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Parking Lot Analysis
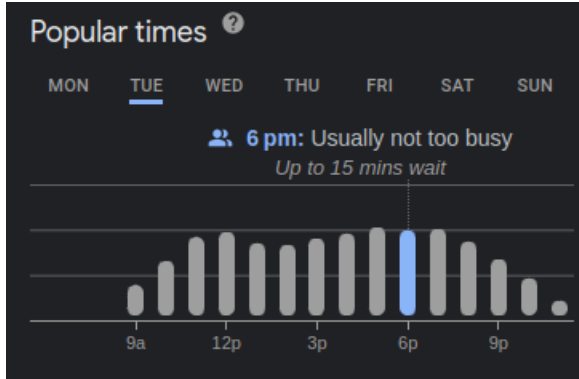Distributed Systems WS2023/24

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Content

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- Workflow
- Live Demo
- Evaluation

Motivation: Popular Times for Restaurants

Googling a restaurant gives the following graph:

Source: [1]

Measure Busy Times for Parking Lots
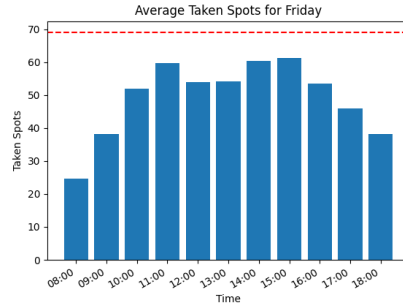
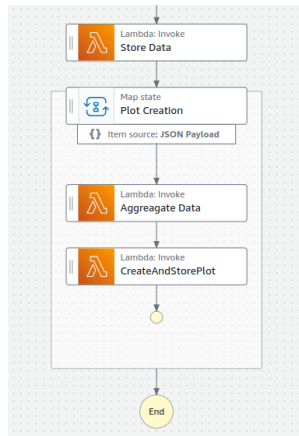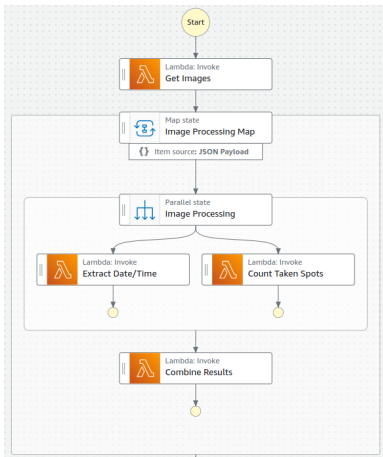Something similar for parking lots?

Image from the Dataset, source: [2]

Desired output

Workflow

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Workflow in Detail I

- **Get Images:** Retrieves the images from an S3 Bucket
- **Extract Data/Time:** Extracts date, time and day of week from an image name
- **Count Taken Spots:** Counts the taken spots for an image using Amazon Rekognition
- **Combine Results:** Combines the JSON output from the previous Lambda Functions
- **Store Data:** Stores the following data in a DynamoDB table (one table entry per timestamp):
  - Time
  - Date
  - Weekday
  - Taken spots

Workflow in Detail II

- Total spots
- **Aggregate Data:** Retrieves the data previously stores in the DynamoDB table and aggregates the data for each timestamp per weekday
- **Create and Store Plot:** Creates a plot for the average taken spots over the time of day for every weekday

Live Demo

Execution Times

For 120 images the execution time of $\sim 1\,\text{min}$ breaks down into the following parts:

- Get images: $< 2\,\text{s}$
- Processing images: $\sim 30\,\text{s}$
- Storing data in DynamoDB table: $\sim 17\,\text{s}$
- Retrieving and aggregating data from table: $< 1\,\text{s}$
- Creating and storing plot: $\sim 11\,\text{s}$

Using concurrency limit of 5 parallel iterations

Execution Cost

One execution with 120 images leads to the following costs:

- Step functions: 0$ (500 state transitions, 4000 per month are free)
- Lambda functions: 0$ (only at a few 100,000 requests per month the lambda functions would you exceed the free tier limit)
- Rekognition: 0.12$

Daily executions for images every 5 min (96 images per day) leads to monthly execution costs of about 3.10$

Does not include storage costs for DynamoDB and S3

Limitations of the Application

- Total number of parking spots needs to be an input and cannot be counted using Amazon Rekognition
- Key-value store does not allow easy aggregation $\rightarrow$ using SQLServer would be more efficient, but no access due to the student account
- Amazon Rekognition not entirely perfect when labeling cars, especially for images with a lot of cars (cars become very small in the images)

Thank you for your attention

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References I

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📄 Parking lot dataset.
https://www.kaggle.com/datasets/ammarnassanalhajali/pklot-dataset.
Accessed: 22.01.2023.