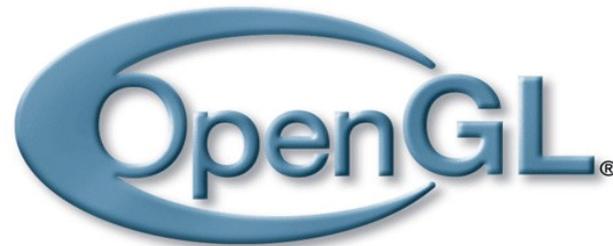




Introduction

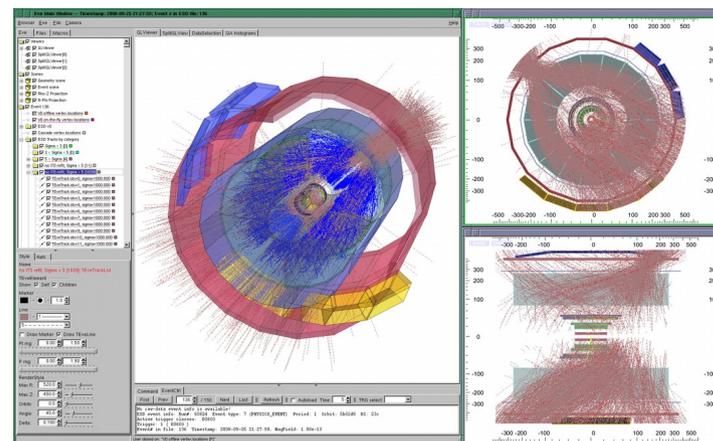
OpenGL

- OpenGL is an API for rendering 2D and 3D graphics.
- Silicon Graphics Inc. (SGI) started developing OpenGL in 1991 and released it in January 1992
- Now managed by the non-profit technology consortium Khronos Group.



OpenGL

- It is widely use in different form factor devices (PC, tablets, mobile phones, embedded devices...) for running applications that require 2D/3D graphics rendering (games, scientific applications, etc)



OpenGL

- However, OpenGL is only an API specification...
 - Implementors are free to provide their own libraries and drivers.
- Possible incompatibilities between implementations and OpenGL.
- Solution: OpenGL conformance test suites



OpenGL conformance test suites

OpenGL conformance test suites

- There is an official OpenGL conformance test suite from Khronos group:
<https://www.khronos.org/opengl/adopters/>
- It is for free (as in beer) for software developers but it is not Free Software (as in speech).

https://www.khronos.org/files/adopters_agreement.pdf

OpenGL conformance test suites

- There are unofficial Free Software OpenGL conformance test suites:
 - Glean
 - DrawElements Quality Program (dEQP)
 - Piglit



Glean

Glean

- Created in 1999 by Allen Akin.
- MIT license.
- Tested on GNU/Linux and Microsoft Windows.
- There hasn't been much activity in Glean for a few years now.
 - Nowadays, it's part of Piglit

<http://glean.sourceforge.net/>



dEQP

dEQP

- Draw Elements Quality Program (dEQP)
 - Developed by Finnish company called drawElements.
 - Bought by Google in 2014
 - Google open-sourced dEQP in the Android Lollipop release.
- Apache License 2.0

dEQP

- Supports OpenGL ES 2.0 and better, OpenCL 1.X, and EGL 1.4.
- Supported OSes include Android, GNU/Linux, Windows, iOS.
- Recently, piglit added support for running dEQP GLES3 tests.

dEQP

- Clone repository:

```
$ git clone https://android.googlesource.com/platform/external/deqp/
```

- [Optional] Add to CMakeLists.txt:

```
set(PNG_INCLUDE_PATH "/usr/include/libpng")
```

```
set(PNG_LIBRARY "/usr/lib/x86_64-linux-gnu/libpng.so")
```

```
set(CMAKE_BUILD_TYPE DEBUG)
```

```
set(CMAKE_C_FLAGS "-O0 -ggdb")
```

```
set(CMAKE_C_FLAGS_DEBUG "-O0 -ggdb")
```

```
set(CMAKE_C_FLAGS_RELEASE "-O0 -ggdb")
```

```
set(CMAKE_CXX_FLAGS "-O0 -ggdb")
```

```
set(CMAKE_CXX_FLAGS_DEBUG "-O0 -ggdb")
```

```
set(CMAKE_CXX_FLAGS_RELEASE "-O0 -ggdb")
```

dEQP

- Build:
\$ cmake .
\$ make
- Note: it doesn't provide an "install" target.

dEQP

- Run the tests with execserver

- Create list of tests to run

```
$ cd modules/gles3
```

```
$ ./deqp-gles3 --deqp-runmode=xml-caselist
```

- Launch server

```
$ execserver/execserver
```

- Launch executor (in other terminal)

```
$ ./executor/executor -b deqp-gles3 -wd modules/gles3/  
-cd modules/gles3/ -t dEQP-GLES3.functional.* -o ./gles3-  
functional.xml --cmdline="--deqp-log-images=disable"
```

dEQP

```
#sessionInfo releaseName 2014.x
#sessionInfo releaseId 0xcafebabe
#sessionInfo targetName Default
#beginSession

#beginTestCaseResult dEQP-GLES3.functional.prerequisite.state_reset
<?xml version="1.0" encoding="UTF-8"?>
<TestCaseResult Version="0.3.3" CasePath="dEQP-GLES3.functional.prerequisite.state_reset" CaseType="SelfValidate">
  <Number Name="TestDuration" Description="Test case duration in microseconds" Tag="Time" Unit="us">2778</Number>
  <Result StatusCode="Pass">Pass</Result>
</TestCaseResult>

#endTestCaseResult

#beginTestCaseResult dEQP-GLES3.functional.prerequisite.clear_color
<?xml version="1.0" encoding="UTF-8"?>
<TestCaseResult Version="0.3.3" CasePath="dEQP-GLES3.functional.prerequisite.clear_color" CaseType="SelfValidate">
  <Number Name="TestDuration" Description="Test case duration in microseconds" Tag="Time" Unit="us">128692</Number>
  <Result StatusCode="Pass">Pass</Result>
</TestCaseResult>

#endTestCaseResult

#beginTestCaseResult dEQP-GLES3.functional.prerequisite.read_pixels
<?xml version="1.0" encoding="UTF-8"?>
<TestCaseResult Version="0.3.3" CasePath="dEQP-GLES3.functional.prerequisite.read_pixels" CaseType="SelfValidate">
  <Number Name="TestDuration" Description="Test case duration in microseconds" Tag="Time" Unit="us">332699</Number>
  <Result StatusCode="Pass">Pass</Result>
</TestCaseResult>

#endTestCaseResult
```

dEQP

- Run the tests without execserver:

```
$ cd ./modules/gles3
```

```
$ ./deqp-gles3 -n dEQP-GLES3.functional.*
```

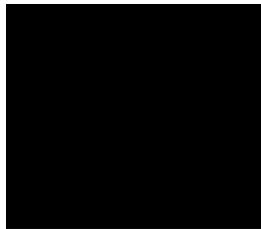
- Results are saved in TestResults.qpa file

dEQP

```
</FragmentShader>
</ShaderProgram>
| <Number Name="VertexCompileTime" Description="Vertex shader compile time" Tag="Time" Unit="ms">0.487000</Number>
  <Number Name="FragmentCompileTime" Description="Fragment shader compile time" Tag="Time" Unit="ms">0.147000</Number>
  <Number Name="LinkTime" Description="Link time" Tag="Time" Unit="ms">0.594000</Number>
  <Text>Image comparison failed: difference = 1351.2, threshold = 0.05</Text>
  <ImageSet Name="ComparisonResult" Description="Image comparison result">
    <Image Name="Result" Width="128" Height="112" Format="RGBA8888" CompressionMode="PNG" Description="Result">
      iVBORw0KGgoAAAANSUgAAAIAAAABwCAYAAADWrHjSAAABJ0LEQVR4n03SMQEA
      IAzAsIF/zyBjRxMFPXpm5g1ZdzuAXQaIM0CcAeIMEGeAOAPEGSD0AHEGiDNAnAHi
      DBBngDgDxBkgzgzBxBogzQJwB4gwQZ4A4A8QZIM4AcQaIM0CcAeIMEGeAOAPEGSD0
      AHEGiDNAnAHiDBBngDgDxBkgzgzBxBogzQJwB4gwQZ4A4A8QZIM4AcQaIM0CcAeIM
      EGeAOAPEGSD0AHEGiDNAnAHiDBBngDgDxBkgzgzBxBogzQJwB4gwQZ4A4A8QZIM4A
      cQaIM0CcAeIMEGeAOAPEGSD0AHEGiDNAnAHiDBBngDgDxBkgzgzBxBogzQJwB4gwQ
      Z4A4A8QZIM4AcQaIM0CcAeIMEGeAOAPEGSD0AHEGiDNAnAHiDBBngDgDxH2v4gHf
      P9CIuAAAAABJRu5ErkJggg==
    </Image>
    <Image Name="Reference" Width="128" Height="112" Format="RGBA8888" CompressionMode="PNG" Description="Reference">
      iVBORw0KGgoAAAANSUgAAAIAAAABwCAYAAADWrHjSAAABQE1EQVR4n03SsQ2A
      MAwAQYcJGJ6tGAoaKlpE9XdSFctF3PzaZ641M9tz1uv+8vbXv/Z/33/0zPHMhAkG
      TgBxAogTQJwA4gQQJ4A4AcQJIE4AcQKIE0CcAOIEECeAOAHECSBOAHECiBNAnADi
      BBAngDgBxAkgTgBxAogTQJwA4gQQJ4A4AcQJIE4AcQKIE0CcAOIEECeAOAHECSBO
      AHECiBNAnADiBBAngDgBxAkgTgBxAogTQJwA4gQQJ4A4AcQJIE4AcQKIE0CcAOIE
      ECeAOAHECSBOAHECiBNAnADiBBAngDgBxAkgTgBxAogTQJwA4gQQJ4A4AcQJIE4A
      cQKIE0CcAOIEECeAOAHECSBOAHECiBNAnADiBBAngDgBxAkgTgBxAogTQJwA4gQQ
      J4A4AcQJIE4AcQKIE0CcAOIEEHcDiNMEFS+y4/8AAAAASUVORK5CYII=
    </Image>
```

dEQP

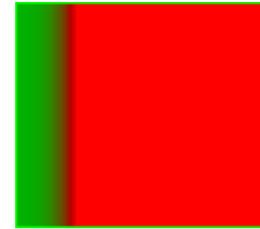
- How to convert Base64 string to PNG images:
 - <http://www.base64-image.net/>



Result



Reference



Error mask

dEQP

- It can convert XML files to CSV
\$ executor/testlog-to-csv
- No HTML output



Piglit

Piglit

- Created by Nicolai Hähnle in 2007
- Widely used in Mesa for testing and development
- MIT license
- Include tests for OpenGL, OpenGL ES, OpenCL.

<http://piglit.freedesktop.org>

Piglit

- Dependencies
 - Python 2.7.x
 - Python mako module
 - numpy
 - cmake
 - GL, glu and glut libraries and development packages (i.e. headers)
 - X11 libraries and development packages (i.e. headers)
 - Waffle: <http://www.waffle-gl.org>

Piglit

- Build:

```
$ git clone git://anongit.freedesktop.org/git/piglit
```

```
$ cmake .
```

```
$ make
```

- Check installation:

```
$ ./piglit run tests/sanity.tests results/sanity.results
```

- Your first complete piglit run:

```
$ ./piglit run tests/all results/all-run
```

Piglit

- Process results file:

- HTML output

- ```
$./piglit summary html summary/summary-all
results/all-run
```

- CLI output

- ```
$ ./piglit summary console results/all-run
```

- CSV output

- ```
$./piglit summary csv results/all-run
```

# Piglit

- CLI output

[...]

```
spec/glsl-1.50/compiler/interface-block-name-uses-gl-
prefix.vert: pass
```

```
spec/EXT_framebuffer_object/fbo-clear-formats/GL_ALPHA16 (fbo
incomplete): skip
```

```
spec/ARB_copy_image/arb_copy_image-targets
GL_TEXTURE_CUBE_MAP_ARRAY 32 32 18 GL_TEXTURE_2D_ARRAY 32 16 15 11
12 5 5 1 2 14 15 9: pass
```

```
spec/glsl-1.30/execution/built-in-functions/fs-op-bitxor-uvec3-
uint: pass
```

```
spec/ARB_depth_texture/depthstencil-render-miplevels 146 d=z16:
pass
```

```
spec/glsl-1.10/execution/variable-indexing/fs-varying-mat2-col-
row-rd: pass
```

# Piglit

summary:

pass: 25085

fail: 262

crash: 5

skip: 9746

timeout: 0

warn: 13

dmesg-warn: 0

dmesg-fail: 0

total: 35111

# Piglit

| Test Name                         | Status       |
|-----------------------------------|--------------|
| api                               | pass         |
| render                            | pass         |
| <b>ARB_pixel_buffer_object</b>    | <b>9/10</b>  |
| fbo-pbo-readpixels-small          | pass         |
| pbo-drawpixels                    | pass         |
| pbo-read-argb8888                 | pass         |
| pbo-readpixels-small              | pass         |
| pbo-textimage                     | pass         |
| pbo-textimage-tiling              | pass         |
| pbo-textimage-tiling-2            | pass         |
| texsubimage array pbo             | pass         |
| texsubimage cube_map_array pbo    | pass         |
| texsubimage pbo                   | fail         |
| <b>ARB_point_sprite</b>           | <b>1/1</b>   |
| point-sprite                      | pass         |
| <b>ARB_provoking_vertex</b>       | <b>0/0</b>   |
| arb-provoking-vertex-control      | skip         |
| arb-provoking-vertex-initial      | skip         |
| arb-provoking-vertex-render       | skip         |
| arb-quads-follow-provoking-vertex | skip         |
| arb-xfb-before-flatshading        | skip         |
| <b>ARB_robustness</b>             | <b>1/1</b>   |
| arb_robustness_client-mem-bounds  | pass         |
| <b>ARB_sample_shading</b>         | <b>22/24</b> |
| arb_sample_shading-api            | pass         |

# Piglit

spec/ARB\_pixel\_buffer\_object/texsubimage pbo - Details - Iceweasel

spec/ARB\_pixel\_buffer\_... x +

file:///home/siglesias/devel/piglit/summary/all-tests/all-tests/spec/ARB\_pixel\_buffer\_object/texsu DuckDuckGo

## Results for spec/ARB\_pixel\_buffer\_object/texsubimage pbo

### Overview

Result: None

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### Details

| Detail      | Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Returncode  | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Time        | 0:00:01.694095                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Stdout      | Using test set: Core formats<br>texsubimage failed<br>target: GL_TEXTURE_2D<br>internal format: GL_COMPRESSED_RGB_S3TC_DXT1_EXT<br>region: 24, 32 4 x 28<br>texsubimage failed<br>target: GL_TEXTURE_2D<br>internal format: GL_COMPRESSED_RGBA_S3TC_DXT1_EXT<br>region: 36, 0 60 x 20<br>texsubimage failed<br>target: GL_TEXTURE_2D<br>internal format: GL_COMPRESSED_RGBA_S3TC_DXT3_EXT<br>region: 40, 36 32 x 16<br>texsubimage failed<br>target: GL_TEXTURE_2D<br>internal format: GL_COMPRESSED_RGBA_S3TC_DXT5_EXT<br>region: 16, 12 64 x 16 |
| Stderr      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Environment | PIGLIT_SOURCE_DIR="/home/siglesias/devel/piglit" PIGLIT_PLATFORM="mixed_glx_egl"                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Command     | /home/siglesias/devel/piglit/bin/texsubimage pbo -auto -fbo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| dmesg       | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

[Back to summary](#)

# Piglit

- How to run standalone tests

```
$ bin/texsubimage pbo -auto -fbo
```

```
Using test set: Core formats
```

```
texsubimage failed
```

```
target: GL_TEXTURE_2D
```

```
internal format: GL_COMPRESSED_RGB_S3TC_DXT1_EXT
```

```
region: 8, 8 48 x 28
```

```
[...]
```

```
PIGLIT: {"result": "fail" }
```

# Piglit

- Tailor your piglit run
  - Add Dmesg information: `--dmesg`
  - Verbose: `-l verbose`
  - Run all concurrent: `--all-concurrent`
  - Disable concurrent test runs: `--no-concurrency`

# Piglit

- Tailor your piglit run
  - Execute by name (\*texture\*)  

```
$./piglit run tests/all -t texture results/all-texture
```
  - Remove tests by name (\*color\*)  

```
$./piglit run tests/all -t texture -x color results/all-texture
```
  - More information:  

```
$./piglit run -h
```

# Piglit

- Test profile
  - List of tests to be executed by piglit in a given run.
  - Usually imports other test profile and edits the list of test (add/remove).
  - Written in python.

# Piglit

```
gpu-gallium-llvmpipe.py
~/devel/piglit/tests

1 # -*- coding: utf-8 -*-
2
3 # quick.tests minus compiler tests.
4
5 from tests.quick import profile
6 from framework.glsl_parser_test import GLSLParserTest
7
8 __all__ = ['profile']
9
10 # Remove all glsl_parser_tests, as they are compiler test
11 profile.filter_tests(lambda p, t: not isinstance(t, GLSLParserTest))
12
13 # Drop ARB_vertex_program/ARB_fragment_program compiler tests.
14 del profile.tests['spec']['ARB_vertex_program']
15 del profile.tests['spec']['ARB_fragment_program']
16 del profile.tests['asmparsertest']
17
18 # Too much time on gallium llvmpipe
19 profile.tests['spec']['!OpenGL 1.0'].pop('gl-1.0-front-invalidate-back', None)
20 profile.tests['spec']['!OpenGL 1.0'].pop('gl-1.0-swapbuffers-behavior', None)
21 profile.tests['spec']['!OpenGL 1.1'].pop('read-front', None)
22 profile.tests['spec']['!OpenGL 1.1'].pop('read-front clear-front-first', None)
23 profile.tests['spec']['!OpenGL 1.1'].pop('drawbuffer-modes', None)
24 profile.tests['spec']['EXT_framebuffer_blit'].pop('fbo-sys-blit', None)
25 profile.tests['spec']['EXT_framebuffer_blit'].pop('fbo-sys-sub-blit', None)
```

Python Tab Width: 8 Ln 1, Col 1 INS

# Piglit

- DEQP GLES 3 support

```
$ export
```

```
PIGLIT_DEQP_GLES3_EXE=~ /deqp/modules/gles3/deqp-gles3
```

```
$./piglit run tests/deqp_gles3.py -t dEQP-GLES3.functional.* results/gles3-functional
```



# Conclusions

# Conclusions

- OpenGL is an API
  - Implementations can be incompatible
- Need OpenGL conformance test suites
  - Khronos provides an official one but it is not Free Software (as in speech).
  - There are unofficial Free Software alternatives:
    - Glean, dEQP, piglit



Questions?



**FOSDEM '15**

**Brussels**  
31 Jan & 1 Feb 2015



**igalia**



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