Cloud Computing Capstone Project
CPSC 436C – FALL 2024

1. Overview:

The Cloud Computing Capstone Project is a culminating team-based assignment designed to give students practical, hands-on experience with designing and deploying a complete cloud-based application. This project allows students to apply the skills they have acquired throughout the course to solve a real-world problem by utilizing cloud computing services. The project requires **designing and implementing an entire data processing pipeline, incorporating one cloud storage system, one computing engine, and one database. The architecture, cost, performance, and security of the project will be key evaluation criteria.**

2. Timeline:

- **Week 5**: Project team formation and initial brainstorming
- **Week 9**: Project proposal submission
- **Week 10**: Feedback on project proposal
- **Week 13 & 14**: Project presentations
- **Week 15**: Final project submission

3. Team Composition:

- Teams will consist of **4-5 students**.
- Teams will be responsible for assigning roles and ensuring balanced contributions to the project.

4. Project Requirements:

- **Cloud Architecture**: Design and implement a cloud-based solution that leverages cloud computing principles. The project should integrate:
    - One storage service (e.g., Amazon S3, Azure Blob Storage).
    - One computing engine (e.g., AWS Lambda, EC2, EMR cluster, Streaming).
    - One database to store results or generate visualizations (e.g., AWS RDS, DynamoDB, Azure SQL).

Sample architectures can be found in projects completed at UBC CIC (Cloud Innovation Center): https://cic.ubc.ca/projects/

Please be noted that you are limited to the services defined in the course policy: https://docs.google.com/document/d/1KzEkrp2GKaAcMHJNLvfjiM-EZOcwMNIIVJWtMRbQcXs/edit

- **Security Considerations**: Projects should include security strategies that protect data and ensure compliance with best practices in cloud security.
- **Cost Management**: Teams must estimate and manage the cost of cloud resources, providing a cost-performance analysis.
- **Performance Optimization**: Teams will be expected to justify their choices based on performance considerations and demonstrate scalability.
- **Final Report**: The final project report should include:
  - Problem statement and solution overview.
  - Detailed cloud architecture diagram.
  - Explanation of chosen services and tools.
  - Security, cost, and performance evaluations.
  - Challenges and lessons learned.

5. Evaluation Criteria:

- **Architecture Design**: Quality and innovation of cloud architecture, including choice of services and how well they are integrated.
- **Security**: Adequacy of security measures implemented to protect data and cloud infrastructure.
- **Cost Efficiency**: Effectiveness in managing cloud costs while maintaining performance.
- **Performance**: Efficiency of the system in terms of speed, resource utilization, and scalability.
- **Final Report**: Clarity, depth, and organization of the written report.
- **Final Presentation**: Clarity, delivery, and completeness of the final presentation, including team participation.
- **Team Collaboration**: Demonstration of teamwork, collaboration, and balanced contribution.

6. Mark Breakdown:

- **Project Proposal (15%)**: Teams must submit a clear and concise proposal that outlines the problem, proposed cloud services, and implementation plan.
- **Final Report (20%)**: A comprehensive document detailing the project design, decision-making process, trade-offs, and reasons for ruling out certain design choices, implementation, and evaluations of architecture, cost, performance, and security. Your final report should be 7-8 pages long.
- **Final Presentation (15%)**: Each team will present their project during the final week, explaining their process, decisions, and results.

- **Architecture (10%), Cost (10%), Performance (10%) and Security (10%) - (Overall 40%)**: These core components will be evaluated based on the design, implementation, and analysis presented in the report and during the presentation.
- **Team Collaboration and Peer Evaluation (10%)**: Based on individual contributions to the team, feedback from peers, and demonstration of effective teamwork throughout the project.

7. Deliverables:

1. **Project Proposal** (Nov 1st)
2. **Final Report & Code Submission** (Dec 10th)
3. **Final Presentation** (Week 13, 14)

8. Bonus (Optional):

Implementing each of the following options can add up to 15% extra mark to your project. For example, if you get 70% of the project mark and implement both bonus options it will add up your mark to 100%. However, bonus options are not mandatory.

- **Implement a Data Visualization Dashboard**:
  - Create a dashboard or a visualization tool to display real-time insights from the processed data.

- **Enhance the security of the application:**

  - Beyond basic cloud security measures (such as IAM, Firewalls, Security Groups, VPC, Authentication & Authorization), you could also consider security aspects specific to your project's components such as data security measures, API security, or endpoint security.

9. Suggested project topics:

You can choose any project topic if you fulfill the requirements of the project. We provided a set of topics in the following. You may want to choose from this list or be inspired to create a new one.

1. **Cloud-based Sentiment Analysis Platform**

Build a web application that collects user feedback from a form, stores it in a database, and runs sentiment analysis using a cloud AI service. The results can be stored and visualized using a front-end interface with real-time updates.

2. **E-commerce Application with Recommendation Engine**

Deploy an e-commerce application with an integrated recommendation engine that analyzes user behavior and product data and serves recommendations dynamically.

3. **Content Delivery Network (CDN) for Video Streaming**

Build a video streaming application that efficiently delivers content from cloud storage and dynamically adjust to user demands. Further visualization could be used to create a dashboard displaying live insights and alerts.

4. **Image Processing Pipeline**

Build an application that processes images uploaded by users. Perform operations like detecting targeted features or objects in images (like violent or scary pictures), classifying them based on the features and store the processed images in cloud storage.

5. **Real-Time Traffic Analysis and Alert System**

This project monitors real-time web traffic or interactions (on a public website), generating alerts when something interesting happens, such as traffic appears crowded. Traffic data will be ingested into chosen storage service and processed in real-time. Results will be stored in the chosen database for further access, and real-time search capabilities. Further visualization could be used to create a dashboard displaying live insights and alerts.

6. **Automated Financial Data Analysis Platform**

This platform will automatically process and analyze financial data, such as file uploads from users (e.g., CSV, Excel files), to provide key insights. Financial data will be uploaded to the chosen storage service, and the computing engine will handle the data processing. Processed data and results will be stored in the chosen database for long-term storage. Data visualization could provide a dashboard for users to visualize financial insights, trends, and analysis.

7. **Real-time Data Streaming for IoT Devices**

Deploy an application that collects sensor data from IoT devices(e.g., health data from IoT wearable devices), processes it in real-time using a cloud service, and stores the processed data in a cloud database. The data can then be visualized through a dashboard. Please be noted that accessing and collecting IoT data may be tricky, so you may want to simulate IoT devices to generate streams of data instead.

10. Mentorship and Supervision

Each project team will be assigned a dedicated Teaching Assistant (TA) to provide consistent mentorship and guidance throughout the project duration. The TA will serve as the primary point of contact for the team, ensuring that students receive support at key stages of their project and encouraging steady progress.

- TAs will be assigned after teams are formed but before the project proposal submission.
- Teams are required to meet with their assigned TA at least once before submitting their project proposal. This meeting will ensure that teams receive early feedback, helping them clarify their ideas and structure their proposal effectively.

- A mandatory follow-up meeting with the TA will be scheduled 1-2 weeks after the proposal submission. This check-in is designed to help teams stay on track and avoid losing momentum after the proposal phase.

- Additional meetings with TAs are encouraged throughout the project to address challenges, improve project direction, and receive technical advice.

11. Proposal Guidelines

- Your proposal should be 3-5 pages long
- Include diagrams where necessary (e.g., architecture diagram).
- Be concise but detailed in all sections.
- Submit your proposal in PDF format by Nov first.
- You should follow this template for your proposal.

12. Resources:

- AI/ML Workshops: https://workshops.aws/categories/AI%2FML

- Data Ingestion, Engineering, Processing, Query & Visualization Workshops (Catalogs at the left, including: AWS Glue, AWS QuickSight …) :
  https://catalog.us-east-1.prod.workshops.aws/workshops/976050cc-0606-4b23-b49f-ca7b8ac4b153/en-US

  https://catalog.us-east-1.prod.workshops.aws/workshops/ea7ddf16-5e0a-4ec7-b54e-5cadf3028b78/en-US/introduction
- Data Query & Visualization Workshop (AWS QuickSight, …):
  https://catalog.us-east-1.prod.workshops.aws/workshops/976050cc-0606-4b23-b49f-ca7b8ac4b153/en-US/800

- SageMaker Workshops:
  https://catalog.us-east-1.prod.workshops.aws/workshops/63069e26-921c-4ce1-9cc7-dd

[882ff62575/en-US](#)

- Amazon Bedrock Workshop (GenAI on AWS):
  https://catalog.us-east-1.prod.workshops.aws/workshops/a4bdb007-5600-4368-81c5-ff5b4154f518/en-US

- CIC Projects List:
  https://cic.ubc.ca/projects/