Programming Fractals in 3D Workshop 1: Fractals in nature





1	; recursive tree
2	;
3	TO tree :size
4	if :size < 5 [forward :size jumpback :size stop]
5	forward :size/3
6	left 30 tree :size*2/3 right 30
7	forward :size/6
8	right 25 tree :size/2 left 25
9	forward :size/3
L 0	right 25 tree :size/2 left 25
11	forward :size/6
12	jumpback :size
13	END
14	clearscreen
15	cm ; change to cemtimeter
16	line ; change to line mode
17	nextcoloron ; rotate pen color
18	ru 90
19	pd tree 100 pu

## Programming fractals in 3D VR

Workshop for Asian Technology Conference in Mathematics (ATCM)

Date/Time: 16<sup>th</sup> December 2017, 4 pm ~ 5 pm

Venue: Computer Lab 504, Science Building II Chung Yuan Christian University, Taiwan

## Handbook for Programming Fractals in 3D Virtual Reality: Fractals in Nature

### VRMath2 Workshop 1

VRMath<sub>2</sub> Community

https://vrmath2.net

is a free online learning environment for STEM

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### 1. Aims and requirements

### Aims

In this hands-on workshop, participants will use a Logo programming language to create fractal geometry in an online 3D virtual reality learning environment named VRMath2. VRMath2 is freely available at <a href="https://vrmath2.net">https://vrmath2.net</a>.

Using the Logo programming language in VRMath2, fractals such as Fern leaves, Trees, Koch curve (snowflake), Sierpinski triangle and carpet, Dragon and Peano curves etc. can be described, experimented, and created using the Logo turtle geometry, and recursive and random capabilities of the programming language. Further, these fractals can be extended to 3D (not to confuse with fractal dimension) in VRMath2's virtual reality interactive space, and presented online in web browsers and/or viewed with Cardboard VR.

Participants will be introduced with a basic structure of recursive function and Logo programming, then they will be able to experiment and invent variations of fractals in 3D. All these will be done online in a web browser. Participants can also publish their fractals online in the VRMath2 website.

In this Workshop, there will be a brief introduction to Logo programing and turtle geometry, then we will focus on creating fractals in the nature, specifically on creating:

- 1. Fern leaves and variants in 2D and 3D.
- 2. Trees variants in 2D and 3D.

### Requirements

- Computer lab (Windows or Mac) with Internet access.
- Web browser (Chrome, Firefox or Safari).
- No Logo programming experience required.
- A mobile phone (e.g., iPhone 6 or newer, Android 6 or newer phone) is optional but encouraged for viewing the created 3D models. Mobile phone needs to have a QR Code App (e.g., i-nigma) installed.
- CardBoard or VR box is optional. There will be some provided in the workshop.
- Time: 1 hour

### 2. VRMath2 introduction

VRMath2 stands for Virtual Reality Mathematics 2.0. It started in Year 2001 as an online learning environment for constructing knowledge of 3D geometry. Over the year, it has evolved to become a STEM (Science, Technology, Engineering and Mathematics) integrated learning environment. The 2.0 indicates that the website is a Web 2.0 style website, which allows users to design, create, share and discuss about the 3D virtual worlds they create. In this workshop, for example, you will be creating 3D atomic models in digital virtual space. While you are constructing a 3D atomic model for science, you will also need and learn about coding (technology, computational thinking), and use mathematics (e.g., geometry, trigonometry) to design and solve problems (engineering your atomic models).

#### VRMath2 Community site (<u>https://vrmath2.net</u>)



The community website is the portal site for VRMath2. In this website, you can browse through community members' blogs, provide your comments, ask and answer questions in the discussion forums, create wiki pages, and most importantly, blog to share your creations of 3D virtual worlds.

#### VRMath2 Editor (<u>https://vrmath2.net/VRM2</u>)



The Editor is a powerful online tool for creating 3D contents. You just run it as a software in a web browser such Google Chrome (PC) and mobile Safari (for iPad). It has friendly user interface and a LOGO programming language for creating 3D contents. All works in the Editor can be saved online in your account space and share (blog) later.

#### VRMath2 VRBox (for mobile device only, <a href="https://vrmath2.net/vrbox">https://vrmath2.net/vrbox</a>)



This is a recent application and is still developing. Using a CardBoard VR Box with a mobile phone (e.g., iPhone 6 and above, Android 6 and above), you can view all your 3D contents created and all 3D contents shared in VRMath2 websites. In this workshop, you will be able to see your 3D models or any models published in VRMath2 in a VR CardBoard.

### 2.1 Create an account

VRMath2 is a free online learning environment. Without needing an account to login, visitors can browse most of the website contents and create 3D contents with VRMath2 Editor. However, with an account, users can further share, discuss, comment and save files to personal folders.

To create an account, simply follow the link below to register.

#### https://vrmath2.net/user/register

You should choose a sensible username, and enter a valid email address to register. After registering, an email will be sent to your registered email address. This email includes an auto-generated password and a one-time login link (can be used once only).

### Status

Your password and further instructions have been sent to your e-mail address.

It is highly recommended that you click on the one-time login link, which will bring you to your account. Then you can click on the **Edit** tab to change password, select/upload own account picture, add your real name and other information.

Home	Home $ ightarrow$ My account $ ightarrow$						
View	Edit	Messages	Posts	Track	Badges	File browser	
Account	Pers	onal information	wsletters				

You should be able to login and logout freely. In case that you forgot your password, you may request a new password from this link: <u>https://vrmath2.net/user/password</u>

### 2.2 Community site overview

The VRMath2 Community site (<u>https://vrmath2.net</u>) is easy to navigate. Below is a screenshot of the



The **Top Menu** has four main functions:

- Create: click to open the VRMath2 Editor in a new window
- Share: click to write a community blog or deposit your creations
- **Discuss**: click to visit forums to ask and/or answer questions
- Wiki: click to visit wiki for documentations

The **Primary Menu** has categorized blogs and challenges, which you may be interested in taking. Please feel free to read a few blogs and see how community members are coding and creating 3D virtual worlds. You are also welcome to leave comments to blogs.

### 2.3 VRMath2 Editor overview

VRMath2 Editor ( <u>https://vrmath2.net/VRM2</u> ) is ar	n online 3D contents crea	ator. Object Bar
VRMath 2.0 File Vedit Viser Shortcut View View View View View View View View	Workspace • Window • Help •	Dropdown Menu Log in I Register
World: untitled O - C ×	Quick Command – ×	Property Inspector - ×
VRMath 2.0	Turtle       no object selected         Distance (meter):       1       0         Angle (degree):       90       0         Pen       Up       Jump       Off         Point       Line       Face         ClearScreen       Clean       Reset       PC	Object name:
Console       Image: Organization of the second secon		Object Tree O > 4 - C ×
		► O TRANSFORM obj_0 ⊗

The **Dropdown Menu** has access to most functions in VRMath<sub>2</sub> Editor. For example, all **Object Bar** functions (insert primitive objects) can be accessed as well from the **Dropdown Menu**. It is suggested that you click on these menus and try out, particularly the **Workspace** and **Window** menus.

A simple click on the objects in the **Object Bar** will insert the clicked object at the turtle's location and direction. You can try to see if you can produce the same **3D World** as in the above image with **Quick Command** and **Property Inspector** windows.

## 2.4 3D Navigation and Logo Editor

### 3D Navigation



It is essential to navigate in the 3D window so to inspect where the turtle is and what you have created. You can try out the icons in the Toolbar, particularly the Reset

navigate-3d-virtual-space

### Logo Editor

The Logo Editor window can be open from the **Window** menu, or by clicking on the pencil in the **Console** window.







The three icons at the left will run your codes in **per line, per block** (selection), or **all** program.

### 3. 3D LOGO programming

LOGO is a programming language developed in 1960s. It became popular mostly due to its Turtle Graphic, in which you program a turtle (a reference point in 2D space) to move and turn so to draw geometric pictures.



In VRMath2, the Turtle Graphic has become 3D. The 3D movements will be introduced in next section. LOGO commands are not case sensitive. As a programming language, it has features of what a programming language requires. Below are some key features for a programming language.

### Variables

To create a variable, we can use the MAKE command. The variable to be made needs a double quote (") in

front. To use the variable created, you need to have a colon (:) in front of the variable name.

**MAKE** "number 100 ; this line stores 1 into the variable named number **PRINT** :number ; then ask the computer to print the variable :number

### Flow control

Common control structures are IF or IFELSE. For example,

MAKE "number 100 IF :number = 100 [ PRINT [ The number is 100 ] ] ; this will print "The number is 100" IFELSE :number > 50 [ PRINT "Big ] [ PRINT "Small ] ; this will print "Big"

### Arithmetic

Programming language usually has many build-in mathematical functions. For example,

PRINT 360 / 8 ; this will print 45
PRINT SQRT 2 ; this will print square root of 2

In LOGO, texts after a semi-colon (;) mean comments, not codes. For more details see:

https://vrmath2.net/content/logo-guidereference

### 3.1 3D rotation and movement

Traditional 2D LOGO has only 2 rotations (**LEFT** *angle* and **RIGHT** *angle*), and 2 movements (**FORWARD** *distance* and **BACK** *distance*). The *distance* is specified as number of pixels in traditional 2D LOGO.

For 3D space, the VRMath2 LOGO has 6 rotations,

- LEFT angle or LT angle
- **RIGHT** angle or **RT** angle
- **ROLLUP** angle or **RU** angle
- **ROLLDOWN** angle or **RD** angle
- TILTLEFT angle or TL angle
- TILTRIGHT angle or TR angle

And 8 movements:

- FORWARD distance or FD distance
- BACK distance or BK distance
- **EAST** distance
- WEST distance
- NORTH distance
- **SOUTH** distance
- UP distance
- DOWN distance

The distance is specified as METER or CENTIMETER. The above

commands can be trialled in the **Quick Command window**.

There are also coordinate movement commands if you wish to move the Turtle to specific 3D coordinates.

- SETX x
- SETY y
- SETZ z
- SETXYZ x y z

For more details, please see wiki page at:

https://vrmath2.net/content/how-move-turtle-3d-virtual-space



## 3.2 Primitive objects

Like traditional LOGO, **PENDOWN** (or **PD**) will start recording the turtle's track, and **PENUP** (or **PU**) will stop recording the turtle's track.

In VRMath2's 3D LOGO, there are a few built-in objects as shown in the **Object Bar** below.



### 3D Objects

These include CUBE (BOX), CYLINDER (CAN), CONE, SPHERE (BALL), TORUS (DONUT), SNOUT, DISH, PYRAMID, RECTANGULARTORUS (RECTORUS), SLOPEDCYLINDER (SLOPEDCAN), and NOZZLE.

### 2D Objects

2D objects has zero Z dimension (no thickness or depth). These include **ARC**, **PIE**, **CIRCLE**, **DISK** and **RECTANGLE**.

### **Special Objects**

These special objects include **WORLD**, **PICTURE**, **VIDEO**, **SOUND**, **POINTLIGHT**, **DIRECTIONALLIGHT** (**DIRLIGHT**), **SPOTLIGH**, **TRANSFORM**, and **VIEWPOINT**. Except for **WORLD**, **PICTURE** and **VIDEO**, other special objects have no geometry in the 3D space.

All objects, when inserted (either from programming or **Object Bar**) into the **3D World** window, will be inserted according to the turtle's location and direction. For example, if you want to insert an up-side-down cone, you will need to flip the turtle first. The codes below will create an up-side-down cone.

HOME ; this brings the turtle to home location (coordinate 0 0 0), facing north (-Z).TILTLEFT 180 ; tilt left 180 degrees is the same as flipping the turtleCONE ; this cone will be up-side-down as the turtle

## 3.3 Material settings

For 3D and 3D objects, you can apply material settings. Material settings define the object's colours with respect to environmental lightings. There are two ways to apply material settings onto geometric objects.

### Via Material Chooser (MC) tab in Property Inspector window.

Click on the geometric object in the 3D World window to select it, then click on a material in the Material Chooser to apply.





### Via LOGO programming



#### The SETMAT or SETMATERIAL

command will make all subsequent objects the same material setting.

For advanced material settings, you can try the **ME** (Material Editor) tab next to **MC** tab, to further customised materials.

See <u>https://vrmath2.net/content/how-change-material-settings-virtual-object</u> for more details.

# 3.4 Scaling objects

Before inserting an object, you can specify a scale so the object can be scaled to the size you need. In VRMath2's LOGO, we use **SETSCALE** *x y z* to change the scale before creating a 3D or 2D object. For example, a default **CYLINDER** has height and diameter as 1, see below:



To make a thin and long cylinder (to represent a bonding between two atoms), we can use **SETSCALE** before the **CYLINDER** command. See below:



With the **SETSCALE** 0.1 2 0.1 command, we created a cylinder that has height as 2, and diameter as 0.1. Note that the 2D and 3D objects will always refer to the turtle's location and direction at the time of their creation. And once the scale has changed, it will affect the rest of 2D and 3D objects being created, unless you specify a different scale such as **SETSCALE** 1 2 0.5 or **RESET**.

**THINK**: What if you want a cylinder that is tilted 45 degrees? What if you want the cylinder to have different material (colour)?

## 3.5 Loop

When you have identified a pattern or you just want repeat some codes, use a loop structure can make your codes more efficient. In LOGO, there are some loop structures and the most common one is the **REPEAT** command. The syntax of **REPEAT** is as below:

**REPEAT** *number\_of\_repeat* [ codes to repeat ] ; it must use square brackets

For example, we can program the turtle to walk a square using the following codes:



In this program, we repeated forward 1 right 90 for four times. Therefore, we can simply replace line 4 to line 11 with the following command:

**REPEAT** 4 [forward 1 right 90]; note that there is a space between command and input

Within the square brackets of a **REPEAT** command, if you want to know the current repeat number, you can use **RECCOUNT** or simply **#** to get the repeat number. For example,

**REPEAT** 100 [print #]; This will print number 1 to 100 in the **Console window**.

### 3.6 Procedures

In computer programming, a procedure is a block of codes that can be reused or used to handle some specific work such as to calculate sum of two numbers. Therefore, procedures are also called sub-routines and/or functions. In LOGO, to define a procedure, we use **TO** and **END** keywords. Below is an example of a function named **double**, which **OUTPUT** the double of the input number.

Logo Editor: untitled – a	Console
<pre></pre>	Command Enter command here Procedure DOUBLE is defined. 10

Note that a procedure can have zero or many inputs, and can have none or one output. In the previous square example, we can make a procedure named **square** to simplify the creation of square and reuse for a simple spiral graph. Below is an example of a simple spiral graph.



THINK: Can you use the 3D rotation commands in 3.1 to create some 3D spiral graphs?

## 3.7 Save your works

As a registered user and a community member of VRMath2, you can save your work in your personal folders. In VRMath2 Editor, you can save 4 types of files:

- .vrm file: the vrm file is the editing-in-progress 3D world. You can save the unfinished 3D worlds in the **3D World** window.
- .x3d file: the x3d file is an international web standard 3D files. X3d files can be published from the **3D World** window as well, and can be later used in blogs to show the whole world your creation.
- .png file: in the **3D World** window, you can take a screenshot of your 3D world and save as an image in .png format. You will need a .png image file when you blog.
- .logo file: the .logo file is the ultimate 3D generator in VRMath2. It is easier to modify the LOGO programs to change the 3D worlds than to directly modify the 3D worlds.

By now, we have created a LOGO program that can generate a simple spiral graph, so it is time that we save



the LOGO program.

In Logo Editor, click on the disk icon to bring up the file manager dialog.

File Manager: S	File Manager: Save Logo		
Home	Path: /logo/	File I	lanager functions
	Name	Size <u>Time Date Created</u>	
	100_flying_balls.logo	286B 02:34:26 07-06-17	
Good to keep in a logo folder	300_flying_cubes.logo	385B 09:50:03 07-06-17	
	🖬 3D_plot.logo	481B 08:03:52 20-03-14	
	🗃 3_drawings.logo	582B 03:46:49 12-07-16	
Preview	ElevationGrid_test.logo	812B 11:42:02 26-11-14	
	🛱 Final_Boron.logo	952B 01:30:52 19-07-1 2. Click to	save program
	📓 James_1.logo	302B 12:10:41 30-03-15	
1. I ype in a file name	Koch_snowflake.logo	700B 09:15:41 27-08	
	File name: square_spiral	Save Cancel	

The file name can only contain alphabets, numbers and underscore ( \_ ). Note that if the browser window is closed, any unsaved work will be lost.

# 4. Programming fractals

Fractals, when described mathematically, could be presented as some formulae, rules, and/or algorithms. They are abstract and their dimensions are not integers (and hence fractals). Computer programming and graphics are great tools to visualise fractal geometry in both 2D and 3D (

There are a few techniques for generating fractals. (see

<u>https://en.wikipedia.org/wiki/Fractal#Common\_techniques\_for\_generating\_fractals</u>). In this workshop series, we will focus on two methods using Logo programming language:

- 1. Iterated or recursive functions
- 2. Random or chaotic games

### 4.1 Recursive procedure

An active procedure that is invoked from within itself or from within another active procedure is a *recursive* procedure. Such an invocation is called recursion. In computer science, recursion also refers to the technique of having a function repeatedly call itself.

Recursive procedures can be used to solve and express many mathematical problems such as in combinatorics, sequence (e.g., Fibonacci sequence) and fractals etc. The **Towers of Hanoi** problem for example, can be expresses and solved using a recursive function (pseudocode) as below:



(source: https://www.cs.cmu.edu/~cburch/survey/recurse/hanoiimpl.html)

Because the recursive procedures or functions repeatedly call themselves, there are usually two key

characteristics of recursive procedures.

- **1**. There is an exit condition. In the above example, the disk == 0 is the exit condition.
- 2. When the recursive procedure calls itself, it calls by reducing or increasing the condition variable, so the exit condition eventually can be met. In the above example, the *disk* 1 is the mechanism to meet the exit condition so the procedure will not fall into some infinite loop.

In this workshop series about programming fractals, the fractals and the recursive computer programs are both considered mathematical. The next sections will introduce how to write recursive procedures in Logo programming language to generate fractals.

### 4.2 Fern leaves

There are different types of ferns, and below are some pictures of typical fern leaves.



In Logo Editor, open the Logo file from:

 $\mathsf{Example} \rightarrow \mathsf{fractal} \rightarrow \mathtt{1}_{\mathsf{fern}} \mathsf{tree} \rightarrow \mathsf{fern}.\mathsf{logo}$ 



#### **Questions: (predict)**

- 1. What is the exit condition of the **fern** procedure?
- 2. What is the purpose of the variables :size and :sign?
- 3. Why rt 7 in line 9?
- 4. Why jump back *:size* \* 2 in line 10?

### **Experiments:**

- 1. Try giving different :size in line 18, then run the program to see the result. For example, fern 10 1
- 2. Try giving different angles in line 6, 8 and 9, then run the program to see the results.
- 3. Try changing the decreasing factor 0.5 and 1 in line 6, 8 and 9, then run the program to see the results.

#### **Questions:**

- 1. Answer the previous questions again to see if any different ideas you have after experiments.
- 2. What is the purpose of line 6 and 8?
- 3. What is the purpose of line 9?

### Challenge:

Using the other rotation commands (see page 8), add in some commands (programming codes) to make the fern leave curl in 3D.

(You may open the file from Example  $\rightarrow$  fractal  $\rightarrow$  1\_fern\_tree  $\rightarrow$  3D\_fern.logo for an example of 3D fern

leave)

## 4.3 Trees

In Logo Editor, open the Logo file from: Example  $\rightarrow$  fractal  $\rightarrow$  1\_fern\_tree  $\rightarrow$  binary\_tree.logo



### **Questions: (predict)**

- 1. What is the exit condition of the **trunk** procedure?
- 2. What is the purpose of the variable :size?
- 3. Why the angles turned in line 6, 7 and 8 are 30, 60, and 30?

#### **Experiments:**

- 1. Try giving different *:size* in line 17, then run the program to see the result. For example, **trunk** 50.
- 2. Try giving different angles in line 6, 8 and 9, then run the program to see the results.
- 3. Try changing the decreasing factor 0.7 in line 6 and 7, then run the program to see the results.

#### Questions:

- 1. Answer the previous questions again to see if any different ideas you have after experiments.
- 2. What is the purpose of line 6 and 7?
- 3. What is the purpose of line 8?

### **Challenge:**

Using the other rotation commands (see page 8), add in some commands (programming codes) to make the tree has more branches in 3D.

# 5. Blogging and publishing

Publishing 3D models (worlds) and blogging in VRMath2 website is the way we learn and share in VRMath2 online learning community.



The term "publish" in VRMath2, is specifically referred to publish 3D models and save as .x3d files.

However, until you blog your 3D models, they are just files in your personal folders and no one can see them.

Blogging in VRMath2 is like writing a personal diary about your learning journey. Through blogging, you can practice your writing and communication skills. And when you write about your programming and virtual worlds, you will be learning and applying

science, technology, engineering and mathematics (STEM).

To blog, you will need to prepare 3 essential files. They are the **.x3d** (3D model), **.png** (an image of 3D model) and **.logo** files. Please read on the following sections for more details.

## 5.1 Publishing 3D model

The 3D models produced in VRMath2 Editor are in the international standard X3D format. This means that you can embed your 3D models online and share to the world in any modern web browsers. More details on <a href="https://wrmath2.net/content/x3d-behind-scenes">https://wrmath2.net/content/x3d-behind-scenes</a>

When you have created your 3D models (draft or complete) in the **3D World** window, you may publish and save your 3D models. To do so, simply click on the publish icon to bring up the **Publish Setting** dialog.



	ng				~		
Author: Andy @ VRMath2							
X3D title:	3D Fern leaves						
Description: My first online 3D world.							
Publish will save current world as .x3d file. This type of files can later be inserted (inline) into another world, or included in a blog. If the x3d file is to be inserted into another world, then the suggestion is not to include current viewpoint, background and navigation info (unless for advanced design). If the x3d file is to be blogged than you should consider including them all							
be blogged,	then you sh	nould consid	der inclu	ding the	em all.		
be blogged, Include curre	then you sł ent Viewpoi	nould consid	der inclu	ding the	em all.		
be blogged, Include curre Include curre	then you sh ent Viewpoi ent Backgro	nould consident of the second consident of the second constant of th	der inclu	iding the	on ON		
be blogged, Include curre Include curre Include Navi	then you sh ent Viewpoi ent Backgro gation Info	nould consid int pund	der inclu	ding the	on all.		
be blogged, Include curre Include curre Include Navi Navigation	then you sh ent Viewpoi ent Backgro gation Info	nould consid int pund	der Inclu	ding the	on all.		
be blogged, Include curre Include curre Include Navi Navigation Examine	then you sh ent Viewpoi ent Backgrc gation Info	nt bund	der inclu /alk	ding the	on ON ON ON		
be blogged, Include curre Include curre Include Navi Examine Fly	then you sh ent Viewpoi ent Backgro gation Info Info	ON W	/alk	ding the	on all.		

As indicated in the dialog, there are two types of x<sub>3</sub>d files to publish. If the <sub>3</sub>D model is for blogging purpose, it is suggested that you include viewpoint, background and navigation info (as show in the image on the left). After filling in the Author, title and description info, click on the Publish button to bring up the **File Manager** dialog.

File Manager: Publish World (.x3d) ×					
Home	Path: /x3d/		6 🕞 📥 🖨 🕫 🕏		
	Name	Size	Time Date Created		
	12table.x3d	39.1KB	02:49:22 11-07-13		
	3D_plot.x3d	8.7KB	02:35:27 11-03-14		
	Sd_fern.x3d	76.7KB	07:55:27 21-02-14		
	Sd_function.x3d	3.4KB	11:01:52 26-11-14		
Preview	S MERGA38.x3d	60.5KB	10:40:43 11-12-15		
	Sea_surface.x3d	11.1KB	08:47:47 30-11-14		
	analog_clock.x3d	51.7KB	11:35:29 06-11-14		
	👼 balihut.x3d	46.3KB	03:03:39 13-06-16		
	File name: untitled		Save Cancel		

By default, you will save in the x3d folder. Provide a sensible file name then click on Save button to finish.

## 5.2 Save an image for blog

An image of your 3D model can be uploaded when blogging, as a thumb nail for your blog. Readers can then see a picture of your 3D model before they click to read your full blog. This is a key aspect of blog in VRMath2 Community.

To save an image of your 3D model, click on the camera icon in the toolbar as below:



You will then see a **Screenshot Preview** window. If you are happy with the screenshot, click on the disk icon to bring up the **File Manager** dialog. For example,

Screenshot Preview ×	File Manager:	Save Screenshot			×
	Home	Path: /image/		8 🕞 📥 é	🔒 🖥 参
THE A		Name	Size	Time Da	te Created
A A A A A A A A A A A A A A A A A A A		2_electrons.png	17.3KB	02:11:28 1	5-10-14
All a tran		2_electrons_tree.png	17.6KB	02:18:57 1	5-10-14
		3D_plot.png	15.9KB	02:35:09 1	1-03-14
		3d_fern.png	30.5KB	07:54:59 2	1-02-14
AT LEFT	Preview	3d_function.png	37.2KB	11:01:30 2	6-11-14
" A LE LE		3d_interface.png	14.8KB	11:42:15 2	3-06-14
A State of the sta		Blender_Gear3D.png	17.8KB	10:43:38 2	0-10-15
		Cayley_graph.png	56.2KB	10:49:12 1	3-07-13
r n		File name: untitled		Save	Cancel

The default folder for saving screenshots is the **image folder**. Provide a sensible file name then click on **Save** button to complete.

## 5.3 Write a blog

To write your blog about your 3D virtual world, click on the **Share** in the main menu of home page.

		_		
TVRMath 2.0	Creat Share	Liscuss Wiki	Search Search	My Account Logout
	-	-		

Then, in the share page, click on **Write a blog**.

Share your creations to the world
in Share I Tweet Like 0 Share G+ Share Email O Save
In VRMath2 Community, you can share your creations of images, Logo programs and 3D virtual worlds from VRMath2 Editor in two ways:           1. Write a blog
All registered members can write blogs in VRMath2 Community. A blog is a form of online article for you to freely express your ideas about your creations. You can explain your ideas with rich-format texts, images, Logo programming codes and of course 3D virtual worlds. Blogs have commenting facility below them, so other members can interact and give you comments about your blogs. Each blog page also has social plugins such as LinkedIn, Twitter and Facebook etc. so all readers can share your blogs further to their social networks.

You will then have the blog form to fill in. It is recommended that you read the **Blog guides** on the right side first before writing. Then, the first part of blogging is title and blog image.

Create Blog entry	Blog guides
Title: *   • Vocabularies	Please observe Netiquette when posting.
Categories: *       2. Select at least one category.         Science       -Biology         - Chemistry       -Earth and Space         - Physics       Technology         - Control       -Material         - System       -Material         - System       3. Type in custom tags if any.         Enter a comma separated list of words. E.g., House, Dining table	Title: * The title of your blog. Image: This is the teaser image for your blog. You can upload, browse from your home directory, or transfer from other website with an url. If leave blank, a default image will be used.
Image: Upload   Remote URL Open File Browser Choose File no file selected Maximum file size: 1 MB Allowed extensions: jpg jpeg png gif	<ul> <li>Vocabularies:</li> <li>Categories are the system's classification based on STEM.</li> <li>Tags are user's own key words.</li> <li>Body:</li> </ul>

The **File Browser** will open in a new tab. You need to click into your **image folder** to find the image you saved in previous section (6.2). Select your image file then click on **Insert file** to close the dialog.

image:	
9	Alternate Text:
ಿಂ	This text will be used by screen readers, search engines, or when the image cannot be loader
	Title:
	The title is used as a tool tip when the user hovers the mouse over the image.
	Remove

If successful, you should see your image displayed and you are asked to enter **Alternate Text** and **Title** for the image. Please do provide a text and title for the image.

Then it will be the main blog body. You should write an introduction paragraph, then click on **Teaser break** icon. The content before the teaser break is treated as a summary to be displayed in the Group page.

ody:				
← → Β Ι <u>U</u> ↔ Α, · Α ·	x² x₂ @ ≣ ≣ ≣		🖬 🖬 😜 Ω 📰	ABC ABC -
🙈 🙈 🏴 🗏 🚝 🥑 🛍 🙈	Normal 👻 Font	▼ Size ▼ Styles	- 🔊 🖓 🖓	<u>_</u>
A methane molecule consists of a carbo	n atom and four hydrogen at	oms	<u>†</u>	
	b</td <td>reak&gt;</td> <td></td> <td></td>	reak>		
Below is the 3D model of methane				
I				
1				

Next, click on the X<sub>3</sub>D icon to insert your <sub>3</sub>D model.

2. Enter the Width as 760	X3D World Properties         General Advanced         URL         /sites/default/files/user/u3/x3d/methane_molecule.x3d         Browse Server         Width         Height         760	1. Click on Browse Server to select your x3d file, and insert file to close the dialog. If successful, you
and Height as 400. PS: You may try different numbers but 760 is maximum.	Cancel × OK M	should see your 3D model displayed in this dialog. 3. Click Ok when done, or Cancel to restart.

After the 3D model, you could write some paragraphs to explain about your 3D virtual world and programming. At the end of the blog, insert links to your 3D model and Logo program files.

Body:

← → Β Ι <u>U</u> ↔ Α	<mark>A</mark> • x <sup>2</sup> x <sub>2</sub> <i>a</i> <b>≡</b> ≡ ≡	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	2 ☺ Ω III A¥ A¥.
🙈 🙈 🏱 🗏 🚍 😽 🖬	👌 Normal 🔻 Font 💌	Size 🔻 Styles 🔻	- 😓 😓

Finally, you can click on **Save** button to publish your blog.

You can edit later your blog as many times as you wish. See next section for how to **Edit**.

## 5.4 Edit own blog

You can edit all your posts when you are viewing them. Simply click on the Edit tab to edit. For example,

Home	Groups	Brisbane State High School
View	Edit	Revisions
Oxyg	en a	tom

In case that you cannot see your blog in the group, you can always find it from your account. Click on **My Account** at the top-right corner of website to view your account details.



Then click on Posts tab to see a list of your posts.

View	Edit	Messages	Posts	Track	Badges	File browser		
			1					
		/						

# 5.5 Commenting blogs

Social interaction is a key aspect of learning. When reading others' blogs, you can provide your comments and in the same manner that others may also provide their comments to your blog.

Commenting is not a part of assessment, but you are encouraged to provide your comments in the form of praise, critique, help and ask further questions.

To comment on blogs, simply click on **Add new comment** button at the end of blogs.



You can also reply to comments by clicking on the **Reply** button in the comments.

## 6. Viewing 3D models in CardBoard

There are different ways of sharing in VRMath<sub>2</sub> Community. These can be blogging, commenting, discussing in forums and creating wikis etc.

In this section, we are introducing about sharing VR experiences on your 3D models using a mobile phone and a VR Cardboard.



In this workshop, you will be given a VR CardBoard to take away. The volunteer helpers will assist you to assessable the CardBoard VR box.

You will need to have a mobile phone such as iPhone 6 and android phone version 6 to better view the 3D models created and blogged in VRMath2 website.

Your mobile phone also needs to have a QR code scanner app such as i-nigma. Please download and install in your phone.

VRMath2 VRBox is an application to view 3D models in VR CardBoard. It has a web address for mobile device only at <a href="https://vrmath2.net/vrbox">https://vrmath2.net/vrbox</a>

### 6.1 Scan QR codes to view in CardBoard

There are two main ways to view your 3D models in CardBoard VR Box.

#### **From blogs**

When viewing a blog with a 3D model in it, click on the square to get a menu as below:



Then click on the **CardBoard** icon to get a QR code. Scan the QR code in your mobile phone to open the **VRMath2 VRBox** application in your mobile browser.



#### From VRMath<sub>2</sub> Editor

Use the **File Manager** to browser your x<sub>3</sub>d files.

File Manager:	Open Logo	×
Home	Path: /x3d/	📴 🗟 🕞 🏯 🔒 🗑 🕏
	Name	Size Time Date Created
	👷 gallery_walk_1.x3a	197.6KB 10:41:00 27-01-14
Example	gear2d_proto.x3d	9KB 11:26:24 12-10-15
	🙀 gear3d.x3d	73.2KB 08:17:22 22-10-15
Media	helium_atom.x3d	4.8KB 06:55:18 10-10-14
	bydrogen_atom.x3d	3.7KB 12:53:38 08-10-14
Preview	by hypercube.x3d	4.3KB 12:28:15 25-10-14
0.0	iccorcam.x3d	2KB 11:28:14 02-03-14
Click for QR Code	🔊 inline_fish.x3d	1.2KB 11:20:18 27-02-16
	File name: helium_atom.x3d	Open Cancel

Once a x3d file is selected, click on the CardBoard icon in the Preview area. A QR code will be displayed. Scan the QR code with a mobile phone to open the VRMath2 VRBox application in a mobile browser.

Once opened, skip/end the tutorial, rotate the phone to landscape, insert your phone to your CardBoard box and enjoy.

## 6.2 VRMath2 VRBox

The VRMath2 VRBox App in still in development. It can be accessed in mobile browsers directly from <a href="https://vrmath2.net/vrbox">https://vrmath2.net/vrbox</a>. In order to get the full screen in mobile browser such as Chrome and Firefox, please save the above URL on to the home screen of the mobile device. In the VRMath2 VRBox App, you can shake your mobile phone (device) to get function menu. This is introduced in a tutorial when first open the URL <a href="https://vrmath2.net/vrbox">https://vrmath2.net/vrbox</a>.



### 7. Forums and Wiki for help

After the workshop, you can still get support about VRMath2 through discussion forum and wiki. You can access forum and wiki from the top menu:

TVRMath 2.0	Create	Share	Discuss	Wiki	Search	Search	My Account	Logout

When in the **Discussion forums**, simply select an appropriate forum to ask questions and you may also answer other's questions.

Forum		Topics	Posts	Last post
Announcement News and events.		11	12	Version 0.9.1 by Andy 28/12/2014 - 22:50
Designer forums				
These forums are related to the de	ssign, create and share of 3D worlds.			
Community forum Discussions about the o	design, functions and services of VRMath2 website.	0	0	n/a
Logo programming Discussions about Logo	g forum o programming in VRMath2 Editor.	8	28	map with by Andy 09/07/2016 - 00:51
VRMath2 Editor for Discussions about the of	rum Jesign, functions and interfaces of VRMath2 Editor.	2	2	ElevationGr by Yeh 25/05/2014 - 00:45

Wiki is a place of tutorials and documentations for VRMath<sub>2</sub> Community and Editor. You may also help edit some of the wiki pages if you wish.

#### The "What is" pages

Click on the above link to find some "what is" questions answered.

#### The "How to" tutorial pages

Click on the above link to find some "How to" questions explained.

### The Logo Programming Guide/Reference

Click on the above link to go directly into the Logo programming guide.