

Memorandum

To: Director of Animal Welfare and Placement, Committee

From: Animal Shelter Volunteer Group in Charge of Website Development

Date: 06/13/2023

Subject: A Cloud-Based Approach for Non-Profit Animal Shelters

Executive Summary

The following proposal outlines an experimental application of AWS cloud services to be used by animal shelters. The proposed solution aims to utilize an existing breed prediction model in conjunction with S3 Buckets, SageMaker, and LightSail. Initially, the solution will focus on dogs within the United States of America with the potential to include other species if the pilot endeavor performs successfully. Section A provides background on the existing capacity problems that shelters face as well as the low adoption rates for dogs that appear to be directed towards pit bulls. Section B evaluates the various populations affected by issues such as shelter capacity problems, limited funding, low adoption rates, etc., and the casualties they form. The populations that will benefit from the proposed solution were analyzed in section B such as shelter dogs, shelter volunteers, and potential adopters. The proposed solution will generate increased rates of adoption which will help shelters operate more effectively. Additionally, potential adopters have access to background information on dogs available for adoption. This allows them to make a more informed decision from the start, and reduce the probability of returning a dog due to incompatibility. Section C identifies the business case for the proposed solution being funded from a financial and ethical perspective of value. It also discusses the internal and external users as well as the target market which is all the animal shelters in the United States seeking to increase their adoption numbers. Furthermore, section D elaborates on how S3 Buckets, SageMaker, and LightSail can work together to carry out the proposed solution. Section E analyzes the implementation cost per year and assesses an affordable and needed amount to fund the solution on a yearly basis. Lastly, section F concludes the proposal and emphasizes the practical and humane contribution that the proposed solution could provide to not only animals in the United States but worldwide.

A. Description of problem or opportunity

Most shelters are funded by donations and grants. With the lack of funding, a nonprofit organization cannot afford individual analysis for the constant flux of shelter dogs. According to the ASPCA, 3.1 million dogs end up in shelters every year. Unfortunately, a mere 10% are likely to be adopted (ASPCA, 2023). Overcrowding occurs as a result of abandonment and misidentified breeds. It is common for inexperienced volunteers to identify dogs based on visual characteristics. This inconsistent form of breed identification is discussed in PLOS ONE, "In

animal shelters, dog breed identification practices are often based upon owner reports or staff determination according to the dog's appearance (2016). ”

“Voith, Ingram, Mitsouras, and Irizarry [27] and Voith et al. [28] have found that discrepancies exist between breed identification by animal shelters and DNA analysis,” (Voith et.al, as cited by Gunter, et.al, 2016). There are approximately 25-30% of purebreds in shelters, while the others are simply mixed breeds (Lebeau, 2014). The inadequacy to properly identify dogs based on visual characteristics could lead to the possibility of not finding a loving home or a good match in terms of personality.

There are additional risk factors associated with the breed that make them more incompatible for adoption. Misidentifying a dog can affect its chances of being adopted. This is especially problematic for dogs who are incorrectly identified as pit bulls. According to Gunter, “Specifically, breed identification of pit-bull-type dogs by shelter staff and veterinarians was shown to be inconsistent among individuals and an unreliable means of identification, “50% of dogs labeled as pit bulls lacked DNA breed signatures of breeds commonly classified as pit bulls [29],” (Gunter et.al, 2016). This increases the chance of euthanization, as demonstrated in a report by the shelter animals count.

According to a recent article, “Getting (and keeping) dogs out of overburdened shelters is important right now, as data shows that not only are more dogs entering shelters than are leaving, the non-live outcome rate for dogs has nearly doubled (from 5.6% to 10%) when comparing Q1 2021 to Q1 2023. This means that nearly twice as many dogs did not leave shelters alive during the first three months of 2023 compared to the same period in 2021,” (shelter animals.org, 2023). See Exhibit 1.

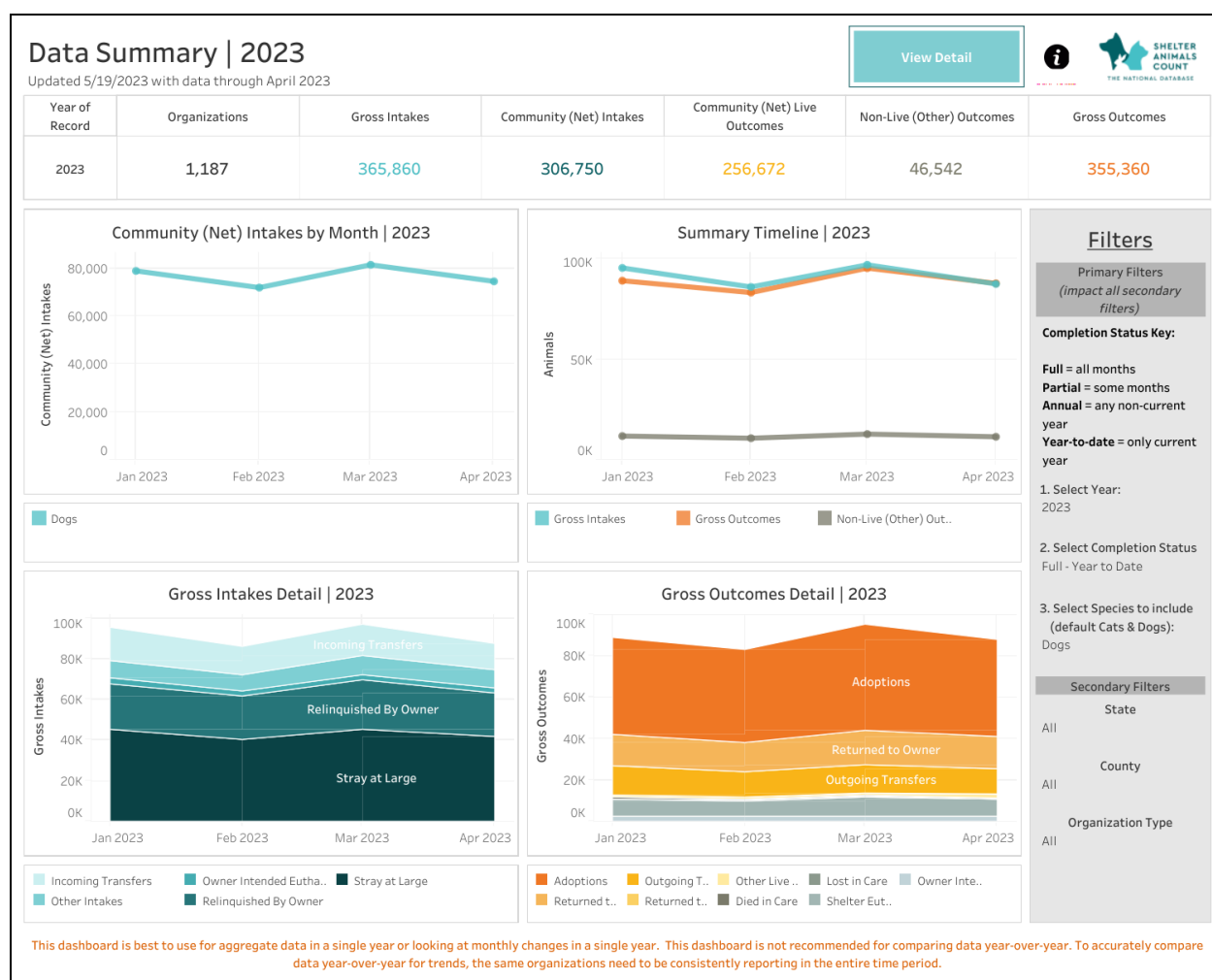


Exhibit 1

<https://www.shelteranimalscount.org/intake-and-outcome-database-iod/>

B. Analysis

1. Who is affected?

- a. Individuals/families seeking to adopt dogs
 - i. Adopted dogs may not fit the owner's lifestyle (living situation, energy level, children, additional pets, financial and time commitments)
- b. Shelters
 - i. Capacity issues
 - ii. Funding
 - iii. Limited staffing
 - iv. Nonprofit 501(C)(3)
- c. Dogs
 - i. Behavioral issues/stress

- ii. Crowded spaces/kennels
- iii. Lack of proper medical and emotional care
- iv. Limited resources

2. Who will benefit?

- a. Those adopting dogs
 - i. Accurate breed matching for lifestyle
- b. Dogs in shelters
 - i. Placed in homes that match breed characteristics
 - ii. Reduced chances of being returned due to incompatibility
- c. Shelter volunteers (solution to be shared with other shelters)
 - i. Better capacity management
 - ii. Reduction of returned dogs due to proper matching
 - iii. Reduce workload for volunteers

C. Business Case

The proposed solution addresses the needs of both the external customers and the internal users. The external customers consist of individuals and families that are seeking to adopt dogs. The external customers are searching for the dog that best fits their home environment without having to make drastic changes to their lifestyle. The internal users are the dogs and shelter volunteers. The internal users are dogs that want to be adopted into an accepting family that will love and care for them. Moreover, shelter volunteers are hoping for dogs to be placed in homes with individuals and families that will properly care for them.

The target market would be animal shelters. Proposing the solution to target dogs would be ideal and if successful, the solution would be used on other animals such as cats. The aim of this solution is not based on financial profit. There is an element of efficiency to be appreciated. Shelters were never meant to be a permanent solution. Ideally, every dog deserves the chance to join a loving family. Hence, other animal shelters around the world could benefit from similar technology to increase the chances of adoption.

Moreover, there is value in this solution being implemented for animal shelters. Traditionally when animals are adopted, there is an adoption fee or donation that is given to the shelter. With more animals being adopted at a faster pace and getting placed into good families, the shelter will make more money and spend less overall. In an ideal situation, the time that a dog spends in a shelter would dramatically decrease and the adoption rate would increase. On the other hand, there would be a process of retaining some percentage of value provided in every transaction. The monetary value in this solution is captured in the adoption process and the

feel-good value when a dog is placed in a good home. This demonstrates how cloud solutions can also serve altruistic purposes that can make a positive impact on animals and animal lovers.

D. Cloud-Based Solution Design

The cloud service that is being utilized for the solution is AWS and its Simple Storage Service (Amazon S3). Its capacity for storing data as well as being used to host web pages as an object in an S3 bucket would be ideal for this solution. Thus, the cloud application that utilizes pictures of shelter dogs in coordination with image recognition and other software to generate an identity and behavioral profile. Moreover, Amazon S3 is utilized by small and large industries for storage and protection of various amounts of data. Amazon S3 use case of a ‘data lake’ closely relates to the proposed solution. In addition, image files of shelter dogs will be stored as objects in the S3 Bucket. The image files will be stored based on various breeds of dogs. On the other hand, to narrow the numerous shelters across the country, the specified region will be the southeast United States. Shelters will have the ability to view the bucket and once a test of properly identifying dogs then access will be granted to multiple locations. Thus, end users of the system will view results from conducting a search of images of adopted dogs through an image classification model. The model results will include several possibilities of dog breeds.

After all the images of dogs are loaded into an S3 bucket, the need to be classified. In this scenario the shelters would be utilizing an open source model that has been previously trained on hundreds of dog breeds. To use the model to run a prediction batch, the model is loaded into a SageMaker notebook. The images will be loaded into the notebook, converted to their tensor form, ran through the classification model, and then prediction results will be stored in a database all upon execution of the notebook. Once the notebook has been set up to run batch predictions, the model will be put on a timer. The timer allows for an automatic prediction run after x amount of hours. Ideally, this would be run once every few days, or whenever new images of dogs need to be added to the website. The flexibility that SageMaker offers will allow for shelters to create algorithms and frameworks that best fit its needs. SageMaker will save time and money by detecting a dog’s breed faster. Once the predictions are written to their own respected database, the predictions will be brought into the animal shelter’s website hosted by AWS LightSail Application to be viewed by the user.

This use case did not identify any direct security concerns. The images of dogs were provided by an animal shelter. AWS automatically encrypts items that are uploaded to S3 Buckets. Since the model is an open-source shelf model, there is no proprietary intellectual property that needs to be secured either. See the diagram below to see the flow of information through the cloud based solution:

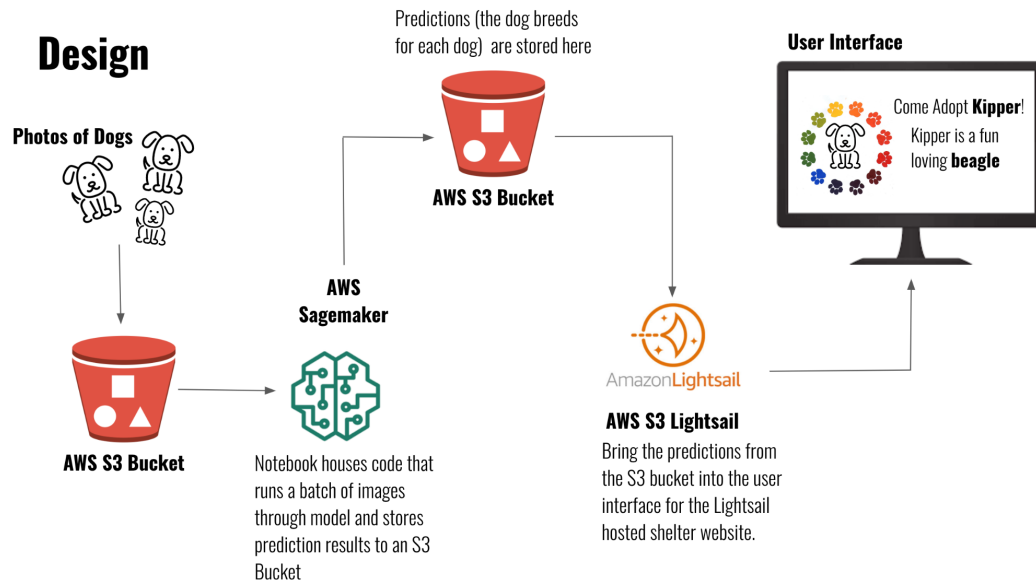


Exhibit 2

E. Financial Analysis

For this specific cloud implementation the cost is not all that expensive, it was intentionally designed on the premise that the animal shelters are non-profit organizations and that they probably do not have extra funds laying around to dedicate to advanced cloud based solutions. The logic behind each one of the prices is as follows:

1. 1 GB is roughly 595 photos
2. S3 = 10 Gigs of Storage (roughly) x 0.023 x 12 (months)
3. SageMaker = \$0.922 x 4 hours x 12 (months)
4. Lightsail = approx \$35 monthly x 12 (months)

The table below describes the three products that are outlined in the solution above. Each of the products is broken down into the cost per unit, the respected tiers and then the total calculated cost of the product per year. The totals were added which results in the grand total of roughly \$467.02 a year per implementation.

Service	Cost	Per	Tiers	Total Cost (Year)	Link
S3 Standard Storage	\$0.023	Gig per Month	Up to the first 50 Tb	\$2.76	
SageMaker Notebooks	\$0.922	Hour on-demand pricing	-	\$44.26	
Lightsail	\$20 - \$40	Month	-	\$420	
			Grand Total	\$467.02	

Table 1

The total request for funding is around \$500 for the first year, however; since it is the first year and the program within the first year is considered to be a pilot program, the total request is \$650. The \$650 will allow for any extra cushion that the development team might need to get everything set up and running. If successful the program has the potential to be used at several different animal shelters across the country. They could follow the same design. The benefits of utilizing Amazon S3 is that it is a service with no minimum charge. However, companies that utilize Amazon S3 pay for the services that are used. The links to the pricing tables from Amazon are linked in the list below:

1. S3
 - a. <https://aws.amazon.com/s3/pricing/?p=pm&c=s3&z=4>
2. SageMaker Notebooks
 - a. <https://aws.amazon.com/sagemaker/pricing/>
3. Lightsail
 - a. <https://aws.amazon.com/lightsail/pricing/>

F. Call for Action (Why the project should be funded)

This is a good idea for animal shelters to implement. Providing the proper details and breed of dog can be beneficial long-term. Animal shelters will have the ability to place dogs with

the best-matched owner. In addition, the dog's characteristics will be better matched with an environment that accommodates its needs. Characteristics such as activity level, agility, and strengths contribute to the decision of adopting a dog. Furthermore, this system could assist in better understanding the dog's personality, traits, and characteristics to find an environment that is best for the dog and the owner.

References

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