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ASSIGNMENT COVER PAGE

Programme	**Course Code and Title**	
Bachelor of Computer Science (Hons)	CAI3204N Intelligent Systems	
Student's name / student's id	**Lecturer's name**	
0204677 Lim Zhe Yuan	AP Dr J. Joshua Thomas	
Date issued	**Submission Deadline**	**Indicative Weighting**
18th SEP 2023	25th OCT 2023	30%
Assignment [1] title	Leveraging Intelligent Systems to Address Climate Change Challenges	

This assessment assesses the following course learning outcomes

# as in Course Guide	**UOWM KDU Penang University College Learning Outcome**
CLO1	-
CLO2	Compare and contrast the various intelligent system techniques to solve such problems.
CLO3	-
CLO4	-

# as in Course Guide	**University of Lincoln Learning Outcome**
CLO1	
CLO2	Apply Artificial Intelligence techniques to solve practical problems.
CLO3	
CLO4	

Student's declaration

I certify that the work submitted for this assignment is my own and research sources are fully acknowledged.

Student's signature: *Zhe Yuan*

Submission Date: 25/10/2023

TurnItIn Similarity Report

Asgn1MainReport

ORIGINALITY REPORT

7%	%	7%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Andrés Velastegui-Montoya, Néstor Montalván-Burbano, Paúl Carrión-Mero, Hugo Rivera-Torres, Luís Sadeck, Marcos Adami. "Google Earth Engine: A Global Analysis and Future Trends", Remote Sensing, 2023 Publication	2%
2	Harshita Jain, Renu Dhupper, Anamika Shrivastava, Deepak Kumar, Maya Kumari. "AI-enabled strategies for climate change adaptation: protecting communities, infrastructure, and businesses from the impacts of climate change", Computational Urban Science, 2023 Publication	2%
3	Varun Khajuria, Mohit Kumar, Arun Gunasekaran, Kuldeep Singh Rautela. "Snowmelt runoff estimation Using Combined Terra-Aqua MODIS Improved Snow product in Western Himalayan River Basin via degree day modelling approach", Environmental Challenges, 2022 Publication	2%

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Main Report

Introduction to Climate Change and the Role of Intelligent Systems

Global climate change has become noticeably worse as reports shows that the hottest temperatures have been recorded in recent years, which had caused the accelerated melting of glaciers and soil degradation – a catalyst for increased disasters such as lack of food production, hurricanes, and droughts (United Nations, 2020). However, although “the climate emergency is a race we are losing, it is a race we can win” (Guterres, 2019). Minevich (2022) mentioned that a report shows 87% of private and public AI sector CEOs believe AI is an essential tool in the fight against climate change. This may be because climate datasets come in large amounts and take significant time to collect, analyze, and use, which is where intelligent systems (IS) are utilized to factor in constantly evolving changes in these datasets to help humans make better, informed predictions about environmental differences, so that mitigation efforts can be deployed earlier (Mastrola, 2023). The important role of IS in helping humans fight climate change is by reducing emissions, improving energy efficiency, and increasing the use of renewable energy sources (Minevich, 2022). It can help by cutting down carbon usage or developing new energy-efficient solutions, such as transportation electrification or agriculture and manufacturing transformations (Mastrola, 2023).

Intelligent Systems for Climate Data Analysis

Lespagnol et al. (2023) mentioned that as climate change is evidently complicated and multi-paradigmatic, the volume and heterogeneity of climate data can be daunting and hard to manage. IS designed for climate data analysis come into play here as they can be used to improve climate modelling and projections by making sense of data from various sources, including satellite imagery, weather patterns, climate models and identifying trends that may not be apparent through traditional methods. Using neural networks and deep learning techniques, IS allow users to expose correlations that may be crucial in establishing climate policies and developing climate change solutions. To name a few, Google Earth Engine, ClimateAI, and IBM Watson are examples of IS that spearhead efforts for climate data analysis (Jain et al., 2023).

To monitor climate change, Google Earth Engine (GEE) provides a cloud computing platform that uses Google’s infrastructure to allow free public access to geospatial data for research purposes. It possesses an inventory of climate data on a global scale by gathering information from Landsat, Sentinel, and MODIS satellites to obtain data on climate models, temperature, and geophysical characteristics (Velastegui-Montoya et al., 2023; see Appendix 1). On the other hand, IBM’s new geospatial foundation model, watsonx.ai model developed from the collaboration of IBM with NASA “converts satellite data into high-resolution maps of floods, fires, and other landscape changes to reveal our planet’s past and possibilities of future climates”. These mappings reveal areas at risk of natural disasters and steer development efforts to protect the world’s population that live in these areas (Raghavan & Shim, 2023; see Appendix 2). Lastly, EcoAct is another analysis tool that helps in interpreting environmental and climate data by explaining how data came to be, and how it fits into various climate change scenarios and models. It combines techniques from data and environmental science to understand business systems to develop strategies that make supply chains more sustainable for stakeholders (Lespagnol et al., 2023; see Appendix 3).

GIS and Remote Sensing in Climate Monitoring

Geographic information systems (GIS) are computer-based tools for mapping and analysing feature events on earth, while remote sensing is the science of taking measurements of the earth using sensors on transports that enable the assessment of terrains, such as airplanes or satellites (Indiana University, 2023). Logically, remote sensing is embedded as a capability within a GIS in order to collect geospatial data around the world and provide map results to GIS database and statistical queries supplied by its users. Statistical data visualized by the GIS, such as geographical and geopolitical characteristics, can then be manipulated by users to create new dynamic links for better inferences in AI sense-making (Indiana University, 2023). GIS and remote sensing is one approach to monitor climate change and obtaining the latest data trends, and its interests are in monitoring environmental, disaster, glacier, and agriculture readings (Spatial Post, 2023).

There are a few application examples of GIS and remote sensing that are currently used to tackle climate issues. Firstly, GIS and remote sensing techniques have been applied in the estimation of groundwater potential zones in the Dang district of Gujarat, Western India, which is where the state receives its heaviest rainfalls during monsoon seasons, but droughts during summer. Results from the system shows that 89% around the area has high probability for finding groundwater due to pediplains and pediments cover, low drainage density and high lineament density (Pancholi et al., 2022; see Appendix 4). Remote sensing is also used in GEE for large-scale data modelling to monitor land conditions and analyze flood-prone locations (Ghosh et al., 2022; see Appendix 5). Lastly, remote sensing is also applied in estimating snowmelt runoff and snow product in the Western Himalayan River Basin using Combined Terra-Aqua MODIS to prevent over-extension of water levels and damage of hydrological systems of the river. A GIS, ArcGIS is reportedly used to delineate the catchment boundary, classification into different elevation zones, stream network generation, and identification of the catchment slope and aspect using Digital Elevation Model, which helps in deriving geographical implications (Khajuria et al., 2022; see Appendix 6)

Climate Change Adaptation and Resilience

Due to catastrophic consequences that may be indiscriminately brought by the ascent of climate change, communities and organizations are urged to be proactive in protecting themselves by transforming current practices and lifestyles into a form that is adaptive and resistant to climate threats. By obtaining worldly data from remote sensing, vulnerabilities in current systems and infrastructures can be assessed and identified earlier, which incentivizes the development of adaptation plans tailored to specific environmental risks. Enabling current infrastructure to adapt to new climate conditions is important as safeguarding communities at risk of first signs of environmental danger is a top priority and it allows them to prepare for evacuation before disasters actually strike. This can be done by using IS to develop early warning systems or simulating impacts of climate change with predicted values (Jain et al., 2023).

As mentioned before, ClimateAI is a leading solution provider for climate change adaptation and resilience by allowing organizations to analyse opportunities and mitigate risk from climate change for their business supply chain. Solutions such as ClimateLens-Adapt and ClimateLens-Assess produce an insightful overview of climate hazards against business interests and provide an actionable series of steps to resolve primary concerns caused by sudden climate changes in a centralized platform (ClimateAI, 2023a; ClimateAI, 2023b). Without an analysis platform, “forecasts will not be meaningful to companies and do not translate climate hazards into financial impacts, which may sabotage long-term investments and operations” (ClimateAI, 2023c). Besides, IBM also launched its own Environmental Intelligence Suite (EIS), which predicts, prepares for and adapts to the worsening climate. EIS also makes predictions of upcoming climate hazards by facilitating the interpretation of climate hazard data meaningfully, which shows the importance of identifying relevant data to be able to come up with adaptation plans (Jones et al., 2021; see Appendix 7).

Challenges and Ethical Considerations

Several challenges and ethical issues have long since been identified by researchers after studying IS implementations. Evidently, energy inefficiency is still a barrier to fully utilizing IS implementations due to an unprecedented growth of carbon footprints caused by IS computations (Ekin, 2019; Chasan, 2023). It is important to overcome this challenge because climate change IS systems are supposed to improve environmental states, and not exacerbate it. Even worse, the slow progress on renewable energy production also hinders the improvement of energy wastage as risks such as resource pollution due to inappropriate site selection and the intermittent nature of renewable energy production (Chen et al., 2023) makes renewable energy currently impractical for the sustainability of IS applications. The scarcity of available climate data and proficient AI experts in analyzing said data also proves to be a major roadblock to identifying real time world conditions. Without more data and experts that can make sense of them, there is a possibility that communities of practice have overlooked a critical pattern that points to the source of climate problems.

Moreover, ethical problems that sprout from the use of AI also plague climate change IS. Specifically, the ethicality of the use of big data is questioned due to the fact that personal and sensitive information might be intruded and used without proper consent. Biases are also commonly present among model training data and even IS developers because it is impossible to adequately include and represent different perspectives and experiences, which leads to favouritism in IS solutions. To make things difficult, the complexity of IS algorithms also caused a lack of transparency which affects the debugging and removal of errors and biases. Last but not least, IS developers are also concerned about causing potential physical consequences that were unintended to happen due to the development and use of IS, such as political concerns, increased unemployment rates and ecosystem damages (Jain et al., 2023).

Conclusion and Future Prospects

In conclusion, although the use of climate change IS allow enthusiasts to perform thorough climate analysis by utilizing remote sensing in GIS to develop climate adaptation plans accordingly, the aforementioned challenges and ethical implications that were caused by the usage of these systems threatened the perspectives of their suitability in sustaining the environment. Therefore, authorities play a significant role in influencing the community and developing contingency plans to spread awareness of the severity of the problem.

For starters, government and corporate entities are obliged to fund further IS research and development in order to cultivate energy-saving AI models. Sponsors should be done financially or physically such as manpower and classified information. They should also actively restrain citizens from indulging in activities that negatively impact the climate. This keeps current climate conditions at bay and allow current IS to stay relevant, while better IS architecture can be developed in the meantime.

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Appendix

1. GEE introduction (Velastegui-Montoya, 2023)

Google Earth Engine (GEE) is a cloud-based computing platform that uses Google's infrastructure to facilitate access to geospatial data and its processing. This platform requires an account to access, and it is free for educational and research purposes. GEE's goals are: (i) to have a dynamic platform that facilitates the development of algorithms on a large scale; (ii) to promote high-impact research by providing free and open access; and (iii) to be part of the progress and solutions to the global demand and management of big data.

GEE has a vast catalog on a petabyte scale. It gathers information from Landsat, Sentinel, and MODIS satellites and data on climate models, temperature, and geophysical characteristics. Its intuitive interface has a code editor (**https://code.earthengine.google.com/**, accessed on 30 January 2023), which is an integrated development environment (IDE) for the elaboration of algorithms using JavaScript programming language. It also has a graphic window for the user to see the processes conducted. In addition, it can also work in Phyton, and others through the Earth Engine library, and R. Finally, it also has a version with a simple interface known as "Explorer" (**https://explorer.earthengine.google.com/#workspace**, accessed on 30 January 2023) for users with little experience in programming languages. Both options allow the entry of local data and the export of information for subsequent processing or visualization within geographic information systems (GIS) software, such as QGIS (Version 3.28), and ArcGIS Pro (Version 3.1.2), among others.

Research methodologies are constantly changing and innovated to construct knowledge. In the area of geoscience and remote sensing, GEE has become a powerful tool for remote sensing, given its multiple applications in fields such as agricultural productivity, vegetation monitoring, grassland monitoring, mangrove mapping, land use and cover, risk and disaster management, islands of heat, surface temperature, forest fires, bathymetry, surface water, built-up area, mining, among others. Its multiple applications show the GEE platform's potential to manage large data sets and contribute to the development of scientific research.

Many researchers have analyzed GEE's potential multiple applications in recent years. Kumar and Mutanga studied the literature published between 2011 and 2017 to present the platform's uses, trends, and potential since its inception. On the other hand, Tamiminia et al. conducted a systematic review of GEE in geographic big data applications. Likewise, Zhao et al. used articles from the Web of Science (WoS) Science Citation Index Expanded (SCIE) and Social Citation Index (SSCI) to study the development of the scientific production of the Google Earth (GE) and GEE platforms through a scientometric analysis. The studies above provide relevant information while focusing on systematic and scientometric literature reviews of the different GEE applications.

Bibliometric analysis helps identify gaps and directions of research in a particular area. Moreover, it offers objective results, which help understand the knowledge area's impact and influence while identifying the publications' evolution. The methodology used the processing of bibliographic information, elaborating structure maps of the fields, and the quantitative analysis of the existing academic literature.

2. WatsonX introduction (Raghavan & Shim, 2023)

Built from IBM's collaboration with NASA, the watsonx.ai model is designed to convert satellite data into high-resolution maps of floods, fires, and other landscape changes to reveal our planet's past and hint at its future.

Nearly a quarter of the world’s population now lives in a flood zone, and that number is expected to climb as rising seas and heavier storms triggered by a changing climate put more people at risk. The ability to accurately map flooding events can be key to not only protecting people and property now but steering development to less-risky areas in the future.

A new geospatial foundation model unveiled today by IBM is designed to enable first steps toward this goal by converting NASA’s satellite observations into customized maps of natural disasters and other environmental changes. The model, part of IBM’s watsonx.ai geospatial offering, is planned to be available in preview to IBM clients through (EIS) IBM Environmental Intelligence Suite during the second half of this year. Potential applications include helping to estimate climate-related risks to crops, buildings, and other infrastructure, valuing and monitoring forests for carbon-offset programs, and developing predictive models to help enterprises create strategies to mitigate and adapt to climate change.

As part of a Space Act Agreement with NASA, IBM set out just four months ago to build the first-ever foundation model for analyzing geospatial data. Foundation models have revolutionized natural language processing (NLP) by allowing developers to train one model on raw text, and with extra training, customize the model for other NLP tasks. Previously, users had to train a new model for each task, which required extensive data curation and compute. Rather than train a foundation model on words, IBM Research taught a model to understand satellite images. Researchers pre-trained NASA’s Harmonized Landsat Sentinel-2 (HLS-2) data. The HLS data provides consistent surface reflectance data from the Operational Land Imager (OLI) aboard the joint NASA/USGS Landsat 8 satellite and the Multi-Spectral Instrument (MSI) aboard the European Union’s Copernicus Sentinel-2A and Sentinel-2B satellites. The combined measurement helps enable global observations of the land every two to three days at 30 meter spatial resolution.

They then fed the model hand-labeled examples to teach it to recognize things like the extent of historic floods and fire burn scars, as well as changes in land-use and forest biomass.

Using the model is designed to be simple as users only need to select a region, a mapping task, and a set of dates. For example, if a user types “Port-de-Lanne, France” into the search bar and selects the dates December 13-15, 2019, the model highlights in pink how far the flood waters extended. Users can overlay other datasets to see where crops or buildings were inundated. These visualizations can help with future planning during similar disaster scenarios: they provide information that could help mitigate flood impacts, inform insurance and risk management decisions, plan infrastructure, respond to disasters, and protect the environment.

3. EcoAct introduction (Lespagnol et al., 2023)

EcoAct assists clients in interpreting environmental and climate data by explaining how data is managed, stored and disseminated, and how it fits into various climate change scenarios and models.

Our goal at EcoAct is to share our climate data analytics expertise with our clients to transform their business model and move towards global net-zero.

The increasing amount of available data is creating new needs for data processing to avoid being overwhelmed by this flow of information. To exploit the potential of data, we need to be able to process it so that stakeholders can understand it, own it, and use it effectively. Therefore, data science and its associated tools offer tremendous opportunities to harness climate data.

The scientific, political and communication practices around data science, machine learning and artificial intelligence have important implications for the climate crisis and for our potential mitigation solutions.

From machine learning to data visualisation, data science techniques are being used to study the effects of climate change on economic and financial systems, mobility patterns, marine biology, land use and restoration, food systems, disease patterns, and many other impacted areas.

Data science is a powerful tool to help understand the uncertainties and ambiguities inherent in data. Data literacy is essential for identifying interventions, strategies and solutions that achieve benefits not only for a company, but also for humanity and the environment, and for assessing the multiple and sometimes conflicting objectives of corporate climate action.

Climate data analysis tools can be seen as tools for organisations to take ownership of the global findings of the IPCC scientific reports at their own scale.

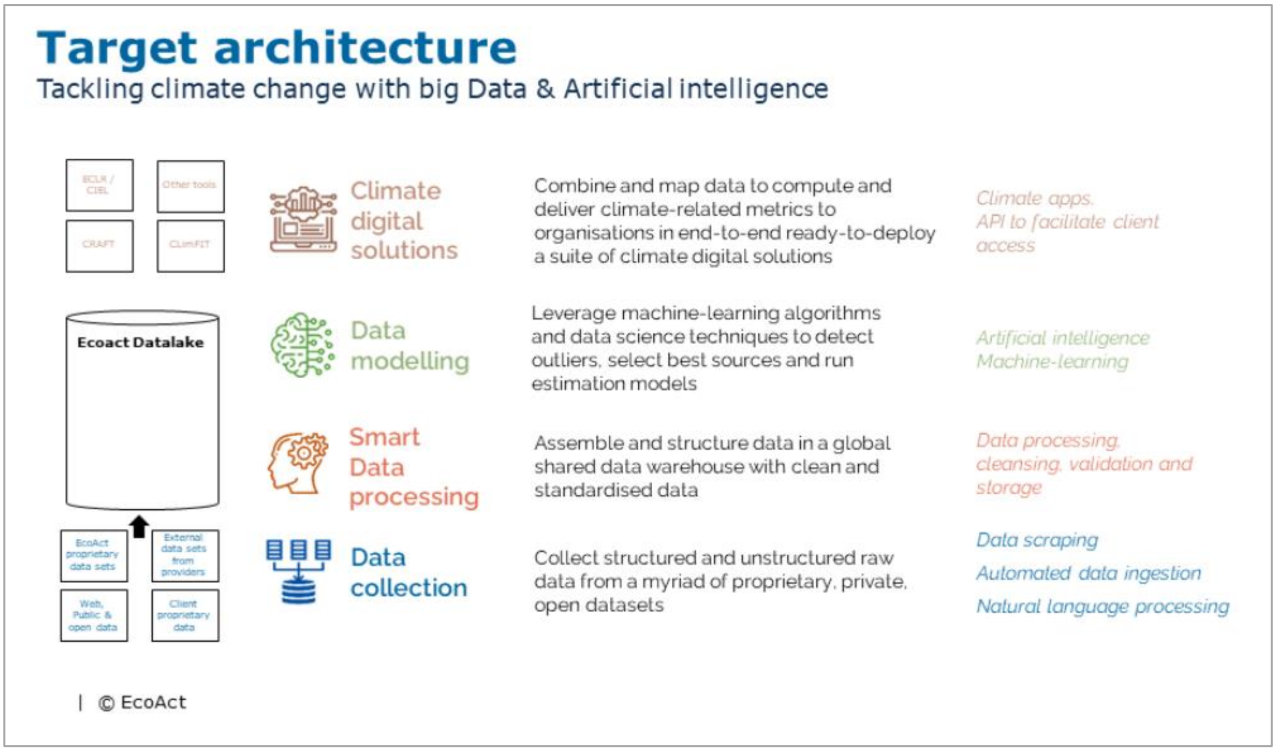
Artificial intelligence (AI) is now seen as a solution for better measurement and ultimately for reducing CO_2 emissions; a company can reduce its CO_2 emissions by 5 to 10% by using AI (Source: BCG, AI: a concrete solution to accompany the climate transition). It will also contribute to the prediction of risks linked to climate change or to the improvement of long-term projections of localised disasters.

EcoAct uses methods and tools from the rapidly growing field of data science and applies them to climate change and environmental issues. For example, our researchers combine techniques from data science and environmental science to understand business system models and develop strategies that make supply chains more sustainable.

They also examine how machine learning can reduce uncertainty in climate models by improving data quality. Our consultants have developed predictive models that rely on decision tree models to estimate emissions data with impressive accuracy.

EcoAct’s researchers have also developed a bespoke approach to exploit geolocation data and climate models to help define locations that may be affected by extreme weather or other physical climate events. This type of information helps orgnisations anticipate and respond to the large-scale natural disasters associated with climate change.

Many analytical projects are underway at EcoAct to apply data science techniques to real-world problems. For example, recent projects have used climate data to develop reliable climate indicators for the agriculture sector; another project cross-referenced climate data with environmental data to improve prediction of the impact of physical hazards such as flood risk.



4. Estimation of groundwater potential zones using remote sensing and geographical information system technique (Pancholi et al., 2022)

Groundwater is an important natural resource and has a significant role in the economy of any nation. The Dang district situated in the south-eastern part of the Gujarat state, Western India faces potable water problems in almost every summer season though the region receives heavy rainfall during monsoon months. The region has steep slopes causing heavy runoff during monsoon. The people of the district mainly rely on agriculture and the major source of the surface water is the perennial flows in Ambika, Purna and Khapri rivers that criss-crosses the district. In this study, we have employed an integrated approach to find out the groundwater potential regions in the Waghai Taluka based on geology, geomorphology, tectonic set-up, present wells' static ground water level and slope length of the region. The field observations were also considered for the verification of our final inputs. The thematic maps are prepared with the use of remote sensing and GIS tools. The groundwater potential zones are classified into potential and non-potential zones based on integrated results and verified with existing well sites in study region. It was found that about 11% of the area comes under non-potential zones has least prospect of finding groundwater, while 89% of the region has more probability of finding groundwater under the potential zones.

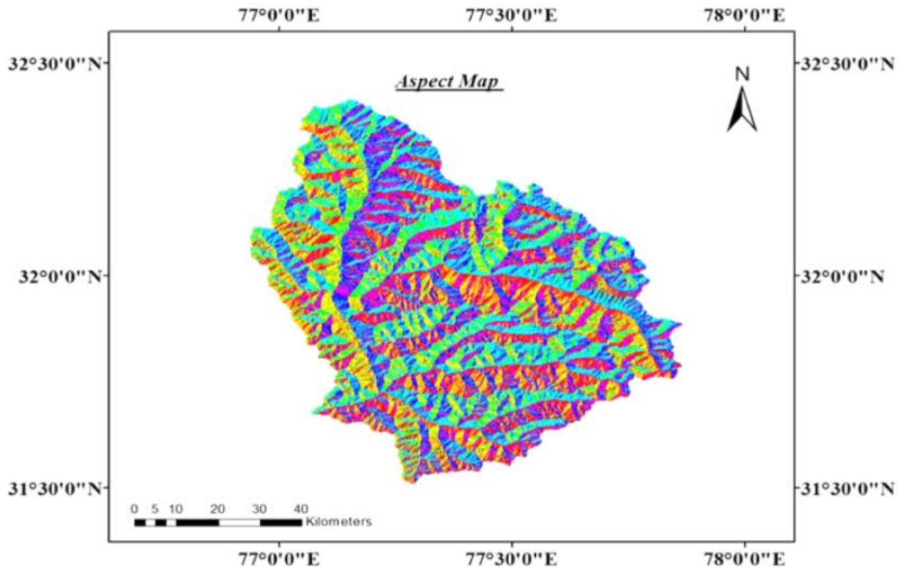
5. Cloud-based large-scale data retrieval, mapping, and analysis for land monitoring applications with GEE (Ghosh et al., 2022)

Cloud-based computing systems are linked with analytical tools for large-scale flood monitoring to solve these problems. Researchers want an exceptionally efficient and resilient geospatial framework with advanced algorithms for immediate results from the examination of large datasets. The study uses web-based analysis to demonstrate the potential of Google Earth Engine (GEE) for geospatial-analytical processes in flood-affected areas and to comprehend the socio-demographic ramifications. Surface water mapping is done using a histogram-based threshold method. The study examines how to analyse Sentinel-1 SAR data for automated flood mapping and how to validate results using data from the optical sensor Sentinel-2. Furthermore, using the Google Earth Engine platform, this study focuses on cloud-based large-scale flood data mapping. The research combines geographic information with advanced data processing techniques, algorithms, and web-based platforms to produce encouraging results and monitor real-time flooding occurrences for significant planning and decision-making. The research effectively assesses the importance of cloud-based data processing for the performance evaluation of algorithms in a cloud-based platform for monitoring real-time issues. The study's findings are useful for analysing surface water mapping applications.

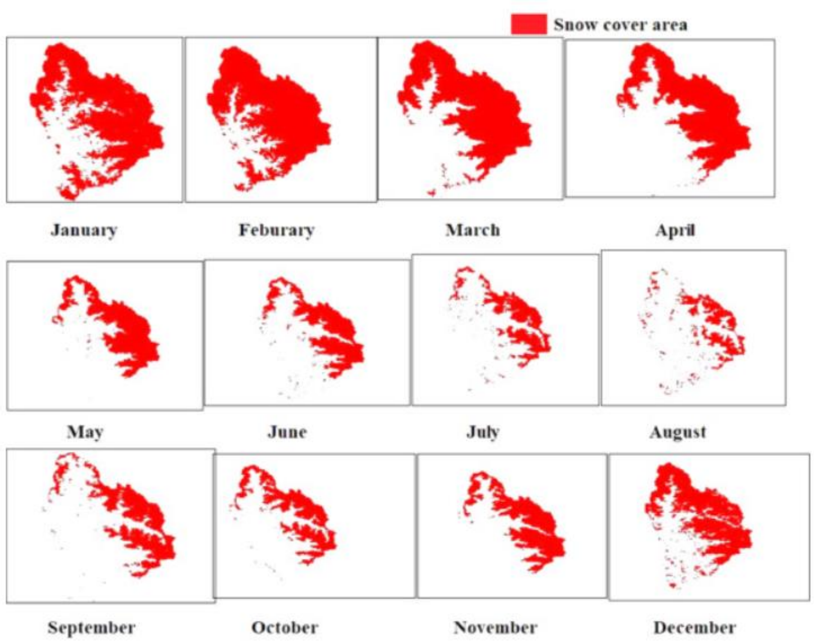
6. Snowmelt runoff estimation Using Combined Terra-Aqua MODIS Improved Snow product in Western Himalayan River Basin (Khajuria et al., 2022)

“Digital Elevation Model (DEM) is the most essential input parameter for each hydrological model. The DEM stores a piece of information about the geographic grid of a particular area where each pixel of the grid describes a specific location with their elevation. In ArcGIS DEM is used to delineate the catchment boundary, classification into different elevation zones, stream network generation, and identification of the catchment slope and aspect.”

“The Basin was divided into 7 elevation zones (Fig. 2) and various basin characteristics were derived using the ArcGIS 10.6 which are as area (Fig. 5), elevation (Fig. 2) and aspect (Fig. 6). The area elevation curve of the basin is shown in fig. 5. Most of the area has been lies under the mid elevation whereas the very less area has been lies under the higher zones. The accumulation of snow has been started from 4800 meters (Table 2). Aspect as the direction of the inclined face, is a significant constituent of topography. Aspect maps show the overall direction of every land space, typically according to eight systems (Fig. 6) The characterized perspective guide of the study region was set up from the SRTM-DEM. But the SRM model uses an aspect of four directions as one of the input variables in four directions as Northeast aspect, Southeast aspect, Northwest aspect, and Southwest aspect.”



"Snow cover area between January 2015 - December 2018 was estimated from Improved MODIS data. The snow-covered area maps in different months are shown in Fig. 7 depicts that maximum accumulation of snow occurs in the month of January and February each year. The classified maps of snow and the total percentage level of snow-cover in the region of interest were assessed for different dates. Based on this information; snow-cover depletion curves have been plotted for each year. The average monthly snow cover area during the simulation period is shown below in Fig. 7"



7. Environmental Intelligence Suite by IBM (Jones et al., 2021)

As the United Nation's Intergovernmental Panel on Climate Change report blatantly states, this is just the beginning. Temperatures will likely continue to rise around 1.5 degrees Celsius over the next 20 years, triggering more frequent sweltering heat waves, stronger storms, higher floods, severe droughts and drastic ecosystem shifts.

We have to continue our efforts to slow down climate change. But we also have to adapt to our rapidly changing environment.

This is why IBM has launched a new Environmental Intelligence Suite (EIS)—to help companies predict, prepare for and adapt to the increasingly severe risks of our warming climate. The technologies now available within the suite also help companies to identify and better understand how their own work impacts nature, as well as steps they can take to start mitigating their own carbon footprint.

This unique integration of AI with environmental, climate, and weather data is aimed at adapting to and mitigating climate change with accurate analysis of climate risk at scale and precise accounting of carbon emissions.

First, there is a new environmental and climate impact modeling framework, CIMF.

It relies on the leading and unique capabilities of IBM PAIRS++, a geospatial data and analytics platform that aggregates hundreds of layers of curated geospatial-temporal data in space and time. PAIRS++ collects, analyzes, and maintains massive amounts of heterogeneous and unstructured data from aerial imagery, maps, IoT infrastructure, drones, LiDAR, and satellites. And it continuously ingests data from major content providers such as The Weather Company, ECMWF, and USGS.

PAIRS++ enables CIMF to predict the risk and potential impact of upcoming climate and weather hazards in a much more efficient, standardized and integrated way than current methods. It addresses the most challenging barriers organizations face today when attempting to model climate risks, including:

- Opening up access to large-scale computing power through the cloud. Climate risk models require large amounts of compute power to draw in and analyze tremendous volumes of large-scale data. Through the cloud, CIMF opens up and accelerates access to these computing resources that many currently do not have.
- Streamlining data inefficiencies that are inevitable when collecting all of the unstructured, heterogeneous and disparate data that weather forecasting requires. Using capabilities built within PAIRS++, CIMF easily converts enormous volumes of images, IoT data, LiDAR and other sources into clean and usable information.
- Standardizing weather forecasting models that are notoriously diverse. CIMF pulls these models into an accessible and easily interpretable framework to show where risks and impact may occur.

Organizations often lack access to specialized AI tools geared towards expediting and improving climate risk and impact analytics, such as weather generators, uncertainty propagation, and model calibrations. By combining the analytical and aggregation strength of PAIRS++ with hyper-local weather data, CIMF forms the critical engine of the Climate Risk Layer within EIS.

[CAI 3024N Intelligent Systems]

MARKING RUBRIC
ASSIGNMENT [1]

Report Writing (30%)

REPORT COMPONENT (100%)							
LEARNING OUTCOME	MARKING CRITERIA	SCALE					
		Fail (0-49)	3rd Class (50-59)	2nd Lower Class (60-69)	2nd Upper Class (70-79)	1st Class (80-100)	YOUR MARKS/COMMENTS
CLO2: Compare and contrast the various intelligent system techniques to solve such problems.	1. Introduction (20%)	Weak or no introduction of the topic. Purpose of the writing is unclear or missing. Topics were not addressed properly.	Basic introduction that states topic but lacks interest.	Adequate introduction and states the topic.	Proficient introduction that is interesting and states topic.	Exceptional introduction that grabs interest of reader and states topic.	
	2. Discussion of two intelligent systems used to solve Climate Change problems (20%)	Fails to provide details about the discussions of the topic which is to solve the Climate change problem using two AI intelligent methods/techniques contributing from the literature.	Partial discussions given are related to the Climate change problem using AI intelligent methods/techniques	Adequate discussions given to the solution to the Climate change problem using AI intelligent methods/techniques	Most of descriptions given are relevant and in details to the solution to the Climate change problem using AI intelligent methods/techniques.	All discussions given are accurate and much-related to the solution to the Climate change problem using AI intelligent methods/techniques.	
	3. Comparison between the various (two or more) intelligent systems in terms of strength and weakness in solving the climate change problems in real-world (20%)	No comparison using two AI intelligent methods/techniques	Poor comparisons between the two using AI intelligent methods/techniques . The explanations are mostly out of topic and not accurate.	Average comparisons between two intelligent systems (e.g. techniques/algorithms). The explanations are appropriate and related to the topic of discussion.	Good comparisons between two intelligent systems. (techniques/algorithms) The supporting points are inter-connected to each other, giving good view of the topic of discussion.	Excellent comparisons between two intelligent systems (multidisciplinary techniques/algorithms) The supporting points are well elaborated based on the topic of discussion.	
	4. Style of Writing (20%)	The report writing does not meet the criteria for the assignment (too short or incomplete, too long, and/or completely off-topic). Reference section is missing.	Many ideas require clarification and/or are off-topic or have marginal relevance to the assignment. Many grammatical and/or spellings errors throughout the paper. The paper is very challenging to read due to poor writing flow. Improper reference section	Ideas are stated clearly and are related to the topic, with only adequate grammatical and/or spelling errors. Reference section with minor flaws	Most ideas are stated clearly and are related to the topic, with only minor grammatical and/or spelling errors. Reference section is in minimal	Writing is clear and relevant, with no grammatical and/or spelling errors – polished and professional. Reference section properly formatted.	
	5. Citation (20%)	Missing or no citation and major flaws on the format.	Very minimal amount of cited works, with incorrect format.	Adequate amount cited works, both text and visual, are done in the correct format. Inconsistencies evident.	All, both text and visual, are done with minimal errors on the format.	All cited works, both text and visual, are done in the correct format with no errors.	
						Total (100%)	
						Overall score (100%)	