John Romero Programming Proverbs

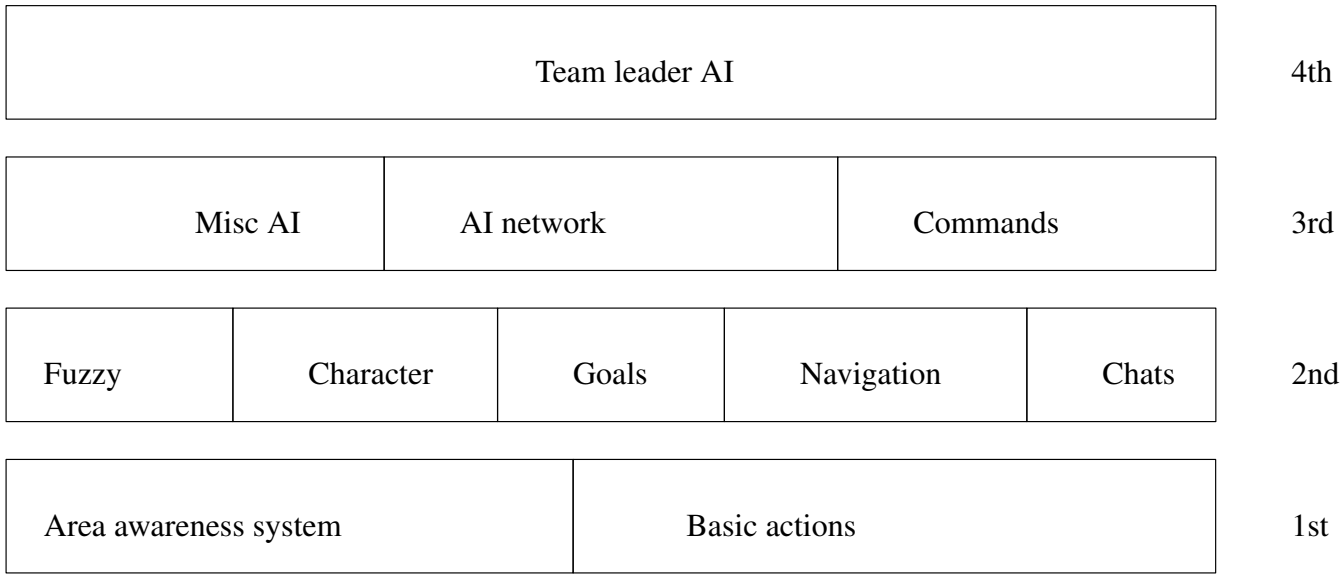
- 7. “Use a development system that is superior to your target.”

- 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



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

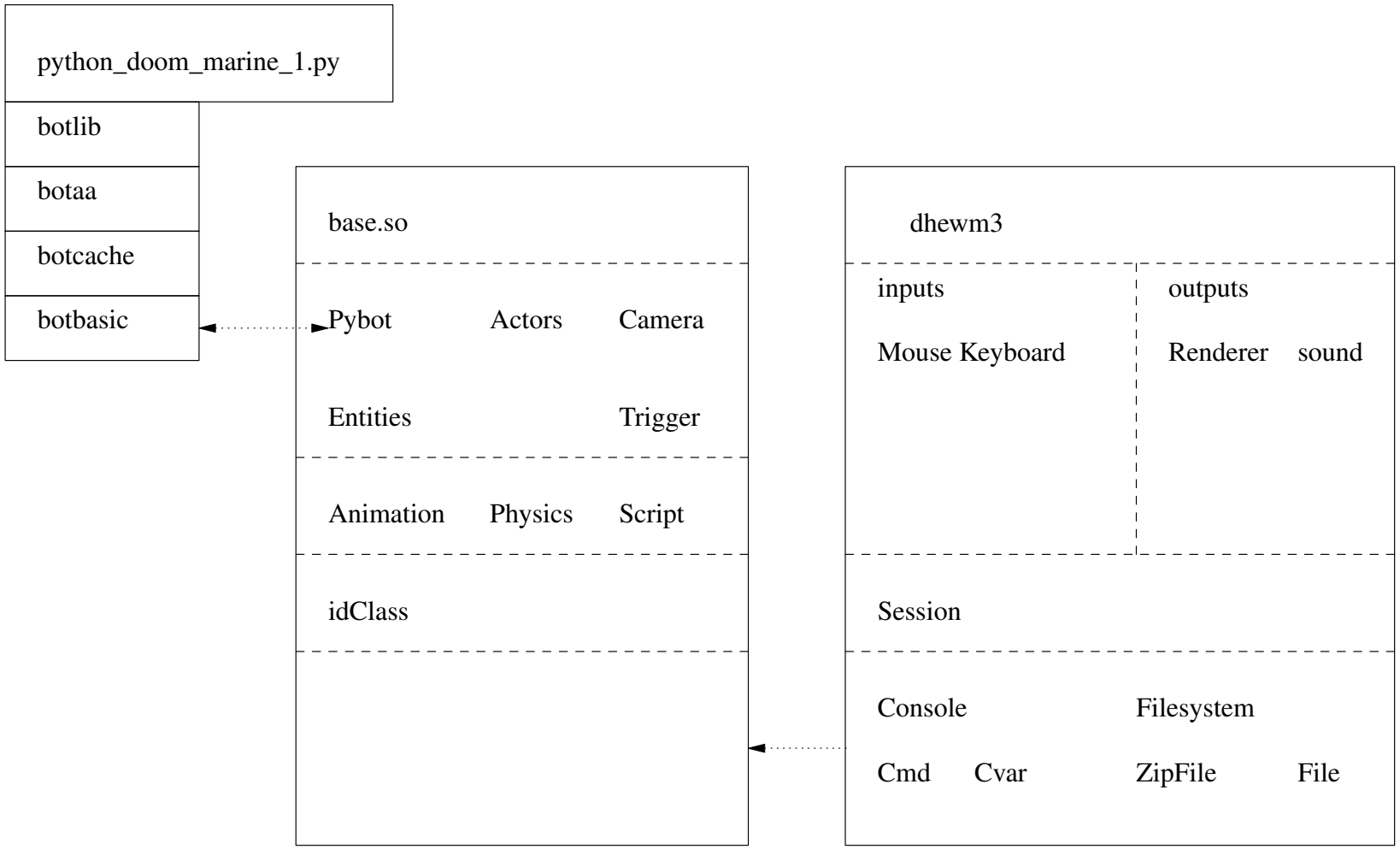
- a mixture of production rules
  - and an AI network with special nodes for different situations and states of mind
  - very similar to a state machine
  - many `if then else` rules
- all higher level thinking and reasoning takes place in this layer
- it also contains the command module
  - which allows 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`⟩) here does much of the above, but it uses an eight bot map and also uses `mrun` to start up the eight python bots