

Time Series Sales Prediction For Walmart

Tiffany Chen, Amy Chiu,
Mandy Liu, Hyemin Yu



Agenda

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Business Problem

Accurate Prediction for Daily Sales in next 28 days

02

Solution Map

Executive Summary

03

Exploratory Data Analysis

Finding Trends

04

Data Preparation

Preprocess Data for Model Building

05

Model Summary

LightGBM+LSTM

06

Business Value

Inventory Management, Resource Allocation

Business Problems (SCKQ)

Situation:

Predict most accurate daily sales of the next 28 days for Walmart.

Complication:

The Large Scale of Processing Data

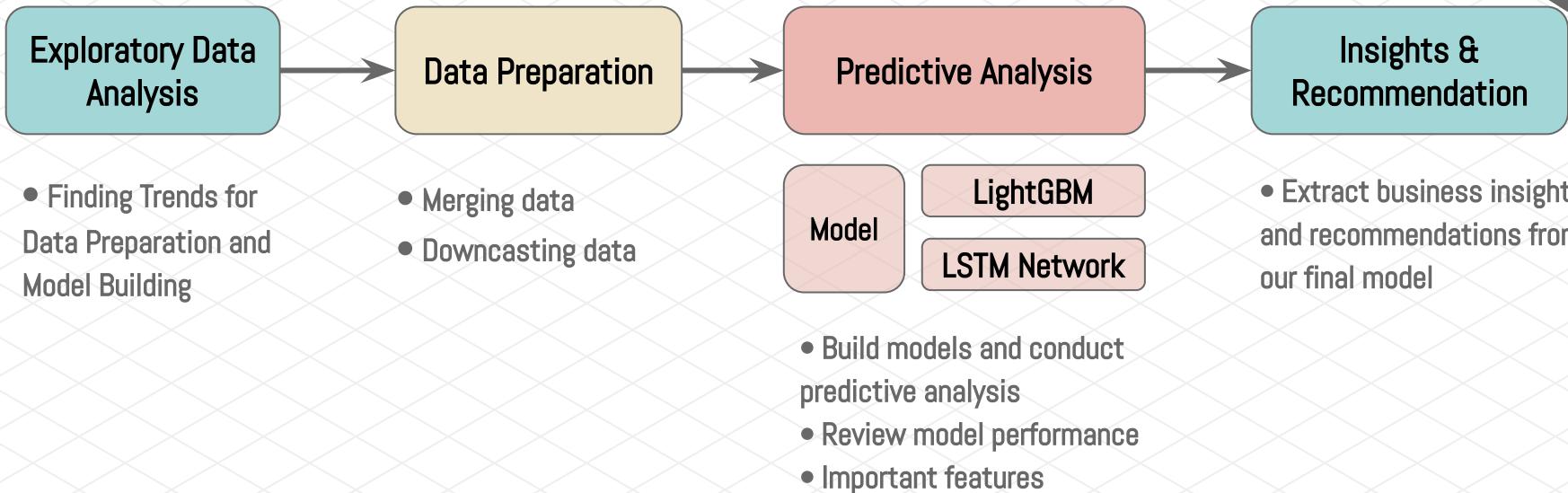
Feature Engineering and Feature Importance for Prediction

Different Prediction Strategy By State, Category, Department, Store

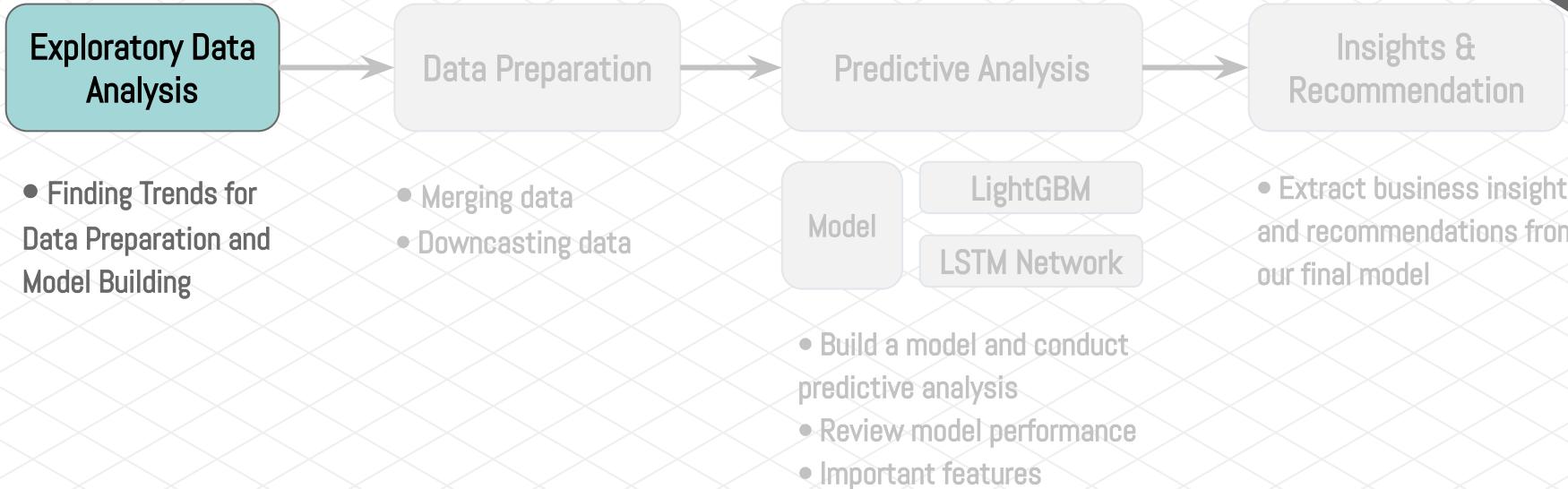
Key Question:

How can we develop forecasting methods that not only accurately predict 28-day ahead point and probabilistic forecasts for a extensive and hierarchical set of time series, but also ensure these methods are reproducible and scalable.

Solution Map



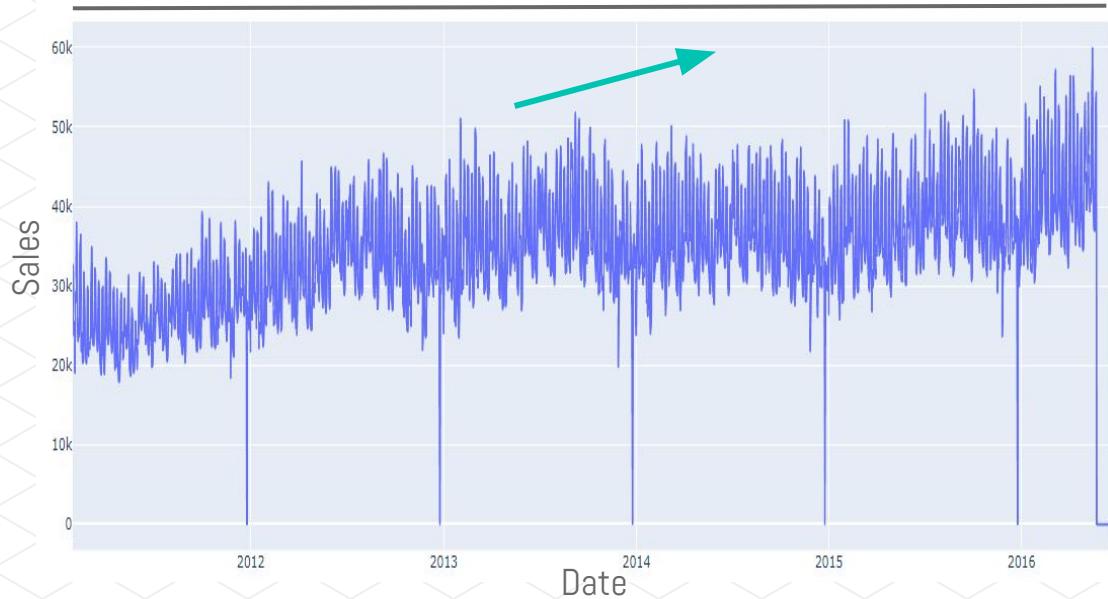
Solution Map



EDA - Upward Trends in Overall Sales, Emphasized by Seasonal Patterns

Models should incorporate sales seasonality

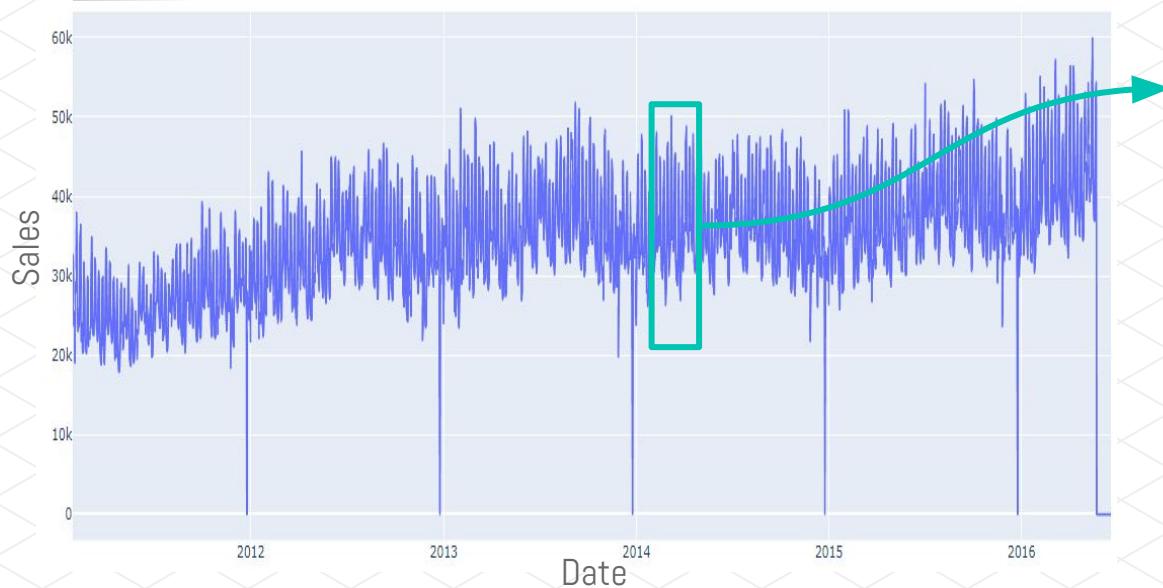
Sales by Date From 2011-2016



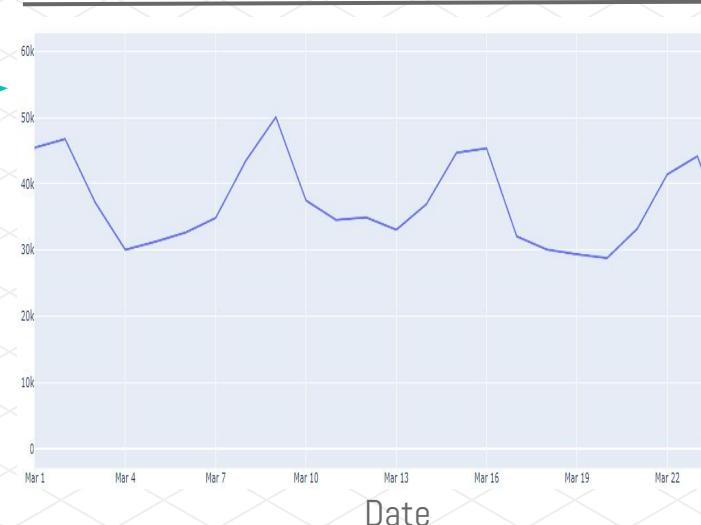
EDA - Upward Trends in Overall Sales, Emphasized by Seasonal Patterns

Models should incorporate sales seasonality

Sales by Date From 2011-2016



Weekly Seasonality Patterns



EDA - Sales Trends Vary Across States Over Time in Different Categories

Models need to adapt to capture distinct patterns in various categories

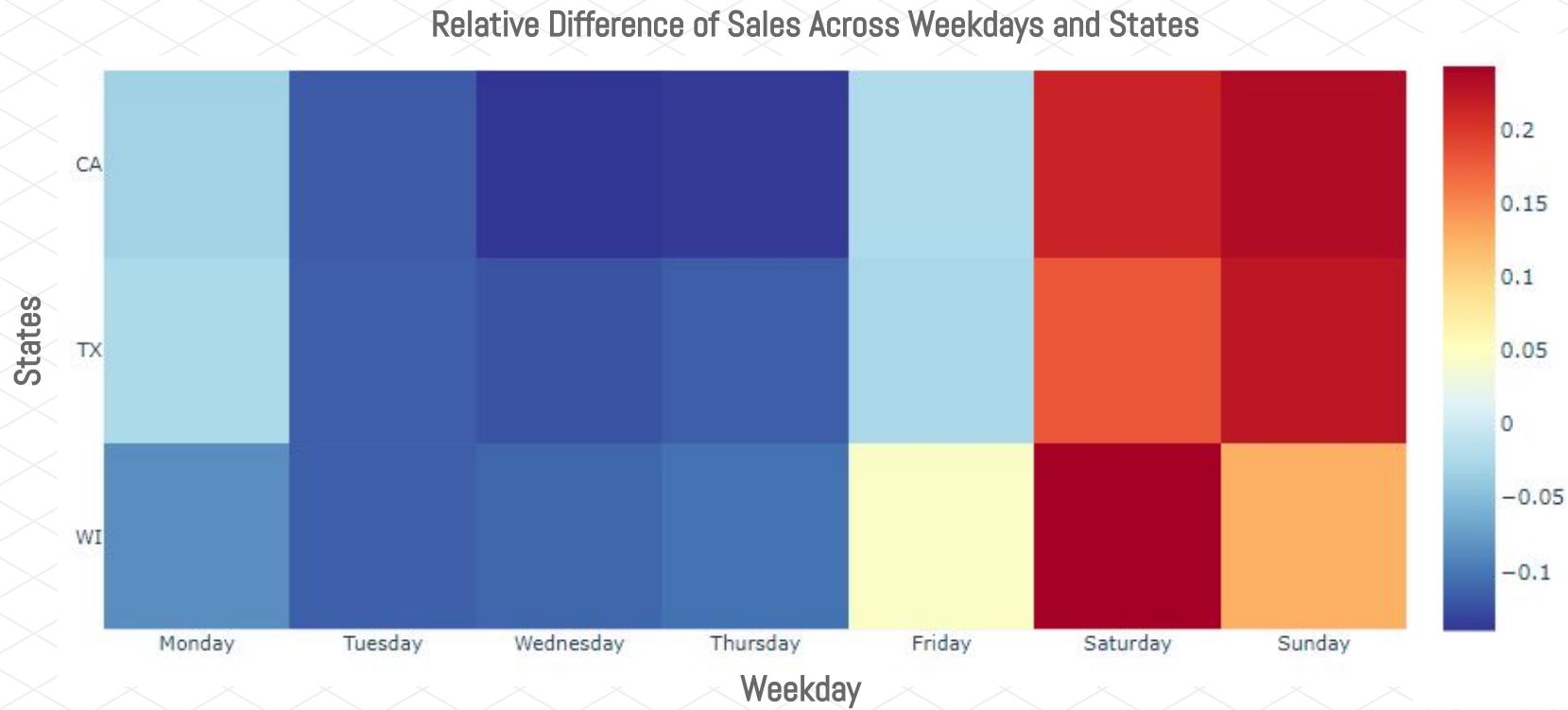
Category Sales Per State

cat_id
FOODS
HOBBIES
HOUSEHOLD

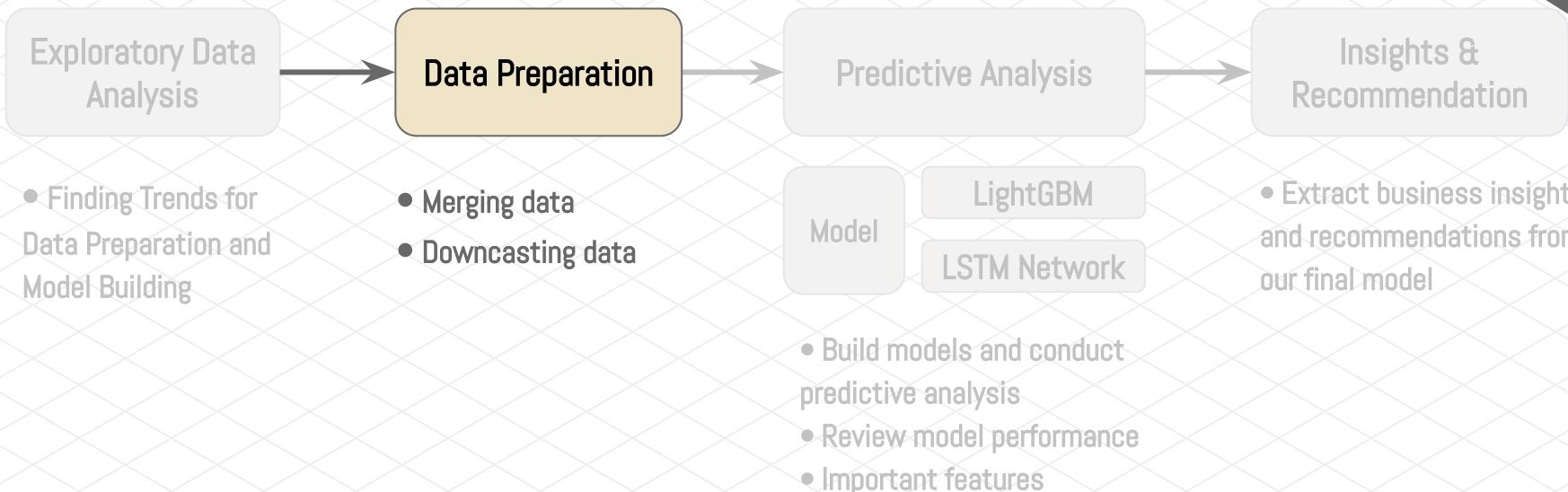


EDA - Noticeable Variations in Weekday Sales, Particularly Higher on Weekends

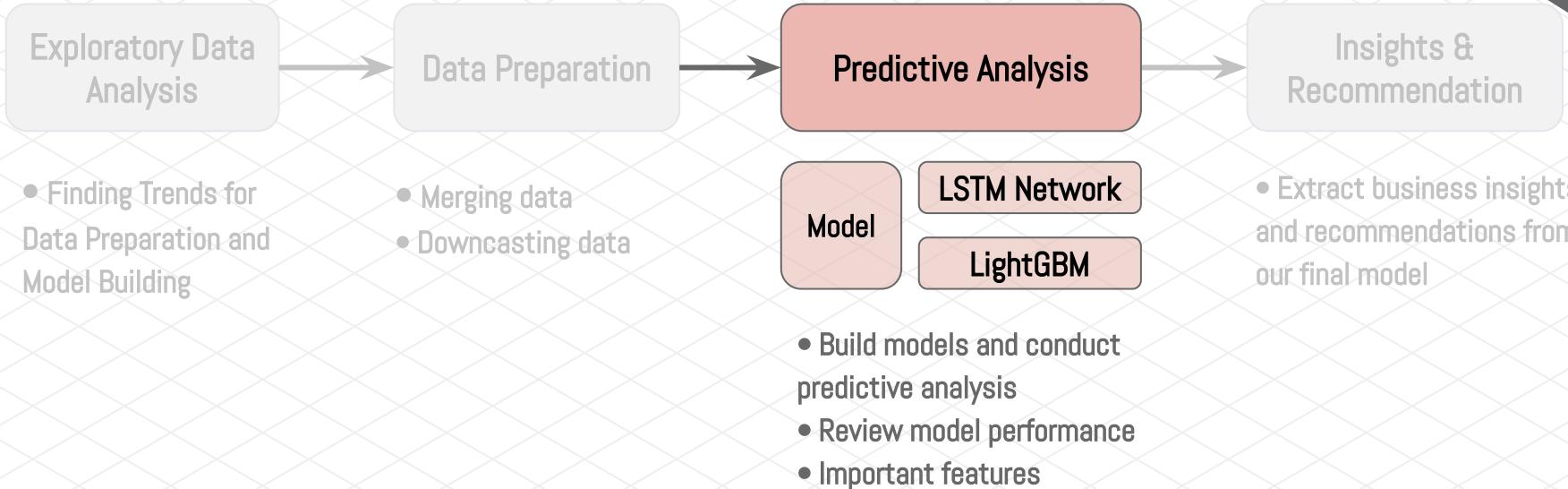
Relative Difference = (Weekday Sales - Week Average) / Week Average



Solution Map



Solution Map



Model Summary

Goal

Multivariate Time Series
Handling

Deal with complicated
relationships

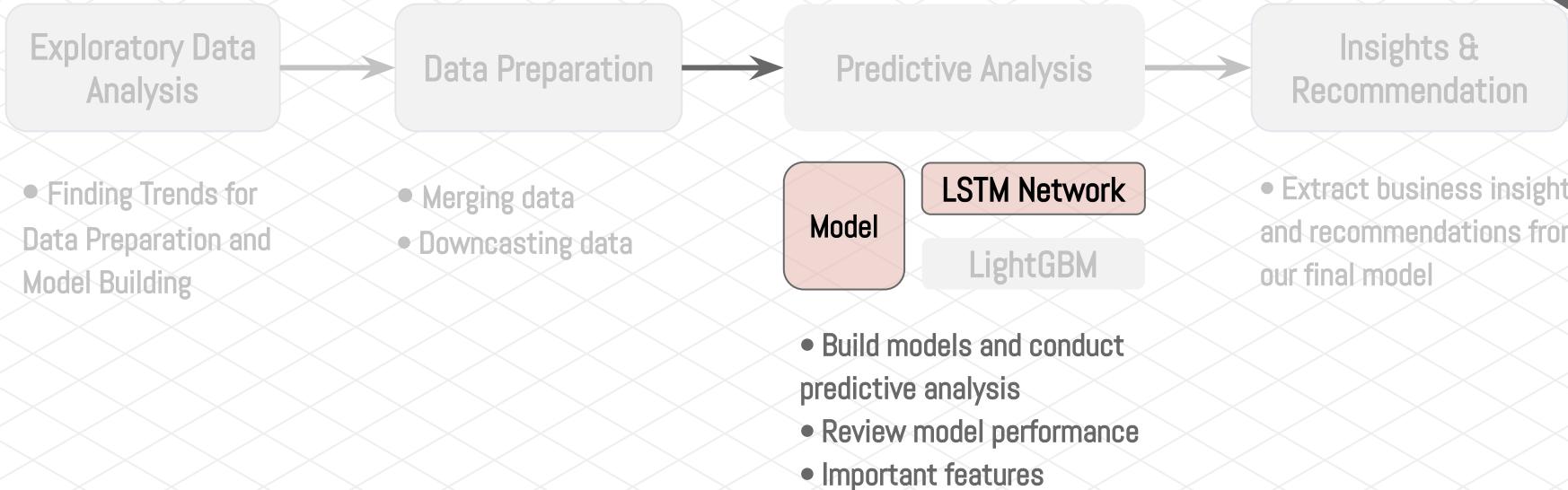
Ensemble Learning

Model Selection

Model 1: LSTM
Network

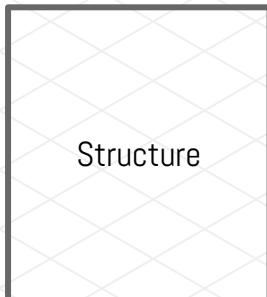
Model 2: LightGBM

Solution Map

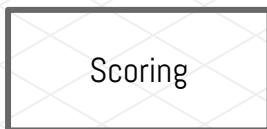


Model Summary - LSTM Network

LSTM: Capture long-term dependencies on sequential data where various factors such as Weekend and Event affect prediction



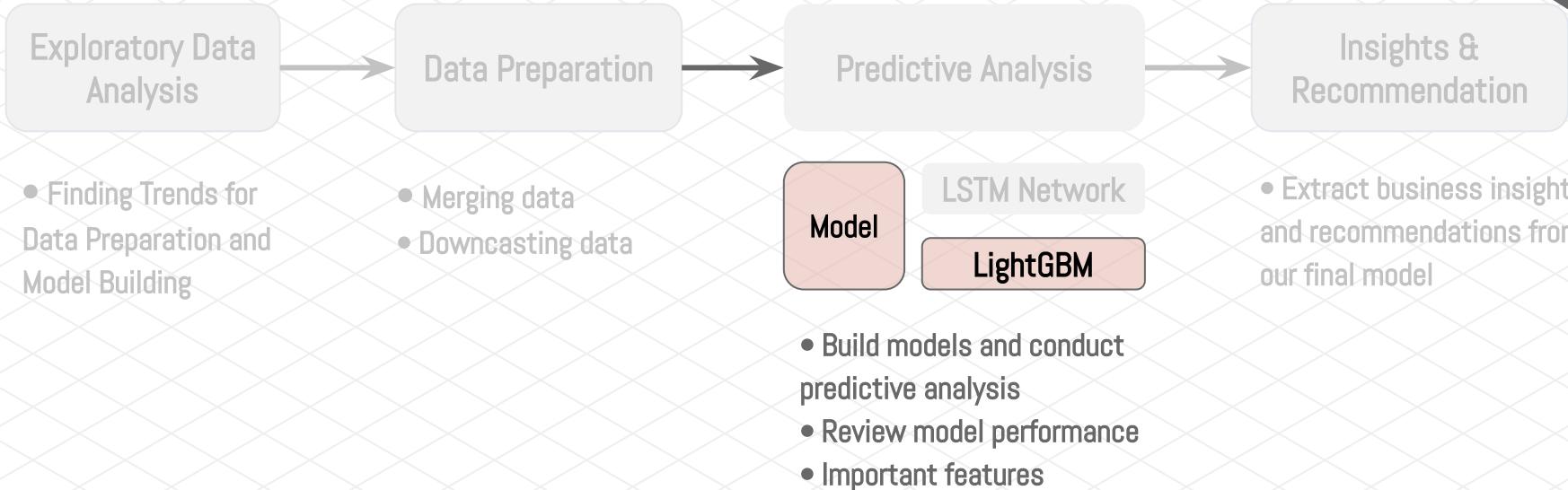
1. Define time range and start day based on trends analysis
2. Create feature to include impact of event and normalization
3. Hyper parameter tuning within various hidden layers
4. Use past 7 days (defined time range) to forecast the sales of the first unknown upcoming day



Private: 0.6919 ; Public: 0.5461

D1908	D1909	D1910	D1911	D1912	D1913	D1914	D1915	D1916	D1917
Use these 7 days for prediction					Predicted value				
	Use these 7 days for prediction					Predicted value			
		Use these 7 days for prediction					Predicted value		

Solution Map



Model Summary - LightGBM

LightGBM: Tree-based model for capturing complex interactions in sales data. It supports ensemble learning for enhancing the robustness and accuracy

Structure

1. Create features for capturing seasonal patterns based on trends analysis
2. Train separate models for different sets of store, category, department
3. Predict sales in 2-day intervals
4. Ensemble multiple models prediction results

Scoring

Private: 0.53199 ; Public: 2.56272

Why did we use Feature Engineering?

In Order To...

Capture Seasonal Patterns

Smoothen Fluctuations

Impact from Events

Impact from Holidays

Stores / States / Category Differences

Time Based

Rolling Statistics

Time Since Last Event

Label Encoding

Mean Encoding

Used Features

- day of week, month, quarter, or year
- sales lag : 7/14/30 days

- sales: rolling mean, exponential moving averages, rolling std.
- price: rolling mean, rolling std.

- days elapsed since the last occurrence of SNAP event

- assigning a unique numerical value to each holiday

- average sales group by states / stores / categories / department / items

Model Summary

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Handling

Deal with complicated
relationships

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Model 1: LSTM
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Scoring

0.6919

0.53199

Model Summary

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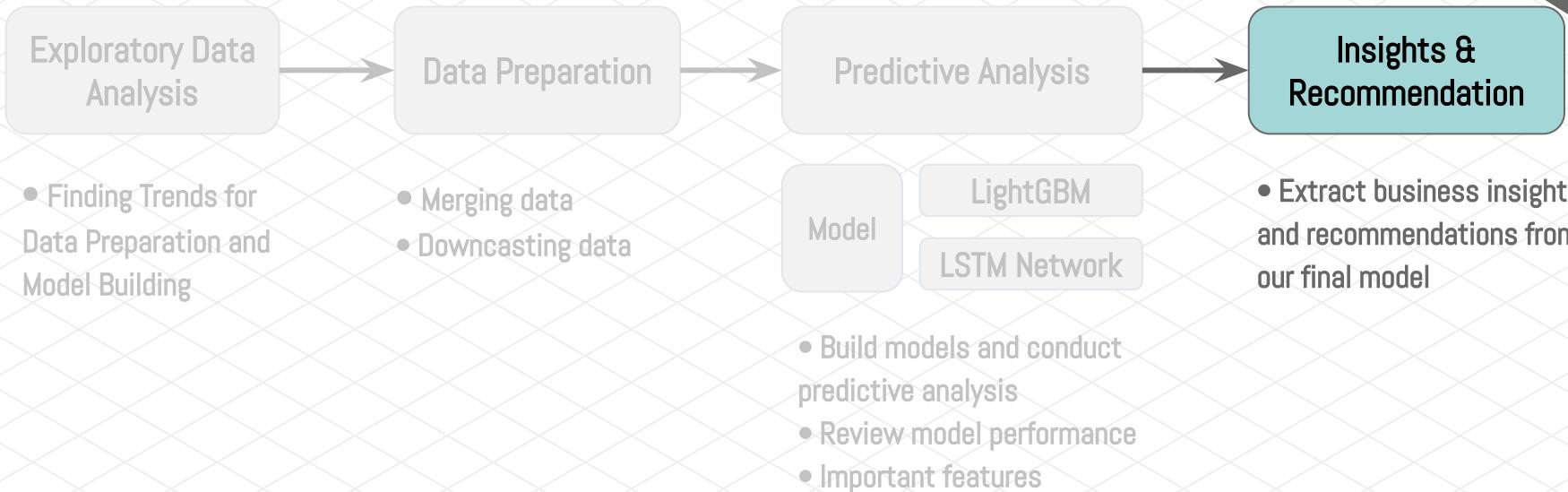
Model 2: LightGBM

Scoring

0.6919

0.53199

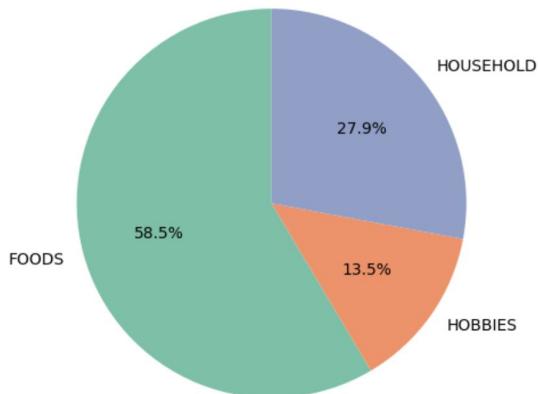
Solution Map



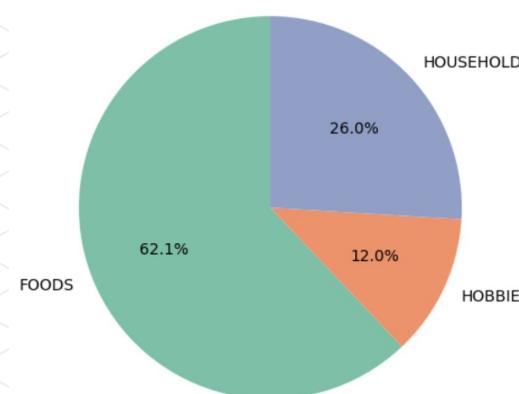
Insight & Recommendation

Based on our prediction, we can extract item sold distribution by categories in each state for the following 28 days

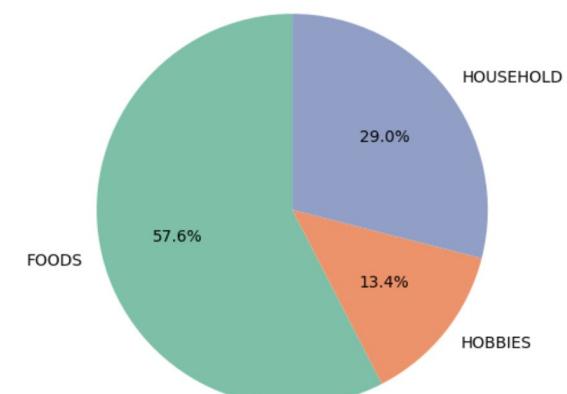
Item Sold by Category for CA



Item Sold by Category for WI



Item Sold by Category for TX



Insight & Recommendation

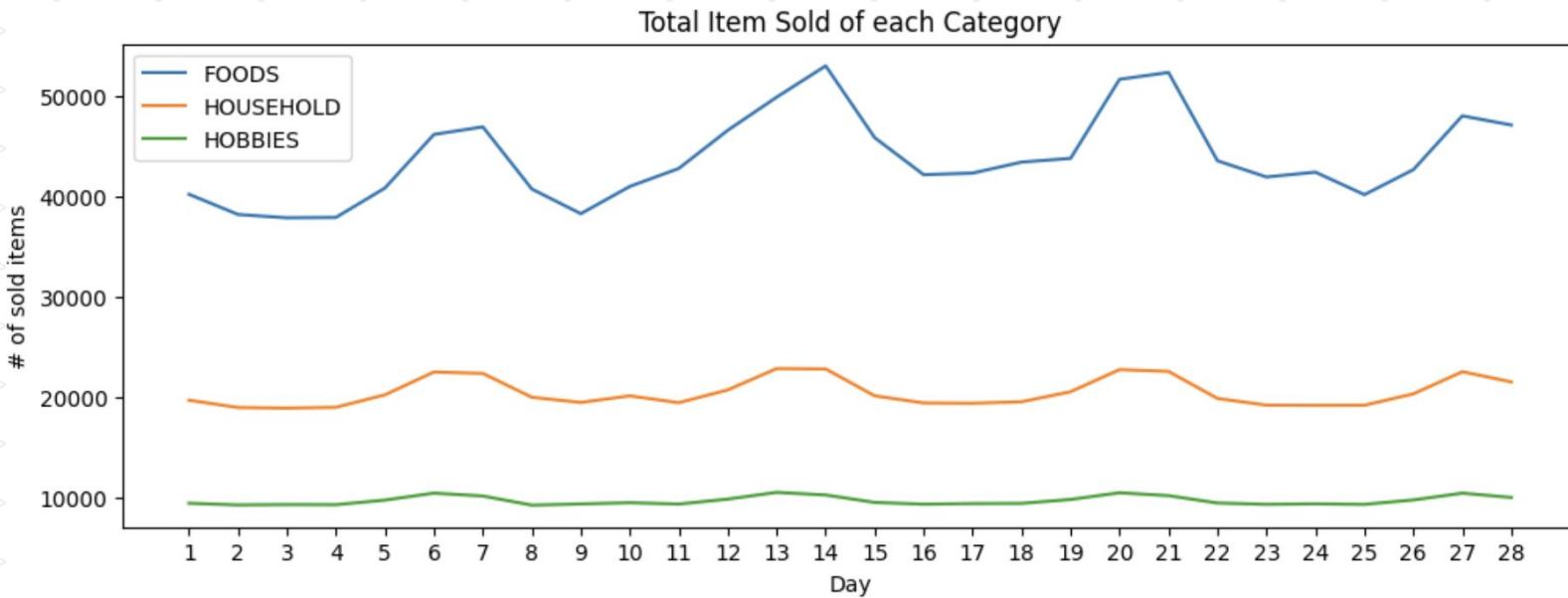
Identify number of sales by store in each state to optimize inventory allocation and streamline logistics management



State	Store (Order by # of sold)	Percentage
CA	CA_3	30.53%
	CA_2	25.45%
	CA_1	25.24%
	CA_4	18.78%
TX	TX_2	34.56%
	TX_3	34.19%
	TX_1	31.25%
WI	WI_2	37.47%
	WI_1	31.29%
	WI_3	31.24%

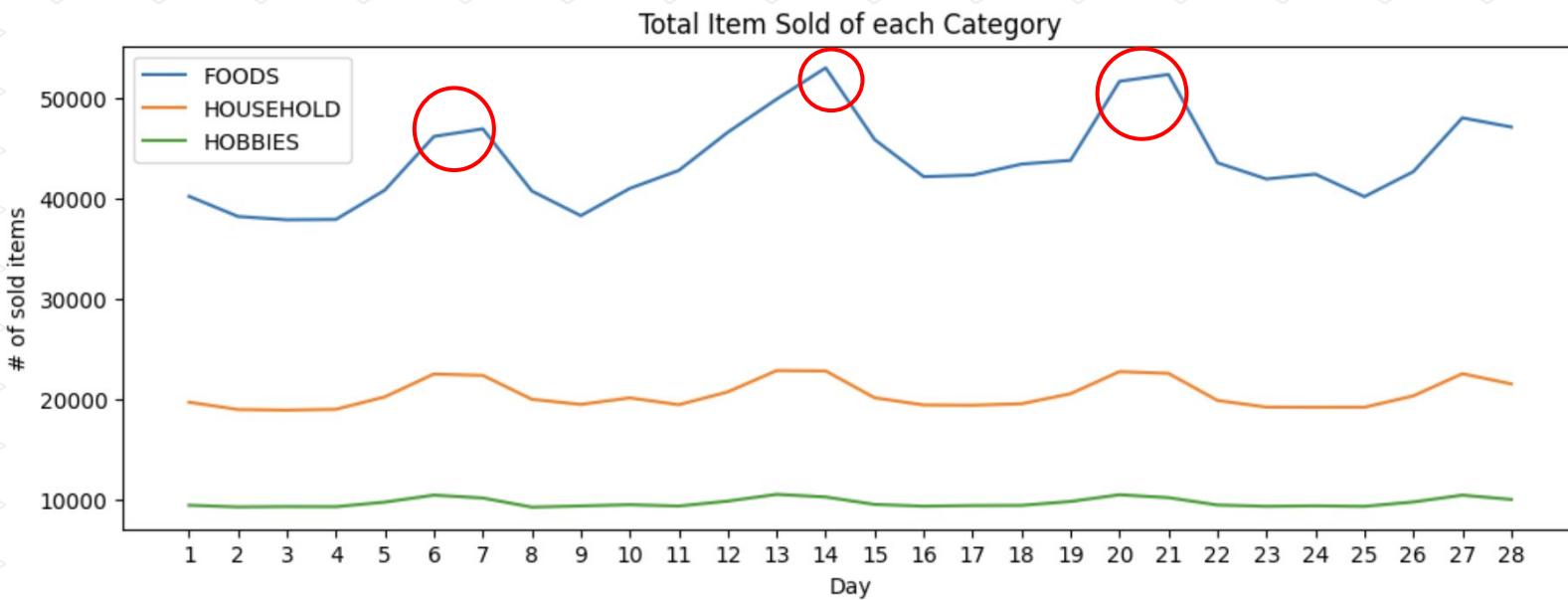
Insight & Recommendation

We can also analyze the patterns and peak of items sold by category over the next 28 days



Insight & Recommendation

We can also analyze the patterns and peak of items sold by category over the next 28 days



Thank You!



Insight & Recommendation

Top Three Items sold: FOODS_3_090, FOODS_3_586, FOODS_3_252

- day of week, month, quarter, or year
- sales lag : 7/14/30 days

- day of week, month, quarter, or year
- sales lag : 7/14/30 days

CA

Insight & Recommendation		
Prediction results: sales % by categories / stores / departments / states		
Business Recommendations for store management / supply chain management		
Next step: deployed models		

Solution Overview

This is a slide structure based on a marketing presentation

You can delete this slide when you're done editing the presentation

FONTS	To view this template correctly in PowerPoint, download and install the fonts we used
USED AND ALTERNATIVE RESOURCES	An assortment of graphic resources that are suitable for use in this presentation
THANKS SLIDE	You must keep it so that proper credits for our design are given
COLORS	All the colors used in this presentation
INFOGRAPHIC RESOURCES	These can be used in the template, and their size and color can be edited
CUSTOMIZABLE ICONS	They are sorted by theme so you can use them in all kinds of presentations

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DIVIDE THE CONTENT



MERCURY

Mercury is the closest planet to the Sun and the smallest one in the Solar System—it's only a bit larger than the Moon



VENUS

Venus has a beautiful name and is the second planet from the Sun. It's hot and has a poisonous atmosphere



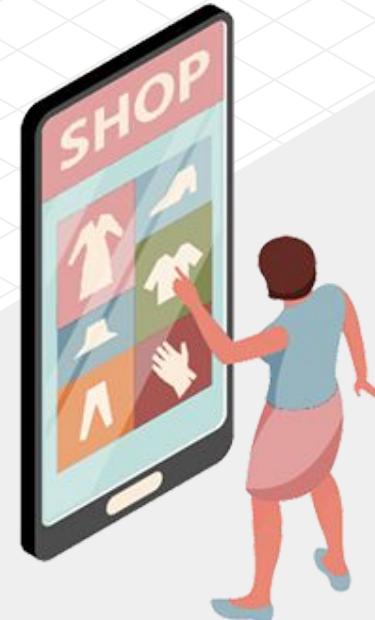
WHOA!

This can be the part of the presentation where you introduce yourself, write your email...

01

ABOUT US

You can enter a subtitle here if you need it



WE ARE CONFIDENT IN TEAMWORK!

Do you know what helps you make your point clear?
Lists like this one:

- They're simple
- You can organize your ideas clearly
- You'll never forget to buy milk!

And the most important thing: the audience won't miss the point of your presentation



AWESOME WORDS



A PICTURE IS
WORTH A
THOUSAND WORDS



OUR COMPANY

Mercury is the closest planet to the Sun and the smallest one in the Solar System. The planet's name has nothing to do with the liquid metal, since Mercury was named after the Roman messenger god



OUR EVOLUTION

2005

Jupiter is the biggest planet
in the Solar System



2008

Venus is the second planet
from the Sun



2010

Despite being red, Mars is a
very cold place



OUR EVOLUTION

2016

Mercury is the closest
planet to the Sun



2018

Neptune is the farthest
planet from the Sun



And still going strong!



WHAT SETS US APART?



MERCURY

Mercury is the closest planet to the Sun and also the smallest one in the Solar System

Despite being red, Mars is actually a cold place. It's full of iron oxide dust



MARS



NEPTUNE

Neptune is the farthest planet from the Sun and the fourth-largest of them all



EFFECTIVE STRATEGIES



VENUS

Venus has extremely high temperatures



JUPITER

Jupiter is a gas giant and the biggest planet



MERCURY

Mercury is the closest planet to the Sun



NEPTUNE

Neptune is the farthest planet from the Sun



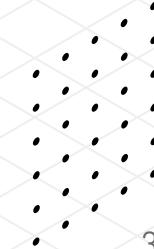
MARS

Despite being red, Mars is a very cold place

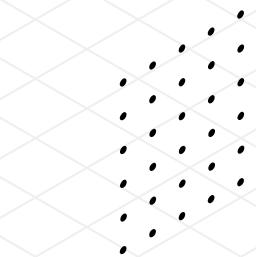


EARTH

Earth is the third planet from the Sun



GUIDING PRINCIPLES



NEPTUNE

Neptune is the farthest planet from the Sun

JUPITER

It's a gas giant and the biggest planet of them all



VENUS

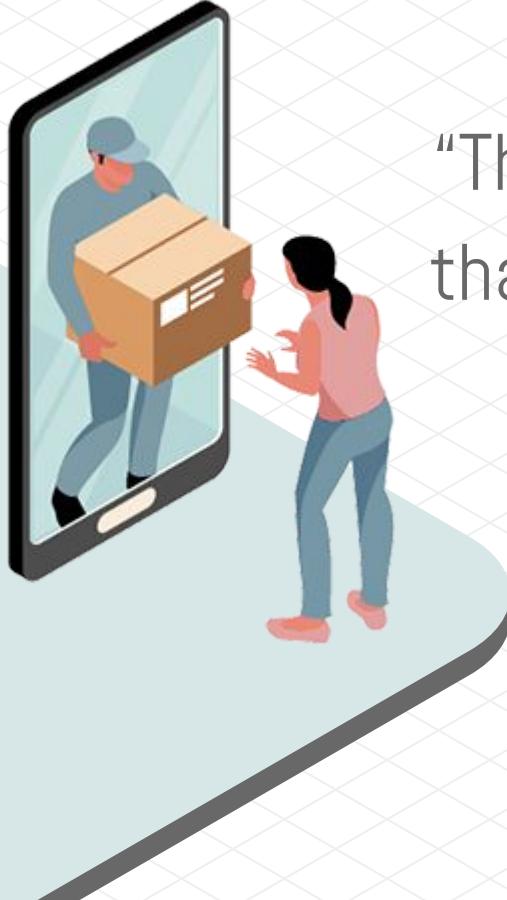
Venus has a poisonous atmosphere

MERCURY

Mercury is the closest planet to the Sun

MARS

Despite being red, Mars is a very cold place

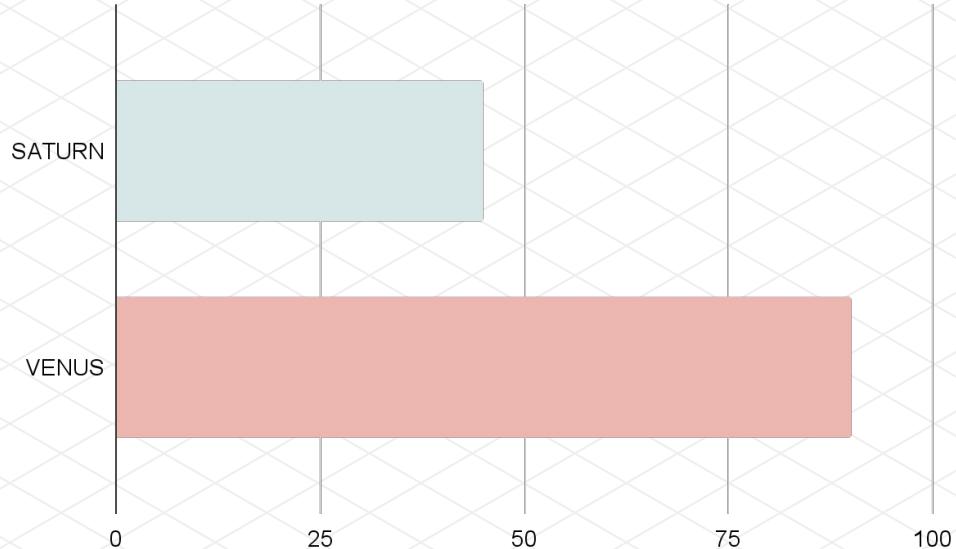


“This is a quote, words full of wisdom
that someone important said and can
make the reader get inspired.”



—SOMEONE FAMOUS

MARKET SHARE



SATURN

Saturn is the ringed planet, is composed mostly of hydrogen and helium

VENUS

Venus has a beautiful name, but also high temperatures and a poisonous atmosphere

Follow the link in the graph to modify its data and then paste the new one here. [For more info, click here](#)

BUYER PERSONA PROFILE

WANTS PRIVACY



Doesn't share location



Blocks ads

OWNS A PROPERTY

SHOPPING CHOICES



43%



20%



37%

Online

Phone

Store

BECKY ROGERS

- Genre: Female
- Age: 20-30
- Country: UK
- Salary: 15,000



PRODUCT EXPERIENCES



Venus is the second planet from the Sun



Despite being red, Mars is a very cold place



Mercury is the closest planet to the Sun

INTERESTS



Aware of climate change



Loves animals

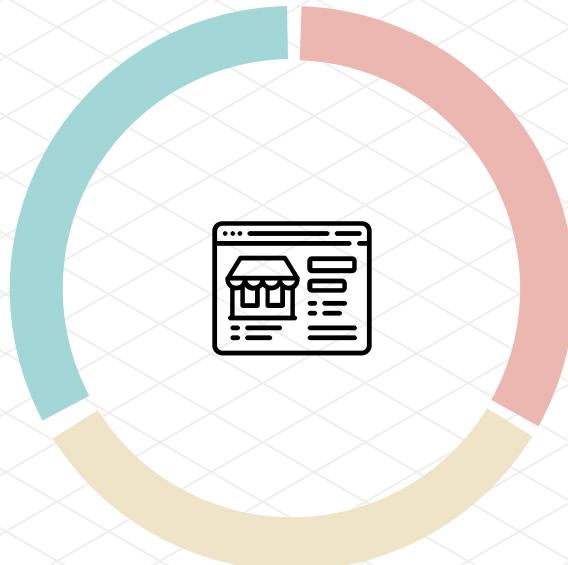


Has plants

BUYER JOURNEY

CONSIDERATION

Mercury is the closest planet to the Sun



AWARENESS

Jupiter is a gas giant and the biggest planet of them all

DECISION

Venus is the second planet from the Sun

SALES FUNNEL

INTEREST

Jupiter is the biggest planet in the Solar System

PURCHASE

Despite being red, Mars is actually a very cold planet

AWARENESS

Venus has very high temperatures

DECISION

Saturn is composed of hydrogen and helium



COMPETITOR ANALYSIS



MERCURY

Mercury is the smallest planet of the Solar System



MARS

Despite being red, mars is actually a very cold planet



NEPTUNE

Neptune is the farthest planet from the Sun



JUPITER

It's a gas giant and the biggest planet in the Solar System



SWOT ANALYSIS

STRENGTHS

Jupiter is the biggest planet in the Solar System

OPPORTUNITIES

Venus has a beautiful name and is the second planet from the Sun

S

W

O

T

WEAKNESSES

Despite being red, Mars is a very cold place

THREATS

Saturn is composed mostly of hydrogen and helium

SHORT TERM

GOAL 1

Jupiter is the biggest planet in the Solar System

GOAL 2

Despite being red, Mars is actually a very cold planet

GOAL 3

Venus has very high temperatures

GOAL 4

Saturn is composed of hydrogen and helium

LONG TERM

STRATEGY



GOAL 1

The Sun is the star at the center of the Solar System



KEY ACTION 1

Neptune is very far away from us



KEY ACTION 2

Venus has extremely high temperatures

1

2

3

4

MERCURY

Mercury is the smallest planet in the Solar System

JUPITER

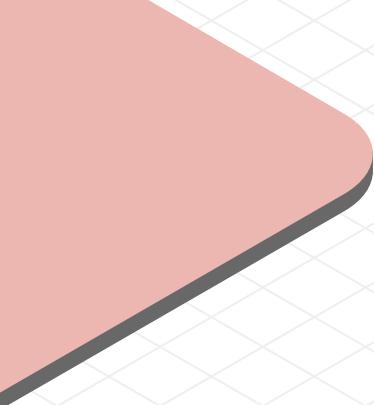
It's a gas giant and the biggest planet in the Solar System

SATURN

Saturn is composed mostly of hydrogen and helium

MARS

Despite being red, Mars is a very cold place



KEY ACTION ITEMS

FIRST QUARTER

KEY ACTION 1

You can describe your items for the quarter here

KEY ACTION 2

You can describe your items for the quarter here

KEY ACTION 3

You can describe your items for the quarter here

SECOND QUARTER

You can describe your items for the quarter here

You can describe your items for the quarter here

You can describe your items for the quarter here

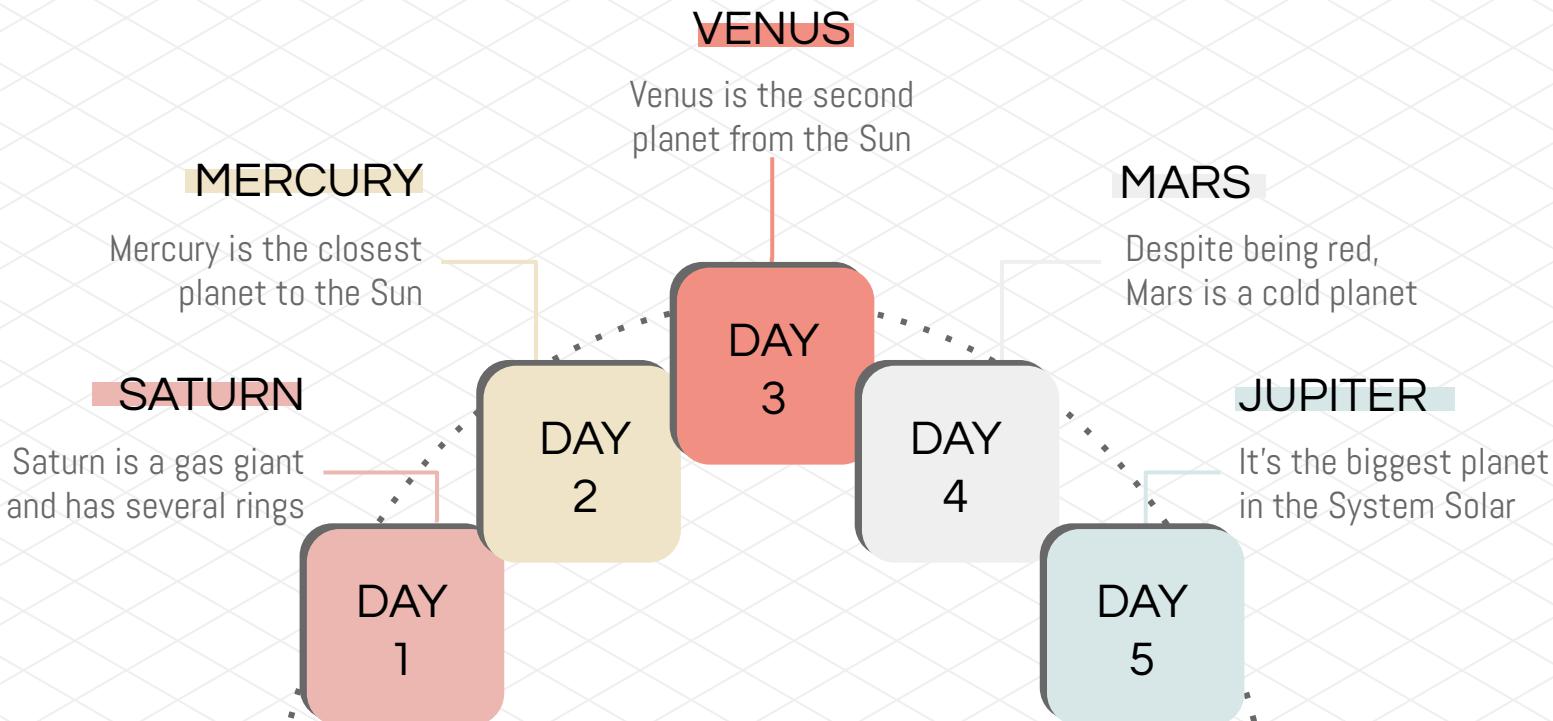
THIRD QUARTER

You can describe your items for the quarter here

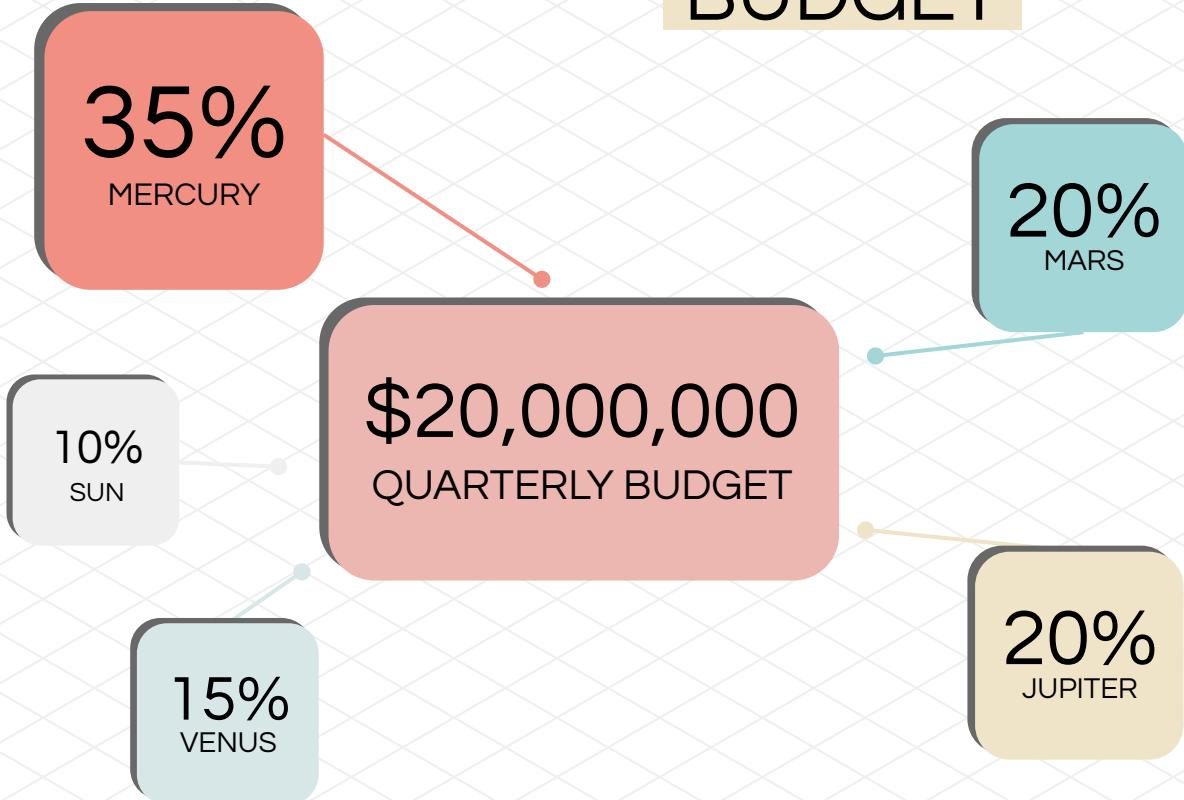
You can describe your items for the quarter here

You can describe your items for the quarter here

TIMELINE

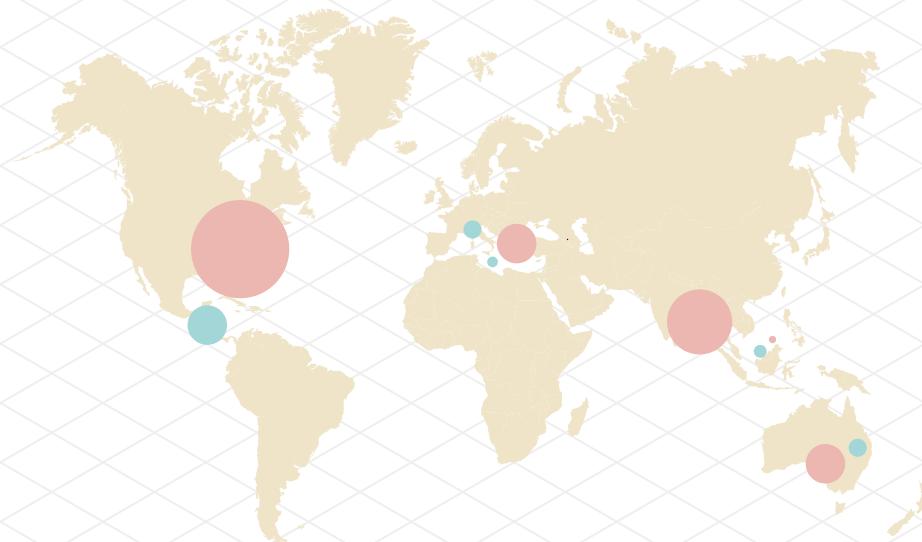


BUDGET

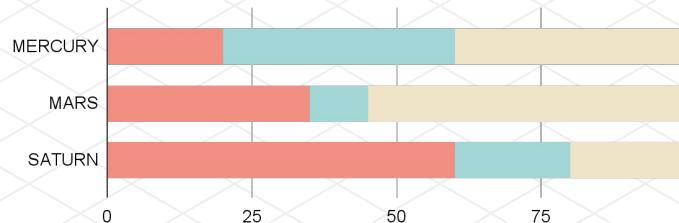


KPI OVERVIEW

OUTREACH



COMPLIANCE RATE



Follow the link in the graph to modify its data and then paste the new one here. For more info, [click here](#)

PRODUCTIVITY



Saturn is a gas giant



Mars is a cold place

SNEAK PEEK

You can replace the image on the screen with your own work. Just right-click on it and select "Replace image"

ONLINE SHOPPING MARKETING PLAN

Here is where your presentation begins



OUR TEAM

HELENA
JAMES



You can speak a bit about this person here

TOMMY
DOE



You can speak a bit about this person here

THANKS

Do you have any questions?

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- Isometric online shopping illustration concept with square compositions of smartphones shop fronts and carts with people
- Delivery door screen concept
- Isometric people online shopping
- Online service set
- Isometric cyber monday sale background

PHOTOS

- Young woman doing her shopping online
- Business people meeting at office hand shake
- Woman with shopping bags talking on the phone
- Medium shot women talking
- Teamwork meeting with business people

ICONS

- Icon Pack: Ecommerce
- Icon Pack: Birthday

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Pana



Amico



Bro



Rafiki



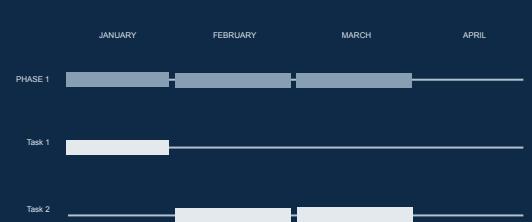
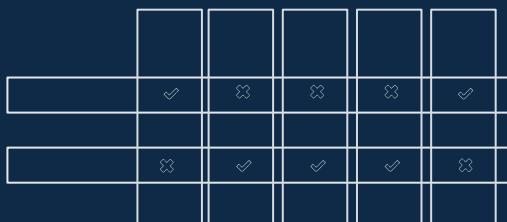
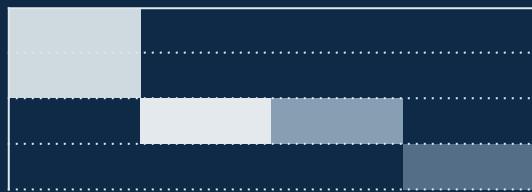
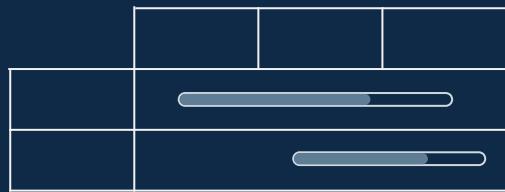
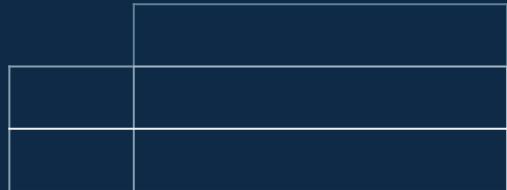
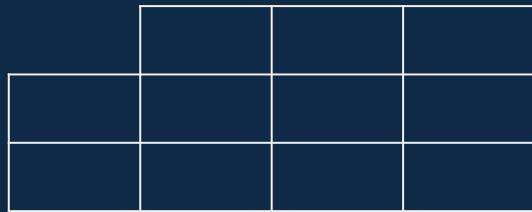
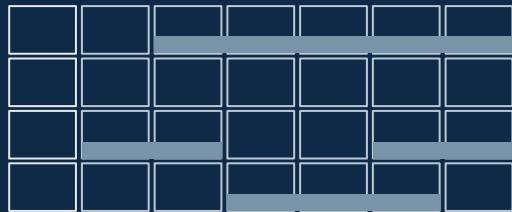
Cuate

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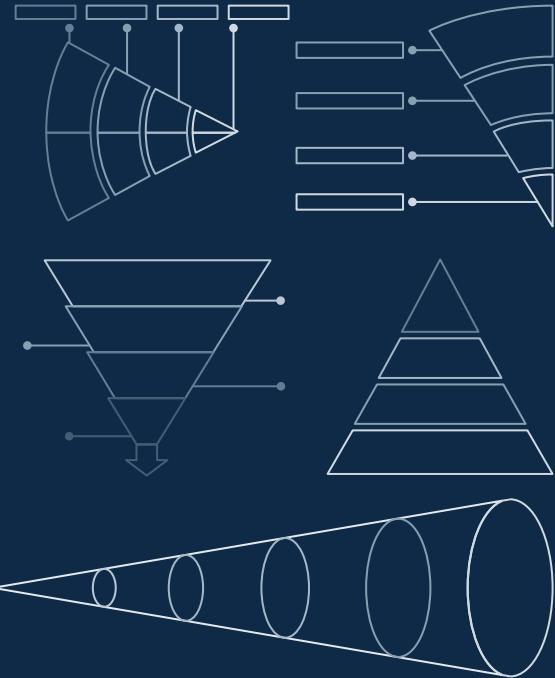
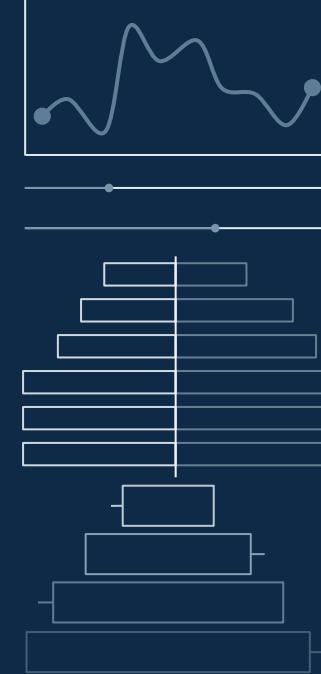
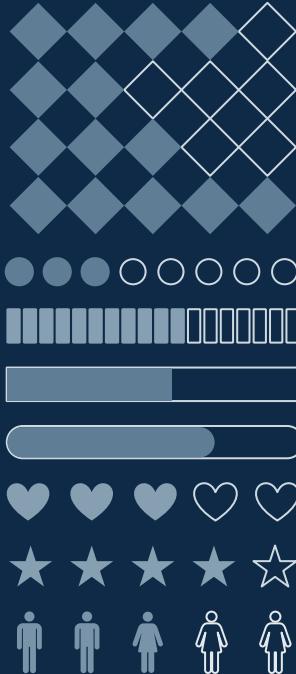
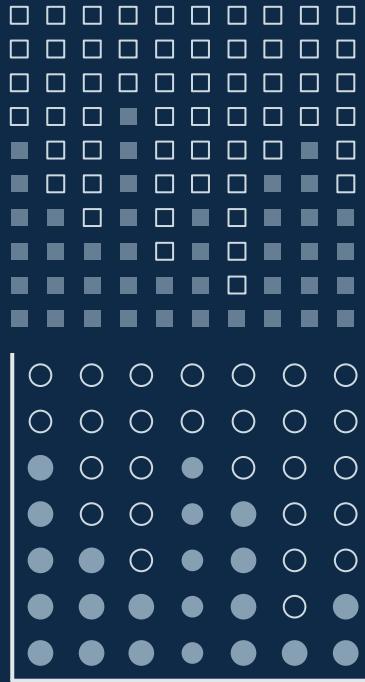
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...and our sets of editable icons

You can resize these icons without losing quality.

You can change the stroke and fill color; just select the icon and click on the paint bucket/pen.

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Educational Icons



Medical Icons



Business Icons



Teamwork Icons



Help & Support Icons



Avatar Icons



Creative Process Icons



Performing Arts Icons



Nature Icons



SEO & Marketing Icons



