Reddit Posts Analysis with Natural Language Processing

By Daniel Seto, Florian Combelles, Goh Yan Da, Joanne Chong, Kenneth Goh

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Executive Summary

Who we are

- ***Smart Pet***, established in **August 2017** by *Florian Combelles*
- Passion for animals with expertise from former vets, pet store owners and animal shelter volunteers
- Worked with organisations and companies such as:
  - **SPCA**
  - **AVA**
  - **Petslovers**

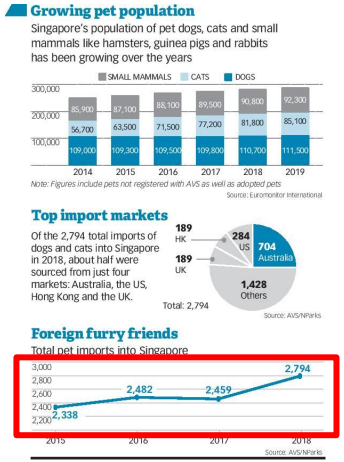
SMART PET

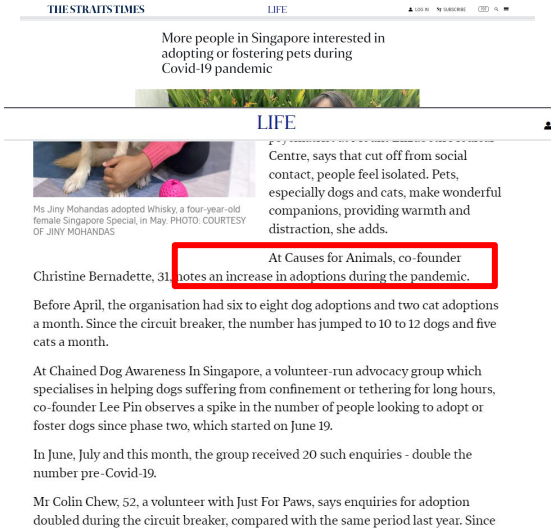
Our mission:
"We care for them"

Background

- Most common pets in Singapore
  - **Dogs - 52%**
  - **Cats - 27%**

Increased interest in pet ownership → Rise of inexperienced pet owners





THE STRAITS TIMES LIFE

More people in Singapore interested in adopting or fostering pets during Covid-19 pandemic

LIFE

Ms Jiny Mohandas adopted Whisky, a four-year-old female Singapore Special, in May. PHOTO: COURTESY OF JINY MOHANDAS

Centre, says that cut off from social contact, people feel isolated. Pets, especially dogs and cats, make wonderful companions, providing warmth and distraction, she adds.

At Causes for Animals, co-founder Christine Bernadette, 31, notes an increase in adoptions during the pandemic.

Before April, the organisation had six to eight dog adoptions and two cat adoptions a month. Since the circuit breaker, the number has jumped to 10 to 12 dogs and five cats a month.

At Chained Dog Awareness In Singapore, a volunteer-run advocacy group which specialises in helping dogs suffering from confinement or tethering for long hours, co-founder Lee Pin observes a spike in the number of people looking to adopt or foster dogs since phase two, which started on June 19.

In June, July and this month, the group received 20 such enquiries - double the number pre-Covid-19.

Mr Colin Chew, 52, a volunteer with Just For Paws, says enquiries for adoption doubled during the circuit breaker, compared with the same period last year. Since

Stakeholders' Concerns

- Lack of local resources regarding information on:
  - Licensing, upkeep costs, aftercare

How does it affect you?

Decrease in work efficiency

- Pet store owners occupied answering queries

Overbooking of Vet appointments

- Pet owners coming in for minor enquiries/non-emergencies

More animals abandoned

- Animals abandoned after pandemic are sent to the shelters

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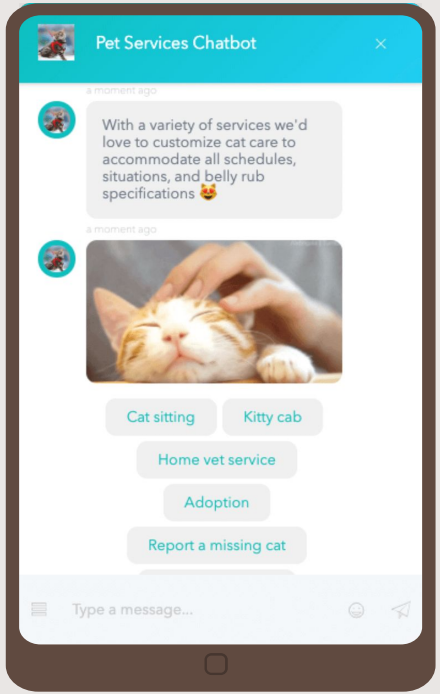
Problem Statement

The challenge at hand

With an influx of **inexperienced** pets owners **overly reliant** on vets and pet store **- reducing their work efficiency,** how can we optimize it?

Our flagship product

- **Pet Companions**, our highly-rated mobile application offering pet owners information through:
  - AI-powered chatbot
    - First level of customer inquiry
    - Source of information for pet owners
  - Recommends articles based on classification of queries
  - A knowledge-bank filled with information sourced from vets, pet experts and users



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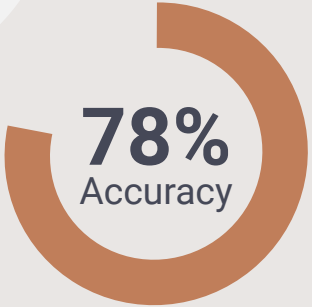
Methodology

How we've been doing it

Existing model - K-Nearest Neighbours (KNN)



How does this work?

- Classification of observation depends on the number of surrounding data points taken as reference

E.g. Classification of ‘Resource guarding’:

- If K = 3 → Dog (correct)
- If K = 5 → Cat (wrong)

Potential model - Naive Bayes

P (dog-related post): 0.60

15	10	4
Toy	Walk	Night

10	2	9
Toy	Walk	Night

P (cat-related post): 0.40

- Classification of the text post is based on comparing the conditional probabilities of the it belonging to either r/CatAdvice or r/DogAdvice

"night walk"

- To compare probability of the phrase belonging to r/CatAdvice or r/DogAdvice given that the text post contains 'night walk'
- Classified according to the highest probability

Potential model - Logistic Regression

Toy | Walk | Night | …

- Each word/token within the model are weighted according to their importance to the respective categories
- The model will generate the probabilities for each category
- The text post will be labelled according to the category with the highest probability

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Data Collection & Cleaning

How we collect and clean the information

Overview of data collected

- *r/CatAdvice* and *r/DogAdvice*
- User-generated data scrapped using Pushshift API

	r/CatAdvice	r/DogAdvice
Period of Posts	12 Oct - 24 Nov	25 Aug - 24 Nov
No. of Posts	4,247	4,000

Cleaning process

Content Management

- Posts w/o main text were dropped
- Text data for analysis: Main text + Title
- Both categories have 2,300 data points for analysis

Word Processing

- Removed stopwords, punctuation, digits, random characters, URLs
- Transformed each word to lower-case and lemmatise*

Removed Common Terms

- Words that are related to either categories e.g. “dog”, “cat”, “kitten”, “puppy”
- Words that are common to both categories e.g. “vet”, “veterinarian”, “month”, “old”

*Lemmatisation is the grouping of inflected forms of similar words so that they can be analysed as a single term (often as the root word)

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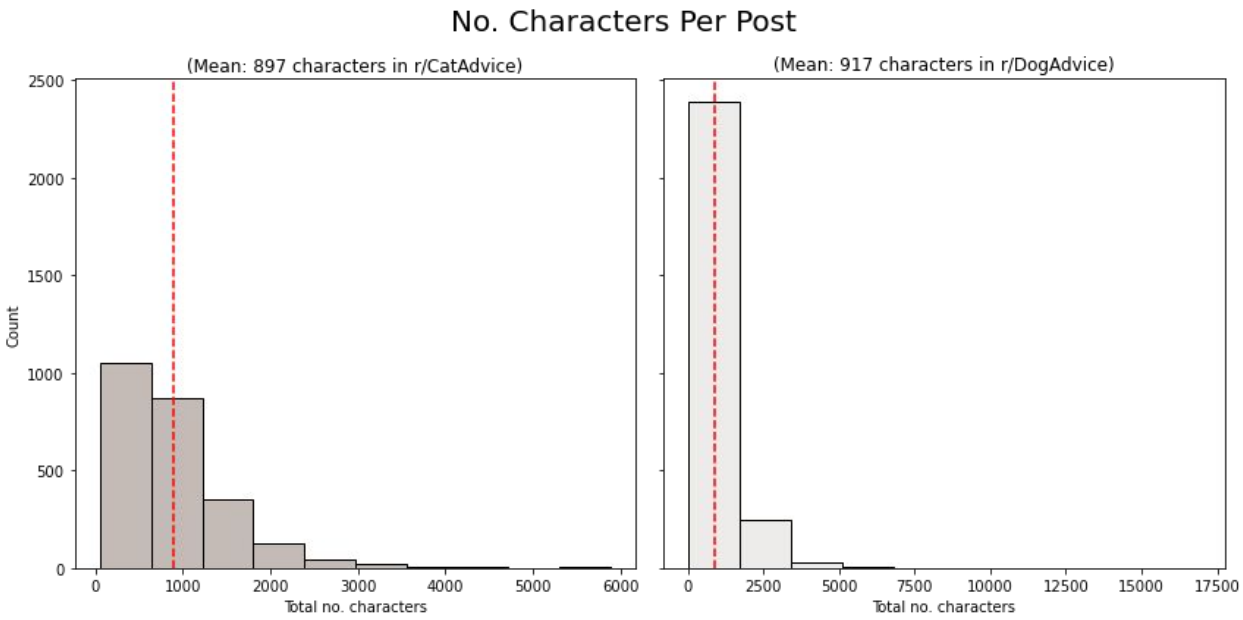
Exploratory Data Analysis

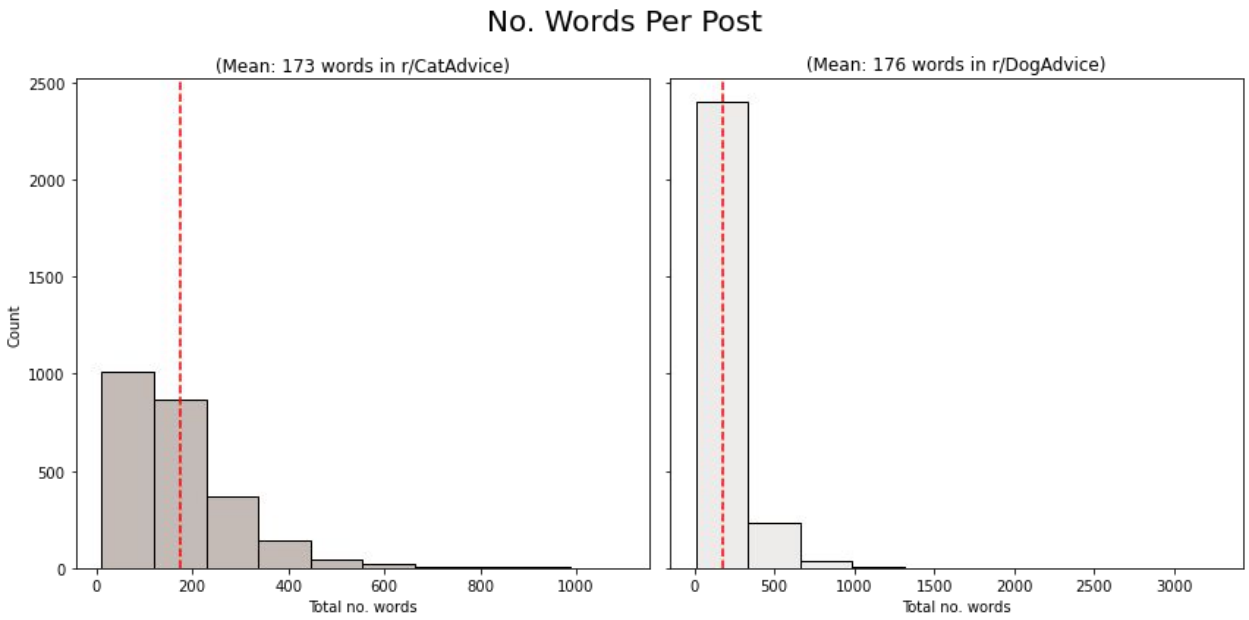
Zooming in on our data

Higher average character count in r/DogAdvice



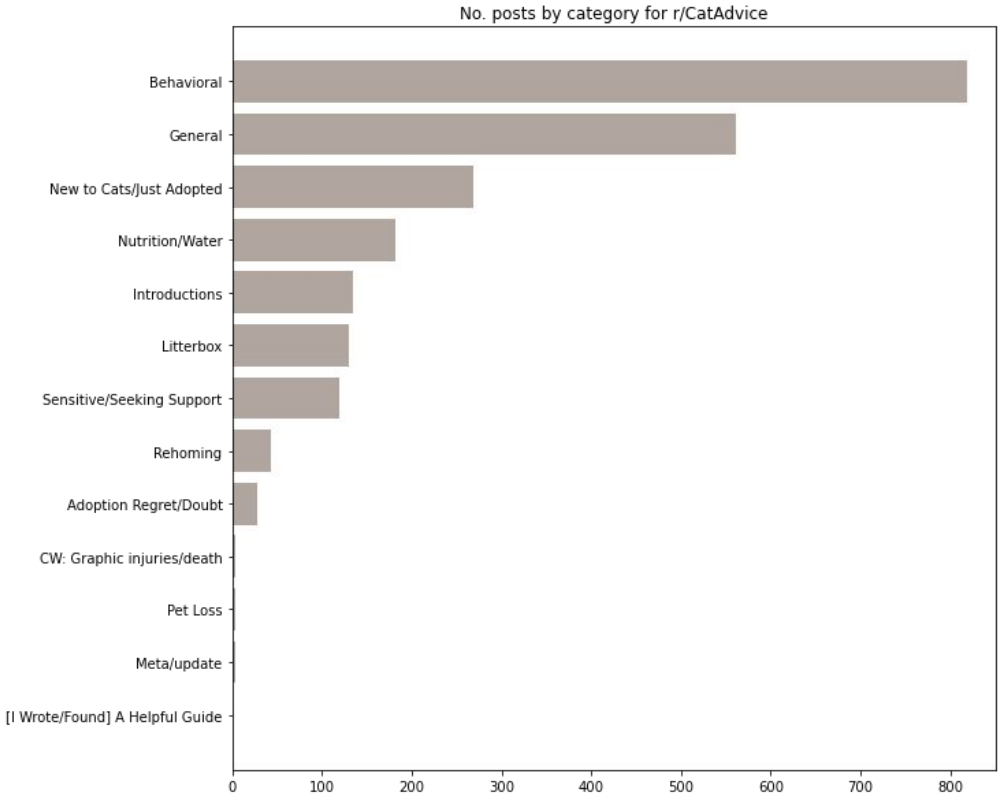
- **Maximum no. characters:** 5,885 in r/CatAdvice & 16,898 in r/DogAdvice
- **Minimum no. characters:** 56 in r/CatAdvice & 39 in r/DogAdvice

Similar word count average in both subreddits



- **Maximum no. words:** 1,097 in r/CatAdvice & 3,267 in r/DogAdvice
- **Minimum no. words:** 11 in r/CatAdvice & 9 in r/DogAdvice

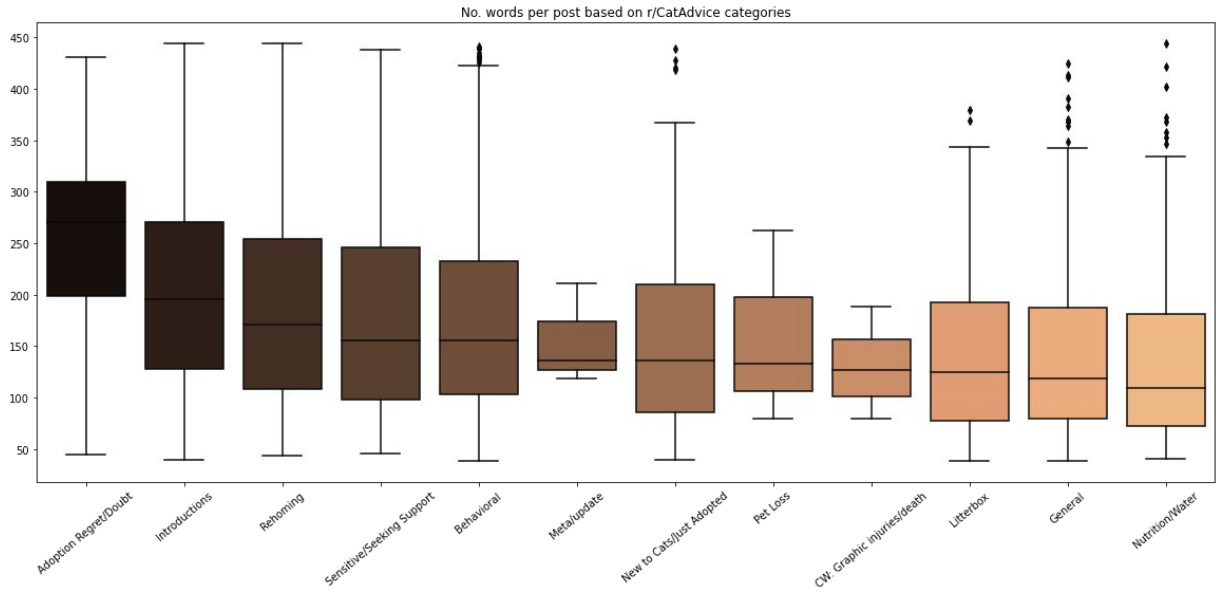
Behavioral queries tops r/CatAdvice discussion



Top topics tagged:

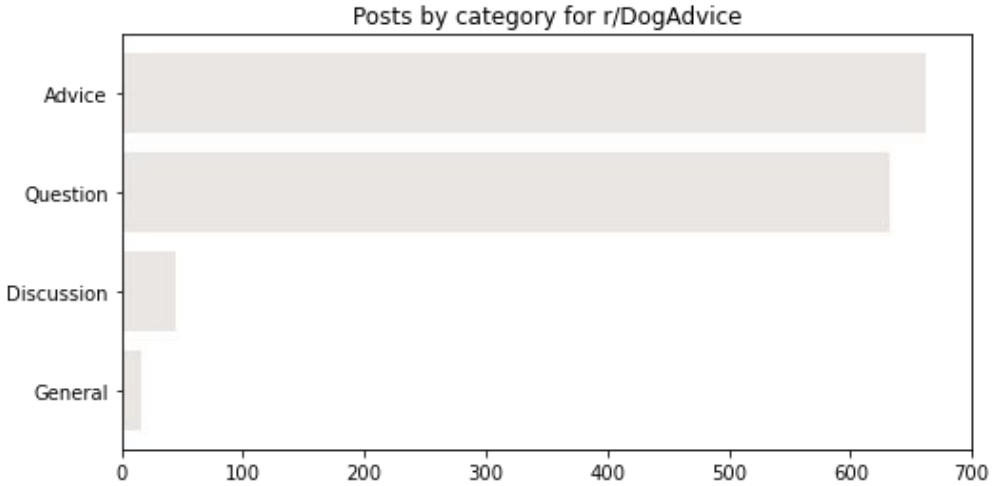
- **Behavioral:** 818 posts
- **General:** 561 posts
- **New Cats/Newly adopted:** 269 posts

Highest word count average on Adoption Regret/Doubt



- **Adoption Regret/Doubt:** 248 average no. words
- **Introductions:** 206 average no. words
- **Behavioral:** 175 average no. words

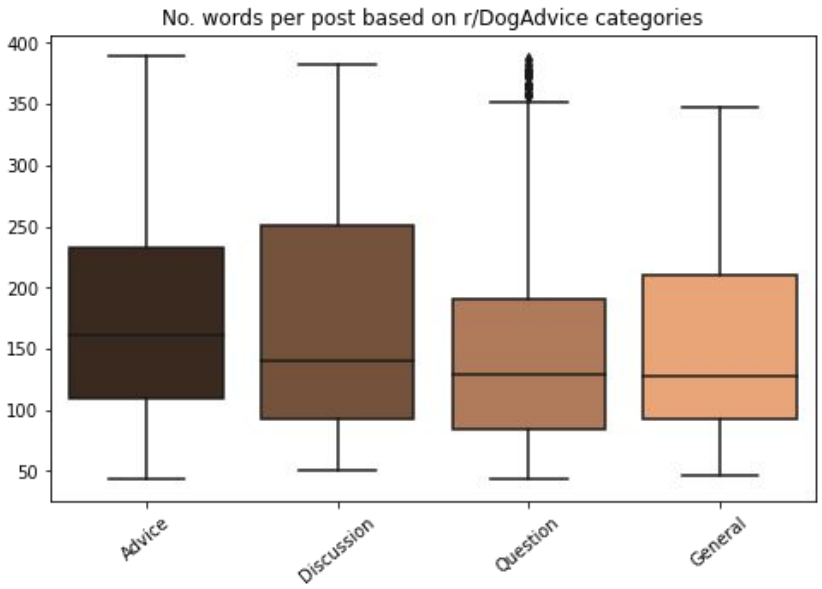
More general categories in r/DogAdvice



Top topics tagged:

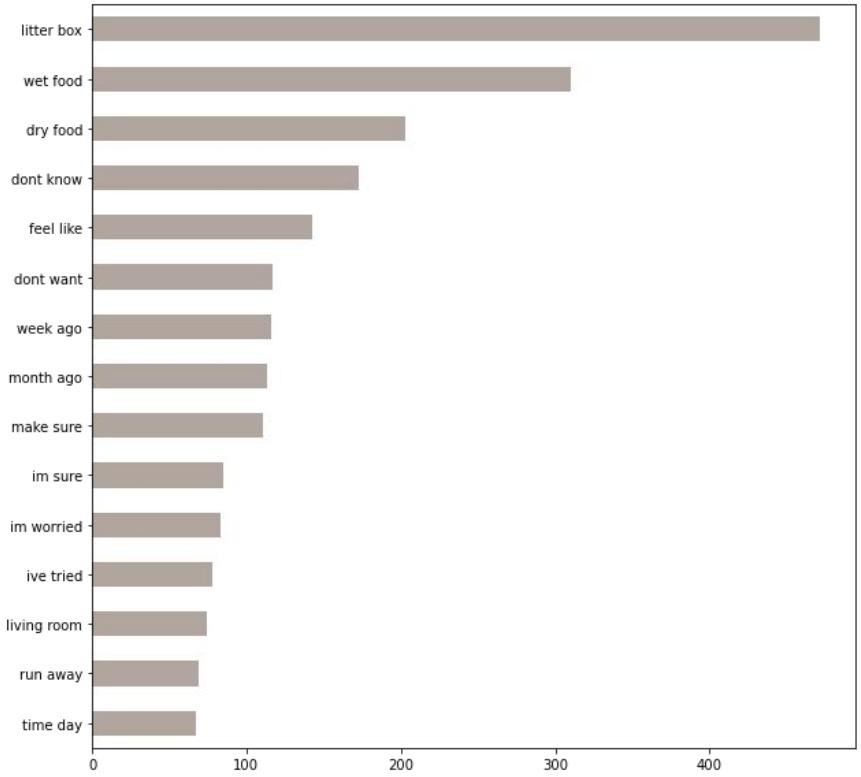
- **Advice:** 662 posts
- **Question:** 632 posts

Highest word count average for Advice category



- **Advice:** 177 average no. words
- **Discussion:** 174 average no. words

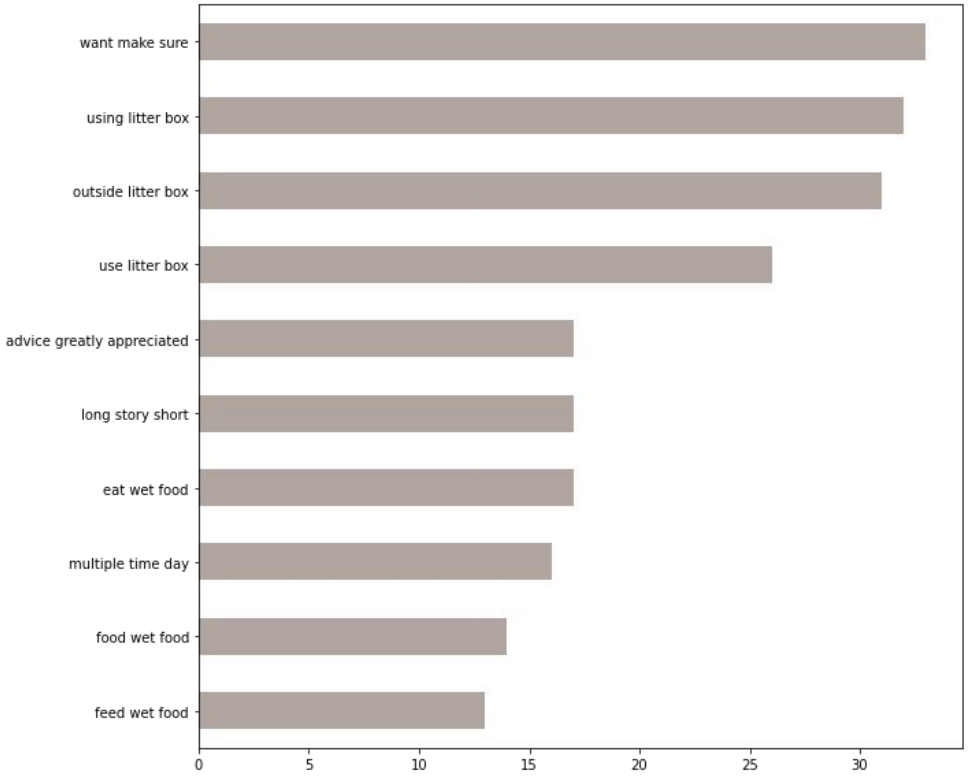
Top 2-word queries in r/CatAdvice



- ‘Litter box’
- ‘Wet food’
- ‘Dry food’

Users are concerned with their cats’ environment and nutrition.

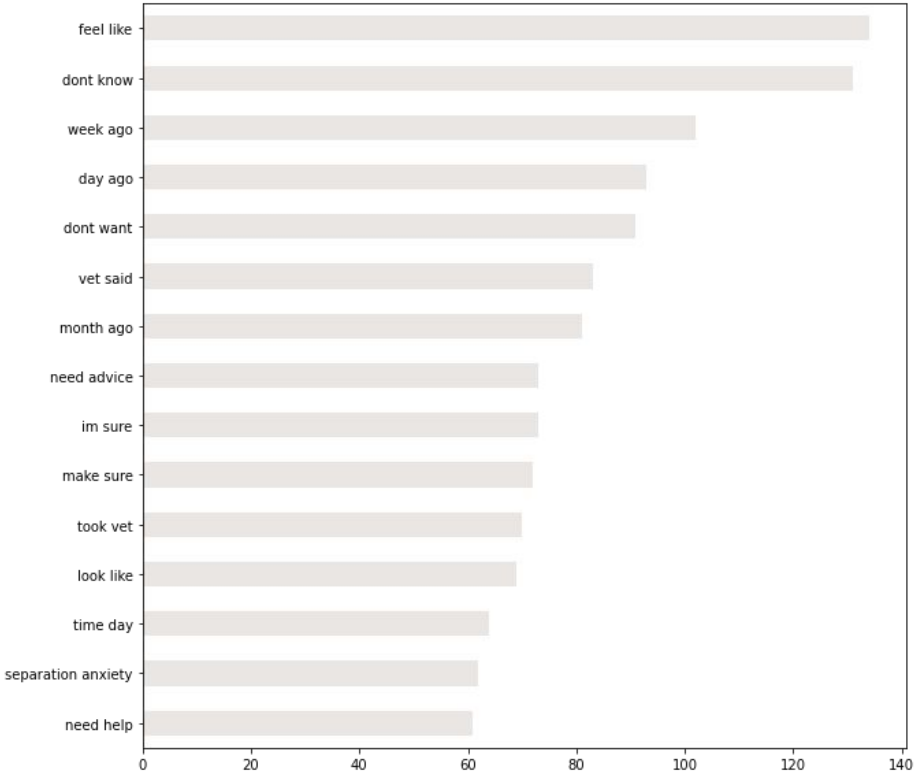
Top 3-word queries in r/CatAdvice



- ‘Using litter box’
- ‘Outside litter box’
- ‘Use litter box’

This reaffirms that users are most concerned with their cats’ environment.

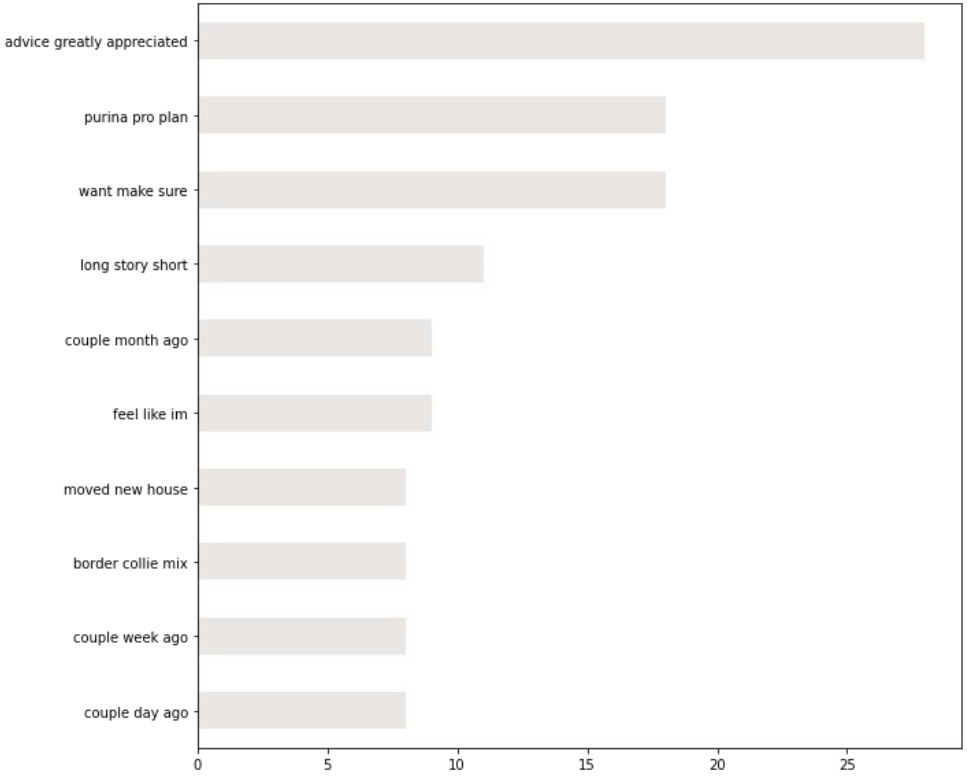
Top 2-word queries in r/DogAdvice



- ‘Feel like’
- ‘Don’t know’
- ‘Need advice / help’
- ‘Separation anxiety’

Users seem mostly uncertain about the issues faced. The only issue mentioned is ‘separation anxiety’.

Top 3-word queries in r/DogAdvice



- ‘Advice greatly appreciated’
- ‘Purina pro plan’
- ‘Want make sure’

This reaffirms users in this forum could be more uncertain and may require more support.

‘Purina pro plan’ was mentioned often - this is a formula to improve dog’s digestion.

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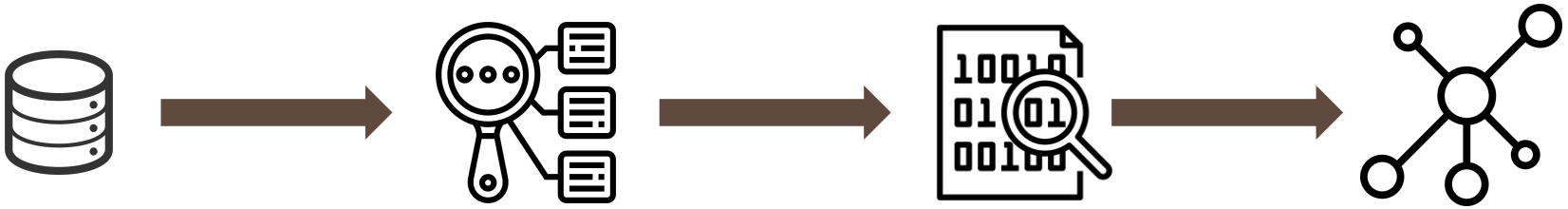
Classification Models

Processing our data

Data preparation and modelling



Split to 2 datasets for model training and testing

Data transformation to convert words to numbers

Train and evaluate models

The training models and measure of success

Classification Models:

1. Logistic Regression
2. Naive Bayes (Multinomial, Bernoulli and Gaussian)

Evaluation Metrics:

- Accuracy Score
  No. of observations classified correctly / Total positive and negative observations
- F1 score
  Balance of precision and recall on positive observations

What we're looking for:

⬆ Higher Accuracy Score , ⬆ Higher F1 score

⬆ Better Model Performance

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- ⬆ Higher F1 score
- ⬆ Better Model Performance

Cat or dog?

Multi Naive Bayes achieved 90% accuracy & F1 score

	Model	Data transformation to	Accuracy Score for train	Accuracy Score for test	F1 score
0	KNN (Baseline)	Tf-idf	0.865489	0.781522	0.789529
1	MultiNB	Tf-idf	0.955978	0.890217	0.891515
2	MultiNB	single_word	0.958152	0.902174	0.900222
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5	BernNB	single_word	0.963587	0.900000	0.897778
6	BernNB	2-word phrase	1.000000	0.825000	0.815578
7	GausNB	Tf-idf	0.971739	0.742391	0.751832
8	GausNB	single_word	0.964402	0.763043	0.777551
9	GausNB	2-word phrase	0.844565	0.773913	0.742574
10	Logistic Regression	Tf-idf	0.960054	0.885870	0.880546
11	Logistic Regression	single_word	0.999728	0.880435	0.878587
12	Logistic Regression	2-word phrase	1.000000	0.781522	0.759857
13	MultiNB with hyperparameter tuning	single_word	0.903261	0.904348	0.901566

Selected model for tuning

Best result post-tuning

Multi Naive Bayes achieved 90% accuracy & F1 score

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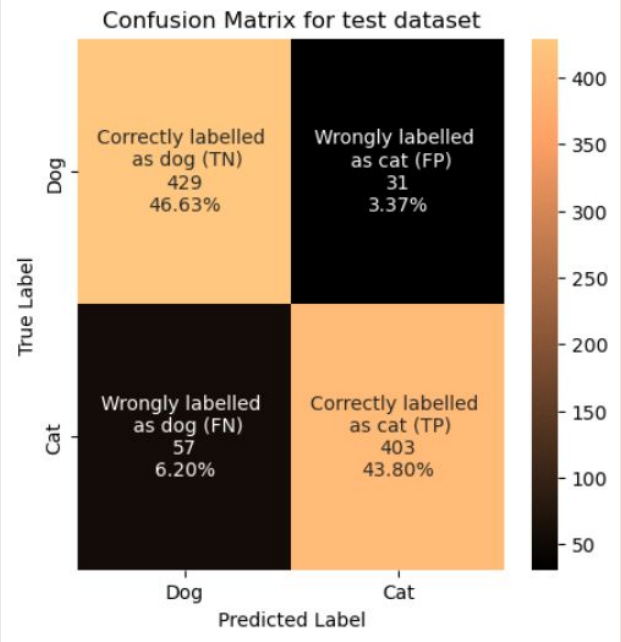
Selected model for tuning

Best result post-tuning

90% of predictions are correctly labeled



Highly accurate model

- Total Observations: 920
- Correct classifications: 832

Low Misclassification

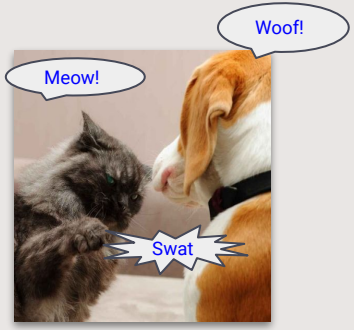
- Wrongly labeled as dog: 6.2%
- Wrongly labeled as cat: 3.3%

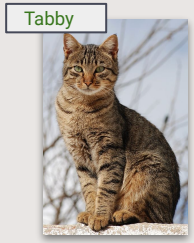
Distinct words between cats and dogs

Top 10 words for cats
Meowing
Meow
Swat
Litterbox
Galaxy
Jackson
Feliway
Diffuser
Tabby
Resident

Behaviours

Cat types





Top 10 words for dogs
Bark
Trainer
Flea
Diarrhea
Infection
Treatment
Collie
Poodle
Terrier
Daycare

Behaviours

Medical

Dog types

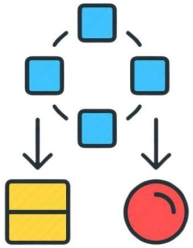
6

Classification Models

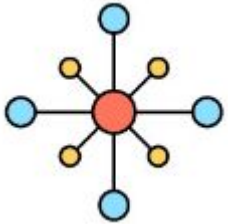
Processing our data

Data preparation and modelling

Split to 2 datasets for model training and testing



Data transformation to convert words to numbers



Train and evaluate models

Choice of Models and Evaluation Metrics

Classification Models

- Logistic Regression
- Naive Bayes (Multinomial, Bernoulli and Gaussian)

Advantages:

- Algorithm works quickly and can save time.
- Provides a measure of how appropriate a factor is for further analysis

Evaluation Metrics

- Accuracy Score

  Accuracy Score = No. of observations classified correctly / Total no. of observations

- F1 score

  It measures the accuracy of the model and how good the model is able to classify the posts to the 2 categories.

⬆ Higher Accuracy Score / ⬆ Higher F1 score,

⬆ Better Model Performance

F1 score formula

F1 Score = 2 * (Precision * Recall) / (Precision + Recall)

where:

- **Precision**: Correct positive predictions relative to total positive predictions
- **Recall**: Correct positive predictions relative to total actual positives

$$\text{Precision} = \frac{\textit{True Positives}}{\textit{Predicted Positives}} = \frac{TP}{TP + FP}$$

$$\text{Sensitivity} = \frac{\textit{True Positives}}{\textit{All Positives}} = \frac{TP}{TP + FN} = \frac{TP}{P}$$

(Recall a.k.a. Sensitivity)

Multinomial Naive Bayes with single word gave the best performance (Accuracy score of 90%)

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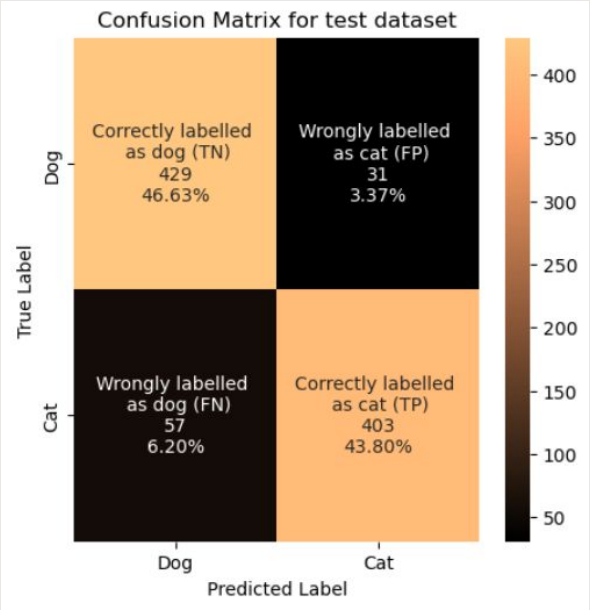
Selected model

Best results post-tuning

Selected Model



- Accuracy score of 90%
  - Total Observations: 920
  - Correct Classification: 832

Distinct words between cats and dogs

Top 10 words for cats

- meowing
- meow
- swat
- litterbox
- galaxy
- jackson
- feliway
- diffuser
- tabby
- resident

Behaviours

Cat types

Top 10 words for dogs

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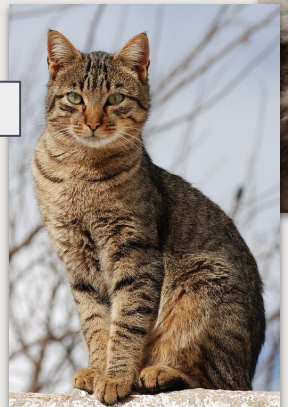
Behaviours

Medical

Dog types



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Conclusion and Recommendations

Our key takeaways

Limitations

Article availability

- Limited availability of articles at launch
  - Rapidly expand based on popular topics and what are people looking for

Cat/Dog specific

- Cat and dogs are the most popular pets
  - Model currently limited to cat and dog classification

Context

- Recommendations and articles are based on global trends
  - Not specific to Singapore

Conclusion

Refocus your business

- Focus on the core of your business
  - Treating pets
  - Driving sales growth

Reduce dependance

- Provide users with extensive and comprehensive articles to cover all their basic needs

Leverage insight

- Get information on customers/patients
- Based on their app usage

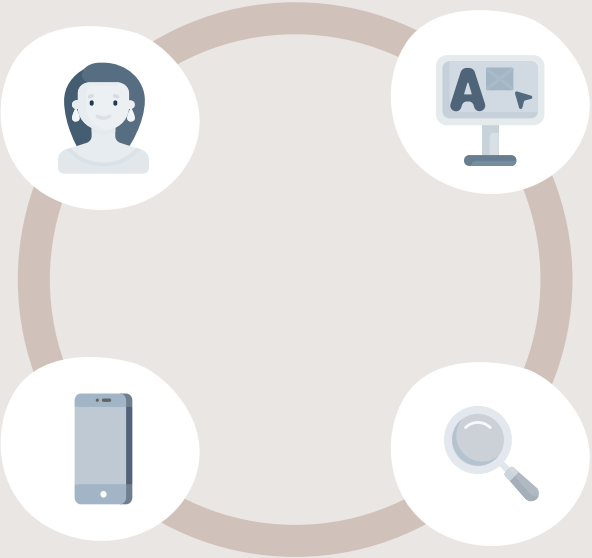
Recommendations

Manpower

Adjust manpower needed to answer phone calls and emails and shift your attention to what really matters

Digitalisation

Display QR codes or provide a device your customers can use to browse articles or get answers



Communication

Improve on communications and website by using focusing on popular and trending terms

Inventory / Stocks

Keep up to date with current trends or outbreaks to always have stocks for critical and popular products

Roadmap

Q1 2023

Offer weekly surveys to gather insights on users preferences and needs

Q2 2023

Provides insights from user usages.

- Popular question
- Survey results

Q4 2023

Organize events and workshops with end users and partners

2025

Deploy service to other countries

- Cater to local markets

Thank you!

Questions?

Reach us at
petwhisperers@smartpet.com

Cat Power 1

You could enter a subtitle here if you need it

1

Cats

Here is where your presentation begins

Contents of This Template

Here's what you'll find in this **Slidesgo** template:

1. A slide structure based on a multi-purpose presentation, which you can easily adapt to your needs. For more info on how to edit the template, please visit **Slidesgo School** or read our **FAQs**.
2. An assortment of pictures that are suitable for use in the presentation can be found in the alternative resources slide.
3. A **thanks** slide, which you must keep so that proper credits for our design are given.
4. A **resources** slide, where you'll find links to all the elements used in the template.
5. **Instructions for use**.
6. Final slides with:
    - The **fonts and colors** used in the template.
    - More **infographic resources**, whose size and color can be edited.
    - Sets of **customizable icons** of the following themes: general, business, avatar, creative process, education, help & support, medical, nature, performing arts, SEO & marketing, and teamwork.

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Table of Contents

Cat Power 1

Here you could describe the topic of the section

Cat Power 2

Here you could describe the topic of the section

Cat Power 3

Here you could describe the topic of the section

Cat Power 4

Here you could describe the topic of the section

Whoa!

It could be the part of the presentation where you can introduce yourself, write your email…

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

—Someone Famous

Cat Power 1

You could enter a subtitle here if you need it

Cat Power 1

You could enter a subtitle here if you need it

Cat Power 1

You could enter a subtitle here if you need it

The Slide Title Goes Here!

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

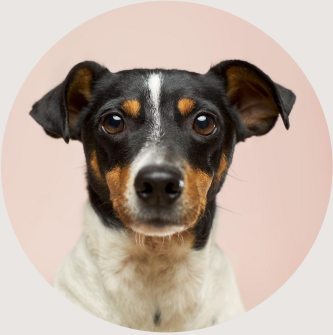
- They’re simple
- You can organize your ideas clearly
- You’ll never forget to buy milk!

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

Maybe You Need to 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 terribly hot, even hotter than Mercury

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You Could Use Three Columns, Why Not?

Mars

Despite being red, Mars is actually a cold place. It's full of iron oxide dust, which gives the planet its reddish cast

Jupiter

It's a gas giant, the biggest planet in the Solar System and the fourth-brightest object in the sky

Venus

Venus has a beautiful name and is the second planet from the Sun. It's terribly hot, even hotter than Mercury

A Picture Always Reinforces the Concept

Images reveal large amounts of data, so remember: use an image instead of long texts

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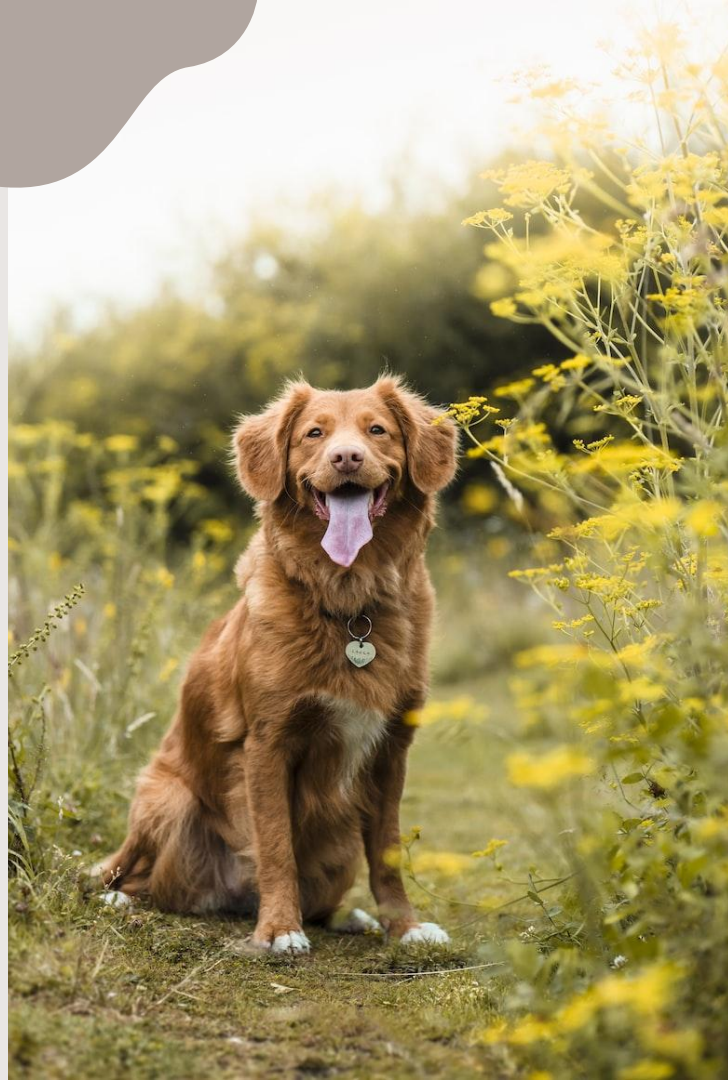

A Picture Always Reinforces the Concept

Images reveal large amounts of data, so remember: use an image instead of long texts

A Picture Is Worth a Thousand Words

Awesome Words

Because key words are great for catching your audience’s attention

What about Four Columns?

Mercury

Mercury is the closest planet to the Sun and the smallest one

Mars

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

Venus

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

Saturn

Saturn is the ringed planet. It's composed of hydrogen and helium

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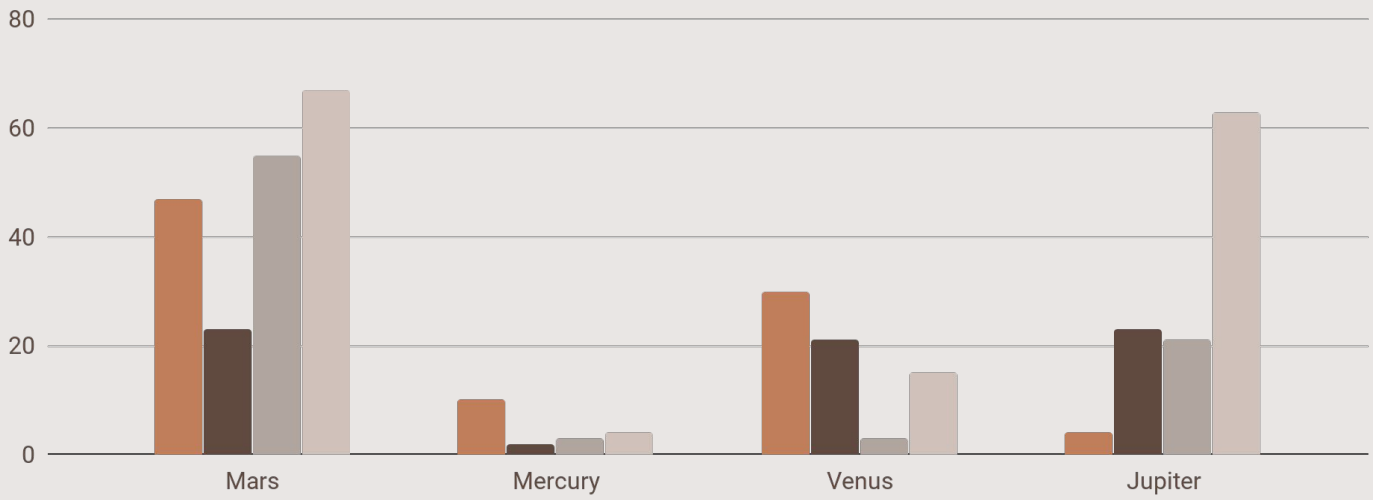
Use a Graph to Show Your Data



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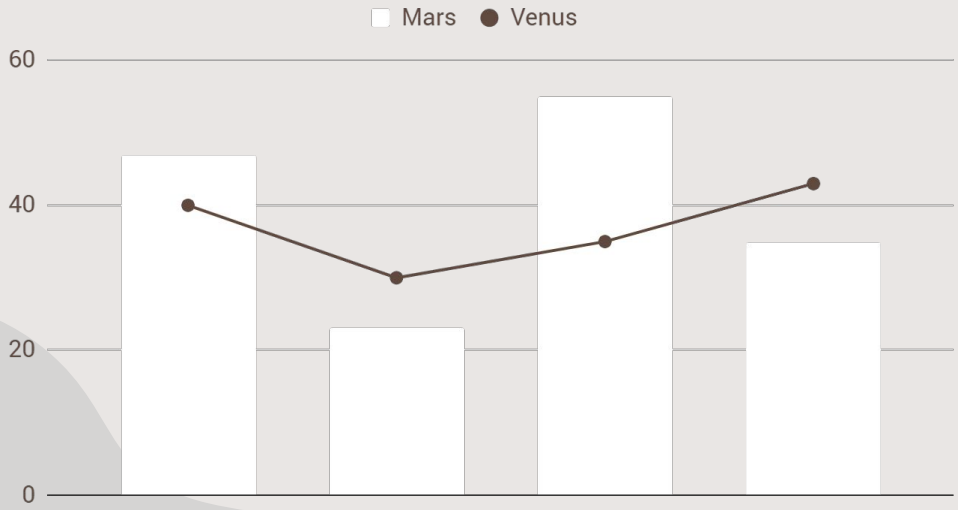
Do You Prefer This Graph?



To modify this graph, click on it, follow the link, change the data and paste the resulting graph here

Mars

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

Venus

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

Cats' Everyday Thoughts

40%

Love

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

25%

Food

Mercury is the closest planet to the Sun and the smallest one

35%

On Their Own

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

Sometimes, Reviewing Concepts Is a Good Idea

Mercury

Mercury is the closest planet to the Sun

Venus

Venus has a beautiful name, but it's terribly hot

Mars

Despite being red, Mars is actually a cold place

Jupiter

It's the biggest planet in the Solar System

Saturn

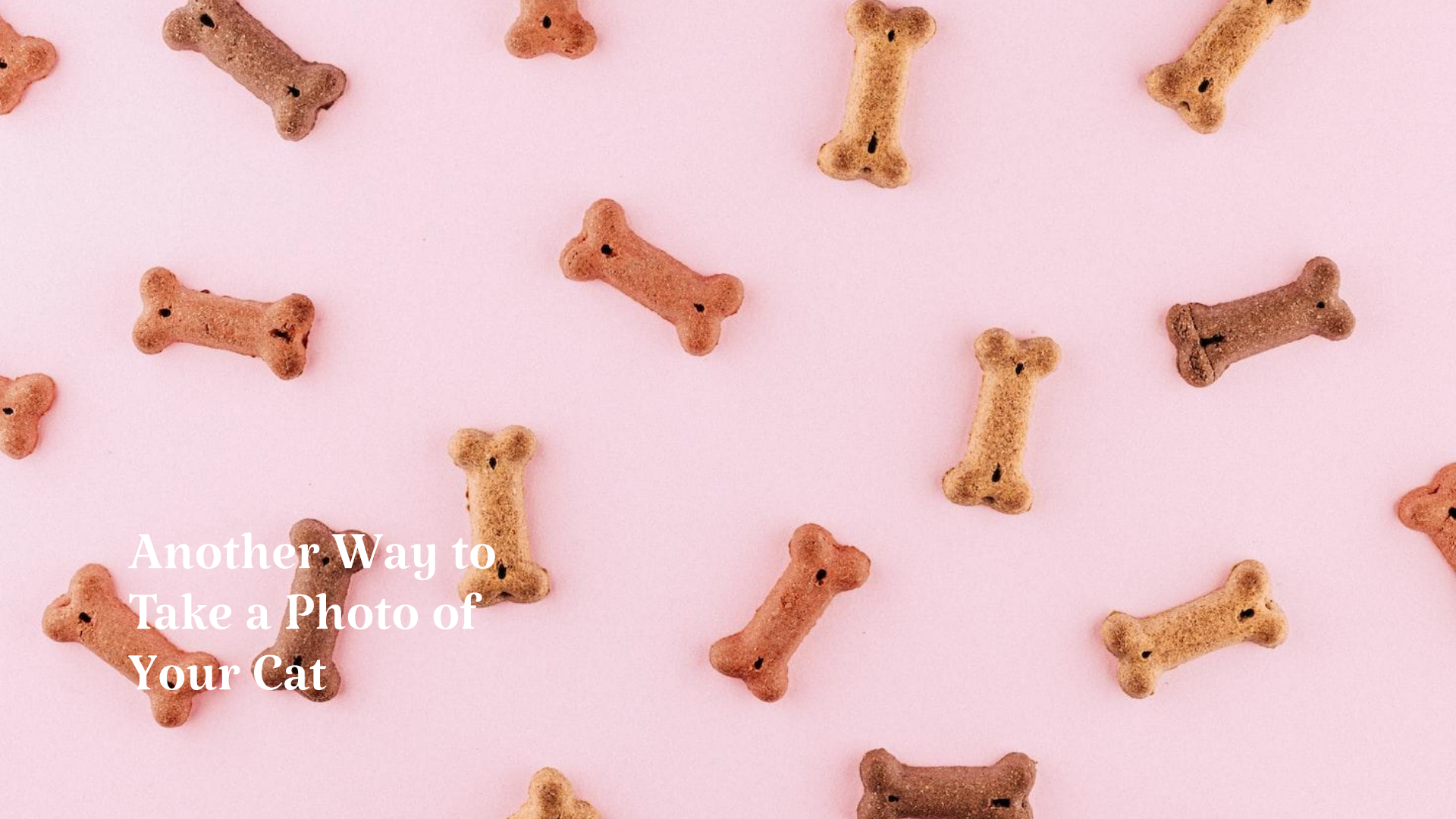
Saturn is the ringed one and a gas giant

Neptune

Neptune is the farthest planet from the Sun

Cat Power 2

You could enter a subtitle here if you need it



Another Way to Take a Photo of Your Cat

Another Way to Take a Photo of Your Cat

Another Way to Take a Photo of Your Cat

Another Way to Take a Photo of Your Cat

Another Way to Take a Photo of Your Cat

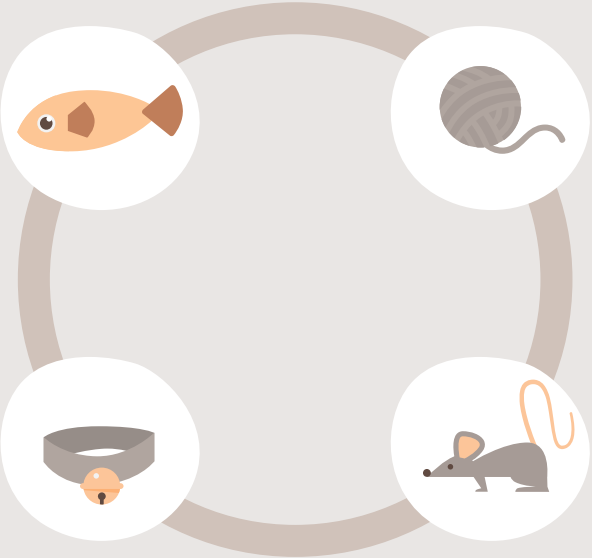
Infographics Make Your Idea Understandable...

Mercury

Mercury is the closest planet to the Sun and the smallest of them all

Venus

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



Mars

Despite being red, Mars is actually a cold place full of iron oxide dust

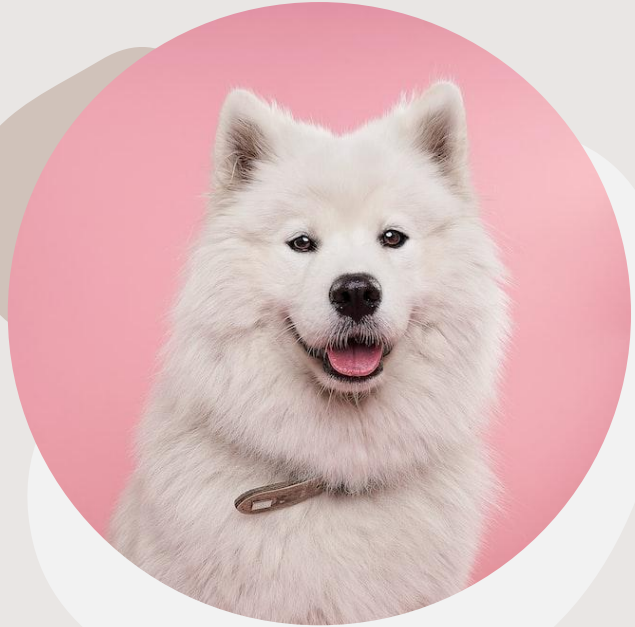
Saturn

Saturn is the ringed planet. It's composed of hydrogen and helium

... And the Same Goes for Tables

	Mass (Earths)	Diameter (Earths)	Surface Gravity (Earths)
Mercury	0.06	0.38	0.38
Mars	0.11	0.53	0.38
Saturn	95.2	9.4	1.16

How about Two Text Boxes?



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 terribly hot—even hotter than Mercury

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This Is a Map

Mars

Despite being red, Mars is actually a cold place

Mercury

Mercury is the closest planet to the Sun

Venus

Venus is the second planet from the Sun

A Timeline Always Works Well

01

Mercury is the closest planet to the Sun and the smallest one

02

Despite being red, Mars is a cold place full of iron oxide dust

03

Jupiter is a gas giant and the biggest planet in the Solar System

04

Neptune is the fourth-largest planet in the Solar System

Cat Power 3

You could enter a subtitle here if you need it

4,498,300

Big numbers catch your audience’s attention

333,000.00

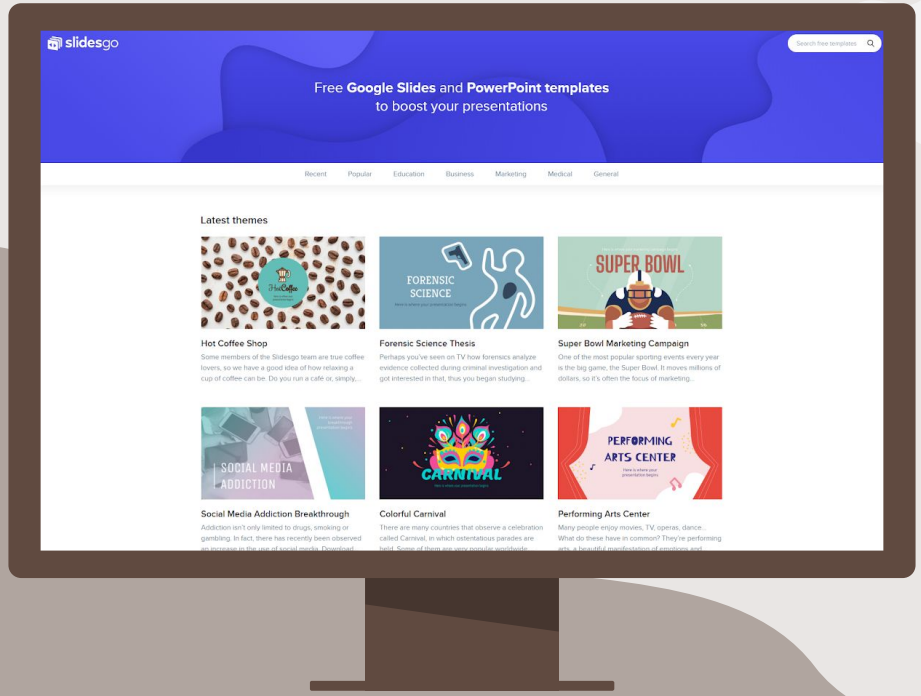
earths is the Sun’s mass

386,000 km

is the distance between the Earth and the Moon

9h 55m 23s

is Jupiter’s rotation period



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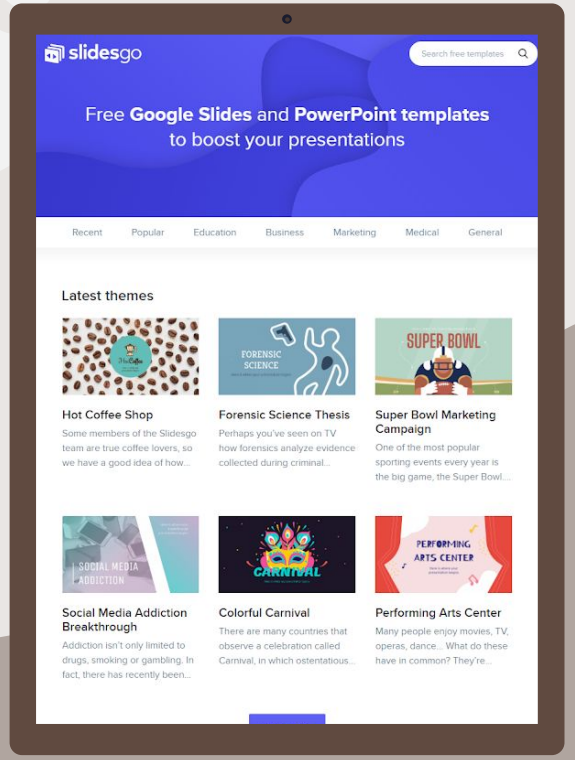

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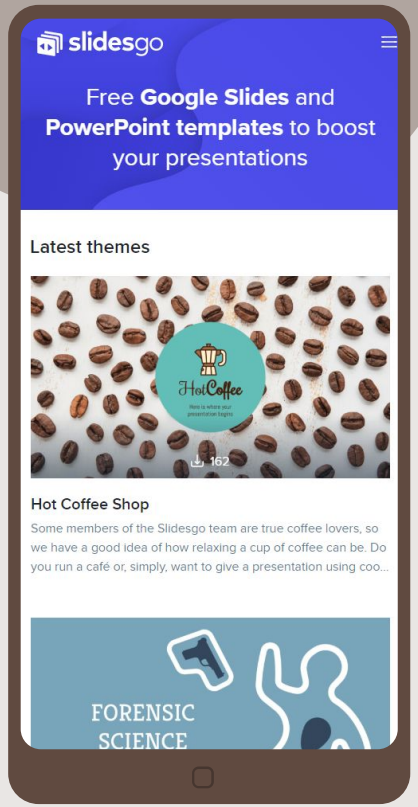

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- Close-up of tabby cat looking away over white background
- Cat looking at wall
- Cute cat with santa hat and gift
- Lovely pets composition with sleepy white cat
- Breakfast tray with a cat
- Copy-space cute cat sitting in owner arms
- White cat sitting on owner shoulder
- Beautiful young woman sitting on wooden chair at patio loving her cat
- Cat playing with feathers on couch
- Lovely cat composition with technological device

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PHOTOS

- Cat having fun with toy on sofa
- Cat sitting on sofa
- Scottish fold cat on blue surface
- Copy-space woman holding cat
- Cute cat with sweater and hat
- Front view domestic cat with chopped ears
- Front view of staring grey british shorthair
- Happy young girl posing with her cat
- Lovely pets composition with sleepy white cat
- Paws of gray cat
- Side view small kitten with fur cap
- High angle cute domestic cat sitting in owner arms
- Close-up cat sitting in owner arms
- Close-up domestic cat looking away
- Cute friendly cat looking at camera
- Lovely pets composition with sleepy white cat

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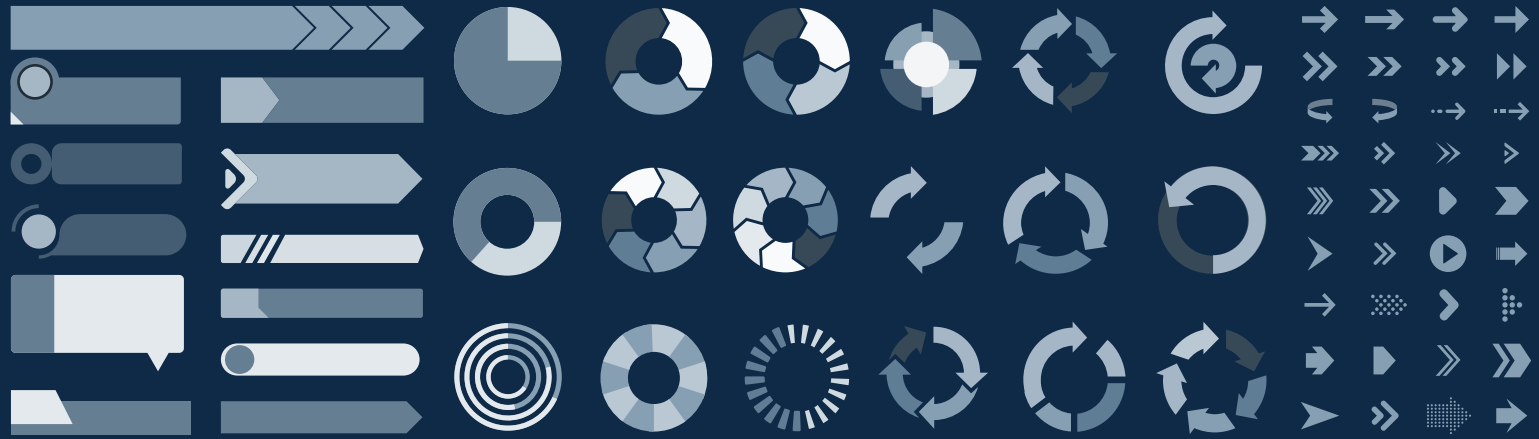

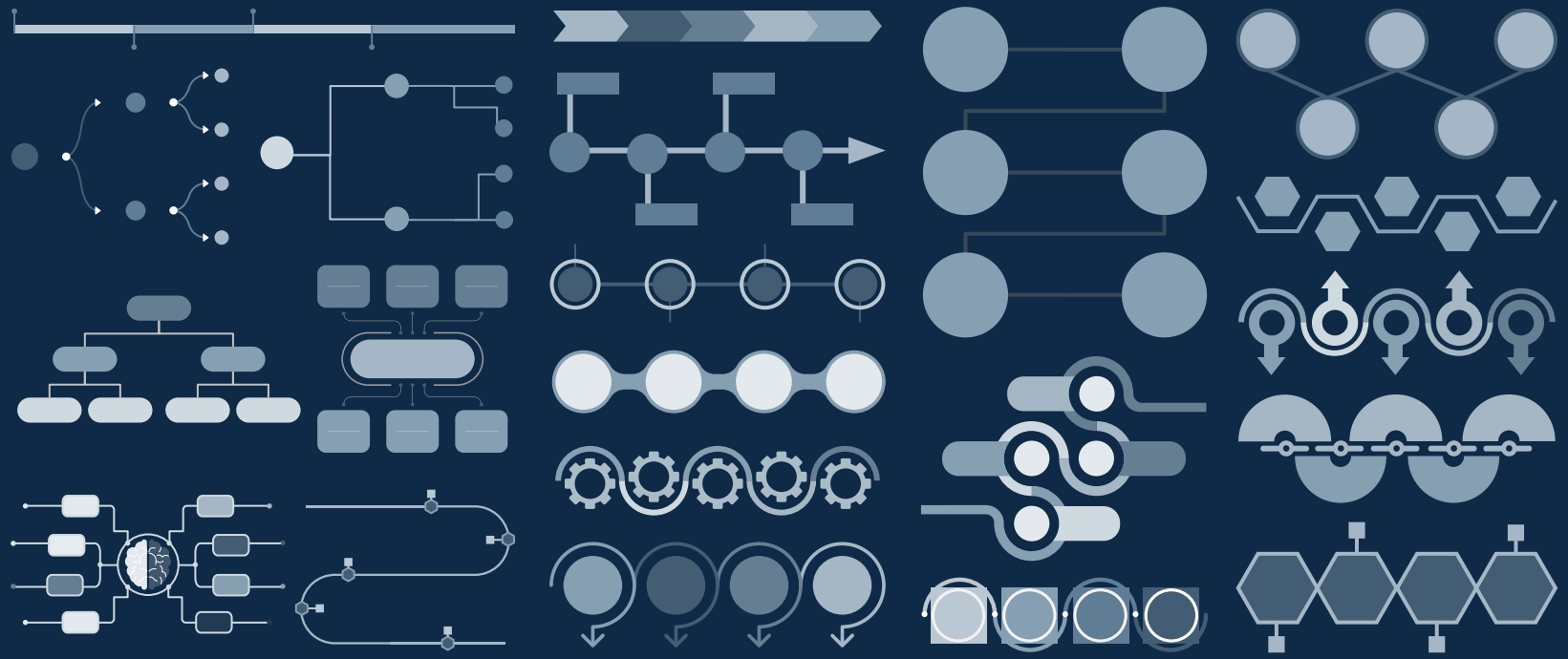

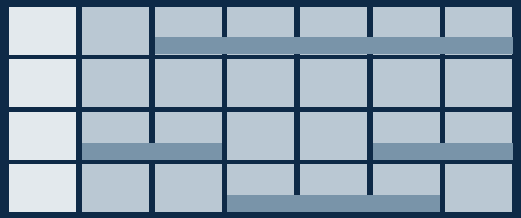

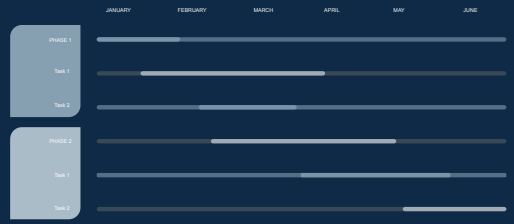
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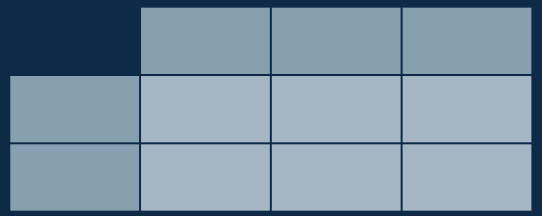
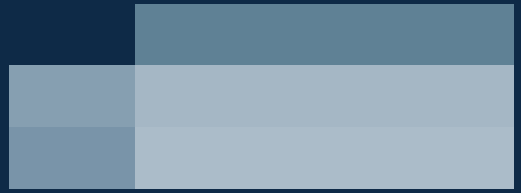
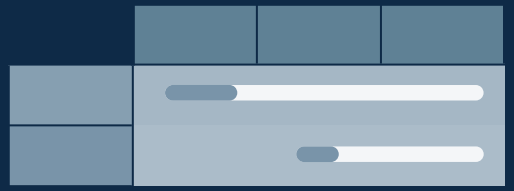
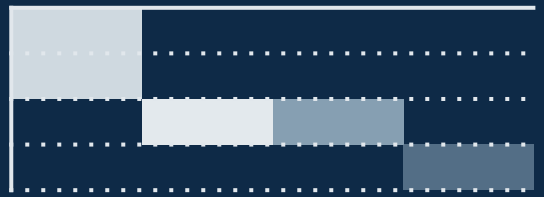
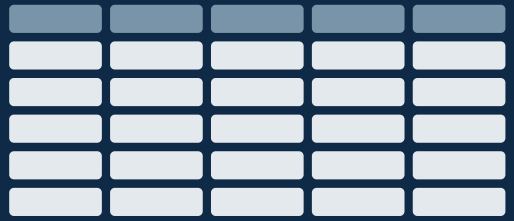
PHASE 1
Task 1
Task 2
PHASE 2
Task 1
Task 2

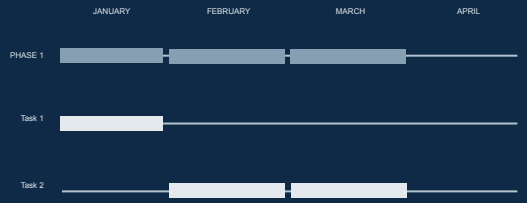








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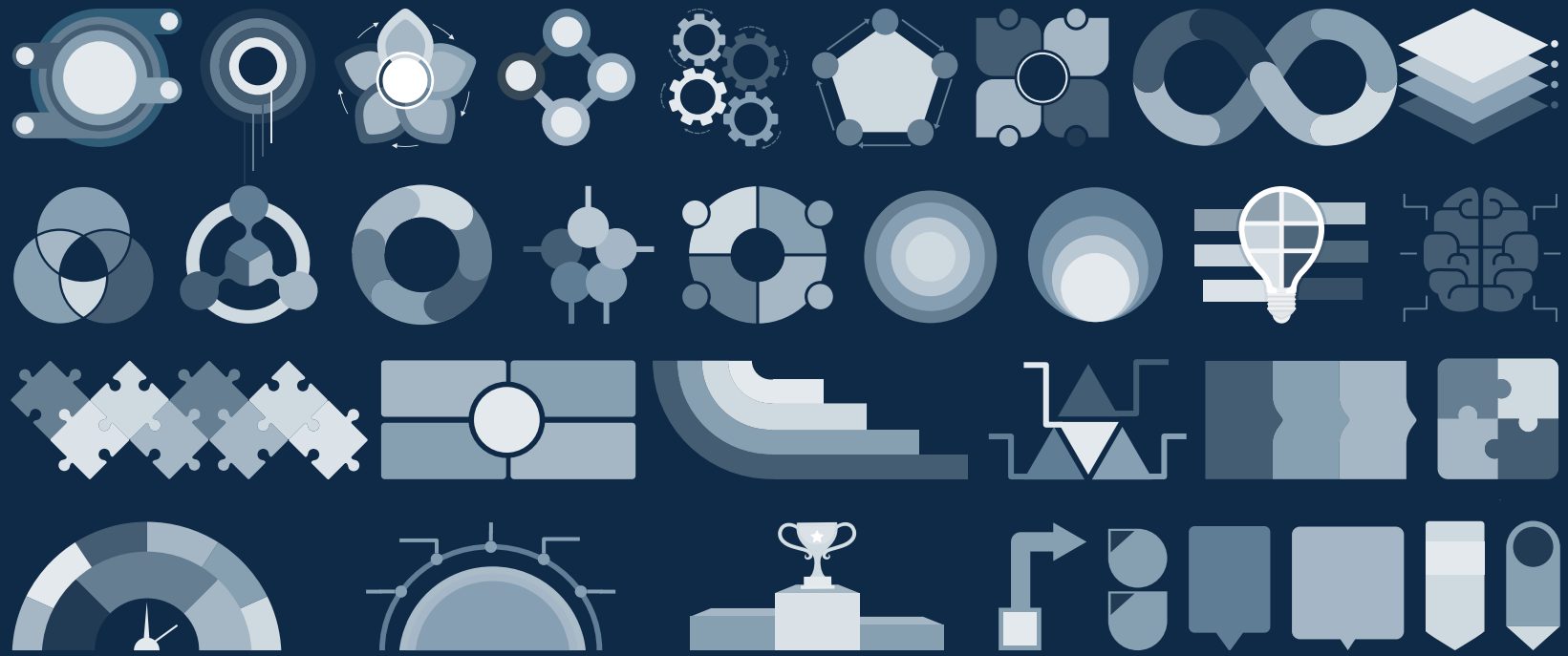
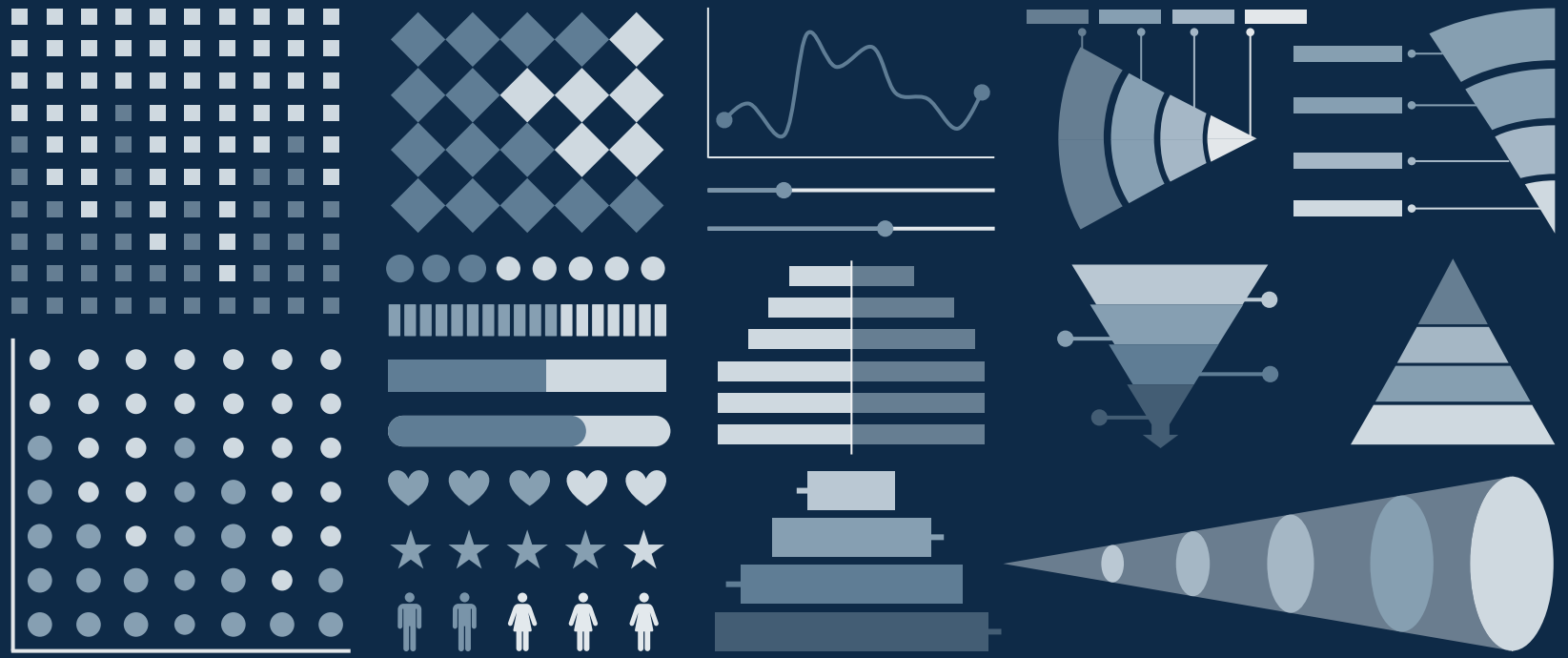
Task 1
Task 2





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