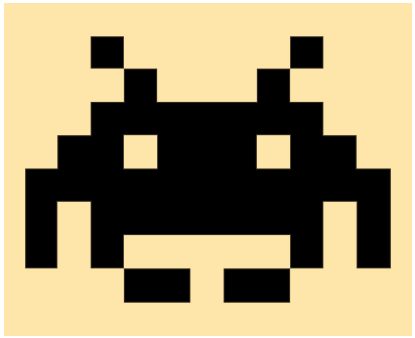
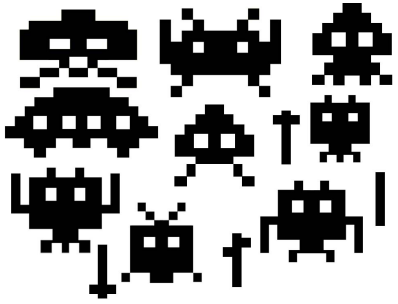
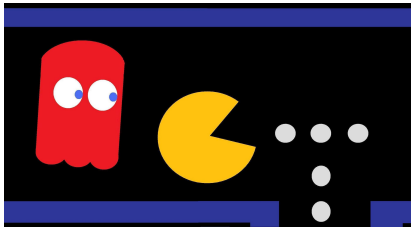
CSCI 1106
Lecture 4



Movement and Collision Detection





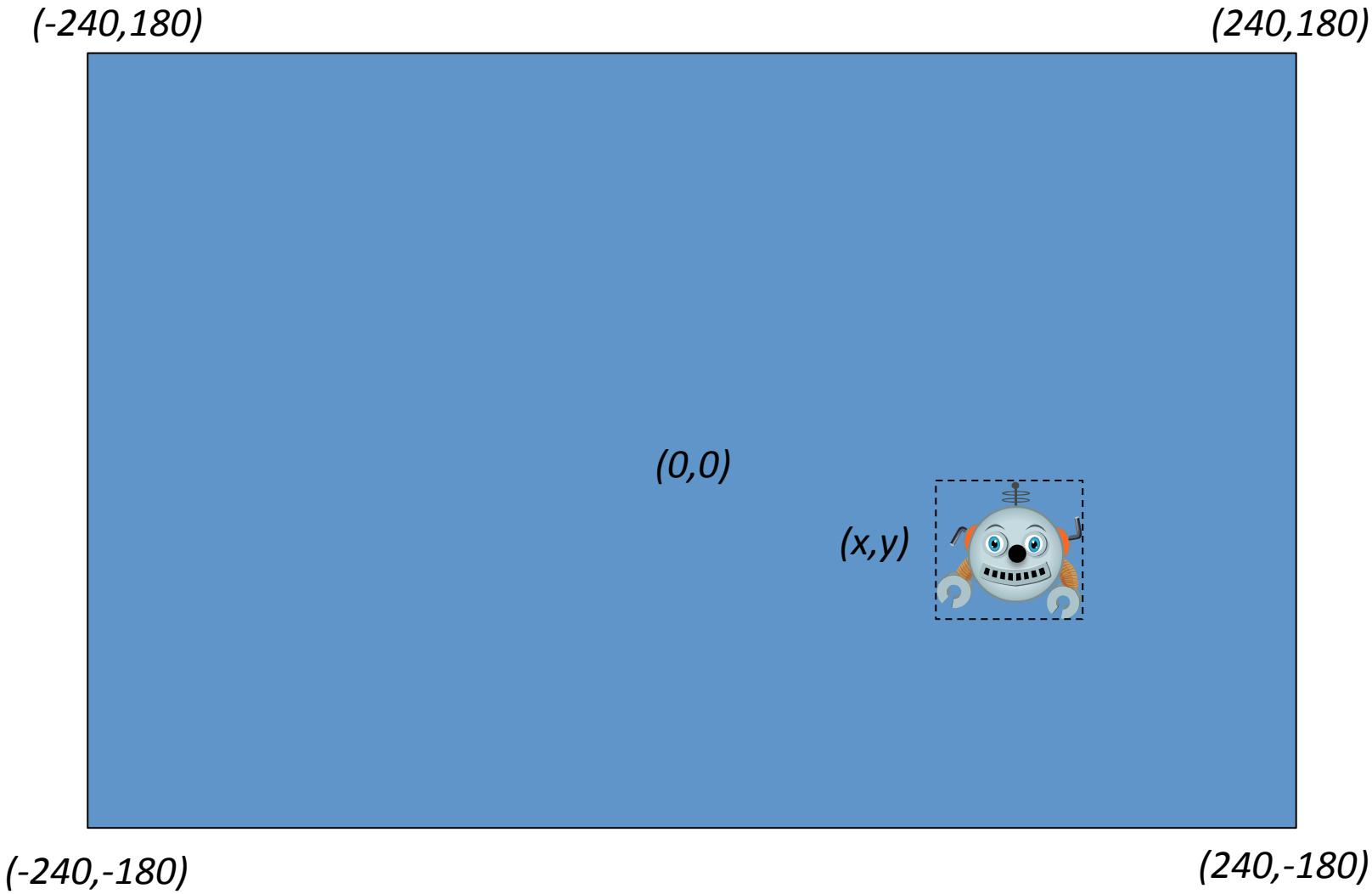
Announcements

- Quiz #1 is this Friday, in class
- Today's Topics
  - A brief reminder of the Movie Metaphor
  - Autonomous sprite movement
  - Movement beyond the stage
  - Collision detection

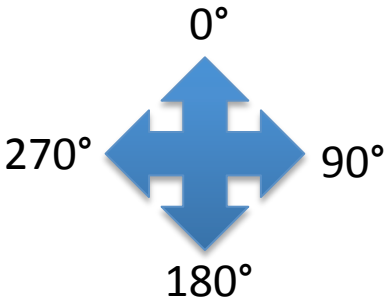
The Movie Metaphor

- Key Idea: Stage is updated 30 times per second
  - Broadcasts a FRAME event
  - All sprites are redrawn on the stage
- Key Idea: On the FRAME event the sprites
  - Update their positions and properties
  - Add/remove sprites as needed
  - Update costumes as needed
- Idea: Change in a sprite's position from frame to frame looks like motion

The Setup



Autonomous Motion



- Set the sprite's velocity
  - Number of steps (pixels) per frame
  - *Can be positive or negative*
- Set the sprite's direction property 

- Create a script to respond to the FRAME event
- On each frame change the position of the sprite by constant steps 

  e.g. move 10 steps per frame at 90°

Issues with Motion

- Where should we set the sprite's velocity?
- What does it mean if the velocity is negative?
- What happens if the velocity is too great?
- Must the velocity be constant?
- What happens if we hit the wall?

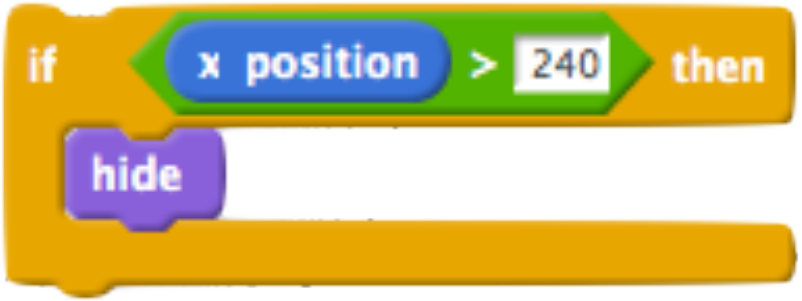
Hitting the Wall

- Fact: If the sprite keeps moving it will reach the edge of the stage
- Two options:
  - Fall off the edge
  - Bounce back
- How do we know when we have hit the wall?
- Does it matter which wall it is?

Falling of the Edge

- Idea: Once sprite is no longer on stage, hide it

- How do we know when a sprite is no longer on stage?
  - Sprite is at the top wall:
    `y position > 180`
  - Sprite is at the bottom wall:
    `y position < -180`
  - Sprite is at the left wall:
    `x position < -240`
  - Sprite is at the right wall:
    `x position > 240`



- Where do we perform the test?
- If the test is positive: remove or hide the sprite
- Is there an easier way?

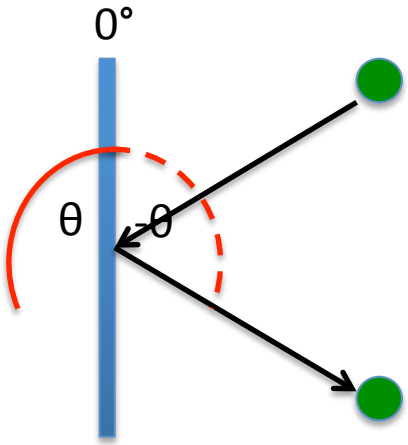
Falling Off when Touching the Edge

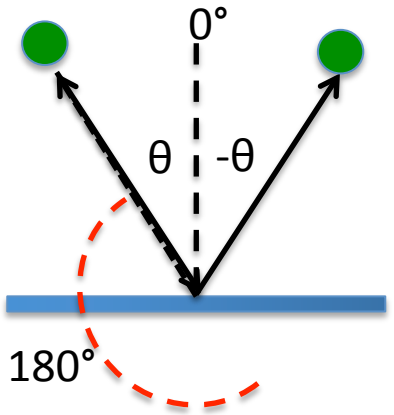
- Idea: If the sprite is touching an edge, hide it

Bouncing of the Wall

- Idea: Once a sprite touches a wall, reverse velocity
- How do we know the new direction?
- Two scenarios
  - Vertical wall

  - Horizontal wall





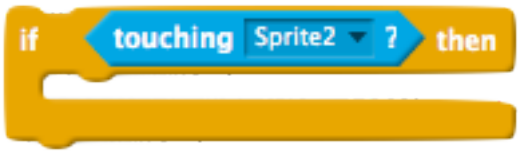
An Easier Bounce of the Wall

Collision Detection

- Obs: We just described a special form of *collision detection*
- In general, *collision detection* is needed to detect if two or more sprites are intersecting or touching in some way
- Why is this useful?

Mechanisms for Collision Detection

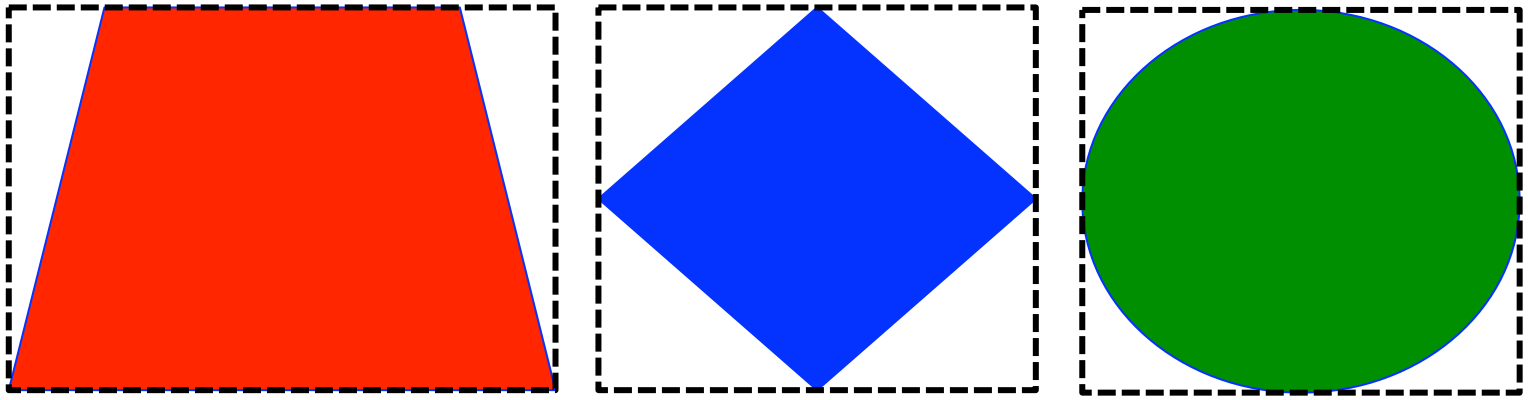
- Four ways to detect collisions:
  - Cheap and fast: Check if bounding boxes overlap
  - Expensive and slow: Check if the points of one sprite intersect with the other



  - Fast but specialized: Use geometry
  - More complicated and fast: Use invisible sprites
- For most purposes, the second way suffices

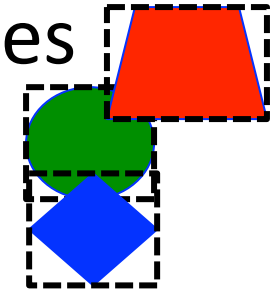
Bounding Boxes

- Defn: A *bounding box* of a sprite is the smallest orthogonal rectangle that can contain the sprite

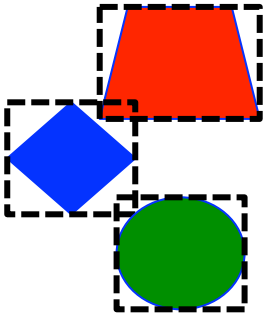


Bounding Box Collision Detection

- Idea: If the bounding boxes of two sprites intersect, a collision has occurred



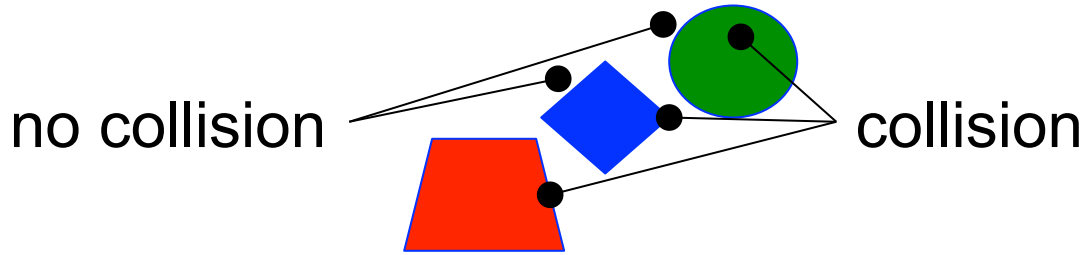
- Pros: Fast, cheap, simple to use
- Cons:
  - Cannot determine where the collision occurred
  - Irregularly shaped sprites have large bounding boxes
  - False positives



- Obs: Need finer granularity mechanism

Point Based Collision Detection

- Ideas:
  - Detect whether a specific point is within the shape of the sprite)
  - Only the drawn part is checked for overlap with the point
  - The bounding box isn't considered!
- Pros: More accurate than bounding box
- Cons: Sprites comprise many points so collisions require multiple checks

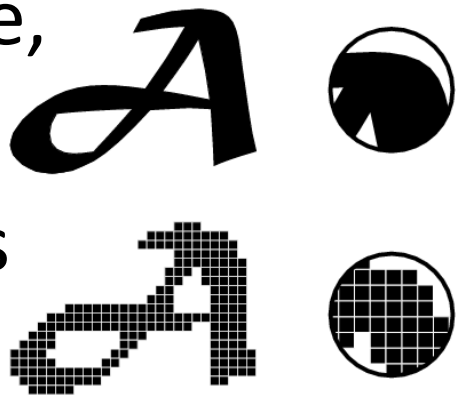


A Compound Approach

- Obs 1:
  - Bounding boxes are fast but inacurate
  - Point-wise detection is accurate but slow
- Obs 2: Collisions are rare compared to FRAME events
- Idea: Use a two-step process
  - Check if bounding boxes overlap
  - If yes, perform point-wise collision detection
  - If no, then no collision has occurred

Vector vs Bitmapped Graphics

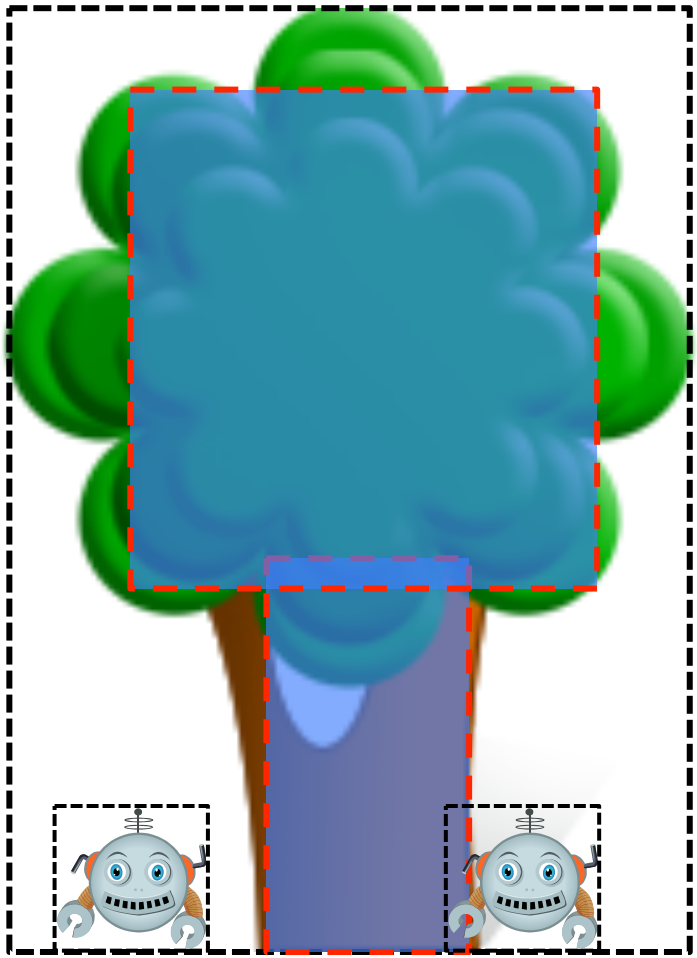
- Vector based graphics are those that you draw using the rectangle, circle, or other tools
- Bitmap based graphics are pictures that you import



http://www.snap.ednet.ns.ca/hhs/tprofittcmt12/images/vector-vs-bitmap.png

Another Compound Approach

- Problem:
  - Want to use bounding box collision detection on irregular shaped sprite
  - Bounding box of sprite differs from its shape
- Solution:
  - Create invisible sprites within this sprite with smaller bounding boxes
  - Use the smaller bounding boxes to detect collisions



no collision collision