

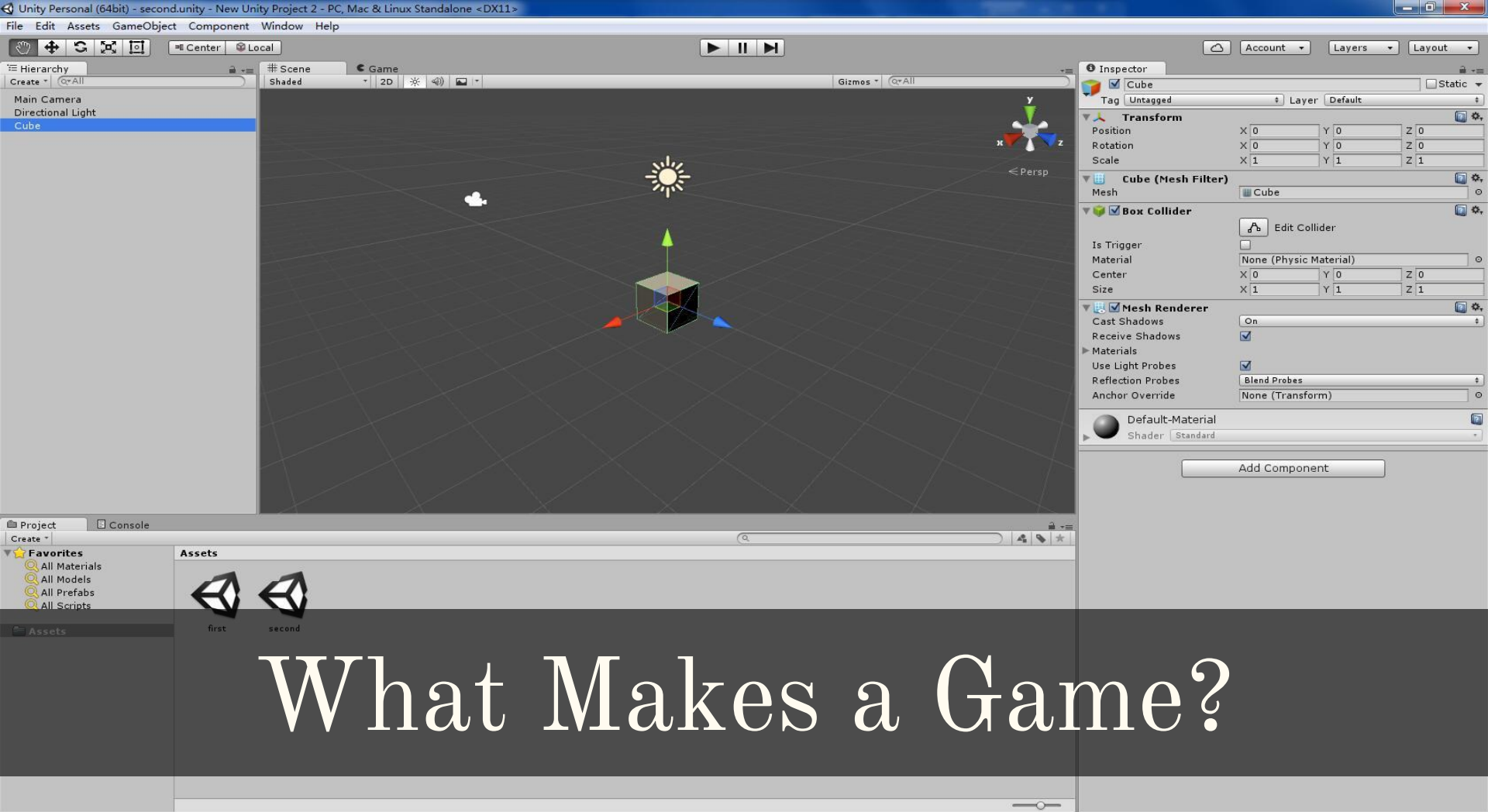
Resources in Game Making

—

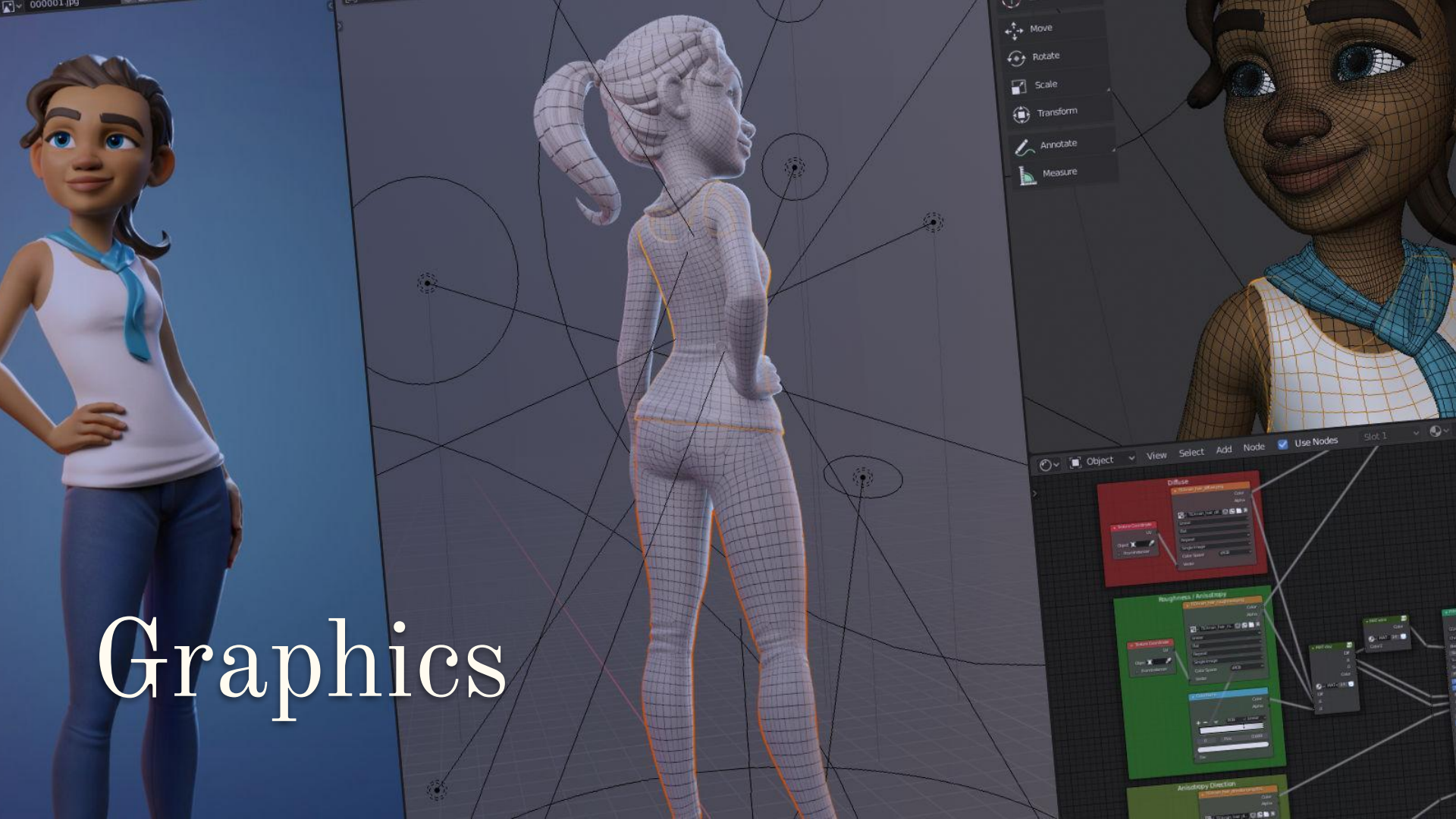
By Taro Omiya

Agenda

- What Makes a Game?
 - What is a Game Engine?
 - How to choose a game engine
 - Art and audio tools and resources
 - Q & A
-



What Makes a Game?



Graphics

TETRIS

BACK
to
BACK

LINES
36/45



TIME
01:42

SCORE
74,282

TOTAL SCORE
74,282

Audio



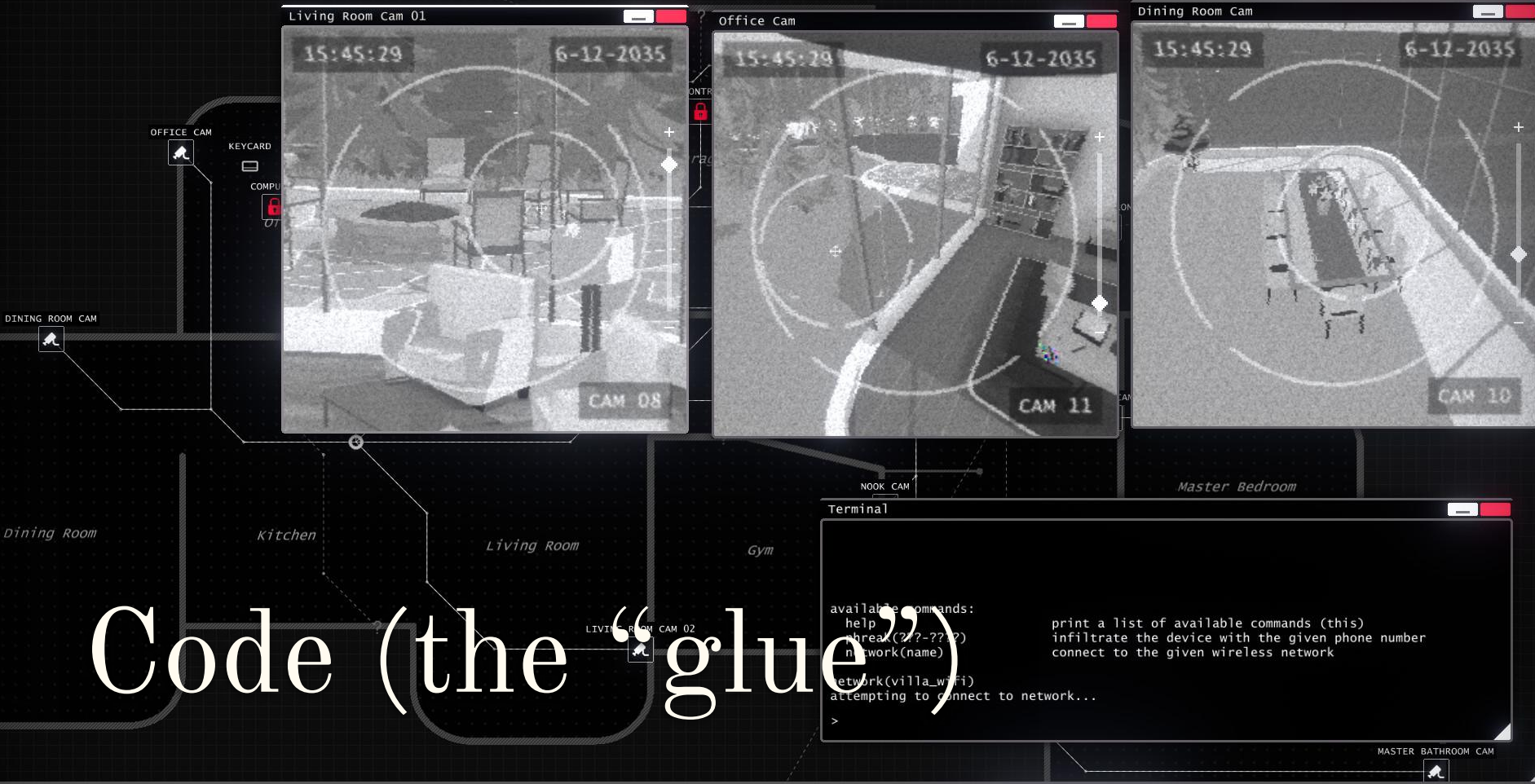
Writing

Input





Rules



Code (the “glue”)

```
Terminal
available commands:
  help                print a list of available commands (this)
  breach(??-??-??)    infiltrate the device with the given phone number
  network(name)        connect to the given wireless network
  network(villa_wifi)  attempting to connect to network...
>
```

Other Extras

- User Interface (Menus, HUD)
- Physics and AI
- Online networking
- Level editor
- And many, many more!



Game engines collect all the necessary frameworks to make a game into a single user friendly package.

What Game Engines are not?

Most game engines *do not* do the following:

- Create 3D models or 2D images.
- Create sounds or music.
- Anything specific to a particular game, such as:
 - Inventory system,
 - Dialog trees,
 - Localization,
 - etc.

Game Engines
broadly fall under
the following
categories...

3D generalist game engines

Builds to nearly all platforms, but
may require a little programming
knowledge

Examples:

- Unreal 4
- Unity
- Godot 3

Easy-to-learn indie game engines

Usually focuses on 2D, and
doesn't require programming
knowledge

Examples:

- Construct 3
- GameMaker Studio 2
- GDevelop

Specialized game engines

They can make one game genre
really, really well, and usually
don't require programming
knowledge

Examples:

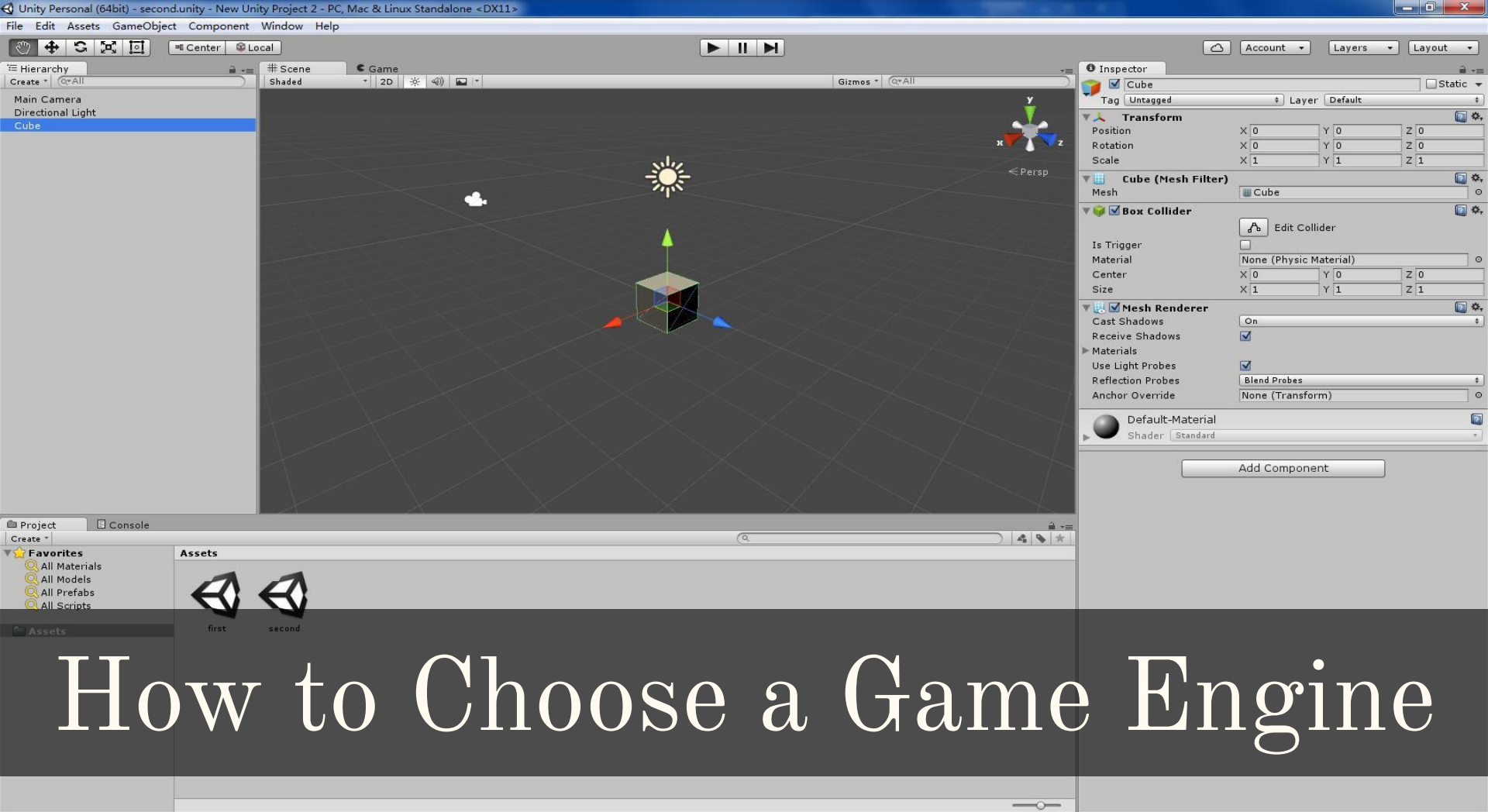
- Old-school turn-based JRPG:
 - RPG Maker MV
 - Visual novels:
 - Ren'py
 - Point-and-click adventures:
 - Adventure Game Studio
 - Text adventures
 - Twine
 - FPS:
 - CryEngine
-

Programming frameworks

Requires programming
knowledge, rarely comes with a
visual editor

Examples:

- HaxeFlixel
 - LÖVE
 - PyGame
 - SDL2
 - libGDX
-



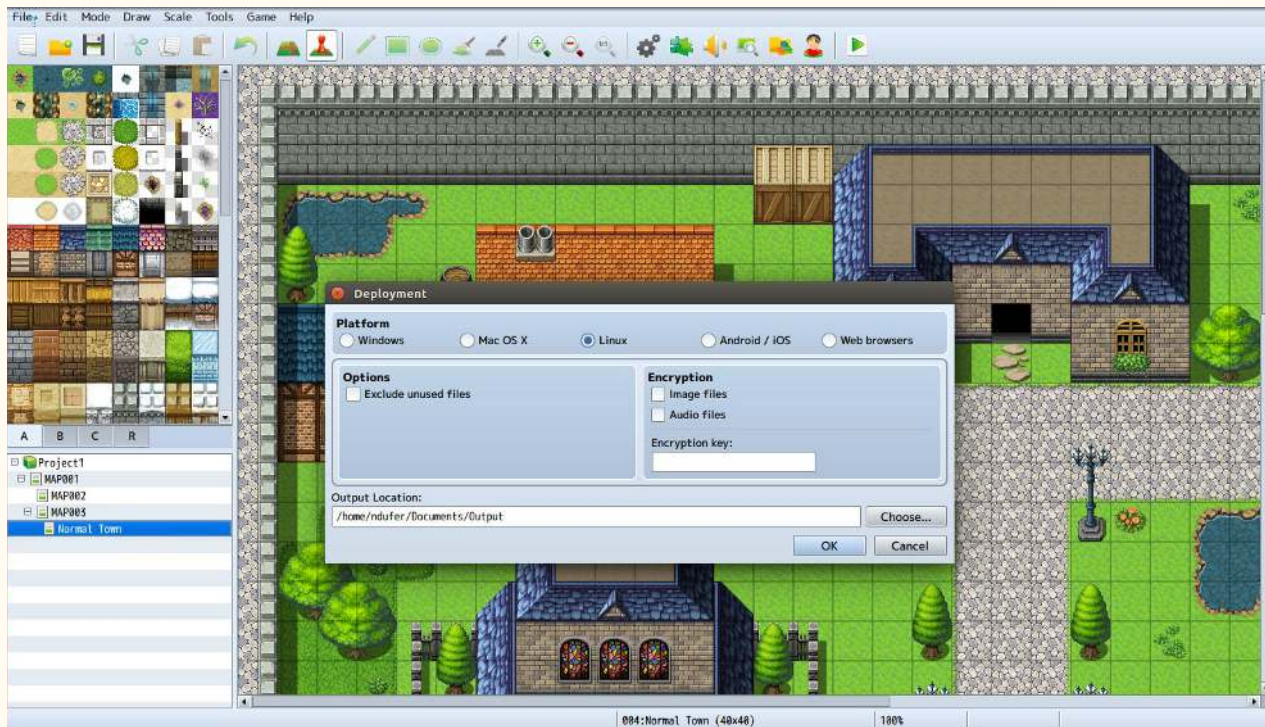
How to Choose a Game Engine

Consider the following questions:

1. Do you know how to code? Are you willing to learn it?
2. Does the game engine have to be (mostly) free?
3. What genre of games do I want to focus on?
 - Check if there are any specialized game engines out there!
4. Must the game be 3D? Can it be 2D?
5. If 3D, how powerful is your development computer?
6. Does it have to be open-source?
 - Open-source: *adj.* an app whose code is openly available, and editable by anyone.

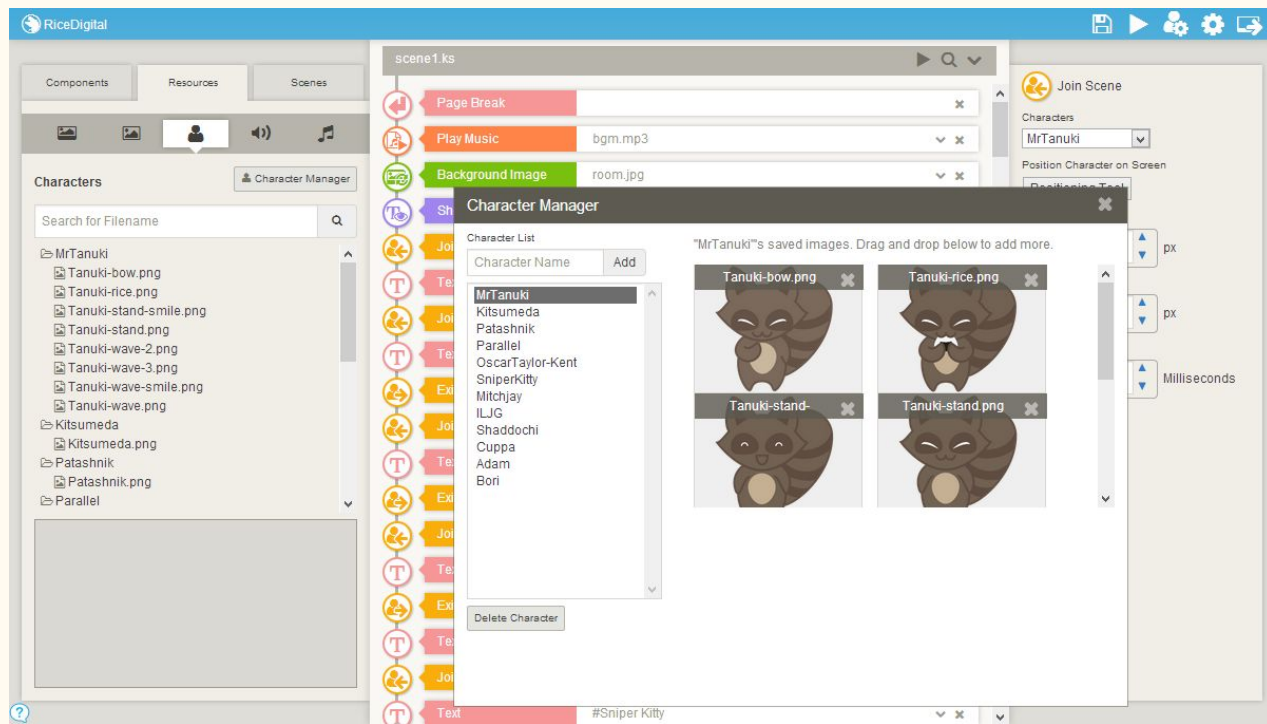
I want to make old-school
Final Fantasy-like JRPGs,
no programming

- RPGMaker MV -
rpgmakerweb.com
 - \$80
 - PC, Mac, Linux
- RPG Paper Maker -
rpg-paper-maker.com
 - Free - \$70
 - PC, Mac, Linux
- GameMaker Studio 2 -
yoyogames.com/get
 - Free - \$100
 - PC, Mac



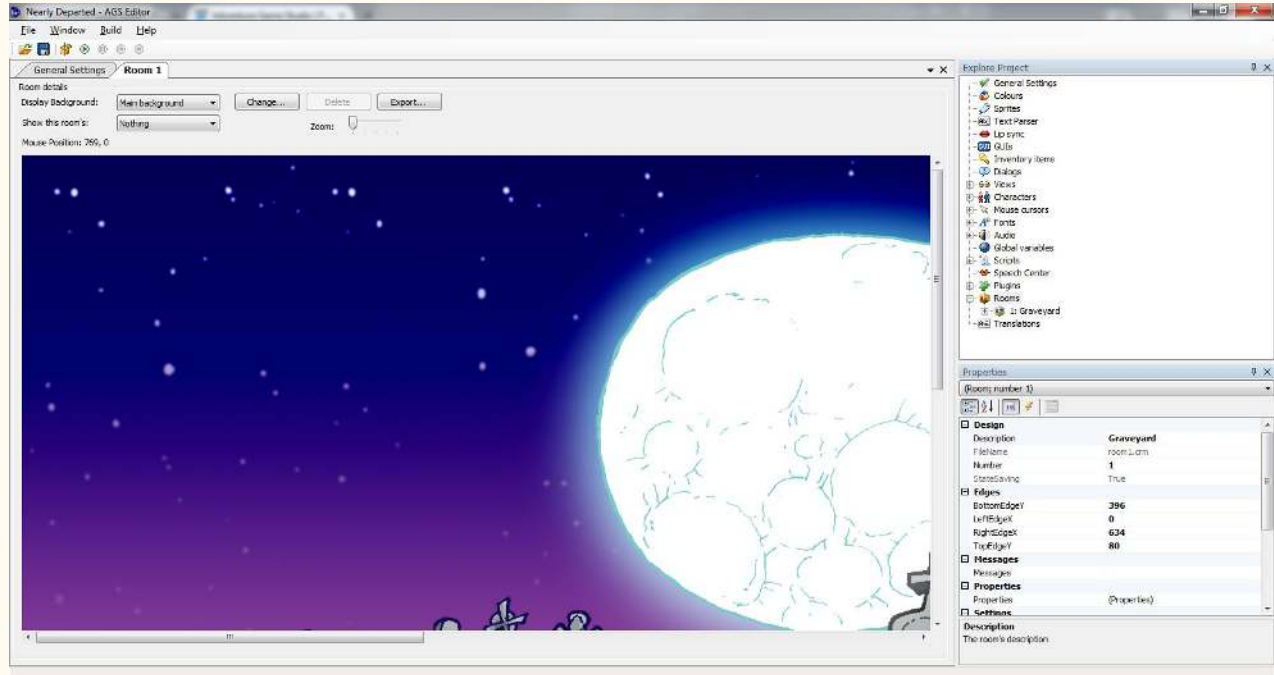
I want to make visual novels, e.g. Doki Doki Literature Club, no programming

- Ren'py - renpy.org
 - Free & open-source!
 - PC, Mac, Linux
- TyranoBuilder - tyranobuilder.com
 - \$15
 - PC, Mac
- Visual Novel Maker - rpgmakerweb.com
 - \$70
 - PC, Mac, Linux
- Twine - twinery.org
 - Free & open-source!
 - Web, PC, Mac, Linux



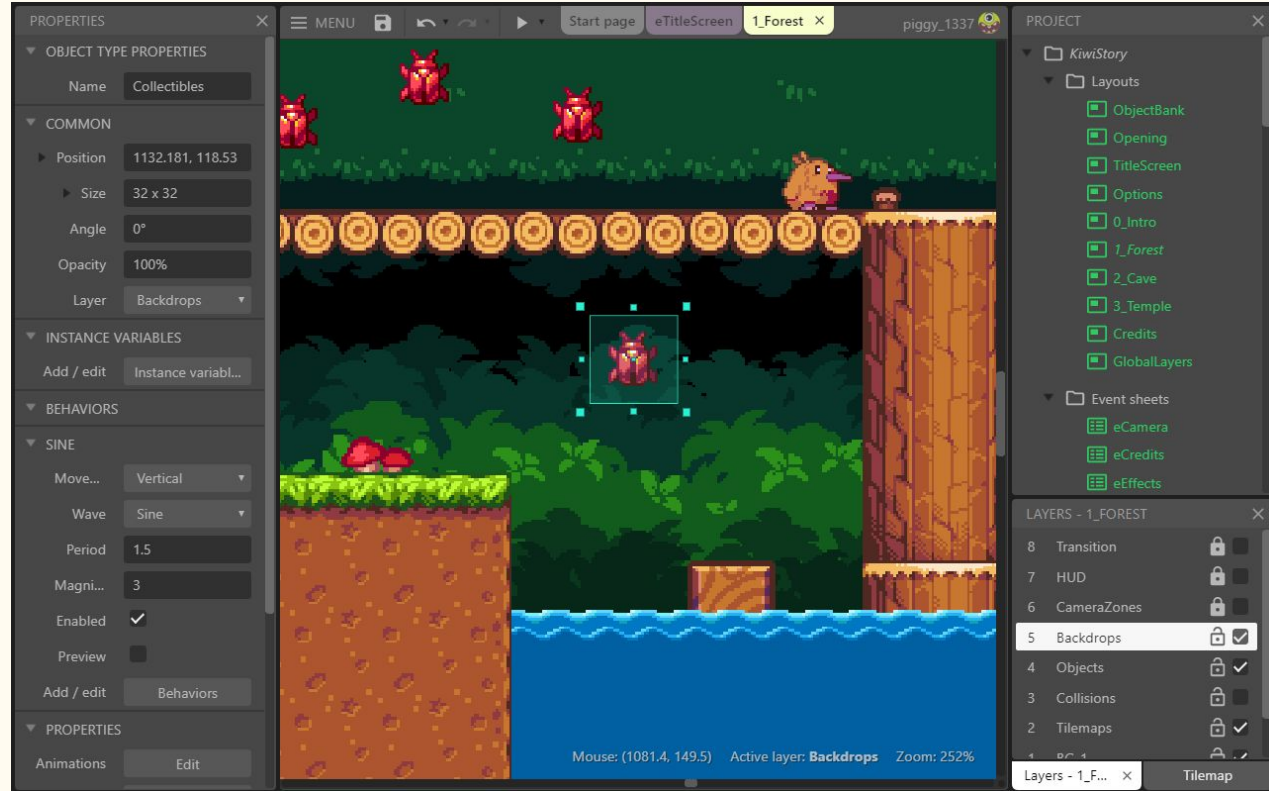
I want to make point-and-click adventures, no programming

- Adventure Game Studio - adventuregamestudio.co.uk
 - Free!
 - PC-only



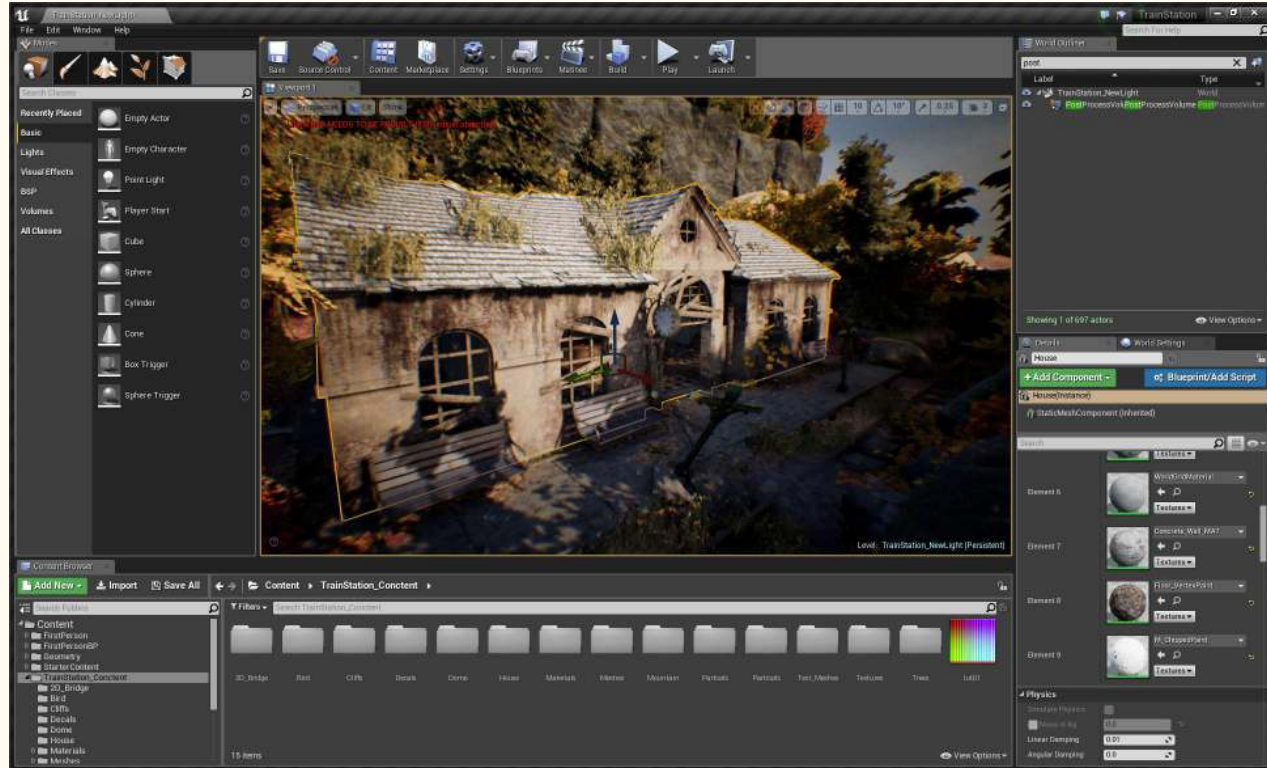
I don't know how to program, OK with 2D games

- Construct 3 - editor.construct.net
 - Free - \$100/year
 - Web
- GDevelop - gdevelop-app.com
 - Free & open-source!
 - Web, PC, Mac, Linux
- GameMaker Studio 2 - yoyogames.com/get
 - Free - \$100
 - PC, Mac
- Construct 2 - scirra.com/construct2
 - Free - \$200
 - PC-only



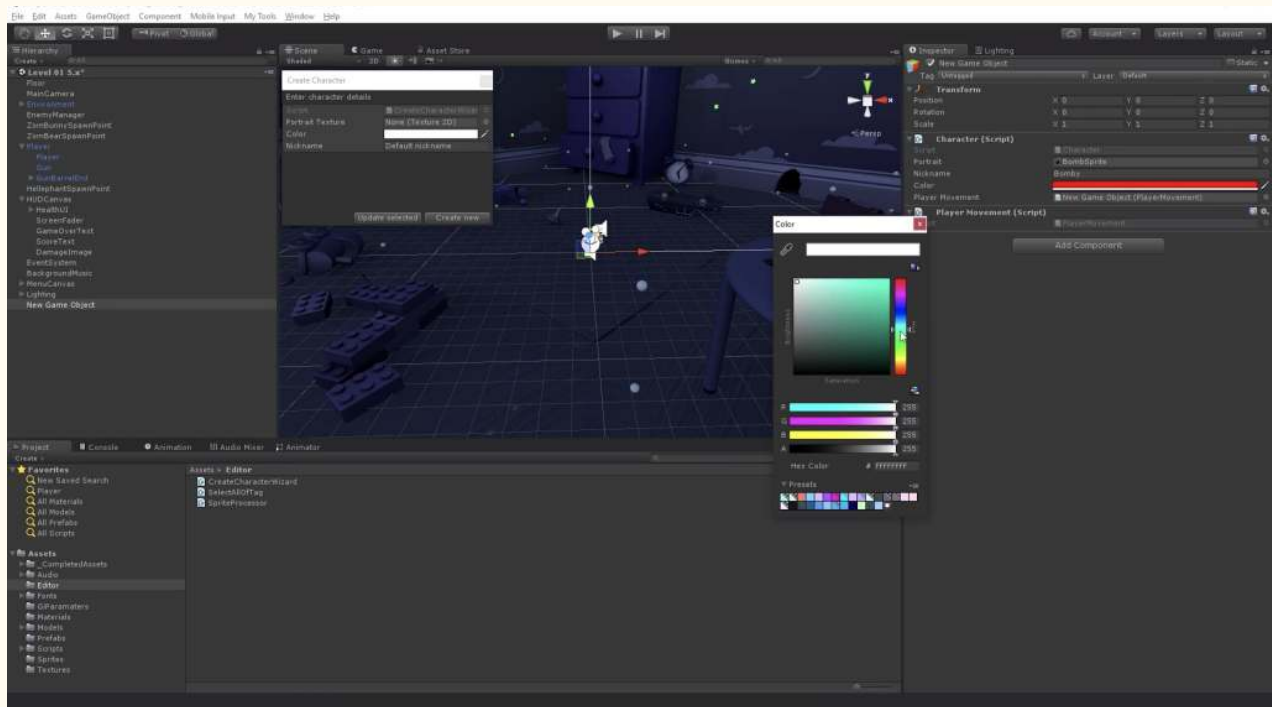
I want to make an FPS,
no programming, and
have a decked-out
computer!

- Unreal 4 - unrealengine.com
 - Free!
 - PC, Mac
- CryEngine - cryengine.com
 - Pay-what-you-want & open-source!
 - PC-only



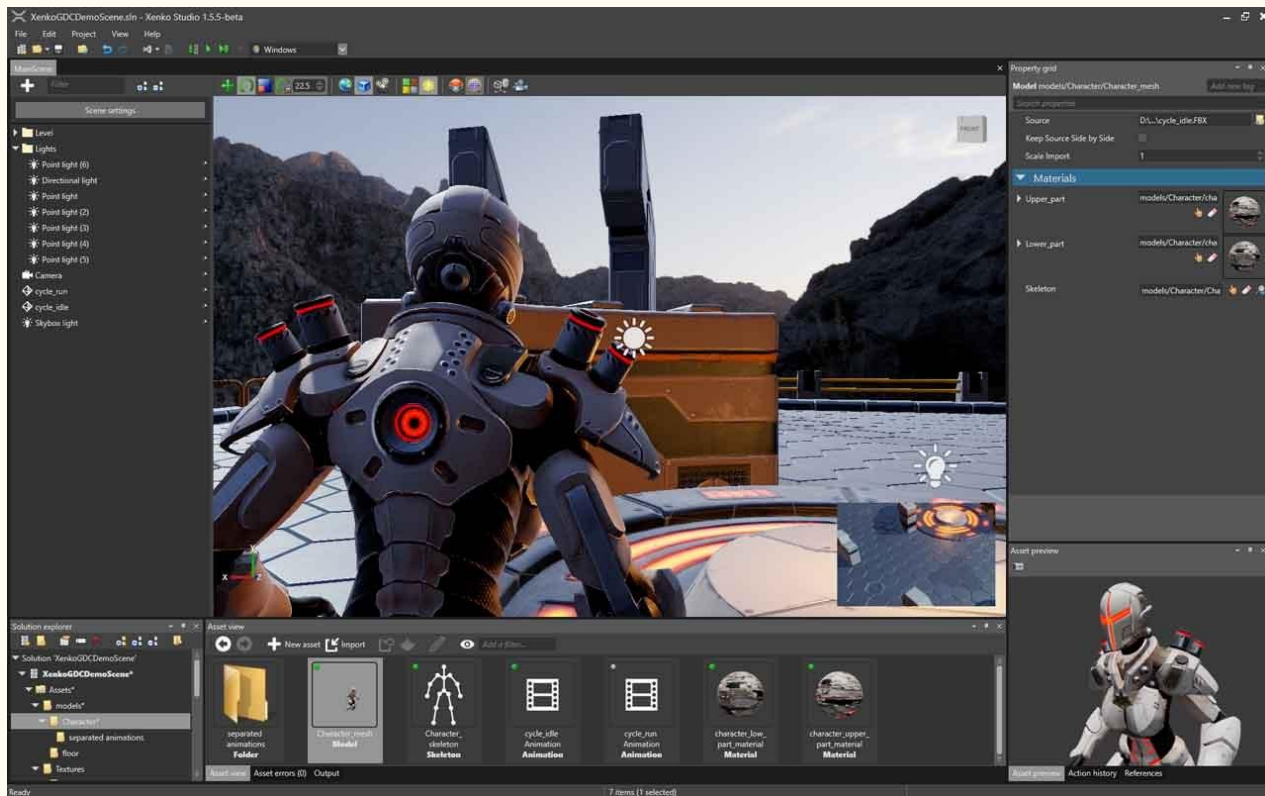
I know programming,
want to make a 3D game,
but don't have a powerful
computer

- Unity - unity.com
 - Free!
 - PC, Mac, Linux
- Godot 3 - godotengine.org
 - Free & open-source!
 - PC, Mac, Linux



I know programming,
want to make a 3D game,
has to be open-source!

- Godot 3 - godotengine.org
 - Free & open-source!
 - PC, Mac, Linux
- Xenko - xenko.com
 - Free & open-source!
 - PC-only
- Torque 3D
 - garagegames.com/products/torque-3d
 - Free & open-source!
 - PC, Mac, Linux



Review the basics on a game engine:

1. Importing assets (images, models, sound, etc.)
2. Adding visuals
3. Moving an object with mouse/keyboard/controller/etc.
4. Setup physic simulations
5. Play sound effects
6. Spawn and delete objects while the game is playing
7. Exporting a playable game

Then make a game!

- Start simple
 - Most tutorials provide instructions on making a specific type of game
- Search for more resources on specific features



2D Art

Some Terminologies

- Lossy
 - *Adj.* descriptor of a file type where through their compression algorithm, fine details may be lost.
- Lossless
 - *Adj.* descriptor of a file type where all details are guaranteed to be preserved, even when compressed.
- Power-of-two
 - *Noun* a number generated by the formula, 2^n . Used for optimization.
 - E.g. 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, etc.
- Pixel
 - *Noun* a unit of measurement, corresponding to a cell on a monitor.
 - E.g a 1024 x 768 screen resolution has 1024 pixels in width, and 768 pixels in height.
- Frame
 - *Noun* a static image that composes an animation.
 - *Noun* a unit of time in an animation.
- Sprite
 - *Noun* a single (potentially animated) image.
- Spritesheet
 - *Noun* an image file with a collection of sprites. Used for optimization.

Some Terminologies

- Bitmap/Raster Art
 - *Noun* any images or artwork created by plotting colors at specific points (i.e. pixels) on a grid. This form of digital art is the closest analogous to regular studio art.
- Pixel Art
 - *Noun* a subset of raster art. This style of artworks deliberately creates blocky image to embrace old-school console looks.
- Vector Art
 - *Noun* any images or artwork composed by formulas providing outlines, contours, and gradients of an area. Due to the mathematical nature of this technique, this form of art can be resized to any resolution, and all details will be preserved.

File Types

- Lossless file types:
 - PNG
- Best for almost everything 2D-related.
- Lossy file types:
 - JPEG
 - GIF
- Good for large, non-transparent images, e.g. static background art.

Pro-tip:

- Most game engines automatically convert a collection of sprites to spritesheets. As such, now-a-days, using sprite as individual image files vs. compiling them all into a single file does not provide significant performance improvements.

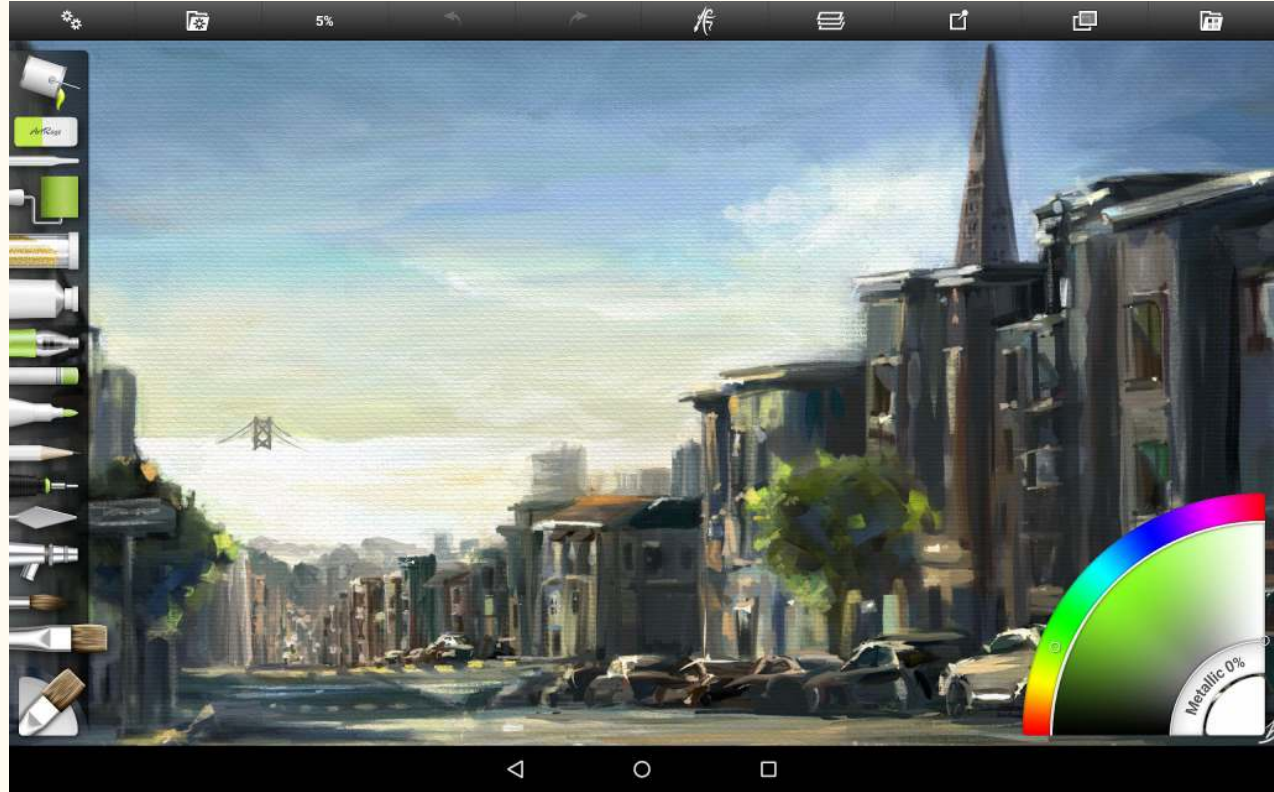
Making Raster Art

- Krita - krita.org
 - Free & open-source!
 - PC, Mac, Linux
- Paint.net - getpaint.net
 - Free
 - PC-only
- MyPaint - mypaint.org
 - Free & open-source!
 - PC, Mac, Linux



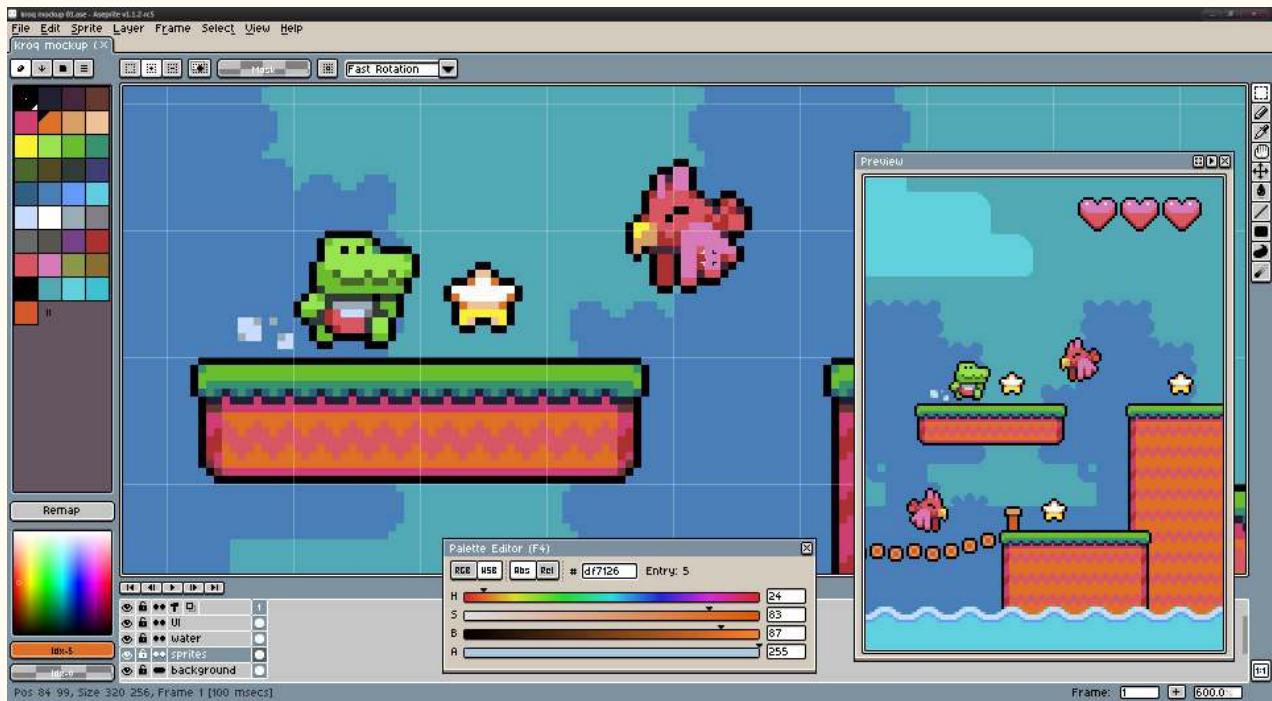
Making Raster Art

- Procreate - procreate.art
 - \$10
 - iPad-only
- ArtRage - artrage.com
 - \$80
 - PC, Mac, iPad, Android
- Autodesk SketchBook - sketchbook.com
 - Free
 - PC, Mac, iPad, Android



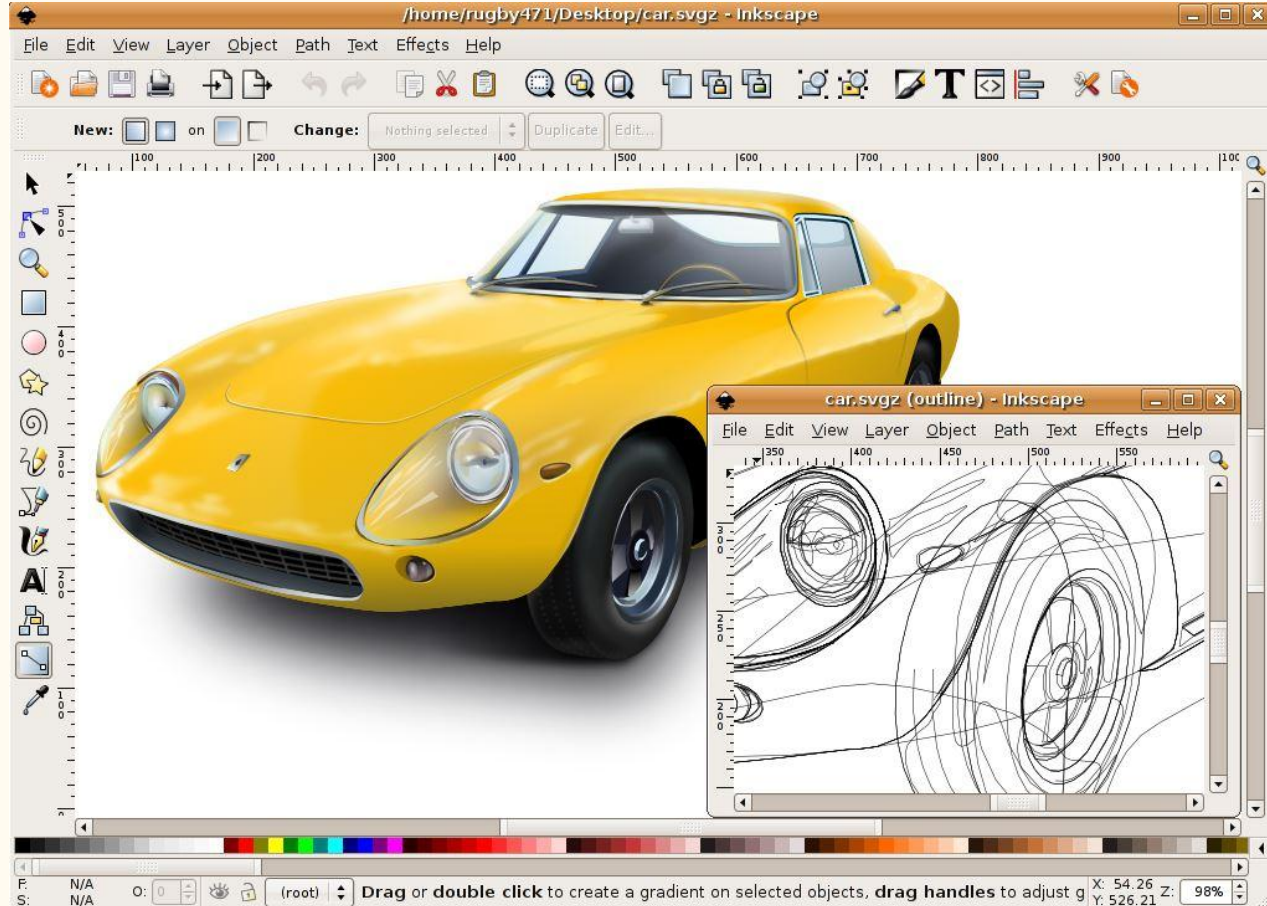
Making Pixel Art

- Piskel - piskelapp.com
 - Free & open-source!
 - Web, PC, Mac, Linux
- Aseprite - aseprite.org
 - \$15
 - PC, Mac, Linux
- Pyxel Edit - pyxeledit.com/get.php
 - \$9
 - PC, Mac
- GraphicsGale - graphicsgale.com/us
 - Free!
 - PC-only



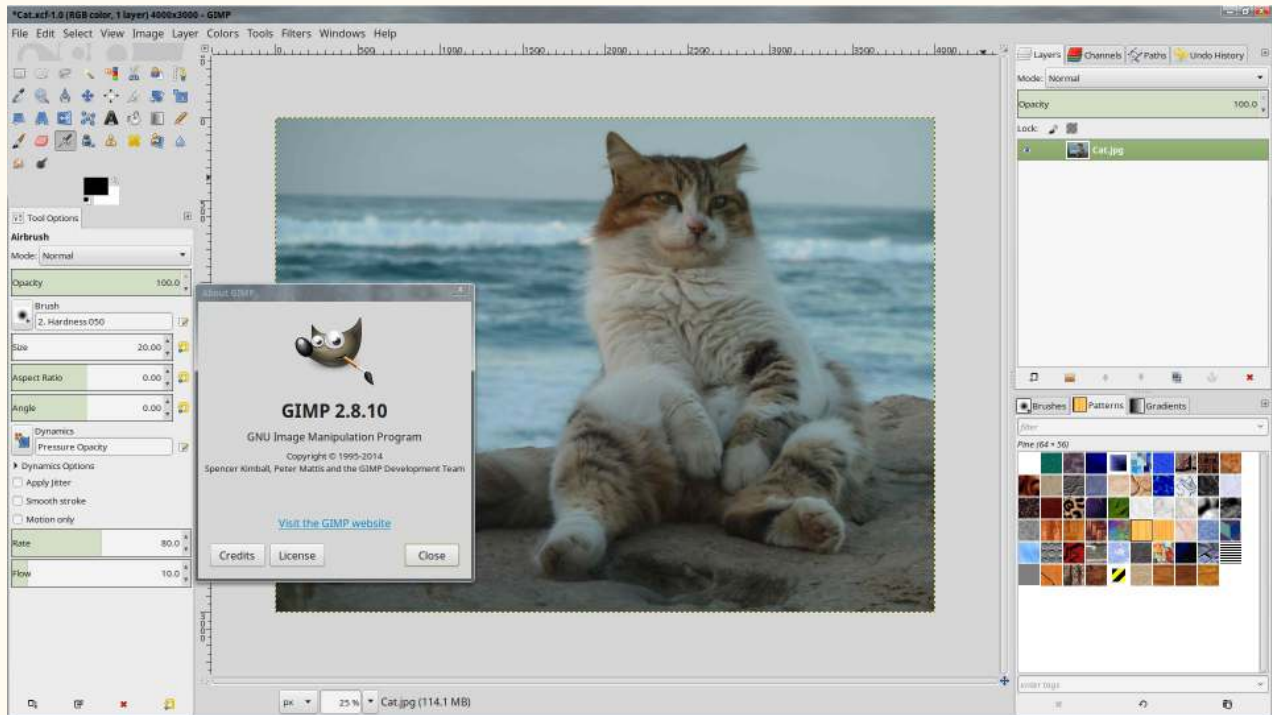
Making Vector Art

- Inkscape - inkscape.org
 - Free & open-source!
 - PC, Mac, Linux
- Adobe Illustrator
 - adobe.com/products/illustrator.html
 - Professional
 - \$360/year
 - PC, Mac



Compositing or Editing Images

- GIMP - gimp.org
 - Free & open-source!
 - PC, Mac, Linux
- Adobe Photoshop
 - adobe.com/products/photoshop.html
 - Professional
 - \$360/year
 - PC, Mac



Royalty-free Art Resources

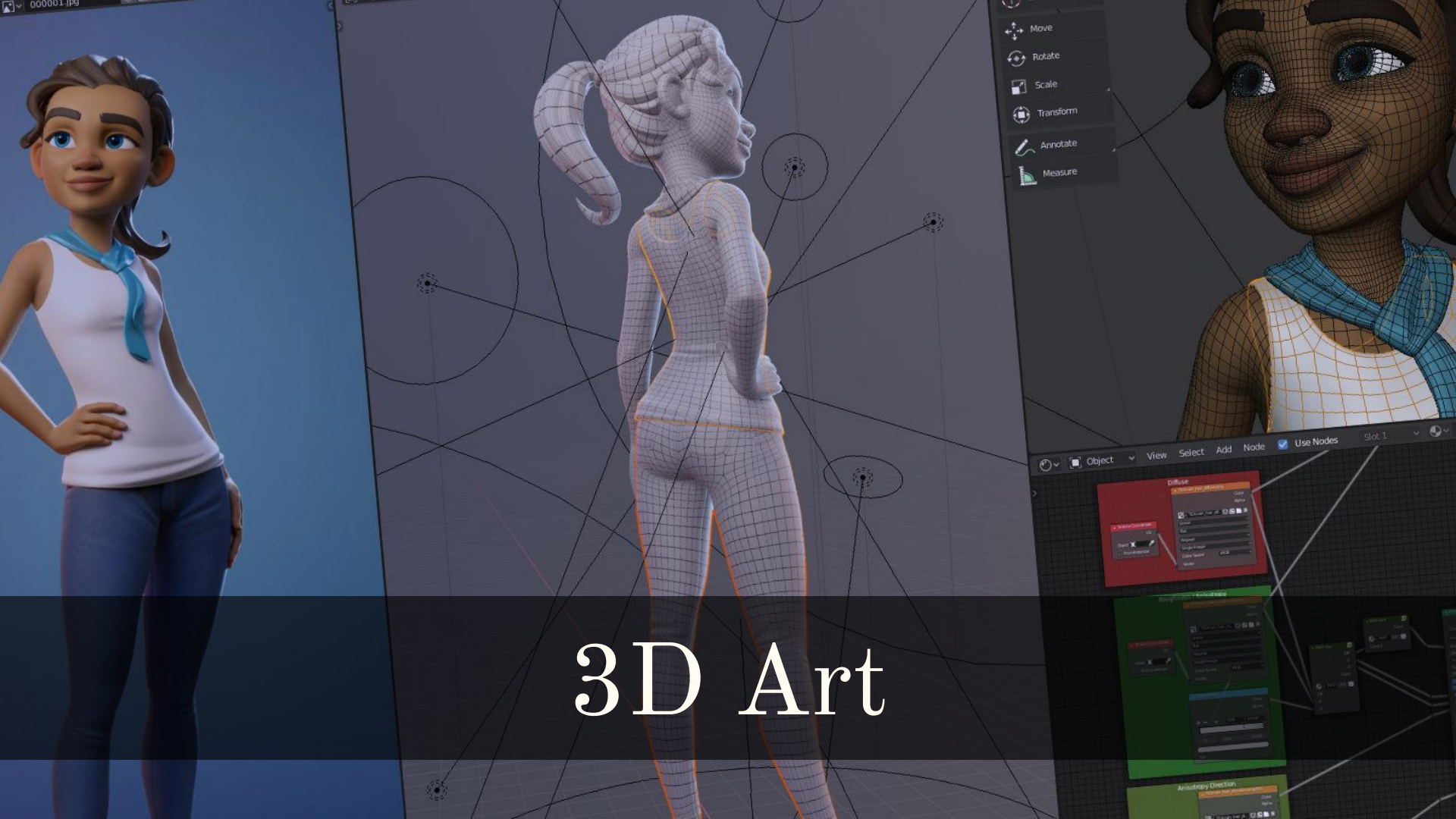
- [OpenGameArt.org](https://opengameart.org/)
- Kenney Assets
 - kenney.nl
- [Game-icons.net](https://game-icons.net/)
 - game-icons.net
- [Wikimedia Commons](https://commons.wikimedia.org/)
 - commons.wikimedia.org
- [Pixabay](https://pixabay.com/)
 - pixabay.com
 - registration necessary
- [MorgueFile](https://morguefile.com/)
 - morguefile.com



Quick Notes About Copylefts

- Creative Commons
 - Creative Commons have a variety of different versions, so pay careful attention!
 - All require giving credit to the user. None allows reselling the asset *by itself* as your own.
 - Some allow modifications, others only allow it if the modified art is released with the same license, and yet others do *not* allow modification.
- GPL
 - Usually applies to code. Any modifications made to GPL code requires releasing publicly with the same license.
- Public Domain
 - Assets that you can use, modify, and even resell if you want to.
 - Easily the loosest license.

WARNING: Public Domain and Creative Commons images of copyrighted material is subject to regular copyright. Be mindful of this when you post your games.



3D Art

Some Terminologies

- **Model**
 - *Noun* a single (potentially animated) sculpture.
- **Vertex**
 - *Noun* a corner of a model.
- **Edge**
 - *Noun* a line connecting two vertices.
- **Face**
 - *Noun* a surface composed of 3 or more vertices and edges.
- **Normal**
 - *Noun* the direction a face is facing, e.g. outwards or inwards.
- **Empty**
 - *Noun* a vertex with no edges.
- **Texture**
 - *Noun* the “skin” of a sculpture. An image file that colors the surface.
- **Normal Map**
 - *Noun* a type of texture that depicts the direction light should bounce from a surface.
- **UV-Map**
 - *Noun* coordinates of which pixel of a texture maps to which part of the model.
- **Voxel Art**
 - *Noun* a blocky 3D art style akin to Minecraft. Composed by voxels, or a “pixel” to a 3D grid.

Some Terminologies

- **Material**
 - *Noun* data specifying the quality of a model's surface, e.g. how shiny, reflective, and/or opaque it should be.
- **Shader**
 - *Noun* code that specifies how to compute the color on a pixel. Materials feeds input data to shaders.
- **Armature/Rig**
 - *Noun* a skeletal framework used as the basis for 3D animations on a model.
- **Rigging**
 - *Verb* creation of an armature. Involves creating bones to a model.
- **Weight-Painting**
 - *Verb* a painting process indicating how much a vertex is affected by the movement of a bone.
- **Keyframe**
 - *Noun* a “frame” of a 3D animation where the pose of the armature and/or the displacement of the model's vertices is set.
- **Tweening**
 - *Verb* the computation of how a model will look like in-between two keyframes.
- **Photogrammetry**
 - *Noun* the process of generating a 3D model by feeding a large number of photos of the same object taken from different angles to an app, allowing it to compute its geometry.

File Types

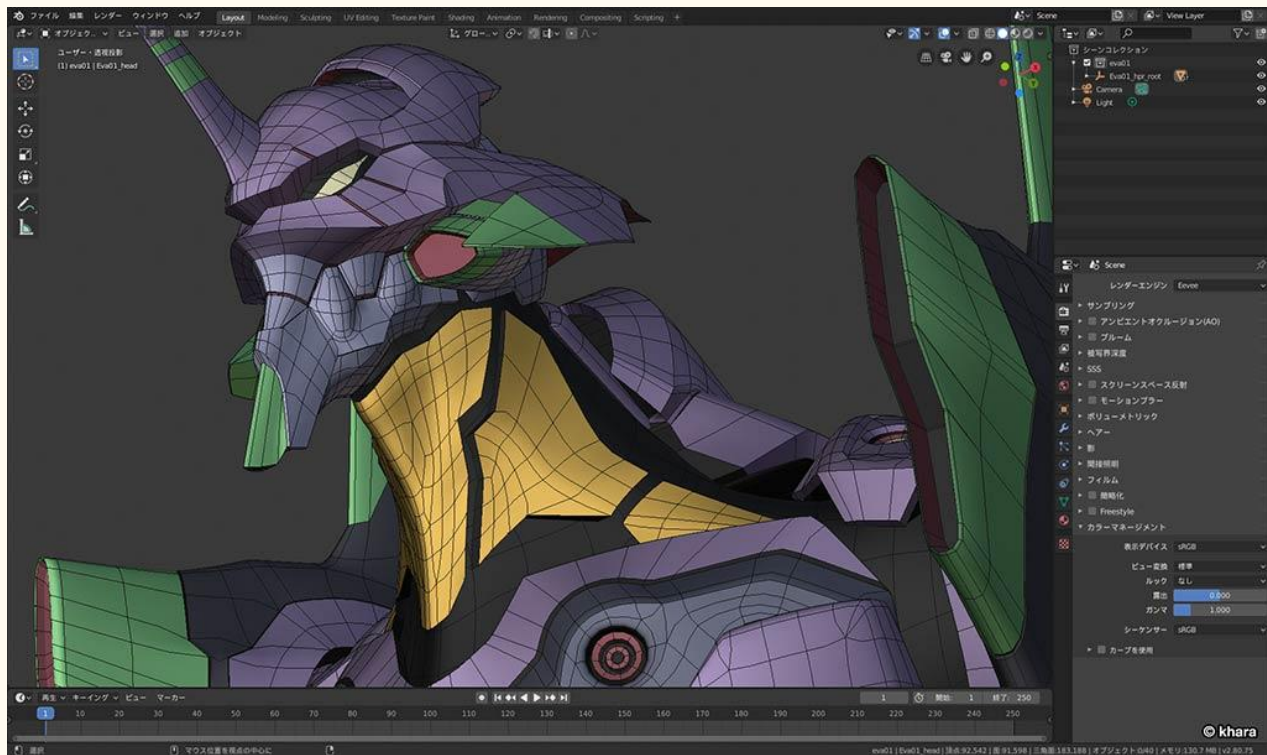
- File types with animations:
 - FBX
 - glTF
 - DAE
- File types without animations:
 - OBJ

Pro-tip:

- Pretty much all model files are lossless.
- Many model files do *not* contain texture and material data.
- Most game engines will automatically resize textures (which, remember, are images) to the closest dimension of power-of-two. It is highly recommended to create textures that already have a power-of-two size.

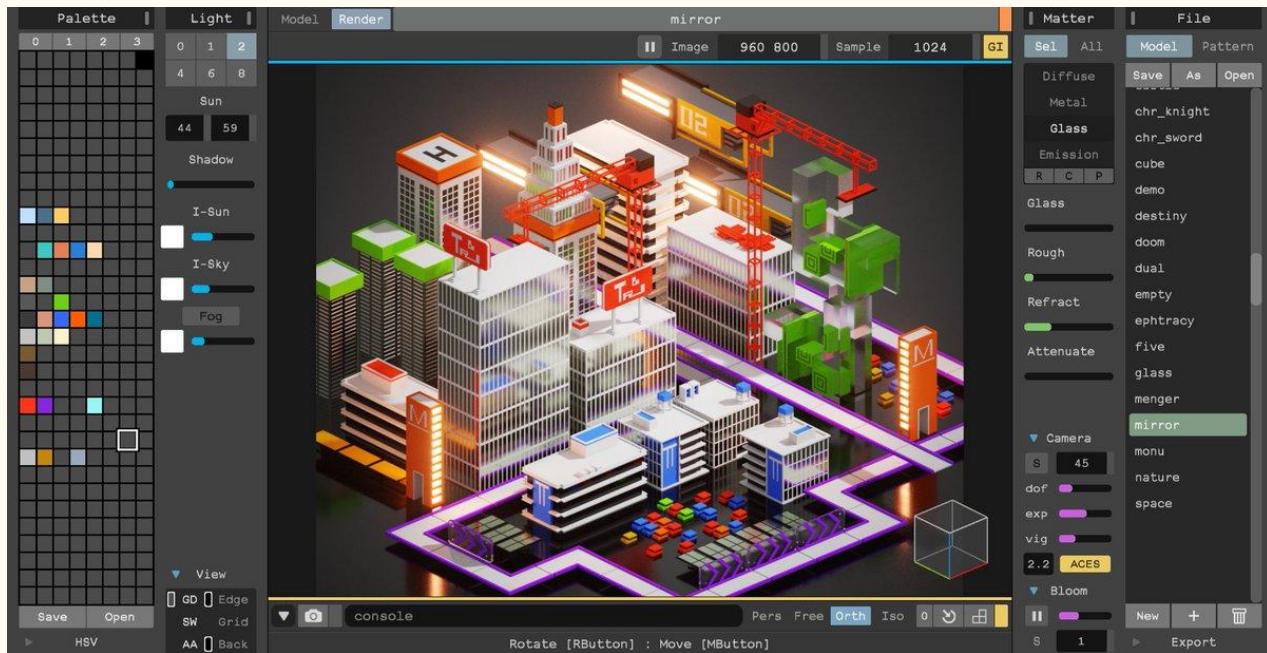
Making 3D Models and Animations

- Blender - blender.org
 - Free & open-source!
 - PC, Mac, Linux
- Autodesk Maya - autodesk.com/products/maya
 - Professional
 - \$1,545/year
 - PC, Mac



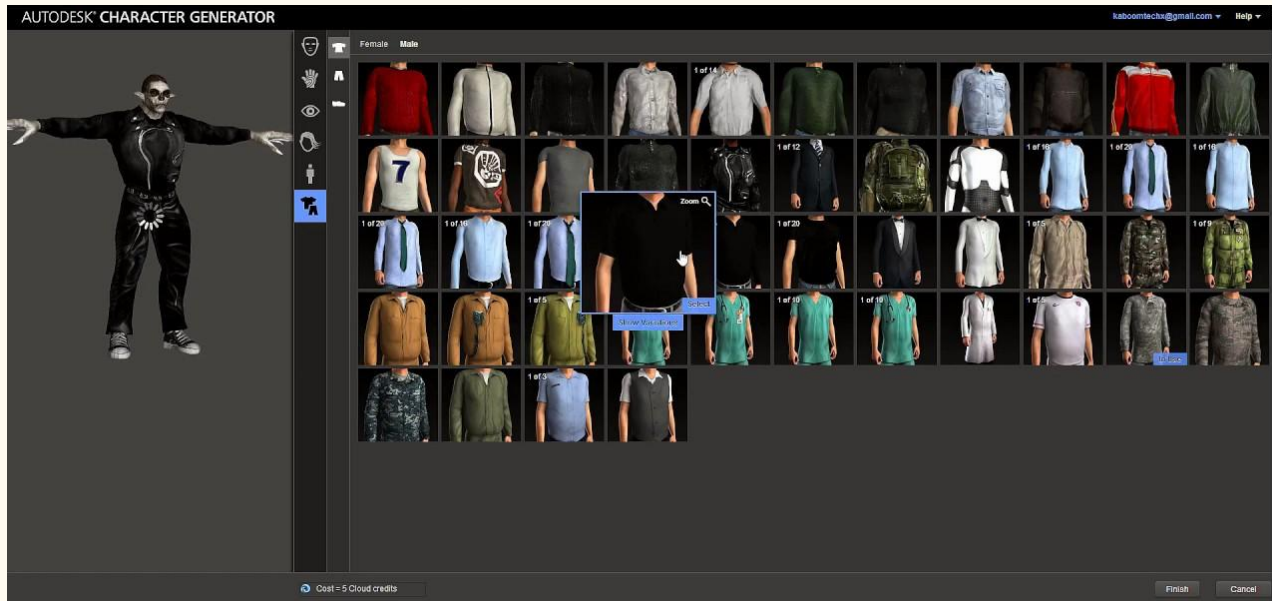
Making 3D Voxel Models

- MagicaVoxel - ephtracy.github.io
 - Free & open-source!
 - PC, Mac
- Goxel - goxel.xyz
 - Free & open-source!
 - PC, Mac, iOS, Android



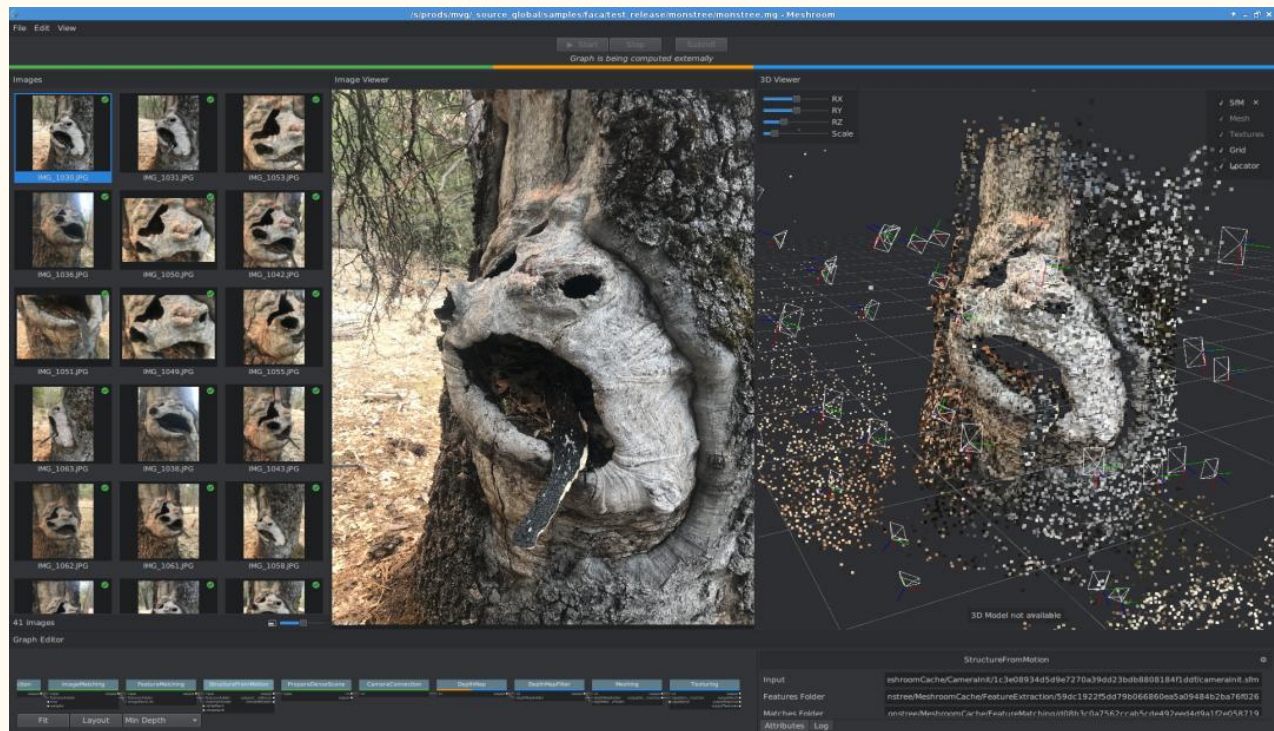
Generating Humanoid Models

- Autodesk Character Generator
 - charactergenerator.autodesk.com
 - For realistic characters
 - Free!
 - Web
- MakeHuman - makehumancommunity.org
 - For realistic characters
 - Free & open-source!
 - PC, Mac
- VRoid Studio - vroid.com/studio
 - For anime characters
 - Free!
 - PC, Mac, iOS, Android



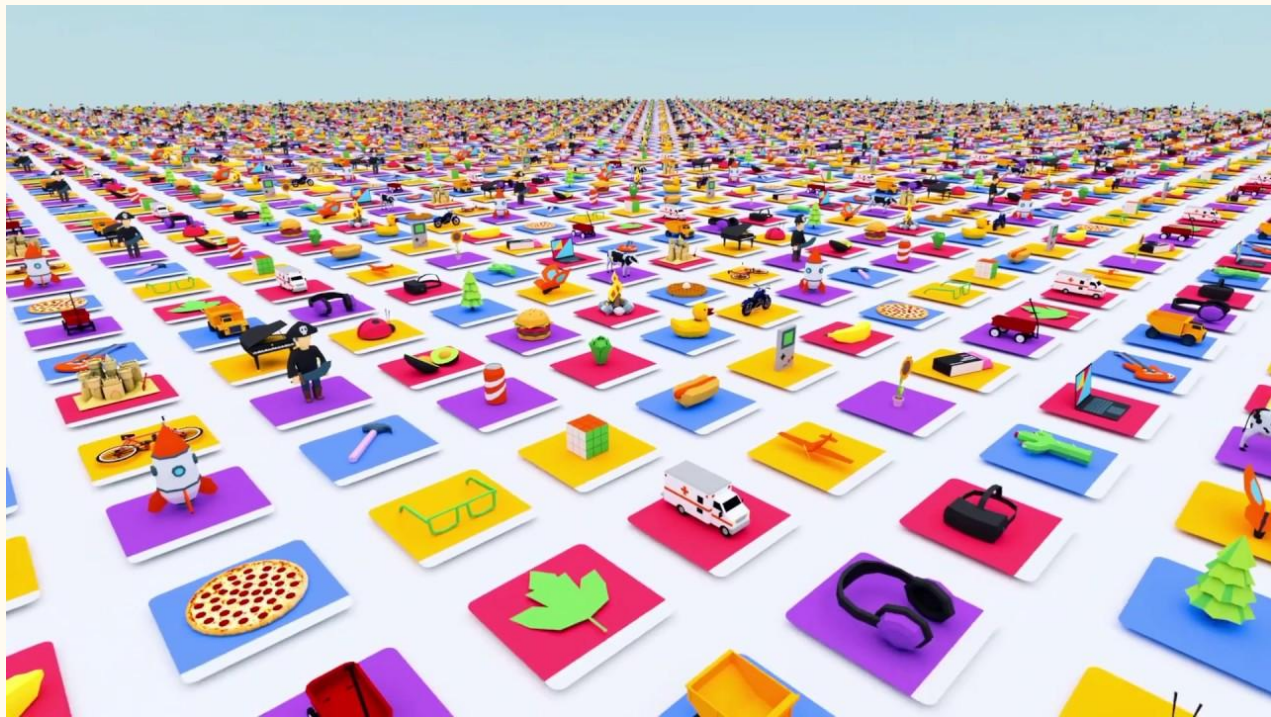
Photogrammetry

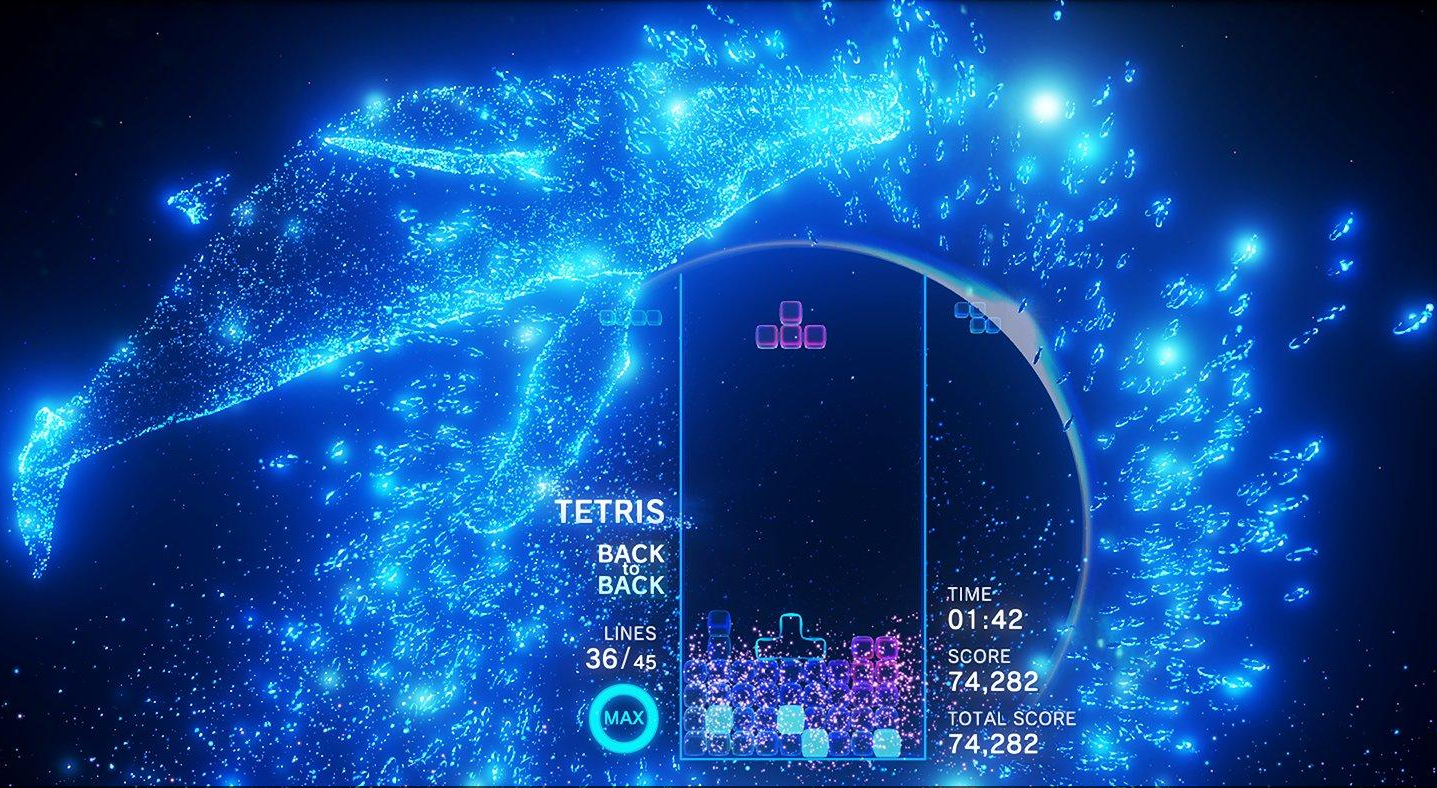
- Meshroom -
alicevision.org/#meshroom
 - Free & open-source!
 - PC, Linux
- Regard3D - regard3d.org
 - Free & open-source!
 - PC, Mac
- 3DF Zephyr Free - 3dflow.net/3df-zephyr-free
 - Free!
 - PC



Royalty-free Art Resources

- Google Poly
 - poly.google.com
- OpenGameArt.org
- Mixamo
 - mixamo.com
 - registration necessary
- Kenney Assets
 - kenney.nl
- Wikimedia Commons
 - commons.wikimedia.org





TETRIS

BACK
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TIME
01:42

SCORE
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TOTAL SCORE
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Audio

Some Terminologies

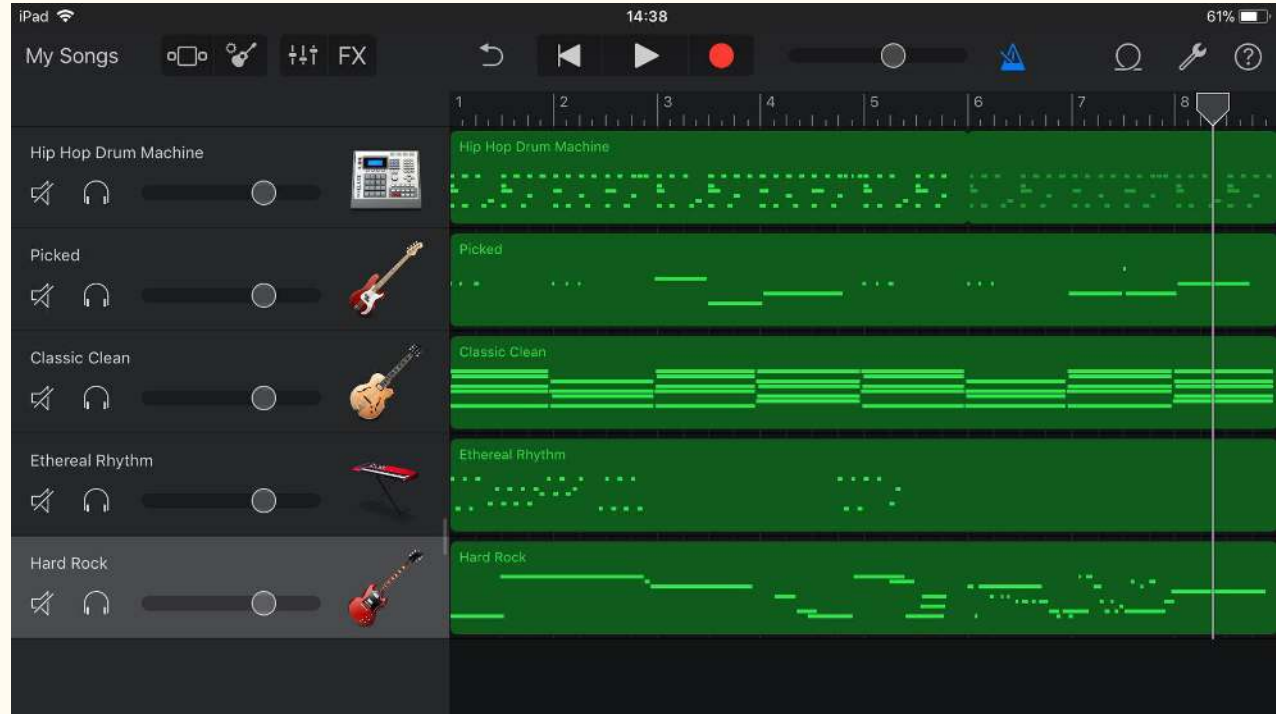
- DAW
 - *Noun* short for Digital Audio Workstation. An app is used for composing music and designing sounds..
- VST Plugin
 - *Noun* short for Virtual Studio Technology. A protocol for plugins to interface with a DAW to generate instrumentation.
- MIDI
 - *Noun* short for Musical Instrument Digital Interface. A protocol that computer accessories use to interface with a computer.
- Sound Font
 - *Noun* a digital instrument.
- Chiptune
 - *Noun* a “genre” of music that primarily uses blips and beeps as instruments, to mimic old-school game music.
- Doppler Effect
 - *Noun* a phenomenon of a sound’s pitch changing based on whether it is rapidly moving towards or away from a listener.

File Types

- Lossless file types:
 - WAV
 - FLAC
- Lossless files are great for short audio, e.g. sound effects.
- Lossy file types:
 - MP3
 - OGG
 - AAC
- Lossy files are great for long audio, e.g. music and long, ambient background sounds.

Composing Music

- GarageBand -
apple.com/mac/garageband
 - Free!
 - Mac, iPad
- Acid Pro Express -
acid-xpress.en.softonic.com
 - Free!
 - PC-only
- LMMS - lmms.io
 - Free & open-source!
 - PC, Mac, Linux



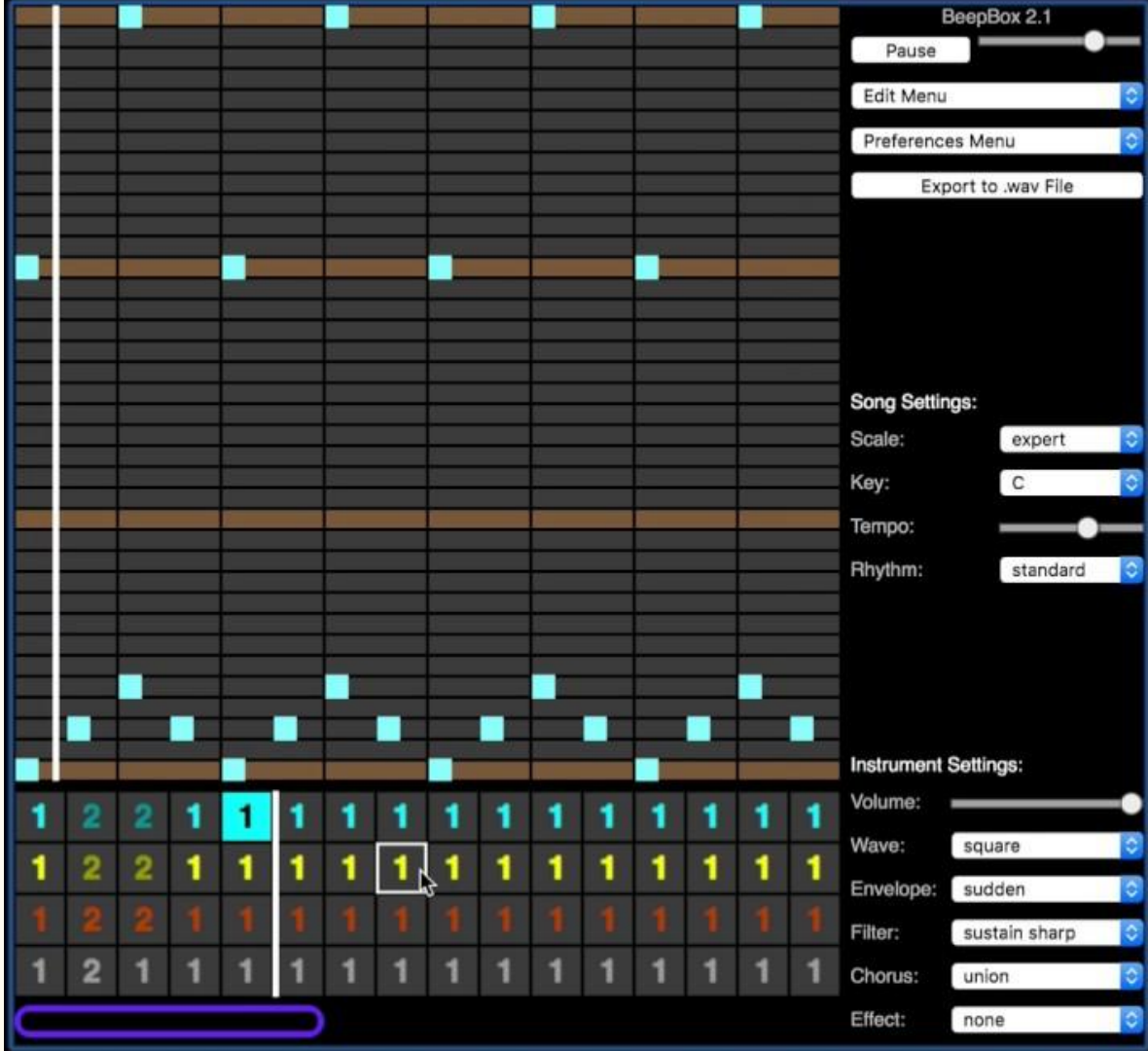
Composing Music

- Tracktion T7 - tracktion.com/products/t7-daw
 - Free!
 - PC, Mac, Linux
- Reaper - reaper.fm
 - \$60
 - PC, Mac, Linux
- FL Studio - image-line.com/flstudio
 - \$100
 - PC, Mac



Composing Chiptune Music

- BeepBox - beepbox.co
 - Free & open-source!
 - Web
- MilkyTracker - milkytracker.titandemo.org
 - Free & open-source!
 - PC, Mac, Linux



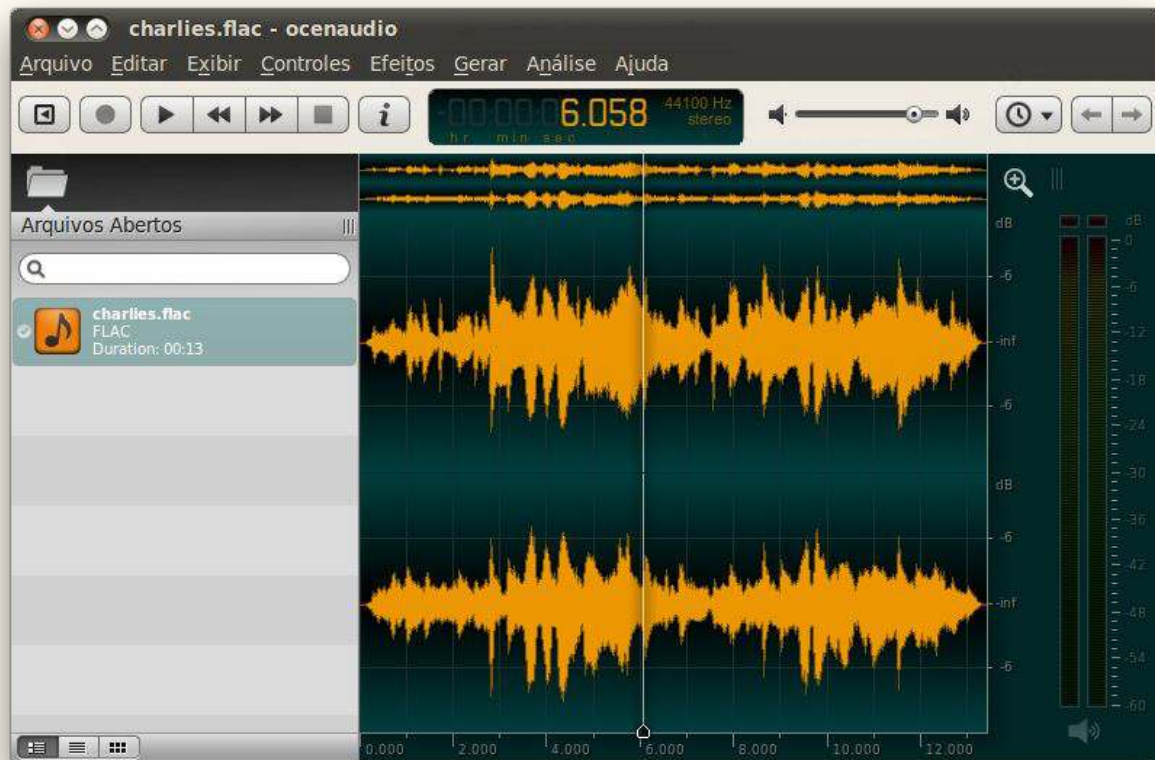
Generating Chiptune Sound Effects

- ChipTone -
sfbgames.com/chiptone
 - Free!
 - Web (Flash)
- BFXR - bfxr.net
 - Free & open-source!
 - Web (Flash), PC, Mac
- LabChirp -
labbed.net/software/labchirp
 - Free!
 - PC-only



Compositing and Editing Audio

- Audacity - audacityteam.org
 - Free & open-source!
 - PC, Mac, Linux
- OcenAudio - ocenaudio.com
 - Free!
 - PC, Mac, Linux
- WavePad - nch.com.au/wavepad
 - Free!
 - PC, Mac, iOS, Android



Royalty-free Audio Resources

- FreeSound
 - freesound.org
 - registration necessary
- Looperman
 - looperman.com
- Incompetech
 - incompetech.com/music
- Bensound
 - bensound.com
- ccMixer
 - ccmixer.org
- Youtube Audio Library
 - youtube.com/audiolibrary/music

The screenshot displays the FreeSound website's search results for the term 'bell'. The interface includes a top navigation bar with links for Home, Sounds, Forums, People, and Help. A search bar at the top right contains the text 'search sounds'. Below the navigation bar, a search filter is set to 'Downloads (most first)'. The results are displayed in a grid format, showing four audio samples:

- Bell System Ringer Model...** by FreqMan: A stereo recording of an old style telephone. This is a genuine Bell System Ringer Model 687A (8/70) made by ... household telephone soundeffect ring effect. 24689 downloads, 107 comments.
- Old Telephone Ring.wav**: Old style telephone ring, (with a real bell) used by Australian and British phone systems, remixed, many thanks to the ... telephone ring. 21982 downloads, 96 comments.
- Dark church bell.wav**: A dark and powerful "bell from hell". This is a remix of Schalkalwis' "Lipari bells.aif" sample. I filtered all of ... remix ominous dark church bell. 21121 downloads, 71 comments.
- Electric_school_bell.wav**: An electric school bell recorded at the Nashua Actorsingers' rehearsal hall in the summer of 2001. The ring lasts for ... school-bell field-recording electric. 18992 downloads, 110 comments.

On the right side of the results, there are sections for 'licenses' (Attribution (36), Attribution Noncommercial (9), Creative Commons 0 (26), Sampling+ (2291)) and 'tags' (ambience, bells, chime, church, city, clock, cymbal, ding, electronic, environmental-sounds-research, field-recording, hit, loop, metal, metallic, multisample, noise, percussion, processed, recording, ring, ringing, sound, soundscape, synth). At the bottom right, there is a 'type' section (aif (262), aiff (59), flac (153), mp3 (313), wav (1567)) and a 'samplerate' section (11025 (7)).

Any Questions?

—