Week 13: Web Technologies, Infrastructure, and Data
CS 240, Spring 2021 - Week 13
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What have you created?

- MP6: PNG Microservice

- MP7: Courses Microservice

- MP7.2: A Docker Container

- MP8: Versioned State Server

- Final Project: Using Docker Containers + Large Microservice

Modern Web Services Technologies

Frontend	Middleware	Backend
Technologies:	Technologies:	Technologies:
Purpose?	Purpose?	Purpose?
Technical Interfaces:	Technical Interfaces:	Technical Interfaces:

[Case Study]: GPA Visualization

[Case Study]: Illinois Open Source Queue

[Case Study]: 91-DIVOC

Scaling on Cloud Infrastructure
Our GPA grade calculator has taken off and gone viral -- how do we scale our website for millions of users every day?

DNS - Domain Name Services
What we know:
- We know that TCP connects two remote hosts together through the internet via an IP address.
- However, most remote hosts we connect to we do so via a domain name ("ex: cs.illinois.edu").

DNS:

FQDN: _____

- Format:

- Read backwards:
  - Ends with the root DNS server:

  - Then a Top Level Domain (TLD):

  - Then a Second Level Domain (2LD/SLD):

  - Optionally, additional level domains:

DNS Resolution: The DNS root contains only **13** authoritative name servers/clusters for the entire Internet!

[Root Servers]:

[DNS Zones]:

DNS Records:
- Every DNS record is a set of key/value pairs that with a TTL ("Time to Live") field.
- The record may be cached by intermediate servers for as long as the TTL is set (ex: 2 hours) before being updated.
- Notable keys in a DNS record:
    - "**A**" (Host, IPv4) Record:

    - "**AAAA**" (Host, IPv6) Record:

    - "**CNAME**" (Alias) Record:

    - "**MX**" (Mail Exchanger) Record:

Optimization: How do we use DNS to make our viral app better?

(1): Redundant Servers, Redundant Records

(2): Content Delivery Networks (CDNs)

[Overview]:

[Technical Implementation]:

[Advantages]:

[Disadvantages]:

CDN as a Service:

Many offerings for CDN services available commercially:
- AWS "Cloudflare"
- Google "Cloud CDN"
- Microsoft "Azure CDN"
- ...and others...

...and extremely cheap (Cloudflare pricing):
- Cost per HTTPS requests: $0.000001 /request
  (== $0.01 /10,000 requests)
- + $0.005 per path requested for invalidation.
- + standard bandwidth costs (~$0.085 /GB)

Example: 1,000,000 requests each receiving 100 KB of static data from the CDN, without any cache invalidations:

Impact of CDN on Modern Apps:

On many, many, many websites, you may arrive to the website to see a spinning loading circle:
- Website is delivered as "static" content, via the CDN.
- Data is seperate from the webpage, may be static or dynamic.

Examples:

Data Storage

Central to almost all cloud applications is data and there are many solutions to data storage available.

[Option 1]: In-Memory Storage

Idea:

Advantages:

Disadvantages:

Examples of Use:

[Option 2]: File-Backed Disk Storage

Idea:

Advantages:

Disadvantages:

Examples of Use:

[Option 3]: Key-Value Stores
Idea:

Advantages:

Disadvantages:

Technologies:

[Option 5]: Relational Database
Idea:

Advantages:

Disadvantages:

Technologies:

[Option 4]: Document Store ("NoSQL" Databases)
Idea:

Advantages:

Disadvantages:

Technologies:

[Other Options]: Specialized Data Stores