

# Programming Proverbs

- 4. “Be aware of other approaches.”
- Henry F. Ledgard, “Programming Proverbs: Principles of Good Programming with Numerous Examples to Improve Programming Style and Proficiency”, (Hayden Computer Programming Series), Hayden Book Company, 1st edition, ISBN-13: 978-0810455221, December 1975.

## Inside Chisel

- design goals
  - in the style of Unix
  - command line only
  - one command to achieve one task well
  
- `chisel` is a package with at least three command line programs
  - `txt2pen` convert a `txt` file into a `pen` file
  - `pen2map` convert a `pen` file into a `map` file (`doom3`)
  - `rndpen` generate a random `pen` file
  
- for your coursework you should consider extending:
  - `pen2map` or `txt2pen` or introducing a third which could manipulate a `pen` or `txt` file

## rndpen

- generate a random pen map
- highly alpha code, but it will generate a corridor based random pen file
- the program does always find a map
- so some experimentation is required for the pseudo random numbers to mesh with the algorithm to generate a map

# rndpen

```
$ rndmap -h
Usage rndpen [-a minroomsize] [-b maxroomsize] \  
  [-c mincorridorlength] [-d maxcorridorlength] \  
  [-e totalcorridorlength] [-h] [-o outputfile] \  
  [-s seed] [-x maxx] [-y maxy]
-a minroomsize          (default is 6)
-b maxroomsize          (default is 13)
-c mincorridorlength    (default is 15)
-d maxcorridorlength    (default is 70)
-e totalcorridorlength  (default is 300)
-o outputfile           (default is stdout)
-s seed                 (default is 3)
-x minx for whole map   (default is 120)
-y maxy for whole map   (default is 80)
```

# rndpen

- `$ rndmap -s 3 -a 5 -b 10 -c 5 -d 10 -e 20 -x 30 -y 30 | pen2map -t -`

- notice how the command line tools can be combined using the pipe



## rndpen

- rndpen prioritises placing random corridors on the map
- it then tries to fill in the remaining gaps with boxes and will combine boxes to give rooms of desired min/max dimensions
- it also restricts the number of walls to 8
- it might be useful if you wanted to generate a map quickly
  - however it might generate concave rooms (pen2map can only encode convex rooms currently)

## Inside: 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
$ python txt2pen.py -h
-d debugging
-h help
-V verbose
-v version
-o outputfile name
```

## Inside: txt2pen

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

## Inside: 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)
```

## Inside: txt2pen

- it uses a dictionary to maintain the defines
- stores the map in a 2D list (array)
  - `mapGrid`

## Inside: txt2pen

- 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
  
- a space should be thought of as not a wall

## Inside: txt2pen

- scanRoom will start at the top right corner of a room and walk around the edge with the wall always on the left
  - it builds a list of walls, a wall stops/starts at each turn
  
- if it sees ## then it must turn right
  - the old wall is stored and a new start position is remembered
  
- if it sees -- then it must turn left
  - the old wall is stored and a new start position is remembered
  
- if it sees #- then it continues moving a square forward

## Extending chisel (txt2pen)

- 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

## Inside: pen2map

- chisel/python/pen2map.py is 2086 lines of Python

```
$ cd $HOME/Sandpit/chisel/python
$ python pen2map.py -h
Usage: pen2map [-c filename.ss] [-dhmtvV] [-o outputfile] inputfile
  -c filename.ss    use filename.ss as the defaults for the map file
  -d                debugging
  -e                provide comments in the map file
  -g type           game type.  The type must be 'single' or 'deathmatch'
  -h                help
  -m                create a doom3 map file from the pen file
  -s                generate statistics about the map file
  -t                create a txt file from the pen file
  -V                generate verbose information
  -v                print the version
  -o outputfile    place output into outputfile
```

## Example style sheet for the map

- how are textures defined - could use the defaults - and ignore this slide!
  - or examine `chisel/python/tiny.ss`

```
# style sheet for simple doom3 maps

define floor textures/hell/qfloor
define portal textures/editor/visportal
define open textures/editor/visportal
define closed textures/hell/wood1
define secret textures/hell/bricks1a_d
define wall textures/hell/cbrick2b
define ceiling textures/hell/wood1
```

## pen2map

- reads in a `pen` file and converts it into a `doom3 map` file
- the `pen` map is parsed by a top down recursive descent parser
  - the `pen` syntax is described by an `ebnf` grammar
  - (extended backus naur form)
  - hand translated into a top down recursive descent parser
- recursive descent parsers are fast and straightforward to implement once the grammar is defined
  - they also allow for strict syntax checking of input
  - they are used extensively in the construction of compilers

## ebnf

- consists of terminal symbols and non-terminal production rules which define the legal sequence of symbols
- in C++ for example, a terminal symbol might be `while`, `for`, `do`, `=` ;  
0 etc
- a rule might be:
- ```
assignment := lhs "=" rhs =:
```
- meaning the `assignment` rule is satisfied if there is a legal `lhs` followed by `=` followed by `rhs`

## pen example

```
ROOM 1
  WALL
    1 21  18 21
    18 21  18 14
    18 14  1 14
    1 14  1 21
  DOOR 18 18 18 17 STATUS OPEN LEADS TO 2
  MONSTER python_doommarine_mp AT 13 18
  LIGHT AT 12 20
  LIGHT AT 4 15
  LIGHT AT 15 15
  SPAWN PLAYER AT 3 18
END
```

## pen grammar in ebnf

```
FileUnit := RoomDesc { RoomDesc } [ RandomTreasure ] "END." =:  
RoomDesc := 'ROOM' Integer  
           { WallDesc | DoorDesc | TreasureDesc } 'END' =:  
WallDesc := 'WALL' WallCoords { WallCoords } =:  
WallCoords := Integer Integer Integer Integer =:  
DoorDesc := 'DOOR' DoorCoords { DoorCoords } =:
```

## pen grammar in ebnf

```
DoorCoords := Integer Integer Integer Integer Status
            'LEADS' 'TO' Integer =:

Status := 'STATUS' ( 'OPEN'
                    | 'CLOSED'
                    | 'SECRET'
                    ) =:

TreasureDesc := 'TREASURE' 'AT' Integer Integer
              'IS' Integer =:

RandomTreasure := 'RANDOMIZE' 'TREASURE' Integer
                 { Integer } =:
```

## ebnf meta symbols

- { foo }
  - means it is legal to have 0 or more occurrences of foo
- [ foo ]
  - means it is legal to have 0 or 1 occurrence of foo
- ( foo | bar )
  - here the ( and ) group together the extent of the |
- "foo" represents the terminal symbol f o o
- as opposed to the rule foo

## Translating ebnf grammar into a top down parser

- once the grammar is defined it is straightforward to implement a top down parser
- if the grammar is said to be well formed if we only need to look at the next token to determine the flow of control in the parser

## Translating ebnf grammar into a top down parser

- we define a few helper functions
  - `expect ("foo")` insists that the next token is "foo" and generates an error if it is not "foo"
  - if "foo" is seen the consume this symbol and move onto the next
  
- `expecting (list)`
  - returns `True` if any symbol in `list` matches the current symbol
  
- `integer` return `True` if the current symbol is an integer
  - if `True` store the value of the integer in `curinteger`

# Conclusion

- to be continued next week