Python Project

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Course Code and Name: Open Source Development Lab

Practical No. 1

AIM: To create Pacman game using Pygame in Python.

Methodology followed:

1) Installation of Pygame module in Pycharm
2) Import necessary files and docs for the game development.
3) Creating layout using Pygame.org libraries.
4) Applying necessary algorithm for movement of the player.
5) Implementing logic and development of game.

Code:

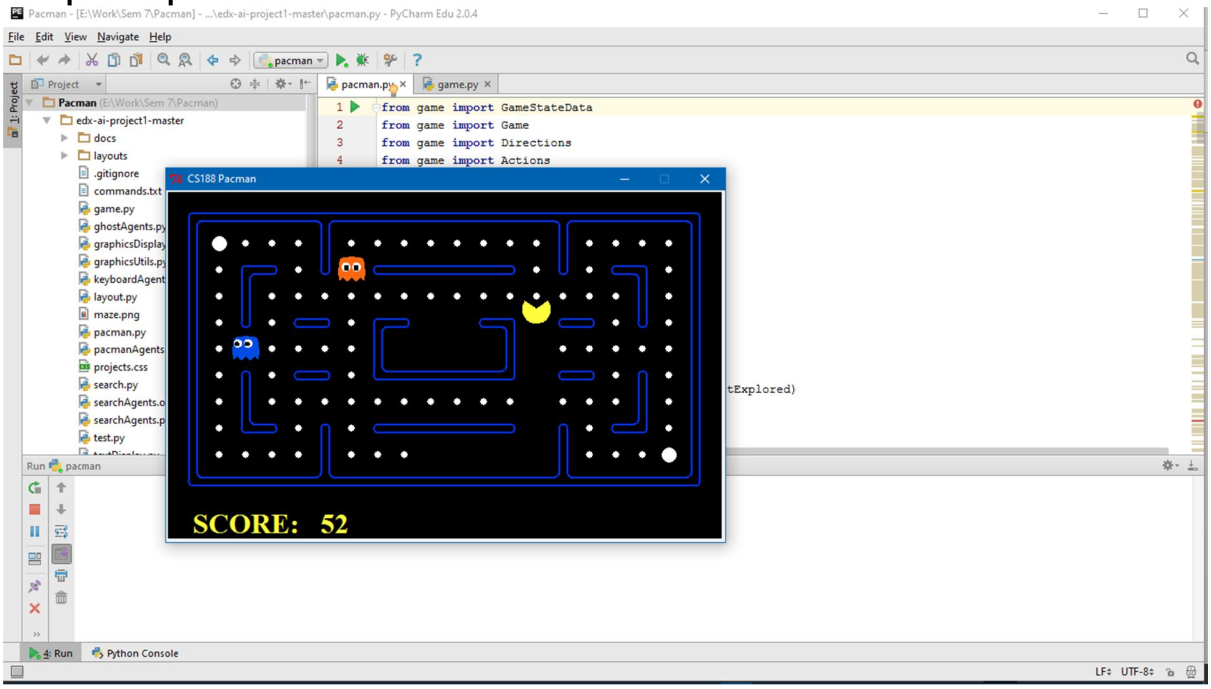
```
from game import GameStateData
from game import Game
from game import Directions
from game import Actions
from util import nearestPoint
from util import manhattanDistance
import util, layout
import sys, types, time, random, os


class GameState:
    explored = set()
    def getAndResetExplored():
        tmp = GameState.explored.copy()
        GameState.explored = set()
        return tmp
    getAndResetExplored = staticmethod(getAndResetExplored)

    def getLegalActions( self, agentIndex=0 ):
        GameState.explored.add(self)
        if self.isWin() or self.isLose(): return []

        if agentIndex == 0:  # Pacman is moving
            return PacmanRules.getLegalActions( self )
        else:
            return GhostRules.getLegalActions( self, agentIndex )

    def generateSuccessor( self, agentIndex, action):
        if self.isWin() or self.isLose(): raise Exception('Can\'t
generate a successor of a terminal state.')

        state = GameState(self)

        if agentIndex == 0:  # Pacman is moving
```

```
            state.data._eaten = [False for i in
range(state.getNumAgents())]
            PacmanRules.applyAction( state, action )
        else:                # A ghost is moving
            GhostRules.applyAction( state, action, agentIndex )

        # Time passes
        if agentIndex == 0:
            state.data.scoreChange += -TIME_PENALTY
        else:
            GhostRules.decrementTimer(
state.data.agentStates[agentIndex] )

        # Resolve multi-agent effects
        GhostRules.checkDeath( state, agentIndex )

        # Book keeping
        state.data._agentMoved = agentIndex
        state.data.score += state.data.scoreChange
        return state

    def getLegalPacmanActions( self ):
        return self.getLegalActions( 0 )

    def generatePacmanSuccessor( self, action ):
        return self.generateSuccessor( 0, action )

    def getPacmanState( self ):
        return self.data.agentStates[0].copy()

    def getPacmanPosition( self ):
        return self.data.agentStates[0].getPosition()

    def getGhostStates( self ):
        return self.data.agentStates[1:]

    def getGhostState( self, agentIndex ):
        if agentIndex == 0 or agentIndex >= self.getNumAgents():
            raise Exception("Invalid index passed to getGhostState")
        return self.data.agentStates[agentIndex]

    def getGhostPosition( self, agentIndex ):
        if agentIndex == 0:
            raise Exception("Pacman's index passed to
getGhostPosition")
        return self.data.agentStates[agentIndex].getPosition()

    def getGhostPositions(self):
        return [s.getPosition() for s in self.getGhostStates()]

    def getNumAgents( self ):
        return len( self.data.agentStates )

    def getScore( self ):
        return self.data.score

    def getCapsules(self):
        return self.data.capsules
    def getNumFood( self ):
        return self.data.food.count()

    def getFood(self):
        return self.data.food

    def getWalls(self):
        return self.data.layout.walls

    def hasFood(self, x, y):
        return self.data.food[x][y]

    def hasWall(self, x, y):
        return self.data.layout.walls[x][y]

    def isLose( self ):
        return self.data._lose

    def isWin( self ):
        return self.data._win

    def __init__( self, prevState = None ):
        if prevState != None: # Initial state
            self.data = GameStateData(prevState.data)
        else:
            self.data = GameStateData()

    def deepCopy( self ):
        state = GameState( self )
        state.data = self.data.deepCopy()
        return state

    def __eq__( self, other ):
        return self.data == other.data

    def __hash__( self ):
        return hash( self.data )

    def __str__( self ):

        return str(self.data)

    def initialize( self, layout, numGhostAgents=1000 ):
        self.data.initialize(layout, numGhostAgents)

SCARED_TIME = 40
COLLISION_TOLERANCE = 0.7
TIME_PENALTY = 1

class ClassicGameRules:
    def __init__(self, timeout=30):
        self.timeout = timeout

    def newGame( self, layout, pacmanAgent, ghostAgents, display, quiet
= False, catchExceptions=False):
        agents = [pacmanAgent] + ghostAgents[:layout.getNumGhosts()]
        initState = GameState()
        initState.initialize( layout, len(ghostAgents) )
        game = Game(agents, display, self,
catchExceptions=catchExceptions)
        game.state = initState
        self.initialState = initState.deepCopy()
        self.quiet = quiet
        return game

    def process(self, state, game):
        if state.isWin(): self.win(state, game)
        if state.isLose(): self.lose(state, game)

    def win( self, state, game ):
        if not self.quiet: print "Pacman emerges victorious! Score: %d"
% state.data.score
        game.gameOver = True

    def lose( self, state, game ):
        if not self.quiet: print "Pacman died! Score: %d" %
state.data.score
        game.gameOver = True

    def getProgress(self, game):
        return float(game.state.getNumFood()) /
self.initialState.getNumFood()

    def agentCrash(self, game, agentIndex):
        if agentIndex == 0:
            print "Pacman crashed"
        else:
            print "A ghost crashed"

    def getMaxTotalTime(self, agentIndex):
        return self.timeout

    def getMaxStartupTime(self, agentIndex):
        return self.timeout

    def getMoveWarningTime(self, agentIndex):
        return self.timeout

    def getMoveTimeout(self, agentIndex):
        return self.timeout

    def getMaxTimeWarnings(self, agentIndex):
        return 0

class PacmanRules:
    PACMAN_SPEED=1

    def getLegalActions( state ):
        return Actions.getPossibleActions(
state.getPacmanState().configuration, state.data.layout.walls )
    getLegalActions = staticmethod( getLegalActions )

    def applyAction( state, action ):
        legal = PacmanRules.getLegalActions( state )
        if action not in legal:
            raise Exception("Illegal action " + str(action))

        pacmanState = state.data.agentStates[0]

        vector = Actions.directionToVector( action,
PacmanRules.PACMAN_SPEED )
        pacmanState.configuration =
pacmanState.configuration.generateSuccessor( vector )

        next = pacmanState.configuration.getPosition()
        nearest = nearestPoint( next )
        if manhattanDistance( nearest, next ) <= 0.5 :
            PacmanRules.consume( nearest, state )
    applyAction = staticmethod( applyAction )

    def consume( position, state ):
        x,y = position
        # Eat food
        if state.data.food[x][y]:
            state.data.scoreChange += 10
            state.data.food = state.data.food.copy()
            state.data.food[x][y] = False
            state.data._foodEaten = position
            # TODO: cache numFood?
            numFood = state.getNumFood()
            if numFood == 0 and not state.data._lose:
                state.data.scoreChange += 500
                state.data._win = True
        # Eat capsule
        if( position in state.getCapsules() ):
            state.data.capsules.remove( position )
            state.data._capsuleEaten = position
            for index in range( 1, len( state.data.agentStates ) ):
                state.data.agentStates[index].scaredTimer = SCARED_TIME
    consume = staticmethod( consume )

class GhostRules:
    GHOST_SPEED=1.0
    def getLegalActions( state, ghostIndex ):
        conf = state.getGhostState( ghostIndex ).configuration
        possibleActions = Actions.getPossibleActions( conf,
state.data.layout.walls )
        reverse = Actions.reverseDirection( conf.direction )
        if Directions.STOP in possibleActions:
            possibleActions.remove( Directions.STOP )
        if reverse in possibleActions and len( possibleActions ) > 1:
            possibleActions.remove( reverse )
        return possibleActions
    getLegalActions = staticmethod( getLegalActions )

    def applyAction( state, action, ghostIndex):

        legal = GhostRules.getLegalActions( state, ghostIndex )
        if action not in legal:
            raise Exception("Illegal ghost action " + str(action))

        ghostState = state.data.agentStates[ghostIndex]
        speed = GhostRules.GHOST_SPEED
        if ghostState.scaredTimer > 0: speed /= 2.0
        vector = Actions.directionToVector( action, speed )
        ghostState.configuration =
ghostState.configuration.generateSuccessor( vector )
    applyAction = staticmethod( applyAction )

    def decrementTimer( ghostState):
        timer = ghostState.scaredTimer
        if timer == 1:
            ghostState.configuration.pos = nearestPoint(
ghostState.configuration.pos )
        ghostState.scaredTimer = max( 0, timer - 1 )
    decrementTimer = staticmethod( decrementTimer )

    def checkDeath( state, agentIndex):
        pacmanPosition = state.getPacmanPosition()
        if agentIndex == 0: # Pacman just moved; Anyone can kill him
            for index in range( 1, len( state.data.agentStates ) ):
                ghostState = state.data.agentStates[index]
                ghostPosition = ghostState.configuration.getPosition()
                if GhostRules.canKill( pacmanPosition, ghostPosition ):
                    GhostRules.collide( state, ghostState, index )
        else:
            ghostState = state.data.agentStates[agentIndex]
            ghostPosition = ghostState.configuration.getPosition()
            if GhostRules.canKill( pacmanPosition, ghostPosition ):
                GhostRules.collide( state, ghostState, agentIndex )
    checkDeath = staticmethod( checkDeath )

    def collide( state, ghostState, agentIndex):
        if ghostState.scaredTimer > 0:
            state.data.scoreChange += 200
            GhostRules.placeGhost(state, ghostState)
            ghostState.scaredTimer = 0
            state.data._eaten[agentIndex] = True
        else:
            if not state.data._win:
                state.data.scoreChange -= 500
                state.data._lose = True
    collide = staticmethod( collide )

    def canKill( pacmanPosition, ghostPosition ):
        return manhattanDistance( ghostPosition, pacmanPosition ) <=
COLLISION_TOLERANCE
    canKill = staticmethod( canKill )

    def placeGhost(state, ghostState):
        ghostState.configuration = ghostState.start
    placeGhost = staticmethod( placeGhost )

def default(str):
    return str + ' [Default: %default]'

def parseAgentArgs(str):
    if str == None: return {}
    pieces = str.split(',')
    opts = {}
    for p in pieces:
        if '=' in p:
            key, val = p.split('=')
        else:
            key,val = p, 1
        opts[key] = val
    return opts

def runGames( layout, pacman, ghosts, display, numGames, record,
numTraining = 0, catchExceptions=False, timeout=30 ):
    import __main__
    __main__.__dict__['_display'] = display

    rules = ClassicGameRules(timeout)
    games = []

    for i in range( numGames ):
        beQuiet = i < numTraining
        if beQuiet:
                # Suppress output and graphics
            import textDisplay
            gameDisplay = textDisplay.NullGraphics()
            rules.quiet = True
        else:
            gameDisplay = display
            rules.quiet = False
        game = rules.newGame( layout, pacman, ghosts, gameDisplay,
beQuiet, catchExceptions)
        game.run()
        if not beQuiet: games.append(game)

        if record:
            import time, cPickle
            fname = ('recorded-game-%d' % (i + 1)) +  '-'.join([str(t)
for t in time.localtime()[1:6]])
            f = file(fname, 'w')
            components = {'layout': layout, 'actions':
game.moveHistory}
            cPickle.dump(components, f)
            f.close()

    if (numGames-numTraining) > 0:
        scores = [game.state.getScore() for game in games]
        wins = [game.state.isWin() for game in games]
        winRate = wins.count(True)/ float(len(wins))
        print 'Average Score:', sum(scores) / float(len(scores))
        print 'Scores:       ', ', '.join([str(score) for score in
scores])
        print 'Win Rate:      %d/%d (%.2f)' % (wins.count(True),
len(wins), winRate)
        print 'Record:       ', ', '.join([ ['Loss', 'Win'][int(w)] for
w in wins])

    return games

if __name__ == '__main__':
    """

    """
    args = readCommand( sys.argv[1:] )
    runGames( **args )
    pass
```

Sample Input

No input required.

Sample Output



```
from game import GameStateData
from game import Game
from game import Directions
from game import Actions
```

Conclusions

The Pacman game developed using pygame module in python is a One level game, following basic rules of pacman. The development environment chosen is Pycharm IDE.

Signature of Teacher