

CS529

Fundamentals of Game Development

Lecture 11a

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Outline

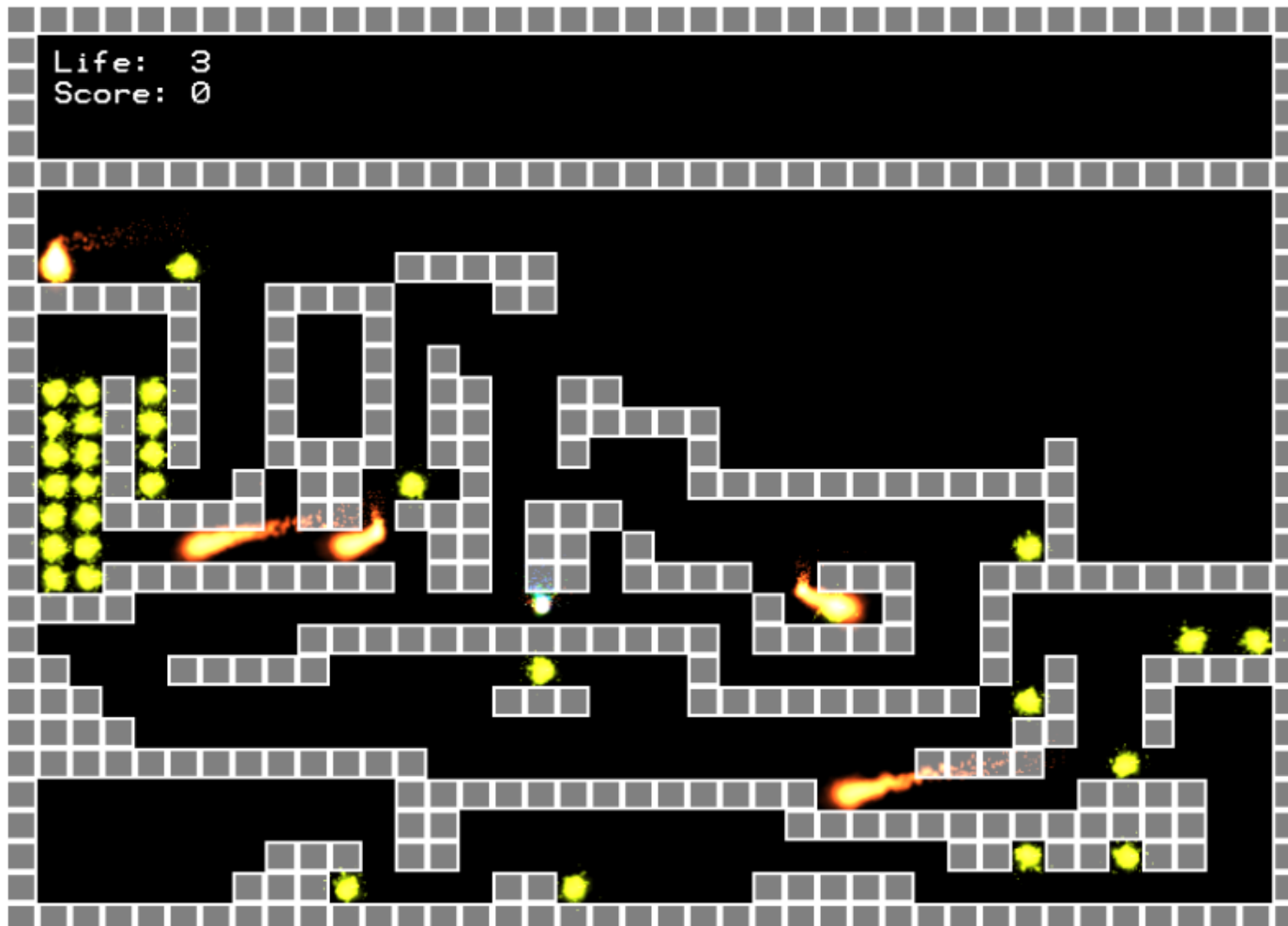
- Binary Collision Map
 - Introduction
 - Initialization
- Sprite Collision using Hot Spots
- Snapping
- Normalized Coordinates System

[illegible]

What Type of Games do we use it for?



Example



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- Binary Collision Map
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Binary Collision Map: Initialization (1/2)

- The map should be a grid (which is formed from cells)
- The collision map is a 2D array of “bools”
- Game objects are able to access a cell depending on that cell’s value in the array

Binary Collision Map: Initialization (2/2)

- Example:

Map Data

1 1 1 1 1

1 0 0 0 1

1 3 2 0 1

1 1 1 3 1

1 1 1 1 1

Collision Data

1 1 1 1 1

1 0 0 0 1

1 0 0 0 1

1 1 1 0 1

1 1 1 1 1

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Checking for Point Collision (1/2)

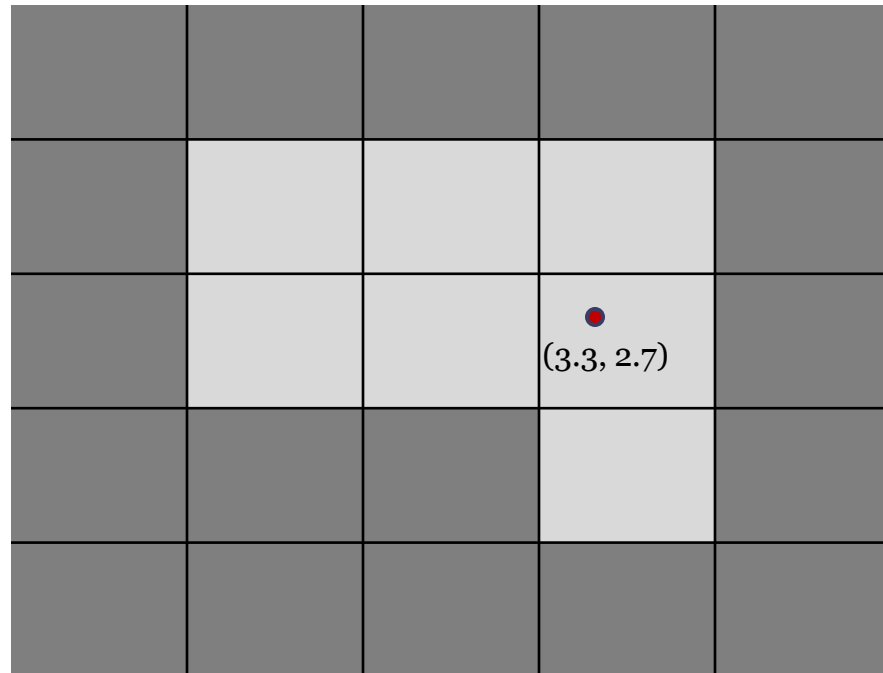
- Knowing that the cell's dimension is (1; 1), to check if a point is in a “solid” cell we get its position in the array (using array indices) and check its value.

Checking for Point Collision (2/2)

- Example:
 - A point is located at (3.3, 2.7)

Collision Data

1 1 1 1 1
1 0 0 0 1
1 0 0 0 1
1 1 1 0 1
1 1 1 1 1

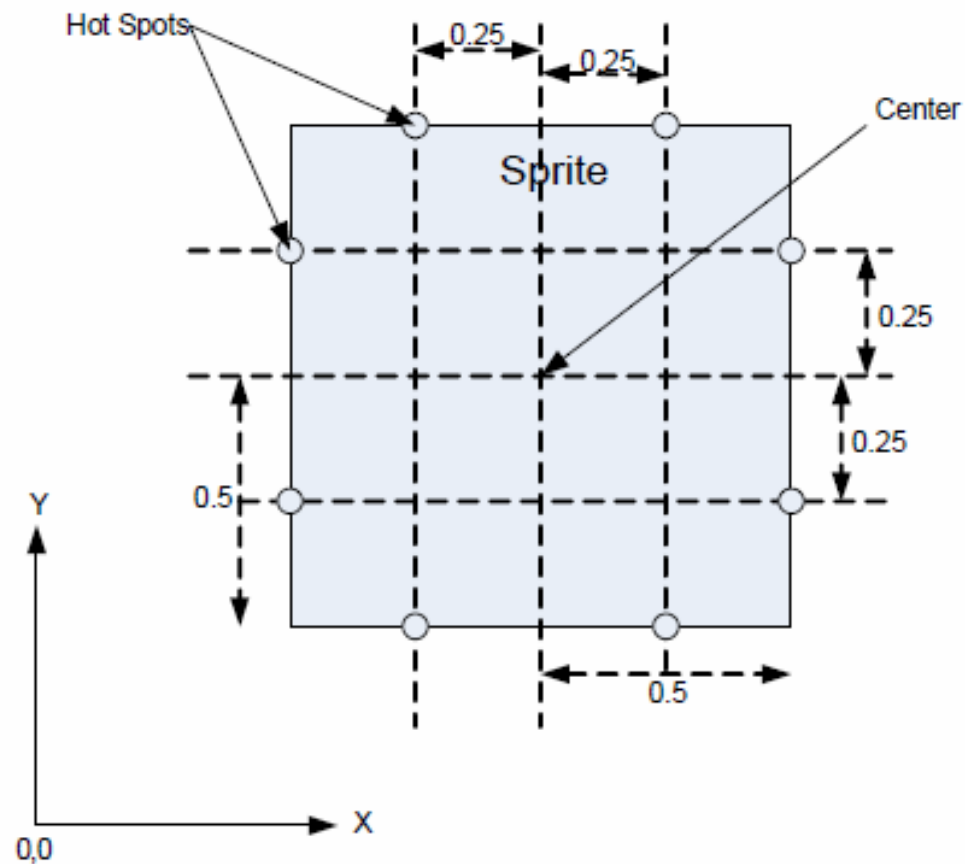


Hot Spots (1 / 3)

- Our object is not just one point but is encapsulated with a bounding rectangle
- We are dealing with more than one point
- These points are called “Hot Spots”
- Note that this method assumes that both width and height of an object are both 1 (same size of a cell)

Hot Spots (2/3)

- Example:

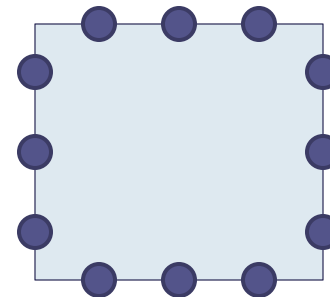
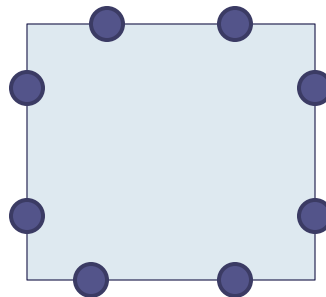
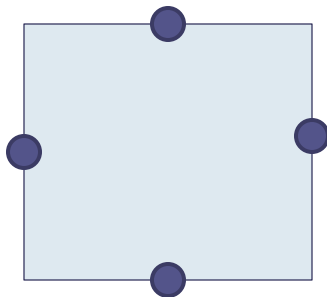


Hot Spots (3/3)

Better Collision Accuracy



Faster Collision Check



Sprite Collision using Hot Spots (1/4)

- The collision can occur on the four sides of the sprite (top , bottom, left and right) and on more than one side.
- Each game object instance will have a collision flag, where each bit represents one side.

Sprite Collision using Hot Spots (2/4)

- The least significant bit represents the left side.
- The second bit represents the right side.
- The third bit represents the top side.
- The fourth bit represents the bottom side.

Sprite Collision using Hot Spots (3/4)

- When a certain side is found in a collision state, we set its corresponding bit in the collision flag variable to 1
- How do we set the corresponding bit to 1?

Answer

- This is done by OR-ing the flag with the correspondent collision side value.

- Collision side values

#define	COLLISION_LEFT	0x00000001	//0001
#define	COLLISION_RIGHT	0x00000002	//0010
#define	COLLISION_TOP	0x00000004	//0100
#define	COLLISION_BOTTOM	0x00000008	//1000

Sprite Collision using Hot Spots (4/4)

- After storing the collision information, how can I check on which side I collided with?
- Answer:
 - This is done by checking the collision flag AND-ed with the correspondent collision side value.

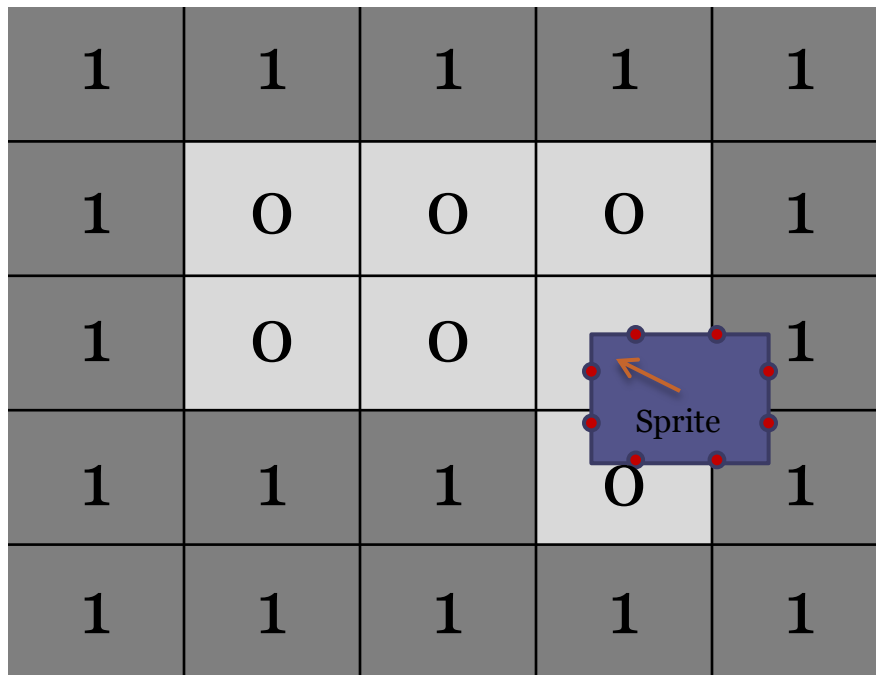
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Snapping (1 / 2)

- If at least one hot spot is inside a collision area, we should snap the sprite back to the center of the cell that it belongs to.

Snapping (2/2)



$$\text{PosX} = (\text{int}) \text{PosX} + 0.5$$

$$\text{PosY} = (\text{int}) \text{PosY} + 0.5$$

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Normalized Coordinates System (1 / 3)

- Why?
 - We might want to scale the entire map to the window size, regardless of the grid's width and height.
 - A cell's width might be greater than its height, where the art assets might require that.
 - The cell's width and height directly affect the collision check

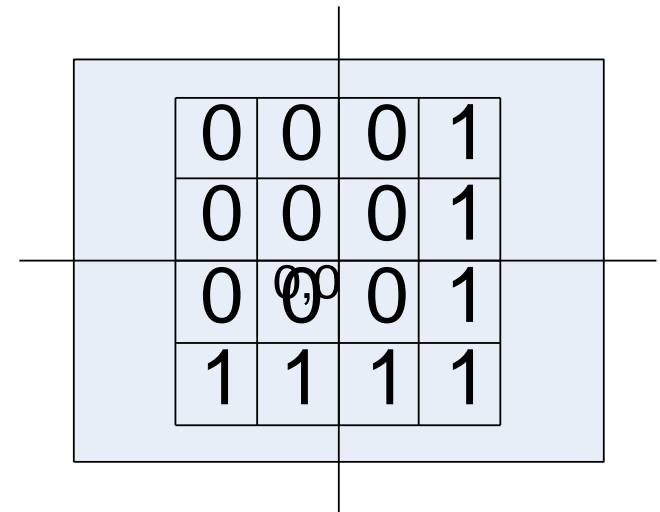
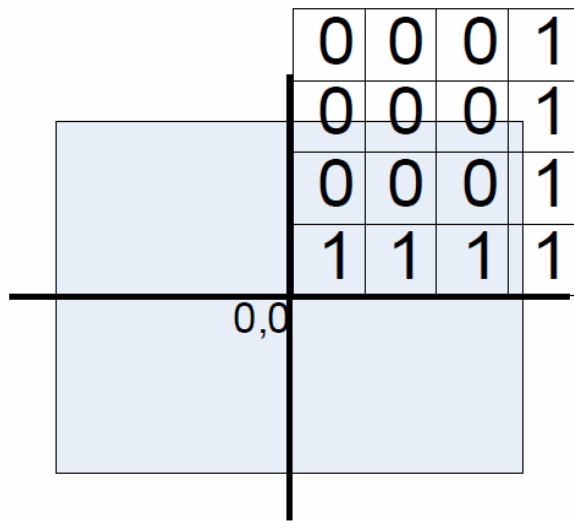
Normalized Coordinates System (2/3)

- How?
 - Have the width and height of each cell in the normalized coordinates system to be 1, independently from the final result
 - All the physics (velocity, acceleration, etc...), movement and collision checks are done in the normalized coordinate system

Normalized Coordinates System (3/3)

- Moving our binary map from normalized coordinates system to the world coordinates system requires a transformation matrix made from:
 - Translation
 - Scale

Translation



$$\begin{bmatrix} 1 & 0 & \frac{-\text{Grid Width}}{2} \\ 0 & 1 & \frac{-\text{Grid Height}}{2} \\ 0 & 0 & 1 \end{bmatrix}$$

Scale (1/2)

	0	0	0	1
	0	0	0	1
	0	0	0	1
	1	1	1	1

0	0	0	1
0	0	0	1
0	0	0	1
1	1	1	1

$$\begin{bmatrix} ScaleX & 0 & 0 \\ 0 & ScaleY & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Scale (2/2)

- Scaling could be bigger than the viewport (i.e. scrolling games)

	0	0	0	1
	0	0	0	1
	0	0	0	1
	1	1	1	1

0		0	0		1
0		0	0		1
0		0	0,0	0	1
1		1	1	1	1

$$\begin{bmatrix} \textit{ScaleX} & 0 & 0 \\ 0 & \textit{ScaleY} & 0 \\ 0 & 0 & 1 \end{bmatrix}$$