How to debug a shared library (PGE)

- generally you should turn off optimization when debugging your code
  - use `-O0 -g`
- this will produce precise code to line number and variable access
  - the code will go slower, obviously, which might in extreme cases change the bug behaviour compared to `-O3`
  - you will need to experiment and become comfortable with these tools
- your experience will enable you to tradeoff these issues with your own bugs

Adding Bungees into PGE

- so far springs, polygons and circle objects have been introduced into PGE
- recall that the spring has an at rest length $l0$ and the two objects are currently $l1$ distance apart
- a bungee is a modification of the spring object
  - it only pull objects together if $l1 > l0$

Bungee API

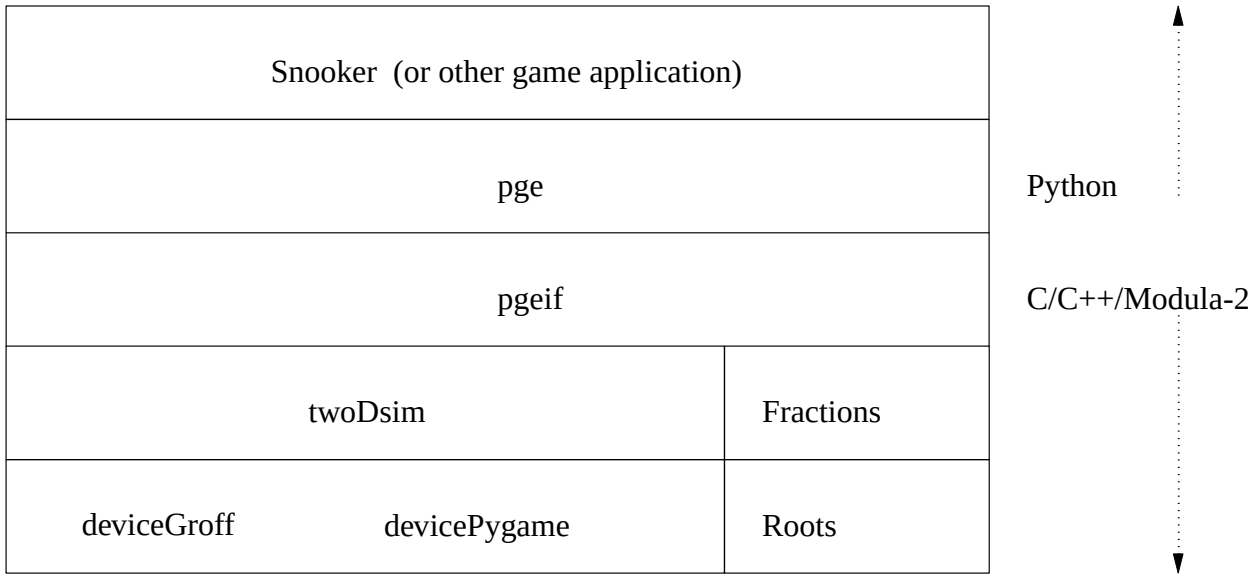
- in Python we could introduce the `bungee` method which is defined as:

- **Sandpit/pge/python/pge.py**

```
#
#  bungee - Pre-condition:  a spring object.  toBungee is a boolean.
#           Post-condition:  if toBungee is True convert the spring
#                               to a bungee
#                            else convert the bungee back into a
#                               regular spring.
#
def bungee (self, toBungee):
   # finish this method
   # it should check self is a spring
```

PGE Layers and associated files

- there are a number of layers in PGE



Layers and source files to be altered

- `pge/python/pge.py`
  - the user level python API file
  - this is the only PGE visible file to the user

- `pge/i/pgeif.i`
  - the swig interface (python calling C/C++ definition)
  - remember to edit both sections (C/C++ section and the Python section)
  - hint look for `%{` and `}%` delimiters

Layers and source files to be altered

- `pge/c/Gpgeif.h`
  - header file for `pgeif.c`
  - contains the external functions implemented inside `pgeif.c`

- `pge/c/pgeif.c`
  - its purpose is to allow, colours, polygons, circles, springs, to be given a unique integer
  - thereafter all references to objects will be achieved via the objects, id.
  - notice that inside `twoDsim.c` colours and circles are different

Layers and source files to be altered

- `pge/c/twoDsim.c`
  - the actual game engine, which implements polygons, circles, springs

- `pge/c/GtwoDsim.h`
  - the header file for `pge/c/twoDsim.c` which defines all external functions

Layers and source files to be altered

- all these files will need `bungee` references added to them
- start at the top `pge/python/pge.py` and work downwards
- follow per object gravity as a guide
- you will need to actually implement bungee's inside `twoDsim.c` (alter the behaviour of a spring)

Layers and source files to be altered

- hint
  - add an extra field to spring `isBungee` and set it to `FALSE` by default in `twoDsim_spring`

Hints on implementing bungees in twoDsim

- extend the spring object to contain the bungee field
- notice the functions `calcSpringFixed` and `calcSpringMoving` calculate the forces for the spring
- this can be adapted to check for the bungee properties
  - keep the code as clean as possible!

Debugging a shared library

- the debugger `gdb` is very powerful, and it makes sense to use it when debugging the game engine

- often in `pge` a bug will be found to occur at a particular frame
  - for example there was a bug in objects falling
  - objects which were connected to a spring fell at a different speed to an object unconnected!

Debugging the object falling bug!

- firstly the game was run and observed
  - secondly the game was inspected using `pgeplayback`
  - this confirms that at the initial frame (1) all is good, the objects are at the same position
  - in the second frame the objects have fallen to different y positions!

Debugging the object falling bug!

- now we add a debug hook into

- **c/deviceIf.c:35**

```
#   include "GDynamicStrings.h"
#   include "GNetworkOrder.h"
#   include "GM2RTS.h"

#   include "Ggdbif.h"

typedef unsigned int deviceIf_Colour;

#   define whiteCID 1
```

Debugging the object falling bug!

c/deviceIf.c:546

```
/*
   frameNote - emit a note to indicate a new frame has commenced.
*/

void deviceIf_frameNote (void)
{
  checkOpened ();
  if (device == groff)
    {
      RawIO_Write (ffile, (unsigned char *) "fn", 2);
      NetworkOrder_writeCard (ffile, nextFrame);
    }
  if (nextFrame == 1)
    gdbif_sleepSpin ();
  nextFrame += 1;
}
```

Debugging the object falling bug!

- now pge needs to be rebuilt and run again
- when running it will issue a console message
-

```
process 1234 is waiting for you to:
attach 1234
```

Debugging the object falling bug!

- ```
  $ cd
  $ cd Sandpit/build-pge
  $ gdb _pgeif.so
  ```

- you can now single step pge and print out variable values

- you might find it useful to use `emacs` which will give you a windowed interface to `gdb`
  ```

Tutorial

- use these slides to add bungees into your version of pge
- write some simple test code in Python to create a bungee spring
  - ensure that it also has a fps counter on screen
  - write down the fps
- now see if you can rebuild pge using some of the optimisation techniques discusseed in the slides
  - does the fps change?