

AWS Cluster GPU RGRT

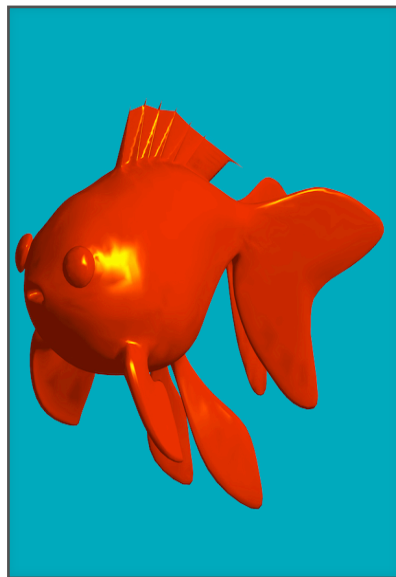
Using EC2 for GPU accelerated Ray Tracing

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CSCI E-175

Cloud Computing Software As a Service

Harvard Extension School



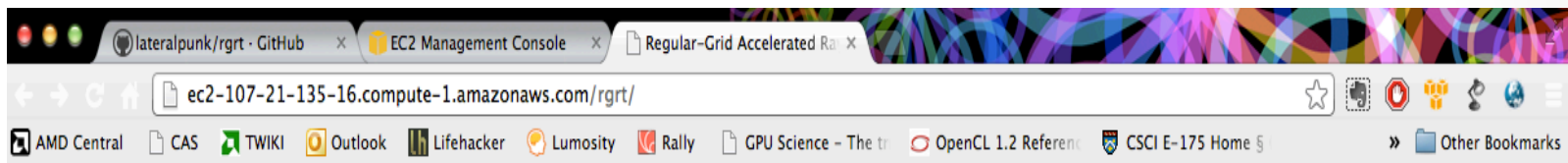
Ray-Tracing In The Cloud

- Ray Tracing is Fun
 - But takes forever
- GPUs are Awesome
 - And available in the cloud
- Solution: do Ray-Tracing in the Cloud
 - EC2 Cluster GPU Instances

Goal

- Employ EC2 to implement a CUDA based Regular-Grid Accelerated Ray Tracer (RGRT)
- Implement Web Service that exposes the RGRT
- Deploy Public AMI

Final Product



More information about the implementation of this application can be found [here](#).

Build File: 5

Grid Acceleration: Yes

Width: 1028



Height: 598



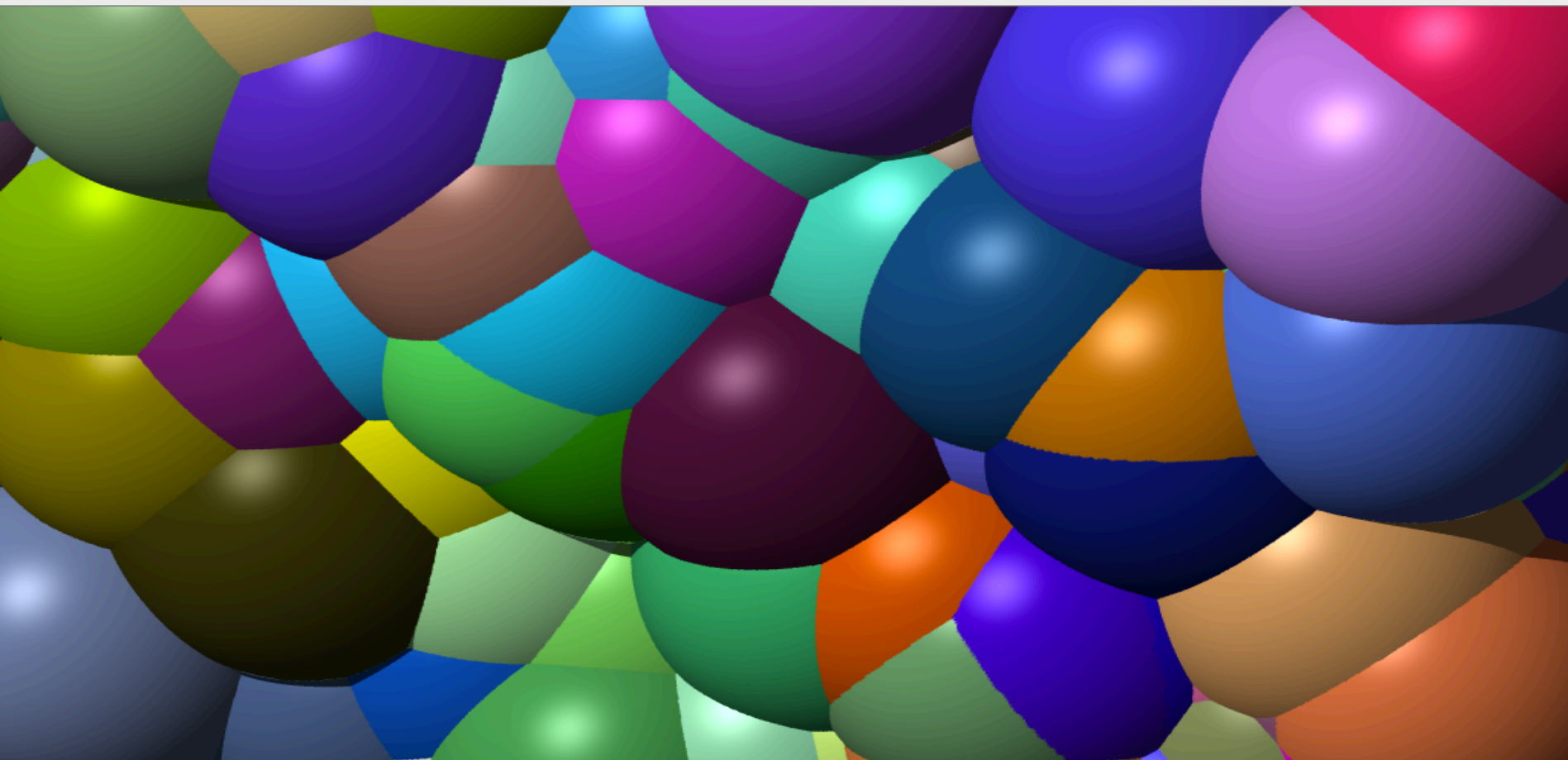
Samples: 9



Zoom: 6

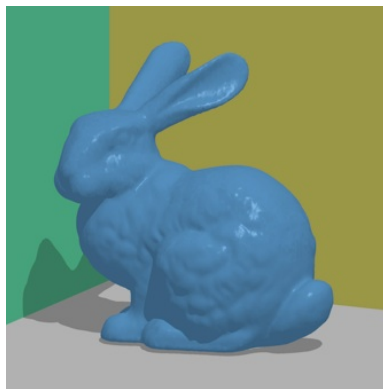


Submit



RGRT – Background Info

- Ray-tracing is embarrassingly parallel problem – great for GPU
- Brute force approach intersects with all objects in the scene
- Regular-Grid acceleration attempts to subdivide the scene into manageable buckets
 - Improves performance by not having to use all objects



Plan

1. Launch Cluster GPU instance (non-spot)
2. Setup CUDA 5 & web hosting software
3. Pull RGRT off Github
4. Ensure RGRT C binary works
5. Ensure Web service works
6. Create AMI of above for safe-keeping (make public)
7. Destroy instance from 1)
8. Launch new instance based on AMI from 6)
9. Test that it all works out off the box

Steps



Cluster Compute Amazon Linux AMI 2012.09

The Amazon Linux AMI 2012.09 is an EBS-backed, HVM image. It includes Linux 3.2, AWS tools, and repository access to multiple versions of MySQL, PostgreSQL, Python, Ruby, and Tomcat.

Root Device Size: 8 GB

☒ 64 bit ☐ 32 bit

<input checked="" type="checkbox"/>	Name	Instance	AMI ID	Root Device	Type	State	Status Checks	Alarm Status	Monitoring	Security Gr
<input checked="" type="checkbox"/>	empty	i-33e87942	ami-02f54a6b	ebs	cg1.4xlarge	running	Loading...	none	basic	default

1 EC2 Instance selected.

EC2 Instance: i-33e87942

ec2-107-21-135-16.compute-1.amazonaws.com

Description

Status Checks

Monitoring

Tags

AMI:

amzn-ami-gpu-hvm-2012.09.0.x86_64-ebs (ami-02f54a6b)

Zone: us-east-1b

Type: cg1.4xlarge

Scheduled Events: No scheduled events

VPC ID: -

Source/Dest. Check:

Placement Group:

RAM Disk ID: -

Key Pair Name: krunalkp

Monitoring: basic

Elastic IP: -

Root Device Type: ebs

Alarm Status:

none

Security Groups:

default. [view rules](#)

State:

running

Owner:

739641513028

Subnet ID:

-

Virtualization:

hvm

Reservation:

r-38808b40

Platform:

-

Kernel ID:

-

AMI Launch Index:

0

Root Device:

sda1

Tenancy:

default

```
lpdome.~ $ ssh -i ~/.ec2/krunalkp.pem ec2-user@ec2-107-21-135-16.compute-1.amazonaws.com
ssh: connect to host ec2-107-21-135-16.compute-1.amazonaws.com port 22: Connection refused
lpdome.~ $ ssh -i ~/.ec2/krunalkp.pem ec2-user@ec2-107-21-135-16.compute-1.amazonaws.com
The authenticity of host 'ec2-107-21-135-16.compute-1.amazonaws.com (107.21.135.16)' can't be established.
RSA key fingerprint is fc:f9:62:9b:16:31:64:78:e3:e6:28:77:2a:da:0b:68.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'ec2-107-21-135-16.compute-1.amazonaws.com,107.21.135.16' (RSA) to the list of known hosts.
```

```
  _|  _|_ )
 _| ( _|_ /
_| \_|_|_|
```

Amazon Linux AMI

```
https://aws.amazon.com/amazon-linux-ami/2012.09-release-notes/
There are 4 security update(s) out of 51 total update(s) available
Run "sudo yum update" to apply all updates.
[ec2-user@ip-10-16-7-196 ~]$
```

```
[ec2-user@ip-10-16-7-196 ~]$ lspci | grep -i nvidia
00:03.0 3D controller: NVIDIA Corporation GF100 [Tesla S2050] (rev a3)
00:04.0 3D controller: NVIDIA Corporation GF100 [Tesla S2050] (rev a3)
```

```
[ec2-user@ip-10-16-7-196 ~]$ uname -m && cat /etc/*release
x86_64
Amazon Linux AMI release 2012.09
```

```
[ec2-user@ip-10-16-7-196 ~]$ mkdir tmp
[ec2-user@ip-10-16-7-196 ~]$ cd tmp/
[ec2-user@ip-10-16-7-196 tmp]$ wget http://developer.download.nvidia.com/compute/cuda/5_0/rel-update-1/installers/cuda_5.0.35_linux_64_rhel6.x-1.run
--2013-01-09 22:21:17-- http://developer.download.nvidia.com/compute/cuda/5_0/rel-update-1/installers/cuda_5.0.35_linux_64_rhel6.x-1.run
Resolving developer.download.nvidia.com... 165.254.27.114, 165.254.27.81
Connecting to developer.download.nvidia.com|165.254.27.114|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 702136770 (670M) [application/octet-stream]
Saving to: "cuda_5.0.35_linux_64_rhel6.x-1.run"

100%[=====>] 702,136,770 22.2M/s in 30s

2013-01-09 22:21:47 (22.6 MB/s) - "cuda_5.0.35_linux_64_rhel6.x-1.run" saved [702136770/702136770]

[ec2-user@ip-10-16-7-196 tmp]$ █
```

```
[ec2-user@ip-10-16-7-196 tmp]$ sudo yum install kernel-devel
Loaded plugins: priorities, security, update-motd, upgrade-helper
Setting up Install Process
Resolving Dependencies
--> Running transaction check
---> Package kernel-devel.x86_64 0:3.2.34-55.46.amzn1 will be installed
--> Finished Dependency Resolution
```

Dependencies Resolved

Package	Arch	Version	Repository	Size
Installing:				
kernel-devel	x86_64	3.2.34-55.46.amzn1	amzn-updates	7.3 M

Transaction Summary

Install 1 Package(s)

Total download size: 7.3 M

Installed size: 26 M

```
[ec2-user@ip-10-16-7-196 tmp]$ sudo sh cuda_5.0.35_linux_64_rhel6.x-1.run
Logging to /tmp/cuda install 1849.log
```

```
Do you accept the previously read EULA? (accept/decline/quit): accept
Install NVIDIA Accelerated Graphics Driver for Linux-x86_64 304.54? ((y)es/(n)o/(q)uit): y
Install the CUDA 5.0 Toolkit? ((y)es/(n)o/(q)uit): y
Enter Toolkit Location [ default is /usr/local/cuda-5.0 ]:
Install the CUDA 5.0 Samples? ((y)es/(n)o/(q)uit): y
Enter CUDA Samples Location [ default is /usr/local/cuda-5.0/samples ]: █
```

```
=====
= Summary =
=====
```

```
Driver:    Installed
Toolkit:   Installed in /usr/local/cuda-5.0
Samples:   Installed in /usr/local/cuda-5.0/samples (pristine) and /root/NVIDIA_CUDA-5.0_Samples (writable)
```

```
* Please make sure your PATH includes /usr/local/cuda-5.0/bin
* Please make sure your LD_LIBRARY_PATH
*   for 32-bit Linux distributions includes /usr/local/cuda-5.0/lib
*   for 64-bit Linux distributions includes /usr/local/cuda-5.0/lib64:/lib
* OR
*   for 32-bit Linux distributions add /usr/local/cuda-5.0/lib
*   for 64-bit Linux distributions add /usr/local/cuda-5.0/lib64 and /lib
* to /etc/ld.so.conf and run ldconfig as root
```

```
* To uninstall CUDA, remove the CUDA files in /usr/local/cuda-5.0
* Installation Complete
```

```
Please see CUDA_Getting_Started_Guide_For_Linux.pdf in /usr/local/cuda-5.0/doc/pdf for detailed information on setting up CUDA.
```

Detected 2 CUDA Capable device(s)

```
Device 0: "Tesla M2050"
CUDA Driver Version / Runtime Version      5.0 / 5.0
CUDA Capability Major/Minor version number: 2.0
Total amount of global memory:              2687 MBytes (2817982464 bytes)
(14) Multiprocessors x ( 32) CUDA Cores/MP: 448 CUDA Cores
GPU Clock rate:                             1147 MHz (1.15 GHz)
Memory Clock rate:                          1546 Mhz
Memory Bus Width:                           384-bit
L2 Cache Size:                              786432 bytes
Max Texture Dimension Size (x,y,z)          1D=(65536), 2D=(65536,65535), 3D=(2048,2048,2048)
Max Layered Texture Size (dim) x layers    1D=(16384) x 2048, 2D=(16384,16384) x 2048
Total amount of constant memory:            65536 bytes
Total amount of shared memory per block:    49152 bytes
Total number of registers available per block: 32768
Warp size:                                  32
Maximum number of threads per multiprocessor: 1536
Maximum number of threads per block:        1024
Maximum sizes of each dimension of a block: 1024 x 1024 x 64
Maximum sizes of each dimension of a grid:  65535 x 65535 x 65535
Maximum memory pitch:                       2147483647 bytes
Texture alignment:                          512 bytes
Concurrent copy and kernel execution:       Yes with 2 copy engine(s)
Run time limit on kernels:                  No
Integrated GPU sharing Host Memory:         No
Support host page-locked memory mapping:    Yes
Alignment requirement for Surfaces:         Yes
Device has ECC support:                     Enabled
Device supports Unified Addressing (UVA):    Yes
Device PCI Bus ID / PCI location ID:        0 / 3
Compute Mode:
    < Default (multiple host threads can use ::cudaSetDevice() with device simultaneously) >
```

```
Device 1: "Tesla M2050"
CUDA Driver Version / Runtime Version      5.0 / 5.0
CUDA Capability Major/Minor version number: 2.0
Total amount of global memory:              2687 MBytes (2817982464 bytes)
(14) Multiprocessors x ( 32) CUDA Cores/MP: 448 CUDA Cores
GPU Clock rate:                             1147 MHz (1.15 GHz)
Memory Clock rate:                          1546 Mhz
Memory Bus Width:                           384-bit
L2 Cache Size:                              786432 bytes
Max Texture Dimension Size (x,y,z)          1D=(65536), 2D=(65536,65535), 3D=(2048,2048,2048)
Max Layered Texture Size (dim) x layers    1D=(16384) x 2048, 2D=(16384,16384) x 2048
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Maximum sizes of each dimension of a grid:  65535 x 65535 x 65535
Maximum memory pitch:                       2147483647 bytes
Texture alignment:                          512 bytes
Concurrent copy and kernel execution:       Yes with 2 copy engine(s)
Run time limit on kernels:                  No
Integrated GPU sharing Host Memory:         No
Support host page-locked memory mapping:    Yes
Alignment requirement for Surfaces:         Yes
Device has ECC support:                     Enabled
Device supports Unified Addressing (UVA):    Yes
Device PCI Bus ID / PCI location ID:        0 / 4
Compute Mode:
    < Default (multiple host threads can use ::cudaSetDevice() with device simultaneously) >
```

```
[c2-user@ip-10-16-7-196 ~]$ sudo yum install httpd24 php54
Loaded plugins: priorities, security, update-motd, upgrade-helper
amzn-gpu | 2.1 kB 00:00
amzn-main | 2.1 kB 00:00
```

```
Setting up Install Process
Resolving Dependencies
--> Running transaction check
--> Package httpd24.x86_64 0:2.4.3-10.35.amzn1 will be installed
--> Processing Dependency: httpd24-tools = 2.4.3-10.35.amzn1 for package: httpd24-2.4.3-10.35.amzn1.x86_64
--> Processing Dependency: libaprutil-1.so.0()(64bit) for package: httpd24-2.4.3-10.35.amzn1.x86_64
--> Processing Dependency: libapr-1.so.0()(64bit) for package: httpd24-2.4.3-10.35.amzn1.x86_64
--> Package php54.x86_64 0:5.4.9-1.28.amzn1 will be installed
--> Processing Dependency: php54-common(x86-64) = 5.4.9-1.28.amzn1 for package: php54-5.4.9-1.28.amzn1.x86_64
--> Processing Dependency: php54-cli(x86-64) = 5.4.9-1.28.amzn1 for package: php54-5.4.9-1.28.amzn1.x86_64
--> Running transaction check
--> Package apr.x86_64 0:1.4.6-1.10.amzn1 will be installed
--> Package apr-util.x86_64 0:1.4.1-4.13.amzn1 will be installed
--> Package httpd24-tools.x86_64 0:2.4.3-10.35.amzn1 will be installed
--> Package php54-cli.x86_64 0:5.4.9-1.28.amzn1 will be installed
--> Package php54-common.x86_64 0:5.4.9-1.28.amzn1 will be installed
--> Finished Dependency Resolution
```

Dependencies Resolved

Package	Arch	Version	Repository	Size
Installing:				
httpd24	x86_64	2.4.3-10.35.amzn1	amzn-updates	1.2 M
php54	x86_64	5.4.9-1.28.amzn1	amzn-updates	3.1 M
Installing for dependencies:				
apr	x86_64	1.4.6-1.10.amzn1	amzn-main	110 k
apr-util	x86_64	1.4.1-4.13.amzn1	amzn-main	87 k
httpd24-tools	x86_64	2.4.3-10.35.amzn1	amzn-updates	83 k
php54-cli	x86_64	5.4.9-1.28.amzn1	amzn-updates	2.9 M
php54-common	x86_64	5.4.9-1.28.amzn1	amzn-updates	969 k

Transaction Summary

```
Install      7 Package(s)

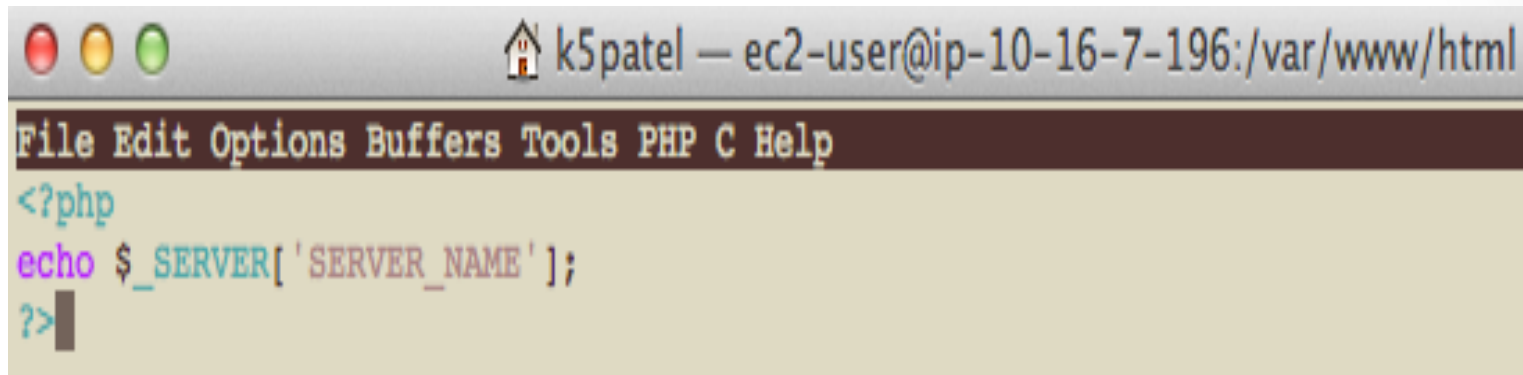
Total download size: 8.3 M
Installed size: 26 M
Is this ok [y/N]:
```



```

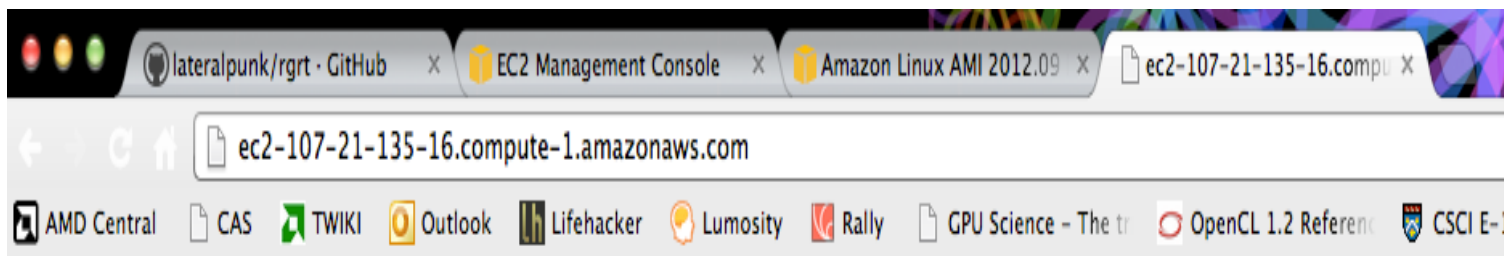
[ec2-user@ip-10-16-7-196 ~]$ sudo chkconfig httpd on
[ec2-user@ip-10-16-7-196 ~]$ chkconfig --list
acpid                0:off    1:off    2:on     3:on     4:on     5:on     6:off
atd                  0:off    1:off    2:off    3:on     4:on     5:on     6:off
auditd              0:off    1:off    2:on     3:on     4:on     5:on     6:off
cloud-init           0:off    1:off    2:on     3:on     4:on     5:on     6:off
cloud-init-user-scripts 0:off    1:off    2:on     3:on     4:on     5:on     6:off
crond                0:off    1:off    2:on     3:on     4:on     5:on     6:off
httpd                0:off    1:off    2:on     3:on     4:on     5:on     6:off
ip6tables            0:off    1:off    2:on     3:on     4:on     5:on     6:off
iptables             0:off    1:off    2:on     3:on     4:on     5:on     6:off
irqbalance           0:off    1:off    2:off    3:on     4:on     5:on     6:off
lvm2-monitor         0:off    1:on     2:on     3:on     4:on     5:on     6:off
mdmonitor            0:off    1:off    2:on     3:on     4:on     5:on     6:off
messagebus           0:off    1:off    2:on     3:on     4:on     5:on     6:off
netconsole            0:off    1:off    2:off    3:off    4:off    5:off    6:off
netfs                0:off    1:off    2:off    3:on     4:on     5:on     6:off
network              0:off    1:off    2:on     3:on     4:on     5:on     6:off
ntpd                 0:off    1:off    2:on     3:on     4:on     5:on     6:off
ntpdate              0:off    1:off    2:on     3:on     4:on     5:on     6:off
nvidia               0:off    1:off    2:off    3:on     4:on     5:on     6:off
psacct               0:off    1:off    2:off    3:off    4:off    5:off    6:off
racoon               0:off    1:off    2:off    3:off    4:off    5:off    6:off
rdisc                0:off    1:off    2:off    3:off    4:off    5:off    6:off
rsyslog              0:off    1:off    2:on     3:on     4:on     5:on     6:off
ssld                 0:off    1:off    2:off    3:off    4:off    5:off    6:off
sendmail             0:off    1:off    2:on     3:on     4:on     5:on     6:off
sshd                 0:off    1:off    2:on     3:on     4:on     5:on     6:off
udev-post            0:off    1:on     2:on     3:on     4:on     5:on     6:off

```



A screenshot of a web browser window. The address bar shows the URL `http://ec2-107-21-135-16.compute-1.amazonaws.com/`. The browser has several tabs open: `lateralpunk/rgrt · GitHub`, `EC2 Management Console`, `Amazon Linux AMI 2012.09`, and `ec2-107-21-135-16.compute-1.amazonaws.com`. The main content area displays a PHP script in a text editor. The script is as follows:

```
<?php
echo $_SERVER['SERVER_NAME'];
?>
```



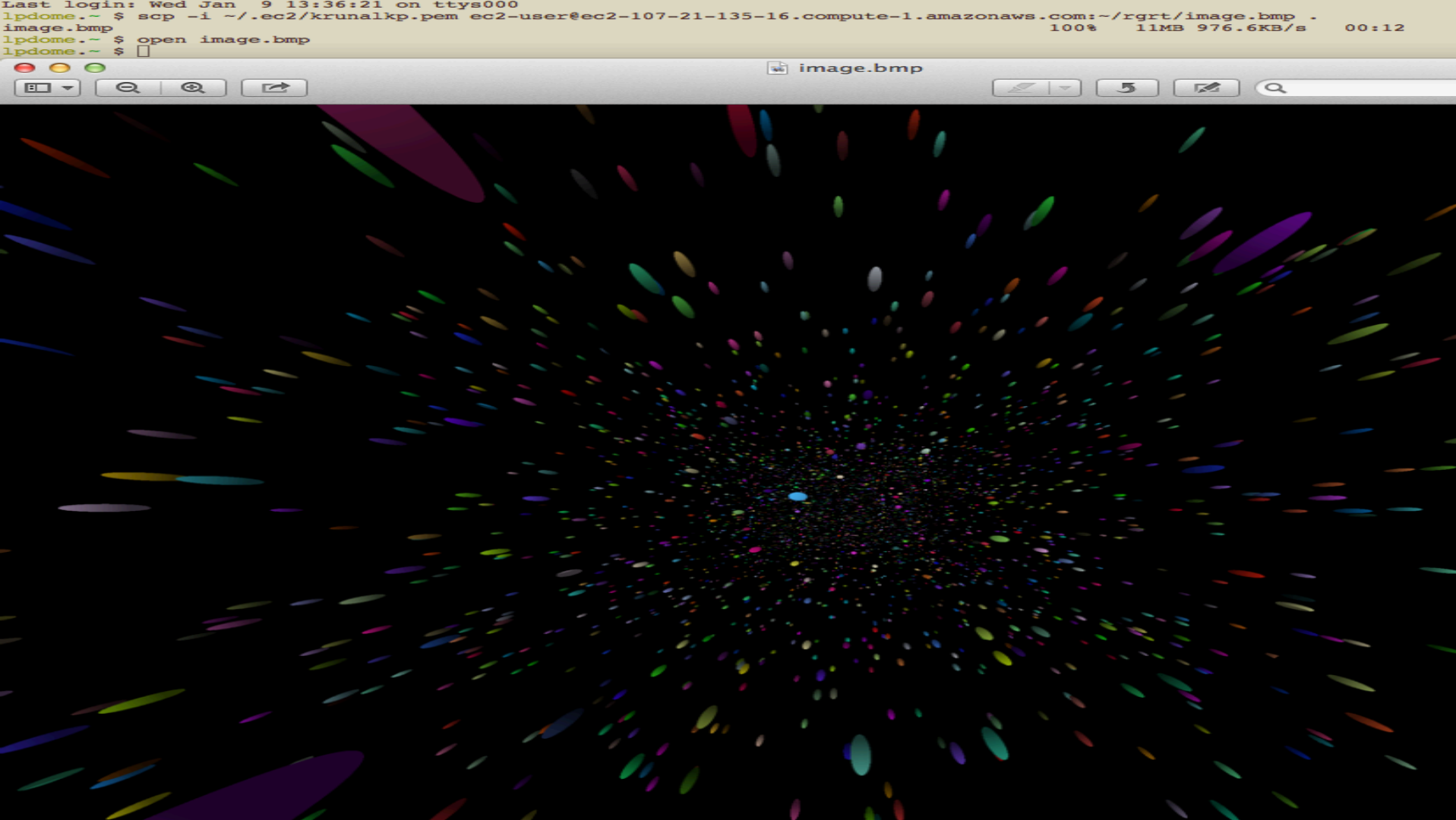
ec2-107-21-135-16.compute-1.amazonaws.com


```
[ec2-user@ip-10-16-7-196 ~]$ git clone https://github.com/lateralpunk/rgrt.git
Cloning into rgrt...
remote: Counting objects: 72, done.
remote: Compressing objects: 100% (64/64), done.
remote: Total 72 (delta 7), reused 69 (delta 7)
Unpacking objects: 100% (72/72), done.
```

```
[ec2-user@ip-10-16-7-196 rgrt]$ pwd
/home/ec2-user/rgrt
[ec2-user@ip-10-16-7-196 rgrt]$ make
make[1]: Entering directory `/home/ec2-user/rgrt/cuda'
/usr/local/cuda/bin/nvcc -m64 -gencode arch=compute_10,code=sm_10 -gencode arch=compute_20,code=sm_20 -gencode arch=compute_30,code=sm_30 -gencode arch=compute_35,code=sm_35 -I/usr/local/cuda/include -I. -I.. -I/usr/local/cuda/samples/common/inc -o main.o -c main.cu
```

```
g++ -m64 -o rgrt-cuda main.o bmploader.o plyfile.o -L/usr/local/cuda/lib64 -lcudart
mkdir -p ../bin/linux/release
cp rgrt-cuda ../bin/linux/release
make[1]: Leaving directory `/home/ec2-user/rgrt/cuda'
Finished building RGRT
```

```
[ec2-user@ip-10-16-7-196 rgrt]$ bin/linux/release/rgrt-cuda -b=build02 -g=1 -w=2000 -h=2000 -n=1 -o=image.bmp
*** Configuration - b: build02, o: image.bmp, g: 1, w: 2000, h: 2000, n: 1, z: 1.00, m: 0, s: 1, p: 0 ****
Starting ray-tracing...
Reorganizing Data Structures...
  Not going to use host pinned memory...
  Using Grid acceleration...
    Organizing grid cells...
      Stats: # of cells that have 0 objects, 1 object, 2 objects, etc...
      num_cells = 5832
      numZeroes = 302, numOnes = 759, numTwos = 1115
      numThrees = 1232 numGreater = 2424
    Finished grid cell organization.
  Finished Consolidation.
World Stats:
  Total # of GeometricObjects: 24379
  Approximate bytes of data: 3901144 bytes
Starting CPU ray tracing...
Starting GPU ray tracing...
  # of threads in a block: 16 x 8 (128)
  # of blocks in a grid : 125 x 250 (31250)
Calculating accuracy...
  Error : 0.008568
Imaged saved: image.bmp
Finished ray-tracing...
[ec2-user@ip-10-16-7-196 rgrt]$ ls image.bmp
image.bmp
```



```
<Directory "/rgrt/www">
    Options Indexes FollowSymLinks
    AllowOverride None
    Require all granted
</Directory>
```

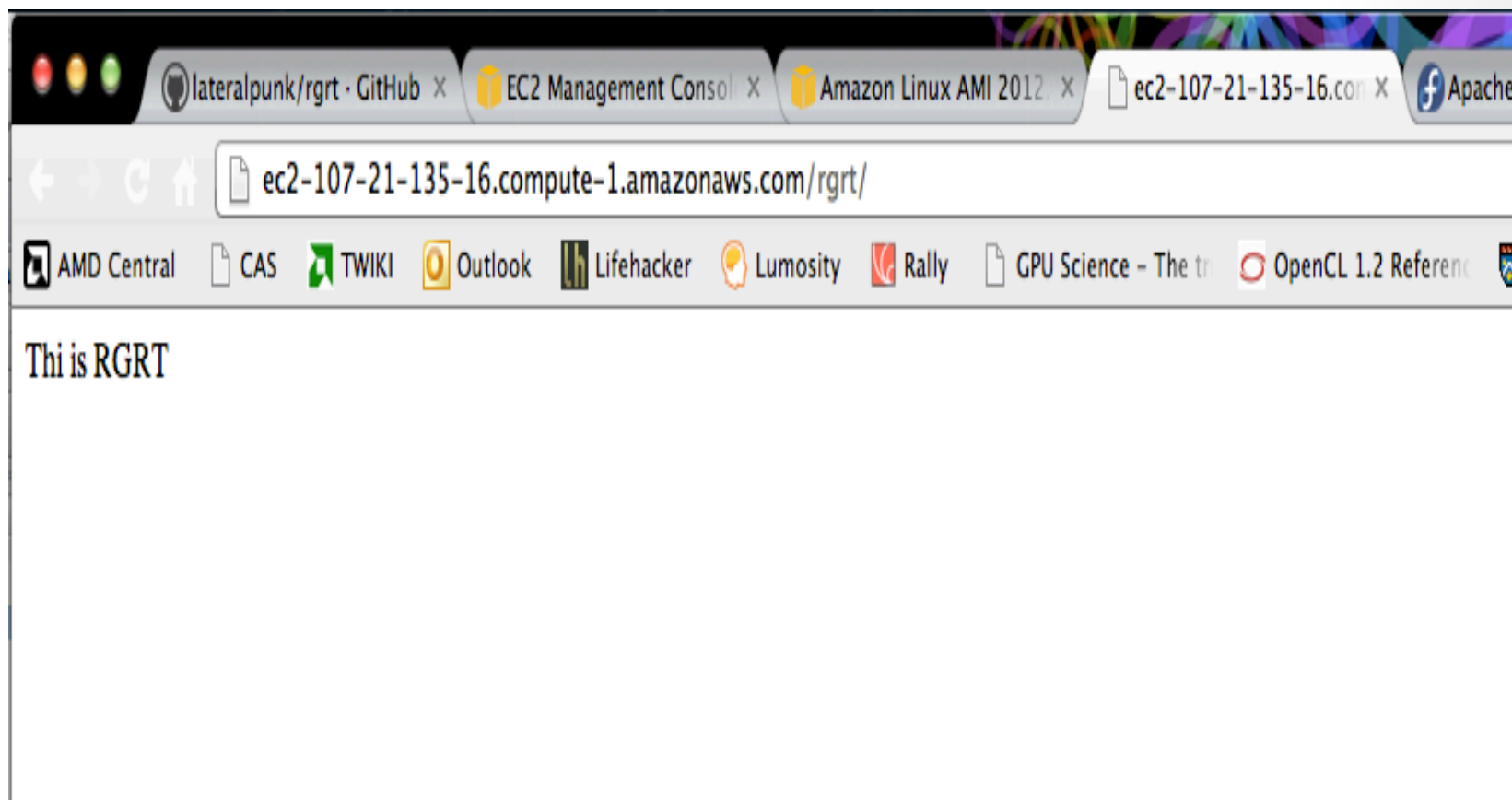
```
<IfModule alias_module>
    #
    # Redirect: Allows you to tell clients about documents that used to
    # exist in your server's namespace, but do not anymore. The client
    # will make a new request for the document at its new location.
    # Example:
    # Redirect permanent /foo http://www.example.com/bar

    #
    # Alias: Maps web paths into filesystem paths and is used to
    # access content that does not live under the DocumentRoot.
    # Example:
    # Alias /webpath /full/filesystem/path
    #
    # If you include a trailing / on /webpath then the server will
    # require it to be present in the URL. You will also likely
    # need to provide a <Directory> section to allow access to
    # the filesystem path.

    #
    # ScriptAlias: This controls which directories contain server scripts.
    # ScriptAliases are essentially the same as Aliases, except that
    # documents in the target directory are treated as applications and
    # run by the server when requested rather than as documents sent to the
    # client. The same rules about trailing "/" apply to ScriptAlias
    # directives as to Alias.
    #
    ScriptAlias /cgi-bin/ "/var/www/cgi-bin/"

    Alias /rgrt/rgrt/www

</IfModule>
```



```

<?php
    //ensure that the script doesn't time out
    set_time_limit(0);

    if (isset($_POST['doit'])) {
        //defaults
        $build = $_POST['build'];
        $g = $_POST['grid'];
        $width = $_POST['width'];
        $height = $_POST['height'];
        $n = $_POST['samples'];
        $z = $_POST['zoom'];
        $o = "/rgrt/www/images/" . uniqid('rgrt-', true) . "-rgrt.bmp";

        //ok execute the rgrt-cuda program.
        shell_exec("export LD_LIBRARY_PATH=/usr/local/cuda-5.0/lib:/usr/local/cuda-5.0/lib64:\$LD_LIBRARY_PATH;cd /rgrt/bin/linux/release/rgrt-cuda m=1 -g=\". $g .\" -b=\". $build .\" -w=\". $width .\" -h=\". $height .\" -n=\". $n .\" -z=\". $z .\" -p=0 -o=\". $o);

        //now use the Linux at command to delete the newly created file after 15 minutes
        shell_exec("export SHELL=/bin/bash && echo rm -f \". $o .\" | at now + 15 minutes");

        //sleep for a sec
        sleep(2);

        //now show the user the image:
        header('Location: images/' . strrrchr($o, '/'));

        exit;
    }
}

```

?>

```

<!doctype html>

<html lang="en">
<head>
    <meta charset="utf-8" />
    <title>Regular-Grid Accelerated Ray Tracing</title>
    <link rel="stylesheet" href="http://code.jquery.com/ui/1.9.2/themes/base/jquery-ui.css" />
    <script src="http://code.jquery.com/jquery-1.8.3.js"></script>
    <script src="http://code.jquery.com/ui/1.9.2/jquery-ui.js"></script>
    <link rel="stylesheet" href="style.css" />
</script>

```

```

$(function() {
    $( "#slider-width" ).slider({
        range: "max",
        min: 16,
        max: 4096,
        value: 512,
        step: 2,
        slide: function( event, ui ) {
            $( "#width" ).val( ui.value );
        }
    });
}

```

```

    }
    });
    $( "#width" ).val( $( "#slider-width" ).slider( "value" ) );
    });

$(function() {
    $( "#slider-height" ).slider({
        range: "max",
        min: 16,
        max: 4096,
        value: 512,
        step: 2,
        slide: function( event, ui ) {
            $( "#height" ).val( ui.value );
        }
    });
    $( "#height" ).val( $( "#slider-height" ).slider( "value" ) );
    });

$(function() {
    $( "#slider-samples" ).slider({
        range: "max",
        min: 1,
        max: 256,
        value: 1,
        step: 1,
        slide: function( event, ui ) {
            $( "#samples" ).val( ui.value );
        }
    });
    $( "#samples" ).val( $( "#slider-samples" ).slider( "value" ) );
    });

$(function() {
    $( "#slider-zoom" ).slider({
        range: "max",
        min: -1024,
        max: 1024,
        value: 1,
        step: 1,
        slide: function( event, ui ) {
            $( "#zoom" ).val( ui.value );
        }
    });
    $( "#zoom" ).val( $( "#slider-zoom" ).slider( "value" ) );
    });

```

```

</script>
</head>
<body>

```

```

<form action="index.php" method="post">
<input type="hidden" name="doit" value="doit">

```

```

<label>Build File:</label>
<select name="build">
<option value="build01">1</option>
<option value="build02">2</option>
<option value="build03">3</option>
<option value="build04">4</option>
<option value="build05">5</option>
<option value="build06">6</option>
<option value="build07">7</option>
<option value="build08">8</option>
<option value="build09">9</option>
</select>
</p>

<p>
<label>Grid Acceleration:</label>
<select name="grid">
<option value="1">Yes</option>
<option value="0">No</option>
</select>
</p>

<p>
  <label>Width:</label>
  <input type="text" id="width" name="width" style="border: 0; color: #f6931f; font-weight: bold;" />
</p>
<div id="slider-width"></div>

<p>
  <label>Height:</label>
  <input type="text" id="height" name="height" style="border: 0; color: #f6931f; font-weight: bold;" />
</p>
<div id="slider-height"></div>

<p>
  <label>Samples:</label>
  <input type="text" id="samples" name="samples" style="border: 0; color: #f6931f; font-weight: bold;" />
</p>
<div id="slider-samples"></div>

<p>
  <label>Zoom:</label>
  <input type="text" id="zoom" name="zoom" style="border: 0; color: #f6931f; font-weight: bold;" />
</p>
<div id="slider-zoom"></div>

<br/>
<input type="submit" value="Submit">

</form>

</body>
</html>

```


More information about the implementation of this application can be found [here](#).

Build File: 5

Grid Acceleration: Yes

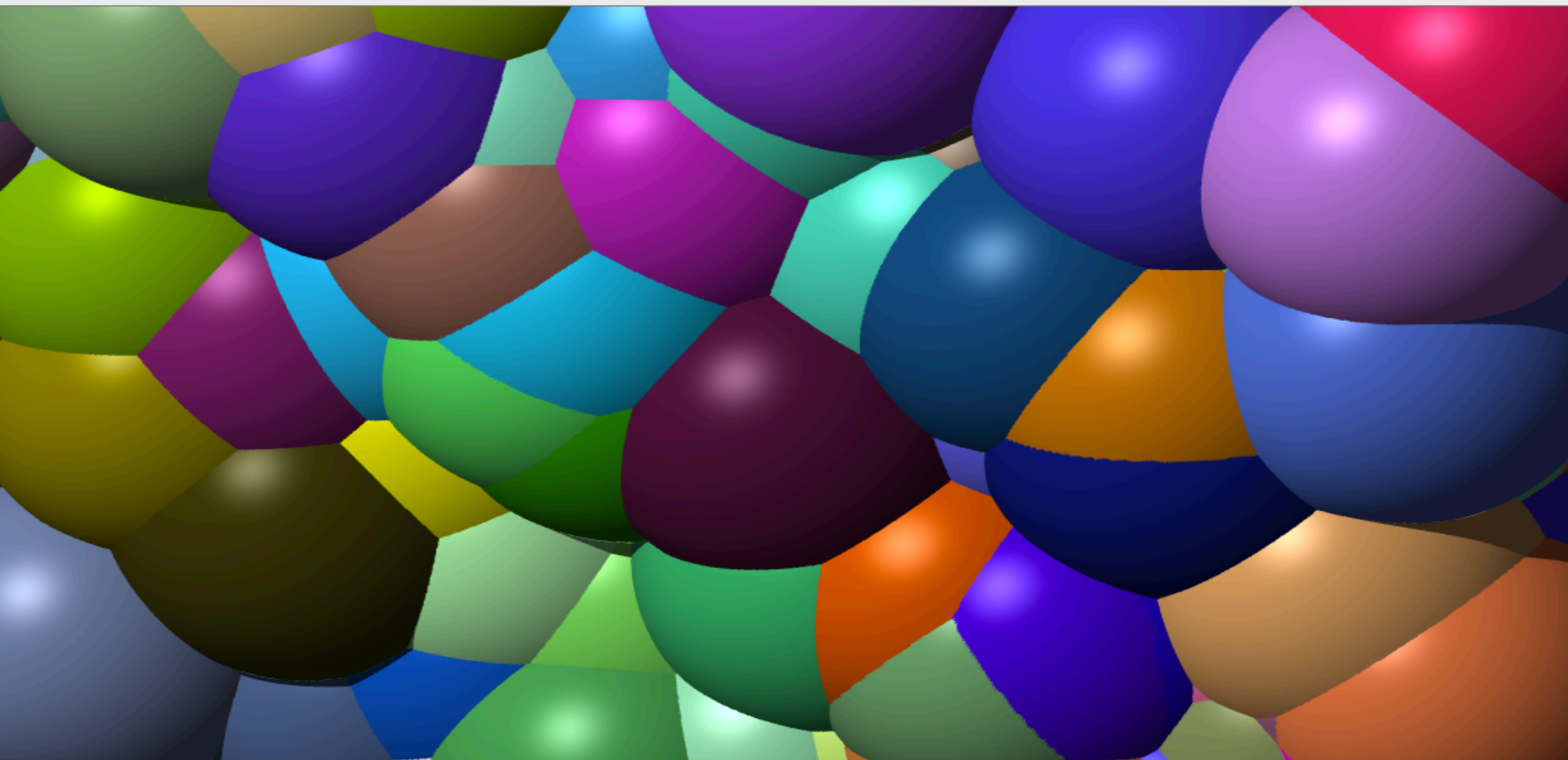
Width: 1028

Height: 598





Samples: 9

Zoom: 6


Submit



```
lpdome.~ $ ec2-create-image -n rgrt_image i-33e87942  
IMAGE    ami-85d35bec
```

<input checked="" type="checkbox"/>	Name 	AMI ID	Source	Owner	Visibility	Status	Platform
<input checked="" type="checkbox"/>	empty	 ami-85d35bec	739641513028/rgrt_image	739641513028	Private	 available	 Other

Set AMI Permissions

Cancel 


This image is currently Private

☒ Public ☐ Private

Cancel

Yes, Edit

Request Instances Wizard

Cancel 



CHOOSE AN AMI

INSTANCE DETAILS

CREATE KEY PAIR

CONFIGURE FIREWALL

REVIEW

Choose an Amazon Machine Image (AMI) from one of the tabbed lists below by clicking its **Select** button.

Quick Start

My AMIs

Community AMIs

AWS Marketplace

Viewing:




Public Images

ami-85d35bec



1 to 1 of 1 Items



AMI ID	Root Device	Manifest	Platform	
 ami-85d35bec	ebs	739641513028/rgrt_image	 Other Linux	Select 

Request Instances Wizard

[Cancel](#)

- CHOOSE AN AMI
- INSTANCE DETAILS
- CREATE KEY PAIR
- CONFIGURE FIREWALL
- REVIEW

AMI: Other Linux AMI ID ami-85d35bec (x86_64) [Edit AMI](#)

Number of Instances:	1	Availability Zone:	No Preference
Instance Class:	Spot	Maximum Price:	\$0.370
Request Valid From:	any time	Availability Zone Group:	none
Request Valid Until:	any time	Launch Group:	none
Persistent Request:	No	Edit Instance Details	
EBS-Optimized:	No		

Placement Group:

Strategy:

Monitoring: Disabled

Tenancy: Default

Network Interfaces:

Secondary IP Addresses:








User Data:

IAM Role: [Edit Advanced Details](#)

Key Pair Name: krunalkp [Edit Key Pair](#)

Security Group(s): sg-5cc83b35 [Edit Firewall](#)

[< Back](#)[Submit](#)

<input type="checkbox"/>	Name	Instance	AMI ID	Root Device	Type	State	Status Checks	Alarm Status	Monitoring	Security G
<input type="checkbox"/>	empty	 i-33e87942	ami-02f54a6b	ebs	cg1.4xlarge	 running	 2/2 checks pa	none	basic	default
<input checked="" type="checkbox"/>	empty	 i-8d5ec3fc	ami-85d35bec	ebs	cg1.4xlarge	 running	 2/2 checks pa	none	 basic	default

1 EC2 Instance selected.

 **EC2 Instance:** i-8d5ec3fc 

ec2-50-16-11-252.compute-1.amazonaws.com

Description

Status Checks

Monitoring

Tags

AMI: rgrt_image (ami-85d35bec)

Zone: us-east-1c

Type: cg1.4xlarge

Scheduled Events: No scheduled events

VPC ID: -

Source/Dest. Check:

Placement Group:

RAM Disk ID: -

Key Pair Name: krunalkp

Monitoring: basic

Elastic IP: -

Root Device Type: ebs

IAM Role: -

Alarm Status: none

Security Groups: default. [view rules](#)

State: running

Owner: 739641513028

Subnet ID: -

Virtualization: hvm

Reservation: r-88e7f3f0

Platform: -

Kernel ID: -

AMI Launch Index: 0

Root Device: sda1

Tenancy: default

Lifecycle: spot

Insert video of demo here