John Romero Programming Proverbs

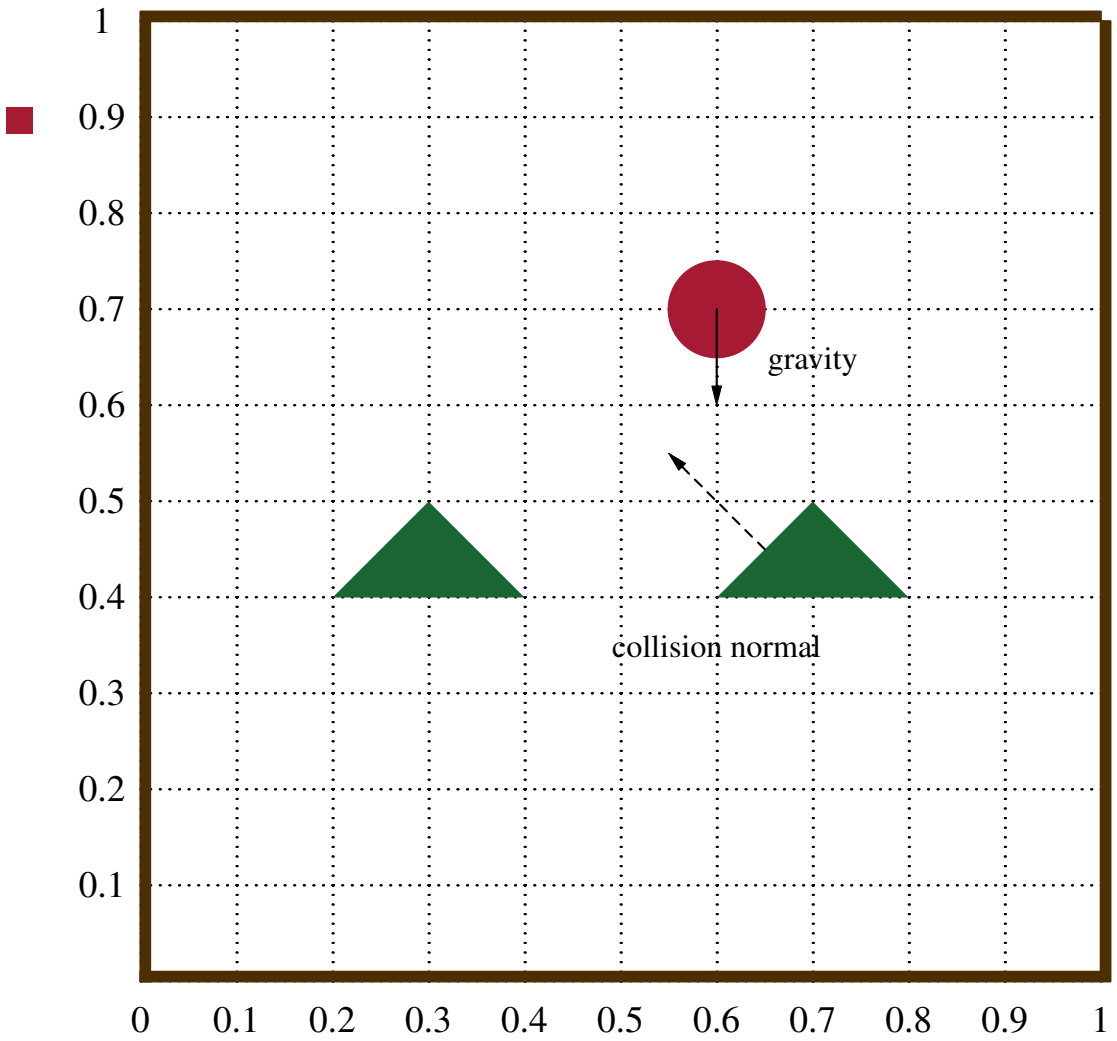
- 10. “Try to code transparently. Tell your lead and peers exactly how you are going to solve your current task and get feedback and advice. Do not treat game programming like each coder is a black box. The project could go off the rails and cause delays.”

- John Romero, “The Early Days of Id Software - John Romero @ WeAreDevelopers Conference 2017”

PGE Input and Timers

- PGE is a Predictive physics Game Engine
  - it operates by predicting the time of next collision rather than using a frame based approach

PGE Screen and world coordinates 1m x 1m



PGE input

- PyGame keyboard and mouse events can be utilised in PGE
- you can define a call back and register it within the game
- **examples/breakout/breakout.py**

```
    ...
    pge.register_handler (myquit, [QUIT])
    pge.register_handler (key_pressed, [KEYDOWN])
    pge.register_handler (mouse_hit, [MOUSEBUTTONDOWN])
    ...
```

Breakout input handler functions

- **examples/breakout/breakout.py**

```
def finish_game ():
    sys.exit (0)

def myquit (e):
    print "goodbye"
    finish_game ()

def key_pressed (e):
    if e.key == K_ESCAPE:
        myquit (e)
```

- notice that the `PyGame` `Event` object `e` is passed into `myquit`

Breakout mouse input

examples/breakout/breakout.py

```
def mouse_hit (e):
    global gb
    mouse = pge.pyg_to_unit_coord (e.pos)
    if e.button == 1:
        # left button
        gb.put_xvel (gb.get_xvel ()-0.3)
    elif e.button == 3:
        # right button
        gb.put_xvel (gb.get_xvel ()+0.3)
    elif gb.moving_towards (mouse[0], mouse[1]):
        # middle button
        pos = gb.get_unit_coord ()
        gb.apply_impulse (pge.sub_coord (mouse, pos), 0.4)
    else:
        # middle button
        gb.put_yvel (gb.get_yvel ()+0.4)
```

Breakout mouse input

- notice a series of helper function/methods exist

- `mouse = pge.pyg_to_unit_coord (e.pos)`
  - mouse is a unit vector `[x,y]` containing the current mouse position
  - x and y are in the PGE world range `0.0` to `1.0`

- `pos = gb.get_unit_coord ()`
  - `pos` is a unit vector containing the gold ball position

Breakout mouse input

- we can test whether an object is moving towards a position using

- ```
  mouse = pge.pyg_to_unit_coord (e.pos)
  if gb.moving_towards (mouse[0], mouse[1]):
    ...
  ```
  ```

Newton's laws of motion

- he stated three physical laws that, together, laid the foundation for classical mechanics
- describe the relationship between a body and the forces acting upon it
- describe its motion in response to those forces

Summary of the First law

- in an inertial reference frame, an object either remains at rest or continues to move at a constant velocity, unless acted upon by a net force

Summary of the Second law

- in an inertial reference frame, the vector sum of the forces F on an object is equal to the mass m of that object multiplied by the acceleration a of the object:

- $F = ma$

Summary of the Third law

- when one body exerts a force on a second body, the second body simultaneously exerts a force equal in magnitude and opposite in direction on the first body

- these three laws of motion were first compiled by Isaac Newton in his Philosophiae Naturalis Principia Mathematica (Mathematical Principles of Natural Philosophy), first published in 1687

- Newton used them to explain and investigate the motion of many physical objects and systems

Adding energy into the PGE world

- one of the considerations in building a game engine, is how to introduce new energy into the simulation
- you need to be careful, too much and objects become chaotic
  - too little and the objects are starved of motion
- the amount of energy depends whether the object collisions are elastic or inelastic
- elastic object collisions, energy is never lost
- inelastic object collisions, energy is lost (modelling friction, heat, noise energy)

Applying an impulse to an object

- **examples/breakout/breakout.py**

```
    gb.apply_impulse (pge.sub_coord (mouse, ball), 0.4)
```

- applies an impulse to an object
- an impulse is a non-physics term and in the game engine it means
- a force applied instantaneously to an object

Applying an impulse to an object

- notice that in Newtons 2nd law we see the equation $F = ma$
- the acceleration, implies time ms^2
- we don't necessarily have a change in velocity over some time
  - we simply want to introduce energy into the engine
- we will see this same problem when handling collisions
  - it is not always necessary to model the world exactly to get the desired effect in the game engine

Applying an impulse to an object

- we can also instantaneously change an objects velocity
  - violating Newtons 2nd law

- **examples/breakout/breakout.py**

```
        gb.put_yvel (gb.get_yvel ()+0.4)
```

- obviously we need to be careful with these hacks, or the game will feel unnatural

Timers

- PGE allows users to introduce timer callbacks
- here is how a simple second count down might be implemented
- **examples/breakout/breakout.py**

```
def timer (event = None, unused = None):
    global seconds_left, previous
    if seconds_left >= 0:
        pge.at_time (1.0, timer)
        s = "%d" % seconds_left
        if previous != None:
            previous.rm ()
        previous = pge.text (0.8, 0.9, s, white, 100, 1)
        seconds_left -= 1
```

Timers

- which when called from `main()` will display the current number of seconds left and register itself to be called `1.0` seconds in the future
- `at_time` returns an integer `id` representing the timer created
- this timer can be cancelled using `at_cancel (id)`

Timers

- if it is cancelled, the callback still occurs, your program could check cancellation by:

```
def timer (event = None, unused = None):
    global seconds_left, previous
    if seconds_left >= 0:
        if event != None and event.was_cancelled ():
           print "event was cancelled"
        pge.at_time (1.0, timer)
        s = "%d" % seconds_left
        if previous != None:
            previous.rm ()
        previous = pge.text (0.8, 0.9, s, white, 100, 1)
        seconds_left -= 1
```

Conclusion

- we have seen how energy can be added into PGE
- we have also explored some of the API calls surrounding
  - timer events
  - mouse movement
  - object movement and how to detect if two objects are moving towards each other
- next week we will examine how the an application can interact with collisions