Overview of Cloud Services (AWS)

- **Amazon EC2**: “Virtual Services in the Cloud” (Identical to your course VM in the UIUC private cloud, but EC2 provides public cloud access.)
- **Amazon Elastic Container Registry**: “Easily store, manage, and deploy container images” (Docker)
- **Amazon Elastic Container Service (ECS)**: “Highly secure, reliable, and scalable way to run containers”
- **Amazon Aurora**: “High performance managed relational database” (SQL)
- **Amazon DynamoDB**: “Managed NoSQL database” (MongoDB-like)
- **Amazon ElastiCache**: “In-memory caching system” (Redis-like)
- **Amazon API Gateway**: “Build, deploy, and manage API’s”
- **Amazon CloudFront**: “Global content delivery network” (CDN)
- **Amazon Route 53**: “Scalable domain name system (DNS)"
- **AWS Lambda**: “Run code without thinking about servers”
- **Amazon Simple Storage Service (S3)**: “Scalable storage in the cloud”
- **Amazon Elastic File System (EFS)**: “Fully managed file system for EC2”

Security and Authentication

One advanced topic in cloud systems is security and authentication. Doing security correctly is very hard and the best practices change rapidly (what I learned 10 years ago is trash-tier security nowadays).

### Token-Based (“Bearer”) Authorization

One of the most fundamental pieces of cloud security is token-based authorization. You have seen this already:

- ...
- ...
- ...
- ...

Q: What is a token?

Assuming the token uses [a-zA-Z0-9], there are 62 possible character choices. What security against guessing the token does various token lengths provide?

<table>
<thead>
<tr>
<th>Length</th>
<th>Combinations</th>
<th>Avg. Time to Find @ 1m guesses /sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$62^1 = 62$</td>
<td>0.031 ms</td>
</tr>
<tr>
<td>2</td>
<td>$62^2 = 3,844$</td>
<td>1.9 ms</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$62^4 = 1,4776,336$</td>
<td>7.4 seconds</td>
</tr>
<tr>
<td>5</td>
<td>$62^5 = 916,132,832$</td>
<td>458 seconds</td>
</tr>
<tr>
<td>10</td>
<td>$62^{10} = 8.4 \times 10^{27}$</td>
<td>13,298 years</td>
</tr>
<tr>
<td>15</td>
<td>$62^{15} = 7.7 \times 10^{46}$</td>
<td>~12,182,899,300,000 years</td>
</tr>
</tbody>
</table>
The Google URL to this sheet worksheet:

| 1P061GTQYgMp0WOXqmJqh2Zz1K2AFZDPeJmWLWThtU1E |
| 1234567890123456789012345678901234567890 |
| 1 2 3 4 |

Total Length: _____ ⇒ Combinations: ____________________

Avg. Time to Find (at 1,000,000 guesses /sec):

Q: What happens if you leak the token?

...does that make token-based authentication insecure?

Authorization vs. Authentication
Tokens provide a form of authorization (access) to a specific resource, and are often used after a form of authentication (verification) is done.

Authentication as a Service
Many applications now rely on “Authentication as a Service” where the authentication is handled by a separate application.

- Ex: “Login with Google” / “Login with Instagram” / ...
- Ex: Queue@Illinois ⇒ Login w/ Illinois
  - Shibboleth (UIUC login technology) provides user authentication without revealing any details except that the user!

Advantages:

Disadvantages:

On Thursday: How does this all happen?

Project MIX - Week 2
https://courses.grainger.illinois.edu/cs240/fa2021/project/part2/

Deliverables:
(1): Extend your Microservice <-> IM interface to use age-based caching technologies, as specified in the HTTP standard.

(2): Create additional IMs so that you have a total of 3p IMs.
- Update your IMs.md to document the new IMs.

(3): Ensure that at least one IM depends on the output of another IM.

Due Date: