

John Romero Programming Proverbs

- 3. “Keep your code absolutely simple. Keep looking at your functions and figure out how you can simplify further.”
- John Romero, “The Early Days of Id Software - John Romero @ WeAreDevelopers Conference 2017”

Relationship of Chisel within Game Engine Design

- in this module we will examine:
 - tools necessary to develop game engines: `gdb`, `emacs` and friends
- examine how one can integrate Python into a game engine `doom3`
 - exploit parallelism
- examine and extend a small physics game engine and expose its API to Python
- learn how to debug shared libraries and exploit remote debugging
 - should a highly useful transferable skill
 - both `doom3` and `pge` use shared libraries

VMWare and Raspberry Pi images

- contains custom software highly tailored for our academic purpose
 - customised doom3
 - pge
 - chisel
 - darkradiant

VMWare and Raspberry Pi images

- we will be looking at:
 - chisel
 - overview of game engines
 - an understanding of tools (`gdb`, `emacs`)
 - doom3
 - BSP and MAP structure
 - pge and game physics

Chisel

- consists of a number of programs
 - `txt2pen` converts a txt file into a pen file
 - recall the txt file is created in a text editor (emacs, gedit etc)
 - a pen file is the format used by penguin-tower
 - `pen2map` converts a penguin tower map into a doom3 map

chisel/map/doors.txt

```
define 1 room 1
define 2 room 2
define 3 room 3
define s worldspawn
define o monster monster_demon_imp
define n monster monster_demon_hellknight
define i light
define a ammo ammo_shells_large 16
```

```
#####
# 1          . 2          #
#          i  #          i  #
#  s          .          #
#          #          #
#          i  .          #
#          #          i  o  #
#          .          #
#####
```

txt2pen

```
$ cd $HOME/Sandpit/chisel/python  
$ python3 txt2pen.py -o doors.pen ../maps/doors.txt
```

■ generates a `doors.pen` file from the `../maps/doors.txt` file

doors.pen

```
ROOM 1
  WALL
    1 9   18 9
    18 9   18 1
    18 1   1 1
    1 1   1 9
  DOOR 18 8 18 8 STATUS OPEN LEADS TO 2
  DOOR 18 6 18 6 STATUS OPEN LEADS TO 2
  DOOR 18 4 18 4 STATUS OPEN LEADS TO 2
  DOOR 18 2 18 2 STATUS OPEN LEADS TO 2
  LIGHT AT 15 7
  LIGHT AT 12 4
  SPAWN PLAYER AT 4 6
END
```


doors.pen

```
ROOM 2
  WALL
    18 9   34 9
    34 9   34 1
    34 1   18 1
    18 1   18 9
  DOOR 18 2 18 2 STATUS OPEN LEADS TO 1
  DOOR 18 4 18 4 STATUS OPEN LEADS TO 1
  DOOR 18 6 18 6 STATUS OPEN LEADS TO 1
  DOOR 18 8 18 8 STATUS OPEN LEADS TO 1
  MONSTER monster_demon_imp AT 32 3
  LIGHT AT 26 7
  LIGHT AT 24 3
END

END.
```

Obtaining chisel

- chisel is already installed on your images, however you might want to get the latest from github

- ```
$ cd
$ mkdir Sandpit
$ cd Sandpit
$ rm -rf chisel
$ git clone https://github.com/gaiusm/chisel
```

## Running: your copy of txt2pen

```
$ cd $HOME/Sandpit/chisel/python
$ python3 txt2pen.py -h
Usage: txt2pen [-dhvV] [-o outputfile] inputfile
 -d debugging
 -h help
 -V verbose
 -v version
 -o outputfile name
```

```
$ python3 txt2pen.py -o doors.pen ../maps/doors.txt
```

## Operating system concepts!

- we will be looking at networking in a game engine
- also looking at architectural parallelism in doom3

## Architectural parallelism in doom3

- within the the doom3 modifications to introduce Python bots
- notice the calls to `fork` and `execl`

## Architectural parallelism in doom3

■ `doom3/source/latest-git/dhewm3/neo/game/ai/pybot.cpp:1144`

```
char buffer[PATH_MAX];

idStr::snPrintf (buffer, sizeof (buffer), "%s/%s/%s.py",
 getHome (), getDir (), name);
gameLocal.Printf ("execl /usr/bin/python3 %s\n", buffer);
int pid = fork ();
if (pid == 0)
 /* child process. */
 {
 int r = execl ("/usr/bin/python3", "python3", buffer,
 (char *)NULL);

 if (r != 0)
 perror ("execl");
 }
```

## Architectural parallelism in doom3

- we notice that `doom3` and `python3` are running in parallel
  - allowing the bot to run its pathfinding and AI simultaneously as the engine

## chisel: txt2pen

- source is in one file:  
`$HOME/Sandpit/chisel/python/txt2pen.py`
  - 690 lines of Python
- uses the following command line options

```
$ cd $HOME/Sandpit/chisel/python
$ python3 txt2pen.py -h
 -d debugging
 -h help
 -V verbose
 -v version
 -o outputfile name
```



## chisel: txt2pen

- notice the `-o` option which takes an additional argument (filename)
- it uses the `getopt` module to handle the options
  - see function `handleOptions`

## chisel: txt2pen

```
def handleOptions ():
 global debugging, verbose, outputName

 outputName = None
 try:
 optlist, l = getopt.getopt(sys.argv[1:], ':dho:vV')
 for opt in optlist:
 if opt[0] == '-d':
 debugging = True
 elif opt[0] == '-h':
 usage (0)
 elif opt[0] == '-o':
 outputName = opt[1]
 elif opt[0] == '-v':
 printf ("txt2pen version " + str (versionNumber) + "\n")
 sys.exit (0)
 elif opt[0] == '-V':
 verbose = True
 if l != []:
 return (l[0], outputName)

 except getopt.GetoptError:
 usage (1)
 return (None, outputName)
```

## chisel: txt2pen

- it uses a dictionary to maintain the defines
- stores the map in a 2D list (array)
  - mapGrid
- it determines the walls of a room
  - it finds the room number (location)
  - moves to the top left inside the room (`generateRoom`)
  - it then attempts to turn left as it moves around the room (the wall is always on the left)
  - examine `scanRoom` for the implementation
  - it looks the square forward and square forward left comparing the two characters: `##` or `--` or `#-`
    - `#` wall and `-` for space

## Extending chisel

- one of the obvious improvements is for chisel to automatically introduce lights
  - add another option to enable automatic lighting
  - `-l`
- copy `scanRoom` into a new function `introduceLights`
- adapt this new function to add lights
  - but only if the rooms has no user defined lights

# darkradiant

- change directory into

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

- view your map using the tool, remember your output file will always be (tiny.map)
 - when running darkradiant you will need to configure the map directory
 - you can click on the right hand mouse button to fix/enable freelook
 - cursor keys will move you around the 3D space

darkradiant

- ```
$ darkradiant
```
- now change the map slightly
- ```
$ gedit ../maps/two.txt  
$ ./developer-txt2map ../maps/two.txt
```
- and view the changes using darkradiant