CSC 547 - HW 5

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Regular Problems

Problem 1

(5.4) Tradeoffs in SaaS design

1. *Mention a few (business? technical?) factors that threaten (i.e., decrease) availability of this service*
    a. Maintenance requirements can threaten the availability of a SaaS service
    b. Upgrade requirements can threaten the availability of the service
    c. Low cost requirements can often lead to suboptimal design and threaten the availability of the service
    d. Logging requirements can also affect the availability of the service
    e. Data storage and retrieval requirements can also affect the availability of the service
2. *Mention a few options you have at your disposal to combat these threats.*
    a. Scheduled maintenance downtime declared in advance
    b. Scheduled upgrade downtime declared in advance
    c. Building redundancies to keep the service up during maintenance and upgrades
    d. Prioritizing availability during budgeting
    e. Asynchronous logging without affecting the service
    f. Smart data sharding and accessible warehousing
3. *Mention a few constraints you must take into account.*
    a. Management of maintenance and upgrade cycles
    b. Queuing system capabilities for asynchronous logging
    c. Database and warehouse capabilities
    d. Cost of building redundancies
4. *Suggest two potential design options and outline the tradeoffs made in each; evaluate their impact of the tradeoffs on the availability requirement*
    a. Prioritize for availability during budget allocation. However this could impact the budget available for other requirements like compute performance.
    b. Reduce the number of maintenance and upgrade cycles. However, this would impact the performance and health of the service
5. *State how you would choose an option.*

We would take a measured approach for both budget allocation, and maintenance and upgrade cycles. We would plan and declare our scheduled downtimes in advance as part of our SLAs.

Problem 2

(5.7) Migrating datasets. Read Google's guide for migrating (large) datasets, found in [22].

1. *List some of the reasons that make transferring data to the cloud challenging. Rank these reasons.*

   Some reasons why transferring data to the cloud can be challenging, ranked by decreasing order of severity, are:

   1. Data security and privacy restrictions may prevent data from being stored anywhere other than on-premise locations.
   2. There may be problems in moving data that is being used constantly, in systems that cannot afford downtime during the transfer process.
   3. If the cost of transfer is significant in comparison to the daily revenue of the company, the transfer might not be economically feasible.
   4. Choosing the right tools for the transfer, and the cloud storage solutions where the data will be stored eventually.

2. *Estimate the $ cost of the transfer process. State your assumptions clearly.*

   Assumptions:

   - A company wants to transfer 100TB of archived data from an on-premise storage to coldline cloud storage.
   - This transfer will be in the South Carolina region (us-east-1) of GCP.
   - Since ingress charges for GCP are nil, we only need to consider networking charges.
   - The company uses AT&T's Business Fiber, which promises 5GBPS upload speed. This package costs $395 a month plus taxes.

   The cost of transfer would be close to $30 (the monthly cost scaled to 2 days), if we go by Google's estimate of the time overhead in part 3.

3. *Estimate the time overhead of the transfer process. State your assumptions clearly.*

   Taking the same example as in part 2, Google provides a tool which calculates the time taken to transfer a certain amount of data provided there is a certain bandwidth available. Assuming a 5GBPS connection, the time taken to transfer 100TB will be 2 days.

4. *Discuss the option offered by the "Transfer Appliance". When does it make sense to use it?*

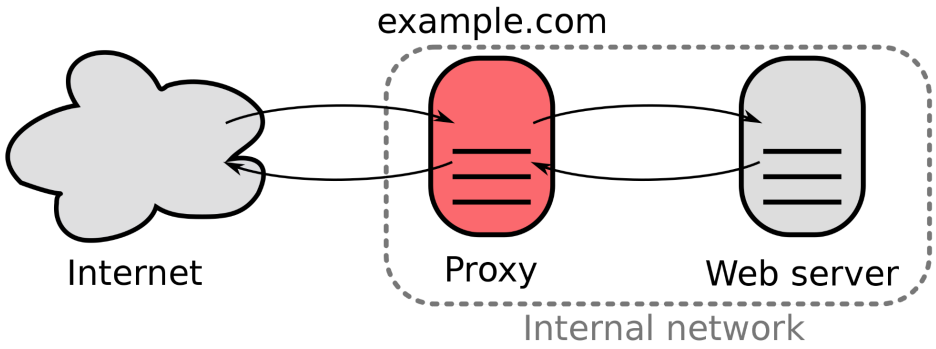
    - Google offers a "Transfer appliance" option if a client wants to perform data migration to the cloud but has a datacenter with limited or no bandwidth.
    - To avail this option, the client needs to request a transfer appliance online and provide Google with a few details about how much data is to be migrated and the location of the datacenter.
    - Then, Google ships some appliances to the requested location. The client has a fixed amount of time to transfer all the data from its datacenter to Google's appliance(s), and ship it back to Google.
    - Google then bears the responsibility of loading the client's data to the cloud. For a dataset of size 300TB, transferring to the appliance usually takes around 25 days, and Google will upload the data to GCP in an additional 25 days plus.
    - For areas with poor network connectivity, this is a good deal. As an extra benefit, the company would not have to pay upload charges for 300TB of data.
    - This option is generally viable when the available network connection is too poor, and it is very costly to purchase additional bandwidth (which means, the time needed to do an online transfer would exceed the time needed to transfer data to a physical drive and ship it to Google)

Problem 3

(5.10) *Load balancing and Reverse Proxy. Search for literature on the concept of Reverse Proxy.*

1. *Describe what a Reverse Proxy does.*

    - A reverse proxy is a server that sits in front of an organization's origin servers and intercepts user requests, preventing users from directly talking to the origin servers.
    - Another way of describing a reverse proxy's function is that it permits servers to communicate with users anonymously.



- When a reverse proxy receives a request from a user, it forwards the request to an appropriate origin server based on predefined rules. When the origin server sends a response, the reverse proxy forwards the response to the user.
- It provides several additional features to the client server connection such as scalability, security and resilience. In this sense, we could say that a reverse proxy server “virtualizes” the client-server connection.

2. *Explain clearly the difference between the functions of Load balancing and Reverse Proxying.*

   - Load balancing is actually a special case of reverse proxying. In other words, load balancing is just one of the many features reverse proxies can provide.
   - Load balancers distribute the user requests evenly to the origin servers so that any one server does not get overwhelmed. Reverse proxies can perform the same function, along with several else such as caching, enabling server isolation, etc.
   - As reverse proxies hide the origin servers from the users, they can prevent external malicious attacks.
   - Load balancing requires 2 or more origin servers, whereas reverse proxies can be used even for a single origin server.

3. *Can you have both in an implementation? Explain.*

   Yes, we can have both.
   A reverse proxy can serve as the public entry point of the website, which protects it from attacks, provides caching features, enables canary development and so on.
   The load balancer can bear the responsibility of distributing requests to origin servers.

Problem 4

In search of beautiful architectures. The world, not just the cloud is full of well-architected artifacts. Let's find some in the space of buildings, using the tool of maps.google.com.

1. *Find an example of a beautifully architected building in Paris, France. Comment on the criteria you used to label it beautiful.*
    - One of the beautifully architected buildings in Paris, France is Notre Dame Cathedral
    - The criteria to label it beautiful is -
        - The golden ratio - In architecture, the golden ratio is visible in any shape composed by a square and a rectangle whose combined dimensions roughly correspond to a 1:1.61 ratio. This ratio is known to be a dimension of perfection in art. Notre Dame Cathedral follows the golden ratio.
        - Facade elements as a component of the building - This cathedral is an example of gothic architecture. Some of the facade elements of the cathedral are the Rose window, exoskeleton transferring structural forces from interior to exterior, flying buttress, glass art, orthographic drawings, and sculptural area of facade.
        - The performance and sustainable design with a proper balance of aesthetics, accessibility - The cathedral is 856 years old which proves its performance and sustainability.

2. *Find an example of a beautifully architected building in Paris, Kentucky. Comment on the criteria you used to label it beautiful.*
    - One of the beautifully architected buildings in Paris, Kentucky is the Shinner building
    - The criteria to label it beautiful is -
        - The performance and sustainable design with a proper balance of aesthetics, accessibility - The Shinner building was built in 1891 and now it is used for Paradise cafe which proves its performance and sustainability.
        - Facade elements as a component of the building and uniqueness - This building is listed as the world's tallest three story structure which shows its uniqueness.

3. *Well-architected artifacts are copied again and again - that's why AWS put the Well-architected framework out there in the first place. How many times did the Eiffel Tower architectural blueprint been implemented?*
    - There are various Eiffel Tower copies around the world.
    - Over 50 times the Eiffel Tower architectural blueprint has been implemented.

4. *Having a well-architected framework and following principles is necessary for coming up with a complex system - but not sufficient. Faithfully executing the architectural diagrams is necessary. What do you think went wrong with the building shown in Figure 5.7?*

- In the figure 5.7, the building is well-architected i.e. the door, windows, space inside the house is well architected but the implementation is not correct.
- In real life, the building is not able to sustain, it will fall down because the base will not withstand the asymmetrical top of the building.
- The building is implemented upside down. Instead, the base of the building should be the top and top of the building should be the base.