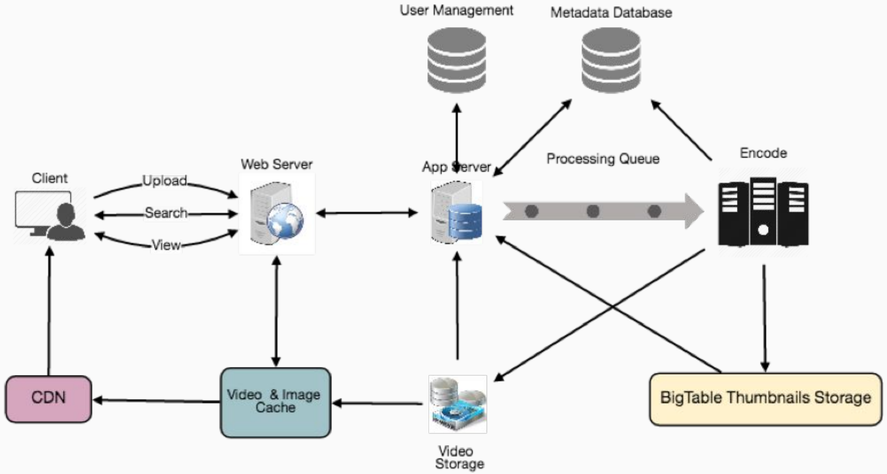
Distributed Systems Design

System Design

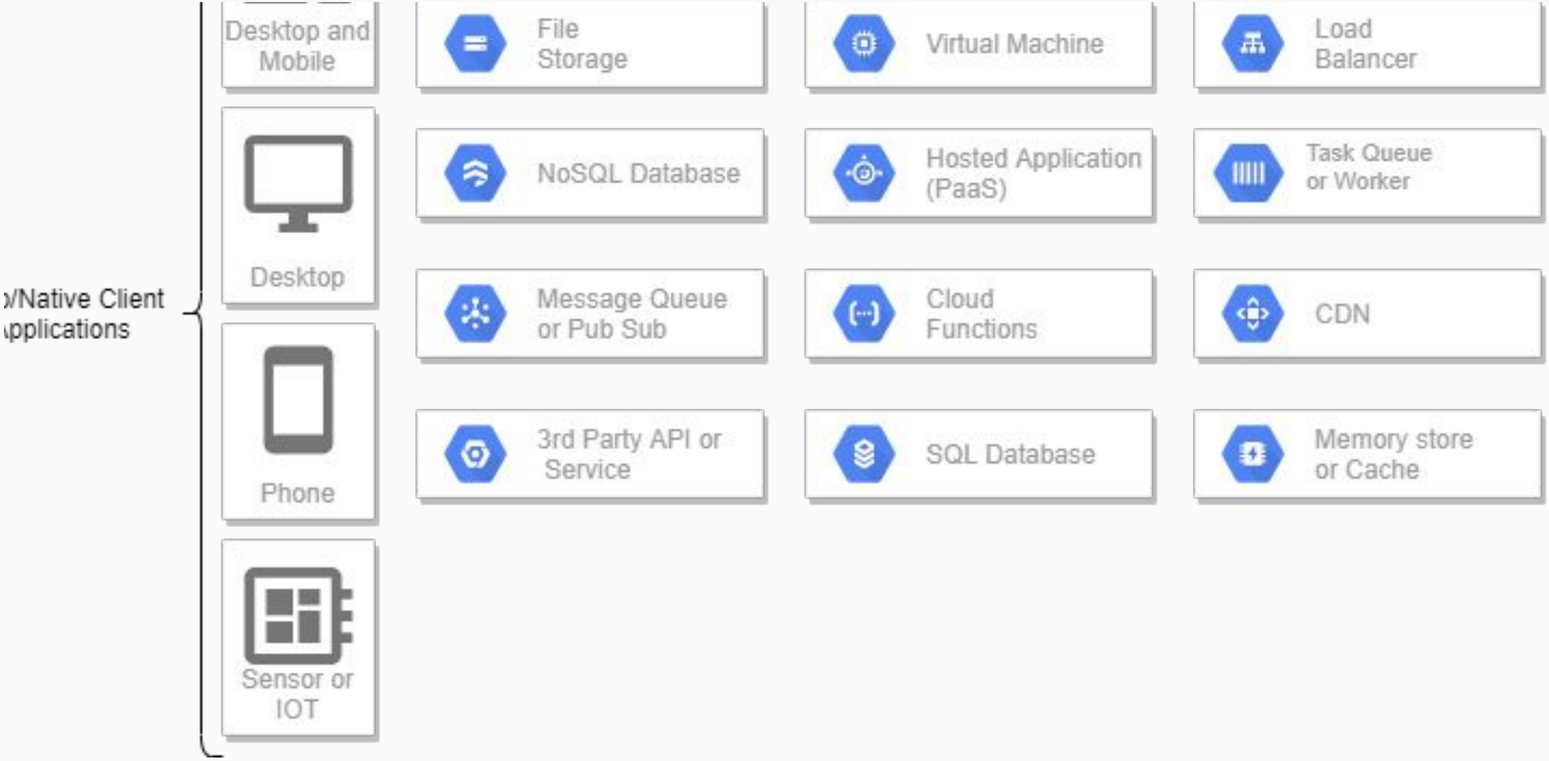
- Process of defining the architecture, modules, interfaces, and data for a system to satisfy specified requirements.
- Applies:
  - Cloud Design Patterns
  - Distributed System Architectural Patterns
- Concepts:
  - Database replication
  - Database partitioning
  - Map Reduce
  - Microservices
  - Message Brokers
  - Queuing
  - Caching
  - Event Stream
  - Load Balancing
- Case Study: Tinder



System Components

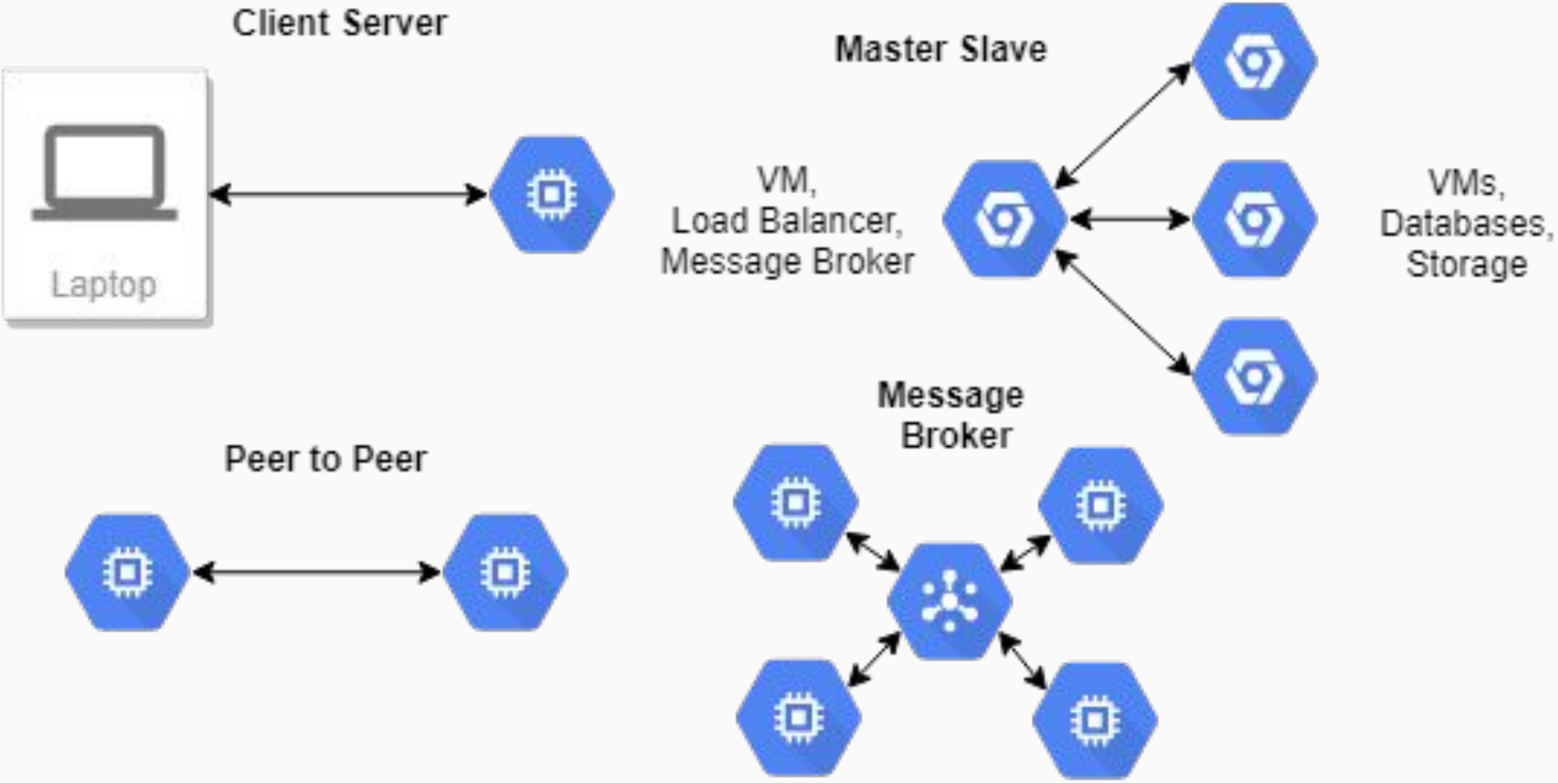
1. **File Storage:** Services for hosting, optimizing and distributing media files
2. **Static Hosting:** Github pages, firebase hosting, netlify
3. **Compute:**
    a. Cloud Virtual Machine: Eg Digital Ocean Droplets, Google Compute Engine, AWS EC2
    b. Cloud Function: Firebase Function, AWS Lambda, Netlify Functions
    c. App/Container Hosting or Platform as a Service (PaaS): Heroku, KintoHub,
    d. VPS/Shared/Managed/Dedicated Hosting
4. **External Systems, 3rd Party APIs/Service:** Eg. Google Maps, Facebook API, YouTube API
5. **Databases**
    a. No/SQL: MongoDB, Firebase Firestore/Real Time Database, Harper DB
    b. Relational: PostGres, MySQL, SQL Server, MariaDB
    c. Graph: TigerDB, Neo4j, DGraph
6. **Message Queue/Pub Sub:** Services for receiving, queueing and delivering messages to multiple components
7. **Memory Store /Caching:** Memcached, Redis
8. **Load Balancer:** A component that receives requests and distributes them evenly among other components
9. **Task Queue/Worker:** Systems for managing scheduled tasks or background workers Eg: Google Cloud Task, Celery, Redis Queue
10. **Content Delivery Network:** Fast high availability hosting of assets and static web sites

Conventions



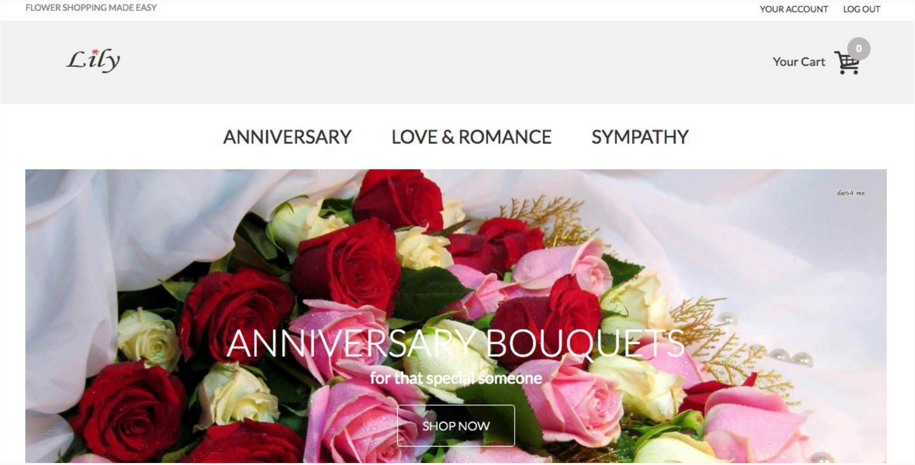
Draw.io Template

Illustrating Distributed Architectural Patterns



Case Study: lily’s

- Lily’s Flower E-commerce Application
- Requirements:
  - Web and Mobile clients
  - Product browsing
  - Order fulfillment
  - Product analytics dashboard
  - Location Based coupons (mobile only)
- Non functional requirements:
  - High volume real time coupon delivery
  - Fast read writes of coupon delivery
  - Coupon delivery service should be independent of web app
  - Prototype deployment < 1000 users
  - Testing load < 100 requests per min



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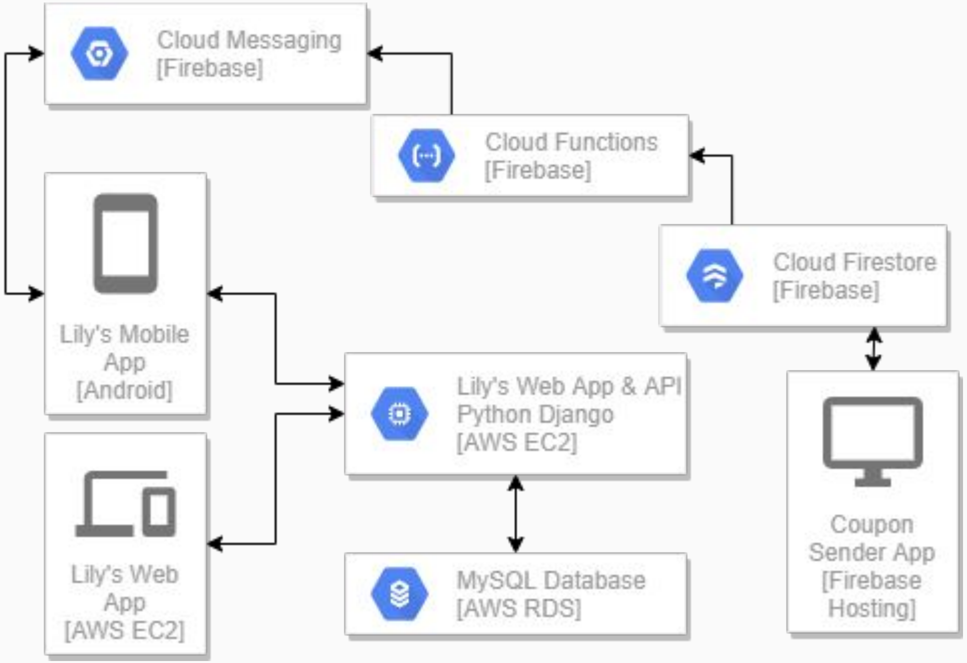
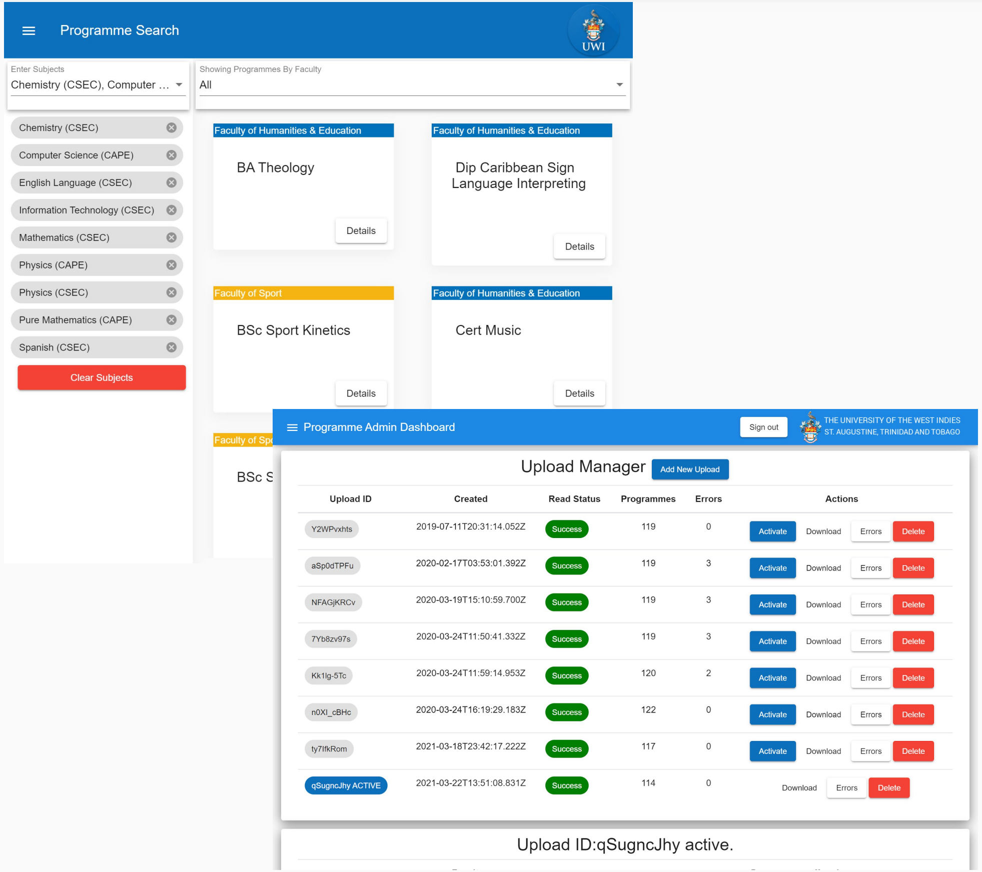
Lily's System Design

- Single VM for website and API
- Database hosted on separate machine
- 3rd Party service for storing coupons and sending notifications
- 3 Party service for hosting coupon delivery app
- Note:
    - Arrows indicate flow of communication, unidirectional/bidirectional
    - Platform/Provider indicated with [brackets]



Case Study: BeUWI

- Requirements:
  - Programme Search Client
    - Browse Programmes
    - Search programmes by requirements
  - Programme Admin Client
    - Upload Programmes via csv files
    - Manage and rollback uploads
- Non functional requirements:
  - High traffic on Search Client
  - Requirements Query Time Should be <500ms
  - Backend Should scale but Database is fixed read only



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Showing Programmes By Faculty: All

Faculty of Humanities & Education
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Faculty of Humanities & Education
Dip Caribbean Sign Language Interpreting

Faculty of Sport
BSc Sport Kinetics

Faculty of Humanities & Education
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Upload Manager

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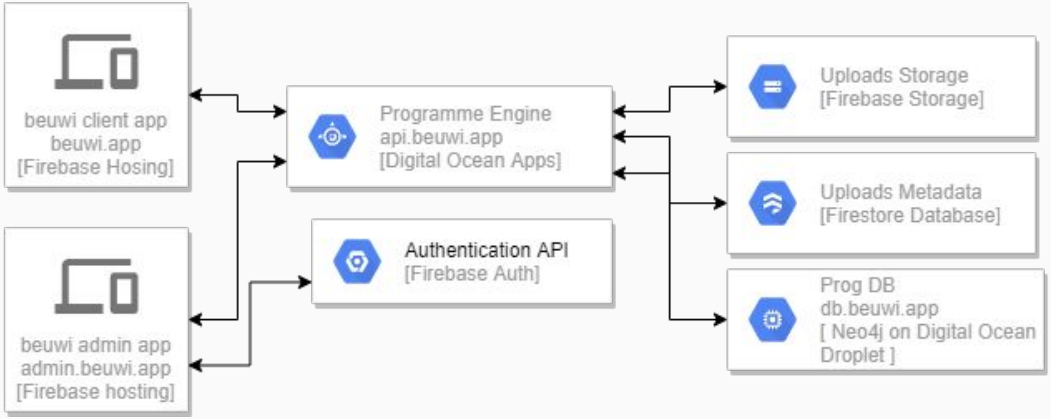
BeUWI System Design

- Graph Database used, deployed on dedicated Digital Ocean Droplet (Virtual Machine)
- Programme engine deploy on Digitalocean Apps platform for auto scaling and DDoS protection
- Stores uploads separately from backend in firebase storage
- Upload metadata stored in NoSQL database, firebase firestore
- Admin and Client apps on CDN via firebase hosting
- Used firebase auth on admin app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