

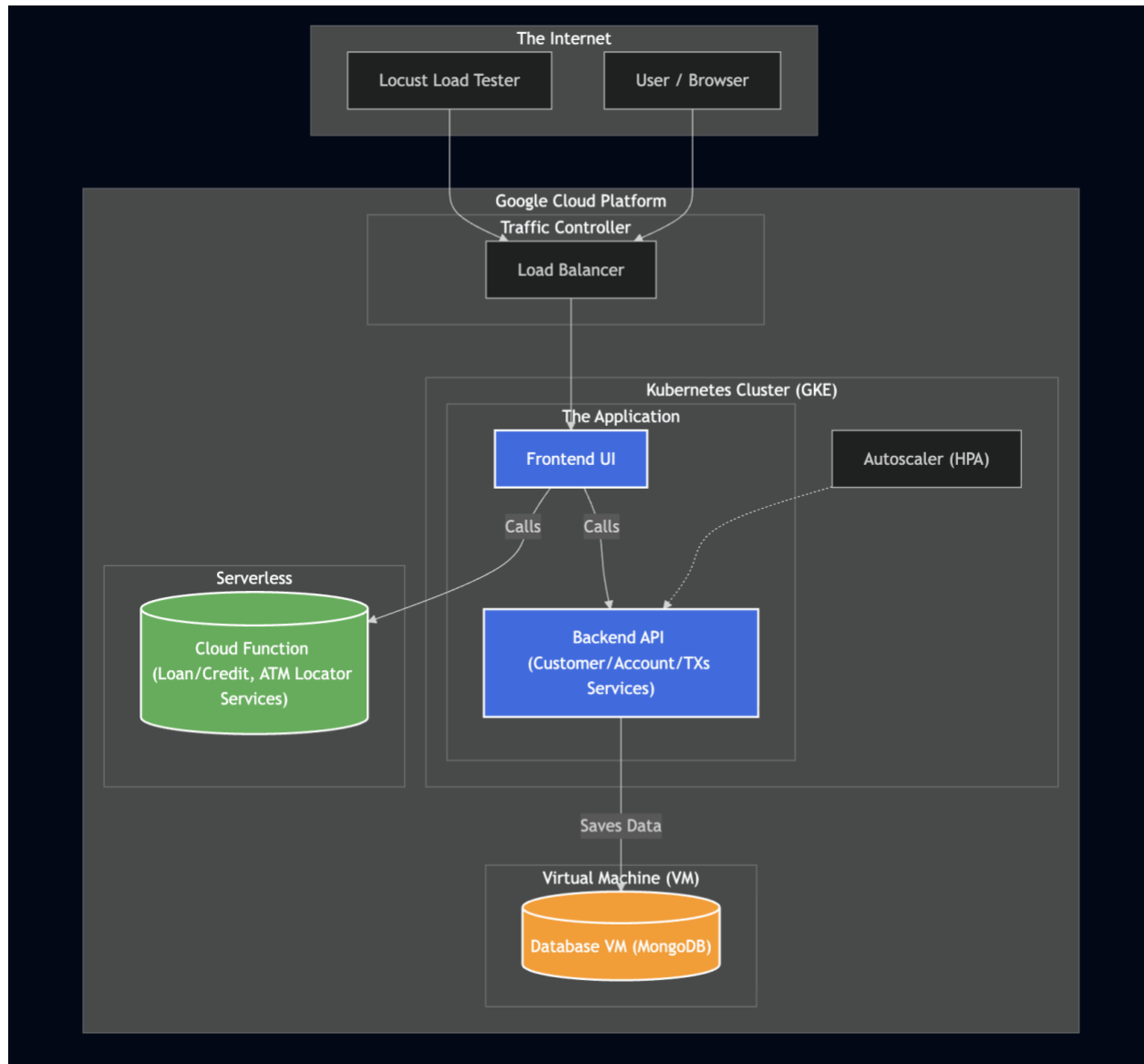
# CMPE 48A: Cloud Computing Term Project

## Phase #1 Report – Ali Gökçek

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Application Source Code: <https://github.com/cisco-open/martian-bank-demo>

### 1. Tentative Cloud Architecture:



We have designed a hybrid cloud-native architecture that leverages the strengths of Containers, Virtual Machines, and Serverless computing. The system is divided into three distinct layers:

**1. Containerized Core (Kubernetes / GKE):**

- **Components:** The **Frontend UI** and the primary **Backend API** (handling Customer Accounts and Transactions) are containerized and deployed on Google Kubernetes Engine (GKE).
- **Scalability:** We utilize a **Horizontal Pod Autoscaler (HPA)** on the Backend API. This satisfies the requirement to deploy workloads in a scalable manner. The HPA will monitor CPU utilization and automatically scale the number of API pods during load testing.
- **Traffic Management:** An External Global Load Balancer routes internet traffic to the cluster, ensuring a unified entry point.

**2. Virtual Machine Layer (Compute Engine):**

- **Component:** The **MongoDB Database** is installed and hosted on a standalone Google Compute Engine (GCE) Virtual Machine.
- **Functional Role:** This VM handles all persistent data storage for the application. Extracting the stateful database from the Kubernetes cluster.

**3. Serverless Layer (Cloud Functions):**

- **Component:** The **Loan/Credit** and **ATM Locator** services are implemented as standalone Google Cloud Functions.

## 2. Cost Estimation:

We have optimized resource selection to ensure the total monthly cost remains well below the **\$300 free trial budget**.

**Projected Monthly Cost: ~\$172.55**

Component	Resource Configuration	Estimated Monthly Cost	Justification
GKE Nodes	3x e2-medium instances (2 vCPU, 4GB RAM)	\$139.20	Sufficient resources to host the Python-based microservices and system pods.

<b>Component</b>	<b>Resource Configuration</b>	<b>Estimated Monthly Cost</b>	<b>Justification</b>
<b>GKE Management</b>	Zonal Cluster	<b>\$0.00</b>	Management fees are waived for a single Zonal cluster.
<b>Database VM</b>	1x e2-small instance (0.5 vCPU, 2GB RAM)	<b>\$11.10</b>	Provides adequate memory for the MongoDB database while minimizing compute costs.
<b>Load Balancing</b>	Global HTTP(S) Load Balancer	<b>\$18.25</b>	Required for external traffic routing and ingress management.
<b>Storage (Disks)</b>	40GB Standard Persistent Disks for each	<b>\$4.00</b>	Covers boot disks for nodes and data storage for the VM.
<b>Serverless</b>	Cloud Functions (Gen 1)	<b>\$0.00</b>	Usage is expected to fall within the free tier (first 2 million invocations).
<b>Total</b>		<b>~\$172.55</b>	<b>(58% of Total Budget)</b>

The estimated cost of \$172.55 leaves a safety buffer of over \$120. We will further control costs by stopping the Database VM and deleting Load Balancers when the environment is not in active use.