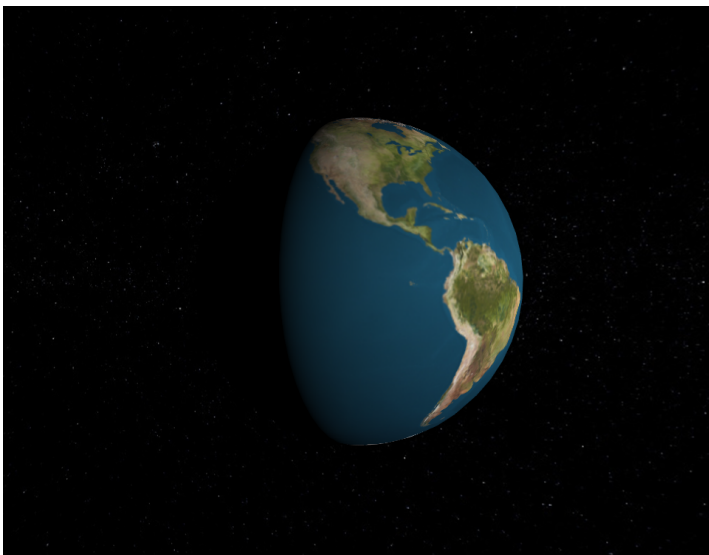
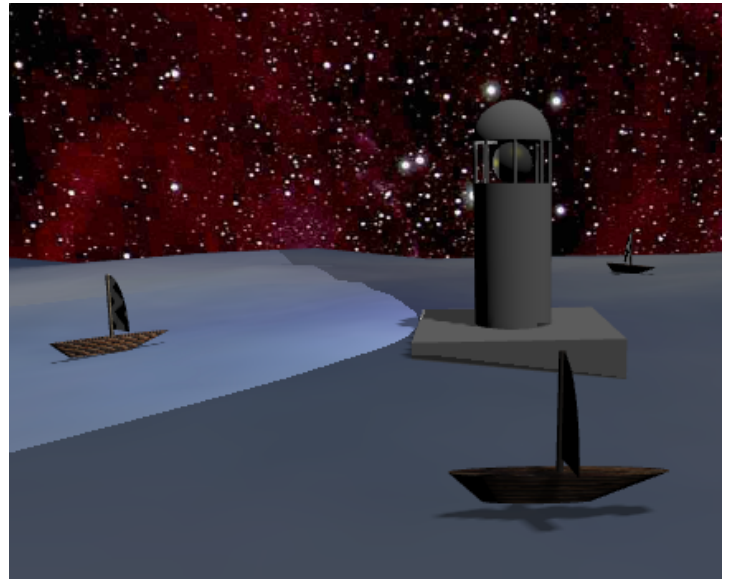


Programming 3D Virtual Worlds: Introducing VRMath2



```
3 cs reset ct
4 setbg 46 ; set background to Universe 1
5 headlightoff ; turn off headlight
6 ; set scale ratio
7 make "r 1/12756 ; earth's diameter is 12756 km
8 ; for time, let's experiment and start with 1 second
  for 1 hour
9 ; Sun at the centre of solar system
10 make "sundiameter 695700*2
11 make "scale :sundiameter*:r
12 setscale :scale :scale :scale
13 setmat 4 8
14 ball
15 make "sun object
16 select :sun
17 SETITURL
  "/sites/default/files/webfm/public/media/texture/sol
  ar/1k/sunmap.jpg
18 deselect
19 spin :sun "lt 24*24
20 showobject :sun
21 (VIEWPOINT {position: 0 0 294.0085, orientation: 0 0
  0 0, centerofrotation: 0 0 0})
22 * pointlight as sun light
```

Programming 3D Virtual Worlds

Introduction to VRMath2 online learning environment

Document prepared for **STEM in Education Conference 2018**

Date/Time: 21st November 2018, 10:30 am ~ 12:30 pm

Venue: The Cube, P504, Gardens Point Campus

Queensland University of Technology, Australia

Programming 3D Virtual Worlds: Introduction to VRMath2

VRMath2 Community

<https://vrmath2.net>

is a free online learning (coding) environment for STEM

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Queensland University of Technology

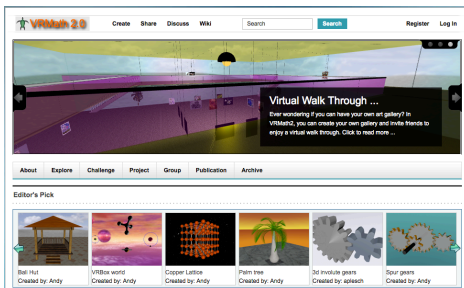
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1. VRMath2 introduction

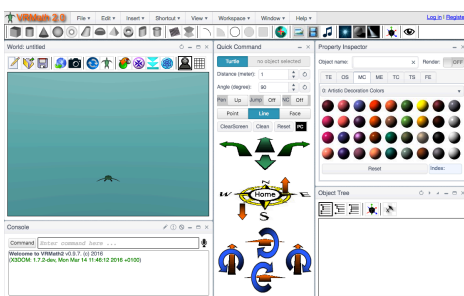
VRMath2 stands for **Virtual Reality Mathematics 2.0**. It started in Year 2001 as an online learning environment for constructing knowledge of 3D geometry. Over the year, it has evolved to become a STEM (Science, Technology, Engineering and Mathematics) integrated learning environment. The 2.0 indicates 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 the atomic models).

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



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 (<https://vrmath2.net/VRM2>)



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, <https://vrmath2.net/vrbox>)



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.

1.1 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.

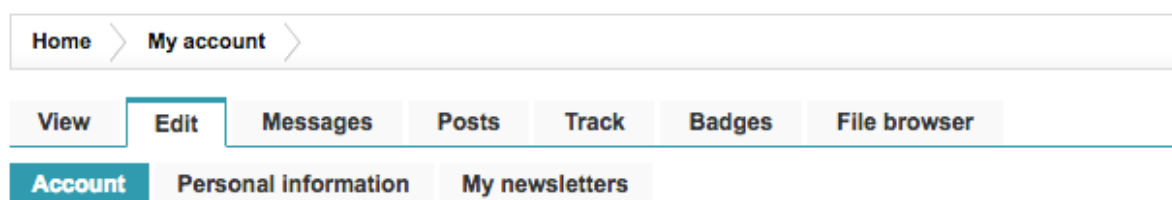
<https://vrmath2.net/user/register>

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.

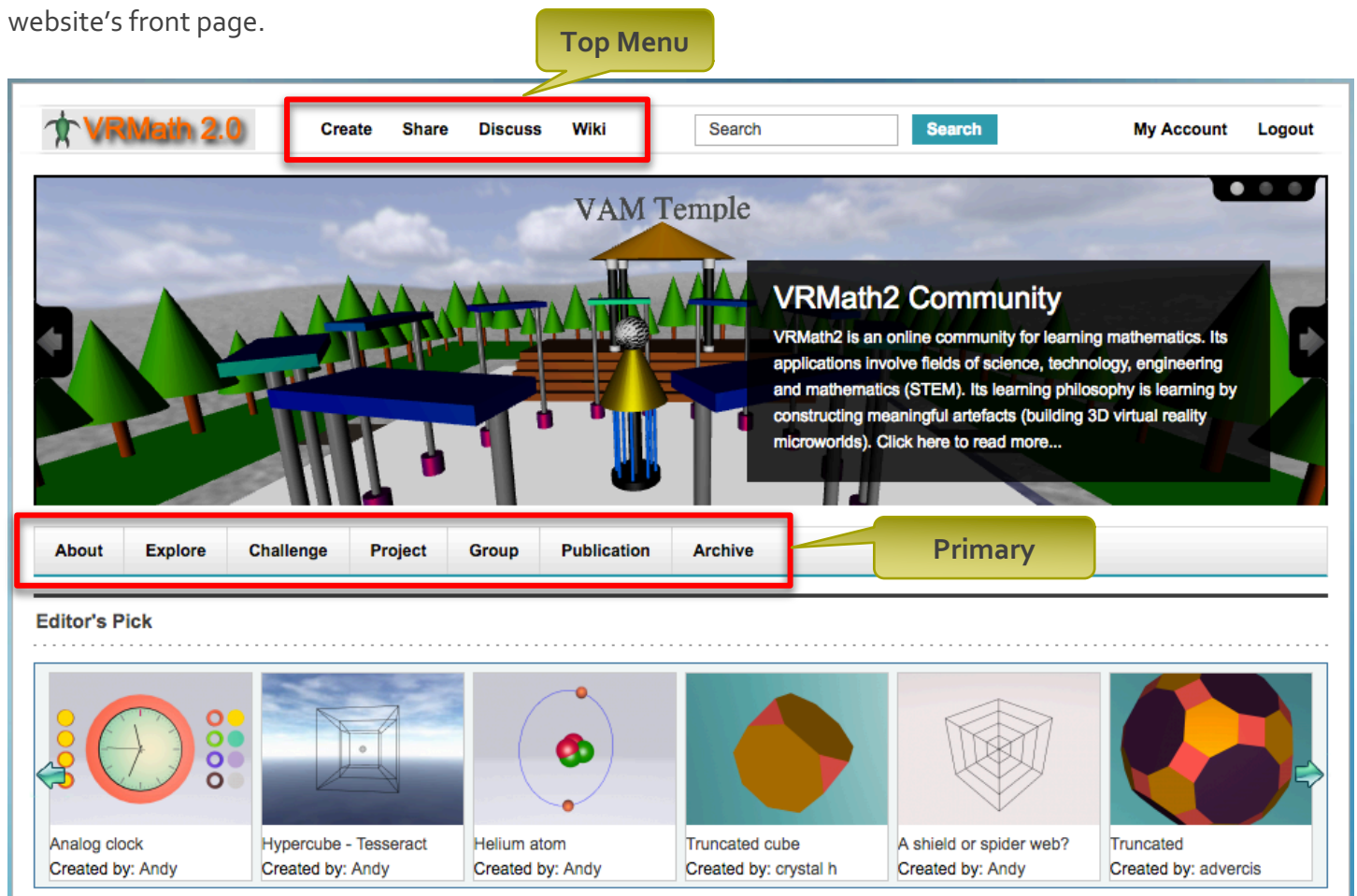
It is highly recommended that you click on the one-time login link, which will bring you to your account. Then you can click on the **Edit** tab to change password, select/upload own account picture, add your real name and other information.



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: <https://vrmath2.net/user/password>

1.2 Community site overview

The VRMath2 Community site (<https://vrmath2.net>) is easy to navigate. Below is a screenshot of the website's front page.



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

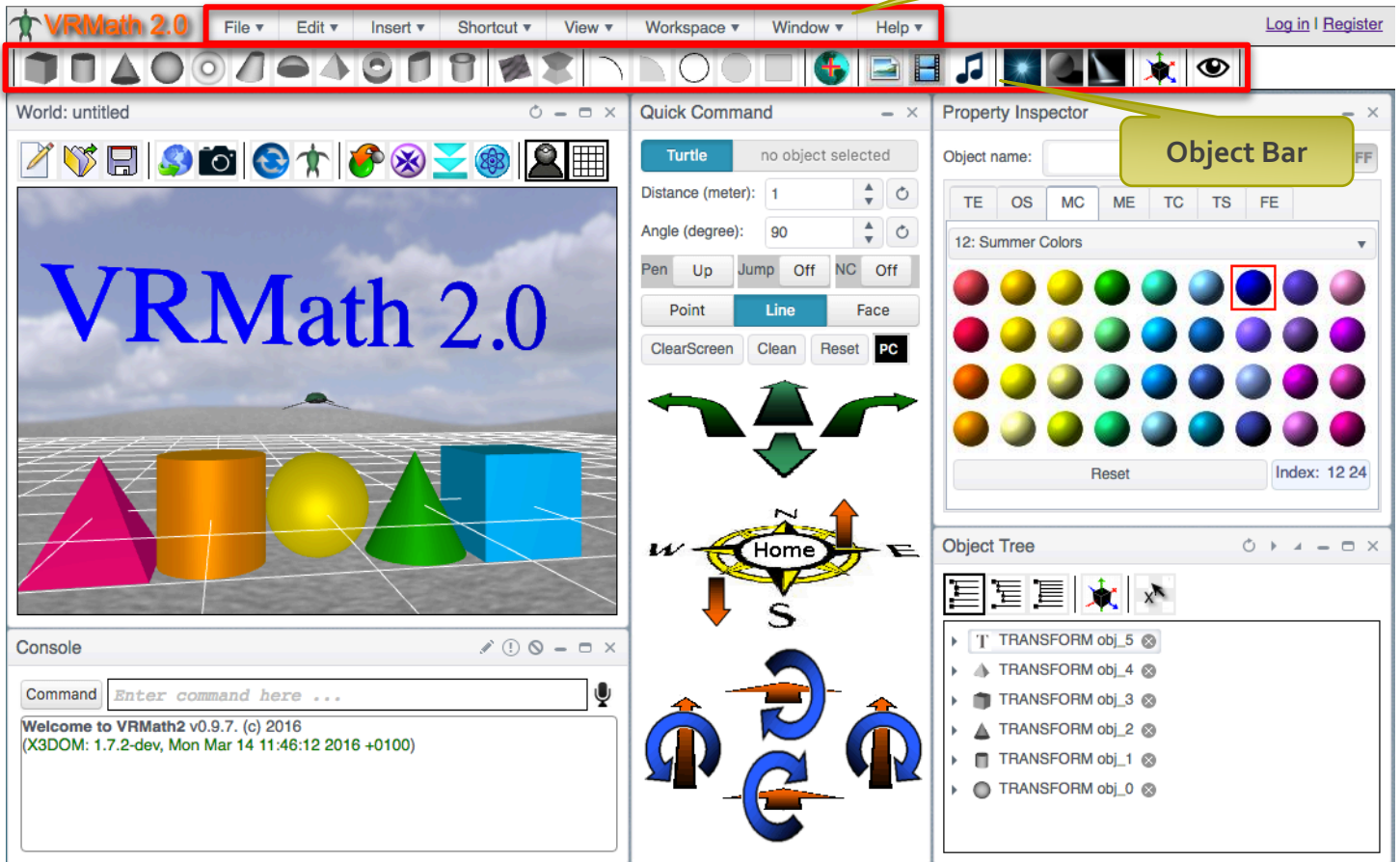
- **Create:** click to open the VRMath2 Editor in a new window
- **Share:** click to write a community blog or deposit your creations
- **Discuss:** click to visit forums to ask and/or answer questions
- **Wiki:** click to visit wiki for documentations

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.

1.3 VRMath2 Editor overview

VRMath2 Editor (<https://vrmath2.net/VRM2>) is an online 3D contents creator.

Dropdown Menu






The **Dropdown Menu** has access to most functions in VRMath2 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.

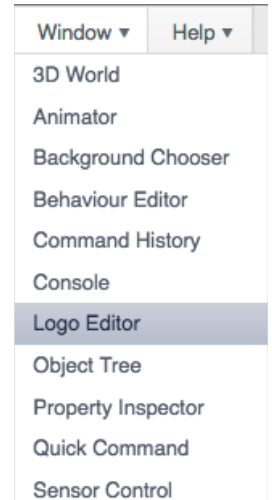
1.4 3D Navigation and Logo Editor

3D Navigation



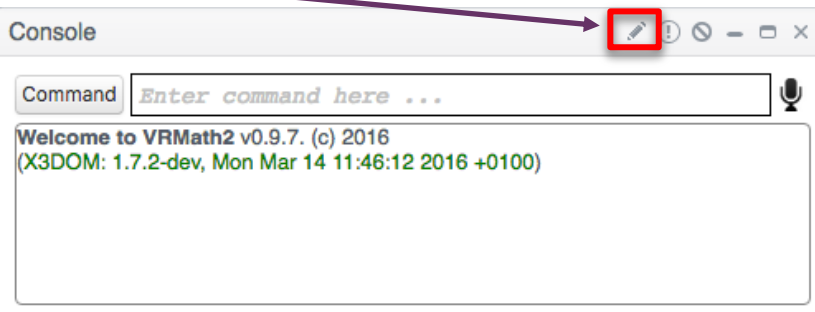
It is essential to navigate in the 3D window so to inspect where the turtle is and what you have created. You can try out the icons in the Toolbar, particularly the Reset Viewpoint , Fit All , and Set Rotation Centre  are very useful when navigating in 3D virtual space. When using a touch screen, you can use two fingers to rotate, pan and zoom. For more details about 3D navigation, please visit wiki at

<https://vrmath2.net/content/how-navigate-3d-virtual-space>



Logo Editor

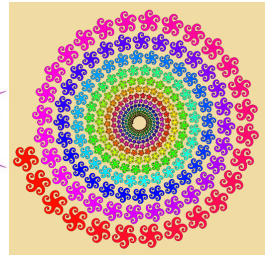
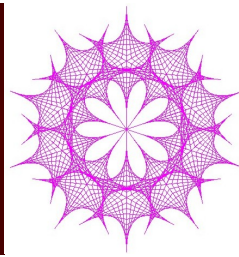
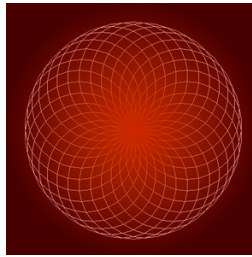
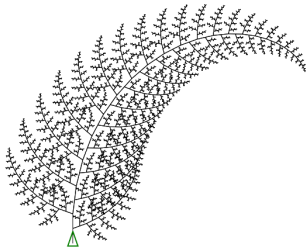
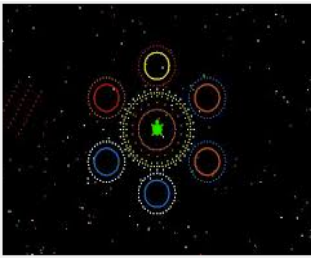
The Logo Editor window can be open from the **Window** menu, or by clicking on the pencil in the **Console** window.



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

2. 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>

2.1 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

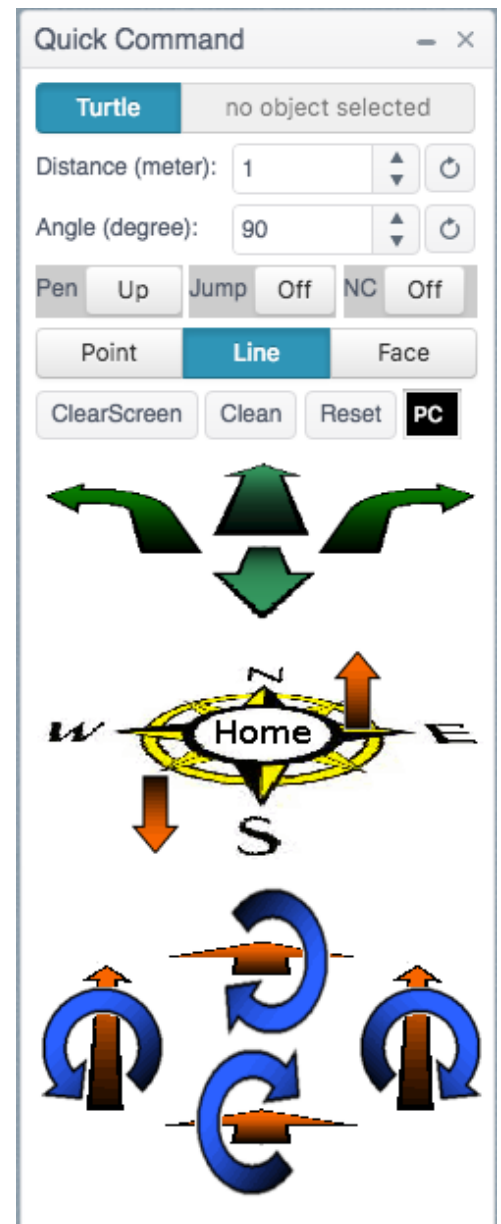
The distance is specified as METER or CENTIMETER. The above commands can be trialled in the **Quick Command window**.

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:

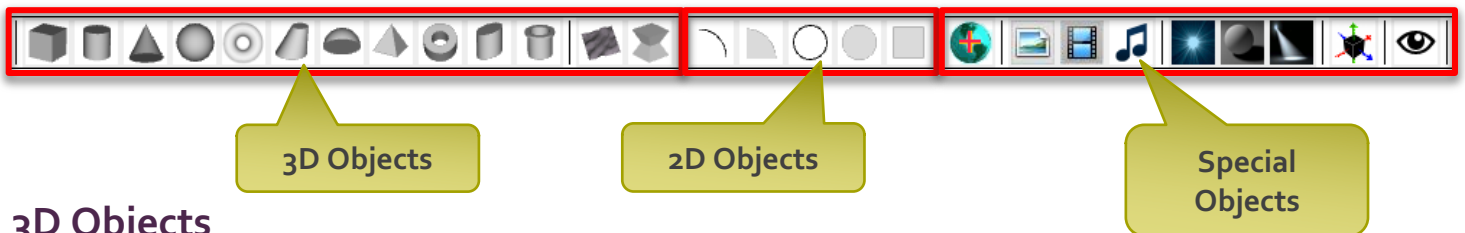
<https://vrmath2.net/content/how-move-turtle-3d-virtual-space>



2.2 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)**, **SPOTLIGHT**, **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 turtle

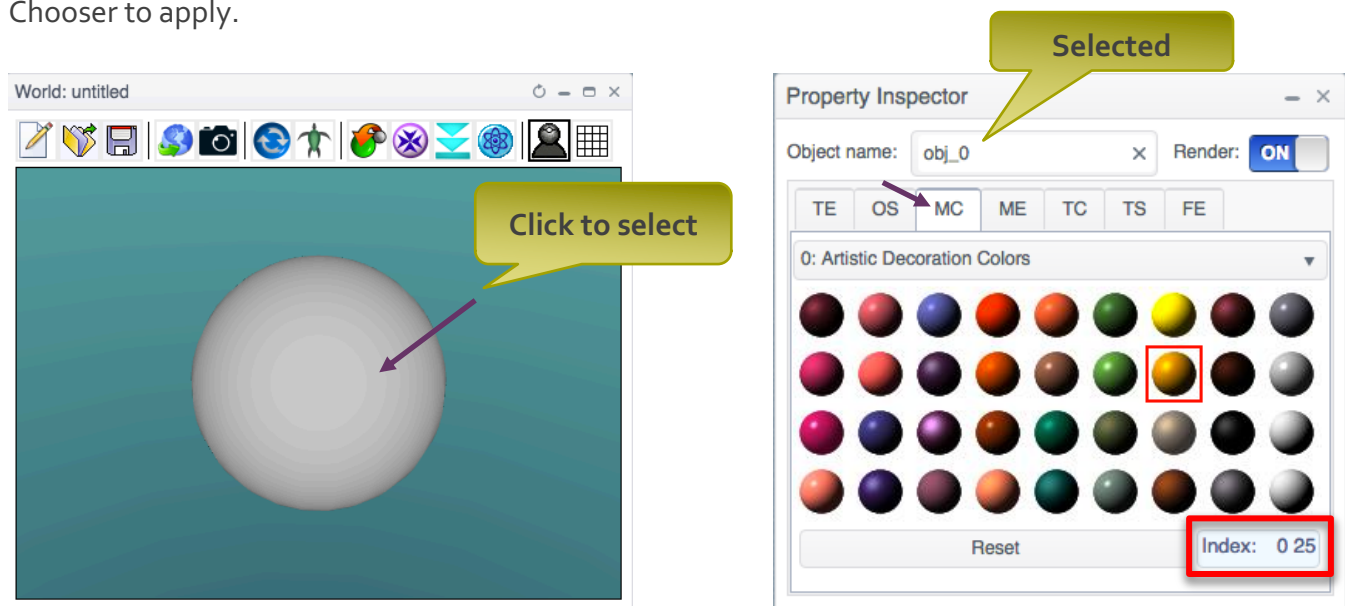
CONE ; this cone will be up-side-down as the turtle

2.3 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.

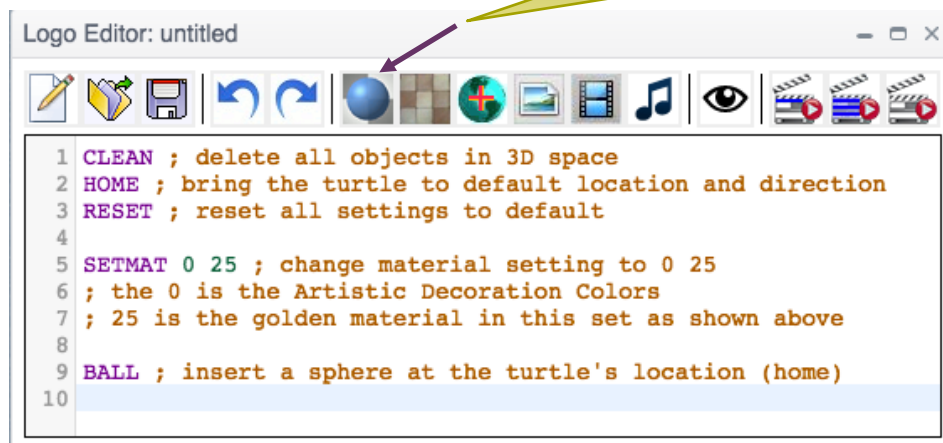
Via Material Chooser (MC) tab in Property Inspector window.

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

Insert material setting commands



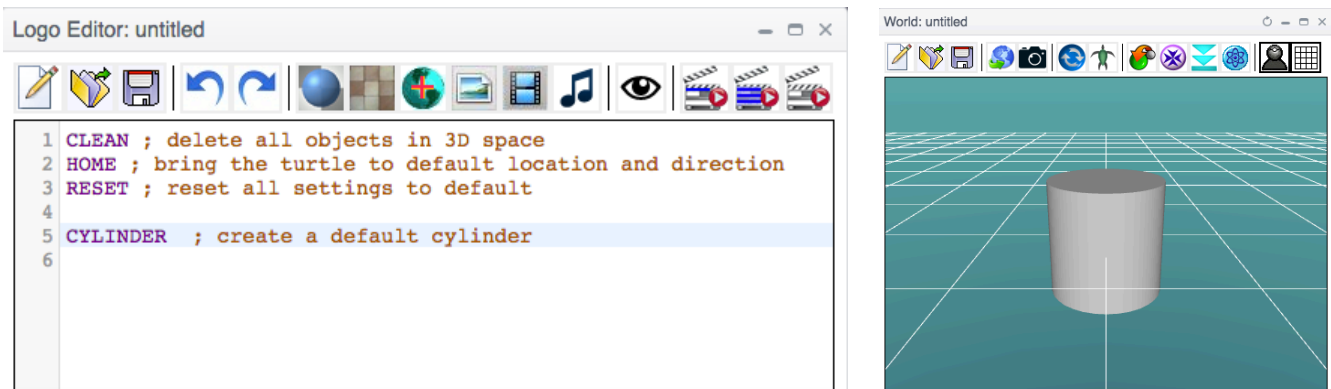
The **SETMAT** or **SETMATERIAL** command will make all subsequent objects the same material setting.

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

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

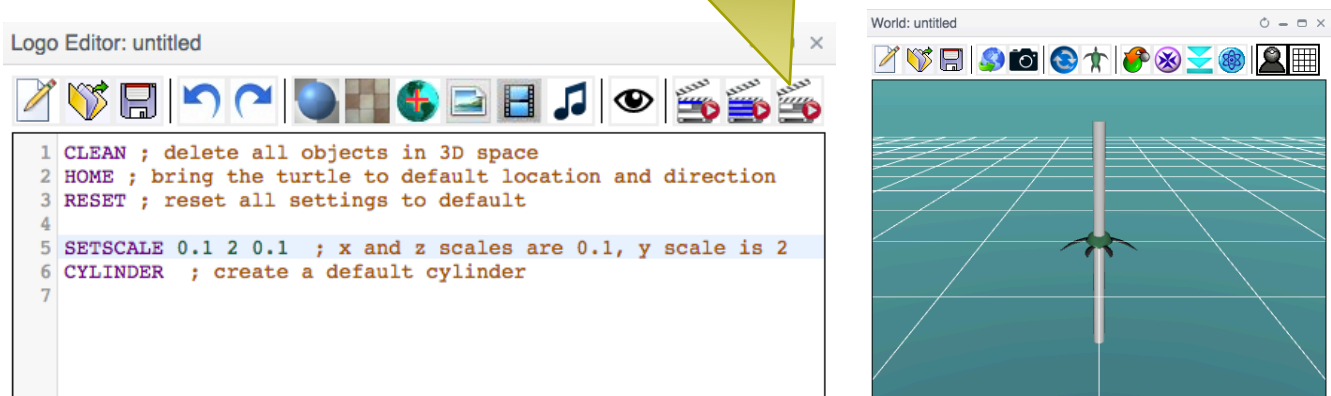
2.4 Scaling objects

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:

Click to run program



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)?

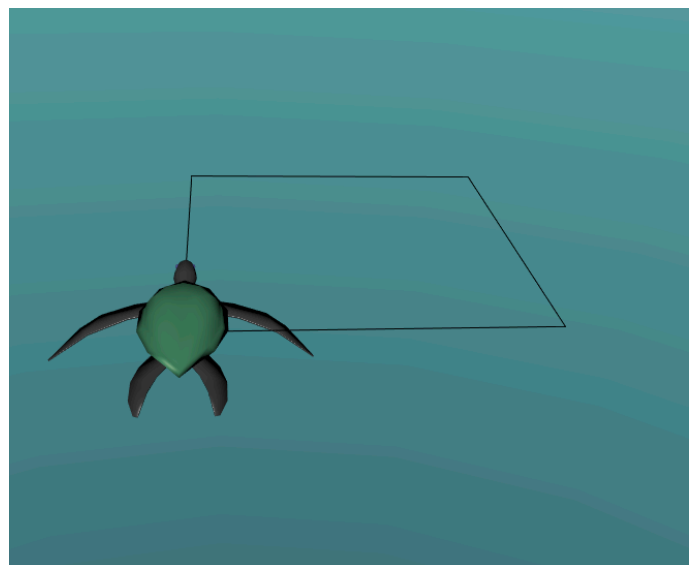
2.5 Loop

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:

```
Logo Editor: untitled
1 ; a square
2 cs reset ; clearscreen and reset
3 pd ; pendown
4 forward 1
5 right 90
6 forward 1
7 right 90
8 forward 1
9 right 90
10 forward 1
11 right 90
12 pu ; penup
13
```



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:

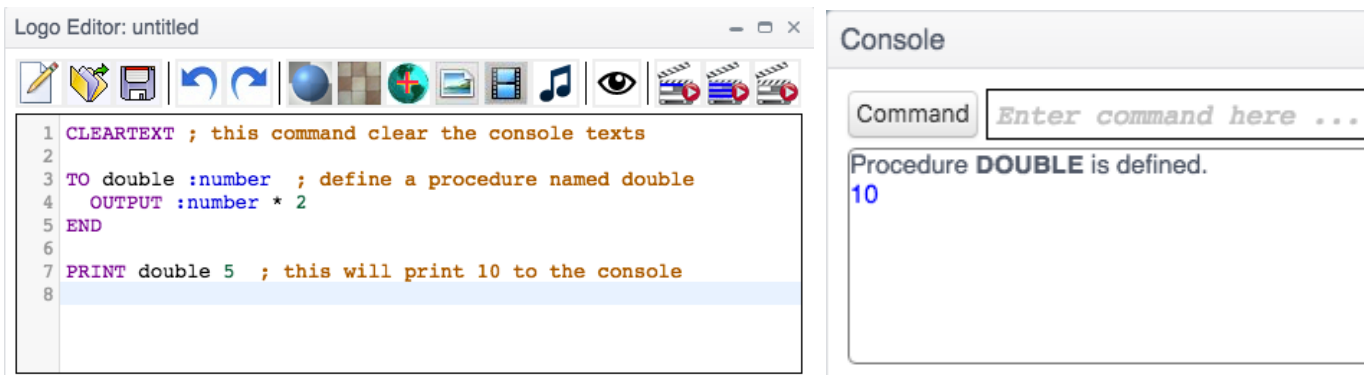
REPEAT 4 [forward 1 right 90] ; note that there is a space between command and input

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**.

2.6 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.



The screenshot shows the Logo Editor window with the following code:

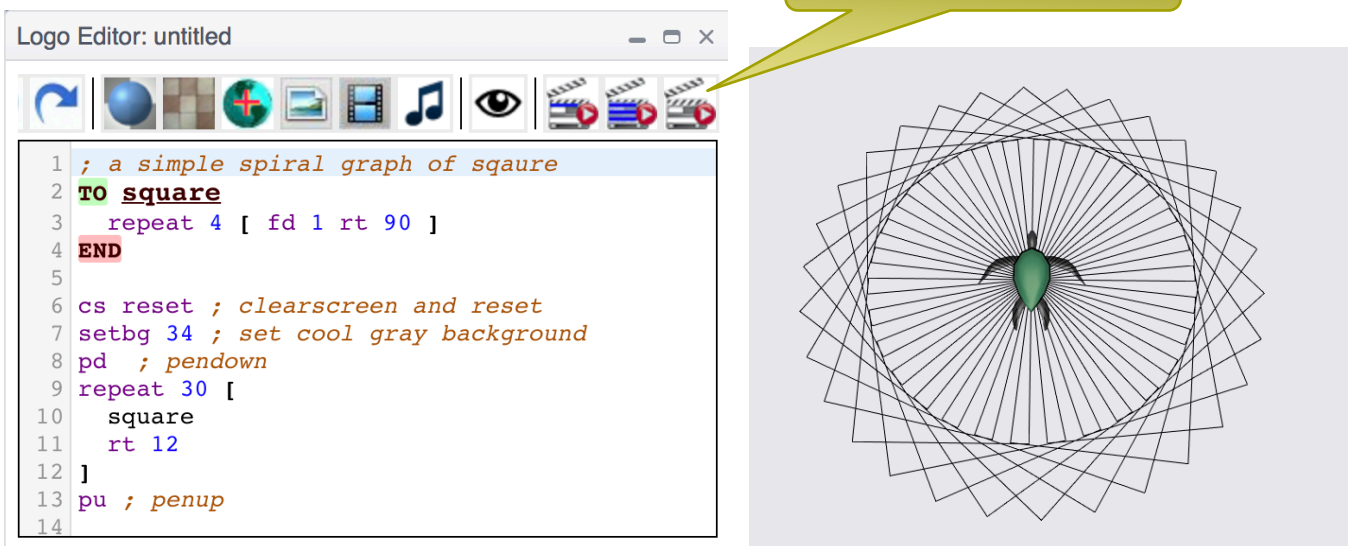
```
1 CLEARTEXT ; this command clear the console texts
2
3 TO double :number ; define a procedure named double
4   OUTPUT :number * 2
5 END
6
7 PRINT double 5 ; this will print 10 to the console
8
```

The Console window shows the output:

```
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

Click to run program



The screenshot shows the Logo Editor window with the following code:

```
1 ; a simple spiral graph of sqaure
2 TO square
3   repeat 4 [ fd 1 rt 90 ]
4 END
5
6 cs reset ; clearscreen and reset
7 setbg 34 ; set cool gray background
8 pd ; pendown
9 repeat 30 [
10   square
11   rt 12
12 ]
13 pu ; penup
14
```

The resulting image shows a green turtle on a gray background, surrounded by a complex spiral graph composed of many overlapping squares.

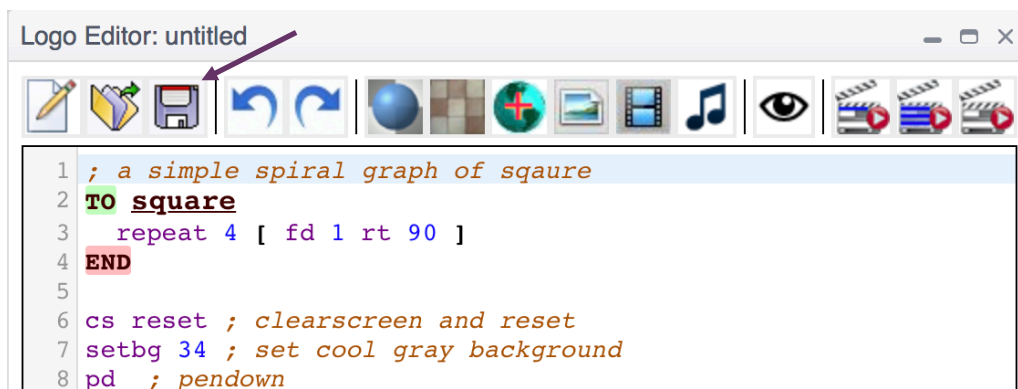
THINK: Can you use the 3D rotation commands in 2.1 to create some 3D spiral graphs?

2.7 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:

- .vrn file: the vrn 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.

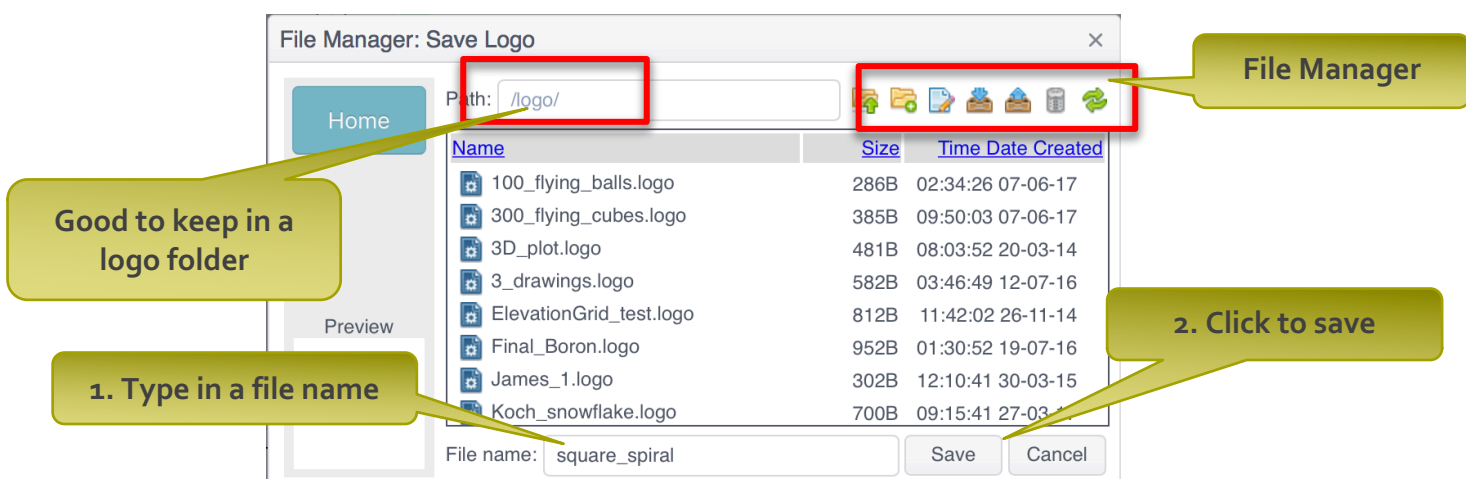
By now, we have created a LOGO program that can generate a simple spiral graph, so it is time that we



```
1 ; a simple spiral graph of square
2 TO square
3   repeat 4 [ fd 1 rt 90 ]
4 END
5
6 cs reset ; clearscreen and reset
7 setbg 34 ; set cool gray background
8 pd ; pendown
```

save the LOGO program.

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



Name	Size	Time Date Created
100_flying_balls.logo	286B	02:34:26 07-06-17
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
ElevationGrid_test.logo	812B	11:42:02 26-11-14
Final_Boron.logo	952B	01:30:52 19-07-16
James_1.logo	302B	12:10:41 30-03-15
Koch_snowflake.logo	700B	09:15:41 27-03-17

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

3. 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

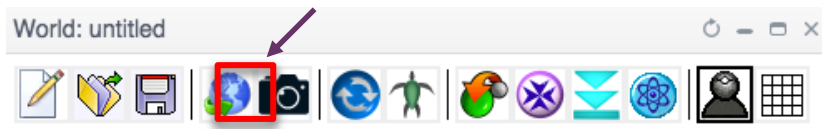
your programming and virtual worlds, you will be learning and applying science, technology, engineering and mathematics (STEM).

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.

3.1 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 <https://vrmath2.net/content/x3d-behind-scenes>

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.



Publish Setting

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, then you should consider including them all.

Include current Viewpoint ON

Include current Background ON

Include Navigation Info ON

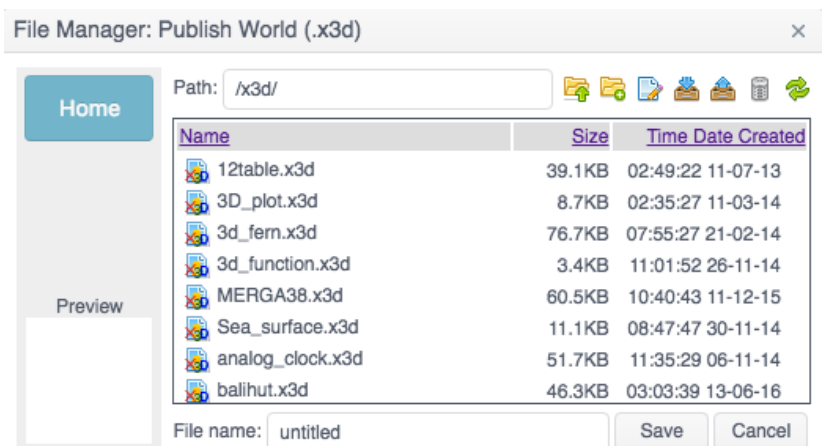
Navigation Info

Examine ON Walk OFF

Fly OFF Any ON

View Codes Publish Cancel

As indicated in the dialog, there are two types of x3d files to publish. If the 3D 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.

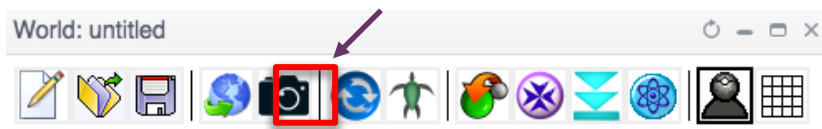


By default, you will save in the **x3d folder**. Provide a sensible file name then click on **Save** button to finish.

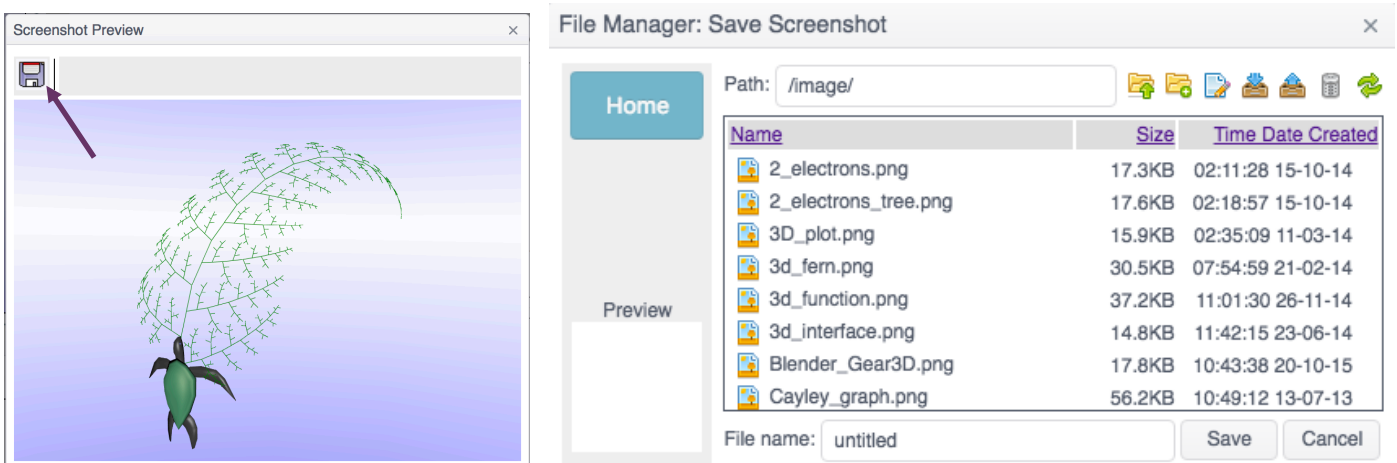
3.2 Save an image for blog

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:



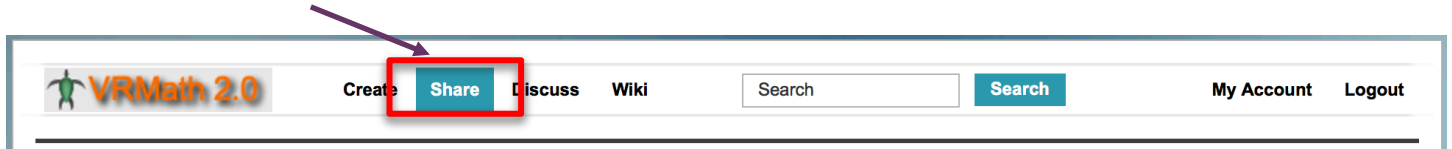
You will then see a **Screenshot Preview** window. If you are happy with the screenshot, click on the disk icon to bring up the **File Manager** dialog. For example,



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

3.3 Write a blog

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



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

Share your creations to the world



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

Title: *

1. Type in a sensible title for your blog.

▼ Vocabularies

Categories: *

- Science
 - Biology
 - Chemistry
 - Earth and Space
 - Physics
- Technology
 - Control
 - Material
 - System

Must select at least one category. Hold Control key (PC) or Command key (Mac) to select multiple categories.

Tags:

Enter a comma separated list of words. E.g., House, Dining table

2. Select at least one category.

3. Type in custom tags if any.

Image:

[Upload](#) | [Remote URL](#)

no file selected

Maximum file size: 1 MB
Allowed extensions: .jpg .jpeg .png .gif

4. Click on this link to choose your blog image.

Blog guides

Please observe **Netiquette** when posting.

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.

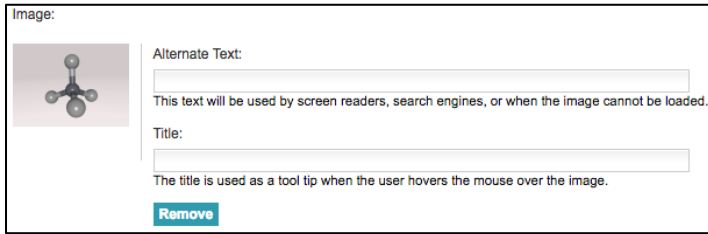
Vocabularies:

Categories are the system's classification based on STEM.

Tags are user's own key words.

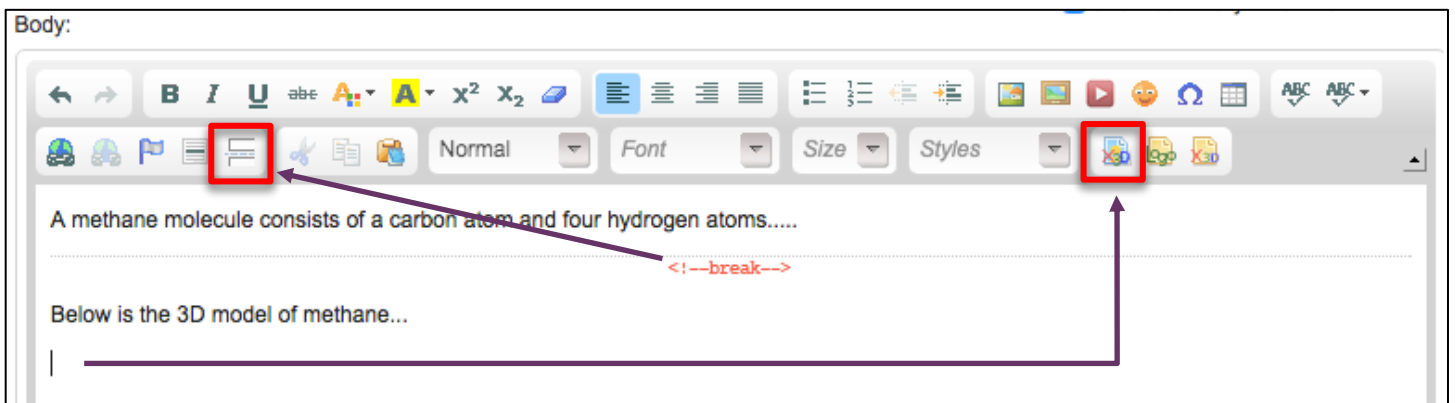
Body:

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.



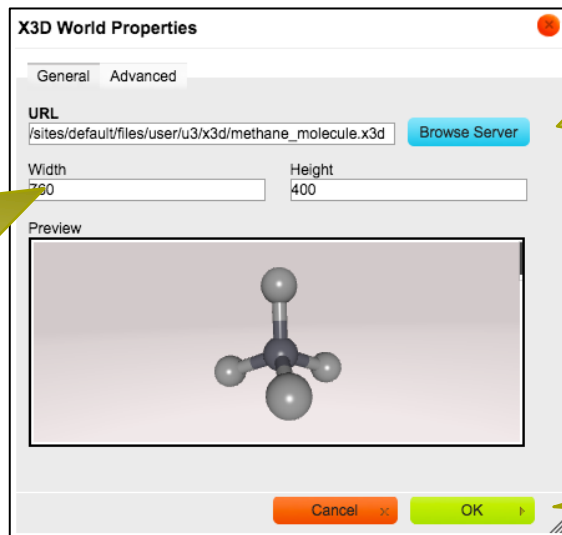
If successful, you should see your image displayed and you are asked to enter **Alternate Text** and **Title** for the image. Please do provide a text and title for the image.

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.



Next, click on the X3D icon to insert your 3D model.

2. Enter the Width as 760 and Height as 400.
PS: You may try different numbers but 760 is maximum.



1. Click on Browse Server to select your x3d file and insert file to close the dialog. If successful, you 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.

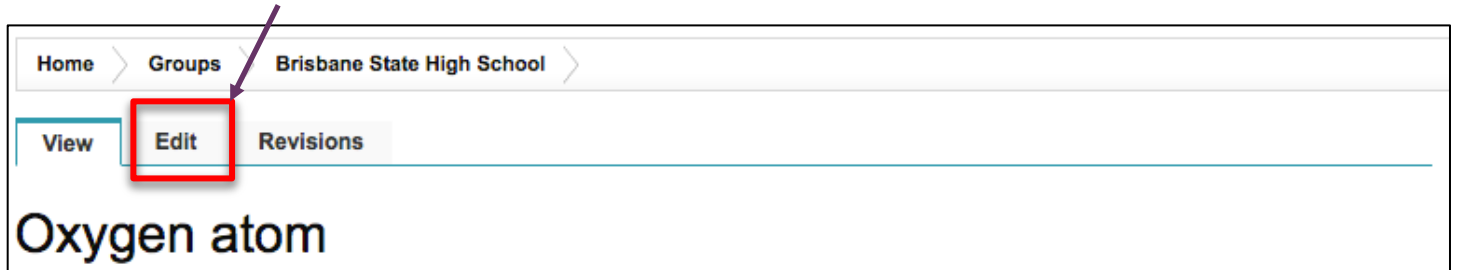


Finally, you can click on **Save** button to publish your blog.

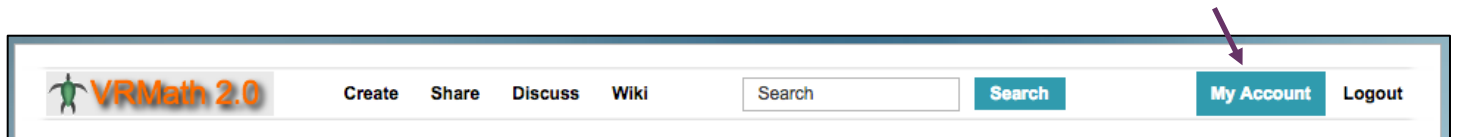
You can edit later your blog as many times as you wish. See next section for how to **Edit**.

3.4 Edit own blog

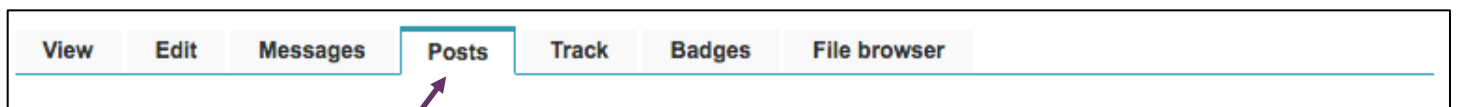
You can edit all your posts when you are viewing them. Simply click on the Edit tab to edit. For example,



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.



3.5 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.

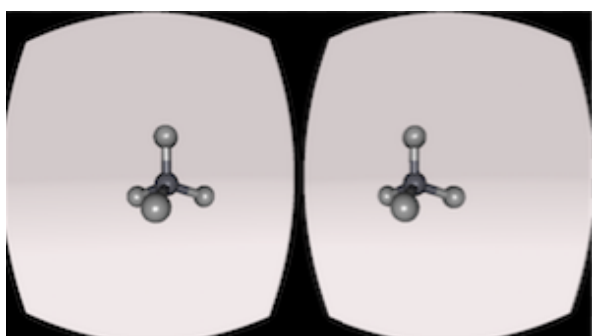


You can also reply to comments by clicking on the **Reply** button in the comments.

4. Viewing 3D models in CardBoard

There are different ways of sharing in VRMath2 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, there will be some VR CardBoards to try the 3D models you create.

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. New smart phones usually can just use the camera App to scan QR code.

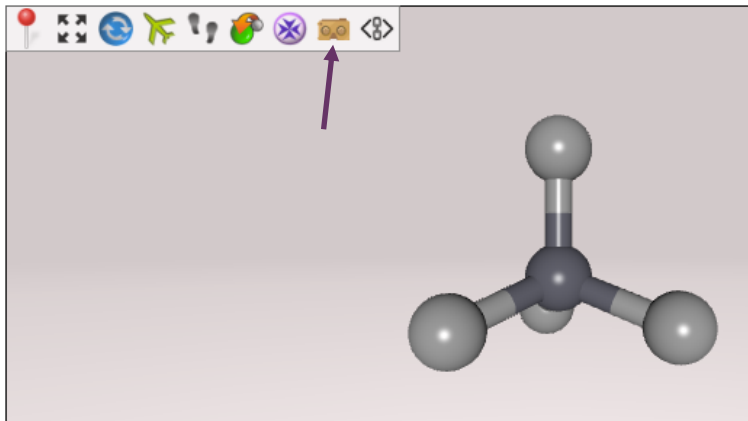
VRMath2 VRBox is an application to view 3D models in VR CardBoard. It has a web address for mobile device only at <https://vrmath2.net/vrbox>

4.1 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:

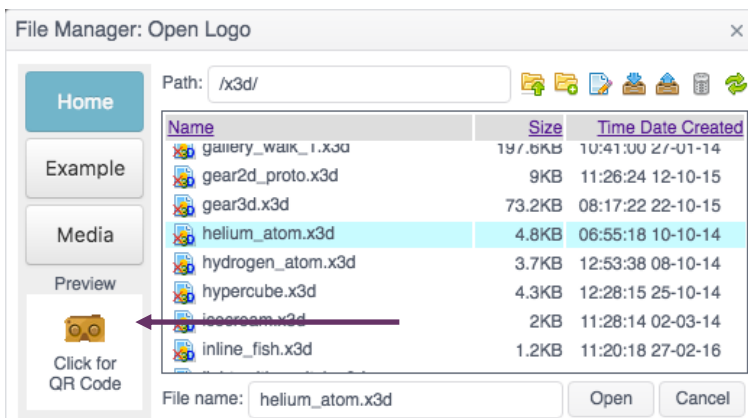


Then click on the **CardBoard** icon to get a QR code. Scan the QR code in your mobile phone to open the **VRMath2 VRBox** application in your mobile browser.



From VRMath2 Editor

Use the **File Manager** to browser your x3d files.

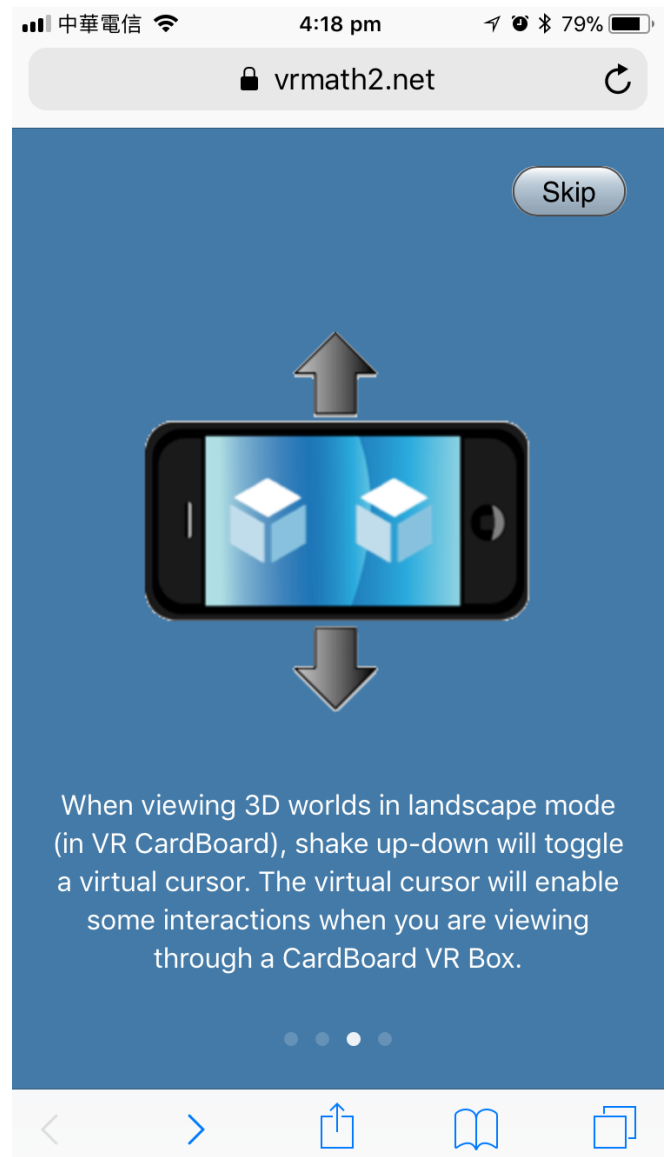
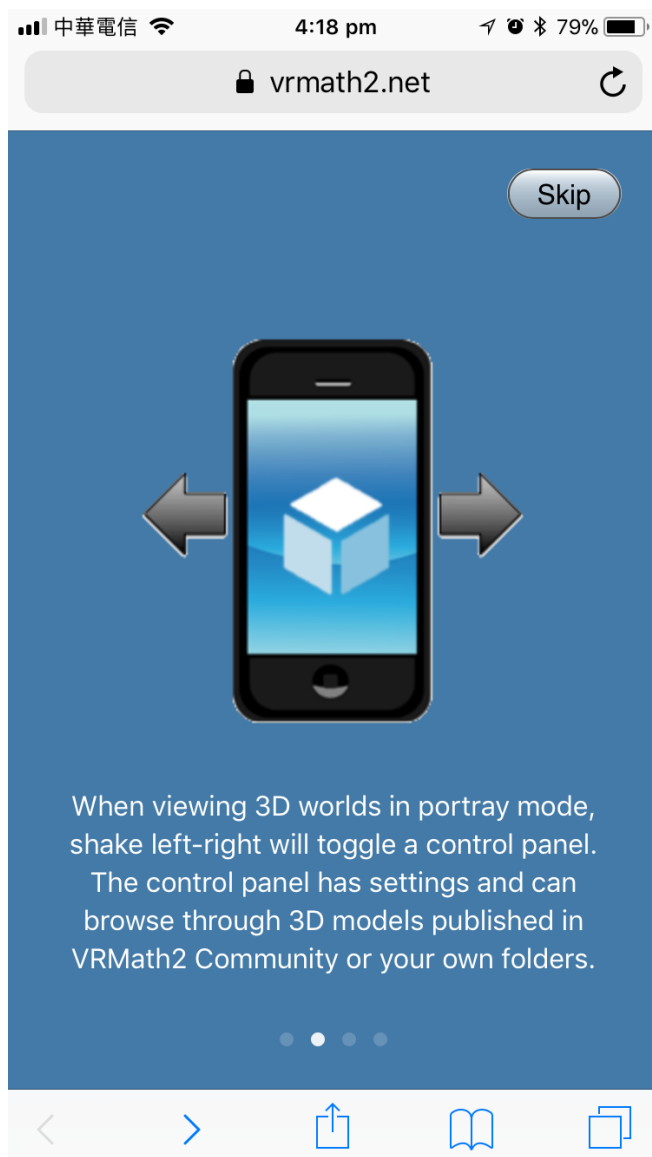


Once a x3d file is selected, click on the CardBoard icon in the Preview area. A QR code will be displayed. Scan the QR code with a mobile phone to open the VRMath2 VRBox application in a mobile browser.

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

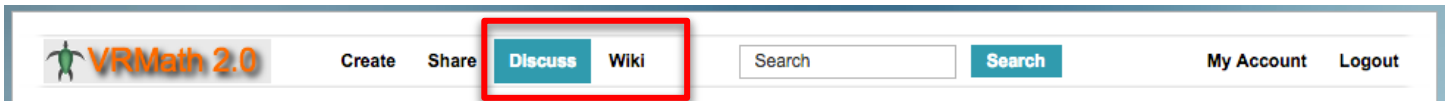
4.2 VRMath2 VRBox

The VRMath2 VRBox App is still in development. It can be accessed in mobile browsers directly from <https://vrmath2.net/vrbox>. 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 <https://vrmath2.net/vrbox>.







5. 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:



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 design, create and share of 3D worlds.			
 Community forum Discussions about the design, functions and services of VRMath2 website.	0	0	n/a
 Logo programming forum Discussions about Logo programming in VRMath2 Editor.	8	28	map with ... by Andy 09/07/2016 - 00:51
 VRMath2 Editor forum Discussions about the design, 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 VRMath2 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.
