# ISOMORPHISM IN GAME DEVELOPMENT

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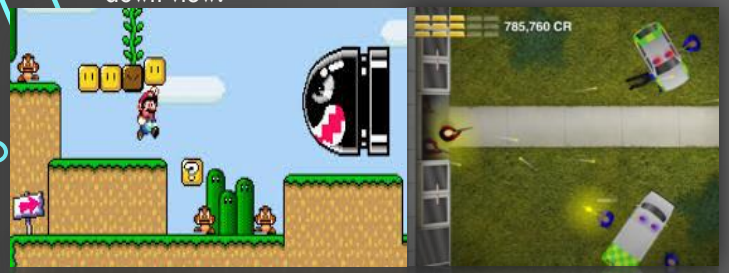
## # PERSPECTIVE OF THE USER

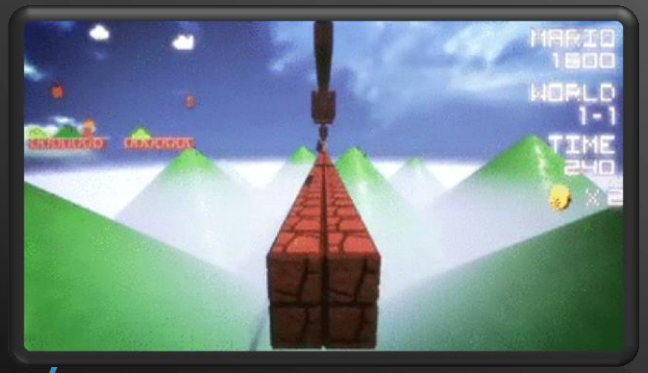
Traditionally games were on a 2D plane. There would be one camera perspective. There were variations like top-down view.

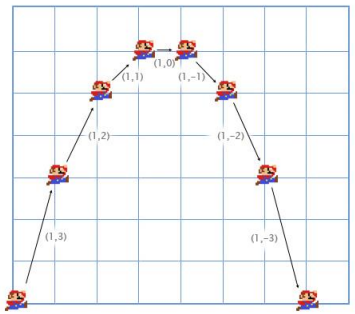





## # 3D RENDERING

More Modern games use Rendering. It's the process of taking 3D models and making it a 2D image/animation for a user to view




## # Vector Addition

One of the most common applications in games is vector addition in physics integration. Any object in a video game will likely have vector for position, velocity and acceleration.

## # DEFINITIONS

**Isomorphism**: A one-to-one relation onto the map between two sets, which preserves the relations existing between elements in its domain.

• Isomorphic vector spaces: Two vector spaces V and W for which there is a one-to-one linear transformation T that maps V onto W.

•Iso from the Greek for "the same" and morph from the Greek for "form" or "Structure."

•To have an isomorphic vector space you must have pts in $R^n$
vectors that belong to $R^m$ where m<n

•Mapping X⟶[x]B is a one-to-one correspondence that makes H look and act the same as $R^2$ though vectors in H may have more than p entries.

**EXAMPLE 1** Let $\mathbf{v}_1 = \begin{bmatrix} 3 \\ 6 \\ 2 \end{bmatrix}$, $\mathbf{v}_2 = \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$, $\mathbf{x} = \begin{bmatrix} 3 \\ 12 \\ 7 \end{bmatrix}$, and $\mathcal{B} = \{\mathbf{v}_1, \mathbf{v}_2\}$. Then $\mathcal{B}$ is a basis for $H = \text{Span}\{\mathbf{v}_1, \mathbf{v}_2\}$ because $\mathbf{v}_1$ and $\mathbf{v}_2$ are linearly independent. Determine if $\mathbf{x}$ is in $H$, and if it is, find the coordinate vector of $\mathbf{x}$ relative to $\mathcal{B}$.

**SOLUTION** If $\mathbf{x}$ is in $H$, then the following vector equation is consistent:

$$c_1 \begin{bmatrix} 3 \\ 6 \\ 2 \end{bmatrix} + c_2 \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 3 \\ 12 \\ 7 \end{bmatrix}$$

The scalars $c_1$ and $c_2$, if they exist, are the $\mathcal{B}$-coordinates of $\mathbf{x}$. Row operations show that

$$\begin{bmatrix} 3 & -1 & 3 \\ 6 & 0 & 12 \\ 2 & 1 & 7 \end{bmatrix} \sim \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 3 \\ 0 & 0 & 0 \end{bmatrix}$$

Thus $c_1 = 2$, $c_2 = 3$, and $[\mathbf{x}]_{\mathcal{B}} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$. The basis $\mathcal{B}$ determines a "coordinate system" on $H$, which can be visualized by the grid shown in Fig. 1. ■

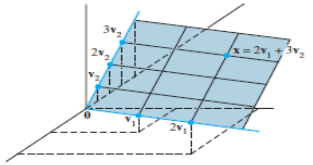


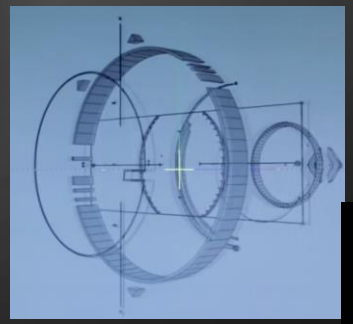

**FIGURE 1** A coordinate system on a plane $H$ in $\mathbb{R}^3$.


## # LINEAR ALG. IN INTERFACES

A primary example for this linear algebra concept in gaming is HUD or Head Up Display that displays information in 2D representation in a 3D space.

A primary example for this linear algebra concept in gaming is HUD or Head Up Display that display information of a 2D model representation in a 3D space.

Artist in game development design multiples model in 2D sketches which later can be turn into a 3D object.



The reticle 3D model (a form of aiming device for pc-game) get translated into code that which can now be use in game object.

# ACKNOWLEDGEMENT:

- Linear Alg. And its application 4th ed; page 154 Figure 1
- Perspective Projection Principle by Joachim Baecker 2005/09/23
- Star Citizen 2013 by Robert Space Industries
- http://blog.wolfire.com/
- Super Mario Bros. 3, Nintendo US
- FreddieW(RocketJump)
- www.johnnytwoshoes.combah