# Programming Proverbs

■ 10. "Use good mnemonic names."

■ Henry F. Ledgard, "Programming Proverbs: Principles of Good Programming with Numerous Examples to Improve Programming Style and Proficiency", (Hayden Computer Programming Series), Hayden Book Company, 1st edition, ISBN-13: 978-0810455221, December 1975.

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
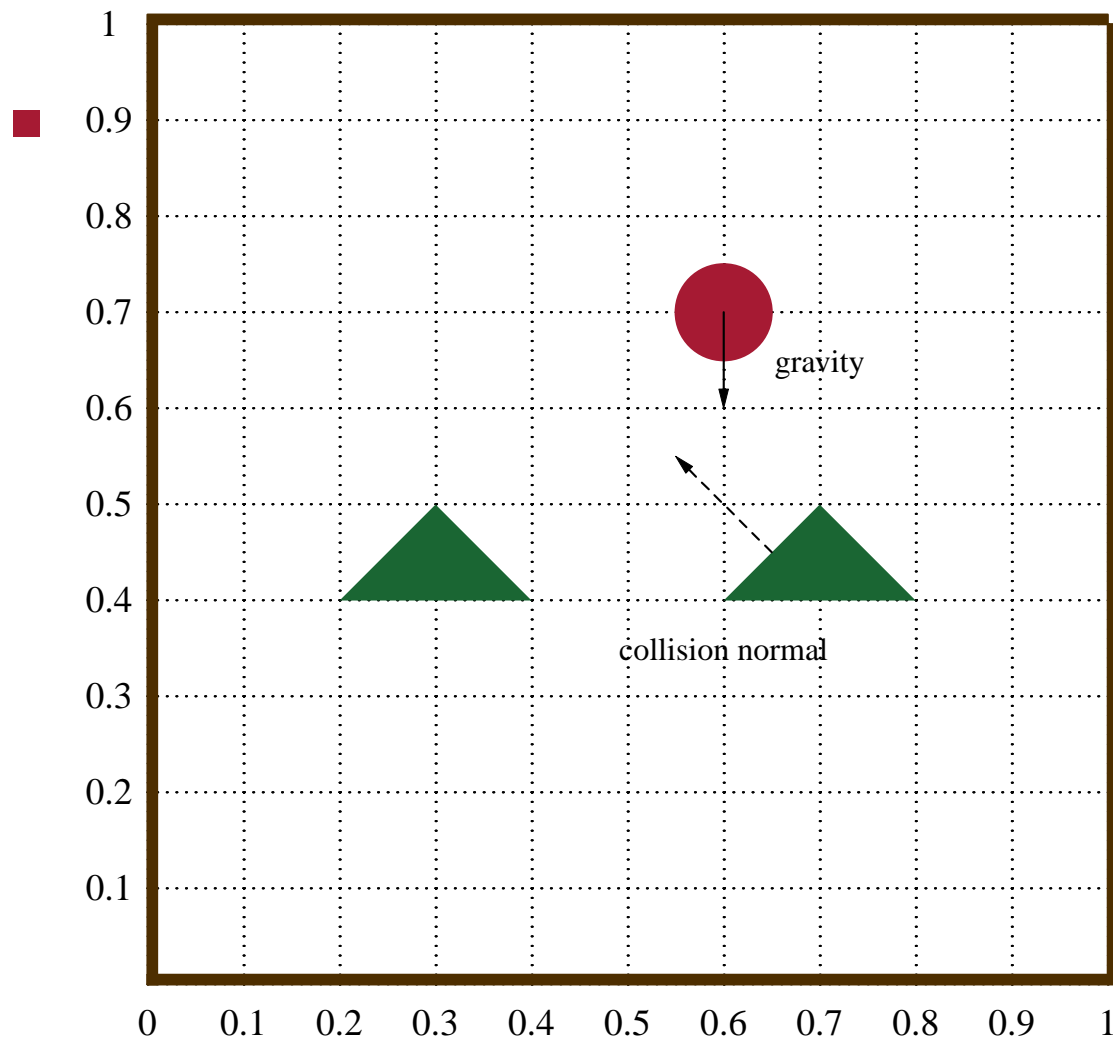
PGE input

■ 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

```python
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

```python
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**

```python
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