MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

D.Y.PATIL POLYTECHNIC(0996)

MICRO PROJECT

Academic Year : 2024-25

TOPIC OF PROJECT:-
Building a CGR model of an ancient civilization

Course: Computer Engineering **Course code: (CO-3-K)**
Subject: Computer Graphics **Subject code:(313001)**

Sr. No	Name of group members	Roll No	Enrollment No	Seat No.
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Prof: S.V. Awachar

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ACKNOWLEDGEMENT

It is a matter of great pleasure by getting the opportunity of highlighting. A fraction of knowledge, I acquired during our technical education through this project. This would not have been possible without the guidance and help of many people. This is the only page where we have opportunity of expressing our emotions and gratitude from the core of our heart to them. This project not have been success without enlightened ideas, timely suggestions and interest of our most respected guide " Prof: Pratik Bhagat " without her best guidance this would have been an impossible task to complete.
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Student Names

1. **Karan Shinde**
2. **Sarthak Shinde**
3. **Pankaj shirsat**

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Certificate

This is to certify that **Mr. Karan Balu Shinde** Roll **No:94** of **3rd Sem** Diploma in **Computer Engineering** of Institute, **D.Y. Patil Polytechnic** (Instt.Code:0996) has completed the Micro-Project in **Computer Graphics (CGR) (313001)** for the academic year 2024-25 as prescribed in the **MSBTE** curricuium of K Scheme .

Place: Ambi,Pune **Enrollment No:23212350286**

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Subject Teacher:	**Head of the Department:**	**Principal:**
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Place: Ambi,Pune **Enrollment No: 23212350384**

Date: ………………………… **Exam Seat No:**

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Place: Ambi,Pune

Enrollment No:**23212350292**

Date: ………………………

Exam Seat No:

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Abstract :-

To build a CGR (Cultural Geographic Relational) model for an ancient civilization, you'll need to focus on three core elements: culture, geography, and relations. Here's an abstract outline to guide you:

1. Cultural Layer: Social Structures & Knowledge

This layer captures the internal workings and values of the civilization.

Beliefs and Religion: Describe the mythologies, rituals, and religious structures (e.g., temples, gods).

Social Hierarchies: Outline the social stratification (e.g., rulers, priests, warriors, commoners, slaves).

Technological/Intellectual Advancements: Include developments in writing, architecture, sciences, or philosophy.

Language & Communication: Specify the language or symbolic systems they used for communication.

2. Geographical Layer: Environmental Influence

Geography shapes the resources, expansion, and limitations of a civilization.

Physical Environment: Map the terrain (mountains, rivers, plains) and how they impact settlement patterns.

Climate & Natural Resources: Detail how climate affects agriculture, trade, and daily life (fertile soil, minerals, etc.).

Urban Centers: Represent major cities or settlements and their influence on the surrounding regions.

Boundaries & Expansion: Capture territorial borders, conflicts over land, or cultural diffusion with neighboring peoples.

3. Relational Layer: Interactions & Exchange

Focuses on how the civilization relates with other entities (internal and external).

Trade Networks: Document trade routes, goods exchanged (e.g., spices, metals), and the spread of ideas.

Diplomacy & Warfare: Map alliances, rivalries, and military engagements, including conquests or defenses.

Cultural Diffusion: Track how cultural elements (art, religion, technology) spread or are adopted from other groups.

Internal Relations: Capture interactions between various social classes or ethnic groups within the civilization.

System Dynamics:

Feedback Loops: Examine how culture, geography, and external relations interact dynamically. For instance, geography may limit resource availability, driving technological advancements or conflict over land. External trade may lead to cultural diffusion, enriching societal practices or destabilizing traditional values.

Time Factor:

Introduce a temporal axis to the model to simulate how the civilization evolves over time. This includes cycles of growth, crisis, and transformation driven by environmental, internal, or external pressures.

The goal of a CGR model is to simulate the rise, sustainment, and collapse of civilizations, allowing you to explore how these three dimensions (culture, geography, and relations) interplay to shape the history of a people.

Introduction :-

The CGR model (Cultural-Geographic-Relational) is a comprehensive framework designed to capture the complexities of ancient civilizations by examining three fundamental dimensions: culture, geography, and relations. This model provides a systematic approach to understanding how civilizations emerge, develop, and interact with their environment and neighboring societies. By integrating these three aspects, the CGR model offers a dynamic perspective that highlights the interconnected nature of societal development, environmental influence, and external interactions.

Ancient civilizations, whether thriving along fertile riverbanks, nestled within mountain ranges, or sprawling across vast plains, were shaped by a combination of internal cultural structures, the physical landscape they inhabited, and their relationships with other civilizations. The CGR model helps map these interconnected factors to offer a holistic view of the civilization's growth, sustainability, and eventual decline or transformation.

In constructing a CGR model for an ancient civilization, one must consider:

1. Cultural Factors, such as social hierarchy, religion, technological advances, and governance structures, which define the internal dynamics of the society.

2. Geographic Influences, which involve the natural environment—climate, resources, and terrain—that both enable and constrain the civilization's development.

3. Relational Dynamics, which focus on the interactions the civilization had with other societies through trade, warfare, alliances, and cultural exchanges.

This model emphasizes that the success or failure of a civilization was often not the result of a single factor but rather the complex interplay between these three dimensions. The goal is to provide a flexible yet robust tool that helps us understand the multifaceted nature of ancient societies and how they adapted to challenges over time.

By leveraging the CGR model, historians, researchers, and enthusiasts can better grasp the underlying forces that shaped ancient civilizations, from the rise of the Egyptian empire along the Nile to the expansion of the Roman Republic across the Mediterranean.

Literature Review:

The construction of a Cultural-Geographic-Relational (CGR) model for ancient civilizations is rooted in multidisciplinary approaches that draw from anthropology, history, geography, and sociology. To build such a model, it is crucial to review the extensive scholarship on the individual components of culture, geography, and relational dynamics, while also integrating modern systems theory and complex adaptive systems in historical analysis. The literature review will explore key works in these areas to provide a comprehensive foundation for the CGR model.

1. Cultural Analysis of Ancient Civilizations

a. Culture, Society, and Structure

Research on the cultural aspects of ancient civilizations is vast, covering various domains such as social hierarchies, religious beliefs, and technological innovations. Scholars like Edward Tylor in Primitive Culture (1871) laid foundational ideas of culture as an adaptive system. More recent work by Peter Burke in What is Cultural History? (2004) emphasizes the cultural forces shaping historical narratives, highlighting how rituals, art, and social structures reveal much about ancient societies.

Additionally, Karl Polanyi's concept of embedded economies in The Great Transformation (1944) explores how social institutions such as religion and politics were inseparably linked to economic life. This view is vital for understanding how cultural practices in ancient societies (e.g., trade, craft guilds, or religious ceremonies) functioned within broader social and relational networks.

b. Religion and Mythology

The role of religion and mythology in shaping ancient civilizations has been extensively studied. Mircea Eliade in The Sacred and the Profane (1957) emphasizes the importance of religious structures and sacred spaces, which shaped societal norms and governance. Civilizations like the ancient Egyptians, Mesopotamians, and the Indus Valley culture developed complex cosmologies that impacted governance, social relations, and even urban planning.

2. Geographical Influence on Civilizations

a. Geography and Environmental Determinism

The role of geography in shaping civilizations has long been debated, with Jared Diamond's Guns, Germs, and Steel (1997) presenting a widely discussed geographical determinist perspective. Diamond argues that geography largely dictates the availability of resources, which in turn affects societal development, political organization, and military capacity. His work, though sometimes criticized for oversimplifying, remains foundational for understanding how environments influence civilizations.

Earlier works by Fernand Braudel, a leading figure in the Annales School, particularly in The Mediterranean and the Mediterranean World in the Age of Philip II (1949), emphasize the long-term influence of geography on the structure and evolution of civilizations. Braudel’s notion of the longue durée—long-term historical structures shaped by geography—underscores the importance of geographic factors in creating the framework within which civilizations evolve.

b. Resource Distribution and Settlement Patterns

V. Gordon Childe's Man Makes Himself (1936) and The Urban Revolution (1950) explore how geographic factors such as fertile land and water availability led to the first urban centers and civilizations. Childe's work highlights the relationship between geography and technological advances in agriculture, which gave rise to surplus economies and complex social hierarchies. Understanding how civilizations exploited their geographic resources helps us frame their expansion, economic power, and eventual decline when resources were exhausted.

3. Relational Dynamics: Interactions Between Civilizations

a. Trade Networks and Cultural Diffusion

Trade and intercultural exchanges have long been central to the development of civilizations. William H. McNeill in The Rise of the West (1963) focuses on how trade, migration, and cultural contact shaped global history, emphasizing the interconnectedness of ancient civilizations. Philip D. Curtin's Cross-Cultural Trade in World History (1984) explores how trade routes like the Silk Road and trans-Saharan networks facilitated not only the exchange of goods but also ideas, technologies, and religious beliefs, thus shaping the relational aspect of civilizations.

b. Diplomacy, Warfare, and Imperialism

The relational aspect of civilizations is also shaped by conflicts, diplomacy, and military conquests. Ian Morris, in War! What is it Good For? (2014), argues that war and imperial expansion, despite their destructive force, often led to the formation of stable, interconnected empires that facilitated the flow of ideas and technology. On a micro level, Victor Davis Hanson’s The Western Way of War (1989) examines the relationship between military strategies and societal organization, showing how warfare influenced the political and cultural frameworks of ancient societies.

4. Systems Theory and Complex Adaptive Models

The concept of modeling civilizations as complex systems has grown in importance. Joseph Tainter's The Collapse of Complex Societies (1988) applies systems theory to explore how ancient civilizations, from the Maya to the Roman Empire, managed complexity and how overextension led to societal collapse. Tainter's work provides a template for understanding how the interaction between cultural practices, geographic limitations, and relational pressures can create feedback loops leading to growth or collapse

Technology Used :-

The construction of a Cultural-Geographic-Relational (CGR) model for an ancient civilization requires the use of a variety of technologies and tools that facilitate data collection, analysis, modeling, and visualization. These technologies help synthesize complex cultural, geographic, and relational information into a coherent model. Below is an overview of key technologies and methodologies used in this process:

1. Geographic Information Systems (GIS)

GIS is a powerful tool used to map and analyze geographic and spatial data. In the context of building a CGR model, GIS helps to:

Map Ancient Settlements: Plot ancient cities, trade routes, and territorial boundaries.

Analyze Environmental Factors: Identify the influence of rivers, mountains, and climate on settlement patterns, agriculture, and expansion.

Track Resource Distribution: Map the locations of natural resources such as fertile land, mineral deposits, or water sources, and analyze how these resources shaped the economy and society.

Examples: ESRI ArcGIS, QGIS, and Google Earth Pro are popular GIS platforms that can integrate archaeological data with geographical maps to provide spatial analysis of civilizations.

2. Agent-Based Modeling (ABM)

Agent-Based Models (ABM) simulate the actions and interactions of individuals (agents) within a system to understand the behavior of the entire civilization. In CGR modeling:

Simulating Social Behavior: ABM helps simulate how individuals or groups within a civilization interact, trade, or engage in conflict based on cultural norms, social hierarchies, and geographic constraints.

Population Dynamics: ABMs are used to simulate demographic changes such as population growth, migration, and urbanization, which affect the civilization’s relations with its environment and neighboring societies.

Trade and Economic Models: Simulate trade networks and the exchange of resources, goods, and ideas between civilizations.

Examples: Platforms like NetLogo and Repast are often used for ABM, allowing historians and researchers to model complex interactions within ancient societies.

3. Remote Sensing and Satellite Imagery

Remote sensing technologies, including satellite imagery and aerial photography, are crucial for identifying and analyzing the physical landscapes where ancient civilizations once thrived. These technologies enable:

Discovery of Archaeological Sites: Satellite imagery can reveal previously unknown ancient cities, roads, and monuments hidden under vegetation or sand.

Environmental Reconstruction: Analyze ancient climate patterns, water sources, and topographical changes to understand how geography influenced cultural and relational development.

Examples: Landsat, SPOT, and Copernicus Sentinel satellite programs provide imagery for environmental analysis, while LIDAR (Light Detection and Ranging) technology helps create high-resolution topographical maps to uncover buried structures.

4. 3D Modeling and Virtual Reconstructions

3D modeling technologies allow for the virtual reconstruction of ancient cities, monuments, and landscapes based on archaeological data. This helps in visualizing cultural and geographic elements:

Architectural Reconstruction: Create 3D models of ancient buildings, temples, and fortifications, enabling researchers to visualize the spatial organization of ancient cities.

Land Use Visualization: 3D models can reconstruct how land was used for agriculture, urbanization, and defense.

Interactive Exploration: Virtual reality (VR) and augmented reality (AR) tools allow historians and the public to explore reconstructions of ancient civilizations in immersive environments.

Examples: Software like Blender, AutoCAD, and SketchUp can be used for 3D modeling, while Unity and Unreal Engine support VR-based reconstructions.

5. Social Network Analysis (SNA)

Social Network Analysis (SNA) is used to study the relationships and interactions between individuals, groups, or civilizations, focusing on trade, diplomacy, and warfare. In the CGR model:

Mapping Inter-Civilizational Networks: SNA maps trade networks, diplomatic ties, and military alliances between civilizations, showing how relational dynamics shaped development.

Internal Social Structures: SNA is used to study the social hierarchies and interactions within the civilization, such as relationships between rulers, priests, merchants, and commoners.

Examples: Tools like Gephi and Pajek help visualize and analyze complex networks in relational studies of ancient societies.

6. Text Mining and Natural Language Processing (NLP)

Text mining and NLP technologies extract and analyze large bodies of written or inscribed texts, such as ancient manuscripts, inscriptions, and legal codes, which reveal important cultural and relational information:

Cultural Insights: Analyze written records for insights into religious practices, governance, trade, and societal norms.

Deciphering Ancient Texts: NLP technologies assist in translating ancient languages and extracting key themes from historical texts.

Relational Context: Study diplomatic letters, trade agreements, or war records to understand the relational dynamics of the civilization.

Examples: Software like AntConc or Voyant Tools can be used for text mining, while Google's

BERT or OpenAI GPT models offer advanced NLP capabilities for analyzing large text corpora.

7. Archaeological Databases and Big Data

Large-scale archaeological databases and big data analytics provide access to vast amounts of archaeological, historical, and geographical data, which is essential for building comprehensive CGR models. These technologies enable:

Data Integration: Combine diverse data sets from excavations, remote sensing, and historical records into a single coherent model.

Pattern Detection: Use big data analytics to identify patterns in cultural practices, population movements, and trade networks.

Predictive Modeling: Leverage historical data to predict future trends in civilization growth, decline, or interaction based on past behaviors.

Examples: Platforms like Open Context, Pleiades, and WorldCat provide access to extensive archaeological and historical data, while tools like R and Python support big data analytics.

8. Chronological and Dating Technologies

Accurate chronological frameworks are crucial for building CGR models. Technologies such as radiocarbon dating, dendrochronology, and optically stimulated luminescence (OSL) provide precise dating of artifacts, structures, and environmental changes:

Establishing Timelines: Chronological dating allows for the accurate placement of cultural, geographic, and relational changes within a specific time frame.

Environmental and Climatic Analysis: Tree rings and ice cores offer insights into climatic conditions that may have impacted the rise or fall of ancient civilizations.

Examples: AMS radiocarbon dating and dendrochronological methods are used for precise dating, helping to anchor CGR models in a clear historical timeline.

System Overview:

The Cultural-Geographic-Relational (CGR) model is designed as an integrated framework to analyze the development, interactions, and dynamics of ancient civilizations by focusing on three interconnected domains: culture, geography, and relations. The system operates through the integration of these domains into a cohesive model that provides a holistic understanding of how ancient civilizations evolved over time. The overview below describes the system architecture and the relationships between its components.

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1. Core Components of the CGR Model

a. Cultural Domain

This domain focuses on the internal structures and processes of the civilization, including:

Social Hierarchies: The organization of society, including the roles of rulers, elites, priests, and commoners.

Religion and Beliefs: The spiritual framework, religious institutions, and mythological narratives that shape behavior and governance.

Technology and Innovation: Developments in tools, infrastructure, and intellectual advancements that enhance economic productivity and social organization.

Governance Systems: Political structures such as monarchies, city-states, and empires, and how power is distributed and maintained.

Data Input: Archaeological records, ancient texts, artifacts, and inscriptions. Output: Cultural models displaying societal structure, religious influences, and technological progress over time.

b. Geographic Domain

This domain examines the physical environment in which the civilization developed and thrived, and how geography shaped its possibilities and limitations.

Topography: Physical features like rivers, mountains, deserts, and plains that influenced settlement patterns, defense, and agriculture.

Climate: Weather patterns and long-term climatic conditions that impacted agricultural production, trade routes, and population growth.

Natural Resources: Availability of raw materials such as metals, fertile soil, water, and timber, which shaped the economy and expansion.

Urbanization: The location and size of cities, settlements, and trade hubs based on geographic advantages.

Data Input: Remote sensing data, satellite imagery, geographic surveys, and environmental records. Output: Maps, settlement patterns, and environmental constraints that influenced civilization's development.

c. Relational Domain

This domain captures the interactions and relationships between civilizations and their surrounding neighbors, including:

Trade Networks: The routes and goods exchanged between civilizations, fostering economic ties and cultural diffusion.

Diplomacy and Warfare: Alliances, conflicts, conquests, and treaties that shaped geopolitical relations.

Cultural Diffusion: The spread of ideas, technologies, languages, and religions through contact with other civilizations.

Migration Patterns: Movement of populations due to warfare, environmental pressures, or economic opportunities.

Data Input: Historical texts, diplomatic records, trade agreements, and archaeological evidence. Output: Interaction maps showing trade routes, conflict zones, and diplomatic relations over time.

2. System Architecture

The CGR model operates as a multidimensional simulation system, where each domain—culture, geography, and relations—acts as a module interconnected with the others. These modules are designed to:

Interact Dynamically: Changes in one domain (e.g., geographic shifts due to climate change) directly impact the others (e.g., cultural adaptations or shifts in trade routes).

Incorporate Feedback Loops: The model accounts for feedback between the domains. For instance, cultural advancements (like irrigation technology) can modify geographic limitations, while relational dynamics (such as war) may affect both geography (through territorial expansion) and culture (by introducing foreign practices).

Integrate Time Series: The system includes a chronological component to simulate the temporal evolution of a civilization, from its emergence to expansion, crisis, and possible decline.

Data Integration Layer

GIS Integration: Combines geographic and environmental data with cultural and relational dynamics.

Cultural Data Module: Contains data sets on social structures, religious practices, and technological advancements, which can evolve based on relational and geographic inputs.

Relational Dynamics Module: Captures interaction networks between civilizations, including trade, conflict, and cultural exchanges.

Simulation Engine

The simulation engine powers the dynamic interactions between the three domains, incorporating rules and algorithms for:

Agent-Based Modeling: Simulates the behavior of individuals or groups within the civilization, allowing for an analysis of population dynamics, social changes, and migration patterns.

Event-Driven Simulations: Models significant events like wars, climatic disasters, or diplomatic alliances, and tracks their cascading effects across the cultural and geographic landscape.

Predictive Analysis: Uses historical data to predict possible outcomes based on trends in resource availability, population pressure, or external conflicts.

3. Functional Workflow

The system's workflow follows a modular and iterative process:

1. Data Collection and Input: Historical, geographic, and archaeological data is collected and input into the respective modules (cultural, geographic, and relational).

2. Model Calibration: The system is calibrated based on known historical data, adjusting parameters such as population growth, resource consumption, and interaction frequency to reflect real-world conditions.

3. Simulation and Analysis:

The system runs dynamic simulations, allowing for observation of how cultural practices, geographic constraints, and relational dynamics interact.

The model tracks changes over time, including how environmental shifts (e.g., droughts or floods) affect cultural adaptation, or how external pressures (e.g., warfare) impact population and trade.

4. Visualization and Output:

Geospatial Mapping: The system outputs maps showing settlement patterns, trade routes, and territorial changes over time.

Social and Cultural Graphs: Outputs visual representations of social hierarchies, religious influence, and technological advancements within the civilization.

Interaction Networks: Displays trade, diplomacy, and warfare networks between the civilization and its neighbors.

4. Applications of the CGR Model

The CGR model offers several key applications for studying ancient civilizations:

Historical Reconstruction: Recreate the rise, expansion, and decline of civilizations by simulating the interplay between cultural, geographic, and relational factors.

Impact Analysis: Analyze how specific events (like natural disasters, invasions, or technological breakthroughs) influenced the civilization’s trajectory.

Comparative Studies: Compare the development of different civilizations by running simulations with varying geographic constraints or relational networks.

Educational Visualization: Provide interactive maps and 3D reconstructions of ancient cities, allowing researchers, students, and the public to explore ancient civilizations.

Implementation (program code):

System in C++:

```
// C program to implement
// the above approach
#include <conio.h>
#include <graphics.h>
#include <stdio.h>

// Declaring functions used
// in this program
void taj_body();
void left_minars();
void right_minars();

// Driver Code
void main()
{
    int gd = DETECT, gm;

    // Initialize of gdriver with
    // DETECT macros
    initgraph(&gd, &gm, "C:\\turboc3\\bgi");

    // Calling taj_body() function
    taj_body();

    // Calling left_minars() function
    left_minars();

    // Calling right_minars() function
    right_minars();

    // Holding screen for a while
    getch();

    // Close the initialized gdriver
    closegraph();
}

void taj_body()
```

```
{
    // Main Base
    rectangle(10, 650, 1350, 680);
    rectangle(550, 300, 800, 650);
    rectangle(540, 290, 810, 650);

    // Left Door Line
    line(600, 650, 600, 400);

    // Right Door Line
    line(750, 650, 750, 400);

    line(600, 400, 675, 390);
    line(675, 390, 750, 400);
    arc(675, 240, 330, 210, 155);

    // Main Finial
    line(655, 85, 675, 30);
    line(675, 30, 695, 87);

    // Left Side
    line(540, 315, 445, 315);
    arc(490, 315, 0, 180, 45);

    // Left Finial
    line(480, 270, 490, 250);
    line(490, 250, 500, 270);

    // Left Vertical Line
    line(445, 315, 445, 355);

    // Lower Left Join
    line(445, 355, 540, 355);

    // Again Lower Left Join
    line(445, 375, 540, 375);

    // Left Tangent
    line(445, 355, 375, 370);

    // Lower Left Tangent
    line(445, 375, 375, 390);

    // Left Last Vertical
```

```
line(375, 370, 375, 650);

// Middle Left Rectangle
rectangle(450, 390, 530, 650);

// Left Rectangle Divider
line(450, 520, 530, 520);

// Left Rectangle Side Structure
line(440, 650, 440, 390);
line(385, 650, 385, 405);
line(440, 390, 385, 405);

// Divider
line(440, 520, 385, 520);

// Creating Left Lower Spike
line(460, 650, 460, 585);
line(520, 650, 520, 585);
line(460, 585, 490, 555);
line(520, 585, 490, 555);

// Creating Left Upper Spike
line(460, 520, 460, 455);
line(520, 520, 520, 455);
line(460, 455, 490, 425);
line(520, 455, 490, 425);

// Right Side
line(810, 315, 905, 315);
arc(860, 315, 0, 180, 45);

// Right Finial
line(850, 270, 860, 250);
line(860, 250, 870, 270);

// Right Vertical Line
line(905, 315, 905, 355);
line(905, 355, 810, 355);

// Lower Right Join
line(905, 355, 810, 355);

// Again Right Left Join
```

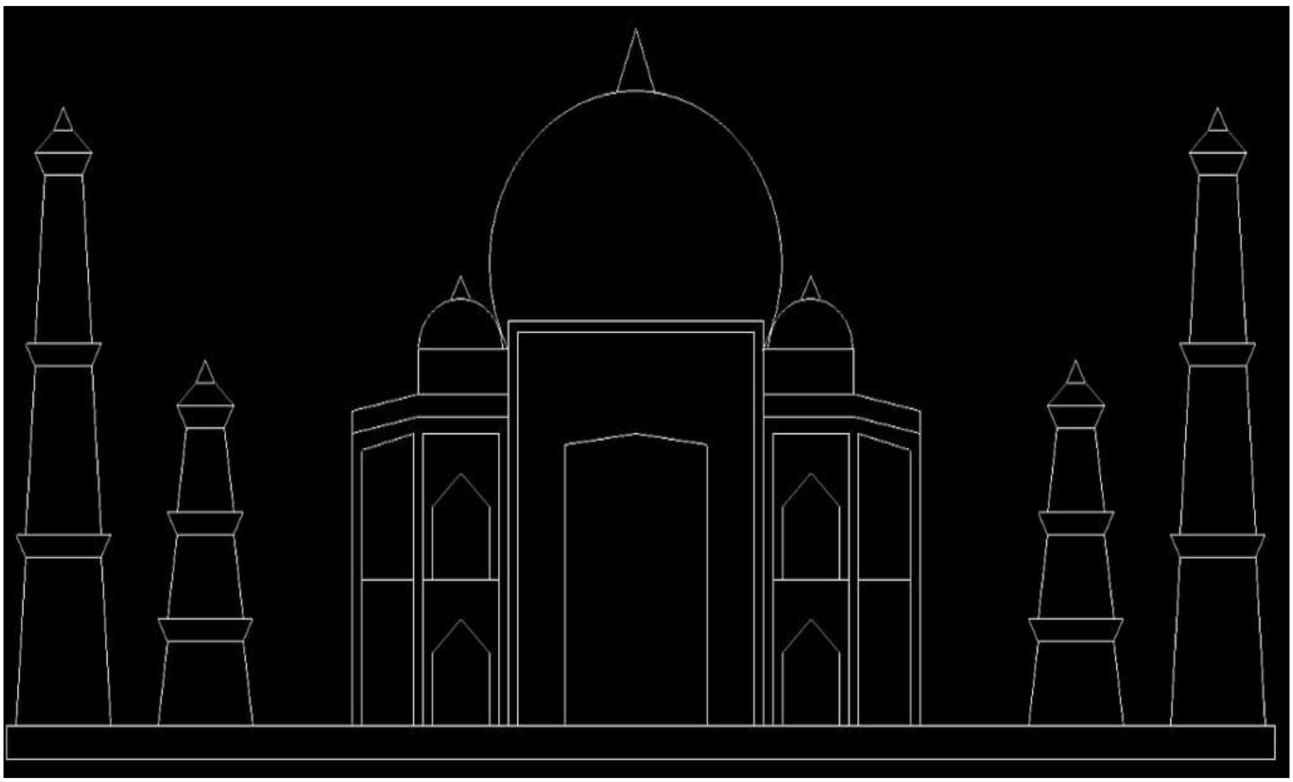
```
    line(905, 375, 810, 375);

    // Right Tangent
    line(905, 355, 975, 370);

    // Lower Right Tangent
    line(905, 375, 975, 390);

    // Right Last Vertical
    line(975, 370, 975, 650);

    // Middle Right Rectangle
    rectangle(820, 390, 900, 650);

    // Right Rectangle Divider
    line(820, 520, 900, 520);

    // Right Rectangle Side Structure
    line(910, 650, 910, 390);
    line(965, 650, 965, 405);
    line(910, 390, 965, 405);

    // Divider
    line(910, 520, 965, 520);

    // Creating Right Lower Spike
    line(830, 650, 830, 585);
    line(890, 650, 890, 585);
    line(830, 585, 860, 555);
    line(890, 585, 860, 555);

    // Creating Right Upper Spike
    line(830, 520, 830, 455);
    line(890, 520, 890, 455);
    line(830, 455, 860, 425);
    line(890, 455, 860, 425);
}

void left_minars()
{
    // 1st Left Minar
    // 1st Step
    line(20, 650, 30, 500);
    line(120, 650, 110, 500);
```

```
line(110, 500, 30, 500);

// 2nd Step
line(30, 500, 20, 480);
line(110, 500, 120, 480);
line(120, 480, 20, 480);
line(30, 480, 40, 330);
line(110, 480, 100, 330);
line(40, 330, 100, 330);
line(40, 330, 30, 310);
line(100, 330, 110, 310);
line(110, 310, 30, 310);

// 3rd Step
line(40, 310, 50, 160);
line(100, 310, 90, 160);
line(50, 160, 90, 160);
line(50, 160, 40, 140);
line(90, 160, 100, 140);
line(40, 140, 100, 140);
line(40, 140, 60, 120);
line(100, 140, 80, 120);
line(60, 120, 80, 120);
line(60, 120, 70, 100);
line(70, 100, 80, 120);

// 2nd Left Minar
// 1st Step
line(170, 650, 180, 575);
line(270, 650, 260, 575);
line(180, 575, 260, 575);

// 2nd Step
line(180, 575, 170, 555);
line(260, 575, 270, 555);
line(170, 555, 270, 555);
line(180, 555, 190, 480);
line(260, 555, 250, 480);
line(190, 480, 250, 480);

// 3rd Step
line(190, 480, 180, 460);
line(250, 480, 260, 460);
line(180, 460, 260, 460);
```

```
    line(190, 460, 200, 385);
    line(250, 460, 240, 385);
    line(200, 385, 240, 385);
    line(200, 385, 190, 365);
    line(240, 385, 250, 365);
    line(190, 365, 250, 365);
    line(190, 365, 210, 345);
    line(250, 365, 230, 345);
    line(210, 345, 230, 345);
    line(210, 345, 220, 325);
    line(220, 325, 230, 345);
}

void right_minars()
{
    // 1st Right Minar
    // 1st Step
    line(1340, 650, 1330, 500);
    line(1240, 650, 1250, 500);
    line(1330, 500, 1250, 500);

    // 2nd Step
    line(1330, 500, 1340, 480);
    line(1250, 500, 1240, 480);
    line(1240, 480, 1340, 480);
    line(1330, 480, 1320, 330);
    line(1250, 480, 1260, 330);
    line(1320, 330, 1260, 330);
    line(1320, 330, 1330, 310);
    line(1260, 330, 1250, 310);
    line(1250, 310, 1330, 310);

    // 3rd Step
    line(1320, 310, 1310, 160);
    line(1260, 310, 1270, 160);
    line(1310, 160, 1270, 160);
    line(1310, 160, 1320, 140);
    line(1270, 160, 1260, 140);
    line(1320, 140, 1260, 140);
    line(1320, 140, 1300, 120);
    line(1260, 140, 1280, 120);
    line(1300, 120, 1280, 120);
    line(1280, 120, 1290, 100);
    line(1290, 100, 1300, 120);
```

```
    // 2nd Right Minar
    // 1st Step
    line(1090, 650, 1100, 575);
    line(1190, 650, 1180, 575);
    line(1100, 575, 1180, 575);

    // 2nd Step
    line(1100, 575, 1090, 555);
    line(1180, 575, 1190, 555);
    line(1090, 555, 1190, 555);
    line(1100, 555, 1110, 480);
    line(1180, 555, 1170, 480);
    line(1110, 480, 1170, 480);

    // 3rd Step
    line(1110, 480, 1100, 460);
    line(1170, 480, 1180, 460);
    line(1180, 460, 1100, 460);
    line(1110, 460, 1120, 385);
    line(1170, 460, 1160, 385);
    line(1120, 385, 1160, 385);
    line(1110, 365, 1120, 385);
    line(1160, 385, 1170, 365);
    line(1110, 365, 1170, 365);
    line(1110, 365, 1130, 345);
    line(1170, 365, 1150, 345);
    line(1130, 345, 1150, 345);
    line(1130, 345, 1140, 325);
    line(1140, 325, 1150, 345);
}
```

Output:



`

Algorithm:

Step-by-Step Algorithm

1. Data Collection Phase

Input: Data sources (archaeological records, historical texts, geographic surveys).

1.1. Gather Cultural Data

Collect data on social structures, religious practices, governance systems, technological innovations, and economic activities.

Sources: Ancient texts, artifacts, and archaeological reports.

1.2. Gather Geographic Data

Collect data on topography, climate, natural resources, and urbanization patterns.

Sources: Remote sensing data, satellite imagery, geological surveys, and environmental records.

1.3. Gather Relational Data

Collect data on trade networks, diplomatic relationships, conflicts, and cultural exchanges with neighboring civilizations.

Sources: Historical records, trade agreements, and archaeological findings.

2. Data Integration Phase

Input: Collected cultural, geographic, and relational data.

2.1. Data Preprocessing

Clean and preprocess the data to ensure consistency and accuracy.

Normalize data formats and resolve discrepancies between sources.

2.2. Create Data Structures

Organize data into structured formats such as databases or data frames, categorizing cultural, geographic, and relational information.

Example structure:

Cultural Data Table: [ID, Social Structure, Religion, Technology, Governance]

Geographic Data Table: [ID, Location, Climate, Resources, Urbanization]

Relational Data Table: [ID, Trade Routes, Diplomatic Relations, Conflicts]

3. Model Initialization Phase

Input: Structured data tables.

3.1. Initialize the CGR Model

Define model parameters (e.g., population size, resource availability, cultural influences).

Set initial states for cultural, geographic, and relational components.

3.2. Define Interactions

Establish rules and algorithms for how cultural, geographic, and relational components interact.

Example rules:

Cultural adaptation in response to environmental changes.

Trade relationships influencing resource distribution.

Social hierarchies affecting conflict and cooperation.

4. Simulation Phase

Input: Initialized CGR model with defined interactions.

4.1. Run Simulations

Execute the model over a defined time period (e.g., centuries or millennia).

At each time step:

Update cultural, geographic, and relational data based on interactions.

Apply defined rules to simulate events (e.g., droughts, invasions, technological advancements).

4.2. Monitor Changes

Track changes in cultural practices, settlement patterns, trade networks, and population dynamics.

Record key metrics such as resource consumption, population growth, and conflict events.

5. Analysis Phase

Input: Simulation results and recorded metrics.

5.1. Analyze Output Data

Assess the results of the simulation to identify trends, patterns, and anomalies.

Use statistical methods to analyze cultural adaptations, geographic changes, and relational dynamics.

5.2. Visualization

Create visual representations of the data, including:

Maps showing settlement patterns and trade routes.

Graphs depicting population changes and cultural shifts.

Network diagrams illustrating relational dynamics.

6. Validation Phase

Input: Simulation results and historical context.

6.1. Compare with Historical Data

Validate the model by comparing simulation outputs with known historical events, archaeological findings, and cultural developments.

Adjust model parameters and rules as necessary based on discrepancies.

6.2. Refine the Model

Iterate on the model design, refining interactions and rules to improve accuracy.

Incorporate new data as it becomes available to enhance the model's reliability.

7. Finalization Phase

Input: Validated and refined CGR model.

7.1. Document Findings

Prepare a comprehensive report detailing the model, its structure, and the insights gained from simulations.

Highlight key findings regarding cultural evolution, geographic influences, and relational dynamics.

7.2. Publish and Share

Share the model and findings with the academic community, historians, and educators for further study and application.

Consider developing an interactive platform for users to explore the CGR model and its implications.

Advantages:

1. Holistic Understanding:

The CGR model provides a comprehensive framework that integrates cultural, geographic, and relational aspects, allowing for a more nuanced understanding of how these factors interact to shape the development and decline of civilizations.

2. Dynamic Interaction Simulation:

The model enables the simulation of dynamic interactions over time, allowing researchers to observe potential outcomes of different scenarios, such as environmental changes, technological advancements, or social upheaval.

3. Interdisciplinary Approach:

By incorporating data and methodologies from various disciplines (anthropology, archaeology, geography, sociology), the CGR model fosters collaboration among researchers and encourages a multidisciplinary perspective on ancient civilizations.

4. Predictive Insights:

The model can help identify patterns and trends that may predict future behaviors or outcomes based on historical data, contributing to a better understanding of societal resilience or vulnerability.

5. Visualization Tools:

The use of GIS and other visualization tools enhances the ability to present complex data in an accessible way, making it easier for both researchers and the public to understand the relationships between culture, geography, and relations.

6. Data Integration:

The model allows for the integration of diverse data sources, enhancing the richness of the analysis and enabling more comprehensive studies of ancient societies.

7. Educational Applications:

The CGR model can serve as an educational tool, helping students and the general public visualize and understand the complexities of ancient civilizations through interactive simulations and visualizations.

Disadvantages:

1. Data Limitations:

The quality and availability of historical and archaeological data can be inconsistent, leading to gaps in knowledge that may affect the accuracy of the model. Some cultures may have insufficient records, making it challenging to create a complete picture.

2. Complexity in Modeling:

Creating a CGR model involves significant complexity in terms of data integration, establishing relationships, and simulating interactions. This complexity can lead to challenges in understanding the underlying assumptions and parameters of the model.

3. Subjectivity in Interpretation:

Cultural interpretations and historical narratives can be subjective, potentially introducing bias into the model. Different historians may interpret the same data differently, leading to variations in the model's structure and conclusions.

4. Resource Intensive:

Building and running a CGR model can require substantial resources, including time, funding, and technical expertise. Access to advanced technologies (e.g., GIS, simulation software) may also be a barrier for some researchers.

5. Limitations of Predictive Power:

While the model can offer insights into potential trends, historical events can be influenced by a multitude of unpredictable factors. Thus, predictions made by the model may not always reflect actual outcomes.

6. Over-Simplification Risk:

In attempting to model complex interactions, there is a risk of oversimplifying cultural, geographic, or relational factors, which could lead to misleading conclusions about the civilization's dynamics.

7. Technical Challenges:

Implementing technologies for data collection, analysis, and visualization requires technical skills that may not be readily available to all researchers, potentially limiting the model's accessibility.

Conclusion:

The technologies used in building a CGR model of an ancient civilization offer a multidisciplinary toolkit that integrates cultural, geographic, and relational data into a dynamic and comprehensive model. Geographic Information Systems (GIS) provide spatial analysis, while 3D modeling and virtual reconstructions offer immersive visualizations of ancient environments and structures. Agent-Based Models (ABM) and Social Network Analysis (SNA) simulate social dynamics and relational interactions, allowing for a deeper understanding of how civilizations functioned and evolved. These technologies, combined with archaeological databases and text mining, ensure that CGR models are based on rigorous data analysis, offering valuable insights into the complexities of ancient civilizations.

Bibliography :-

The following bibliography provides a selection of key texts, articles, and resources that can inform the development of a Cultural-Geographic-Relational (CGR) model of an ancient civilization. This collection includes works from archaeology, anthropology, geography, and history that address the integration of cultural, geographic, and relational data.

Books

1. Trigger, Bruce G. (2006). A History of Archaeological Thought. Cambridge University Press.

A comprehensive overview of the development of archaeological theory and methodology, addressing the integration of cultural and environmental factors.

2. Renfrew, Colin, & Bahn, Paul. (2016). Archaeology: Theories, Methods, and Practice. Thames & Hudson.

A foundational text that discusses archaeological methodologies and the interpretation of cultural data within geographic contexts.

3. Miller, David J. (2000). The Cultural Landscape: An Introduction to Human Geography. Prentice Hall.

This book explores the relationship between culture and geography, emphasizing the importance of cultural landscapes in understanding human history.

4. Hodder, Ian. (2012). Entangled: An Archaeology of the Relationships between Humans and Things. Wiley-Blackwell.

An exploration of how human and material relationships shape cultural practices and historical developments.

5. Crumley, Carole L., & Marquardt, William H. (1987). Regional Dynamics: Burgundian Landscapes in Historical Perspective. Westview Press.

This work discusses the interplay between cultural and environmental factors within specific regions, providing insights applicable to CGR modeling.

Articles and Journals

6. Kohler, Timothy A., & Van Der Leeuw, Sander. (2007). “The Model-Data Relationship in Archaeology: The Importance of Interdisciplinarity.” Advances in Complex Systems, 10(3), 365-384.

Discusses the need for interdisciplinary approaches in archaeological modeling and the importance of data integration.

7. Barton, Christopher, & Goff, John. (2010). “A GIS-Based Model of Ancient Settlement Patterns.” Journal of Archaeological Science, 37(10), 2459-2470.

Presents a case study using GIS to analyze ancient settlement patterns, illustrating the application of geographic data in understanding cultural development.

8. Waller, Steven. (2005). “Agent-Based Modeling of Archaeological Systems.” Journal of Archaeological Method and Theory, 12(3), 251-283.

Examines the use of agent-based modeling in archaeology to simulate cultural interactions and dynamics.

9. Perry, D. B., & Johnson, M. H. (2007). “Cultural Evolution and the Interplay of Environmental and Social Factors.” American Anthropologist, 109(4), 610-622.

Explores the complex interactions between cultural evolution and environmental factors, relevant for CGR modeling.

Online Resources

10. Cultural Heritage Information Management. (n.d.). “Cultural-Geographic-Relational Modeling.” Cultural Heritage and Science [Website].

A resource detailing methodologies for integrating cultural and geographic data in heritage studies. Available online.

11. ESRI. (n.d.). “GIS and Ancient Civilizations.” ESRI Education Resources [Website].
Provides case studies and resources on the use of GIS in archaeological research and modeling. Available online.

12. Open Context. (n.d.). “Open Data for Archaeology.” [Website].
An open-access repository for archaeological data, allowing researchers to share and access datasets relevant to CGR modeling. Available online.

WEEKLY PROGRESS REPORT

MICRO PROJECT

SR.NO	WEEK	ACTIVITY PERFORMED	SIGN OF GUIDE	DATE
01.	1st	Discussion and finalization of topic		
02.	2nd	Preparation and submission of Abstract		
03.	3rd	Literature Review		
04.	4th	Collection of Data		
05.	5th	Collection of Data		
06.	6th	Discussion and outline of Content		
07.	7th	Formulation of Content		
08.	8th	Editing and proof Reading of Content		
09.	9th	Compilation of Report		
10.	10th	Seminar		
11.	11th	Viva voc		
12.	12th	Final submission of Micro Project		

Sign of the student **Sign of the Faculty**

ANEEXURE

Evaluation sheet for Micro project Acedmic year : 2024-25

Name of faculty :- Prof. Pratik Bhagat

Subject : Computer Graphics (CGR)

Course code : 313 001

Semester : Third

Title of the micro Project :- Building a CGR Model of an ancient civilization

Roll no :-	Student name:-	Marks out of 6 for performance in group activity	Marks out of 4 for perfomance in oral	Total out of 10
94	Karan Balu Shinde			
95	Sarthak Uttam Shinde			
96	Pankaj Mahesh Shirsat			

Name and signature of Faculty