

John Romero Programming Proverbs

- 7. “Use a development system that is superior to your target.”
- John Romero, “The Early Days of Id Software - John Romero @ WeAreDevelopers Conference 2017”

Introduction to the Pybot API

- firstly examine the AI in ioquake
 - these notes deliberately contain last weeks and this weeks lectures/tutorial together as they form a contineous story
- Quake 3 arena box AI is layered
- much like a network protocol stack
- decisions made at higher layers are executed through lower layers

Introduction to the Pybot API



| | | | | | |
|-----------------------|------------|---------------|------------|-------|-----|
| Team leader AI | | | | | 4th |
| Misc AI | AI network | | Commands | | 3rd |
| Fuzzy | Character | Goals | Navigation | Chats | 2nd |
| Area awareness system | | Basic actions | | | 1st |

Layer one

- the input and output layer for the bot
 - area awareness system is the system which provides the bot with all information about the world
 - much of the information has already been preprocessed when building the maps
 - some of it will be dynamic
 - access to it is fast
 - everything the bot senses goes through the Area Awareness System AAS
- basic actions are the output of the bot
 - outputs are presented in a way which is very similar to keyboard/mouse input of a human player

Layer two

- provides the intelligence that is often subconscious to a skilled human player
 - includes AI to select goals using fuzzy logic
 - AI to navigate towards a goal
 - AI to interpret chats
 - AI to construct chats

- functionality to store and retrieve characteristics of bots, for example
 - aim skill
 - aim accuracy
 - aggression
 - weapon jumping

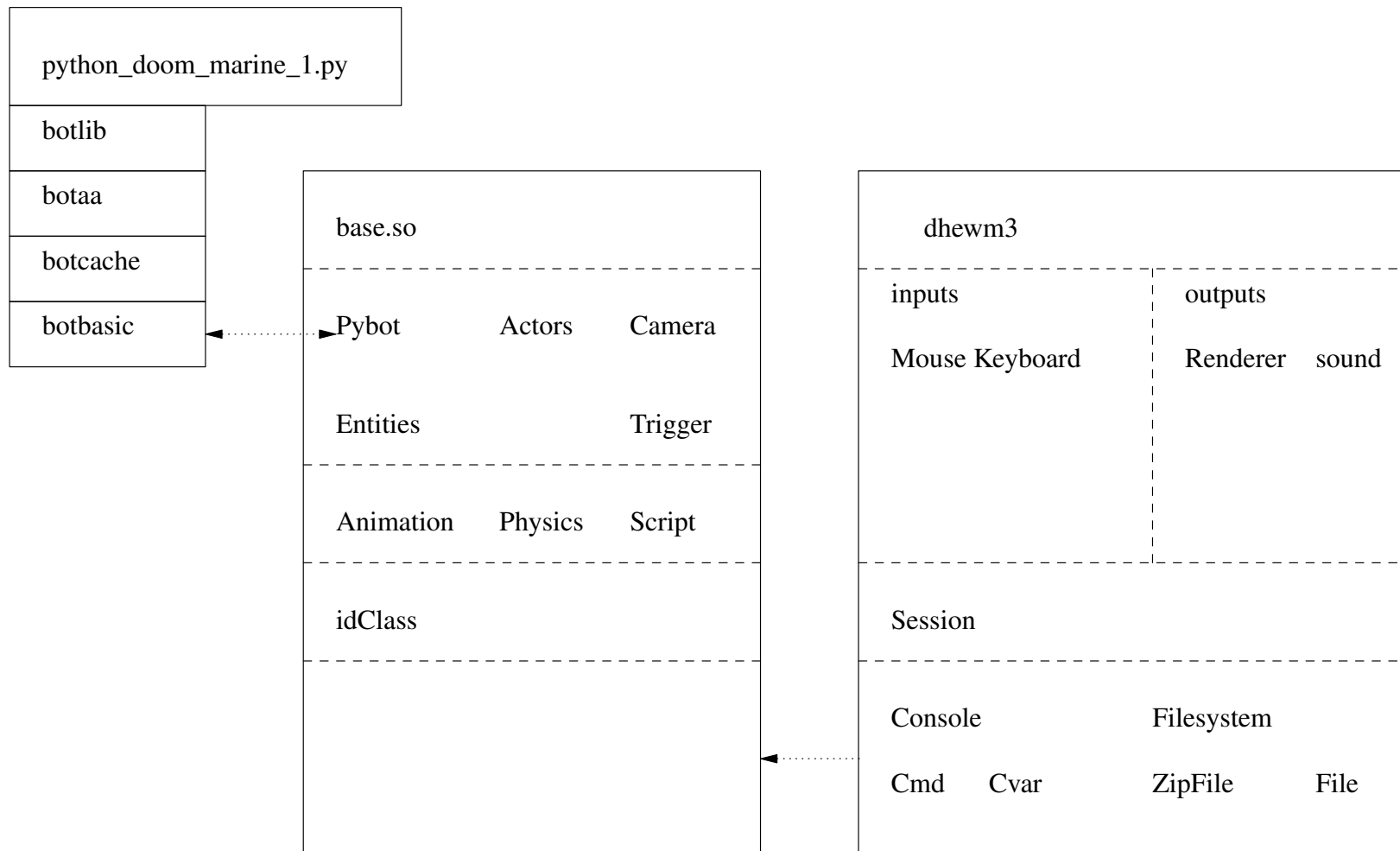
Layer three

- a mixture of production rules
 - and an AI network with special nodes for different situations and states of mind
 - very similar to a state machine
 - many `if then else` rules
- all higher level thinking and reasoning takes place in this layer
- it also contains the command module
 - which allows the bot to understand orders and commands
 - from other players or a team leader
- misc AI module supports AI for fighting, navigating around obstacles and solving puzzles

Layer four

- one of the bots is designated as team leader which enables this layer
 - all other bots disable this layer
- typically the leader might request other bot to follow me
 - track enemy, attack enemy etc

Introduction to the Pybot API



Introduction to the Pybot API

- layered approach
- top layer, `botlib` will ultimately be the interface to user level bots (`python_doommarine.py`)
- will contain both access to basic movement and access to navigation mechanisms
- maintains the transform between the doom3 map and penguin tower map

botaa

- contains area awareness code for the python bot
- parses the equivalent pen map and creates internal simple 2D map of the world in Python
- implements Dijkstra's algorithm for routing to pickups and player/monsters

botcache

- provides the same interface as
 - `botbasic` but it caches all results
 - which allows the higher layers (`botaa`) the ability to query the bot without having to worry about the overhead of the remote procedure call
- it also contains a method
 - `reset` which deletes the cache, forcing all future requests to be sent over to the `dhewm3` engine to retrieve up to date values

botbasic

- provides socket connection to the dhewm3 engine
- it also implements the underlying remote procedure call mechanism
- generally maps onto basic commands
 - such as: move, fire, reload, turn, aim, etc

Example `python_doommarine.py` code

■ `Sandpit/git-doom/python/python_doommarine.py`

```
b = botbasic.basic ("localhost", 'python_doommarine')
print ("success!  python doom marine is alive")
print ("trying to get my id...", end=" ")
me = b.me ()
print ("yes")
print ("the python marine id is", me)
circle ()
```

- notice this code is currently accessing the `botbasic.py` layer directly
- as we are testing this layer in isolation

Example python_doommarine.py code

■ [Sandpit/git-doom/python/python_doommarine.py](#)

```
def circle ():  
    while True:  
        for a in range (0, 360, 45):  
            runArc (a+180)  
            time.sleep (5)
```

Example python_doommarine.py code

■ [Sandpit/git-doom/python/python_doommarine.py](#)

```
def walkSquare ():
    b.forward (100, 100)
    b.select (["move"])
    b.left (100, 100)
    b.select (["move"])
    b.back (100, 100)
    b.select (["move"])
    b.right (100, 100)
    b.select (["move"])

def runArc (a):
    b.forward (100, 100)
    b.turn (a, 1)
    b.select (["move"])
    b.select (["turn"])
```

Pybot API

- please read through the file `Sandpit/git-doom/python/botbasic.py`
 - and write down a list of all methods
 - and alongside each method write a functional synopsis

- `forward`
 - takes two arguments `vel` and `dist`
 - `vel` is the velocity to move forward
 - `dist` are the number of doom3 units to move forward (inches)

- `left`
 - takes two arguments `vel` and `dist`
 - `vel` is the velocity to move left
 - `dist` are the number of doom3 units to move left (inches)

Pybot API

- right
 - same parameters as left but moving right

- back
 - same parameters as forward but moving backwards

- stepvec
 - three parameters: `velforward`, `velright`, and `dist`
 - `velforward` velocity forward, `velright` velocity right, and `dist`, distance travelled in inches

select

- notice that the pybot takes time to complete a movement or action
- how do we know if a movement has completed?
- we can use the method `select` which like its Unix counterpart allows us to block for an event to occur
- `select`
 - takes a single argument, a list, containing any of:
 - `['move', 'fire', 'turn', 'reload']`
 - indicates which activity it should wait to complete
 - it returns when any specified activity has finished

select

- examine the `select` in `testturn`

- `Sandpit/git-doom/python/python_doommarine.py`

```
def testturn (a):  
    b.turn (a, 1)  
    b.select (["turn"])
```

- without `select` we would have to carefully calibrate calls to `sleep`
 - and hope that the pybot has completed the activity

Conclusion

- we have examined the bot API in detail
- we will continue to see how this connects with the dhewm engine next week
- in particular we will examine the network stack

Tutorial

- use emacs to load the file `$HOME/Sandpit/git-doom3/pybot-dhewm3/python-bot/python_doommarine.py`
 - remember `$HOME` is shorthand for `/home/yourusername`
 - recall that you can use the `<tab>` key to complete filename and directory names in emacs

Tutorial

- now press F12 and when this has completed F5
 - this will compile dhewm3 (F12) and then debug dhewm3 (F5)
 - press F10 for help

- make sure that dhewm3 has been configured to run in a window (not full screen)
 - if not reconfigure it and quit dhewm3 and then press F5 in emacs

Tutorial

- open up another terminal

- ```
$ cd $HOME/Sandpit/chisel/python
$./developer-txt2map ../maps/onebot.txt
```

# Tutorial

- open up another terminal

- ```
$ cd $HOME/Sandpit/git-doom3/pybot-dhewm3/python-bot  
$ python python_doommarine.py 0
```

- this will run the python bot from the command line and allows you to see any debugging output
- return to the dhewm program and pull down the in game console (using ~)
- now type:
 - `dmap tiny.map`
 - `map tiny.map`

Tutorial

- you should see Python bot appear and run in a circle
 - the game engine is being run under the debugger
 - python bot is being run from the command line

Tutorial

- see if you can change `python_doommarine.py` to make Python bot walk around in a circle rather than run
- create two functions `walkCircle` and `runCircle`
- finally change the program to make Python bot turn without walking
 - see if you can change `botlib.py` so that an turn angle of 0 degrees is straight up in the penguin map
- you will need to read and study the file `$HOME/Sandpit/git-doom3/pybot-dhewm3/python-bot/botlib.py`

Tutorial

- homework, write out a list of functions implemented in `botlib.py` together with their functionality
 - complete the `walkCircle/runCircle` and turn exercises from above
- consider what extra basic movements are desirable in `botlib.py`

Tutorial

- open the file `Sandpit/git-doom/python/botbasic.py` in emacs
- find the method `left`
 - understand what this is doing
- now we will trace its functionality to the game engine
- find the method `right`
 - write a line by line commentary for this method

Tutorial

- at the top of the file change the line of code

- ```
debug_protocol = False
```

- to

- ```
debug_protocol = True
```

- now rerun dhewm3 and rerun the pybot (consult the earlier slides if necessary)

- can you see the call to `left`?
 - hint look for the word `right` in the debugging output on the gnome terminal

Tutorial

- see if you can extend Pybot so that you can obtain his health, or change weapon, jump, crouch, etc

Screencast of eightbots coming to life

- the video ([eight-bot-screencast](http://floppsie.comp.glam.ac.uk/download/avi/eight-python-bots-dijkstra-routing-algorithm.mp4) `<http://floppsie.comp.glam.ac.uk/download/avi/eight-python-bots-dijkstra-routing-algorithm.mp4>`) here does much of the above, but it uses an eight bot map and also uses `mr` to start up the eight python bots