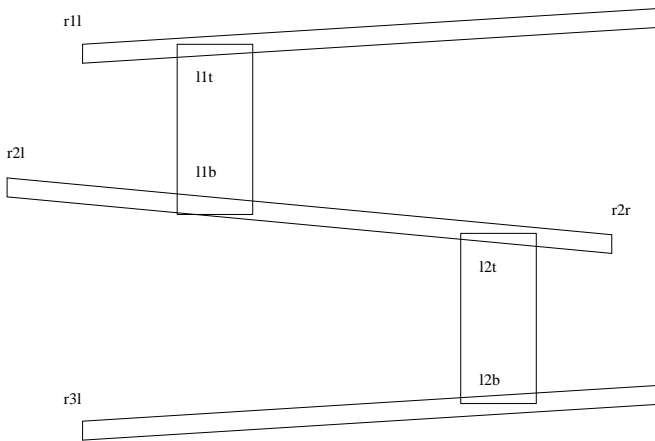


## Python Pygame: Mario movement



- Mario requires the movement
  - along ramps
  - up ladders
  - up to next ramp and down to lower ramp, when he reaches the end
- ideally he should be able to jump off ladders!
  - left as an exercise for the reader
- Mario also needs the ability to jump
  - left as an exercise for the reader

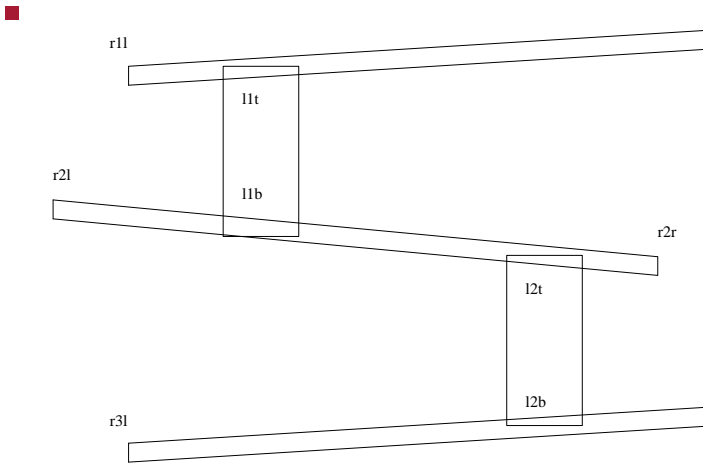
## Python Pygame: Mario movement

- one solution is to put Mario on rails
  - he can change direction (or path at the end of the current path)
  - he can reverse direction at any time
  - he needs the ability to choose a ladder
- placing Mario on rails is just one solution
  - another might be to use sprites for ramps and ladders and detect collisions

## Mario on rails

- in Computer Science we often have the tradeoff between complex data structures or complex code
- adding a little complexity to the data structures will reduce the complexity of the code
- define a map for Mario, map is a dictionary of paths
  - at each end point in the Mario diagram we have a path for any chosen direction

## Mario on rails



## Mario on rails

- starting at r3l we note:
  - he cannot move up
  - he can move right towards r3r he will pass ladder 12b
  - he cannot move down
  - if he moves left he dies

```
map = { "r3l-0": None,           # up
        "r3l-1": ["r3r", ["12b"]], # right
        "r3l-2": None,         # down
        "r3l-3": ["d3", []],   # left
        ...
```

- where
  - pointname-0 is up, pointname-1 is right, etc
  - if the path exists it is a list

## Mario on rails

- when he reaches r3r his choices are:
  - up to ramp 2
  - back to r3l
- he cannot go down and he cannot go right

```
"r3r-0": ["r2r", []], # up
"r3r-1": None,       # right
"r3r-2": None,       # down
"r3r-3": ["r3l", ["12b"]], # left
```

## Path list

- all path lists must be entered into the dictionary map
  - however is a path is not an option for Mario then its value in the dictionary is None
- any non None path will consist of the following entries:
  - first element is the furthest destination way point
  - the second element is also a list of optional ladders

## Consider paths for ramp 2

```

"r2r-0": None,          # up
"r2r-1": None,          # right
"r2r-2": ["r3r", []],  # down
"r2r-3": ["r2l", ["12t", "11b"]], # left

```

- he cannot go up or right from point r2r
  - he can go down to r3r
  - and he can move left to r2l and optionally chose ladders 12t or 11b

## Consider paths for ramp 2

- and if he reaches point r2l

```

"r2l-0": ["r1l", []],  # up
"r2l-1": ["r2r", ["12t", "11b"]], # right
"r2l-2": None,        # down
"r2l-3": None,        # left

```

- here at point r2l he can move
  - up to r1l
  - right (and return) to r2r possibly choosing ladders 12t and 11b
- he cannot go left or down

## Code changes to get basic movement working

- global variables initialised

```

max_speed = 50
step_horizontal = 30
step_vertical = 20
M = None

stand_left, stand_right, jump_left, jump_right, up_left, up_right,
mario_actions = [stand_left, stand_right, jump_left, jump_right, up_left, up_right]

action_image_names = ["mario-stand-l.png", "mario-stand-r.png",
                      "mario-jump-l.png", "mario-jump-r.png",
                      "mario-up-l.png", "mario-up-r.png"]

```

## Mario sprite class

```

class mario (pygame.sprite.Sprite):
    image = None
    def __init__ (self, o, d, startpos, path):
        pygame.sprite.Sprite.__init__(self)
        mario.image = pygame.image.load (barrel_colour())
        self.images = []
        self.orientation = o
        for i in mario_actions:
            self.images += [pygame.image.load (action_image_names[i])]
        self.image_height = 0
        self.image_width = 0
        self._change (d)
        self.rect = self.image.get_rect()
        self.newpath = path
        startpos = self.adjust (startpos)
        self.route = bres.walk_along (startpos, startpos)
        self.curpos = self.route.get_next ()
        self.rect.topleft = self.curpos
        self.next_update_time = 0
        self.Xspeed = 0
        self.direction = None
        self.path = None
        self.pathname = None

```

**Mario sprite class**

```

def new_goal (self, d):
    print "new_goal says our newpath is", self.newpath
    self.pathname = "%s-%d" % (self.newpath, d)
    print "Mario is using path", self.pathname
    path = map[self.pathname]
    print "=", path
    if path == None:
        print "no path to walk along"
        self.route = bres.walk_along (self.curpos, se
    else:
        print "newpath =", self.newpath
        self.path = self.newpath
        self.newpath = path[0]
        print "path =", self.path, "newpath =", self.
        endpos = self.adjust (points[self.newpath])
        self.route = bres.walk_along (self.curpos, en
        self.direction = d

```

**Mario sprite class**

```

def on_ladder (self):
    if self.pathname != None:
        path = map[self.pathname]
        if path != None:
            for l in path[1]:
                print l
                if self.is_on (points[l][0]):
                    return True, l
    return False, self.newpath

def go (self, k):
    if k == K_RIGHT:
        self._horizontal (1, stand_right)
    elif k == K_LEFT:
        self._horizontal (3, stand_left)
    elif k == K_UP:
        self._vertical (0, up_right)
    elif k == K_DOWN:
        self._vertical (2, up_left)

```

**Mario sprite class**

```

def _horizontal (self, newdir, o):
    if self.direction in [0, 2]:
        # could be going up a ladder or between ramps
        if self.route.finished ():
            # we have reached the end of the ladder o:
            self.orientation = o
            self._change (o)
            self.next_update_time = 0
            self.new_goal (newdir)
    else:
        if self.direction == newdir:
            # same direction, just continue, faster
            self.Xspeed = min (self.Xspeed + step_hor.
        else:
            self.orientation = o
            self._change (o)
            self.next_update_time = 0
            self.new_goal (newdir)

```

**Mario sprite class**

```

def _vertical (self, newdir, o):
    if self.direction in [1, 3]:
        # going left or right, check if we can use la
        b, self.newpath = self.on_ladder ()
        if b:
            print "using a ladder", self.newpath
            self.orientation = o
            self._change (o)
            self.next_update_time = 0
            self.new_goal (newdir)
        elif self.route.finished ():
            # can also go up at the end of the ramp
            self.orientation = o
            self._change (o)
            self.next_update_time = 0
            self.new_goal (newdir)

```

## Mario sprite class

```

else:
    # already going up or down, might be on a ladder
    if self.direction == newdir:
        # same direction, just continue, faster
        self.Xspeed = min (self.Xspeed + step_ver
    else:
        # change of direction
        self.orientation = o
        self._change (o)
        self.next_update_time = 0
        # check to see if already on ladder
        if (self.pathname != None) and (self.path:
            # make new goal the previous start
            self.newpath = self.path
            self.new_goal (newdir)
        else:
            self.new_goal (newdir)

```

## Mario sprite class

```

def _change (self, d):
    self.image = self.images[d]
    self.image_height = mario.image.get_height()
    self.image_width = mario.image.get_width()
    self.next_update_time = 0
def update (self, current_time):
    if self.next_update_time < current_time:
        if self.Xspeed > 0:
            self.curpos = self.route.get_next ()
            self.rect.topleft = self.curpos
            self.Xspeed -= 1
            self.next_update_time = current_time + 1
def adjust (self, p):
    return [p[0], p[1]-self.image_height]
def is_on (self, x):
    return not ((self.curpos[0] + self.image_width <
                (self.curpos[0] > x + xpos (ladder_wi

```

## Mario sprite class

```

def checkInput():
    for event in pygame.event.get():
        if event.type == KEYDOWN:
            if event.key == K_ESCAPE:
                sys.exit (0)
            elif event.key in [K_RIGHT, K_LEFT, K_UP, K_DOWN,
                M.go (event.key)
            elif event.key == K_f:
                pygame.display.toggle_fullscreen()

```

## Mario sprite class

```

def play_game (screen):
    global M
    o = -1
    M = mario (stand_right, 1, points["r31"], "r31")
    while True:
        t = pygame.time.get_ticks()
        if o != t:
            activity_scheduler (t)
            o = t
        checkInput()
        screen.fill(white) # blank the screen.
        draw_polygons ()
        for b in barrels:
            b.update (t)
            screen.blit (b.image, b.rect)
        M.update (t)
        screen.blit (M.image, M.rect)
    pygame.display.flip ()

```

## Homework and tutorial

- finish the path map definition and integrate the movement into your code
- make Mario jump, fall off ladders
- improve speed of movement and smoothness/playability
- scoring, timing, sounds etc

## PGE input

- implementing Mario using the Physics game engine is much easier!
- since the ball representing Mario is free running it just needs to be given a push when we want it to move
- we could
  - push it left with the left mouse button
  - push it right with the right mouse button
  - up with the middle mouse button

## PGE input

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

## PGE input

- in the main function we register the mouse event with our function
- ```
pge.register_handler (mouse_hit, [MOUSEBUTTONDOWN])
```
- please see the implementation of breakout to see how this is integrated into a game [breakout example](http://floppsie.comp.glam.ac.uk/Glamorgan/gaius/pge/homepage.html) (<http://floppsie.comp.glam.ac.uk/Glamorgan/gaius/pge/homepage.html>)

## Collisions in PGE

- referring again to the [breakout source code example](http://floppsie.comp.glam.ac.uk/Glamorgan/gaius/pge/example_games.html) ([http://floppsie.comp.glam.ac.uk/Glamorgan/gaius/pge/example\\_games.html](http://floppsie.comp.glam.ac.uk/Glamorgan/gaius/pge/example_games.html))
- notice that the section of code containing `delete_me` and `box_of`

## Collisions in PGE

- ```
def delete_me (o, e):
    global blocks, winner, loser

    blocks.remove (o)
    o.rm ()
    if blocks == []:
        if not loser:
            winner = True
            pge.text (0.2, 0.3, "Winner", white, 100, 1)
            pge.at_time (4.0, finish_game)

def box_of (pos, width, height, color):
    global blocks

    blocks += [pge.box (pos[0], pos[1], width, height, color)
               .fix ().on_collision (delete_me)]
```

## Collisions in PGE

- the function `box_of` creates a blue box at `pos` with a width and height
- it also stipulates that this box is `fixed`
- furthermore if anything hit this box then the function `delete_me` is called

## Collisions in PGE

- the function `delete_me` is a call back registered by the call to `on_collision` (described on the previous slide)
- this call back must be defined taking two parameters
  - the first, `o`, is the object whose callback is being called
  - the second, `e`, is the collision event which has describes the collision
- by using the event, `e`, it is possible to find out the other object in collision and other properties (if necessary)