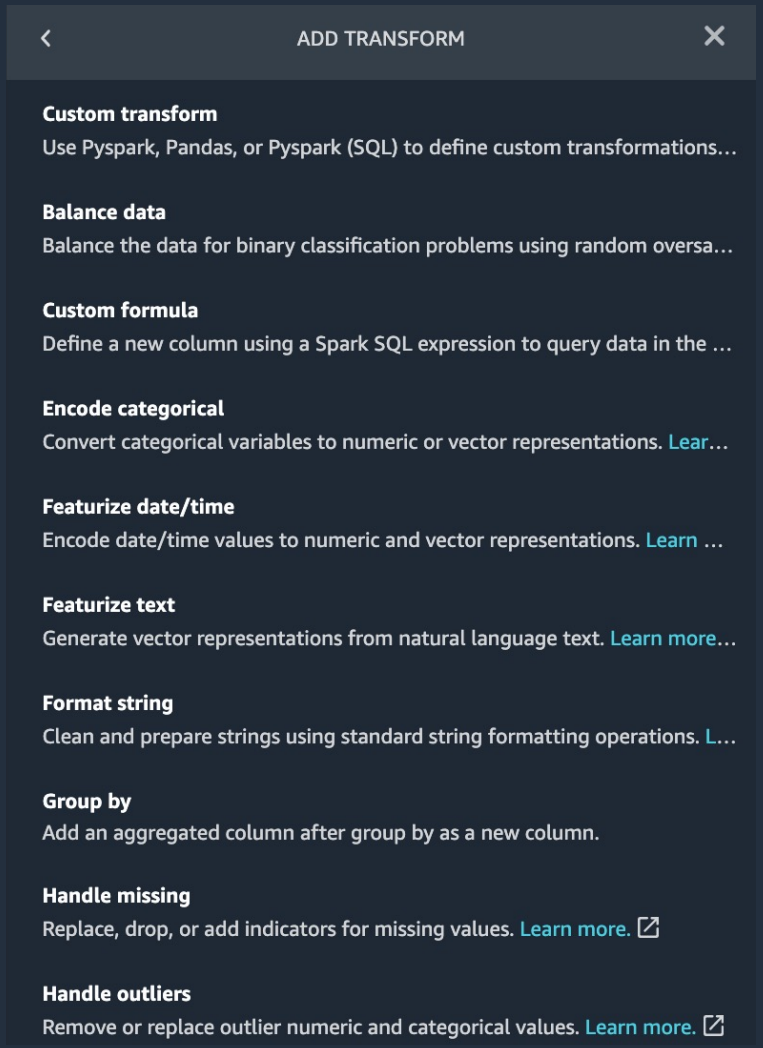
Easily transform data for ML with 300+ built-in transforms

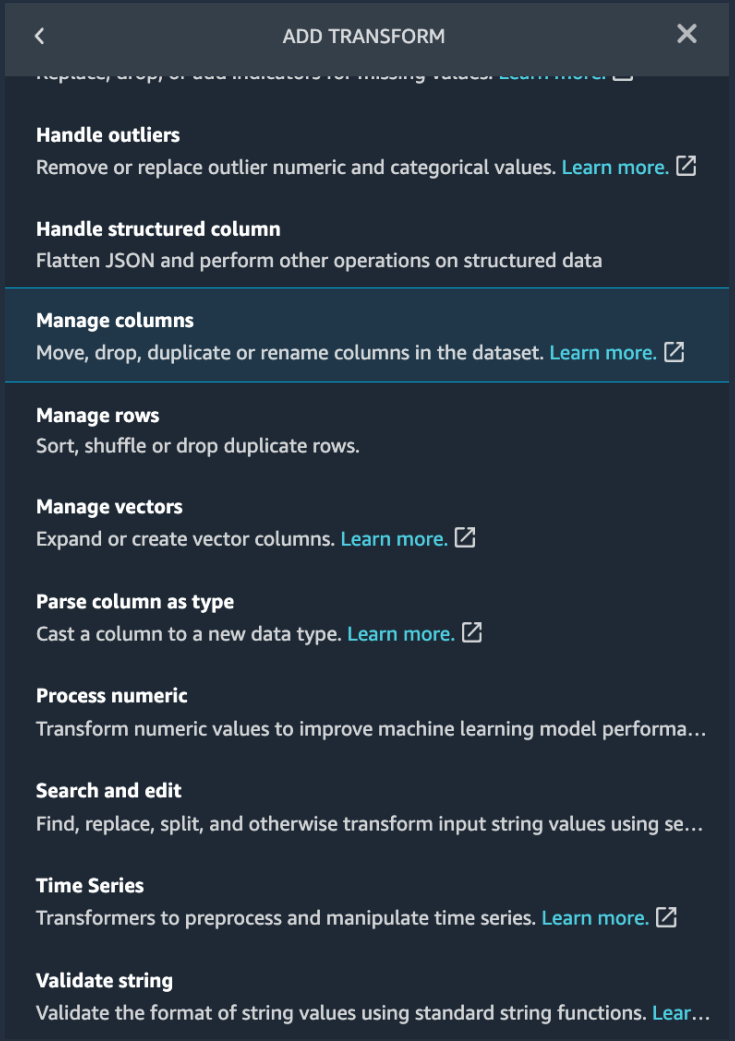
300+ built-in data transformations (no code) for common data prep needs and ML specific needs

Built by data scientists for data scientists

ML specific transforms such as:

One hot encoding
Balance data
Time series transforms





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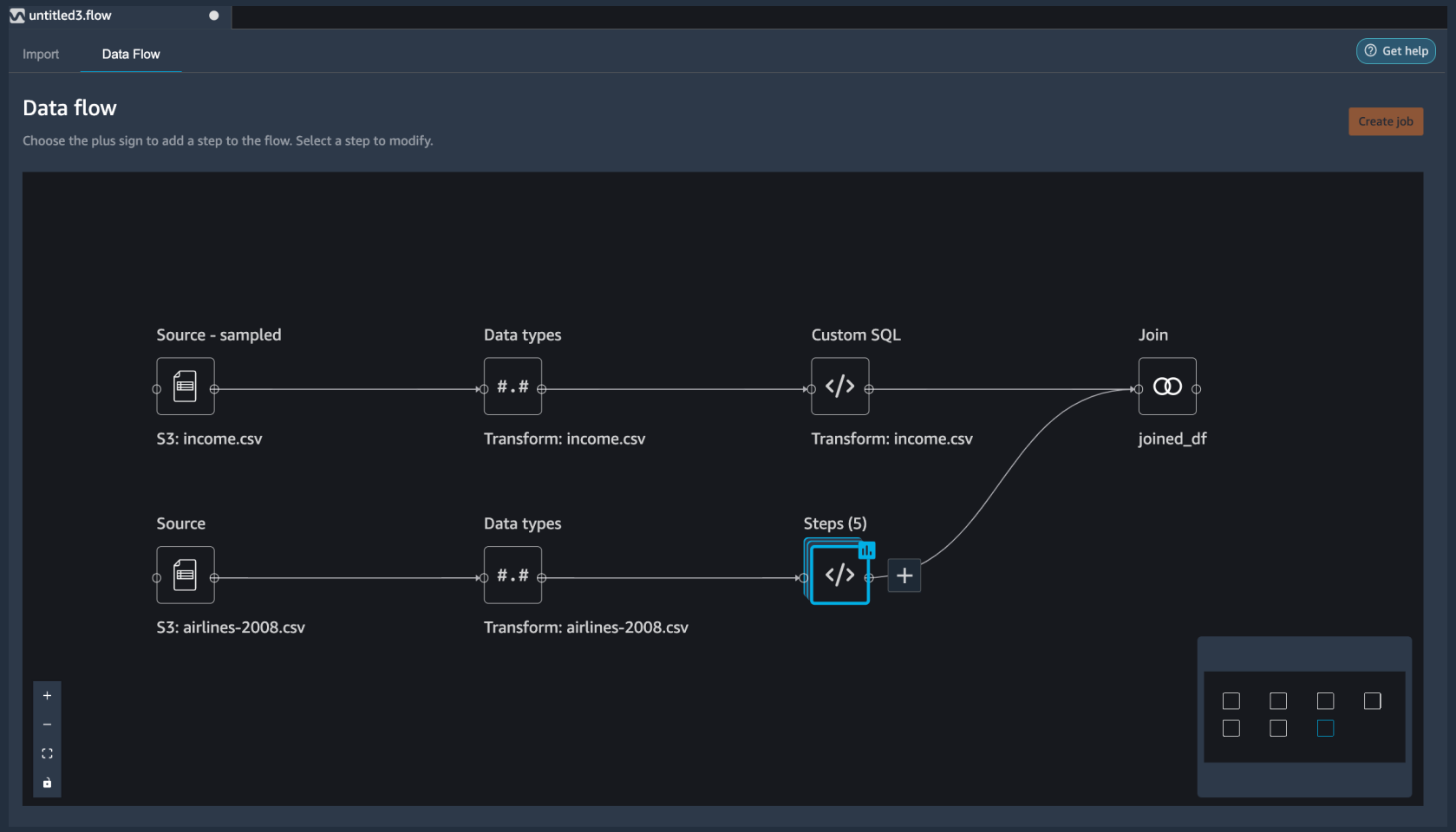
Easily visualize the steps of your data processing pipeline

Data Wrangler records all the steps of data prep workflow in a data flow graph

Visualize the order of transformations, join and concatenate operators

Easily navigate data transformation flow, and modify and delete steps iteratively



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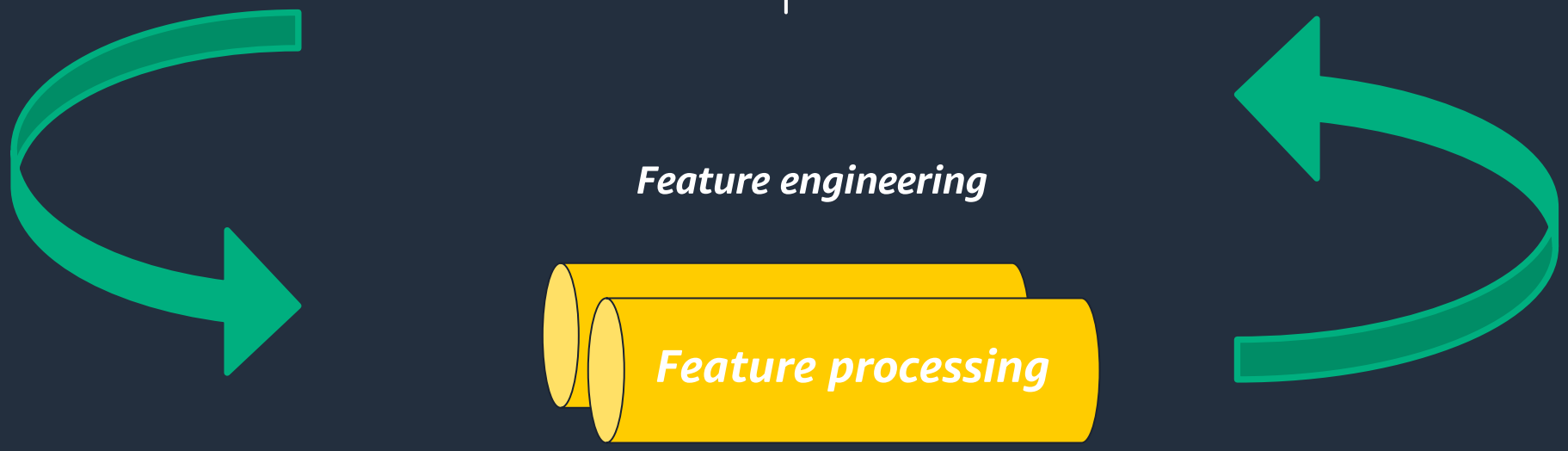
What is a feature and why is it important?

Raw data

Gender	Male, female
Driver rating	Poor, Fair, Good, Excellent
Vehicle color	Red, blue, black, gold, silver, white

Feature vector

Gender	[0,1]
Driver rating	[0,1,2,3]
Vehicle color	[1,0,0,0,0,0]



Challenges of separate feature stores

Feature drift

Feature duplication

Slow model development/deployment

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Amazon SageMaker Feature Store

SECURELY STORE, DISCOVER, AND SHARE FEATURES FOR ML

- Online and off-line
- Millisecond latency
- Consistent features
- Visual search
- Sharing and collaboration

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Support for separate feature stores

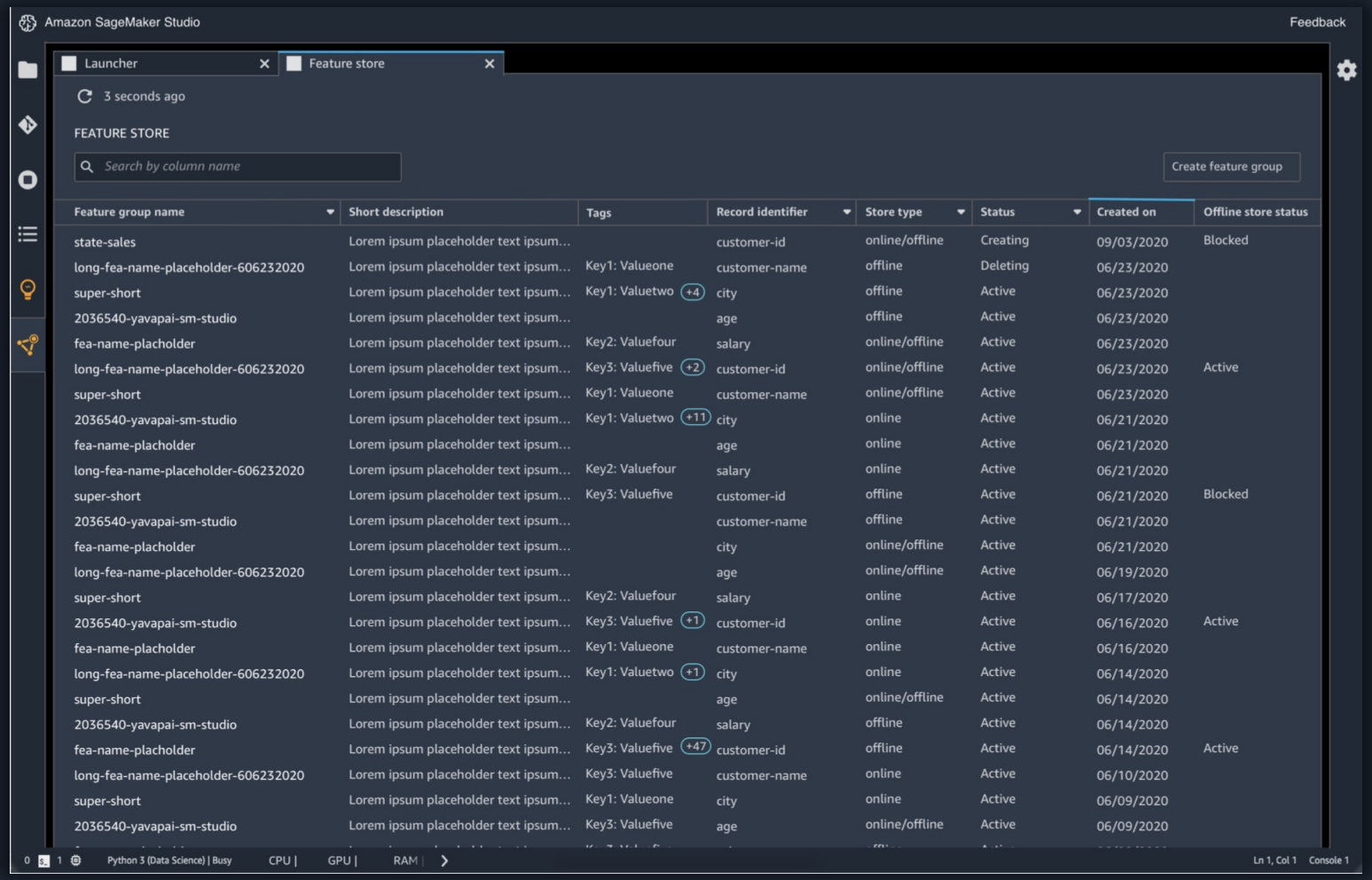
Online feature store

- Primarily used for real time predictions
- Use cases such as real-time fraud detection
- Latest copy of feature data
- High throughput writes
- Low millisecond latency reads

Offline feature store

- Primarily used for batch predictions and model training
- Historical record of feature data
- High throughput writes
- <15 minutes read after write consistency

Search and discover features using Feature Store



Feature group name	Short description	Tags	Record identifier	Store type	Status	Created on	Offline store status
state-sales	Lorem ipsum placeholder text ipsum...		customer-id	online/offline	Creating	09/03/2020	Blocked
long-fea-name-placeholder-606232020	Lorem ipsum placeholder text ipsum...	Key1: Valueone	customer-name	offline	Deleting	06/23/2020	
super-short	Lorem ipsum placeholder text ipsum...	Key1: Valuetwo (+4)	city	offline	Active	06/23/2020	
2036540-yavapai-sm-studio	Lorem ipsum placeholder text ipsum...		age	offline	Active	06/23/2020	
fea-name-placholder	Lorem ipsum placeholder text ipsum...	Key2: Valuefour	salary	online/offline	Active	06/23/2020	
long-fea-name-placeholder-606232020	Lorem ipsum placeholder text ipsum...	Key3: Valuefive (+2)	customer-id	online/offline	Active	06/23/2020	Active
super-short	Lorem ipsum placeholder text ipsum...	Key1: Valueone	customer-name	online/offline	Active	06/23/2020	
2036540-yavapai-sm-studio	Lorem ipsum placeholder text ipsum...	Key1: Valuetwo (+11)	city	online	Active	06/21/2020	
fea-name-placholder	Lorem ipsum placeholder text ipsum...		age	online	Active	06/21/2020	
long-fea-name-placeholder-606232020	Lorem ipsum placeholder text ipsum...	Key2: Valuefour	salary	online	Active	06/21/2020	
super-short	Lorem ipsum placeholder text ipsum...	Key3: Valuefive	customer-id	offline	Active	06/21/2020	Blocked
2036540-yavapai-sm-studio	Lorem ipsum placeholder text ipsum...		customer-name	offline	Active	06/21/2020	
fea-name-placholder	Lorem ipsum placeholder text ipsum...		city	online/offline	Active	06/21/2020	
long-fea-name-placeholder-606232020	Lorem ipsum placeholder text ipsum...		age	online/offline	Active	06/19/2020	
super-short	Lorem ipsum placeholder text ipsum...	Key2: Valuefour	salary	online	Active	06/17/2020	
2036540-yavapai-sm-studio	Lorem ipsum placeholder text ipsum...	Key3: Valuefive (+1)	customer-id	online	Active	06/16/2020	Active
fea-name-placholder	Lorem ipsum placeholder text ipsum...	Key1: Valueone	customer-name	online	Active	06/16/2020	
long-fea-name-placeholder-606232020	Lorem ipsum placeholder text ipsum...	Key1: Valuetwo (+1)	city	online	Active	06/14/2020	
super-short	Lorem ipsum placeholder text ipsum...		age	online/offline	Active	06/14/2020	
2036540-yavapai-sm-studio	Lorem ipsum placeholder text ipsum...	Key2: Valuefour	salary	offline	Active	06/14/2020	
fea-name-placholder	Lorem ipsum placeholder text ipsum...	Key3: Valuefive (+47)	customer-id	offline	Active	06/14/2020	Active
long-fea-name-placeholder-606232020	Lorem ipsum placeholder text ipsum...	Key3: Valuefive	customer-name	online	Active	06/10/2020	
super-short	Lorem ipsum placeholder text ipsum...	Key1: Valueone	city	online	Active	06/09/2020	
2036540-yavapai-sm-studio	Lorem ipsum placeholder text ipsum...	Key3: Valuefive	age	online/offline	Active	06/09/2020	

- Search features individually or by groups visually with SageMaker Studio
- Discover features by name, description, tags, and other metadata
- Understand how features are grouped relevant to ML applications

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Thank you!

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