Game Programming: Lecture 1: Introduction

Prepared by

Dr. Mohammed Salah Al-Obaidi

Game Programming

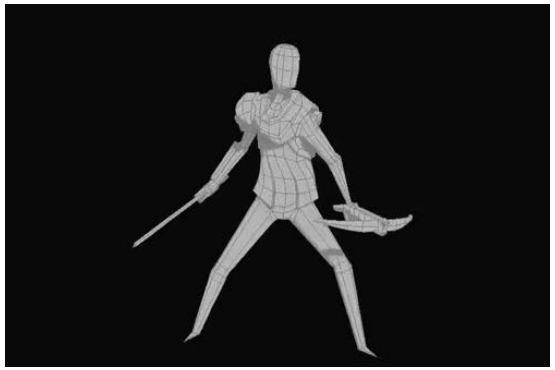
- Game programming is the process of creating computer software that controls the behavior and appearance of video games.
- To program a game, you need to work with game engines.
- These engines do the following tasks:
  - rendering graphics,
  - handling input from the player,
  - managing game states.

Types of game programming

- 2D game programming involves designing and coding video games that use two-dimensional graphics.
- 3D game programming involves designing and coding video games that use three-dimensional graphics.
- physics game programming involves designing and coding video games that incorporate realistic or simulated physics into the gameplay.
- AI game programming involves designing and coding video games that incorporate artificial intelligence into the gameplay.

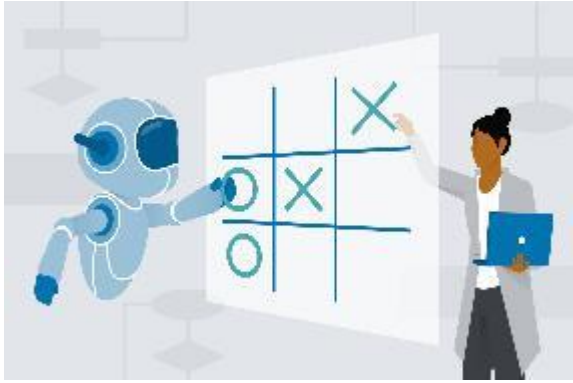
2D

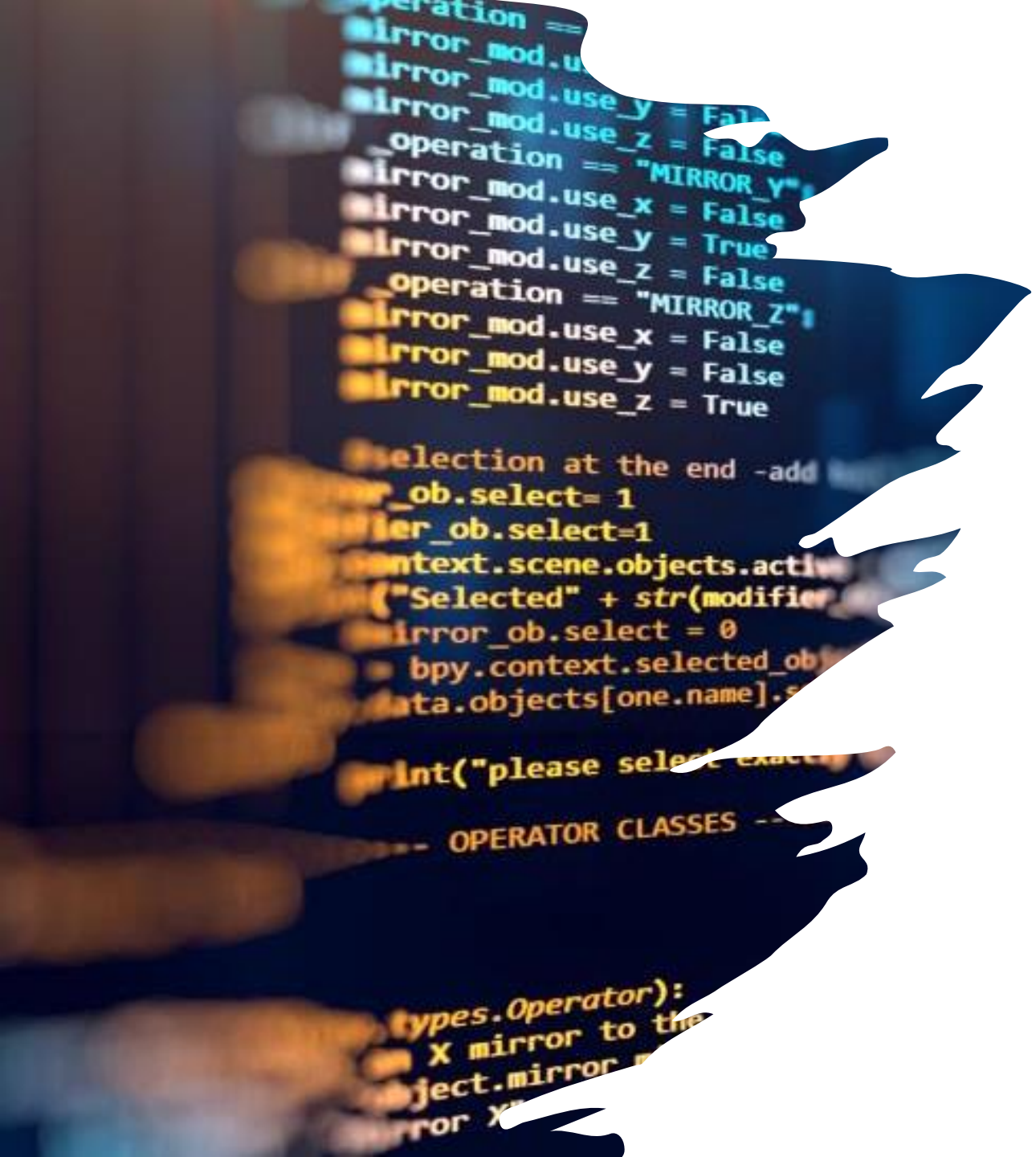
3D



Physics Game

AI Games

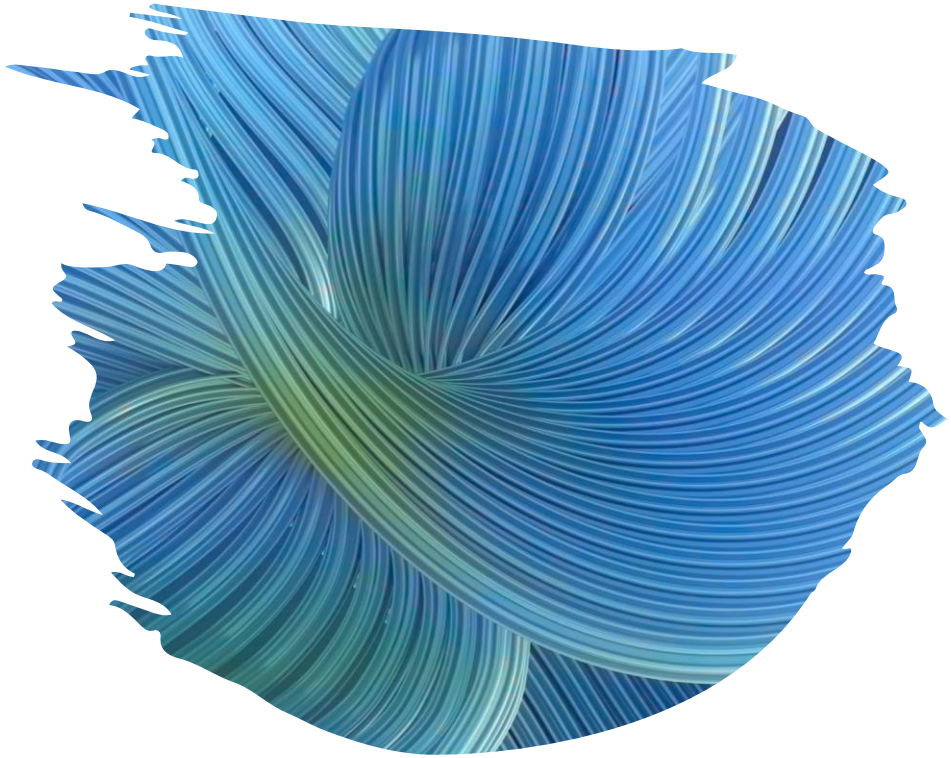




Programming languages used in game development

- C++
- C#
- Java
- Python
- JavaScript
- Lua
- Swift

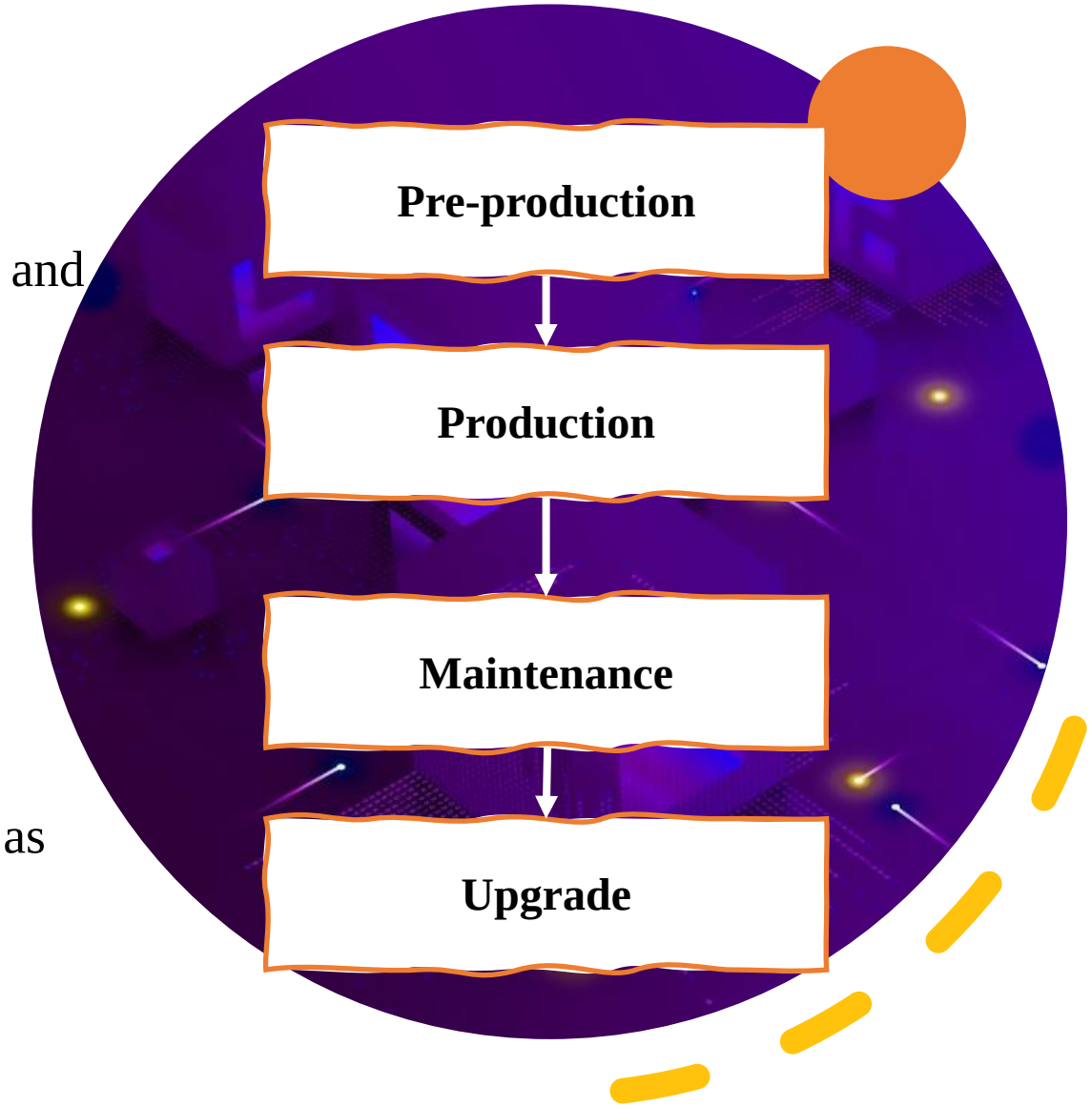
Types of Games

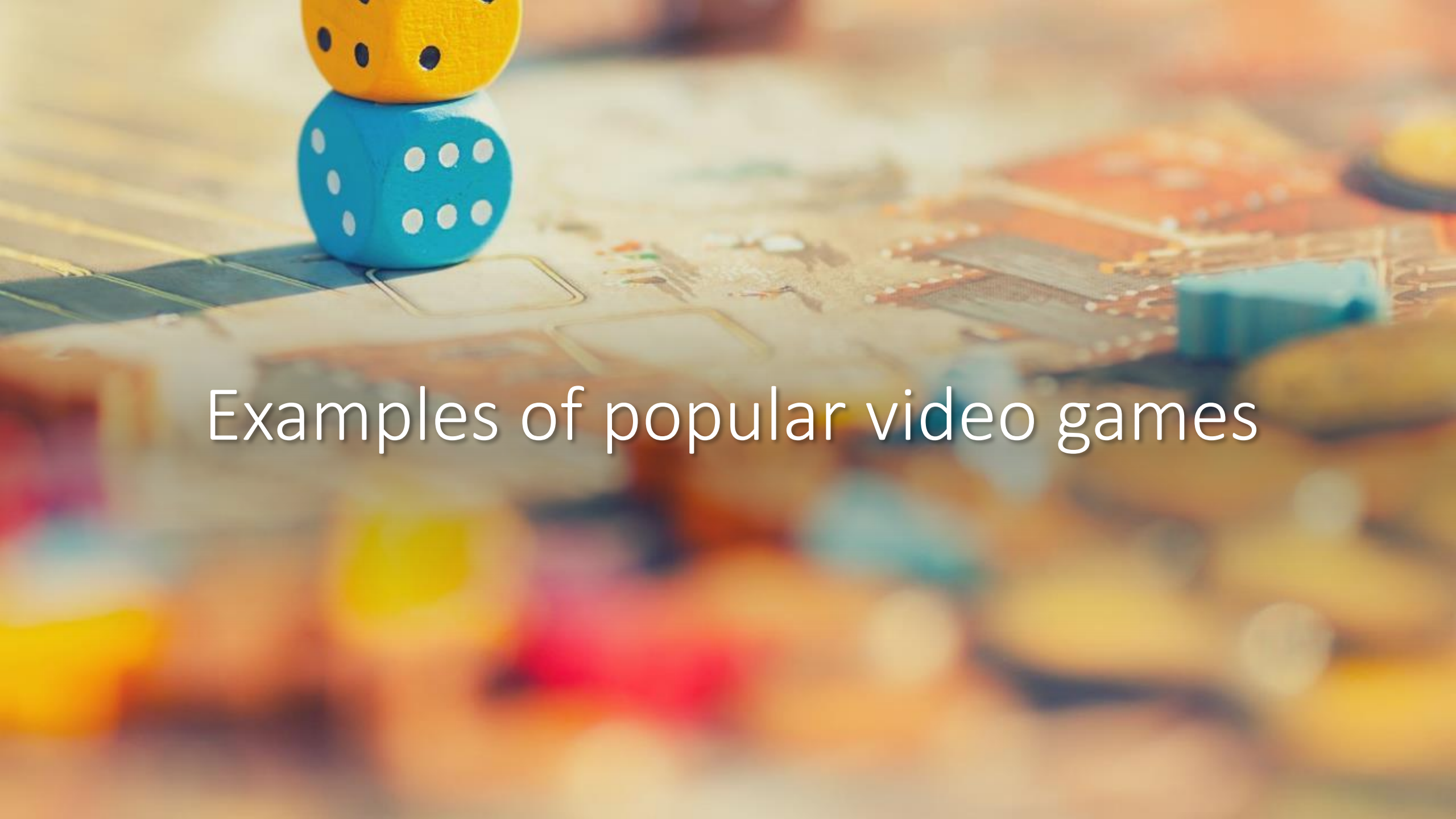


- Action
- Adventure
- Arcade
- Fighting
- Puzzle
- Racing
- Shooter
- Simulation
- Sports
- Strategy
- Survival

Game Production Pipeline

- **Pre-production :**Create the game design document and technical design document.
- **Production:**
  - Implementing assets and creating game play
  - building the game for release.
- **Maintenance**
  - Fixing bugs and releasing patches
  - Incremental functionality improvements
- **Upgrade**: Building and releasing new content such as new levels, seasonal content, special release

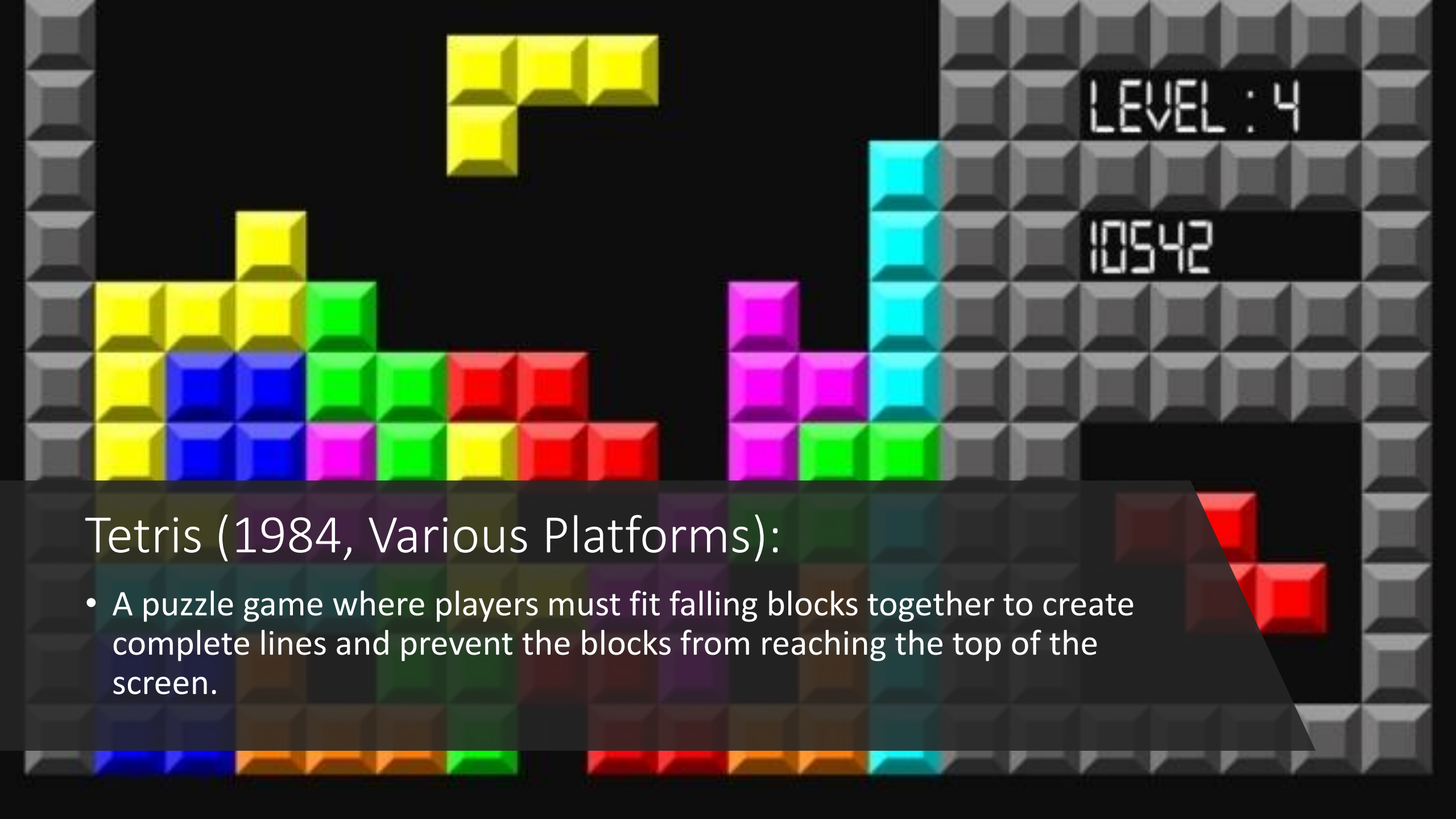




Examples of popular video games

Super Mario Bros. (1985, Nintendo Entertainment System):

- A platformer game that features the iconic character Mario and his adventures through the Mushroom Kingdom.

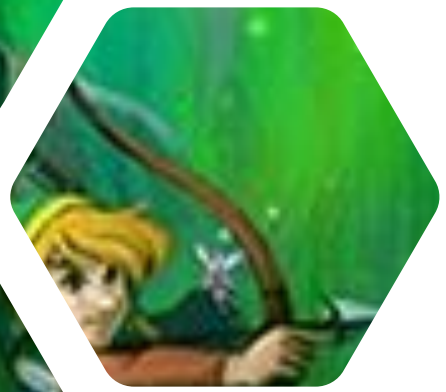


Tetris (1984, Various Platforms):

- A puzzle game where players must fit falling blocks together to create complete lines and prevent the blocks from reaching the top of the screen.

Doom (1993, MS-DOS):

- A first-person shooter (FPS) game that helped popularize the genre and establish the conventions of modern FPS games.



The Legend of Zelda (1986, Nintendo Entertainment System):

- An action-adventure game that features the hero Link as he battles monsters, solves puzzles, and explores a vast open world.

Minecraft (2011, Various Platforms):

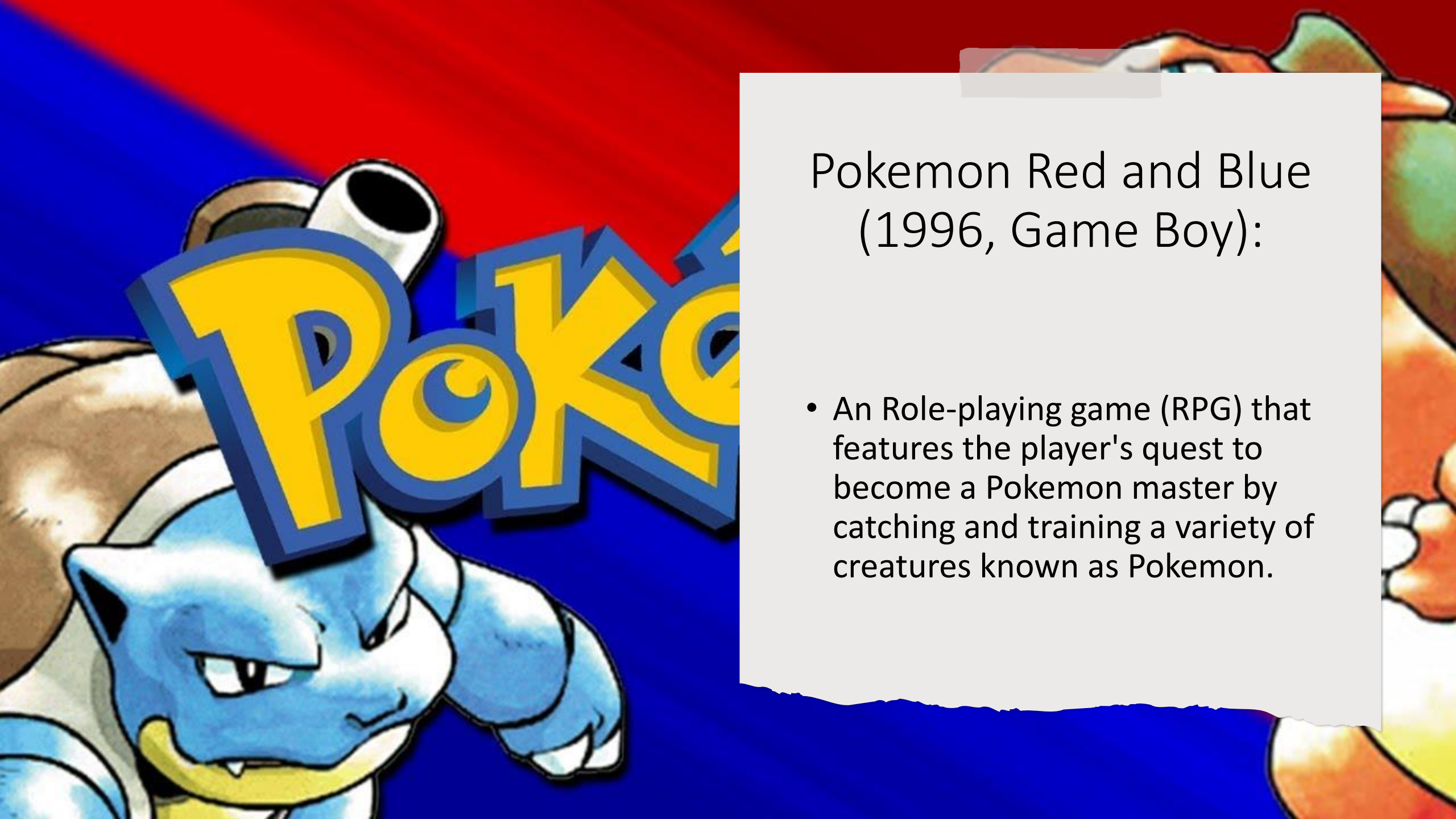
- A sandbox game that allows players to build and explore their own virtual worlds, with a focus on crafting and survival.

Grand Theft Auto V (2013, Various Platforms):

- An open-world action game that takes place in a fictionalized version of Los Angeles and allows players to engage in various activities such as driving, shooting, and heists.

Fortnite (2017, Various Platforms):

- A battle royale game that pits 100 players against each other on an island and challenges them to be the last player standing.



Pokemon Red and Blue (1996, Game Boy):

- An Role-playing game (RPG) that features the player's quest to become a Pokemon master by catching and training a variety of creatures known as Pokemon.

Benefits of being a game programmer

- You Can Make Your Own Games.
- You Can Do More Than Entertain.
- You Know You're In A Growing Industry.
- You Get Paid To Do What You Love.
- You Don't Need A Degree To Make Games.
- You Get To Work In A Casual Environment.
- You Get To Be Creative.

Game Programming: Lecture 2: Game design

Prepared by

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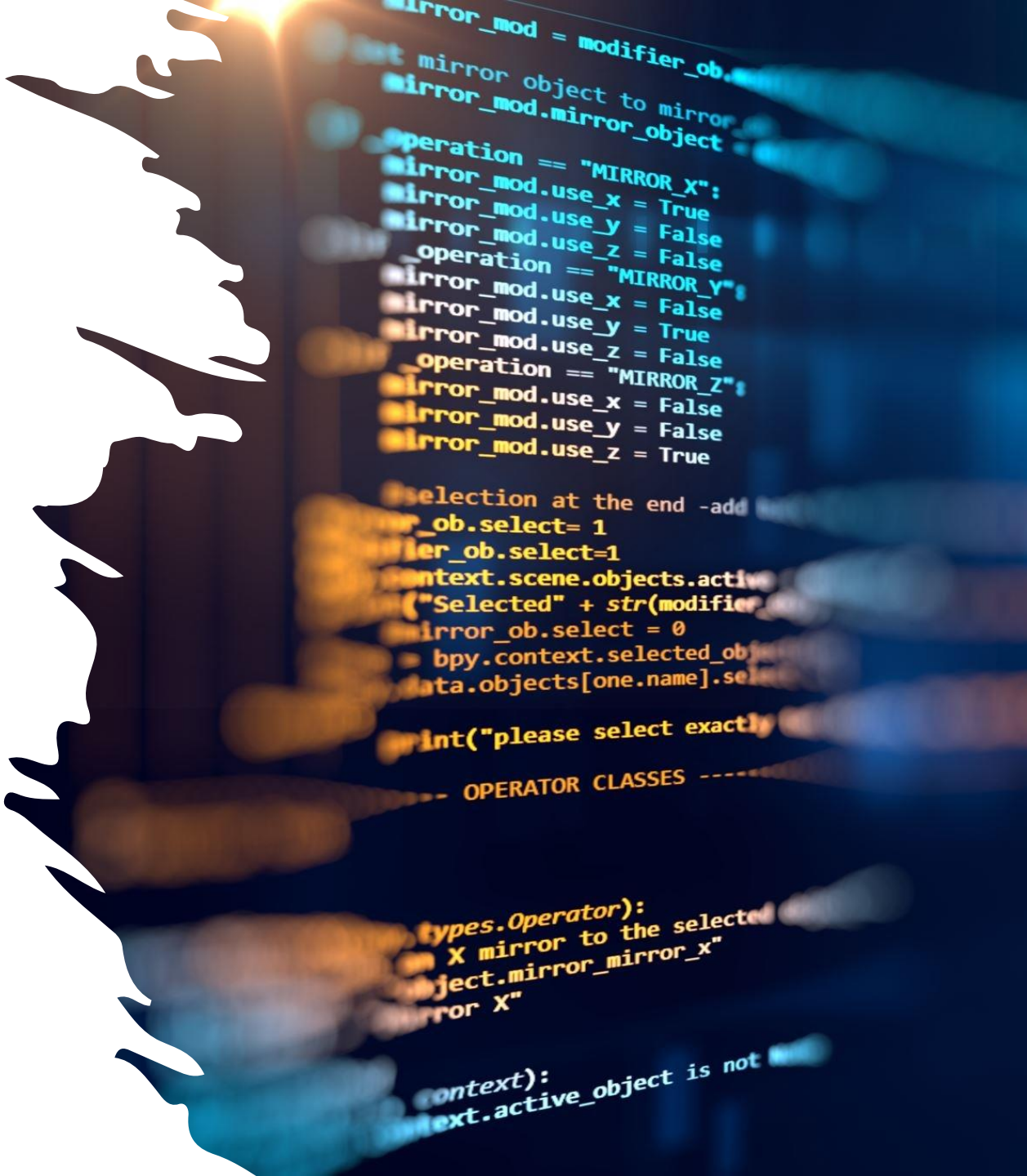


What is a game design

Game design is the **creation of the rules and content of a game**

Games can be created for:

- Entertainment
- Education
- Exercise
- Experimental purposes

Game design consists of:

- **Gameplay,** which is the interaction between the player and the mechanics and systems
- **Mechanics and systems,** which are the rules and objects in the game
- **Player experience,** which is how users feel when they're playing the game

Gameplay

Gameplay is the specific way in which players interact with a game.

Gameplay is the core component of most video games.

Gameplay makes games enjoyable and engaging for players.

Good gameplay is often characterized by a balance between **challenge** and **reward**.

- Games that are too easy can quickly become boring

Mechanics and systems: Game rules

Rules are what differentiate games from other kinds of play.

If you don't have rules you have free play, not a game.

Why are rules so important to games?

- Rules impose limits they force us to take specific paths to reach goals
- Ensure that all players take the same paths.
- They put us inside the game world by letting us know what is in and out of bounds.

Why game designer needs to set game rules?

Rules limit player action.

Rules are explicit and unambiguous.

Rules are fixed.

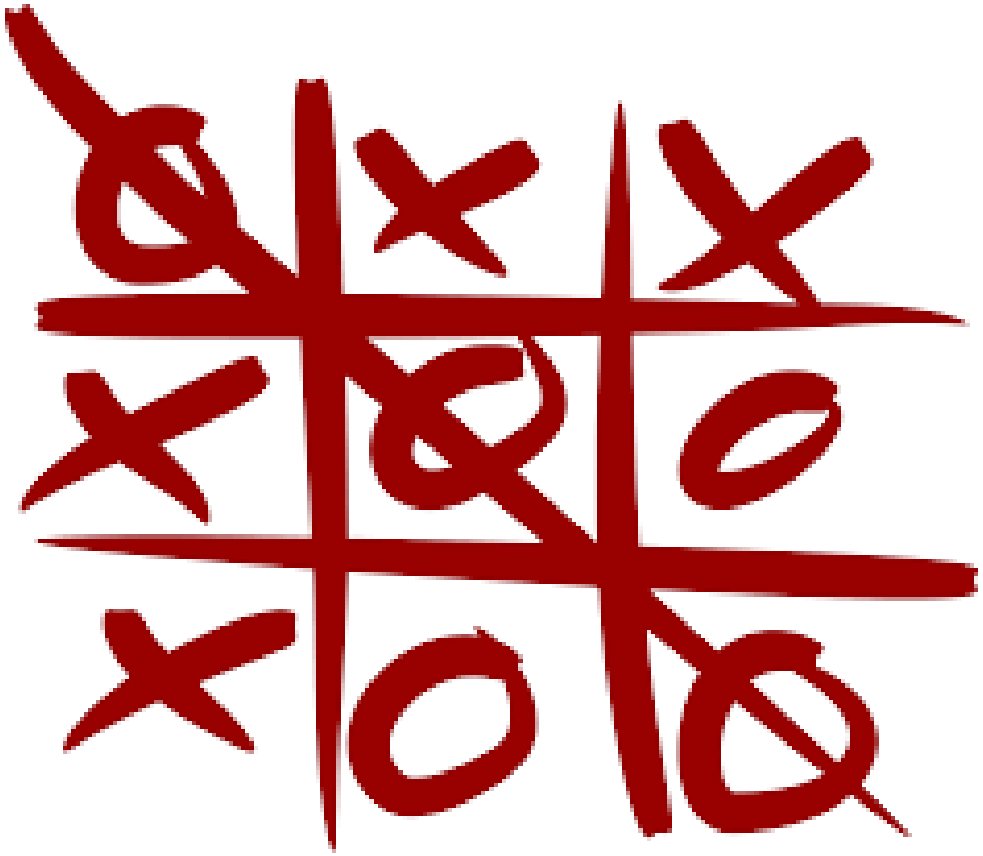
Rules are repeatable.

Rules are shared by all players.

Example of some game rules

Tic tac toe rules

1. Play occurs on a 3 by 3 grid of 9 empty squares.
2. Two players take turns marking empty squares where the first player places Xs and the second player places Os.
3. If one player places three of the same marks in a row, that player wins.
4. If the spaces are all filled and there is no winner, the game is over

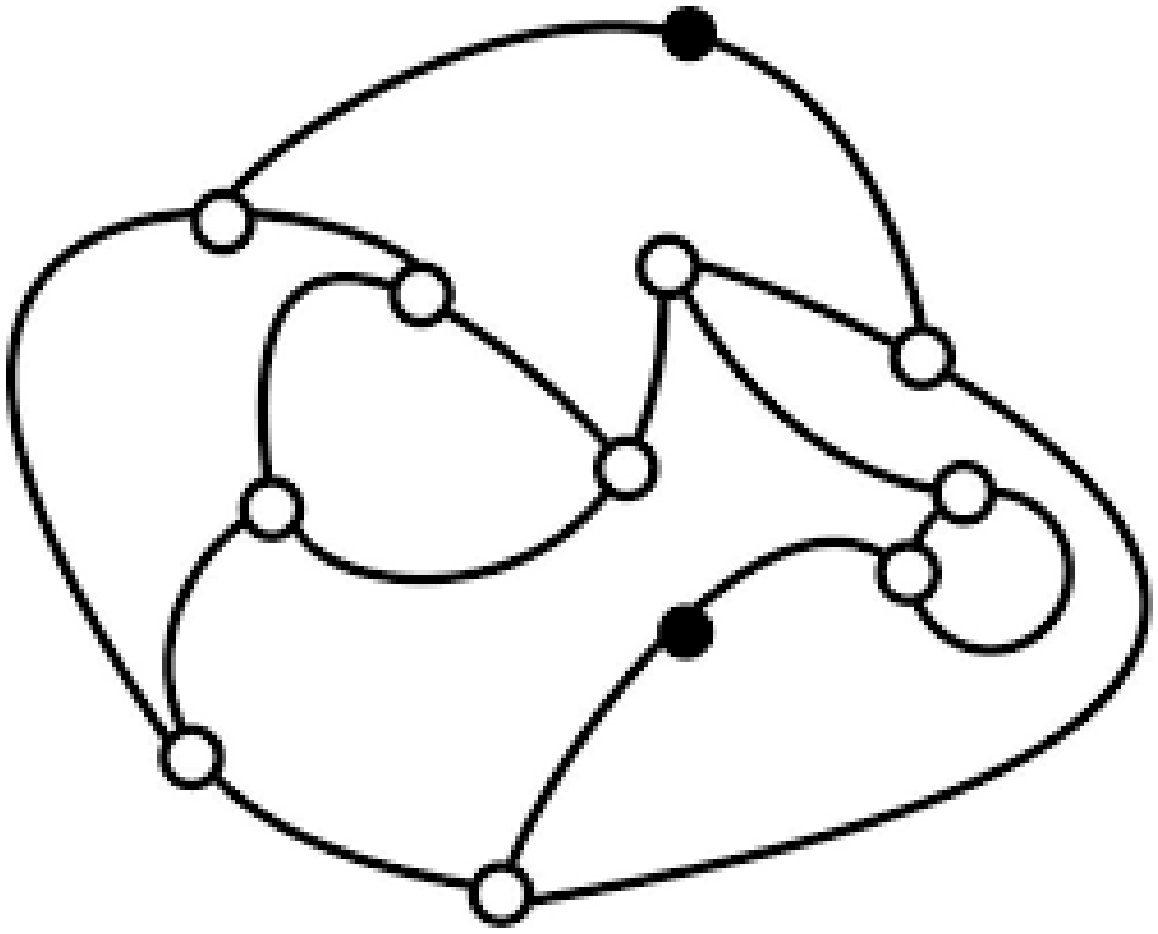


Uno Card game

1. Each player gets 7 Uno cards to start.
2. Match one of your cards with the card that's been placed from the draw pile.
3. The first player to finish his cards, he wins the round.

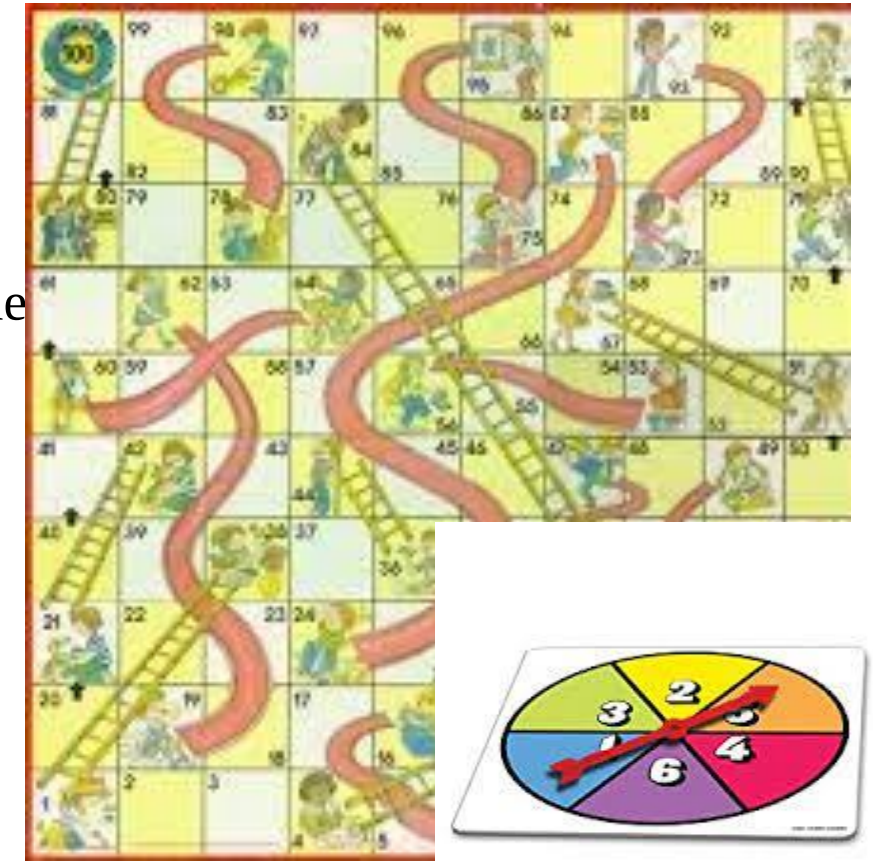
Sprouts Game

1. Draw a line joining two spots, or a single spot to itself.
2. The line must not cross another line or pass through another spot.
3. Draw a spot on the new line.
4. No more than three lines can emerge from any spot.
5. When no more joining are available, the last one plays is the winner.



Chutes and ladders

1. Everyone spins the spinner.
2. The player with the highest number goes first.
3. Play proceeds to the left.
4. Move your pawn, square by square, the number shown on the spinne
5. Going Up or Down a Chute or Ladder:
   - If the pawn at the bottom of a ladder, that pawn must climb up.
   - If the pawn at the top of a chute, that pawn must slide down.
6. You win:
   - If your counts reaches square with number 100.



Tetris Rules

1. Play on a grid of 19 by 10 squares.
2. The player can move the currently falling block left, right, or rotate.
3. The blocks fall slowly but you can speed their falling.
4. The goal is to fill all the empty space in a line at the bottom of the screen so each row can disappear,
5. The more blocks you destroy, the more score you get.

Games feelings to the player

- Sensation: *Game as sense-pleasure*
- Fantasy: *Game as make-believe*
- Narrative: *Game as drama*
- Challenge: *Game as obstacle course*
- Fellowship: *Game as social framework*
- Discovery: *Game as unexplored place*
- Expression: *Game as self-discovery*

Game Programming: Lecture 3: Game Physics

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Developers need to know physics

Video games use laws of physics, so objects "behave" as they do in the normal world.

Programmers need to know the physical science equations to apply them accurately and appropriately to the game code.

Modern video games use physics **to achieve realistic behavior and special effects**.

Everything from billiard balls, to flying debris, to tactical fighter jets is simulated in games using fundamental principles of physics.

The main parts of game physics include:

1. Collision Detection
2. Rigid Body Dynamics
3. Fluid dynamics
4. Cloth simulation
5. Physics Engines
6. Optimization

1. Collision detection:

This refers to the process of determining when two objects in the game world have come into contact with each other. It is essential for creating realistic interactions between objects.

Collision examples

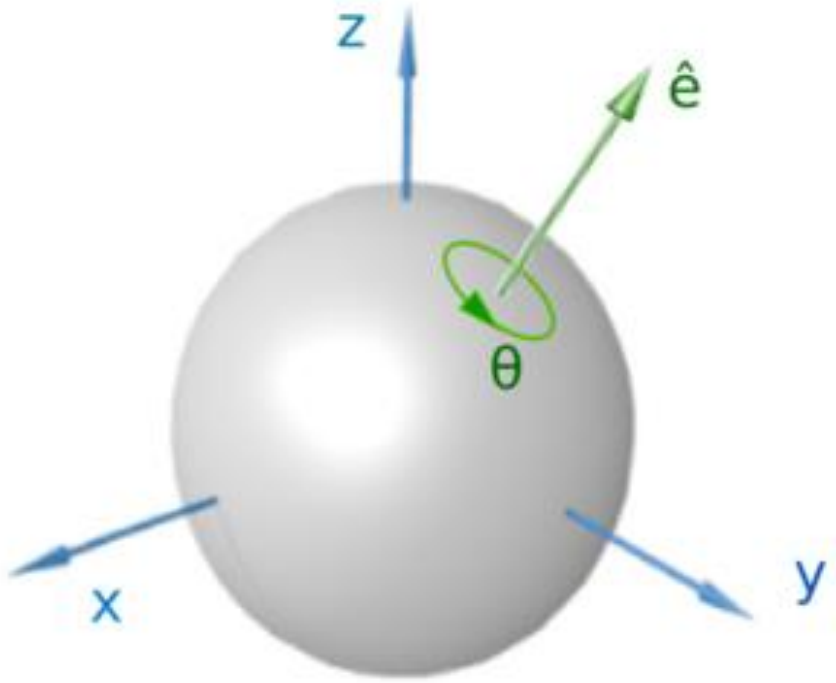
- a game of billiards, where two billiard balls collide with each other on a table.
- When one ball strikes another, they transfer momentum and kinetic energy to each other, causing the struck ball to move and the striking ball to slow down or stop.
- The angle and speed of the collision between the two balls will determine the direction and speed of each ball

Collision examples

- a car crash. When two vehicles collide, their momentum and kinetic energy transfer to each other, causing damage to the vehicles and potentially injuring the passengers.
- The speed, angle, and mass of each vehicle will determine the severity of the collision and the resulting damage.
- The force of the collision can cause the cars to crumple and deform, while the passengers may be thrown around inside the car or even ejected from the vehicle.

Collision examples

- Another example of two objects colliding is a football. When a player kicks the ball, the ball collides with another player.
- The collision between the ball and another object is governed by the laws of physics, including the mass, velocity, and angle of the objects involved.
- football is a popular sport around the world, and the collisions between the players and the ball are an essential part of the game's excitement and dynamics.



2.Rigid body dynamics:

- It is the simulating the motion of solid objects in a game, taking into account factors such as mass, velocity, and acceleration.

Three fundamental laws of rigid body dynamics:

- Newton's first law of motion: Everybody continues in its state of rest or of uniform motion in a straight line, unless it is compelled to change that state by external forces acting on it.
- Newton's second law of motion: The acceleration of a body is directly proportional to the net force acting on the body, and inversely proportional to its mass. Mathematically:
  - $F = ma$, where F is the net force acting on the body, m is its mass, and a is its acceleration.
  - Suppose you have a body with m=10kg, and moving with a=20s, so F=10*20=200N
  - Suppose m=5kg, and F=10N, then a=10/5= 2s.
- Newton's third law of motion: For every action, there is an equal and opposite reaction. This means that when one body exerts a force on another body, the second body exerts an equal and opposite force on the first body.

Example of Newton's first law of motion :

Imagine a book resting on a table. According to Newton's first law, the book will remain at rest until an external force is applied to it. If you push the book gently, it will start to move.

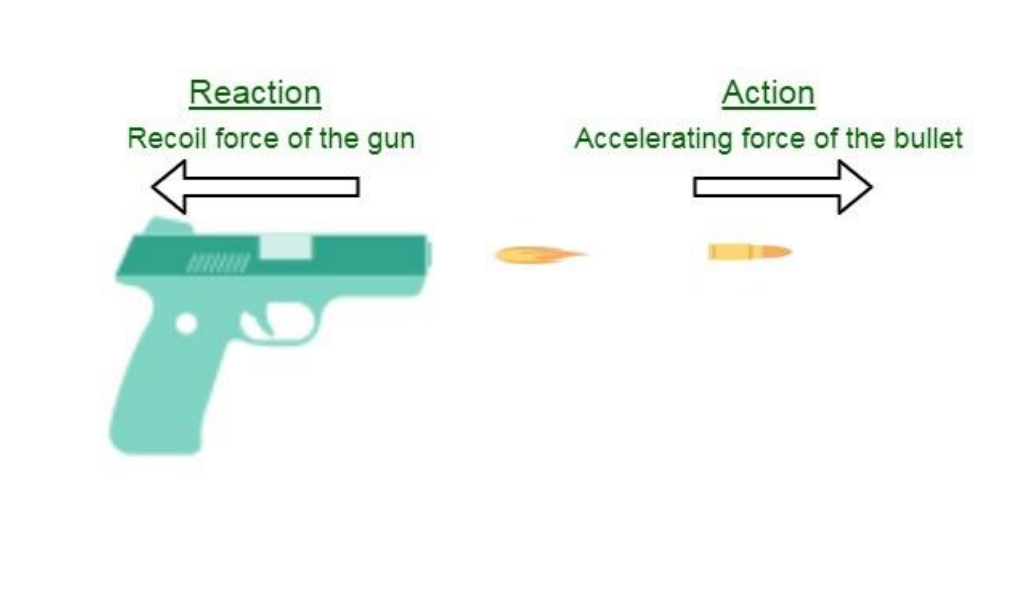
Another example is a car parked on a flat road. The car will remain at rest until an external force, such as a person pressing on the accelerator pedal, is applied.

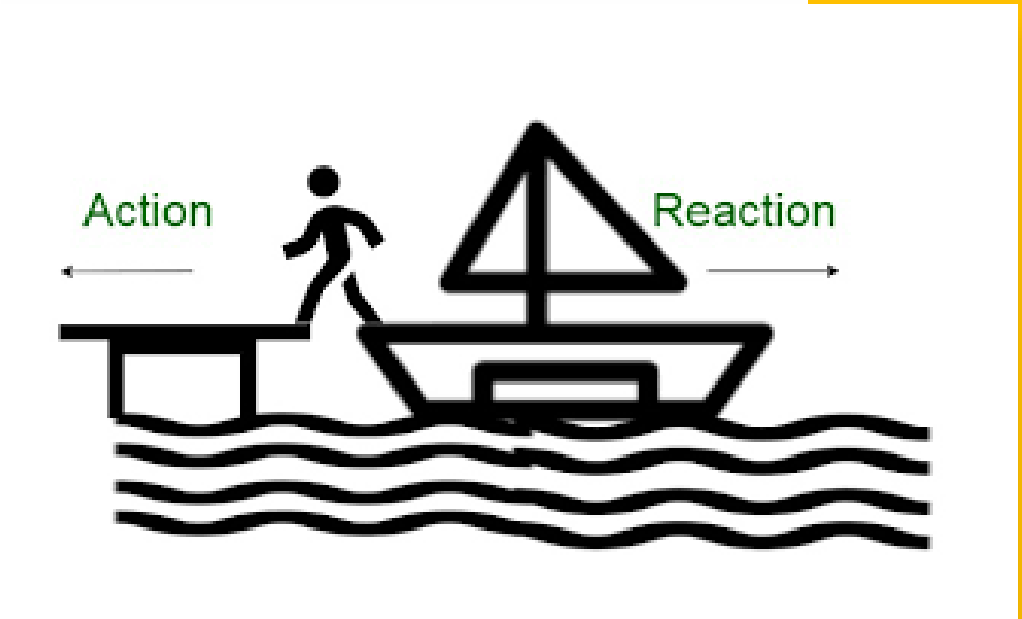
Examples of Newton's second law of motion :

- In a rocket launch, the engines generate a large amount of force to accelerate the rocket off the launch pad and into space. The mass of the rocket affects the amount of force required to accelerate it to a certain speed.
- When a car accelerates from a stop, the force generated by the engine pushes the car forward, causing it to accelerate. The mass of the car affects how quickly it can accelerate

Examples of Newton's third law of motion:

- When you shoot a gun, the bullet is propelled forward by the explosion of the gunpowder. At the same time, the gun recoils backward, exerting an equal and opposite force on your hand.
- When you jump off a diving board, your feet push down on the board, and the board pushes up on your feet, propelling you into the air.





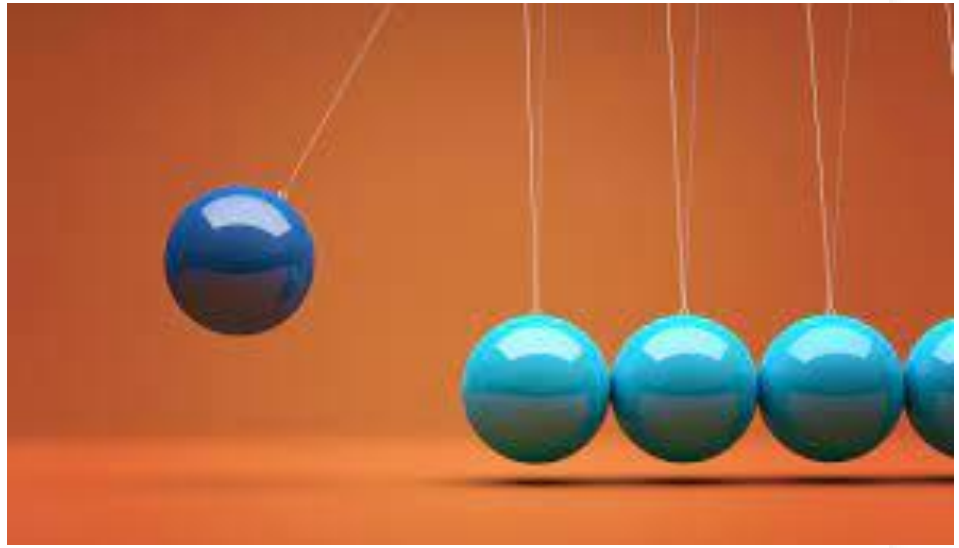
Example of Rigid body dynamics

- a see-saw: When two people sit on opposite ends of a see-saw and begin to move up and down, the see-saw rotates around a fixed axis.
- As one person moves up, they gain potential energy, which is converted into kinetic energy as they move down. At the same time, the other person moves down, losing potential energy and gaining kinetic energy.

Example of Rigid body dynamics

A pendulum is a rigid object that swings back and forth under the influence of gravity.

The motion of a pendulum can be described using the concept of the center of mass and moment of unchanging.



3. Fluid dynamics:

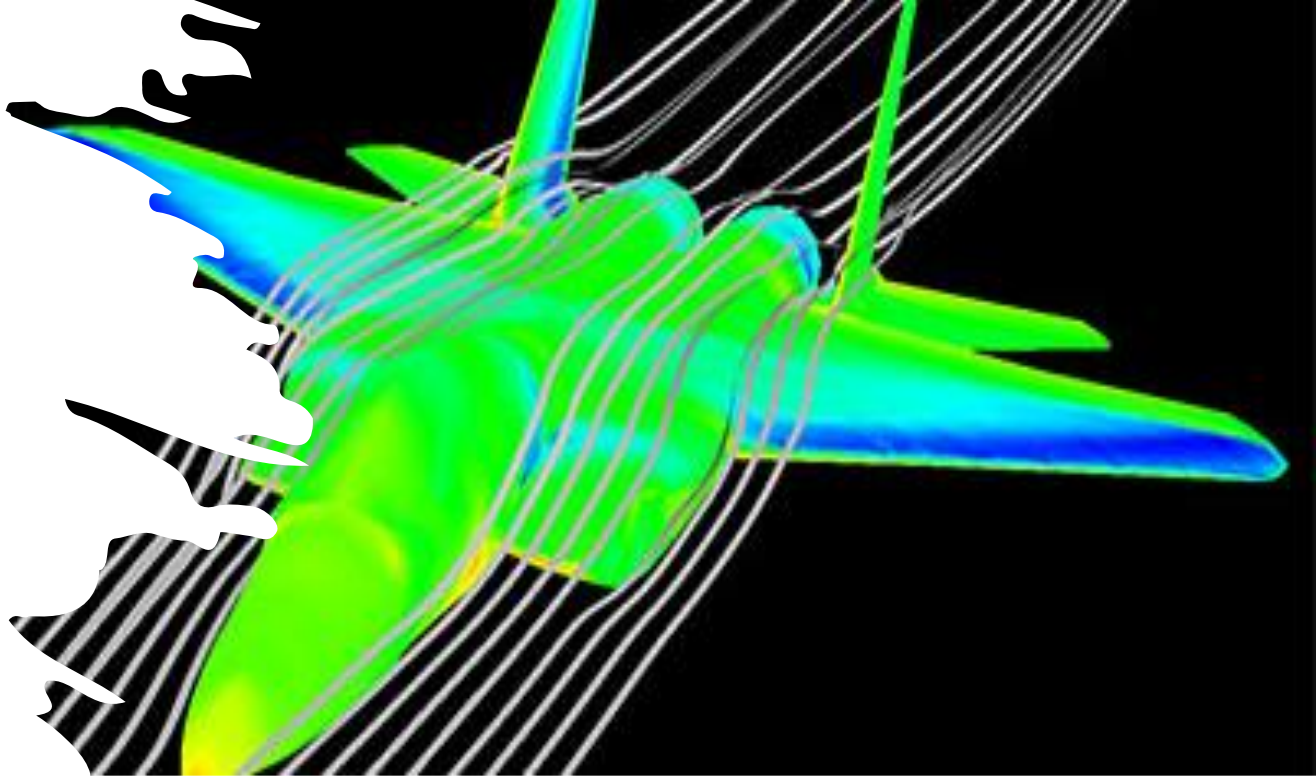
- This is the simulation of the movement and behavior of liquids and gases in the game world, such as water or air.

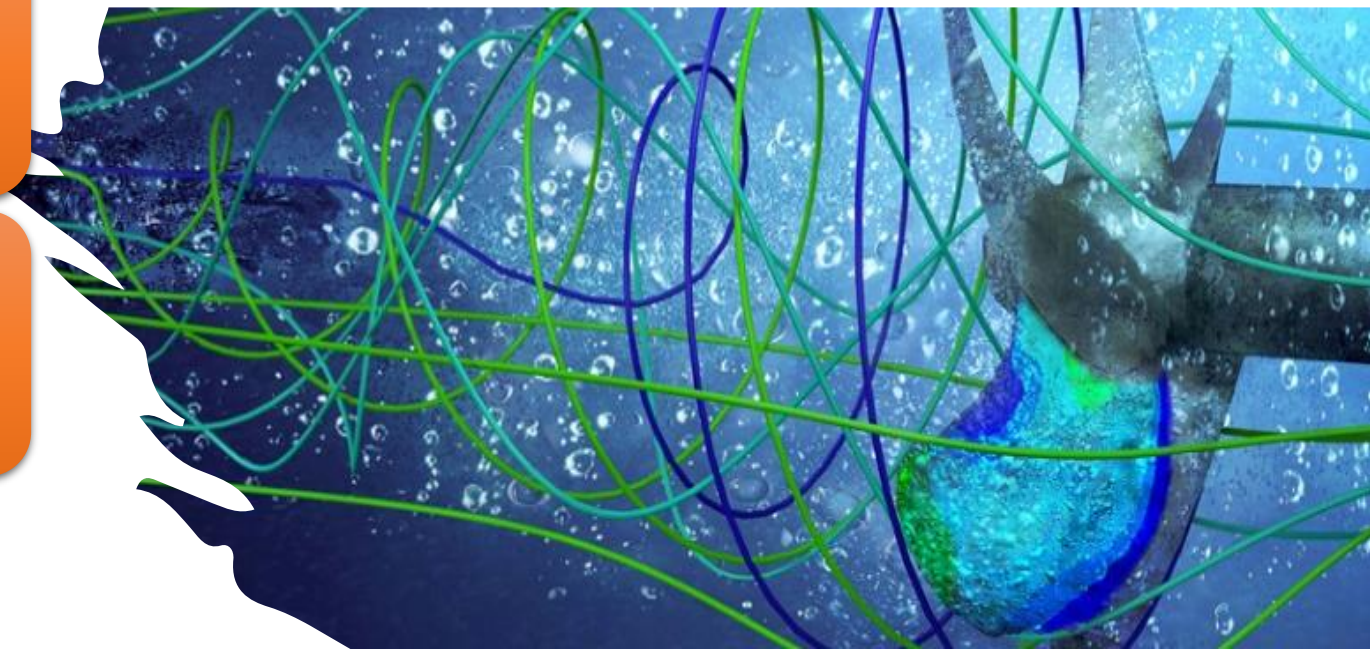
Examples of Fluid dynamics:

Weather patterns: Fluid dynamics can define cloud movements, rain falling, air tree leaves movement.

Aerodynamics: Fluid dynamics plays a major role in the design and operation of airplanes, helicopters, and other aircraft.

Ocean currents: The movement of ocean waves and other ocean movements.





4.Cloth simulation:

1. This involves simulating the movement and behavior of fabrics and other flexible materials in the game world.
2. The cloth simulation in games helps to create a more realistic and immersive experience for the player.

Examples of Cloth Simulation

Batman: Arkham series: The Batman: Arkham games feature realistic cloth simulation in the movement of Batman's cape and other clothing.

Sims game: Sims can wear a variety of clothing options, and their clothing moves and reacts to their movements and interactions with the environment.

5. Physics engines:

A physics engine is a software component that is used to simulate the physical behavior of objects in a virtual environment.

Example of physics engines:

- Unity Physics.
- Havok Physics.
- Bullet Physics.
- NVIDIA PhysX.
- Box2D.

6. Optimization:

- Game physics can be computationally expensive, so it is important to optimize the physics calculations to ensure that the game runs smoothly on a variety of hardware platforms.

Thanks

فورت نايت هي لعبة فيديو الكترونية من نوع البقاء وهي تعمل على نظام تشغيل بلاي ستيشن 4 واكس بوكس ون و مايكرو سوفت و ويندوز وماك او اس واي اس والاندرويد

مخترع لعبة فورت نايت هو تيم سويني مخترع الألعاب الأمريكي الشهير، وهو مبرمج ورجل أعمال والرئيس التنفيذي لشركة Epic Games

بالاضافة الى مصمم اللعبة دارين سوج

صدرت اللعبة يوم 27 يوليو 2017، وحصدت شعبية عالية

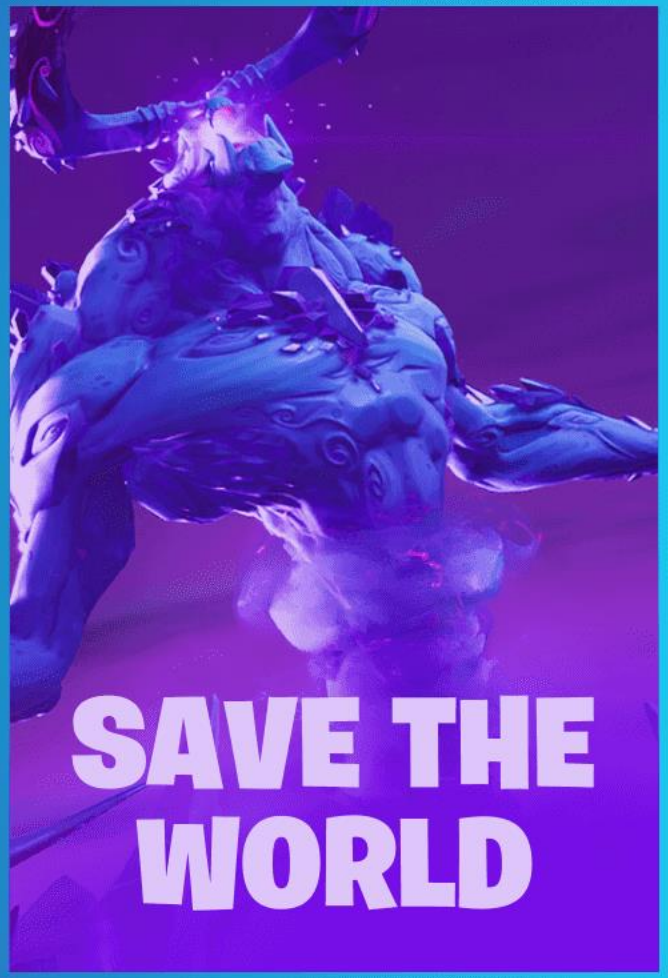
تمت برمجة لعبة فورتنايت بواسطة
لغة سي++
من قبل الشركة المنشئة "ايبك كيمز"
وصل عدد مستخدمي اللعبة الى 250
مليون شخص حول العالم
حافظت اللعبة على شعبيتها بين
اللاعبين وذلك من خلال محتواها
المتجدد والتحديات المستمرة

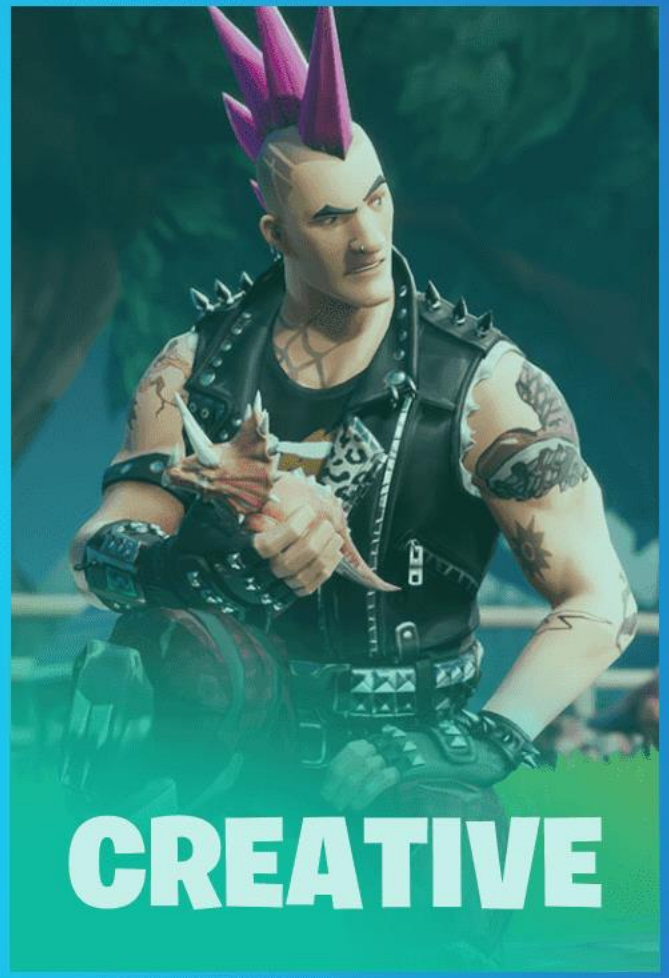
فكرة اللعبة

محاربة العاصفة وحماية الناجين، وبناء الأسلحة والفخاخ للمشاركة في القتال ضد موجات من مخلوقات الزومبي التي تحاول تدمير الأهداف. يحصل اللاعبون على مكافآت من خلال هذه المهام لتحسين مواصفات البطل ويمكن تحسين او تطوير اللاعب من خلال ال"باتل باس"

تقدم اللعبة طريقتين للعب:
الطريقة الاولى يكون اللعب بالنظام المفرد حيث يخوض اللاعب قتال يدور بين 100 لاعب

الطريقة الثانية يكون نظام اللعب بشكل فرق حيث يتكون الفريق الواحد من اربعة لاعبين





SELECT A GAME MODE

Signed in as: **bebo969696**

FORTNITE

مميزات اللعبة

1_اللعب مجانا

2_رسومات وتصميمات اللعبة الممتعة

3_منصة لعب تفاعلية ضخمة

4_ تحديثات اللعبة مستمرة

5_واحدة من اكثر المجتمعات النشطة

6_المشاهير يحبونها

7_ امكانية اجراء دردشة بين الاصدقاء اثناء اللعب

التعليقات السلبية حول اللعبة

1_تعتمد اللعبة على الكسب المادي من اللاعبين من خلال إضافة مزايا يجب شراءها

2_تزيد من أنانية الطفل لأن هدف اللعبة هو الوصول إلى المصلحة فقط

3_تبعد الطفل أو الشباب عن المجتمع الحقيقي وزيادة الانطوائية.

4_يصل اللاعب إلى مرحلة الإدمان، مما تؤثر على دراسة وصحته.

GAME PROGRAMMING REPORT

Work on this report

Musab thamr

Israa hamd

Under the supervision of Dr. Mohamed Salah

BATTLEFIELD2042

the introduction

Battlefield 2042 is a first-person shooter video game developed by Digital Illusions and Electronic Arts. It is the seventeenth installment in the Battlefield series. It was released on November 19, 2021 on PlayStation 4, PlayStation 5, Xbox One, Xbox Series X and Series S, and Microsoft Windows.

باتلفيلد 2042 : (Battlefield 2042)هي لعبة فيديو تصويب منظور الشخص الأول طورتها ديجيتال إلوجينز سيتها إيتها إلكترونيك آرتس. هي الجزء السابع عشر في سلسلة باتلفيلد. صدرت في 19 نوفمبر 2021 على بلاي ستيشن 4 ، بلاي ستيشن 5 ، إكس بوكس ون ، إكس بوكس سيريس إكس وسيريس أس ، مايكروسوفت ويندوز.

the way of playing

Similar to its predecessors, as this sequel is set in the near future, it features futuristic weapons and gadgets such as deployable turrets and drones, as well as vehicles that players can control.

على غرار سابقاتها، نظرًا لأن أحداث هذا الجزء تدور في المستقبل القريب، فإنها تتميز بأسلحة وأدوات مستقبلية مثل الأبراج والطائرات بدون طيار القابلة للنشر، بالإضافة إلى المركبات التي يمكن للاعبين السيطرة عليها

the way of playing

Players can now request a vehicle airdrop to any location. The game also introduces a new "Plus" system that allows players to customize their weapons instantly. He significantly reformed the caste system

يمكن للاعبين الآن طلب إنزال جوي للمركبة إلى أي مكان. تقدم اللعبة أيضًا نظام «بلس» جديد يسمح للاعبين بتخصيص أسلحتهم على الفور. أصلح النظام الطبقي بشكل كبير

the way of playing

Players can choose to take control of a "specialist" operator who falls within the four traditional gameplay classes in the Battlefield series: Assault, Engineer, Medic, and Recon. These characters can use all the weapons and items that players have unlocked. They also each have their own unique skills and tools.

يمكن للاعبين الاختيار لتولي السيطرة على عميل «متخصص» يندرج ضمن فئات اللعب التقليدية الأربعة في سلسلة باتلفيلد وهي " Assault" و" "Engineerو" "Medic"و" ."Reconيمكن لهذه الشخصيات استخدام جميع الأسلحة والأدوات التي فتحها اللاعبون. يتمتع كل منهم أيضًا بمهاراته وأدواته الفريدة.

the way of playing

For example, one specialist is equipped with a wing suit, while another is equipped with a healing gun

على سبيل المثال، جُهِزَ أحد المتخصصين ببدلة جناح، بينما جُهِزَ آخر بمسدس علاجي

the way of playing

The game was released with 10 "specialized" agents. The map variables and building destruction the series is known for are returning, including extreme weather effects such as tornadoes and sandstorms that can lift players into a whirlpool and greatly reduce visibility respectively

صدرت اللعبة مع 10 عملاء «متخصصين». تعود العوامل المتغيرة في الخريطة وتدمير الأبنية الذي عرفت به السلسلة، والتي تتضمن تأثيرات الطقس القاسية مثل الأعاصير والعواصف الرملية التي يمكن أن ترفع اللاعبين إلى دوامة وتقلل بشكل كبير من الرؤية على التوالي

the way of playing

The game features three main game modes. Total War includes Hack and Conquest, two main modes in the series. In Total War, two teams battle each other for control points. Once control points in a sector are captured, the team will control that sector. In Conquest mode, one team must try to capture another team's control points, while another team must defend them. Both modes can be played with and against the AI. The PlayStation 5, Xbox Series X and Series S versions support Microsoft Windows for 128 players, while the PlayStation 4 and Xbox One versions support only 64 players. Other modes included in the game include Danger Zone mode, cooperative multiplayer mode, and a third mode developed by Danger Close Games

تتميز اللعبة بثلاثة أوضاع لعب رئيسية. تشمل «الحرب الشاملة» «الاختراق» و «الفتح»، وهما نمطان أساسيان في السلسلة. في «الحرب الشاملة»، يتقاتل فريقان ضد بعضهما البعض من أجل الاستيلاء على نقاط التحكم. بمجرد السيطرة على نقاط التحكم في قطاع ما، سيتحكم الفريق في هذا القطاع. في نمط «الفتح»، يجب أن يحاول فريق واحد التقاط نقاط سيطرة فريق آخر، بينما يجب على فريق آخر الدفاع عنها. يمكن لعب كلا النمطين مع وضد الذكاء الاصطناعي. تدعم إصدارات بلاي ستيشن 5، إكس بوكس سيريس إكس وسيريس أس، مايكروسوفت ويندوز 128 لاعبًا، بينما تدعم إصدارات بلاي ستيشن 4، إكس بوكس ون 64 لاعبًا فقط. تشمل الانماط الأخرى المضمنة في اللعبة نمط «منطقة الخطر»، ونمط تعاوني متعدد اللاعبين، ونمط ثالثًا طورته دينجر كلوز غيمز

Development

The game was developed by Swedish company Digital Illusions CE, with assistance from Danger Close Games, Ghost Games and Criterion Games. With these studios, Battlefield 2042 has the largest development team ever in the series' history, and Criterion Studios had to halt development of the next Need for Speed game in order to help Digital Illusions CE. Unlike the previous installments in the series, the game will not contain a story phase. This allowed Digital Plugins CE to devote more resources to multiplayer development, which was the company's area of expertise

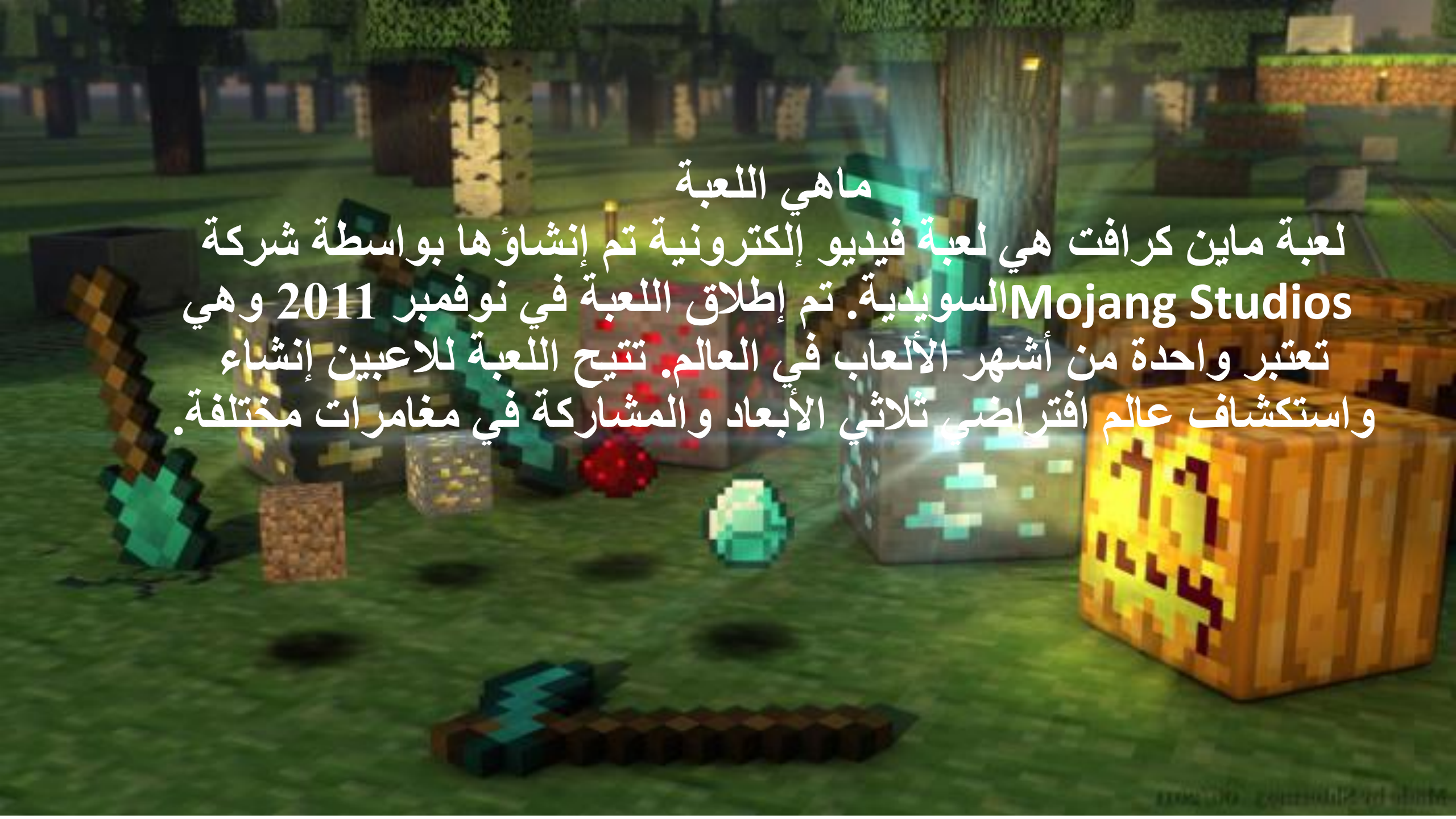
طورت اللعبة شركة ديجيتال إلوجينز سي إي السويدية، بمساعدة دينجر كلوز غيمز وغوست جيمز وكريتريون جيمز. مع هذه الاستوديوهات تعد باتلفيلد 2042 صاحبة أكبر فريق تطوير على الإطلاق في تاريخ السلسلة، وكان على استوديو كريتريون أن يوقف تطوير لعبة نيد فور سبيد التالية من أجل مساعدة ديجيتال إلوجينز سي إي. على عكس الأجزاء السابقة في السلسلة، لن تحتوي اللعبة على طور قصة. سمح هذا الأمر لديجيتال إلوجينز سي إي بتخصيص المزيد من الموارد لتطوير طور تعدد الاعبين، والذي كان يعتبر مجال خبرة الشركة

Programming Games

Minecraft

اعداد الطالب: مروان فلاح

باشراف الدكتور محمد صلاح



ماهي اللعبة

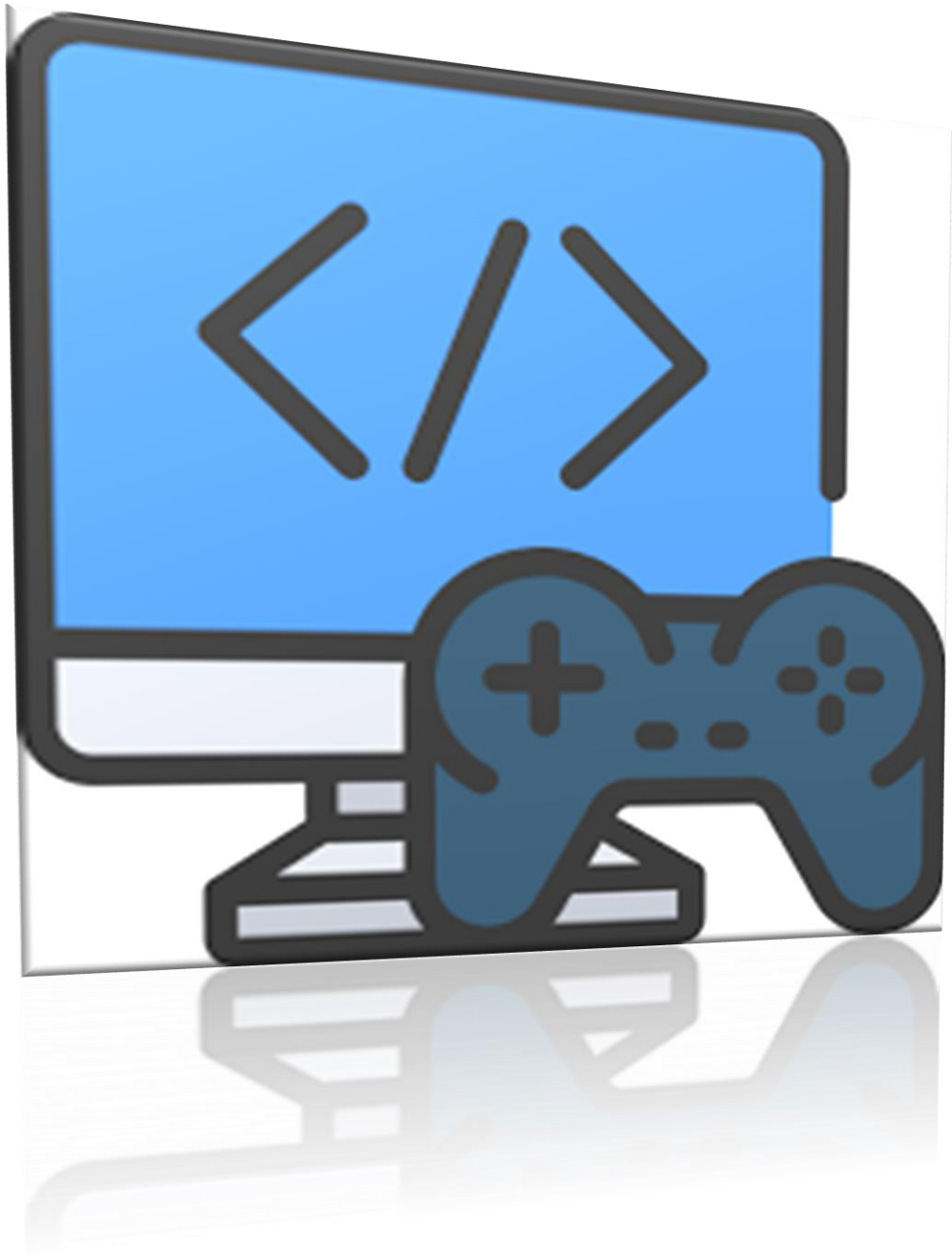
لعبة ماين كرافت هي لعبة فيديو إلكترونية تم إنشاؤها بواسطة شركة Mojang Studios السويدية. تم إطلاق اللعبة في نوفمبر 2011 وهي تعتبر واحدة من أشهر الألعاب في العالم. تتيح اللعبة للاعبين إنشاء واستكشاف عالم افتراضي ثلاثي الأبعاد والمشاركة في مغامرات مختلفة.

فكرة اللعبة

- بناء منازل ومدن وحتى مملكات كاملة باستخدام المواد المتوفرة فى اللعبة والتى تشمل الحجارة والأخشاب والطين والزجاج والحديد وغيرها. كما يمكن للاعبين صيد الحيوانات والمواد الغذائية والتعدين على الموارد الطبيعية ومحاربة المخلوقات الأسطورية.

ابرز إصدارات لعبة ماينكرافت

اصدار Minecraft Java Edition
إصدار Minecraft Bedrock
إصدار Minecraft Dungeons
إصدار Minecraft Earth
إصدار Minecraft Story Mode
إصدار Minecraft Education Edition



من ابرز نسخ ماين كرافت هي :-

Minecraft Java Edition

هو الإصدار الأصلي للعبة ويمكن لعبه على الحاسوب الشخصي. يحتوي الإصدار على العديد من الميزات والإضافات التي لا توجد في الإصدارات الأخرى.

Minecraft Bedrock Edition

برز هذا الإصدار بالقدرة على اللعب عبر لإنترنت مع لاعبين آخرين من مختلف لأجهزة.

المنصات المشغلة للعبة ماين كرافت

- يمكن تشغيل لعبة ماين كرافت على العديد من المنصات المختلفة، وهي:
- - الحاسوب الشخصي ((PC
- -أجهزة الكمبيوتر المحمول ((Laptop
- -الهواتف الذكية ((Smartphones
- -الأجهزة اللوحية ((Tablets
- -أجهزة الألعاب ((Game Consolesمثل Xbox One, PlayStation 4, Nintendo Switch
- -أجهزة الواقع الافتراضي ((Virtual Realityمثل Oculus Rift, HTC Viv

- تعتمد إمكانية تشغيل اللعبة على الإصدار المحدد للعبة، حيث يمكن تشغيل الإصدار الأصلي ((Java Edition على الحاسوب الشخصي والإصدارات الأخرى (Bedrock Editionو (Education Editionعلى الأجهزة الأخرى كالهواتف الذكية والأجهزة اللوحية والأجهزة اللعبة.

- سلبيات وإيجابيات لعبة ماين كرافت

- **إيجابيات**
  - **نضام مفتوح**
  - **تنوع الادوات**
  - **الحيوانات الاليفة**
  - **متعدد المهمات**
  - **استبدال الاسلحة والدروع**
  - **عالم افتراضي**

سلبيات

- **وجود الزومبيات للقضاء على حياتك ولعودة بك من حيث بدأت.**
- **دخول الأشخاص الغرباء الى عالمك وسرقت مقتنياتك وأعمالك.**

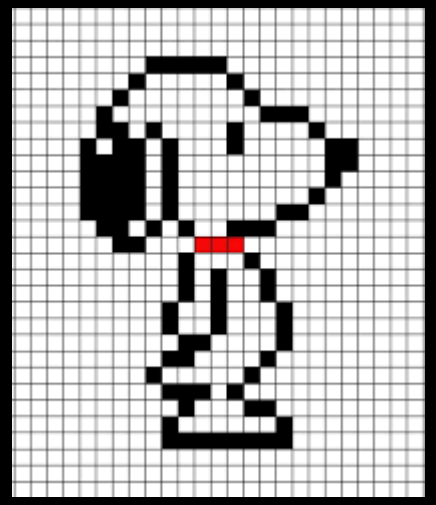
ابرز الأبنية التي بنيت في لعبة ماين كرافت

Game Programming
Lecture 4: Game Graphics

Prepared by

Dr. Mohammed Salah Al-Obaidi

Basics of graphics: Pixels



- Pixels: A pixel is the smallest unit of a digital image or display.
- It is a tiny square or dot that contains a specific color value
- When combined with other pixels, they create an image
- Each pixel is represented by a binary code that stores its color information.
- This code is often represented in the RGB (Red, Green, Blue)
- Each pixel is assigned a value for its intensity of red, green, and blue light.
- These values typically range from 0 to 255. 0 representing no color while 255 maximum color intensity

To be contin…

a red pixel with an RGB value of (255, 0, 0) would contain maximum intensity of red light and no green or blue light.

A black pixel would have an RGB value of (0, 0, 0), representing the absence of all colors,

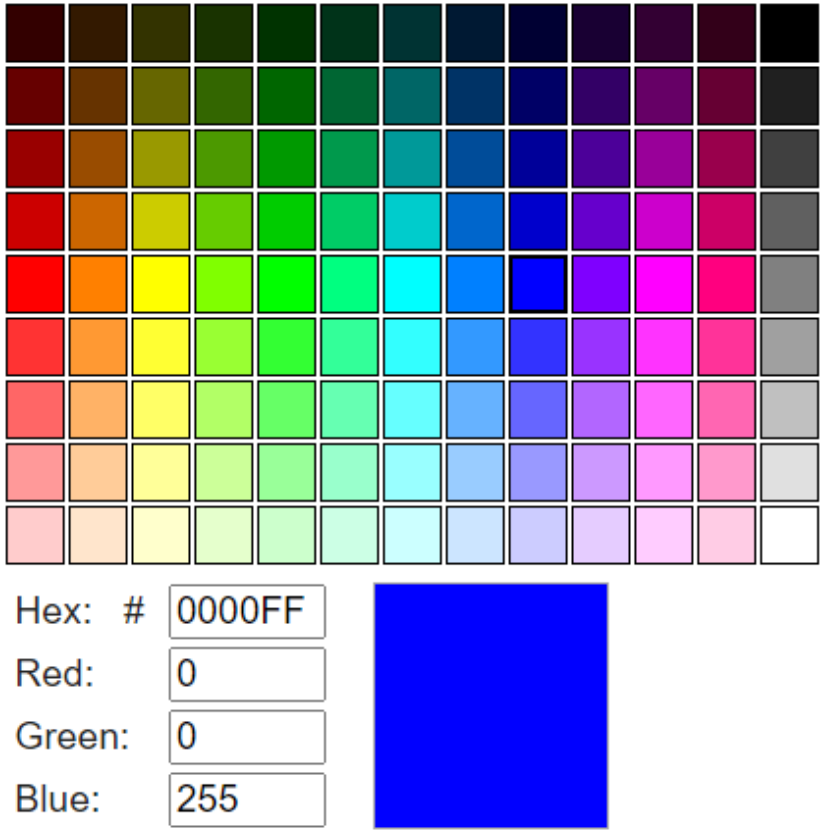
While a white pixel would have an RGB value of (255, 255, 255), representing the maximum intensity of all colors.

A Green Pixel = (0, 255, 0)

A Blue Pixel = (0, 0, 255)

RGB color

- The red, green and blue use 8 bits each, which have integer values from 0 to 255.
- This makes 256*256*256=16777216 possible colors.
- Each pixel in the monitor displays by combination of red, green and blue.
- Any value between 0-255 sets the pixel to partial color.
- In the picture, blue is chosen (0,0,255). If I want the *light blue* color, then keep blue =255, and change green to 204, and red =153.
- Same if I want a light red, we fix red=255, and change in blue=153 and green=153.



Resolution

- Resolution: refers to the number of pixels that are displayed on an image or screen.
- The resolution of an image is determined by the number of pixels it contains.
- Resolution is typically measured in terms of horizontal and vertical pixel counts.
- such as 1920 x 1080 (also known as 1080p) or 3840 x 2160 (also known as 4K).
- To calculate the resolution of an image, simply multiply the number of horizontal pixels by the number of vertical pixels:
- If we have 1920 x 1080 pixels, its total resolution would be 2,073,600 pixels.

Aspect Ratio

- Aspect ratio refers to the proportional relationship between the width and height of an image, such as 16:9 or 4:3.
- The first number in the ratio represents the width, while the second number represents the height.
- Here are a few common aspect ratios and their typical uses:
  - 16:9: This is a popular aspect ratio for modern widescreen displays and video content, including HDTV, Blu-ray discs.
  - 4:3: This was a common aspect ratio for older television sets and computer monitors
  - 1:1: This square aspect ratio is common in some social media platforms like Instagram
  - 21:9: This ultrawide aspect ratio is becoming more common in some high-end monitors and gaming displays

To be cont…

- If you know that the height of a 1:1 image is 1000 pixels, then the width would also be 1000 pixels since the aspect ratio is 1:1
- If you know that the width of a 1:1 image is 500 pixels, then the height would also be 500 pixels since the aspect ratio is still 1:1.
- If you know that the width of a 4:3 image is 3000 pixels, then the height would be 3000/(4/3)=2300 pixels.
- In general, to calculate the size of an image with a specific aspect ratio, you can use the following formula:
  - width = height x aspect ratio
  - height = width / aspect ratio

To be conti…

- For example, if you have an image with a height of 1000 pixels and an aspect ratio of 16:9, you can calculate the width as follows:
  - aspect ratio = 16:9 , which means (16/9)
  - width = height x aspect ratio
  - width = 1000 x (16/9) width = 1777.778 (rounded to nearest pixel)
- So the width of the image would be approximately 1778 pixels.
- Example of calculating height:
  - an image with a width of 1920 pixels and an aspect ratio of 4:3
  - height = width / aspect ratio
  - height = 1920 / (4/3) height = 1920 / 1.333 height = 1440
  - So the height of the image would be 1440 pixels.

Basics of graphics: color models

RGB (Red, Green, Blue): RGB is an additive color model that is used for digital displays such as computer monitors, TVs, and projectors.

CMYK (Cyan, Magenta, Yellow, Black): CMYK is a subtractive color model that is used in printing.

HSL (Hue, Saturation, Lightness): HSL is a color model that defines colors by specifying their hue (the color itself), saturation (the intensity of the color), and lightness (the brightness of the color). Used by Adobe Photoshop

HSV (Hue, Saturation, Value): HSV is like HSL, but uses value instead of lightness. Used in image editing software such as Adobe Photoshop.

LAB (Lightness, A, B): LAB is a color model that defines colors by their perceived color differences. It is used in applications such as color matching and color correction.

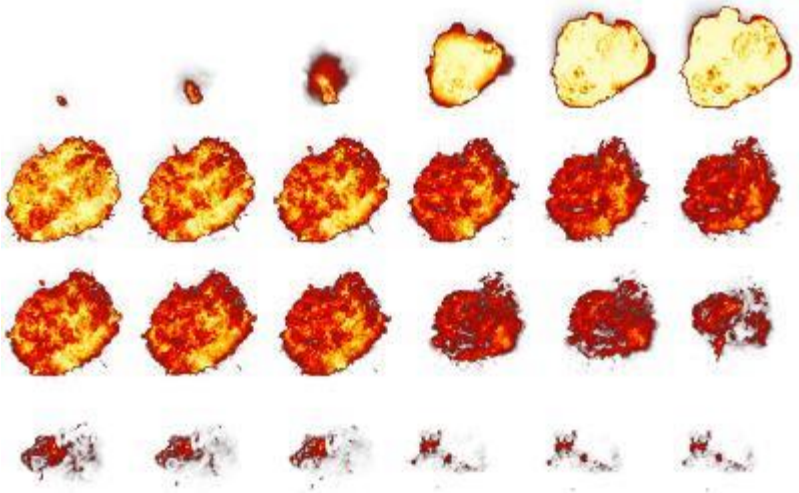
Game Programming Lecture 5: Game Design

Prepared by

Dr. Mohammed Salah Al-Obaidi

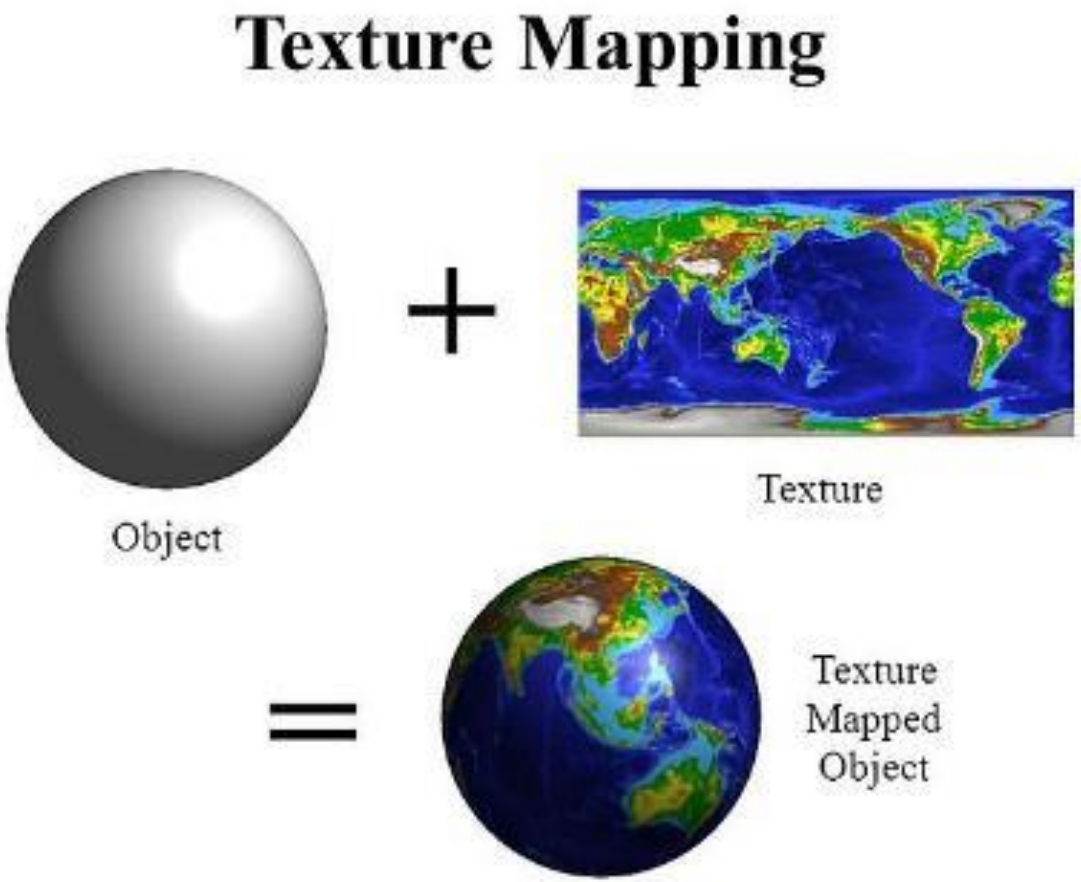
Sprite Sheets in 2D graphics:

- Sprite sheet is an image that consists of several smaller images (sprites).
- Sprite sheets are commonly used in 2D gaming
- Sprite sheet might contain images for walking, jumping, attacking, and other actions.
- sprite sheets can help:
  - reduce file size.
  - improve performance.
  - manage and organize the sprites.



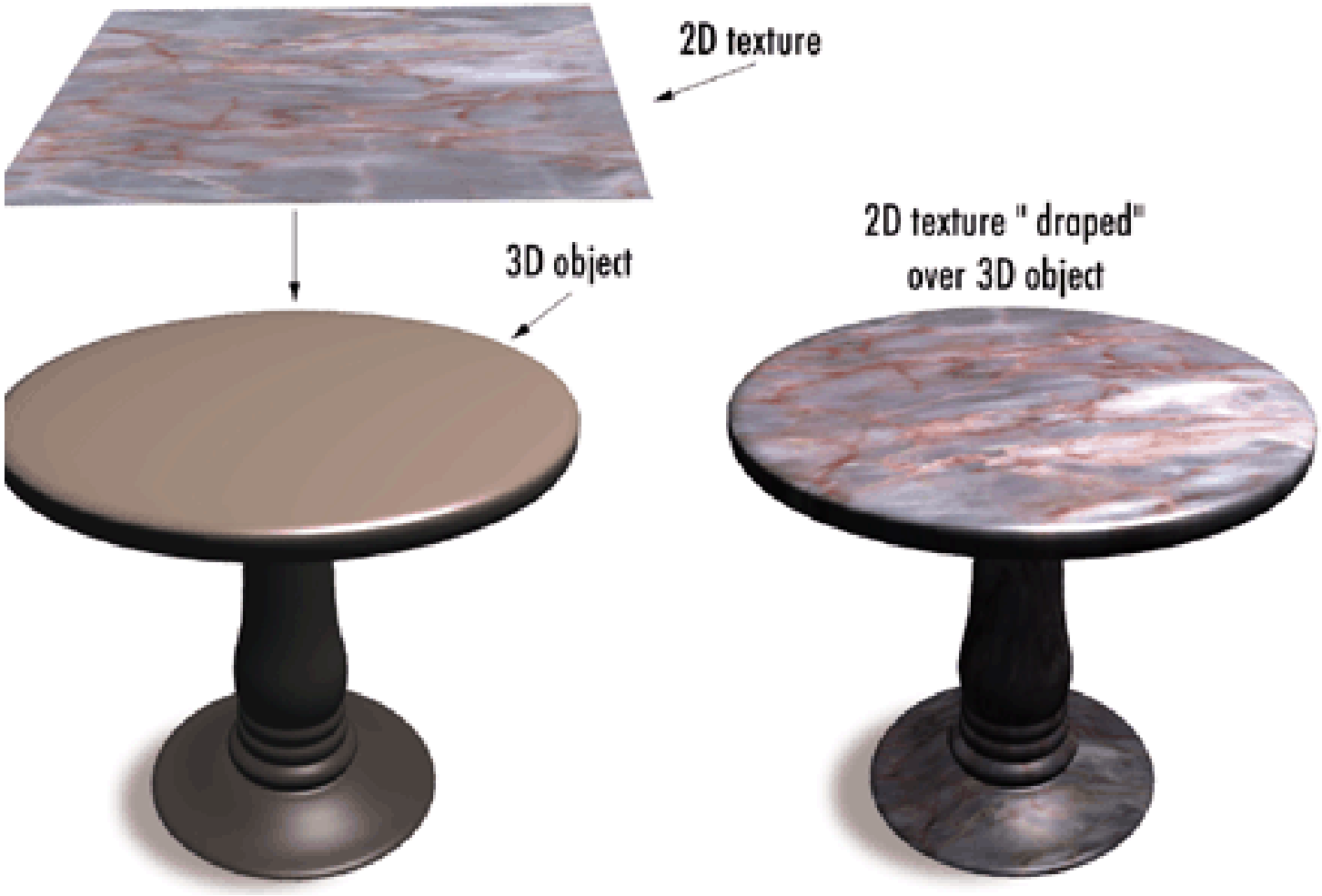
2D texture mapping

Texture mapping is used to add detail to a flat surface, such as a polygon or shape



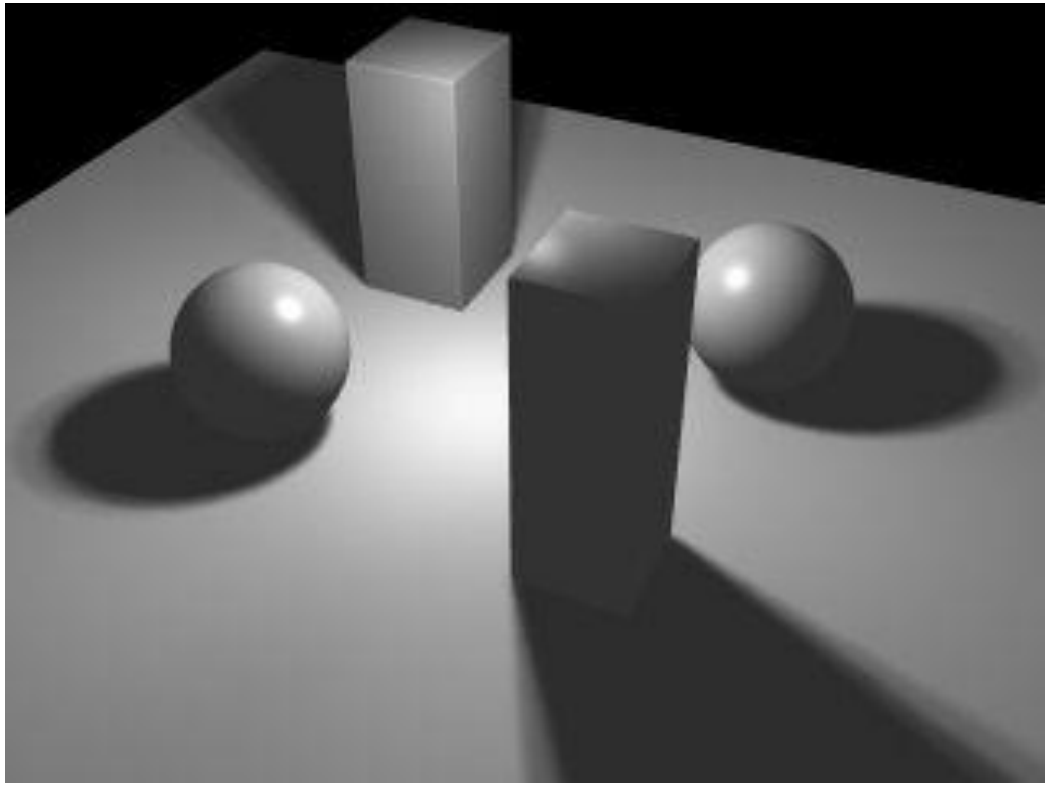
3D texturing

- In 3D graphics, texturing is the process of adding a 2D image, called a texture map, to the surface of a 3D object.



3D graphics lighting

- In 3D graphics, lighting is the process of simulating the way light interacts with objects in a 3D scene.
- Lights bring focus on important parts that you want player to see.



3D graphics animation techniques.

- Keyframe animation: example sprit sheet.
- Motion capture: example actor in Avatar
- Physics-based animation: football player kicking a ball.
- Procedural animation: moving water, fire, or clouds.
- Morph targets: moving face and lips.
- Rigging: moving human skeleton

Keyframe animation

- Keyframe animation: example spirit sheet where you make sprite movement.

Motion capture:

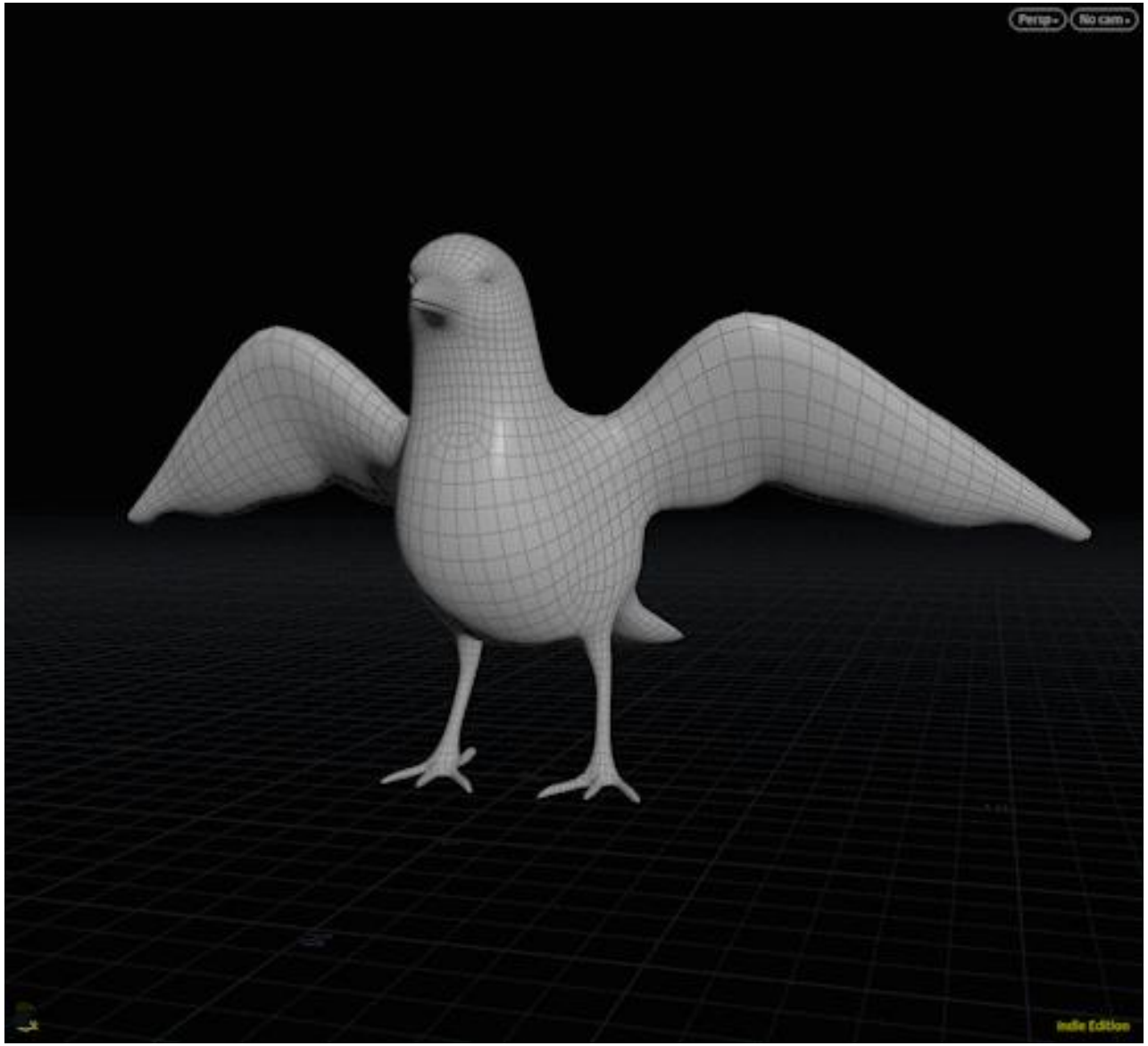
recording the movements of real actors or objects using motion capture sensors or cameras

Physics-based animation:

- This technique uses physics simulations to create realistic movement and interactions between objects.

Procedural animation

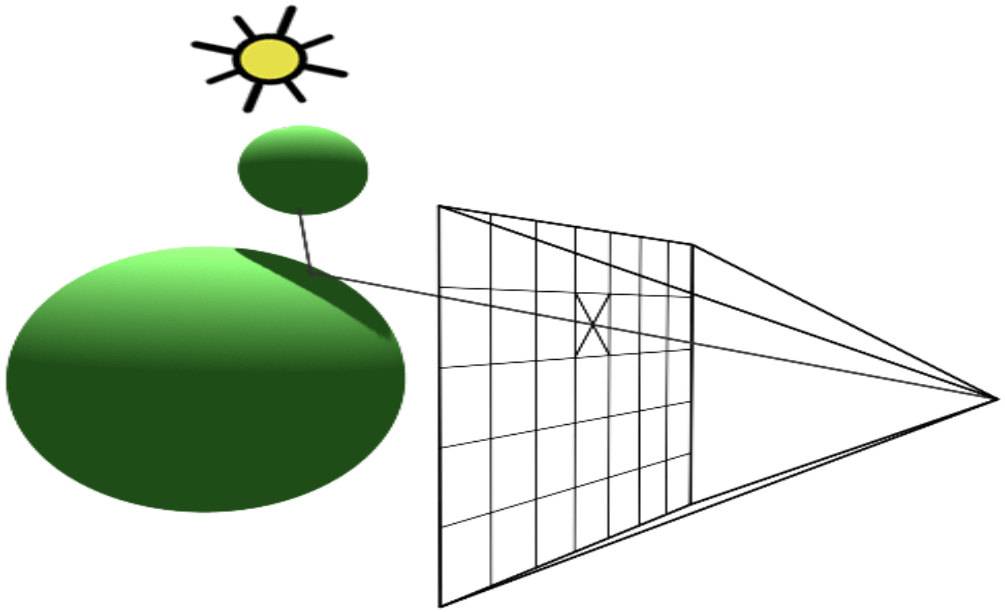
This technique involves using mathematical algorithms to create animations.

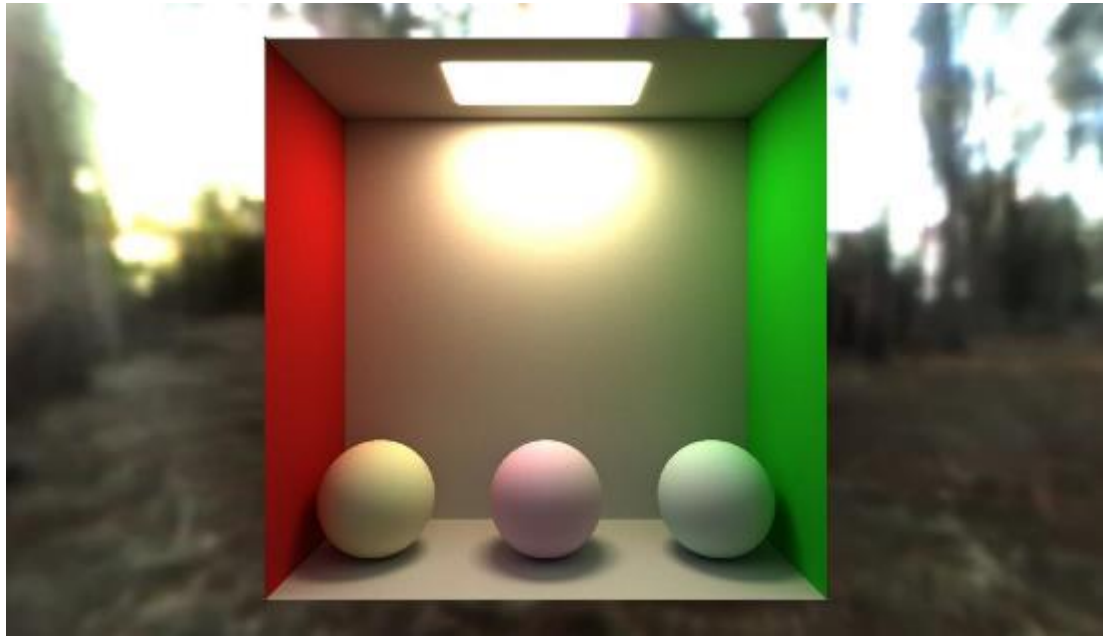


Ray tracing.

Rasterization.

Global illumination.



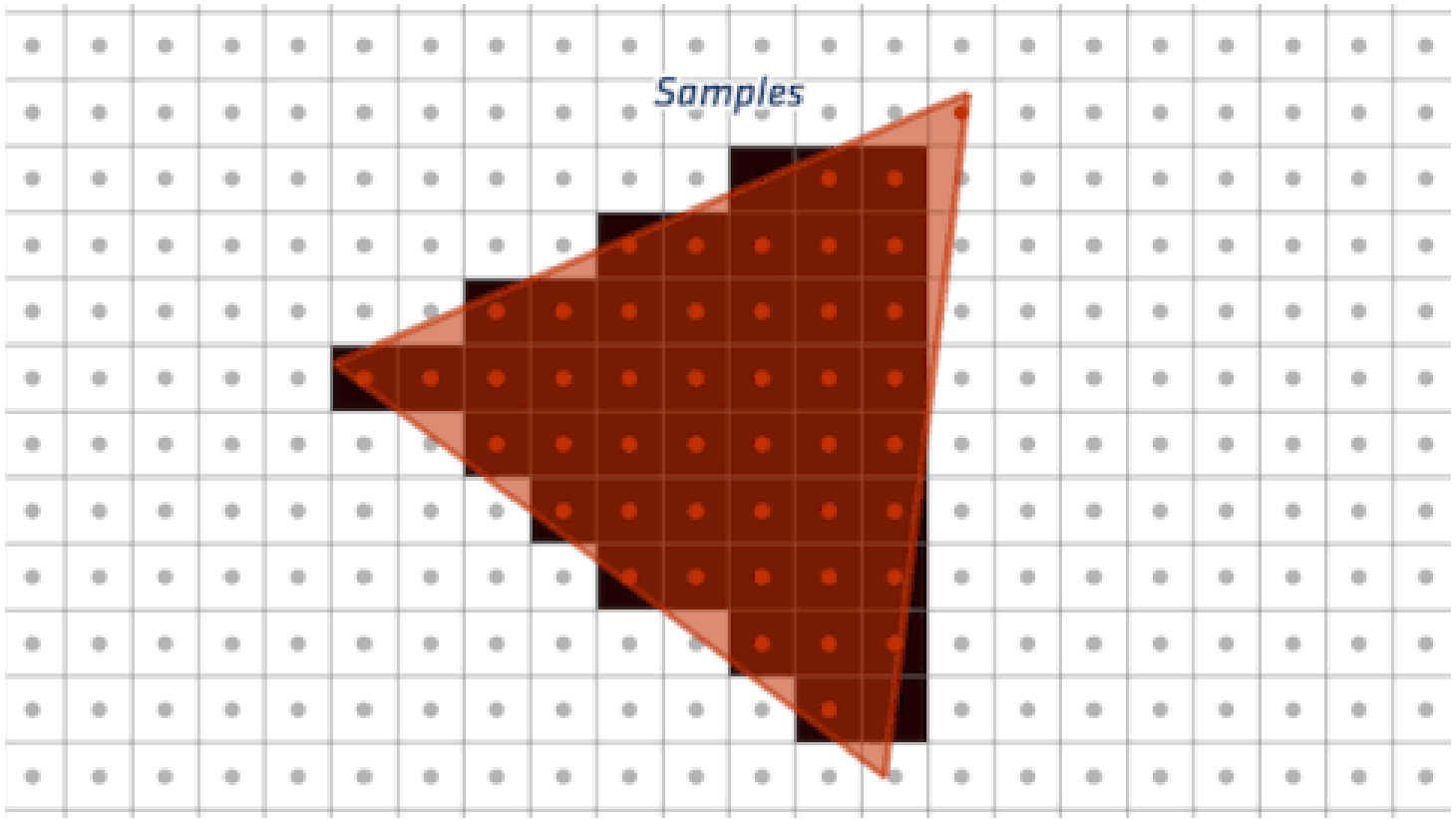


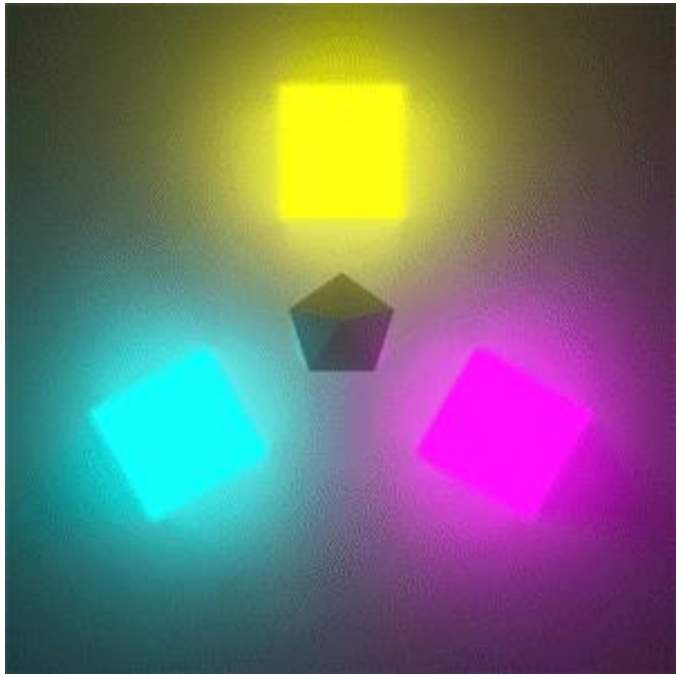
Ray tracing

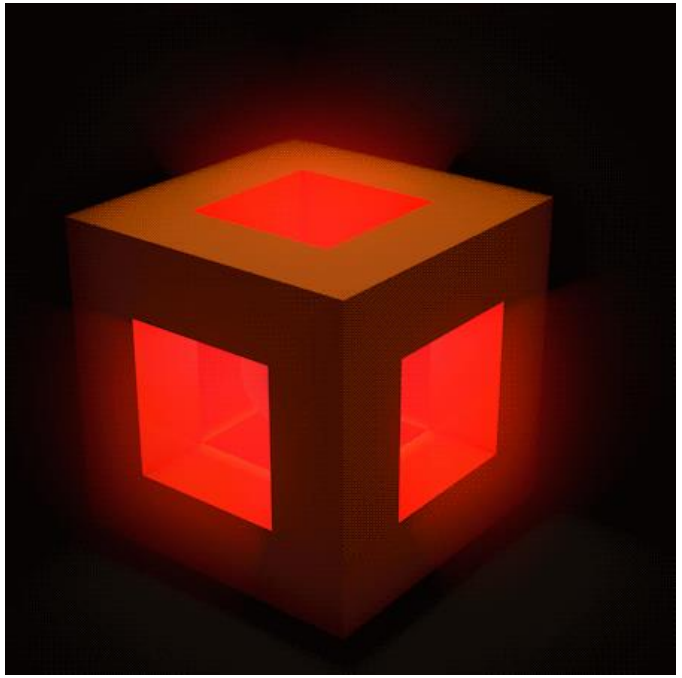
- Is a technique used to simulate the behavior of light in a scene.
- Ray tracing produces highly realistic images, with accurate:
  - Shadows,
  - Reflections, and
  - Refractions
- Ray tracing now widely used in a variety of applications, including
  - video games,
  - films, and
  - architectural visualization

Rasterization

- Rasterization: is the task of taking shapes and converting them into a raster image (a series of pixels, dots or lines).







Global illumination

- Is a system that models how light is bounced off of surfaces onto other surfaces.
- There are several algorithms used for global illumination, including:
  - Ray tracing,
  - Radiosity, and
  - Photon mapping