Supplementary - I2MVFormer: Large Language Model Generated Multi-View Document Supervision for Zero-Shot Image Classification

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In this supplementary, we perform additional experiments on I2MVFormer to confirm our design choices. Moreover, we perform further analysis of our LLM prompting strategy to confirm that it is robust to the choice of LLM, the choice of the prompt and the choice of k-shot examples. Finally, we qualitatively analyze the LLM Views to confirm that each view provides complementary information about a class which allows for a highly discriminative zero-shot image classification model.

The content of the supplementary is organized as follows.

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1. Extra experiments for I2MVFormer.

1.1. Performance of the global and the local scores.

I2MVFormer has two scoring heads, s_{CLS} in the I2MVGlobal module and s_{Local} in the I2MVLocalSearch module. Our final model only uses the s_{CLS} head as it achieves better performance. We ablate over training each module separately and jointly in I2MVFormer and report the performance in Table 1. We observe that the two modules have a symbiotic relationship where training both modules jointly achieves the best performance for each head in I2MVFormer. s_{CLS} achieves better performance than s_{Local}. This is a similar observation to [3], where the authors note that it is harder to align fine-grained features than global features. We see this trend continue when we train each module individually, where I2MVGlobal achieves better performance than I2MVLocalSearch.

1.2. Direction of Cross-Modal Attention.

I2MVFormer utilizes an Image-to-Text cross-attention layer in I2MVLocalSearch module. We ablate over other choices of attention, including Text-to-Image cross-attention and Symmetry attention from Image-to-Text and from Text-to-Image. We report results in Table 2. We notice that Image-to-Text attention achieves the best performance for zero-shot and unseen accuracy in generalized zero-shot setting. We notice that Text-to-Image attention generally performs worse in our zero-shot image classification setting. We attribute this to the asymmetry in the information in using text for classification as also noticed by [3]. A document describes the visual components of an image and other non-visual details that are not observed in an image, e.g., what season a flower blooms in. When we use Image-to-Text attention, the model can query for visual information and choose to ignore the irrelevant detail in the text. However, when we use Text-to-Image attention, the model queries for visual as well as non-visual information of the document which isn't observable in an image leading to worse performance. We see that training for symmetric attention leads to the best harmonic mean. However, this comes at the cost of performance on unseen classes, and we, therefore, opt for only including Image-to-Text attention in our I2MVLocalSearch module.

1.3. Number of Summary Tokens in I2MVFormer.

We ablate on the number of summary tokens used in both SVSummary and MVSummary modules in Table 3. These tokens summarise the information in multiple views of a

Model	Scoring Module	Zero-Shot Learning			Generalized Zero-Shot Learning								
		AWA2	CUB	FLO	AWA2			CUB			FLO		
		T1	T1	T1	u	s	H	u	s	H	u	s	H
I2MVGlobal	s_{CLS}	74.1	48.5	39.1	66.7	81.4	73.3	39.7	60.3	47.1	35.3	83.6	49.6
I2MVLocalSearch	s_{Local}	57.7	32.5	24.2	47.4	84.6	60.8	23.8	63.4	34.6	22.1	94.2	35.7
I2MVFormer (ours)	s_{Local}	77.2	47.4	45.0	66.3	75.1	70.4	40.4	59.0	48.0	38.6	86.8	53.4
I2MVFormer (ours)	s_{CLS}	**79.6**	**51.1**	**46.2**	**75.7**	79.6	**77.6**	**42.5**	59.9	**49.7**	**41.6**	91.0	**57.1**

Table 1. **Ablation over the two scoring heads of I2MVFormer.** We observe that the two heads, when jointly trained in I2MVFormer achieve the best performance. Moreover, we observe that the global score s_{CLS} achieves better performance than the local score s_{Local}.

Cross-Modal Attention	Zero-Shot Learning			Generalized Zero-Shot Learning								
	AWA2	CUB	FLO	AWA2			CUB			FLO		
	T1	T1	T1	u	s	H	u	s	H	u	s	H
Image-to-Text	**79.6**	**51.1**	**46.2**	**75.7**	79.6	77.6	**42.5**	59.9	**49.7**	**41.6**	91.0	57.1
Text-to-Image	78.5	49.4	43.8	74.7	74.4	74.6	40.4	61.2	48.7	39.2	80.5	52.7
Symmetric	76.9	50.0	44.1	74.2	**82.9**	**78.3**	39.4	**64.8**	49.0	41.5	**96.7**	**58.1**

Table 2. **Ablation over the direction of attention in I2MVLocalSearch.** We observe that Image-to-Text attention achieves the best result in zero-shot accuracy in ZSL and unseen accuracy in GZSL. Moreover, we see that Text-to-Image attention achieves worse performance due to information asymmetry in the zero-shot image classification problem setting. Finally, we observe that training for both Image-to-Text and Text-to-Image attention improves the seen class performance at the cost of unseen class performance.

Number of Tokens T	AWA	CUB	FLO
	T1	T1	T1
32	72.4	49.4	42.6
64	75.9	**51.1**	45.4
128	**79.6**	51.0	**46.2**

Table 3. **Ablation over Summary Tokens.** We observe that the best performance for CUB is achieved at 64 tokens while the best performance for AWA and FLO is achieved at 128 tokens.

LLM	Zero-Shot Learning		Generalized Zero-Shot Learning					
	AWA2	FLO	AWA2			FLO		
	T1	T1	u	s	H	u	s	H
PaLM 62B	74.0	38.6	66.1	**82.3**	73.3	37.1	70.3	48.6
OPT 66B	74.1	33.6	67.2	81.5	73.7	33.4	84.4	47.8
GPT3 175B	74.2	44.2	68.8	81.0	74.2	40.4	83.4	54.5
PaLM 540B	**76.4**	**44.4**	**72.7**	81.3	**76.8**	**41.1**	**91.1**	**56.6**

Table 4. **Ablating over different LLM**, we observe that our prompting strategy can be used with different LLMs for generating powerful supervision for zero-shot image classification.

class into a fixed number of token features. These token features are used for our I2MVGlobal and I2MVLocalSearch modules. From Table 3 we observe that there is an increase in performance from 32 to 128 tokens on the three datasets. The best performance on CUB is achieved at 64 tokens while the best performance on AWA and FLO is achieved at 128 tokens.

2. Extra Experiments on LLM.

We report additional experiments on LLM prompting in this section. We do not use the Wiki article as a view to only study the quality of LLM-generated text supervision.

2.1. Ablation over different LLM.

In the main manuscript, we ablate over PaLM62B, PaLM540B [2] and GPT3 175B [1] Large Language Models(LLM). We show that our model and prompting can be used with different sizes and families of LLM. We further ablate over OPT66B [7] and report the results in Table 4. We confirm our observation from the main paper that OPT66B also produces good text supervision with our model and prompting. Moreover, we observe a correlation between I2MVFormer performance and the size of the LLM with the PaLM540B, the largest LLM, achieving the best performance.

2.2. Ablation over different k-shot prompts.

Our k-shot prompting involves appending a prompt with the labeled examples which are used as input to the LLM. To test the robustness to a particular prompt, we test the following 4 prompts with the same set of k-shot examples.

Prompt 1: *"A person wants to recognize {**'type'**} in images. They come across {**class name**} and search online for facts about {**class name**}. They think the following descrip-*

	Template Style	Zero-Shot Learning		Generalized Zero-Shot Learning					
		AWA2	FLO	AWA2			FLO		
		T1	T1	u	s	H	u	s	H
a)	Prompt 1	**76.4**	44.4	**72.7**	81.3	**76.8**	41.1	**91.1**	56.6
b)	Prompt 2	73.0	**49.0**	66.4	76.4	71.1	43.2	90.9	58.6
c)	Prompt 3	70.4	40.4	61.3	**83.9**	70.9	39.4	88.0	54.5
d)	Prompt 4	72.7	46.7	65.4	79.1	71.6	**45.5**	83.7	**58.9**

Table 5. **Ablation Over Different Prompts.** We observe that the LLM can generate good text views with different prompts. This makes the use of LLM appealing for generating text for ZSL as we do not require extensive prompt engineering.

	k-shot Examples	Zero-Shot Learning		Generalized Zero-Shot Learning					
		AWA2	FLO	AWA2			FLO		
		T1	T1	u	s	H	u	s	H
1)	Set 1	**76.4**	**44.4**	**72.7**	81.3	**76.8**	**41.1**	**91.1**	**56.6**
2)	Set 2	75.6	43.2	67.6	**81.5**	73.9	39.4	86.8	54.2
3)	Set 3	74.6	43.1	72.3	74.4	73.3	37.6	86.4	52.4

Table 6. **Ablation over different sets of k-shot examples.** We observe that our prompting strategy is fairly robust to the choice of specific k-shot examples used to prompt the LLM.

tion of {***class name***} *is a good description.".*

Prompt 2: *"Write a blog post on '*{***class name***}*' that lists all attributes of '*{***class name***}*'.*

Prompt 3: *"We want to train an algorithm to classify images of* {***'type'***}*. We require a rich description of* {***class name***} *containing discriminative attributes that can be seen in an image. We think the following is a good description of* {***class name***}*.*

Prompt 4: *"A person wants to train an image classification model for* {***'type'***}*. While curating facts about different* {***'type'***} *they come across* {***class name***} *and search the internet for a good description of* {***class name***}*. They think that following description of* {***class name***} *is a good description.*

In the given templates, we use type as "animals", "birds" and "flowers" for AWA2 [6], CUB [5] and FLO [4], respectively, moreover {**class name**} defines the name of the labelled class.

From Table 5 we observe that all 4 prompts achieve competitive performance. This confirms that our prompting strategy can be used for different datasets without requiring extensive prompt engineering.

2.3. Ablation over different sets of k-shot examples.

To test robustness to a particular set of k-shot examples used to prompt the LLM, we ablate over 3 different sets and report performance in Table 6. For each set, we randomly select three classes for each dataset and curate their wiki articles from [3] to remove noise. We provide the examples later in Section 4. We observe that each set of randomly selected examples used to prompt the LLM achieves competitive performance further validating that our method can scale without extensive prompt engineering.

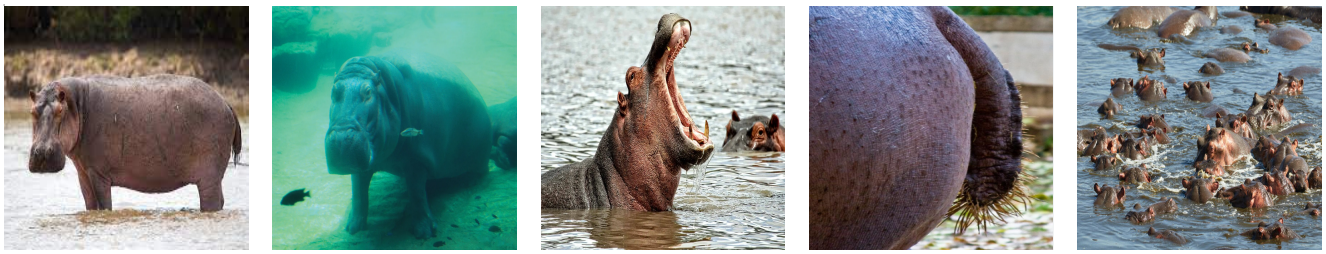
2.4. Qualitative Examples of Different Views.

In this section, we qualitatively analyze the information present in each LLM and Wiki view in Figures. 1,2,3,4, 5,6. We prompt the LLM in the 2-shot manner as presented in Section. 3 of our manuscript. In each figure, we highlight the class information that is unique to each view. This information in each view is complementary to each other and helps I2MVFormer learn a more discriminative zero-shot model. We underline the information that is not present in the Wiki article released by [3] but was generated by the LLM. This information shows that LLM can complement human-curated knowledgebases like Wikipedia with extra knowledge available from other sources on the internet.

2.4.1 AWA2.

Figure. 1 shows qualitative results of class **"Hippopotamus"**. We observe that all views contain complementary information to Wiki in Figure. 1. LLM View 1 focuses on the genus information and provides useful physical information, such as hinting at the Hippopotamus's similarity with pigs and toed ungulates. LLM View 2 provides new information about physical attributes such as 'charcoal-grey' color, the mouth that can open 150 degrees, description of hair, and the measurements of the thickness of their skin. LLM View 3 focuses on behavioral attributes such as Hippos' tendency to be territorial and dangerous to humans. LLM View 3 provides useful physical information like skin's "greyish-brown" color and sparse hair. Furthermore, the Wiki view contains information not present in any LLM View, such as length of teeth, swimming abilities, and physical aspects that enable Hippos to be good swimmers.

Figure. 2 shows qualitative results of class **"Giraffe"**. We repeat our observation that all the views contain unique and complementary information. All LLM Views provide novel facts on the physical measurements of a Giraffe, such as the length of the neck, overall height, and length of the tongue. LLM View 1 provides unique information about the material of horns and a Giraffe's dietary habits. LLM View 2 distinguishes between male and female giraffes and also provides more facts about a Giraffe's diet, drinking, and behavior. LLM View 2 describes a Giraffe's skin pattern in a novel way by stating that the skin is covered with large irregular spots, usually red-brown to orange-brown. LLM View 2 further provides information about a Giraffe's weight and reaffirms other attributes such as height, length of neck, and description of legs. LLM View 3 provides novel facts about the social behavior of Giraffes, such as grieving for their dead and approaching humans out of curiosity. LLM View 3 also reaffirms the facts about the physical attributes such as height and length of the tongue. Fi-



Wiki View:

The Hippopotamus is a large semi-aquatic mammal that is found wallowing in the rivers and lakes across sub-Saharan Africa. The Hippopotamus has an enormous grey barrel-shaped body that can measure up to five meters in length and weigh more than four tonnes, and which is held up by short and stocky legs. One of the Hippopotamus's most distinctive features is their enormous jaws which contain two long canine teeth (tusks) which can grow up to 50 cm long and are used for fighting. Due to the fact that the Hippopotamus is an animal that spends most of its life resting in the water, they have a number of excellent adaptations to aid their semi-aquatic lifestyle including four webbed toes on each foot that help with swimming and walking on slippery banks, and the eyes, ears and nostrils of the Hippopotamus are situated on the top of its head. This means that when the Hippopotamus's body is immersed in the water, they are still able to see, hear and breath whilst keeping cool in the hot sun.

LLM View 1:

The hippopotamus is a large, mostly herbivorous mammal in sub-Saharan Africa, and one of only two extant species in the family Hippopotamidae (the other is the pygmy hippopotamus). The name comes from the ancient Greek for "river horse". After the elephant and rhinoceros, the hippopotamus is the third-largest type of land mammal and the heaviest extant artiodactyl. Despite their physical similarity to pigs and other terrestrial even-toed ungulates, the closest living relatives of the Hippopotamus are cetaceans (whales, dolphins, porpoises, etc.) from which they diverged about 55 million years ago. The common ancestor of whales and hippopotamuses split from other even-toed ungulates around 90 million years ago. The earliest known hippopotamus fossils, belonging to the genus Kenyapotamus in Africa, date to around 16 million years ago.

LLM View 2:

The hippopotamus is a large, charcoal-grey mammal with short legs, a big body and a huge head. They can weigh up to 3,500kg (7,700lb) and grow to be up to 5m (16ft) long. They have a long, wide mouth that can open to 150 degrees, revealing large teeth. They have a thin, mane-like layer of hair that runs along their spine, and their skin is very thick (up to 50cm, or 20in, thick in some places). They are very good swimmers, and can hold their breath for up to 6 minutes underwater. They are mostly herbivorous, and eat up to 80kg (180lb) of vegetation per day. They are found in Africa, and live in rivers, lakes and swamps.

LLM View 3:

The hippopotamus is a large, herbivorous mammal that is native to sub-Saharan Africa. Hippos are one of the largest land mammals, and can grow to be 14 to 16 feet long and weigh up to 3,000 pounds. They have a barrel-shaped body, short legs, and a huge head with a wide mouth. Their skin is thick and grayish-brown in color, and is covered in short, sparse hair. They have small eyes and ears, and their nostrils and lips can close underwater. Hippos are very social animals, and live in groups of up to 30 individuals. They are very aggressive, and have been known to attack and kill humans. They are also very territorial, and will often fight to the death over their territory. Hippos are one of the most dangerous animals in Africa, and are responsible for more human deaths than any other animal on the continent.

Figure 1. **Wiki and LLM Views for Hippopotamus.** We observe that each view provides complementary information about the class. We underline the information that is unique compared to the Wiki article. We highlight the information that is unique to each view. We confirm our hypothesis that each view of the LLM provides new facts about a class. This increased information available in the LLM-generated views contribute to learning a highly discriminative zero-shot image classification model.

nally, the Wiki View contains considerable unique information that is not present in any LLM View, such as the Giraffe's height advantage to find food, facts about bones in the neck, the utility of the tail to keep flies away and information about the skin pattern and color of Giraffes.

2.4.2 CUB.

Figure. 3 shows qualitative results for class **"Purple Finch"**. We repeat our observation that all views contain unique and complementary information. LLM View 1 provides novel facts about the habitat of the bird along with physical attributes such as a short neck and short blunt beak. Furthermore, LLM View 1 provides a description of the bird's dominant color by defining the color of males' heads as rosy red. LLM View 2 provides more details on the habitat and information about migration and sexual behavior. LLM View 2 also provides a description of the bird's colors, defining the face as reddish-brown and the rump as pale gray. LLM View 2 further provides a more detailed distinc-

Wiki View:
The Giraffe is an animal with an enormously long neck which allows it to exploit the leaves and vegetation that are too high up for other animals to find. Despite their length, the neck of the Giraffe actually contains the same number of bones as numerous other hoofed mammals but they are simply longer in shape. The Giraffe's elongated neck leads into a short body, with long and thin, straight legs and a long tail that is tipped with a black tuft that helps to keep flies away. The Giraffe tends to be white in colour with brown or reddish markings that cover its body (with the exception of their white lower legs). The markings of each Giraffe are not only unique to that individual but they also vary greatly between the different Giraffe species in size, colour and the amount of white that surrounds them. All Giraffes though have large eyes that along with their height give them excellent vision, and small horn-like ossicones on the top of their heads. Giraffes are animals that inhabit open woodlands and savannah where using their height they are able to see for great distances around them to watch out for approaching danger.

LLM View 1:
The giraffe is a tall, long-necked mammal. They are the tallest living land mammals, and can grow to be 18 to 20 feet tall. They have a long neck, which can be up to 8 feet long, and a long tail. They have a small head, with large eyes and small ears. They have two horns, which are made of keratin. They are herbivorous, and eat leaves, flowers, and fruits. They are social animals, and live in herds of up to 30 individuals. They are found in Africa, and are a popular tourist attraction.

LLM View 2:
The giraffe is a tall, long-necked, even-toed ungulate mammal native to Africa. Its coat is patterned with large, irregular spots, and it is usually red-brown to orange-brown in color. The average giraffe is about 18 feet (5.5 meters) tall, with males taller than females. The tallest recorded giraffe was about 21.5 feet (6.6 meters) tall. They are the tallest living land animals. Giraffes weigh between 1,600 and 3,000 pounds (725 and 1,360 kilograms). They have very long necks, which can be up to 7 feet (2.1 meters) long, and very long legs. Their necks are so long that they have to spread their front legs wide apart to reach the ground to drink. They also have very long tongues, which can be up to 20 inches (50 centimeters) long. They use their tongues to strip leaves off of trees. Giraffes are herbivores, and their diet consists mostly of leaves from trees and bushes. They are browsers, and they do not compete with grazers for food. Giraffes are social animals, and they live in herds of up to 50 individuals.

LLM View 3:
The giraffe is a large mammal that is easily recognizable thanks to its long neck and legs. Giraffes are the tallest mammals in the world, and can grow to be 18 to 20 feet tall. They have a long, protruding tongue that can be up to 18 inches long, and their eyes are relatively large in comparison to their body size. Giraffes are very social animals that live in herds of up to 20 individuals. They are very curious and playful, and have been known to approach humans out of curiosity. Giraffes are very emotional creatures, and have been known to grieve for their dead. They have a long life span, but a slow rate of reproduction, which has led to them being classified as a vulnerable species.

Figure 2. **Wiki and LLM Views for Giraffe.** We observe that each view provides complementary information about the class. We underline the information that is unique compared to the Wiki article. We highlight the information that is unique to each view. We confirm our hypothesis that each view of the LLM provides new facts about a class. This increased information available in the LLM-generated views contribute to learning a highly discriminative zero-shot image classification model.

tion between males, females, and juveniles by stating that females are duller but they maintain the streaking on flanks. LLM View 2 also provides a comparison with the similarly looking house finch bird species for better distinction. LLM View 3 also defines the bird's face as reddish brown. LLM View 3 provides information about the small patch of orange or yellow colour below the bird's eyes. LLM View 3 also provides information about the color of the beak that changes in summers and winters from black to brown. LLM View 3 further provides information about the dietary and nesting behavior of the bird. Furthermore, Wiki view defines the bird's dominant color as raspberry red and defines the tail as short, brown, and forked. Finally, the Wiki View mentions a white line on the face above the eye that is not present in any other view. Length and weight measurements in the Wiki view are repeated across all 3 LLM Views. In conclusion, all views provide unique as well as complementary information leading to a diverse collection of facts about the class.

Figure. 4 shows qualitative results for class **"Mangrove**

Wiki View:
The purple finch (Haemorhous purpureus) is a bird in the finch family, Fringillidae. Adults have a short forked brown tail and brown wings. Adult males are raspberry red on the head, breast, back and rump; their back is streaked. Adult females have light brown upperparts and white underparts with dark brown streaks throughout; they have a white line on the face above the eye. Measurements: Length: 4.7-6.3 in (12-16 cm) Weight: 0.6-1.1 oz (18-32 g) Wingspan: 8.7-10.2 in (22-26 cm)

LLM View 1:
The purple finch (Haemorhous purpureus) is a small North American songbird, a member of the true finch family. Breeding in the coniferous forests of the boreal regions of Canada and the northern United States, it is a rare but regular vagrant to the western Palearctic. It is a bird of medium size with a short neck and short blunt beak. It is overall a plump bird with a wingspan of about 20 cm (8 in). The male is easily identified by its bright rosy-red head and breast, with a pale brown back, grey wings and tail. The brow is white and there are 2 white wing bars. Females and immature birds are much duller, with an overall brownish coloration, but still retain the distinctive wing bars. The song is a repetitive chek-chek-chek, weaker and more monotonous than that of the house finch.

LLM View 2:
The purple finch (Haemorhous purpureus) is a finch species found in North America. The purple finch is broadly distributed across Canada and the northern United States. It is a local breeder in southern Canada and the northern United States. It is strongly migratory, with northern birds wintering in the southern United States and Mexico. This bird is sexually dimorphic. The adult male has reddish-brown upperparts with some streaking, and brownish underparts with some streaking on the flanks. The crown and face are generally reddish-brown, and the rump is pale gray. The adult female is similar to the male, but duller overall. The female also has streaking on the flanks that is often more extensive than in the male. Juveniles resemble the female, but are paler overall and have more extensive streaking. Both sexes have two white wing bars and a white tail with dark streaks. The bill is black and the legs are black. The plumage of both the male and the female purple finch is variable, and the female is often mistaken for a sparrow. The purple finch is slightly larger than a house finch and is on average 12.5 cm (5 in) long with a wingspan of 21 cm (8.3 in). The adult male purple finch weighs 25 g (0.88 oz) on average, while the adult female weighs 22 g (0.78 oz). The song of the purple finch is a loud, monotonous twitter that is similar to the song of the house finch.

LLM View 3:
The purple finch (Haemorhous purpureus) is a bird in the finch family. It is also known as the common finch, hinge, or purple fincher. The adult measures 11 to 13 cm (4.3 to 5.1 in) in length with a wingspan of 18 to 21 cm (7.1 to 8.3 in). It has a stout bill and the head is large. Adults have a reddish brown back, wings, and tail. The underparts are buff or whitish. The flanks are streaked with brown or black. The crown is brownish red and there is a small patch of orange or yellow below each eye. The bill is black in winter and brown in summer. Juveniles are brown above with buff underparts. The bill is brown. The purple finch is found in open woodlands, farmlands, and gardens. It is a seed-eater but also takes insects when feeding young. The nest is built in a tree or bush and is made of twigs, bark, and grasses. The female lays 3 to 5 eggs which are incubated for 12 to 14 days.

Figure 3. **Wiki and LLM Views for Purple Finch.** We observe that each view provides complementary information about the class. We underline the information that is unique compared to the Wiki article. We highlight the information that is unique to each view. We confirm our hypothesis that each view of the LLM provides new facts about a class. This increased information available in the LLM-generated views contribute to learning a highly discriminative zero-shot image classification model.

Cuckoo". We repeat our observation that all views contain unique and complementary information. LLM View 1 provides novel facts about habitat, migration, and visual information about the bird, such as the length and color of different parts of the bird's body. LLM View 2 provides differences between males and females of the species. LLM View 2 differentiates juvenile birds from adults by stating that they are browner overall and have more extensive streaking on the underparts. LLM View 3 expands more on the habitat of the bird and its nesting behavior. LLM View 3 also mentions novel physical descriptions by stating the bill as slim, black, and the tail as shorter. LLM View 3 further differentiates juveniles from adult birds by describing the buff streaks on the throat and breasts. Furthermore, Wiki View provides unique visual and non-visual information, such as the bird's black facial mask, buffy underparts, and the bird's call. The Wiki View also provides facts about habitat, bird body measurements, and weight.

Wiki View:

The mangrove cuckoo (Coccyzus minor) is a species of cuckoo that is native to the Neotropics. Adults have a long tail, brown above and black-and-white below, and a black curved bill with yellow on the lower mandible. The head and upper parts are brown. There is a yellow ring around the eye. This bird is best distinguished by its black facial mask and buffy underparts. Although the scientific name is minor (meaning \"small\"), this species is on average the largest of North America's three Coccyzus cuckoos. Adults measure 28–34 cm (11–13 in) in length, weigh 64–102 g (2.3–3.6 oz) and span 38–43 cm (15–17 in) across the wings. The most common call heard is a guttural "gawk gawk gawk gawk gauk gauk". It will also call a single "whit"

LLM View 1:

The Mangrove Cuckoo (Coccyzus minor) is a small cuckoo of the Americas. It occurs in Cuba, the Bahamas, the Greater Antilles, and much of Central and South America. It is a migrants, wintering in Mexico and Central America. This is a bird of mangrove swamps, where it can be difficult to see as it creeps about in the dense foliage or perches quietly. It is less often seen in other types of forest. The Mangrove Cuckoo is a small cuckoo, measuring 23 cm (9.1 in) in length. The upperparts are grayish brown, with darker streaks on the back. The underparts are white, streaked with gray on the breast and flanks. The bill is black, and the legs are gray. The Mangrove Cuckoo is a fairly common bird, and its numbers appear to be stable. It is not considered to be threatened at this time.

LLM View 2:

The Mangrove Cuckoo is a smallish cuckoo. It is overall grayish or brownish with some white on the underparts, and has a long tail that is black-and-white barred. It has a red eye and a long, curved bill. The legs are black. Females are similar to males, but may have a bit more brown on the upperparts. Juvenile Mangrove Cuckoos are browner overall and have more extensive streaking on the underparts. This cuckoo is found in mangrove forests and other wooded habitats near coasts, mainly in the Caribbean. It is a shy bird that is often heard before it is seen. The Mangrove Cuckoo's call is a loud, metallic kuk-kuk-kuk-kuk.

LLM View 3:

The Mangrove Cuckoo (Coccyzus minor) is a small cuckoo of the New World. This tropical bird is a resident breeder from extreme southern Texas in the United States south through Mexico, Central America and the West Indies to northern Argentina, Uruguay and southern Brazil. It is a bird of mangrove swamps and other wet woodlands. Like other cuckoos, it is a brood parasites, which means it lays its eggs in the nests of other bird species, such as the Yellow-billed Cuckoo. The adult is about 15.2 cm (6.0 in) long and weighs about 35 g (1.2 oz). It is grey above, with a white throat and underparts, and a slim black bill. The female is slightly smaller than the male, and has a shorter tail. The juvenile is browner above and has buff streaks on the throat and breast. This is a shy bird which is hard to see in the foliage of its swampy habitat. The only vocalization is a repetitive chuck sound.

Figure 4. **Wiki and LLM Views for Mangrove Cucko.** We observe that each view provides complementary information about the class. We underline the information that is unique compared to the Wiki article. We highlight the information that is unique to each view. We confirm our hypothesis that each view of the LLM provides new facts about a class. This increased information available in the LLM-generated views contribute to learning a highly discriminative zero-shot image classification model.

2.4.3 FLO.

Figure. 5 shows qualitative results for class **"Garden Phlox"**. We repeat our observation that all views contain unique and complementary information. LLM View 1 provides measurements for flower heads, colours for petals, and habitat and usage of the flower. LLM View 2 provides a novel description of the flower's foliage, new habitat information, and a novel visual description of the flower itself. LLM View 3 provides new genus information, a new visual description of the flower's petals, propagation method, and usage. LLM View 3 also provides the shape and measurement of leaves not present in Wiki View. LLM View 1 and LLM View 2 provide a range of colors for flower(white, pink, red, purple, and lavender). All views provide visual information not originally present in Wiki View, such as measurements for flowers, petals, and leaves. While Wiki View provides an overview of physical attributes, LLM Views share finer details about the flower, such as different colors and the shape of leaves and stems.

Figure. 6 shows qualitative results for class **"Bird of Paradise"**. LLM View 1 provides unique information about the height of the flower. LLM View 1 provides new information on the visual appearance, such as the curved shape of the beak. In addition, LLM View 1 provides information

Wiki View:
Phlox paniculata is a species of flowering plant in the phlox family (Polemoniaceae). It is native to parts of the eastern and central United States. It is extensively cultivated in temperate regions as an ornamental plant and has become established in the wild in scattered locales in other regions. Common names include fall phlox, garden phlox, perennial phlox, summer phlox, and panicled phlox. Phlox paniculata is an erect herbaceous perennial growing to 120 cm (47 in) tall by 100 cm (39 in) wide, with opposite, simple leaves on slender green stems. The flowers are 1.5–2.5 cm (0.6–1.0 in) in diameter, often strongly fragrant and borne in summer through fall (autumn). The flowers are grouped in panicles (with many branching stems), hence the specific epithet paniculata. Typical flower colors in wild populations are pink or purple (rarely white). Fall phlox is native to parts of the central and eastern United States. It occurs as an introduced species in other parts of the United States, Canada, Europe, and Asia.

LLM View 1:
Garden phlox (Phlox paniculata) is a summer-blooming perennial. The flower heads are large, up to 8 in (20 cm) across, and are borne in large panicles. The individual flowers have five petals which may be white, pink, red, or purple. The plant is native to the eastern United States, where it is found in woodlands, prairies, and along roadsides. Garden phlox is a popular garden plant, grown for its showy flowers. It is also used as a cut flower.

LLM View 2:
The garden phlox is a hardy, upright, herbaceous perennial that typically grows 3-5' tall and forms a dense, bushy mound of foliage. It is native to open woods, rocky hillsides and stream banks in the southeastern and south-central U.S. (Kentucky to Texas). This plant features tubular, five-lobed, lavender to pink flowers (to 1" across) which bloom in panicles (to 8-12" long) from mid-summer to fall. Each flower has a small, dark eye. Fragrant flowers attract butterflies, bees and hummingbirds. Lance-shaped, medium green leaves (to 4" long) are opposite. Genus name comes from the Greek word phlox meaning flame in probable reference to the intense flower colors of some species. Specific epithet means growing in woods.

LLM View 3:
The garden phlox (Phlox paniculata) is a native of the eastern United States and is one of the most popular garden flowers. It is a tall, upright plant with clusters of fragrant, showy flowers in a wide range of colors. The garden phlox is a member of the Polemoniaceae, or phlox family, which also includes the related wildflower, Phlox drummondii. The garden phlox is a perennial plant that grows from 2 to 5 feet tall. The leaves are opposite, lanceolate, and 2 to 6 inches long. The flowers are borne in dense, pyramidal clusters at the ends of the stems. Each flower has five petals that are fused at the base to form a tube. The petals range in color from white to pink, purple, or red and are often striped or flecked with another color. The flowers bloom from late spring to early summer. Garden phlox is propagated by rooted stem cuttings or by dividing the rootstocks. It is a popular plant for borders, mass plantings, and cut flowers.

Figure 5. **Wiki and LLM Views for Garden Phlox flower.** We observe that each view provides complementary information about the class. We underline the information that is unique compared to the Wiki article. We highlight the information that is unique to each view. We confirm our hypothesis that each view of the LLM provides new facts about a class. This increased information available in the LLM-generated views contribute to learning a highly discriminative zero-shot image classification model.

on the genus and habitat of the flower. LLM View 2 provides habitat information in addition to the novel description of the visual appearance of the flower. LLM View 3 describes the flower's leaves as large, broad, green, and arranged in a spiral pattern. LLM View 3 provides a novel description of the climate in which the flower blooms, i.e. tropical climate, and expands on the habitat information and the flower's significance in different cultures like Hawaiian, Maori, and Polynesian. LLM View 3 also describes the beak of the flower that attracts birds for pollination. Finally, the Wiki View provides more details about the different flower species and their origin and attributes. In addition, Wiki View provides unique visual information, such as the height of the flower and the shape of foliage described as a fan-like crown. Wiki view also provides information on pollination.

We observe that each view contains unique information as well as redundant information that reaffirms the information from other LLM Views and Wiki view. In conclusion, our prompting methodology leads to a diverse collection of facts about a class. I2MVFormer further exploits these diverse collection of facts to learn a robust zero-shot classifier.

Wiki View:
Strelitzia /strɛˈlɪtsiə/ is a genus of five species of perennial plants, native to South Africa. It belongs to the plant family Strelitziaceae. The genus is named after Queen Charlotte of the United Kingdom. A common name of the genus is bird of paradise flower/plant, because of a resemblance of its flowers to birds-of-paradise. In South Africa, it is commonly known as a crane flower and is featured on the reverse of the 50-cent coin. It is the floral emblem of the City of Los Angeles; two of the species, S. nicolai and S. reginae, are frequently grown as houseplants. The species S. nicolai is the largest in the genus, reaching 10 m (33 ft) tall, with stately white and blue flowers; the other species typically reach 2.0 to 3.5 m tall, except S. caudata, which is a tree of a typically smaller size than S. nicolai. The leaves are large, 30–200 cm long and 10–80 cm broad, similar to a banana leaf in appearance, but with a longer petiole, and arranged strictly in two ranks to form a fan-like crown of evergreen foliage. The flowers are produced in a horizontal inflorescence emerging from a stout spathe. They are pollinated by sunbirds, which perch on and drink from the spathe. The weight of the bird when standing on the spathe opens it to release the pollen onto the bird's feet, which is then deposited on the next spathe it visits. Strelitzia species lack natural insect pollinators; in areas without sunbirds, plants in this genus generally need hand pollination to successfully set seed

LLM View 1:
The bird of paradise is a stunning and unique flower that is native to South America. The plant can grow up to 10 feet tall and the flowers can be up to 12 inches long. The bird of paradise flower is orange and blue with a long curved beak. The flowers are pollinated by birds that are attracted to the nectar. The bird of paradise is the national flower of Paraguay and is also the symbol of the city of Los Angeles. The bird of paradise is a member of the banana family.

LLM View 2:
The bird of paradise is the national flower of Paraguay, and is also the official flower of the city of Los Angeles, California. The bird of paradise is a native of South America, but it has been naturalized in many other parts of the world, including the West Indies, Hawaii, and Southern California. The bird of paradise is a member of the banana family (Musaceae), and it is closely related to the plantain. The bird of paradise is a herbaceous perennial that grows to a height of 3-4 feet (91-122 cm). The leaves are large, broad, and dark green, and they are arranged in a spiral pattern on the stem. The flowers are borne on a stalk that arises from the center of the plant. The flowers are large and brightly colored, and they resemble the head and beak of a bird. The bird of paradise is pollinated by hummingbirds, which are attracted to the flowers by their color and shape. The bird of paradise is an evergreen plant, and it will flower year-round in tropical climates. The bird of paradise is a popular landscaping plant, and it is also used in cut flower arrangements.

LLM View 3:
The bird of paradise is the national flower of Papua New Guinea. It is also the provincial flower of the Southland Province in New Zealand. The bird of paradise is a widespread symbol of paradise owing to its exotic appearance. The flowers are a popular garden plant in warm climates such as Australia, California, and South Africa. The bird of paradise is also an important part of Polynesian, Māori, and Hawaiian culture. The bird of paradise is a large flower that grows on a stalk. The flowers are brightly colored and have a long, curved beak. The beak is used to attract birds, which pollinate the flowers. The bird of paradise is native to Papua New Guinea and Indonesia. It is also found in the Solomon Islands, Fiji, and Samoa.

Figure 6. **Wiki and LLM Views for Bird of Paradise Flower.** We observe that each view provides complementary information about the class. We underline the information that is unique compared to the Wiki article. We highlight the information that is unique to each view. We confirm our hypothesis that each view of the LLM provides new facts about a class. This increased information available in the LLM generated views contribute to learning a highly discriminative zero-shot image classification model.

3. Additional Training Details.

Our model is implemented in PyTorch and trained with a computational budget of a single A100 per experiment run of I2MVFormer. The MLPs used in the Image Transformer and SVSummary use LayerNorm, ReLU, and Dropout. We use a batch size of 16 for all three datasets and each experiment converges to the reported numbers within 24 hours. We use a learning rate of $1e^{-4}$ with the Adam Optimizer. The relative weights of L_{CLS} and L_{Local} are chosen via ablation. Regarding Large Language Model (LLM) inference, we rely on the web API for GPT-3 [1], we use the restricted API for PaLM [2] from the authors, and finally, for OPT we

deploy our own instance using HuggingFace. The cost for running GPT-3 on the three datasets is $25 for generating 3 views. We have attached the LLM responses for GPT3 to the supplementary. The detailed hyperparameters for the reported numbers in the main manuscript are as follows:

AWA2. Image Transformer MLP: 3 layers, SVSummary MLP: 2 Layer, SVSummary and MVSummary configuration: 2 Transformer layers with 4 multiheaded attention heads. Joint Embedding space r: 128. Weight of L_{CLS}: 0.9. Weight of L_{Local}: 0.1.

CUB. Image Transformer MLP: 3 layers, SVSummary MLP: 2 Layer, SVSummary and MVSummary configuration: 2 Transformer layers with 4 multiheaded attention heads. Joint Embedding space r: 128. Weight of L_{CLS}: 0.9. Weight of L_{Local}: 0.1.

FLO. Image Transformer MLP: 2 layers, SVSummary MLP: 2 Layer, SVSummary and MVSummary configuration: 2 Transformer layers with 4 multiheaded attention heads. Joint Embedding space r: 64. Weight of L_{CLS}: 0.67. Weight of L_{Local}: 0.33.

4. Few Shot Examples

In this section, we provide the k-shot examples used to prompt the LLM. The last example in each dataset is the *Reserve* class. The Reserve class is used to replace the query class in the examples. On AWA and FLO, we ablate over 3 different sets of examples. Set 1 refers to the examples used in the main paper. For CUB, we only use 1 set of k-shot examples. We have attached the LLM output for GPT-3 on CUB and Set 1 of AWA and FLO to the supplementary.

4.1. CUB

Winter Wren: The winter wren (Troglodytes hiemalis) is a very small North American bird and a member of the mainly New World wren family Troglodytidae. It was once lumped with Troglodytes pacificus of western North America and Troglodytes troglodytes of Eurasia under the name winter wren. It breeds in coniferous forests from British Columbia to the Atlantic Ocean. It migrates through and winters across southeastern Canada, the eastern half the United States and (rarely) north-eastern Mexico. Small numbers may be casual in the western United States and Canada. The scientific name is taken from the Greek word troglodytes (from 'trogle' a hole, and 'dyein' to creep), meaning 'cave-dweller', and refers to its habit of disappearing into cavities or crevices while hunting arthropods or to roost. Small tail is often cocked above its back, and short neck gives the appearance of a small brown ball. Rufous brown above, grayer below, barred with darker brown and gray, even on wings and tail. The bill is dark brown, the legs pale brown. Young birds are less distinctly barred. Most are identifiable by the pale 'eyebrows' over their eyes. Measurements: Length: 3.1–4.7 in (7.9–11.9 cm) Weight: 0.3–0.4 oz (8.5–11.3 g) Wingspan: 4.7–6.3 in (12–16 cm)

Laysan Albatross: The Laysan albatross is a large seabird that ranges across the North Pacific. The Northwestern Hawaiian Islands are home to 99.7% of the population. This small (for its family) gull-like albatross is the second-most common seabird in the Hawaiian Islands, with an estimated population of 2.5 million birds, and is currently expanding (or possibly re-expanding) its range to new islands.The Laysan albatross averages 81 cm (32 in) in length and has a wingspan of 195 to 203 cm (77–80 in). Males, which weigh 2.4 to 4.1 kg (5.3–9.0 lb), are larger than females, which weigh 1.9 to 3.6 kg (4.2–7.9 lb). This albatross has blackish-gray upperwing, mantle, back, upper rump, and tail, and its head, lower rump, and underparts are white. It has a black smudge around the eye, and its underwing pattern varies between individuals, with some having narrower black margins and variable amounts of black in the underwing coverts. Finally, the bill is pink with a dark tip. Juveniles have a gray bill and a dark upper rump. This species does not have a breeding plumage.

Orange Crowned Warbler: Orange-crowned Warblers are small songbirds. Compared with other warblers, they have noticeably thin, sharply pointed bills. They have short wings and short, square tails. Slightly larger than a Ruby-crowned Kinglet; slightly smaller than a Yellow-rumped Warbler. Both Sexes Length: 4.3-5.5 in (11-14 cm) Weight: 0.3-0.4 oz (7-11 g) Wingspan: 7.5 in (19 cm). Orange-crowned Warblers are fairly plain yellowish or olive—they are more yellow on the Pacific coast and grayer, particularly on the head, farther east. They have a thin white or yellow stripe over the eye, a blackish line through the eye, and a pale partial eyering. The namesake orange crown patch is rarely seen, but may become visible when the bird raises its head feathers in excitement or agitation. The undertail coverts are bright yellow and are often the brightest part of the plumage. Orange-crowned Warblers forage in dense shrubbery and low trees. They tend to be quiet and unobtrusive, although their low foraging habits can help you spot them. They often give a high, faint contact call while foraging. Orange-crowned Warblers breed in dense areas of deciduous shrubs, usually within or adjacent to forest. They can occur from low-elevation oak scrub to stunted forest near timberline. During migration you may find them in nearly any habitat, though they still show a preference for dense, low vegetation. Orange-crowned Warblers of the Pacific slope are quite bright, even yellowish, and can be readily confused with Yellow Warblers (see Similar Species). The stripe over the eye (superciliary) is always yellow, as are their underparts, and the blurry olive streaks contrast more strongly than in other forms of the species. In the Interior West, Orange-crowned Warblers usually have gray heads. Though some may have yellow-green heads, they

still usually contrast fairly obviously with a brighter olive back. These birds may have white or yellow superciliaries. The largest subspecies, sordida, occurs only on the Channel Islands of California.

***Song Sparrow*:** Song Sparrows are medium-sized and fairly bulky sparrows. For a sparrow, the bill is short and stout and the head fairly rounded. The tail is long and rounded, and the wings are broad. Slightly smaller than a Dark-eyed Junco; slightly larger than a Chipping Sparrow Both Sexes Length: 4.7-6.7 in (12-17 cm) Weight: 0.4-1.9 oz (12-53 g) Wingspan: 7.1-9.4 in (18-24 cm). Song Sparrows are streaky and brown with thick streaks on a white chest and flanks. On a closer look, the head is an attractive mix of warm red-brown and slaty gray, though these shades, as well as the amount of streaking, vary extensively across North America. Song Sparrows flit through dense, low vegetation or low branches, occasionally moving onto open ground after food. Flights are short and fluttering, with a characteristic downward pumping of the tail. Male Song Sparrows sing from exposed perches such as small trees. Look for Song Sparrows in nearly any open habitat, including marsh edges, overgrown fields, backyards, desert washes, and forest edges. Song Sparrows commonly visit bird feeders and build nests in residential areas. Scientists recognize 24 subspecies of Song Sparrows and have described some 52 forms: they are one of the most regionally variable birds in North America. In general, coastal and northern birds are darker and streakier, with southern and desert birds wearing paler plumages.

4.2. AWA

Set 1: Killer Whale, Fox, Collie, Dolphin

Killer Whale: The killer whale is a large marine mammal that is easily recognizable thanks to its black and white coloration. Killer whales are the largest members of the dolphin family, and can grow to be 23 to 32 feet long and weigh up to 6 tons. They have a large dorsal fin that can be up to 6 feet tall, and their tail fin (or fluke) is large and powerful. Their pectoral fins are small in comparison to their body size. They have a long, rounded snout, and their large teeth can be up to 4 inches long. They have white patches around their eyes, and white patches on the sides of their bodies. Killer whales are very social animals that live in groups, or pods, of up to 40 individuals. They are very intelligent, and have been known to cooperate with each other when hunting. They are also very curious and playful, and have been known to approach boats and other objects out of curiosity. Killer whales are emotional creatures, and have been known to grieve for their dead. They have a long life span, but a slow rate of reproduction, which has led to them being classified as an endangered species.

Fox: The fox is a small to medium sized, omnivorous mammal. They have a flattened skull, and upright triangular ears. They have a pointed, slightly upturned snout. They have a long bushy tail (or brush). They are digitigrade (meaning they walk on their toes). They have partially retractable claws. They have vibrissae, or whiskers, which are black. They have mystacial vibrissae, which average 100-110 millimetres (3+7/8-4+3/8 inches) long. They also have whiskers (carpal vibrissae) on the forelimbs, which average 40 mm (1+5/8 in) long, and point downward and backward. Their physical characteristics vary according to their habitat and adaptive significance. Their fur color, length, and density can vary. Coat colors range from pearly white to black-and-white to black flecked with white or grey on the underside. Arctic foxes live in the Arctic tundra, while red foxes live in North America, Europe, Asia, and Australia.

Collie: The collie is a medium-sized dog with a rather large and muscular frame. Males are slightly larger than females on average. Here is a breakdown of the sizes: Collies are generally medium-sized dogs of about 22 to 32 kg (48 to 70 lb) and light to medium-boned. Cattle-herding types are more stocky. The fur may be short, or long, and the tail may be smooth, feathered, or bushy. In the 1800s, the occasional naturally bob-tailed dog would occur. The tail can be carried low with an upward swirl, or may be carried higher but never over the back. Each breed can vary in coloration, with the usual base colors being black, black-and-tan, red, red-and-tan, white with a colored head with it without other body coloration of sable, black and tan, blue merle, sable merle sable. They often have white along with the main color, usually under the belly and chest, over the shoulders, and on parts of the face and legs, but sometimes leaving only the head colored – or white may be absent (unusual) or limited to the chest and toes (as in the Australian Kelpie). Merle coloration may also be present over any of the other color combinations, even in landrace types. The most widespread patterns include sable, black and white, black and tan and tricolour (black-and-tan and white).

Dolphin: A dolphin is an aquatic mammal within the infraorder Cetacea. Dolphins range in size from the 1.7-metre-long (5 ft 7 in) and 50-kilogram (110-pound) Maui's dolphin to the 9.5 m (31 ft 2 in) and 10-tonne (11-short-ton) orca. Several species of dolphins exhibit sexual dimorphism, in that the males are larger than females. They have streamlined bodies and two limbs that are modified into flippers. Dolphins have torpedo-shaped bodies with generally non-flexible necks, limbs modified into flippers, a tail fin, and bulbous heads. Dolphin skulls have small eye orbits, long snouts, and eyes placed on the sides of its head; they lack external ear flaps. Dolphins range in size from the 1.7 m (5 ft 7 in) long and 50 kg (110 lb) Maui's dolphin to the 9.5 m (31 ft 2 in) and 10 t (11 short tons) orca. Overall, they tend to be dwarfed by other Cetartiodactyls. Several species have female-biased sexual dimorphism, with the fe-

males being larger than the males. All dolphins have a thick layer of blubber, thickness varying on climate. This blubber can help with buoyancy, protection to some extent as predators would have a hard time getting through a thick layer of fat, and energy for leaner times; the primary usage for blubber is insulation from the harsh climate. Calves, generally, are born with a thin layer of blubber, which develops at different paces depending on the habitat. Most people visualize them as grey in color, but many have blocks of black, white, or even yellow. Some are speckled. One species of river dolphin is even pale pink. Dolphins belong to the same Order as whales, which is Cetacea. Dolphins are generally different than whales in some key ways. First, they're generally smaller than whales. Second, dolphins live in pods that are generally much larger. Most species prefer the warm waters of the tropic zones, but some, like the right whale dolphin, prefer colder climates.

Set 2: German Shepherd, Hippopotamus, Leopard, Otter

German Shepherd: The German Shepherd Dog, also known as the Alsatian, is a German breed of working dog of medium to large size. German Shepherds are medium to large-sized dogs. The breed standard height at the withers is 60–65 cm (24–26 in) for males, and 55–60 cm (22–24 in) for females. German Shepherds are longer than they are tall, with an ideal proportion of 10 to 8+1⁄2. The AKC official breed standard does not set a standard weight range. They have a domed forehead, a long square-cut muzzle with strong jaws and a black nose. The eyes are medium-sized and brown. The ears are large and stand erect, open at the front and parallel, but they often are pulled back during movement. A German Shepherd has a long neck, which is raised when excited and lowered when moving at a fast pace as well as stalking. The tail is bushy and reaches to the hock. German Shepherds have a double coat which is close and dense with a thick undercoat. The coat is accepted in two variants: medium and long. The gene for long hair is recessive, and therefore the long-haired variety is rarer. Most commonly, German Shepherds are either tan/black or red/black. Most colour varieties have black masks and black body markings which can range from a classic 'saddle' to an overall 'blanket'. Rarer colour variations include sable, pure-black, pure-white, liver, silver, blue, and panda varieties.

Hippopotamus: The Hippopotamus is a large semi-aquatic mammal that is found wallowing in the rivers and lakes across sub-Saharan Africa. The Hippopotamus has an enormous grey barrel-shaped body that can measure up to five meters in length and weigh more than four tonnes, and which is held up by short and stocky legs. One of the Hippopotamus's most distinctive features is their enormous jaws which contain two long canine teeth (tusks) which can grow up to 50 cm long and are used for fighting. Due to the fact that the Hippopotamus is an animal that spends most of its life resting in the water, they have a number of excellent adaptations to aid their semi-aquatic lifestyle including four webbed toes on each foot that help with swimming and walking on slippery banks, and the eyes, ears and nostrils of the Hippopotamus are situated on the top of its head. This means that when the Hippopotamus's body is immersed in the water, they are still able to see, hear and breath whilst keeping cool in the hot sun.

Leopard: The Leopard is an animal with a long and slender body that is supported by short, stocky legs and a long tail that is used to aid balance whilst in the trees. Leopards can vary greatly in their colouration and markings depending on their surrounding habitat, with those found on open grasslands having a light yellow background coat where those that are found in forests tend to be darker in colour and with more markings. The dark, ring-like patterns that cover the Leopard's coat are called rosettes, but these turn to solid spots on the face and limbs (and rings on the tail) and provide the Leopard with camouflage into the surrounding environment. Leopards are incredibly strong and muscular animals and are able to pull themselves up trees using their legs and retractable claws. Like a number of other large feline species, the Leopard is able to draw their claws into folds of skin on their paws to ensure that they are not blunted whilst the animal is walking about. Their keen hearing and sight coupled with their long and very sensitive whiskers, means that Leopards are also incredibly well adapted for hunting under the cover of night. The Leopard can be found inhabiting numerous different areas providing that there is a good source of cover and an ample supply of food including tropical rainforests, tree-lined savannah, barren deserts and mountain highlands.

***Otter*:** Otters are animals that are known for being slim and short. They have a muscular neck and short legs. Their long flat tails and four webbed feet help them swim faster. They have short noses and ears and their fur is brown, soft and thick. Their outer fur varies in its shade of brown, with the fur underneath being lighter. Having two layers of fur keeps them warm and dry. On each square inch of their body, they may have as much as one million hairs. The smallest of this animal weighs six pounds (or eight times more than the average can of soup,) and as the largest of the breed, sea otters weigh 99 pounds (or 10 times more than the average cat.)The typical otter is between two and six feet long. In comparison, a full-sized bed is 10 feet in length. In the Southern Pacific Ocean, the world's smallest otters, Chungungos, can be found. The world's largest otter to date was found in the Big Fish, a body of water in Maine. While most otters are an average size of 40 inches (or half Michael Jordan's height,) this one was 76 inches long, making it approximately as tall as Michael Jordan is. Otters enjoy being together. They live as families that consist of

a mother and her offspring. When they are not eating or sleeping they can be seen playing and often choose the bank of a river to turn into their own sliding board. There are many places in the world where otters live. They prefer a wet habitat and often make their home on coastlines, lakes, oceans and freshwater rivers. Most choose to live in dens that beavers and other similar animals build. These dens are found underground and include various inner chambers that keep them dry.

Set 3: Rabbit, Weasel, Humpback Whale, Seal

Rabbit: The rabbit's appearance is an animal that sits on its large hind legs and has shorter front legs. The animal also has large ears that vary in size based on the type. The hare looks similar to the rabbit but is not the same. These ears are used to radiate heat into the air when the animal has been running or is otherwise excited or when it lives in the wilderness and needs to use its ears to maintain its comfort. They can also be turned to listen to sounds to determine where a predator might be coming from or to make sure that an area is safe. These animals come in a variety of sizes. Pygmy rabbits grow to only eight inches long and weigh in at less than a pound, even when fully grown. Chinchillas are at the other end of the scale, weighing in at about 16 pounds. Most Flemish giants stop at about 22 pounds, but one rabbit, also a Flemish giant, beat all the rest by weighing in at 49 pounds and stretching 4 foot, 3 inches long. These animals live in large groups known as warrens, living under the ground in spaces carved out by them as they move in. They typically live in these warrens with a group of other rabbits in a meadow, desert, woods, grassland, wetland, or forest. Not all rabbits live in a warren. Some species live out in the open instead.

Weasel: The Weasel has evolved to prey on small animals like no other carnivore as their long, slender bodies are perfectly suited for following mice into their burrows. Weasels are animals with small and narrow heads that are not much thicker than their necks and along with their short legs and flexible spines means that they are able to easily manoeuvre themselves around in small, confined spaces. The Weasel has a sharply pointed snout and triangular head, small rounded ears and black eyes. Their coat is dark or light brown in colour on their head, back, legs and tail and white on their underside and moults twice a year from the darker winter coat to the flatter, lighter one in April, and again from the summer to the winter coat in August or September. This not only ensures that by November the Weasel is as warm as possible but in areas further north, individuals will often change from brown to white in colour so that they are camouflaged amongst the snow. Weasels are animals that are natively found in a variety of habitats such as woodlands, coniferous forest and on grassy plains in North America, Europe, Asia and in northern parts of Africa.

Humpback Whale: The humpback whale is easy to distinguish from other whales. It has a small hump near the dorsal fin (which is particularly prominent when it arches its back), a massive pectoral fin about a third the size of the entire body, and hair follicles all over the head and jaw. In place of teeth, the whale has a complex network of baleen plates that filter out food from the water. This baleen is composed of keratin, the same substance in fingernails and hair. The humpback also sports a dark back and lighter underside. Each pattern of colors and scars along its stomach is entirely unique to the individual. The humpback whale measures a truly massive 48 to 62 feet long (about the size of a school bus) and some 40 tons in weight. Females are larger than males on average, which is unusual for a mammal. The humpback whale (Megaptera novaeangliae) is a species of baleen whale. It is a rorqual; a member of the family Balaenopteridae. Adults range in length from 14–17 m (46–56 ft) and weigh up to 40 metric tons (44 short tons). The humpback has a distinctive body shape, with long pectoral fins and a knobbly head. It is known for breaching and other distinctive surface behaviors, making it popular with whale watchers.

***Seal*:** Pinnipeds are a diverse and heterogeneous group. While they do share several features in common, including long, flexible bodies, flipper-shaped limbs, short snouts, and round heads, it also easy to spot the many differences between them. The location of the ears and the presence of thicker coats of fur are the two major characteristics that distinguishes the eared seals from the true seals. The walrus diverges from both families. This species can be identified by its large tusks, smaller eyes, especially prominent whiskers, and almost completely hairless bodies. Beyond these broad characteristics, individual species have evolved many unique features to suit their conditions. For example, elephant seal males have an elongated nose that aids them during mating and reproduction. Hooded seals have a nasal cavity on the top of their heads that can inflate and deflate at will. Species with unique ornamentations like this tend to be sexually dimorphic, meaning that males and females differ in appearances. One glance at these animal's anatomy will tell you that seals are extraordinarily well-adapted for the water. Their dense layers of blubber keep them insulated from the frigid temperatures. They also have the remarkable ability to detect vibrations in the water with their whiskers. But their penchant for the ocean is best exemplified by the Pinniped's most important innovation: the flipper. It allows them to cut gracefully through the water to catch prey and avoid predators. The flipper is an excellent example of convergent evolution in mammals: the cetaceans, seals, and sea cows all evolved the flipper independently as a means of navigating the watery areas of the world. Even in this crucial aspect, however, true seals

and eared seals have evolved difference methods of locomotion. To swim, true seals move their hind limbs and lower body from side to side for continuous propulsion, while their forelimbs are used to help them maneuver. Because they lack the ability to turn their hind limbs forward, their movements are heavily hindered on land. They have to pull their bodies forward in a clumsy and cumbersome manner. Eared seals are more like penguins and sea turtles. They use their front limbs for propulsion in a sort of discontinuous rowing motion. When on land, they have ability to turn their hind limbs forward and walk. Walrus locomotion combines elements of both true and eared seals. Their hind limbs are capable of propulsion in the water and walking on land. Pinnipeds inhabit saltwater regions almost exclusively, but they do swim up rivers and estuaries to hunt for food.

4.3. FLO

In this section, we provide the k-shot examples of FLO used for Set 2 and Set 3 analysis shown in Table.6. In each set last k-shot example represents the reserved class.

Set 1: Pink Primrose, Cyclamen, Camellia, Bishop Of Llandaff

Pink Primrose: The pink primrose is a beautiful flower that has many different nicknames. It is also known as the showy evening primrose, pink ladies, and pink evening primrose. This flower is native to the southeastern United States and is considered an attractive wildflower in many locations. The pink primrose grows low to the ground and spreads vigorously in an informal and loose way. The foliage of the pink primrose is dark green with some variation. The flowers are about two inches across with petals that are almost completely fused. They are most often pink, but the flowers can also be pink to white or entirely white. The pink primrose is closely related to the yellow evening primrose. The pink primrose has glabrous (smooth) to pubescent stems that grow to 50 cm (20 in) in height. The pubescent leaves are alternate with very short or no petiole (sessile), reaching 10 cm (4 in) long to 4 cm (1+1⁄2 in) broad. They are variable in shape, from linear to obovate, and are toothed or wavy-edged. It produces single, four-petaled, cup-shaped flowers on the upper leaf axils. These fragrant shell-pink flowers bloom throughout the summer into early autumn. The pink primrose blooms both day and night, but typically in the pre-dawn hours, closing when the full sun hits them. They bloom from March to July, and occasionally in the fall. The flowers are frequented by several species of insect, but moths are the most common as the flowers are mostly open at night. This plant is also frequently referred to as a buttercup.

Cyclamen: Cyclamen species are native to Europe and the Mediterranean Basin east to the Caucasus and Iran, with one species in Somalia. They grow from tubers and are valued for their flowers with upswept petals and variably patterned leaves. Cyclamen have a tuber, from which the leaves, flowers and roots grow. In most species leaves come up in autumn, grow through the winter and then die in spring, then the plant goes dormant through the dry Mediterranean summer. Flowering time may be any month of the year, depending on the species. Cyclamen hederifolium and Cyclamen purpurascens bloom in summer and autumn, Cyclamen persicum and Cyclamen coum bloom in winter and Cyclamen repandum blooms in spring. Each flower is on a stem coming from a growing point on the tuber. In all species the stem is normally bent 150-180° at the tip so that the nose of the flower faces downwards. Cyclamen hederifolium 'Stargazer' is an exception: its nose faces upwards. Flowers have 5 petals, bent outwards or up, sometimes twisted, and connected at the base into a cup, and five sepals behind the cup. Petal shape varies depending on species and sometimes within the same species. Cyclamen repandum has petals much longer than wide, Cyclamen coum has stubby, almost round petals, and Cyclamen hederifolium usually has petals with proportions between the two. Petal color may be white, pink or purple, often with darker color on the nose. Many species have a pink form and a white form but a few have only one color, such as Cyclamen balearicum, which is always white. The dark color on the flower nose varies in shape: Cyclamen persicum has a smooth band, Cyclamen hederifolium has a streaky V and Cyclamen coum has an M-shaped splotch with two white or pink 'eyes' beneath. In some species, such as Cyclamen hederifolium, the petal edges at the nose are curved outwards into auricles (Latin for 'little ears'). Most species, such as Cyclamen persicum, have no auricles. In most species the style protrudes 1–3 mm out of the nose of the flower but the stamens are inside the flower. In Cyclamen rohlfsianum, however, the cone of anthers sticks out prominently, about 2–3 mm (0.08–0.12 in) beyond the rim of the corolla, similar to shooting-stars (Primula sect. Dodecatheon). Cyclamen are commonly grown for their flowers, both outdoors and indoors in pots. Several species, particularly Cyclamen hederifolium, are hardy and can be grown outdoors in mild climates such as northwest Europe and the Pacific Northwest of North America.

Camellia: They are found in eastern and southern Asia, from the Himalayas east to Japan and Indonesia. Camellias are evergreen shrubs or small trees up to 20 m (66 ft) tall. Their leaves are alternately arranged, simple, thick, serrated, and usually glossy. Their flowers are usually large and conspicuous, one to 12 cm in diameter, with five to nine petals in naturally occurring species of camellias. The colors of the flowers vary from white through pink colors to red; truly yellow flowers are found only in South China and Vietnam. Tea varieties are always white-flowered. Camellia

flowers throughout the genus are characterized by a dense bouquet of conspicuous yellow stamens, often contrasting with the petal colors. The so-called 'fruit' of camellia plants is a dry capsule, sometimes subdivided in up to five compartments, each compartment containing up to eight seeds. The various species of camellia plants are generally well-adapted to acid soils rich in humus, and most species do not grow well on chalky soil or other calcium-rich soils. Most species of camellias also require a large amount of water, either from natural rainfall or from irrigation, and the plants will not tolerate droughts. However, some of the more unusual camellias – typically species from karst soils in Vietnam – can grow without too much water. Camellia plants usually have a rapid growth rate. Typically they will grow about 30 cm per year until mature – though this does vary depending on their variety and geographical location.

***Bishop Of Llandaff*:** 'Bishop of Llandaff' is a cultivar of the dahlia, a garden plant. It is a branching, tuberous tender perennial with dark purple, almost black, foliage. This produces a stunning contrast with its scarlet flowers. The plant is about 1 m tall and flowers from June until September. As with all dahlias, frost blackens its foliage, and in areas prone to frost its tubers need to be overwintered in a dry, frost-free place. A seed strain has been produced from this plant called 'Bishops Children', they retain the dark foliage colour but produce a mix of flower colours and flower shapes from single to semi-double flowers in different sizes. Plant Profile: Height: 1.1 m (3+1⁄2 ft) Spread: 45 cm (18 in) Site: full sun Soil: fertile, free-draining Hardiness: half-hardy Also comes in rich reds and purples, yellows and oranges, as well as paler shades It has dark bronze green foliage and contrasting bright red, single to semi-double flowers. It flowers its socks off right up until the first frosts, and the single, open nature of its blooms make it attractive to bees. It's perfect for cutting. The Royal Horticultural Society has given it its Award of Garden Merit (AGM). Grow Dahlia 'Bishop of Llandaff' at the front of a sunny border, in moist but well-drained soil. After the first frost, cut off the top growth, dig up the tuber and leave it to dry for three weeks. Overwinter it in an airy, frost-free place, and replant the following spring. Alternatively, grow dahlias in pots and move them indoors in autumn.

Set 2: King Protea, Fire Lily, Corn Poppy, Sweet William

King protea: Protea cynaroides, also called the king protea, is a flowering plant. It is widely distributed in the southwestern and southern parts of South Africa in the fynbos region. The king protea has several colour forms and horticulturists have recognized 81 garden varieties, some of which have injudiciously been planted in its natural range. In some varieties the pink of the flower and red borders of leaves are replaced by a creamy yellow. This unusual flower has a long vase life in flower arrangements, and makes for an excellent dried flower. Protea cynaroides is adapted to survive wildfires by its thick underground stem, which contains many dormant buds; these will produce the new growth after the fire. P. cynaroides is a woody shrub with thick stems and large dark green, glossy leaves. Most plants are one metre in height when mature, but may vary according to locality and habitat from 0.35 to 2 metres (1 ft 2 in to 6 ft 7 in) in height. The 'flowers' of P. cynaroides are actually composite flower heads (termed an inflorescence) with a collection of flowers in the centre, surrounded by large colourful bracts, from about 120 to 300 millimetres (5 to 12 in) in diameter. Large, vigorous plants produce six to ten flower heads in one season, although some exceptional plants can produce up to forty flower heads on one plant. The colour of the bracts varies from a creamy white to a deep crimson, but the soft pale pink bracts with a silvery sheen are the most prized.

Fire Lily: This herbaceous perennial grows from a fleshy rhizome. It is scandent, climbing using modified leaf-tip tendrils, the stem reaching 4 m (13 ft) long. The leaves are mainly alternately arranged, but they may be opposite, as well. They are somewhat lance-shaped and tipped with tendrils, and they are up 13 to 20 cm (5.1 to 7.9 in) long. The showy flower has six tepals each up to 5 to 7.6 cm (2.0 to 3.0 in) long. They are generally bright red to orange at maturity, sometimes with yellowish bases. The margins may be quite wavy. The six stamens also are long, up to 4 cm (1.6 in), and each bears a large anther at the tip that drops large amounts of yellow pollen. Pollen grains The style may be more than 6 cm (2.4 in) long. One flower may weigh over 2.5 g (0.09 oz). The fruit is a fleshy capsule up to 6 to 12 cm (2.4 to 4.7 in) long containing red seeds. Cultivars of this popular garden plant may vary from these wild-type characteristics; the cultivar 'Lutea' has all-yellow tepals, 'Citrina' is yellow with red markings, and 'Nana' is a dwarf. Whitish forms are also known. The plant likely is pollinated by butterflies and sunbirds. It grows in many types of habitat, including tropical jungles, forests, thickets, woodlands, grasslands, and sand dunes. It can grow in nutrient-poor soils. It can be found at as high as 2,500 m (8,200 ft) in elevation. In general, this plant is common in the wild. It is in great demand for medicinal use, so it is cultivated on farms in India. In Australia, for example, it now can be found growing in coastal areas of Queensland and New South Wales. It also is cited as an invasive species in the Cook Islands, French Polynesia, Kiribati, and Singapore.

Corn Poppy: It is notable as an agricultural weed (hence the common names including 'corn' and 'field'). Especially in the Commonwealth, it is used a symbol of remembrance of the fallen soldiers and other military, during World War I and thereafter. Before the advent of herbicides, Papaver rhoeas was often abundant in agricultural fields, as the

plant thrives in areas of disturbed soil. Flushes of poppies may still appear in fields where herbicides are not used, as well as those in fallow. The corn poppy and its cultivars such as the Shirley poppy are widely grown in gardens, and are frequently found in packets of seed labelled 'wildflower mixes'. Papaver rhoeas is a variable, erect annual, forming a long-lived soil seed bank that can germinate when the soil is disturbed. In the northern hemisphere it generally flowers in late spring (between May and October in the UK) but if the weather is warm enough other flowers frequently appear at the beginning of autumn. It grows up to about 70 cm (28 in) in height. The stems hold single flowers, which are large and showy, 5–10 cm (2–4 in) across, with four petals that are vivid red, most commonly with a black spot at their base. The petals slightly overlap each other. The plant can produce up to 400 flowers in a warm season, that last only one day. The flower stem is usually covered with coarse hairs that are held at right angles to the surface, helping to distinguish it from Papaver dubium in which the hairs are more usually appressed (i.e. held close to the stem). The capsules are hairless, obovoid (egg-shaped), less than twice as tall as they are wide, with a stigma at least as wide as the capsule. Like many other species of Papaver, the plant exudes white to yellowish latex when the tissues are broken. Not all corn poppies that are available commercially have red flowers. Selective breeding has resulted in cultivars in yellow, orange, pink, and white. The Shirley poppy is a well known cultivar. A very pale speckled variety, derived from the Shirley, is also available. A nearly black-flowering hybrid, known as 'Evelina', was bred in Italy in the late 1990s, with P. dubium, but does not appear to be available commercially. Papaver rhoeas is a temperate native with a very wide distribution area, from Africa to temperate and tropical Asia and Europe.

***Sweet William*:** Dianthus barbatus, the sweet William, is native to southern Europe and parts of Asia. It has become a popular ornamental garden plant. It is a herbaceous biennial or short-lived perennial plant growing to 13–92 cm tall, with flowers in a dense cluster of up to 30 at the top of the stems. Each flower is 2–3 cm diameter with five petals displaying serrated edges. Wild plants produce red flowers with a white base, but colours in cultivars range from white, pink, red, and purple to variegated patterns. The exact origin of its English common name is unknown but first appears in 1596 in botanist John Gerard's garden catalogue. The flowers are edible and may have medicinal properties. Sweet William attracts bees, birds, and butterflies. Sweet William grows in the mountains of southern Europe from the Pyrenees east to the Carpathians and the Balkans, with a variety disjunct in northeastern China, Korea, and southeasternmost Russia. It grows to 13–92 cm tall (depending on the variety), with green to glaucous blue-green tapered leaves 4–10 cm long and 1–2 cm broad. The flowers are produced in a dense cluster of up to 30 at the top of the stems (known as an umbel) and have a spicy, clove-like scent; each flower is 2–3 cm diameter with five petals with serrated edges; in wild plants the petals are red with a white base. Sweet William is a popular ornamental plant in gardens, with numerous cultivars and hybrids selected for differing flower colour, ranging from white, pink, red, and purple to variegated patterns. The plant was introduced to northern Europe in the 16th century, and later to North America and elsewhere, and has become locally to widely naturalised in these areas.

Set 3: Artichoke, Bolero Deep Blue, Pelargonium, Mallow

Artichoke: The globe artichoke (Cynara cardunculus var. scolymus), also known by the names French artichoke and green artichoke in the U.S., is a variety of a species of thistle cultivated as a food. The edible portion of the plant consists of the flower buds before the flowers come into bloom. The budding artichoke flower-head is a cluster of many budding small flowers (an inflorescence), together with many bracts, on an edible base. Once the buds bloom, the structure changes to a coarse, barely edible form. Another variety of the same species is the cardoon, a perennial plant native to the Mediterranean region. Both wild forms and cultivated varieties (cultivars) exist. The flowers develop in a large head from an edible bud about 8–15 cm (3–6 in) diameter with numerous triangular scales; the individual florets are purple. The edible portions of the buds consist primarily of the fleshy lower portions of the involucral bracts and the base, known as the heart; the mass of immature florets in the center of the bud is called the choke or beard. These are inedible in older, larger flowers. The flowers grow on tall flower stalks that can reach 6 feet (2 metres) tall so they really stand out in the garden. The thistle-like blooms can grow up to 6 inches (15 cm) in diameter and have bright, lavender blue centers. Artichoke plants usually produce 4 to 6 flower heads in their first year of growth and 10 to 12 in the second year. Artichokes buds appear in early spring and the flowers are usually in full bloom during the summer months.

Bolero Deep Blue: Common names include Texas bluebells, Texas bluebell, bluebell, showy prairie gentian, prairie gentian, and Lisianthus. There is a cultivar, 'Bolero Deep Blue'. Eustoma russellianum has blue-green waxy leaves and showy bell shaped flowers in blue pink or white each borne singly on an upright plant. Depending on where it grows it may present as an annual, biennial or perennial plant. It is found primarily in the Great Plains region of North America, from Wyoming southeast to Nebraska, and south to Texas and Mexico. Due to its popularity and the frequency it's picked, it has been unable to naturally reseed itself in its native distribution. It prefers moist, sandy soils and often grows near streams or creek-beds. Texas

bluebell is a popular garden flower, and has been cultivated in Japan for over 70 years. Many varieties, including those with double petals, or a variety of colored flowers, have been developed. They are herbaceous annuals, growing to 15–60 cm tall, with bluish green, slightly succulent leaves and large funnel-shaped flowers growing on long straight stems: sometimes erect single stems, other times growing on branching stems that can rise to be 5.5 m (18 ft) tall. The flowers can grow up to 50 millimetres (2 in) across and can be found in a variety of colors. They have been found in all shades of pink, purple, white, and blue. In addition, some are bicolored and some are occasionally found in yellow or carmine-red. Eustoma flowers are either single-flowered or double-flowered. Both types of flowers can be found in all ranges of the possible colors listed above. They are usually 30–90 cm (1–3 ft) tall, although there are dwarf varieties that only grow up to 200 mm (8 in) in height.

Pelargonium: Pelargonium is commonly called geraniums, pelargoniums, or storksbills. Geranium is also the botanical name and common name of a separate genus of related plants, also known as cranesbills. Both genera belong to the family Geraniaceae. Carl Linnaeus originally included all the species in one genus, Geranium, and they were later separated into two genera by Charles Louis L'Héritier de Brutelle in 1789. While Geranium species are mostly temperate herbaceous plants, dying down in winter, Pelargonium species are evergreen perennials indigenous to warm temperate and tropical regions of the world, with many species in southern Africa. They are drought and heat tolerant, but can tolerate only minor frosts. Some species are extremely popular garden plants, grown as houseplants and bedding plants in temperate regions. They have a long flowering period, with flowers mostly in red, orange, or white; but intensive breeding has produced a huge array of cultivars with great variety in size, flower colour, leaf form and aromatic foliage. Pelargonium occurs in a large number of growth forms, including herbaceous annuals, shrubs, subshrubs, stem succulents and geophytes. The erect stems bear five-petaled flowers in umbel-like clusters, which are occasionally branched. Because not all flowers appear simultaneously, but open from the centre outwards, this is a form of inflorescence is referred to as pseudoumbels. The flower has a single symmetry plane (zygomorphic), which distinguishes it from the Geranium flower, which has radial symmetry (actinomorphic). Thus the lower three (anterior) petals are differentiated from the upper two (posterior) petals. The posterior sepal is fused with the pedicel to form a hypanthium (nectary tube). The nectary tube varies from only a few millimeters, up to several centimeters, and is an important floral characteristic in morphological classification. Stamens vary from 2 to 7, and their number, position relative to staminodes, and curvature are used to identify individual species. There are five stigmata in the style.

***Mallow*:** Abelmoschus is a genus of about fifteen species of flowering plants in the mallow family (Malvaceae), native to tropical Africa, Asia and northern Australia. It was formerly included within Hibiscus, but is now classified as a distinct genus. The genus comprises annual and perennial herbaceous plants, growing to 2 m tall. The leaves are 10–40 cm long and broad, palmately lobed with 3-7 lobes, the lobes are very variable in depth, from barely lobed, to cut almost to the base of the leaf. The flowers are 4–8 cm diameter, with five white to yellow petals, often with a red or purple spot at the base of each petal. The fruit is a capsule, 5–20 cm long, containing numerous seeds. Abelmoschus ficulneus is a species of flowering plant in the genus Abelmoschus, family Malvaceae. Commonly known as white wild musk mallow or native rosella, it is fibrous perennial with a woody stem. Its flowers are about an inch in diameter, either pink or white, with a rose center; its leaves are palmate. The species grows as a small erect shrub, 2 to 5 ft (1 to 2 m) tall and 2 to 6 ft (1 to 2 m) across. Leaves are 5 to 8 cm (2 to 3 in) long and 4 to 7 cm (2 to 3 in) wide, with a circular shape (heart-shaped near base). Leaves are rough on both sides, toothed, and have 3 to 5 lobes. Flower stock are covered in velvety hair, and the flowers themselves are 5 to 7 cm (2 to 3 in) across. The stocks are short and colored white to pink with a dark purple center. Flowers last a few days. The plant has small hairs which may cause irritation. The plant's seed heads are hairy and sticky, ovalar in shape and 2.5–4 cm (1–2 in) long and 1.3–2 cm (1–1 in) wide, with five ribs and a short beak. Seeds that are still in their growth period are medium to dark green, and when they are mature they turn dark brown, and split into five parts to release 10 to 20 brown to black spherical seeds, covered in tiny hairs.

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