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UNIVERSIDAD YACHAY TECH

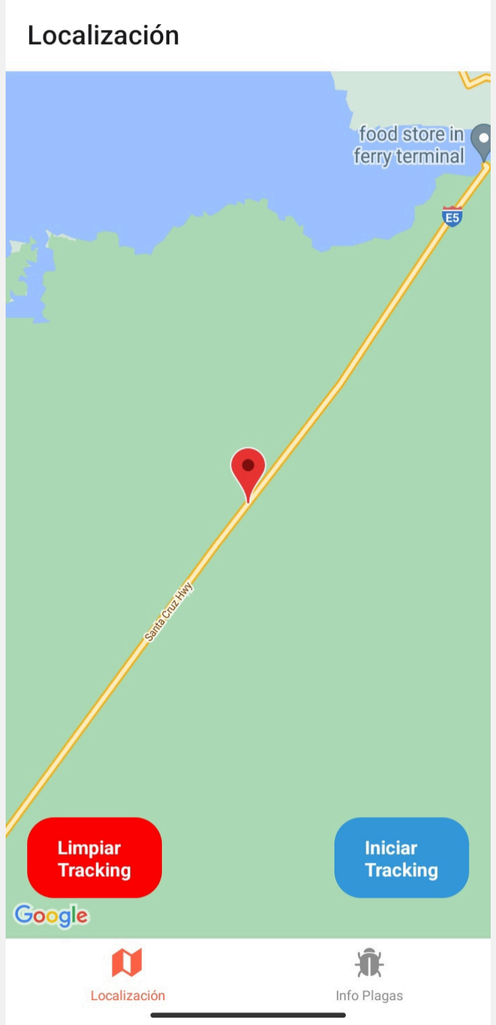
Agencia de Regulación y Control de la Bioseguridad y Cuarentena para Galápagos

Artificial Intelligence-Based Detection and Prediction of Giant African Snail (Lissachatina fulica) Infestation in the Galápagos Islands

ICSOFT 2024

19th International Conference on Software Technologies

Dijon-France



Agenda

Introduction

Objective

Methodology

Dataset

Transformer for forecasting

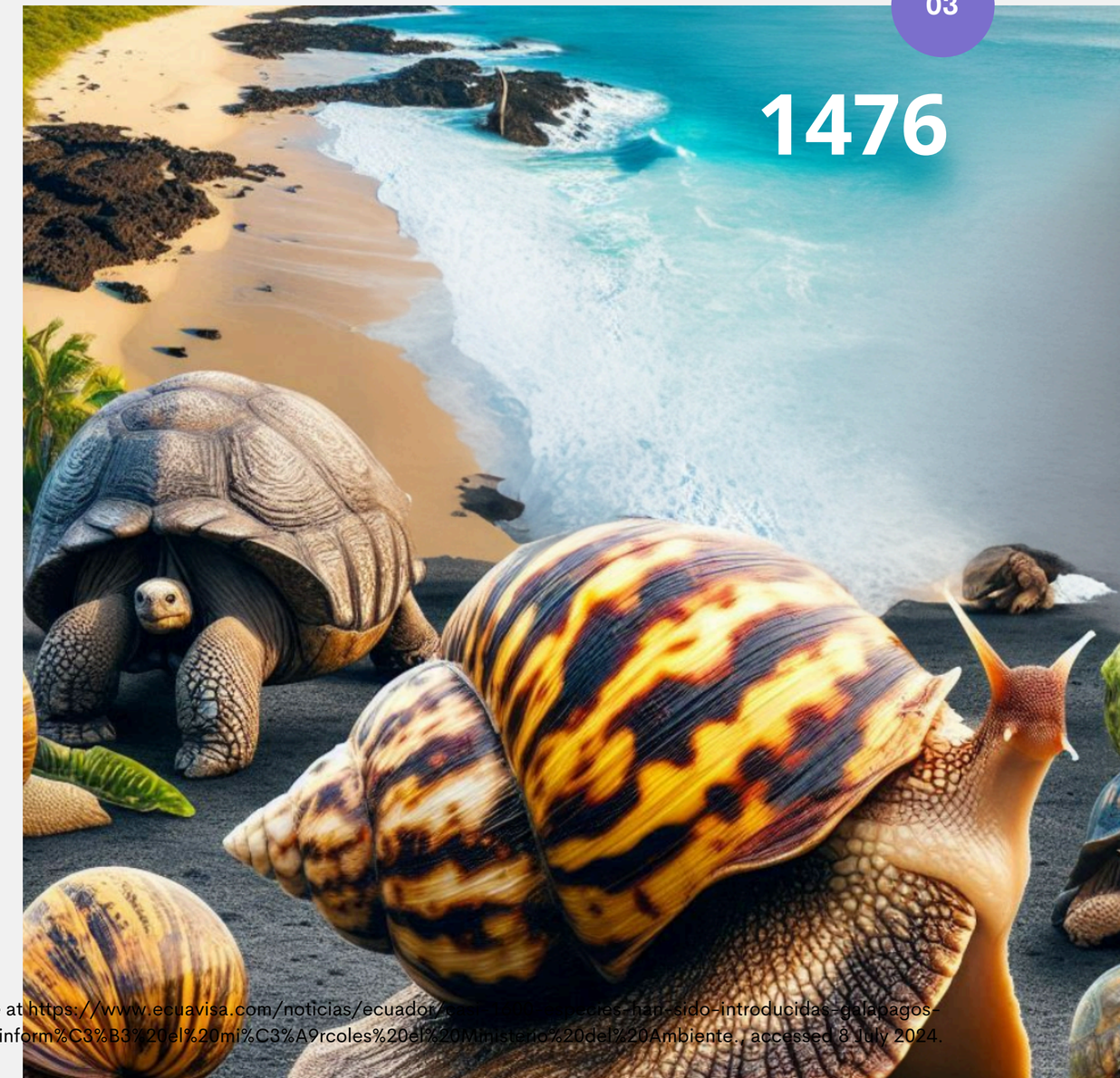
Results & discussion

Conclusion & future works

DALL.E 3

Introduction

The Galapagos Archipelago faces problems with invasive species, such as the giant African snail. An innovative solution proposes the use of mobile applications and AI to automate the detection and **prediction of infestations**. This reduces costs and errors, enabling a faster and more effective response to protect native ecosystems.

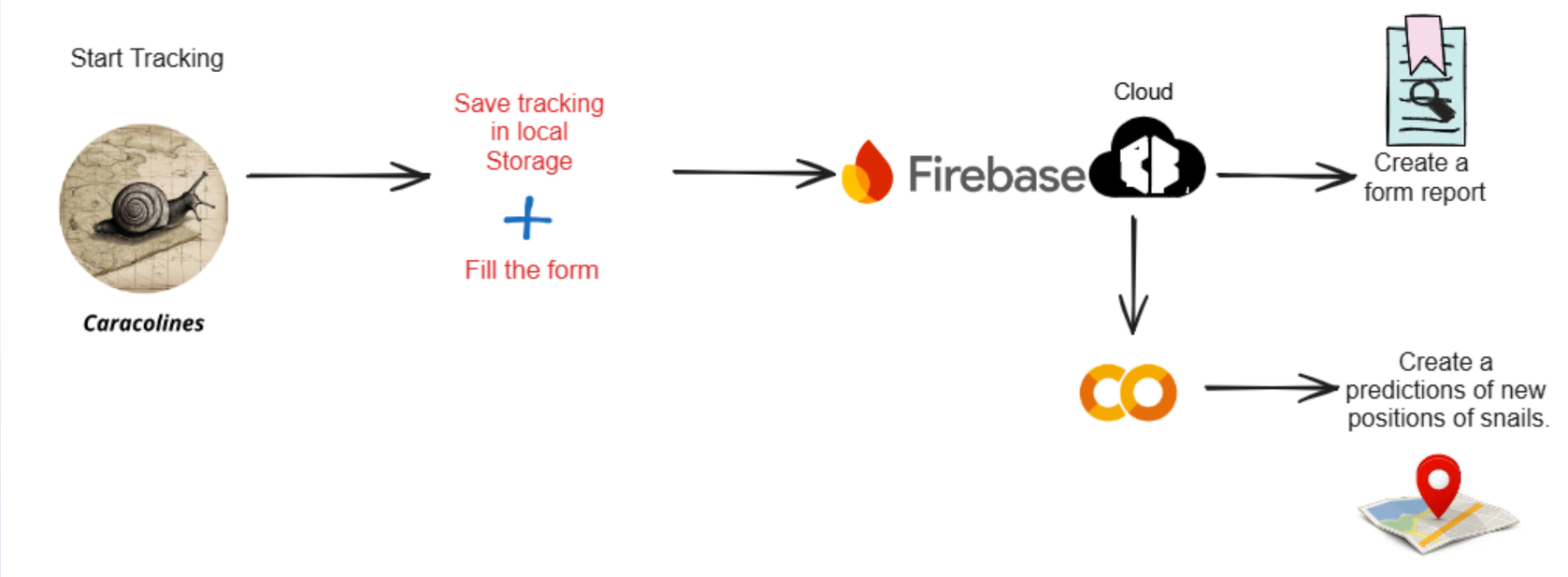


REDACCIÓN. 2019. Casi 1.600 especies han sido introducidas en Galápagos. www.ecuavisa.com. Ecuavisa. Available at https://www.ecuavisa.com/noticias/ecuador/[illegible]-especies-han-sido-introducidas-galapagos-FHEC456276#:~:text=Un%2050%25%20de%20las%20variedades%20%22han%20sido%20introducidas,mundo%2C%20inform%C3%B3%20el%20mi%C3%A9rcoles%20el%20Ministerio%20del%20Ambiente. accessed 8 July 2024.

Objective

Create a mobile application that tracks and predicts the new positions of the giant African snail in order to control and eradicate this invasive species.

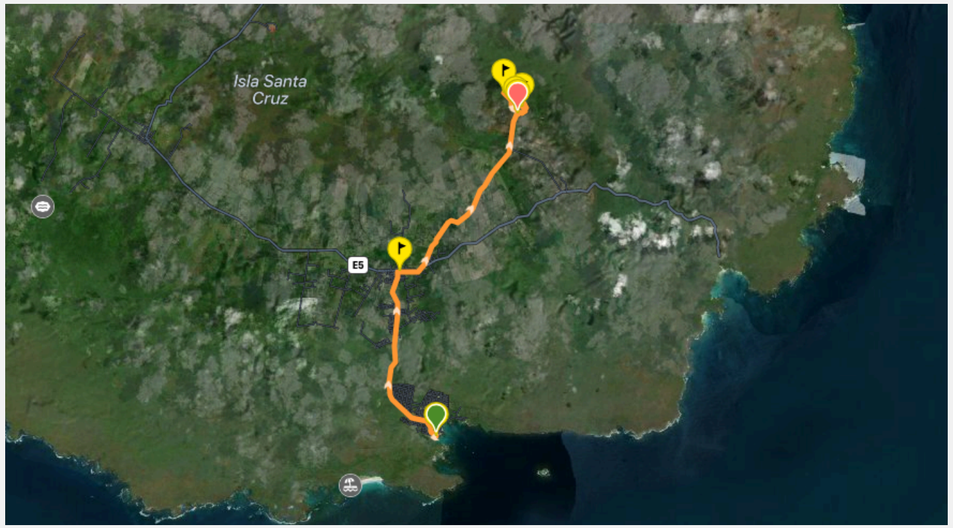
Methodology



Dataset

56000 Geographic positions tracking activities such as hiking.

Also Galápagos Biosecurity and Quarantine Control Agency. Give a real data of the snail position of some months.



Transformer for forecasting

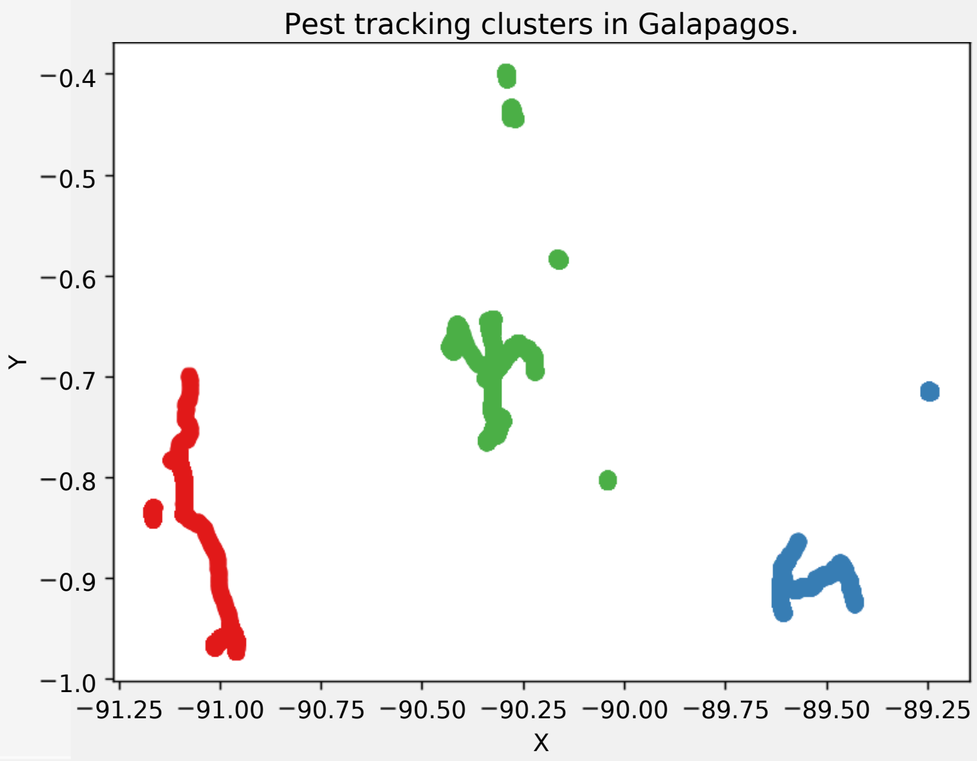
07

01

Machine Learning K-means

They are the key to im-
proving the number of
correct positions, as they
prevent the
transformer model from
better modeling the
phenomenon
in a specific area

Weakness



Transformer for forecasting

08

02

What is the next position of the snails for this month?

Attending to the most important parts of an input.

Intuition Behind Self-Attention

Transformer for forecasting

02

What is the next position of the snails for this month?

Attending to the most important parts of an input.

1.Identify wich parts to attend to.
2. Extract the features with high attention.

Intuition Behind Self-Attention

Transformer for forecasting

02

What is the next position of the snails for this month?

A Simple Example:Search

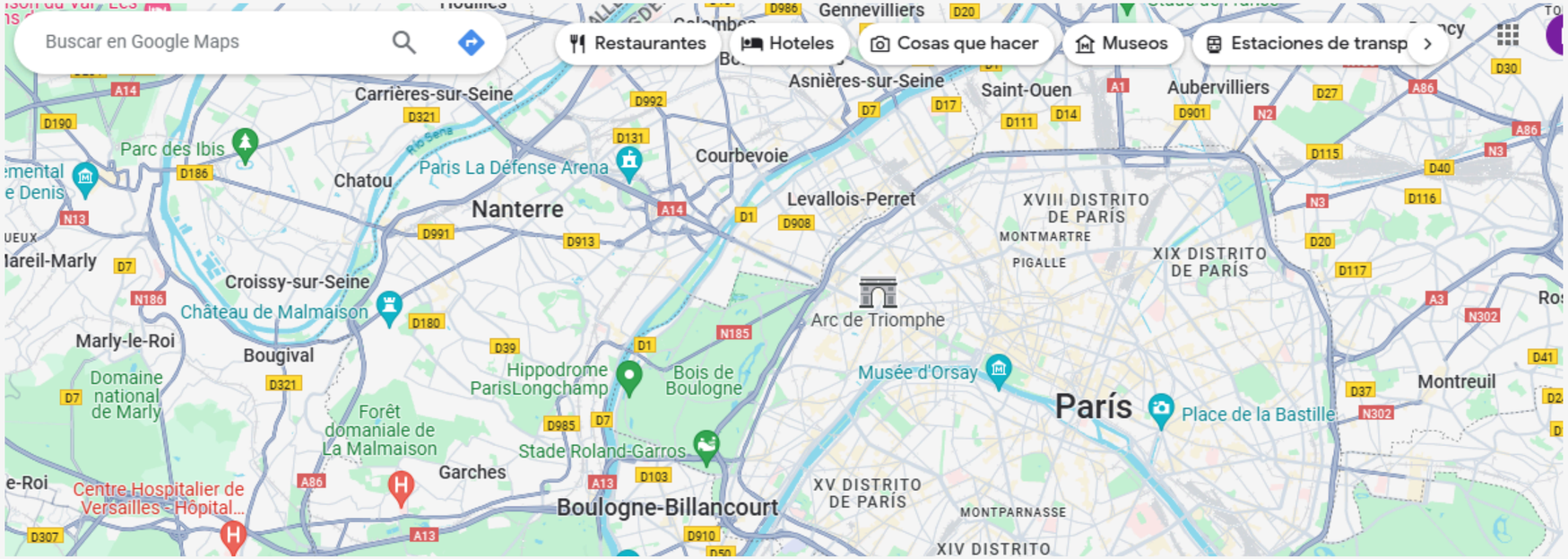
How do I know where Yachay Tech University is located?

Transformer for forecasting

02

What is the next position of the snails for this month?

Understanding Attention with Search



Transformer for forecasting

02

What is the next position of the snails for this month?

Understanding Attention with Search

Transformer for forecasting

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What is the next position of the snails for this month?

Understanding Attention with Search

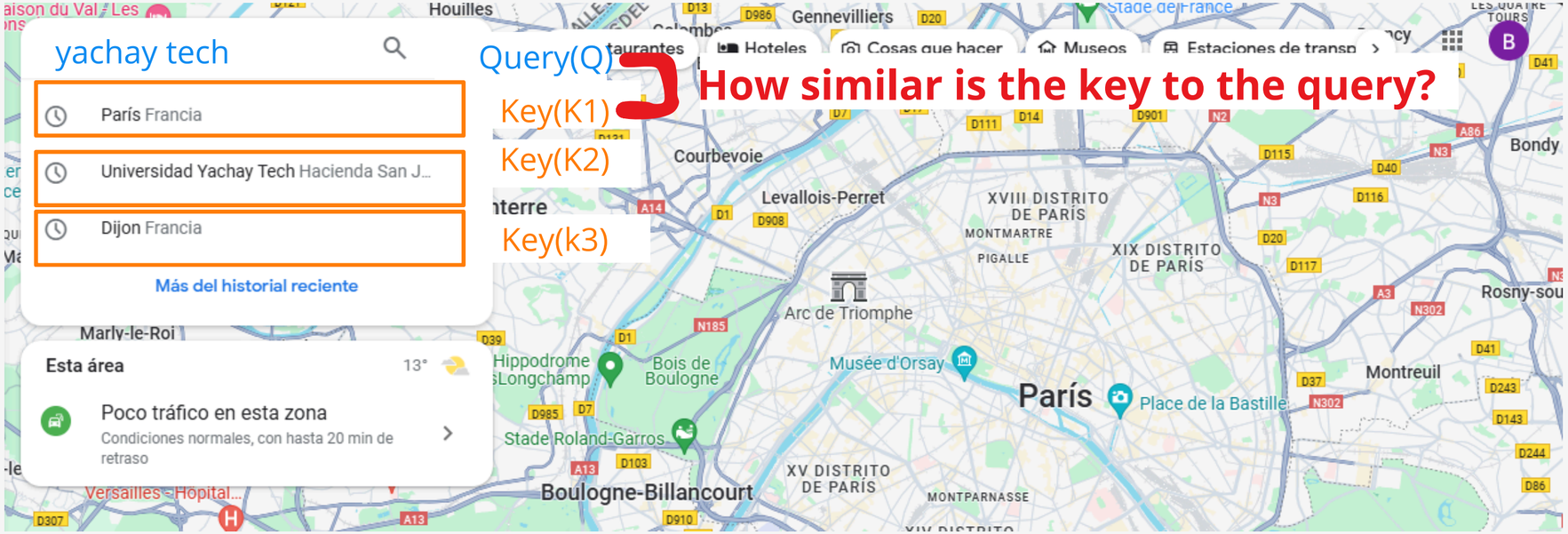
Transformer for forecasting

02

What is the next position of the snails for this month?

Understanding Attention with Search

1.Compute attention mask: How similar is each key to the desired query-



Transformer for forecasting

02

What is the next position of the snails for this month?

Understanding Attention with Search

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Transformer for forecasting

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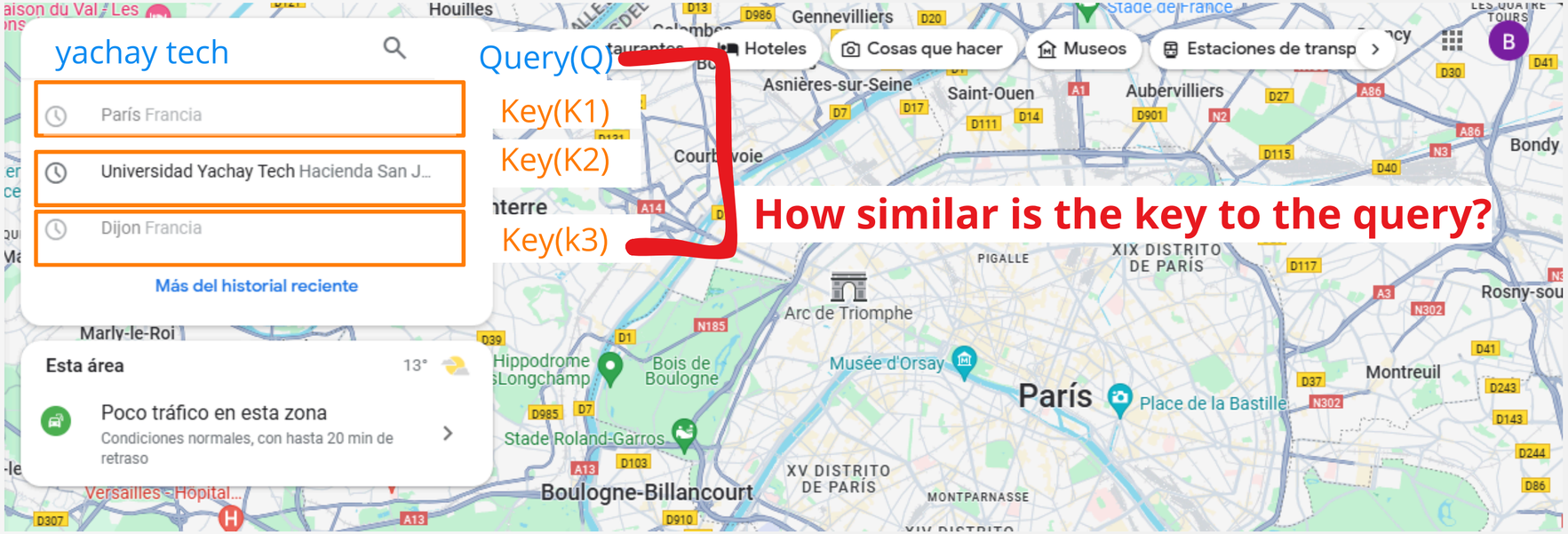


Transformer for forecasting

02

What is the next position of the snails for this month?

Understanding Attention with Search

1.Compute attention mask: How similar is each key to the desired query-
2.Extract values based on attention: Return these values with highest attention-

Transformer for forecasting

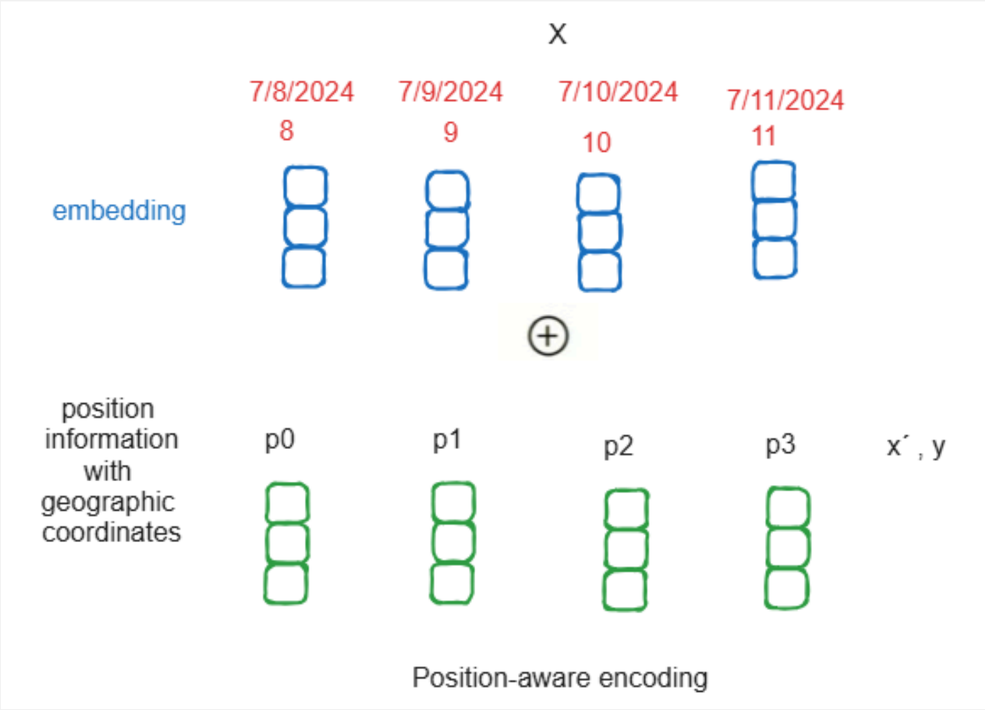
02

What is the next position of the snails for this month?

Attending to the most important parts of an input.

1. Encode **position** information.

Learning Self-Attention with Neural Networks



Transformer for forecasting

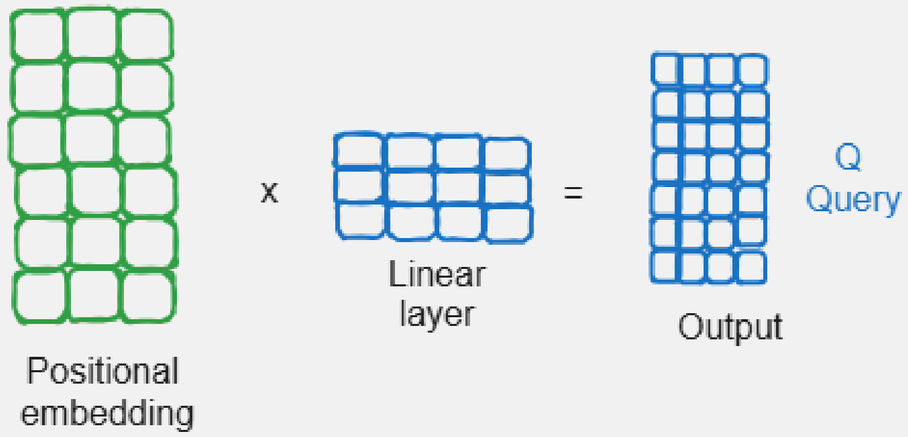
02

What is the next position of the snails for this month?

Attending to the most important parts of an input.

1. Encode **position** information.
2. Extract **query,key, value** for search.

Learning Self-Attention with Neural Networks



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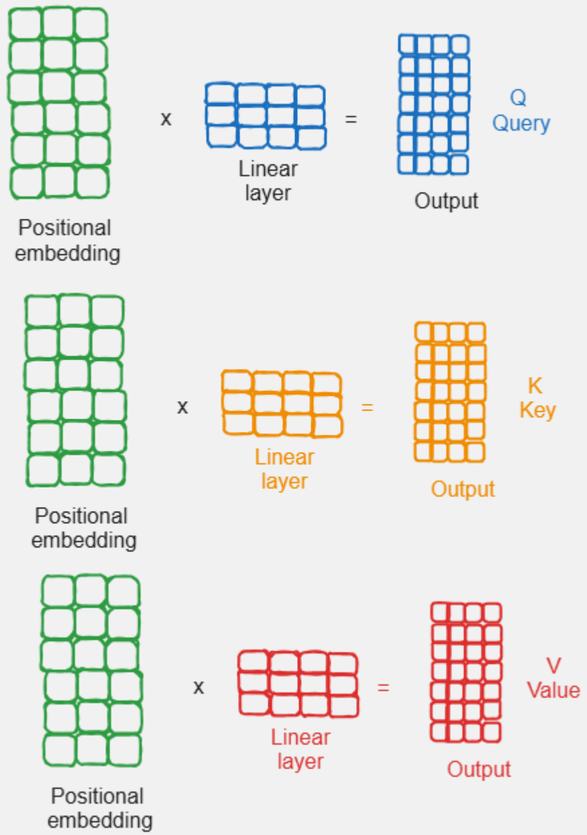


Transformer for forecasting

02

What is the next position of the snails for this month?

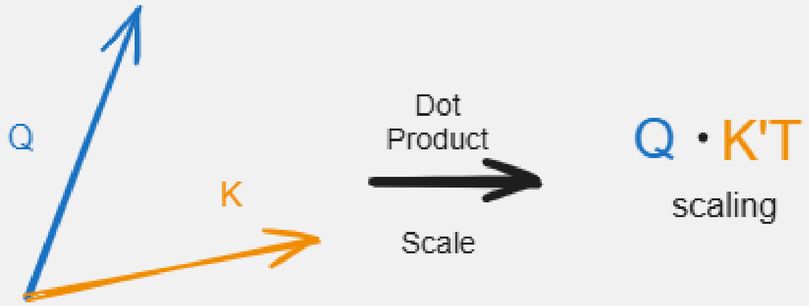
Attending to the most important parts of an input.

1. Encode **position** information.
2. Extract **query,key, value** for search.
3. Compute **attention weighting.**

Learning Self-Attention with Neural Networks

Attention Score: compute paiwise similarity between each query and key.

How to compute similarity between two sets of features?



Also know as the 'cosine similarity'

Transformer for forecasting

02

What is the next position of the snails for this month?

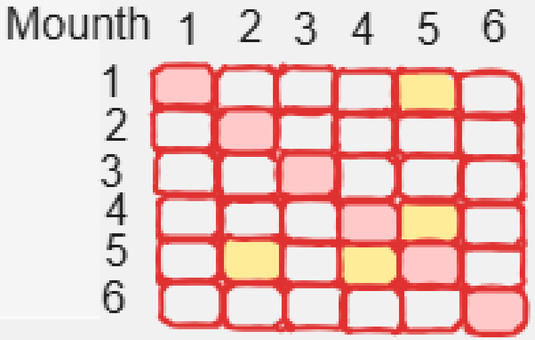
Attending to the most important parts of an input.

1. Encode **position** information.
2. Extract **query,key, value** for search.
3. Compute **attention weighting.**

Learning Self-Attention with Neural Networks

Attention weighting: where to attend to.

How thee similar Is the Key to the query?



$$\text{softmax}\left(\frac{Q \cdot K'T}{\text{scaling}}\right)$$

Transformer for forecasting

02

What is the next position of the snails for this month?

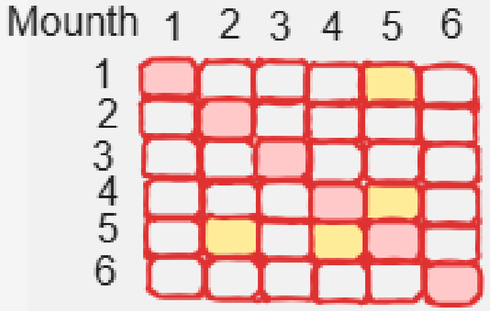
Attending to the most important parts of an input.

1. Encode **position** information.
2. Extract **query,key, value** for search.
3. Compute **attention weighting.**

Learning Self-Attention with Neural Networks

Attention weighting: where to attend to.

How thee similar Is the Key to the query?



$$\frac{\text{softmax}\left(\frac{Q \cdot K'T}{\text{scaling}}\right)}{\text{Attention weighting}}$$

Transformer for forecasting

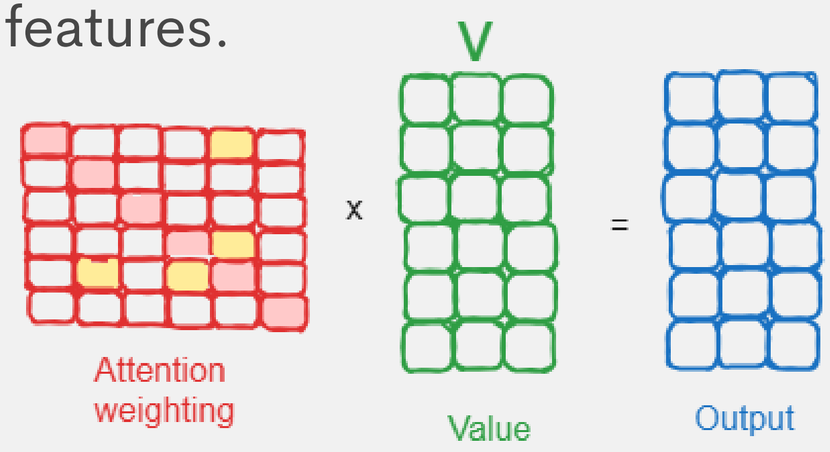
02

What is the next position of the snails for this month?

1. Encode **position** information.
2. Extract **query,key, value** for search.
3. Compute **attention weighting.**
4. Extract **fractures with attention.**

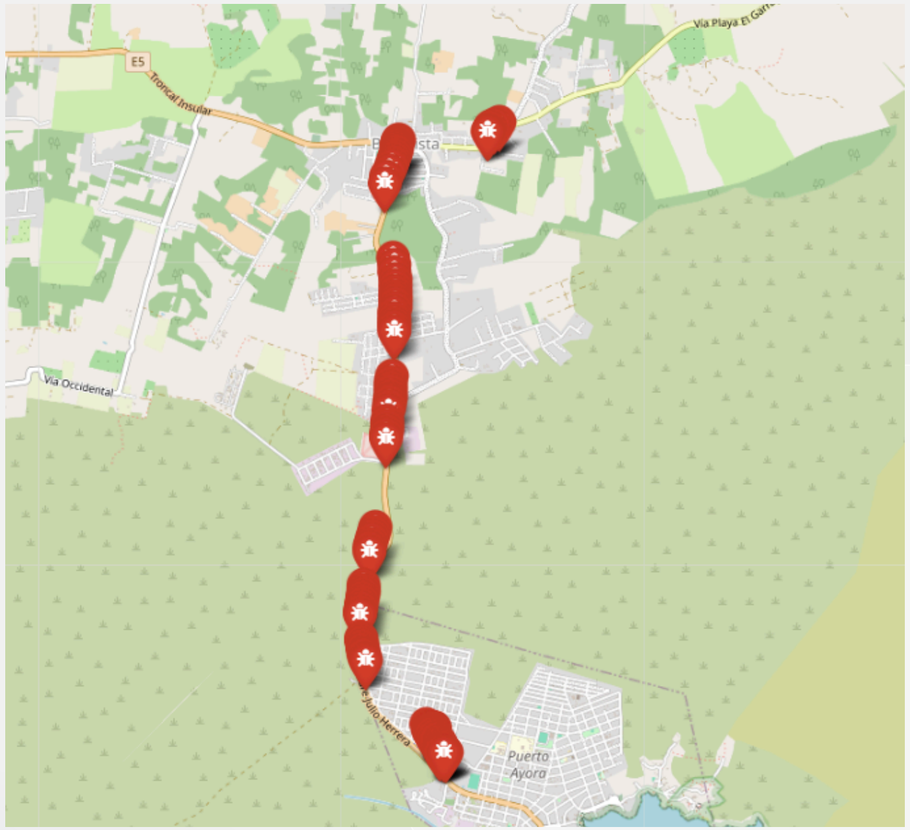
Learning Self-Attention with Neural Networks

Last step: self-attend to extract features.



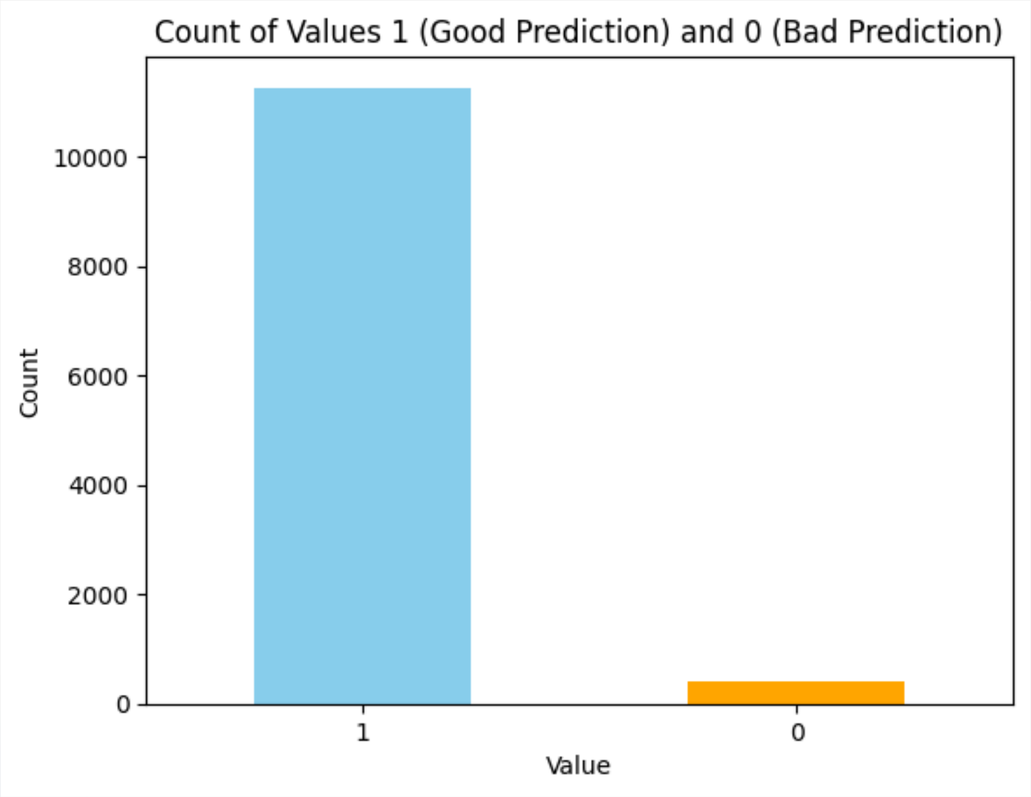
$$\underbrace{\text{softmax}\left(\frac{Q \cdot K'T}{\text{scaling}}\right)}_{\text{Attention weighting}} \cdot \underline{V} = \underline{A(Q,K,V)}$$

Results



- This image represents 112 predicted points where plagues were found in the first days of the 16th month, with an error of 0.001 in the geographic system in both x (longitude) and y (latitude).

Results



- This bar chart represents the total positions from month 16 to month 24 which are the test positions in graph 1 are the correct positions and 0 are the incorrect coordinates which were predicted with a value of 0.001 in geographic coordinates.

Results

- In predictions of destinations, the team uses root mean square error (RMSE).

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}$$

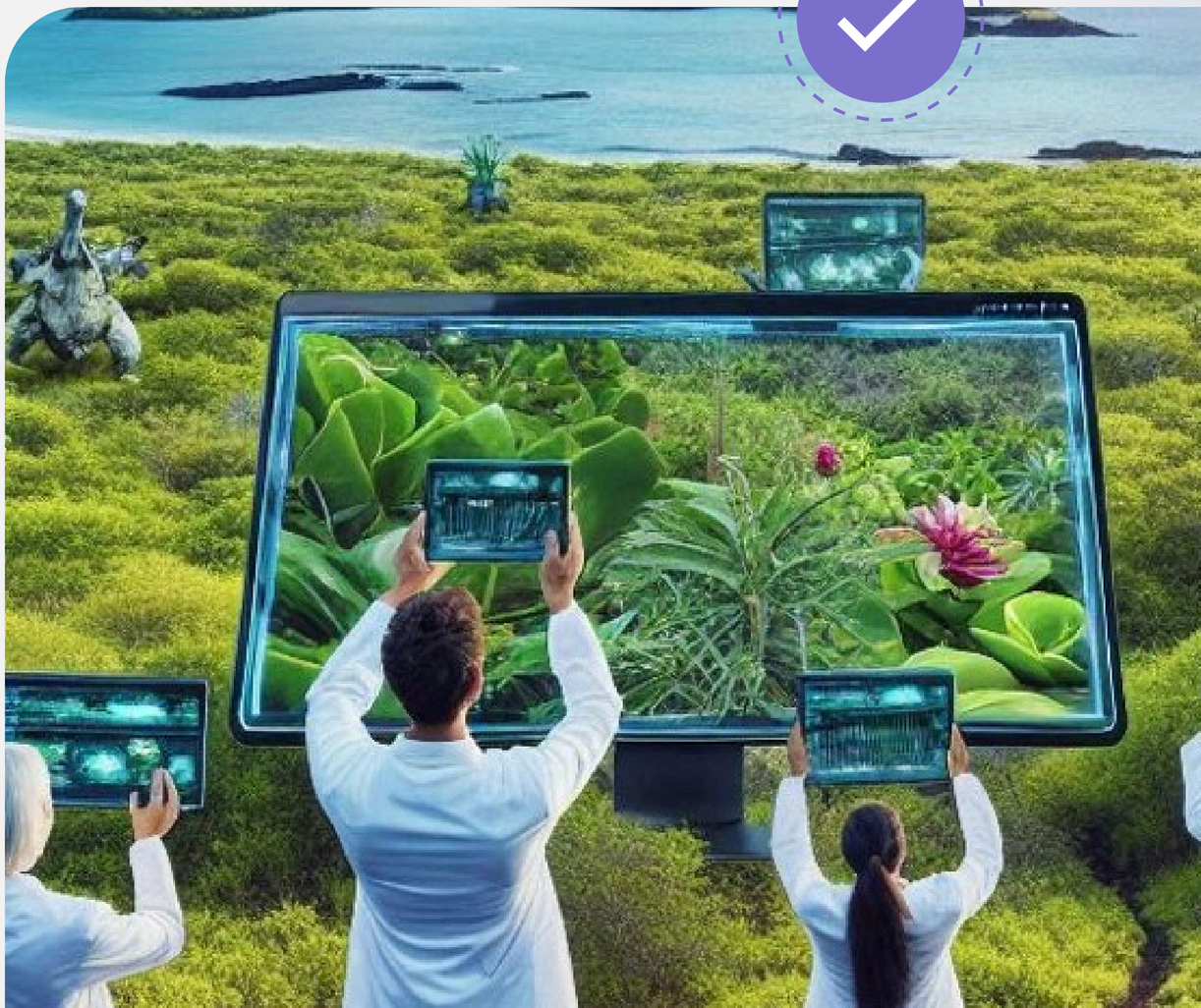
Where:

- n is the total number of observations.
- y_i are the observed values.
- $\hat{y}_i$ are the predicted values.

	RMSE	
Model	**X**	**Y**
Prophet	0.6734	0.1393
LSTM	0.0599	0.0121
Transformer	0.0118	0.0111

Conclusion & future work

This research demonstrates improved surveillance efficiency and accuracy, enabling rapid reporting and proactive response to potential outbreaks. This integration of mobile tech and AI provides actionable insights for targeted control measures, contributing to the preservation of the Galápagos' ecological integrity.



Thank You!

Jonathan Loor, Ariana Jiménez, Juan Moromenacho Grace Rodríguez, Iván Reyes, Paulina Vizcaíno and Manuel Eugenio Morocho

Puissiez-vous passer un bon après-midi.

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