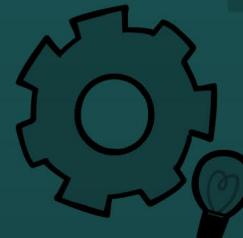
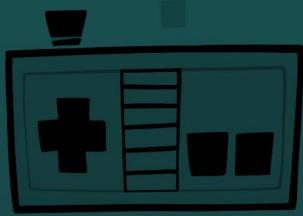


PIXEL LOGIC



Pixel art tutorials



Written by
Michael Azzi

Sold to
couragemouse@gmail.com

PDF Edition



About the Author



Michael Azzi, also known as Michafrar

Michael has been making pixel art since his teens back in 2004. Pixel art is one of the several artistic activities he enjoys doing. He graduated as a foreign language teacher, took his pedagogical skills and applied them to his pixel hobby. He quit teaching and became a freelancer, working for friends, companies and clients.

In 2019, he released *Pixel Logic*, a comprehensive book about pixel art.

During its production, he created pixel art and animation for television productions like *Voltron: Legendary Defender* (2017) and video games such as *Wargroove* (2019), *Super Meatboy Forever* (2020), and *Cassette Beasts* (TBD)

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 pixiv.net/users/8167587

 youtube.com/c/michafrar

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Thank you for reading!

Pixel Logic : Pixel Art Tutorials
2022 Edition

www.pixellogicbook.com



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This book is a console-focused historical journey through classic and modern pixel art. All images used within this book are used for strictly educational purposes. The video games and computer graphics featured in this guide are copyright property of their respective licensees. The creator of this title claims no ownership or endorsement of any of the products, websites, softwares, services or people listed in this book.

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Written by Michael Azzi.

www.michafrar.com

Design by Jenna Brown.

www.cyanatar.com

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PIXEL LOGIC



Introduction Getting started

What is pixel art?



Why is it different from other *pixelated* art?

Pixel art are computer graphics where placing each pixel is intentional.

Historically, they were low in resolution and low in colour.

Over time, the resolution and colour limitations loosened up,
but one thing remains absolute :

You have total control.
You can manipulate every single pixel yourself.

Advanced tools will *not* do the job and take control away from you. Of course, this will make your artwork look sharp because you don't have the soft blur from paintbrushes. However pixel art is not just about the tools. Learning techniques is equally as important to get good results and work faster.



Non-pixel art



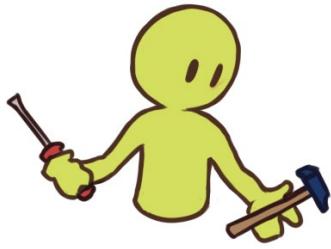
Oekaki or binary art



Pixel art

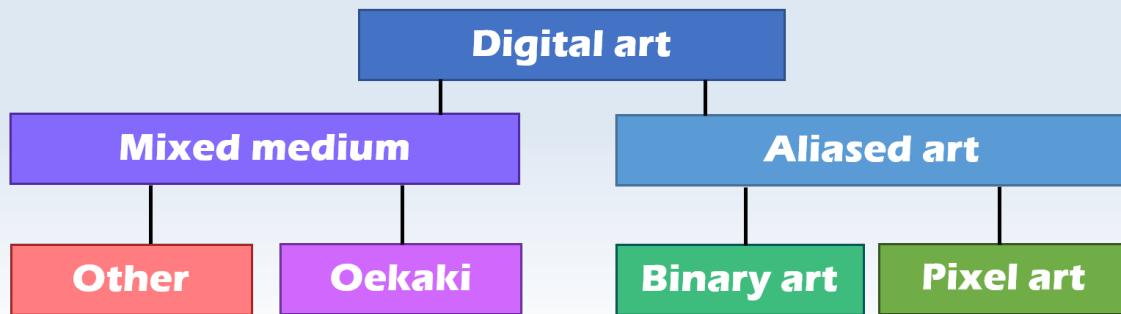


by Michafrar



Pixel art is often confused with other art such as Oekaki or Binary art. That's because they often use aliased graphics: art made with non smoothing tools. Regular paintbrushes smooth your lines. Aliased art keeps everything pixely & sharp.

Below is a short summary:



**You control the pixels.
The tools don't control you.**

It doesn't mean you have to place every single pixel like a brick. There are shortcuts. Don't worry!

Non-pixel art:

Doesn't require you to zoom much.
Doesn't require pixel-precision.
Uses brush strokes and pen pressure.



by Michafrar

Technological progress gave new possibilities in 2D games: digitized pictures and photographs, pre-rendered 3D models, full motion video and much more. Once sprites stopped being edited on pixel level, they were not considered pixel art anymore. **They are still sprite objects on screen, but not the traditional hand-made pixel-sprites we know of.**

Pixel art was born from limitations.
That's why many manual techniques are still used today.

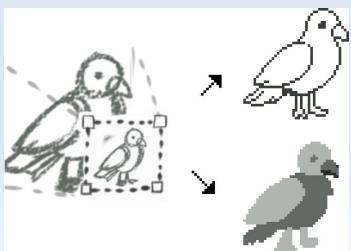
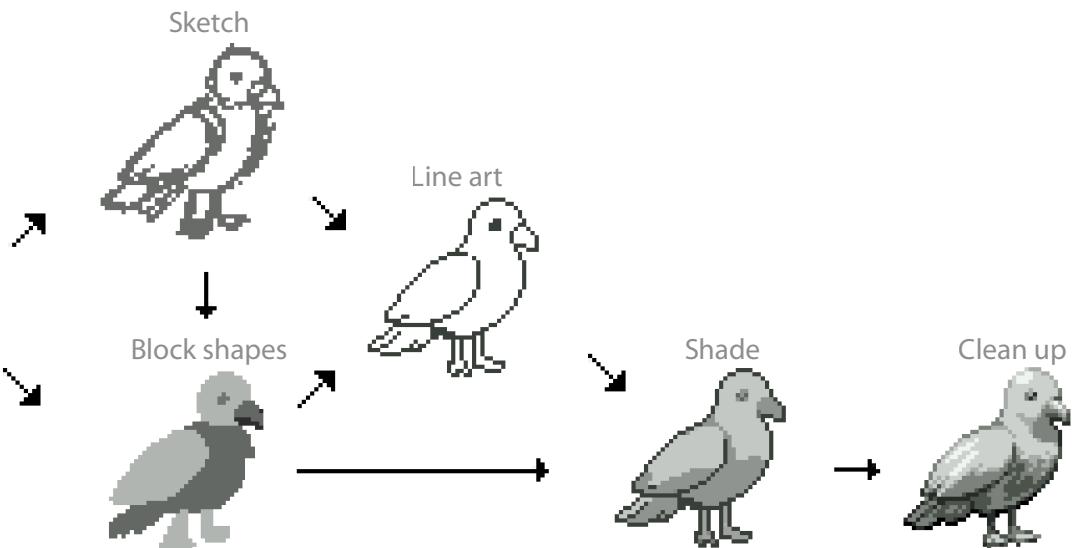
Where to start?



There are **many ways** to start!

Let's compare it to something more familiar: drawing & painting.
The methods aren't all that different from pixel art!

Go!



Having trouble drawing on a tiny canvas? Don't worry.
Start drawing in high resolution, then shrink your drawing.
Once you've got the right dimensions, you can trace the sketch
and continue as planned. Even veterans start with this method
to get quick results. You'll learn more about this in [Chapter 7](#).

If you already make illustrations, stick to your method of preference!

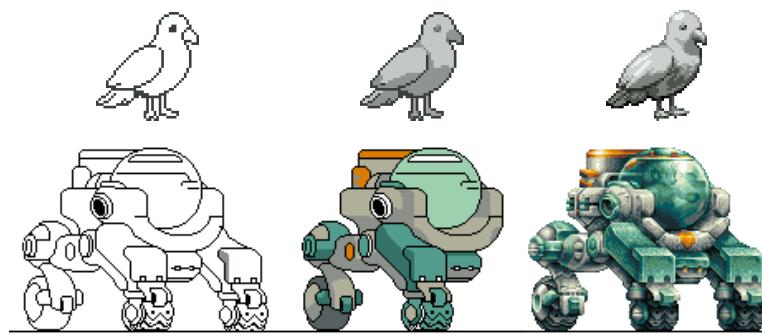
If you're feeling adventurous, try something new.

Just remember that pixel art is usually drawn on 1 layer. This brings it closer to traditional art. If you're not comfortable working on a single layer, don't fret. Make sure to combine the layers when you end up having too many. For animation in particular, layers are useful. Many overlapping parts can be separated this way. If you make scenes or mock game screenshots, layers will be necessary!

Pixel art is like 2D sculpting.
You start with a base, then chisel and add pixels!



Here are a few examples of the multiple ways to make your sprites/pixelart.



by Yaa



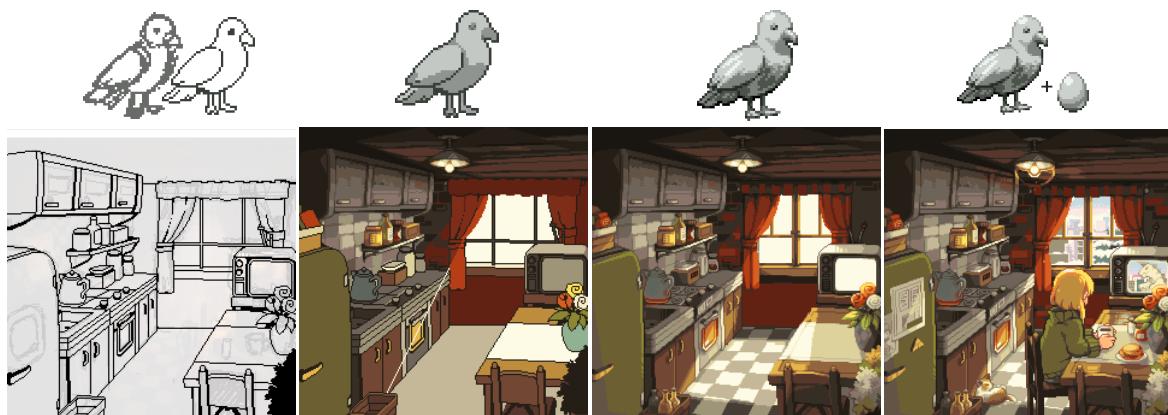
by Anubis Jr.



by Michafrar



by YAA



By SoapH

What software to use?

Keep using the software you already know or switch to a new one. Some programs do more than just pixel art. In the end, it doesn't matter how advanced or fancy the technology is. Even something as simple as Microsoft Paint does the trick! **Your tools will not define you as an artist.**



These programs will help make the process easier so you can comfortably improve your skills. Each program listed below offers their own unique benefits and you may find one program that suits you more than others.

It's important to try them out for yourself and see what you enjoy!

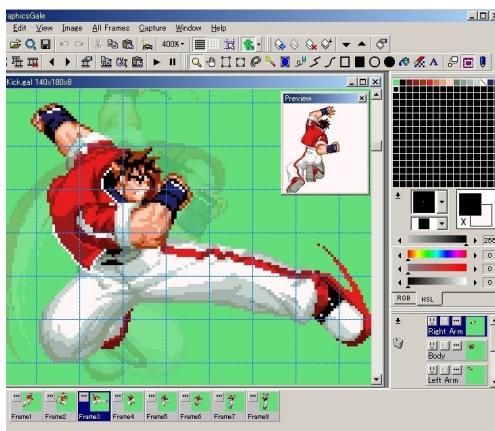
Speciality pixel-art programs

Graphicsgale

Price: FREE



Fan-favourite!



graphicsgale.com/us/

This powerful pixel tool is suitable for pixel art and animation. With game dev friendly tools, such as tile sets, export options and palette editors; this program is quite popular with veteran pixel artists.

The customizable layout and hotkeys make it very versatile software. Unfortunately, the timeline is a bit too basic to create complex scenes. It's also great for binary artists with an extensive array of customizable brushes.

This Japanese program is fully translated into English and completely free!

Aseprite

Price: \$20 *Free version with limited features.*



Fan-favourite!



www.aseprite.org

Aseprite excels at animation. Easily the best. It's pretty cheap, has an intuitive animation timeline similar to programs from Adobe or Toonboom.

This indie developed software is always full of surprises! With frequent updates, this is the most powerful pixel software yet. You can easily edit and load colours and even access palettes from retro hardware.

If you dislike the low resolution user interface you can easily download different skins and layout options.

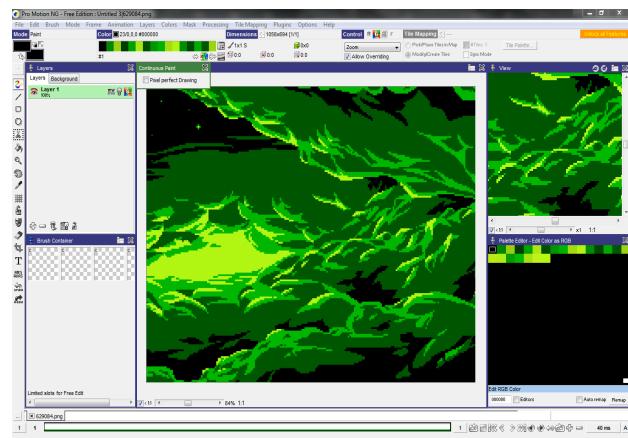
Pro Motion by Cosmigo

Price: \$40 *Free version available with limited features.*

This tool has grown in popularity after the success of the indie game "Shovel Knight" by Yacht Club Games.

This software is a great way to animate sprites. It features an advanced onion skin tool and allows you to zoom in up to 5000%. It's quite plug-in friendly and allows you to customize the layout! The price is slightly higher than the other cheap software, but look out for sales every now and then.

Graphics from "Shovel Knight" (PC) created within Promotion



www.cosmigo.com

MS Paint XP/Vista

Price: Free *This version is not pre-installed on Win. 7/8/10/11*

The tool that many beginners and masters have used over the past decades. Make sure you use the Windows XP or Windows Vista version of Paint. Every version after Windows 7 features non-pixelart tools that don't allow you to make clean pixelart.

This software just has the bare minimum, but sometimes, that's all you need. Paint is great to start your pixel adventure!



by Michafrafr

General art programs

Paint tool SAI

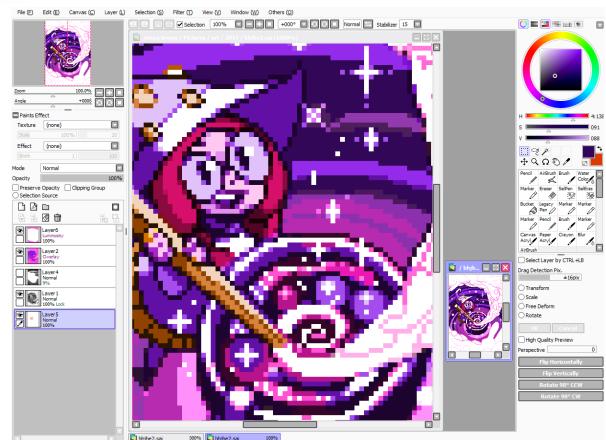
Price: 5,500 JPY ~ \$50 *31 day free trial available*

This software combines the ability to create both pixelated and non-pixelated images. Its key features include a colour shifting options which allows more colour control.

It also features the ability to make smooth 1px lines with the legacy pen and stability options, along with an accurate wand tool. The program is also tablet user friendly.

www.systemax.jp/en/sai/

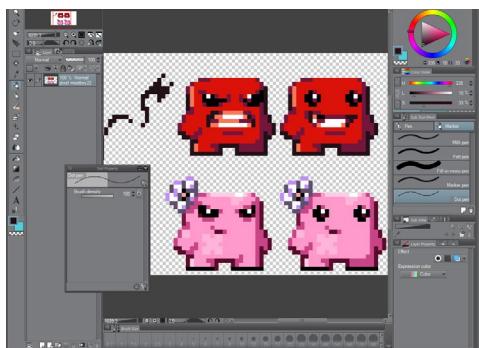
Fan-favourite!



Guest artist: cyanatar

Clip Studio Paint

Price: \$50 *31 day free trial available*



www.clipstudio.net

Clip Studio is easily the favourite software of many illustrators working in digital art. Pixel art is easily accessible with the "Dot Pen" brush in the subtools of your basic pen.

This software goes on sale fairly often and it's always a good bang for your buck. The best part: it's a one time purchase! This product even includes basic animation tools for you to play with.

It's easily the new standard for digital art.

Adobe Photoshop

Price: Subscription *Extremely expensive over time*



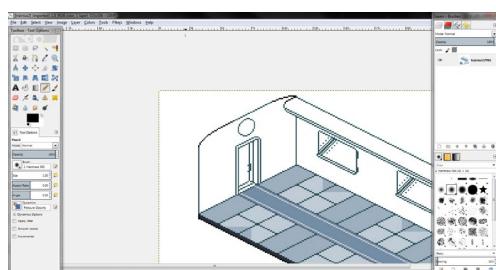
Guest artist: cyanatar

Photoshop is well known as the software standard for digital art, as well as being the most expensive! There are more wallet-friendly options thanks to adobe cloud subscriptions but if you're tight on a budget it's still quite expensive.

If you can afford it, the program really does everything you could need including pixel work. It may lack the precision of dedicated software, so if you want to set up pixel art tools in the program you may need to read up on specific tutorials to get the most out of it.

GIMP

Price: Free *An open source software app*



by Michafrar

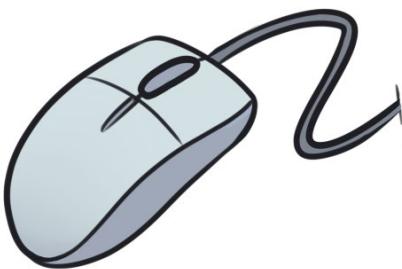
www.gimp.org

GIMP is a free drawing software with, of course, the ability to make pixel art. This immediately makes it more accessible than the programs listed before, however while free it doesn't have an intuitive interface for pixel-art.

The program includes a lot of useful tools, including customizable grids and transparency options. It also has a text tool. Having the option to have extensive configurations to suit your needs will either be convenient or overwhelming, depending on your preferences.

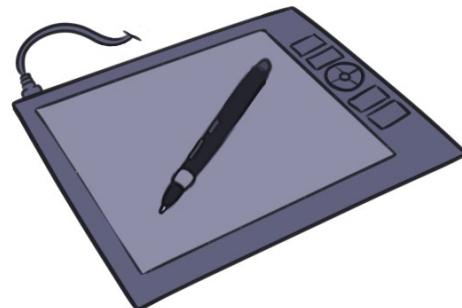
What hardware to use?

Both mouse and tablet are perfectly fine!



OK!

A **mouse** is good with clicks.
Harder to draw and paint with,
but it offers clicking precision.
Good for clean up and final touches.



OK!

A **tablet** is good with strokes.
Harder to click or tap constantly,
but easier for intuitive control.
Good for the sketch/beginnings.

It doesn't matter what you use. Remember the saying:
"It's not about the tools. It's how you use them"



Remember: your keyboard is a powerful tool for art too!

You can use keyboard keys to map actions and shortcuts.
Flip through animation frames with simple button presses.
Your mouse or tablet may have additional buttons:
try and make use of those too!

Stick to the tools that let you work more efficiently and faster.

Retro hardware

Here's how sprites were made back in the 80's and 90's.

The methods are not all that different from today, just more archaic!

Early video game developers used special tech such as tablets attached to a mouse with a crosshair. The tablet's surface was calibrated to the monitor's screen, unlike a regular mouse. These devices were called **digitizers** and the mouse was called a **digitizer puck**.

Sprites were first sketched on paper, then placed over the digitizer and traced with the puck.



Capcom artists drew sprites on grid paper and pixelated them with digitizers.

Felicia art by Akira "Akiman" Yasuda featured in Darkstalkers™ (Arcade) 1994.



Images from the development of Golden Axe™ on Mega Drive (1989)

from the French Magazine "MegaForce #4" January-February 1992.



Another peripheral was a digitizer connected to a **light pen**: a stylus that can interact with the surface of a monitor. The pen's position matches the coordinates of the cursor on the screen.

They can be considered the precursor of LCD drawing tablets of today, such as the Wacom Cintiq™, letting you draw directly on screen.



Other developers drew directly on computers with a regular mouse and keyboard. Some pixel artists today still use this setup. These pictures are from a documentary that features the game *Comix Zone* (1993-1995) with animator Dean Ruggles.

Full video: youtu.be/-M8Rlc6Ek0Q



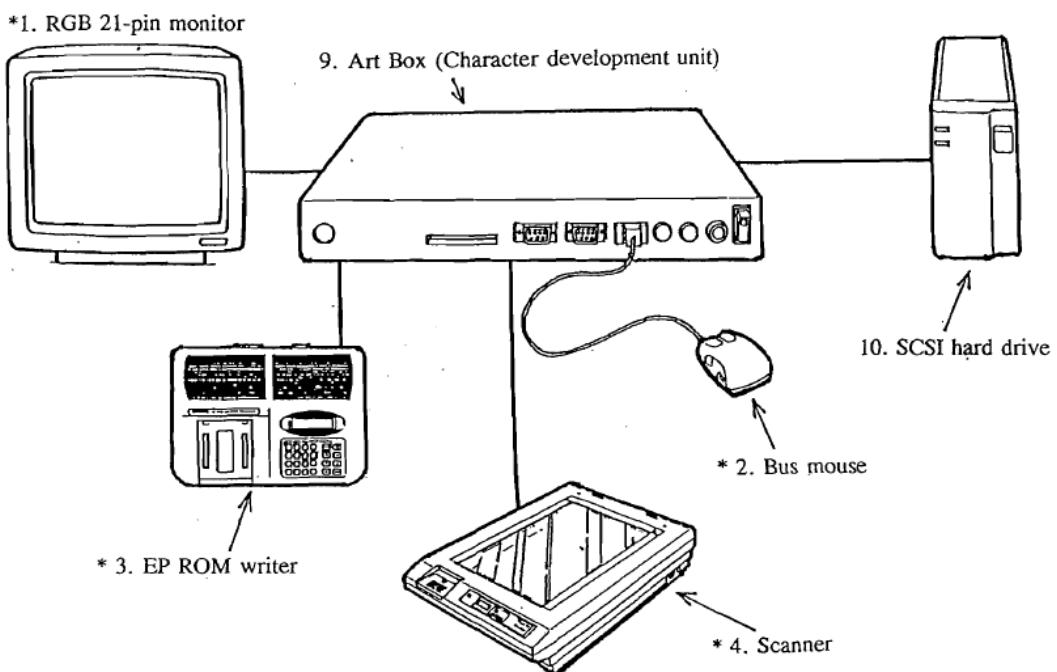
A dual monitor setup isn't required since modern computers have high resolutions. Having a **second monitor** is extremely useful, though!

Screenshots from a 1995 Promotional commercial for *Fatal Fury 3 Neo Geo CD* (Japan).



**An artist's workspace at SNK for Neo Geo hardware circa 1995
Notice the inclusion of a scanner and a mouse.**

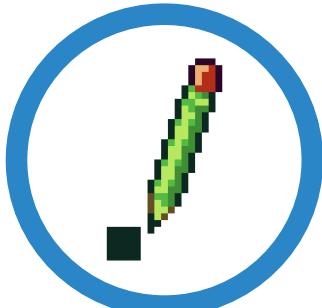
- Structural Diagram of Character Development Tool



From the "Neo-Geo Hardware Specification" booklet, page 93, issued by SNK Playmore Corporation

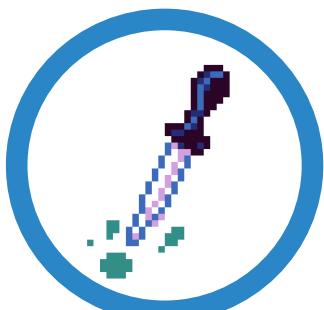
Software tools

Regardless of the software, you will need **at least** these **4 tools**.
These are the minimum required to make pixelart.



Pencil

Most basic tool. Some software have a **brush**.
It gives you a **1 px tool** of crisp and clean pixels.



Eyedropper

Picks up a colour. Sometimes assigned to the right click.
It allows you to **pick up colours** and make palettes.



Eraser

Erases your mistakes. Some software don't include it
because you can just **erase with white** or transparency.



Bucket

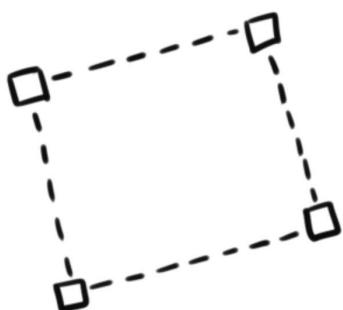
Makes your life easier. It **fills an empty area** with 1 solid colour.
Watch out for gaps! Or it will fill the whole screen.



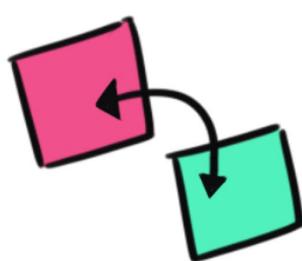
Some programs don't include an eraser,
they combine the eyedropper with the pencil.
The pencil is on the left click, the eyedropper is on the right



Other must-have tools:



Selection tool



Recolour tool

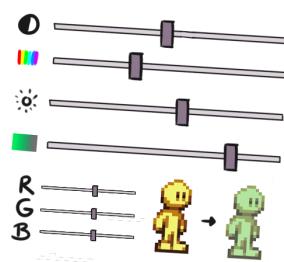


Line tool

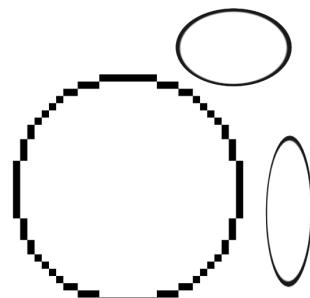
Use & edit manually:



Rotation tool

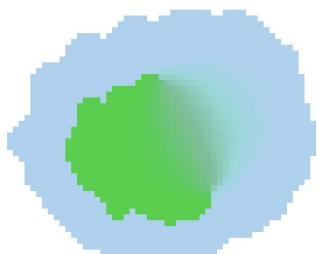


Colour settings



Circle tool

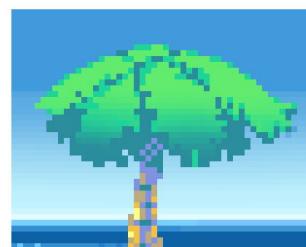
Avoid:



Blur



Brushes



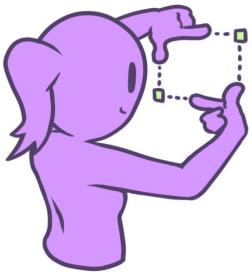
Blurred gradients

Why avoid automatic tools? Because the artist can't predict how the result will turn out.

Remember: Pixel art is about having 100% control over what you do.



Canvas size



“How small do I make my sprite?
How large do I draw my pixel art?
What size ?”

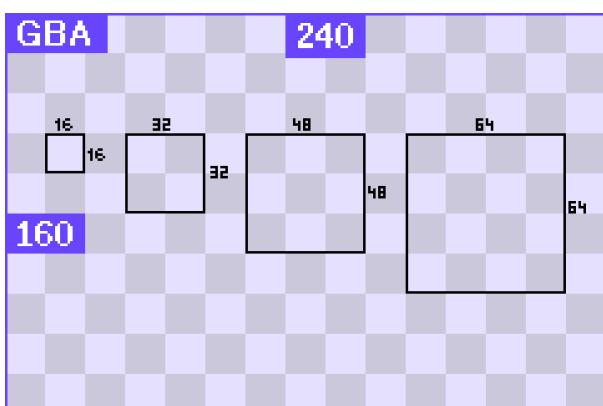
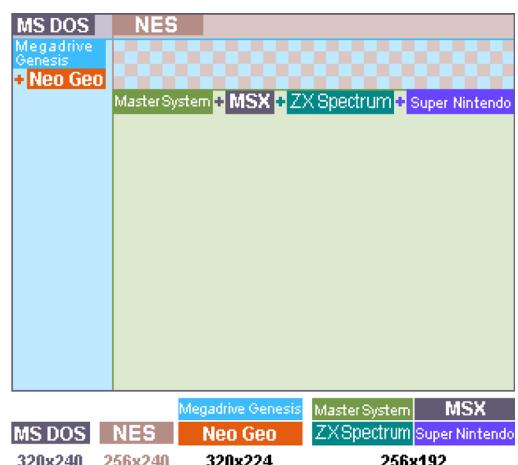
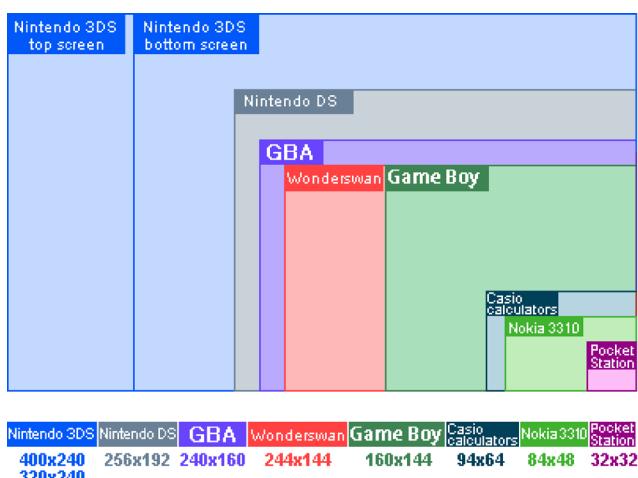
Old computer graphics had low resolution, so pixel art is often small.
When making pixel art, you will have to decide a canvas size from the very start.

For more information on sprite sizes, read [Chapter 4: Readability](#)

“I want to display my art online.”

Draw however big or small you want your artwork to be.

A good canvas tends to be the maximum screen resolution found in older videogames. For beginners, I suggest a canvas smaller than a GBA screen (240x160).

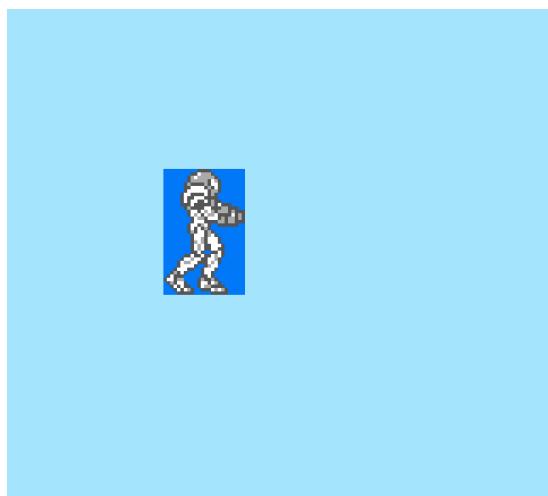
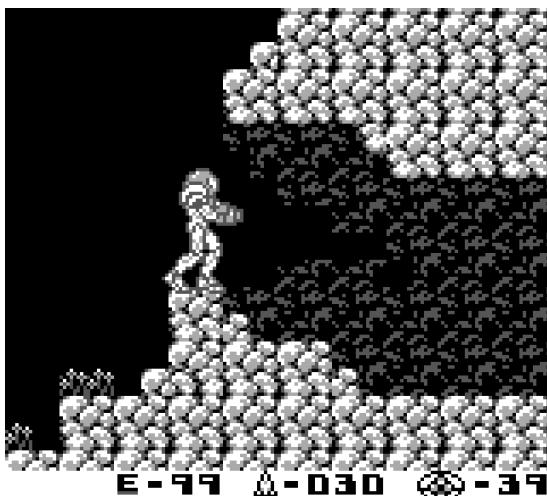


Tiles are also useful a size indicator for smaller pixel art, like sprites!

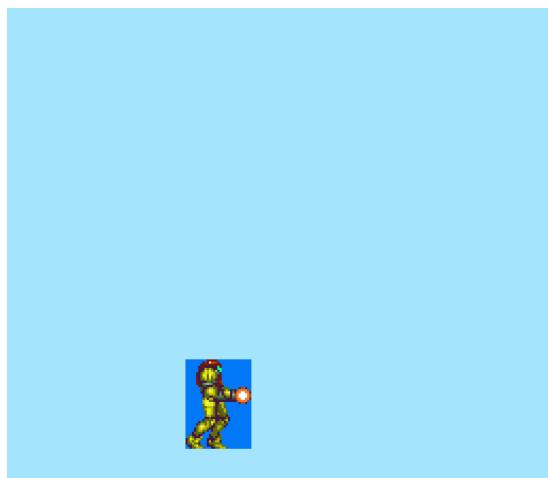


"I want to make sprites for a video game."

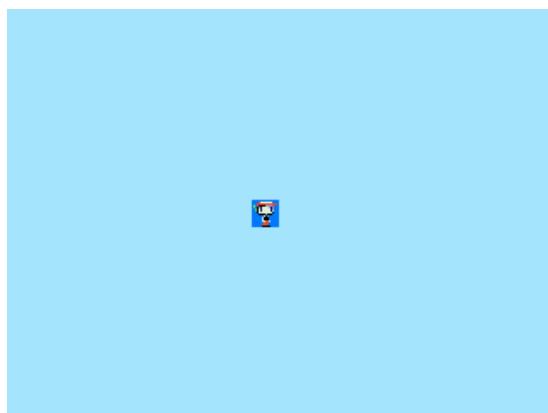
Check the ratio between your sprite and your canvas.



Metroid II: Return of Samus (Gameboy) has a **LARGE sprite to canvas ratio** for a playable character. The sprite is 1:24, about 4% of the screen. It's not very suitable for manoeuvring in level.



Super Metroid (Super Nintendo) has a **LOW sprite to canvas ratio** for a playable character. The sprite is 1:38, about 2,5% of the screen. It allows for the player to see more of their environment.



Cave Story /Doukutsu Monogatari (PC) has a **TINY sprite to canvas ratio** for a playable character. The sprite is 1:300, about 0.33% of the screen. Characters are still visible but minimalist due its tiny size.

Mixels

This may sound obvious to many artists, but when resizing **ALWAYS** stick to **WHOLE NUMBERS**.

If you do decide to resize, check out "Scaling & Rotating" on [page 177](#) in [Chapter 7](#)



Even more importantly, **NEVER EVER mix different aspect ratios**.

These are called **Mixels**. Rotated mixes are often included.

Never combine rotated or resized pixel art in a piece.



Visible mixels:
face ≠ hammer ≠ wrench ≠ table ≠ girl



Visible mixels:
background ≠ numbers ≠ characters ≠ grass

Rotated mixels



Only include mixels for gameplay purposes. You can have turning arms, aiming guns or anything that needs smooth 360° motions.

Gameplay takes center stage,
Graphics can take a step back.

Owlboy™ (Multiplatform)



Super Mario™ Maker (Wii U)



Adventure Time: EtDBIDK!



Duckgame™ (Multiplatform)

Rotated mixels can really look out of place or not faithful to pixel art visuals.



Chapter

Line art

1

Introduction



by guest artist AnubisJr.



Earthbound™ (SNES)



Mother 3 (GBA)

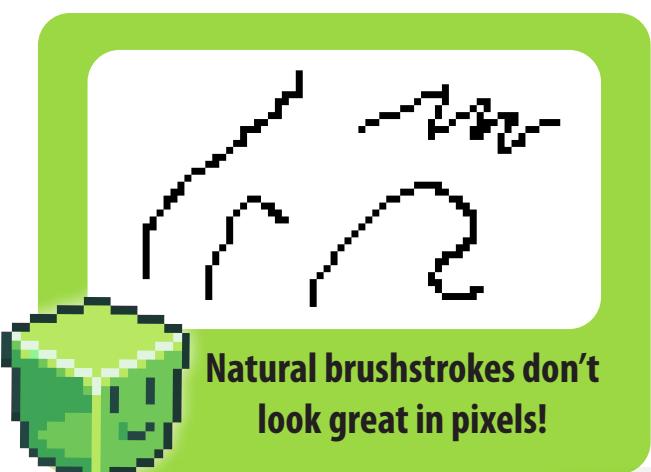


Tekken™ Card Challenge (WonderSwan)

Line art is the **base of your sprite** regardless of whether you start with shapes, loose sketches or no line art at all!

It will be applied at some point in the process.

Consistency is essential.



Natural brushstrokes don't look great in pixels!

Keep the same line width throughout the whole sprite!



It makes sprites more readable and appealing.

Prefer thicker lines? Make sure to keep the line art clean and easy to follow. Some lines however **can** be thinner than the rest of the drawing if the style requires it

Thin lines are better for small areas.



Mother 3 (GBA)



Tekken™ Card Challenge (WonderSwan)



SNK vs Capcom: Card Fighters' Clash (Neo Geo)



Pokémon® Pinball: Ruby & Sapphire (GBA)

Sprites are often small graphics! As a result, you will notice that in games ...

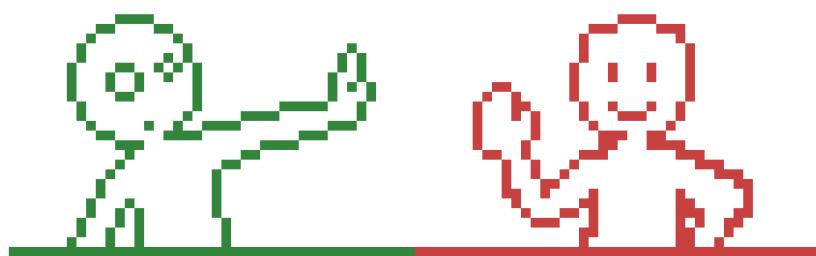
Most pixel art has 1px line art.



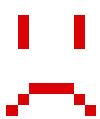
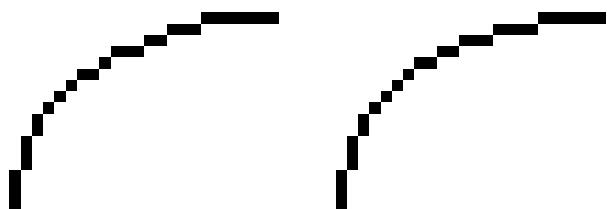
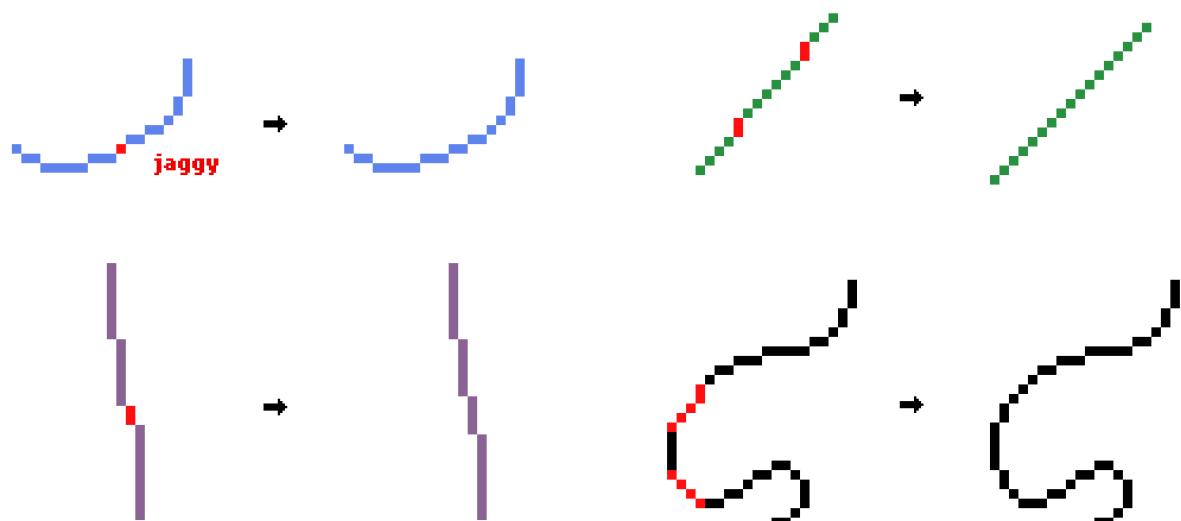
By Michafrar

Lines and curves

Drawing a line in a single stroke is harder than it looks.



That is because of **jaggies**. These are jagged parts of a line or curve.



Oh no!

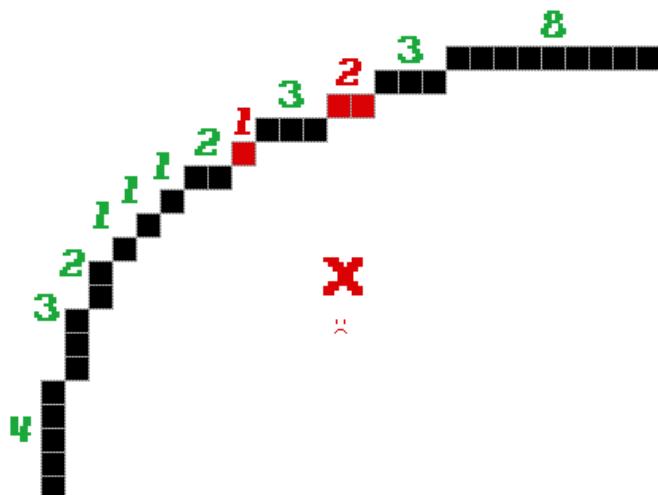


Much better!

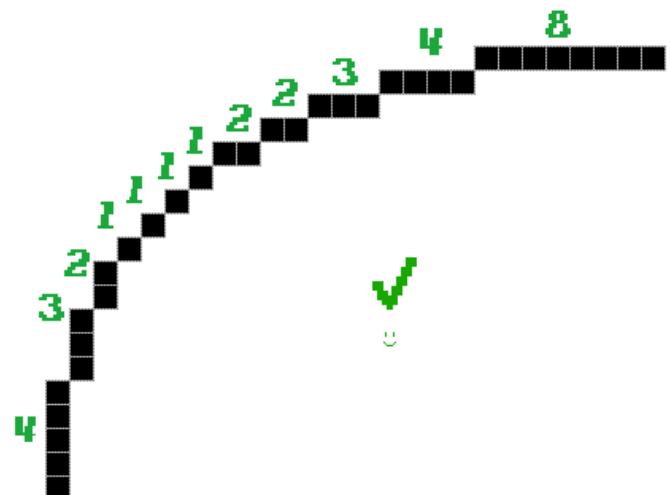
So how do you fix your lines with jaggies?
Easy!
There is a process that works for every type of line!



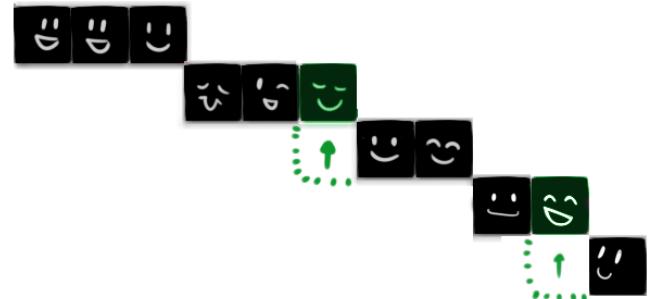
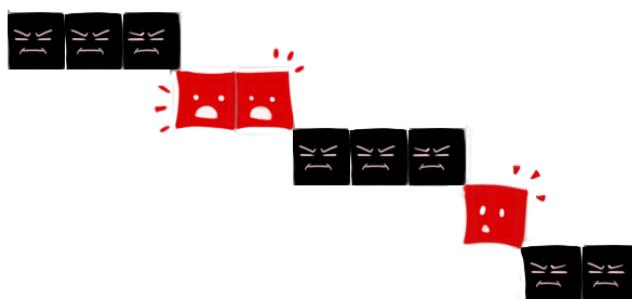
The key thing to remember with jaggies?
Don't surround a row of pixels with bigger ones.



4-3-2-1-1-1-2-1-3-2-3-8



4-3-2-1-1-1-1-1-2-3-4-8



This will happen **ALL** the time!



Keep in mind

You do NOT need to draw curves pixel by pixel. That's too much work!

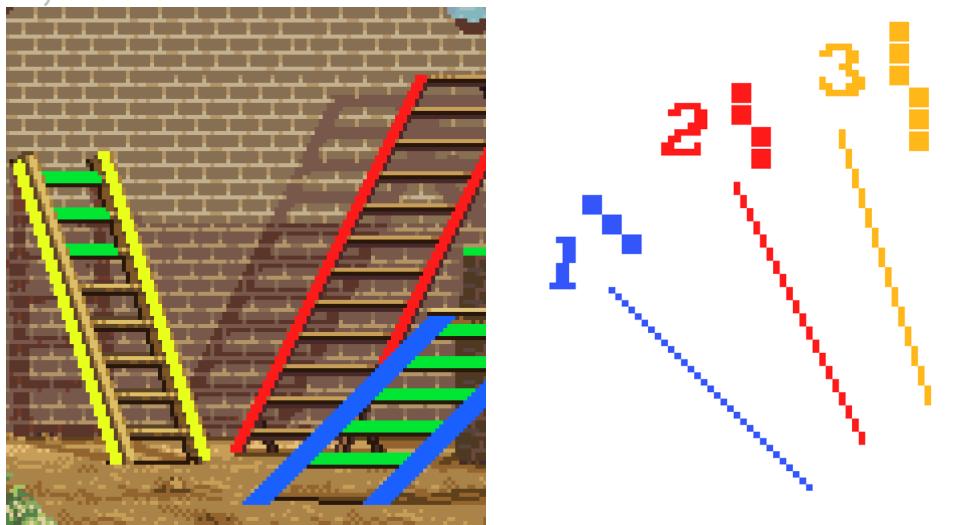
Draw the line first and then chisel away parts you don't need.

While some programs offer better pixel brushes that can avoid thicker parts, but in the end : **jaggies are UNAVOIDABLE. So fix them!**

Pixel art loves lines that have the same “**stairs**”,
staircases with the same number of pixels on each step.



By Steven M.



The steeper the line, the bigger the ‘step’!

DON’T MIX STAIRCASES. If you have stairs of TWO-pixel steps, don’t include a ONE pixel step. Keep your staircase equal and avoid jaggies.



There’s no need to redraw the lines or **CTRL+Z for every mistake.**

Remember to use the selection tool. You can also chisel away pixels. Chip away or add pixels to get some nice lines!



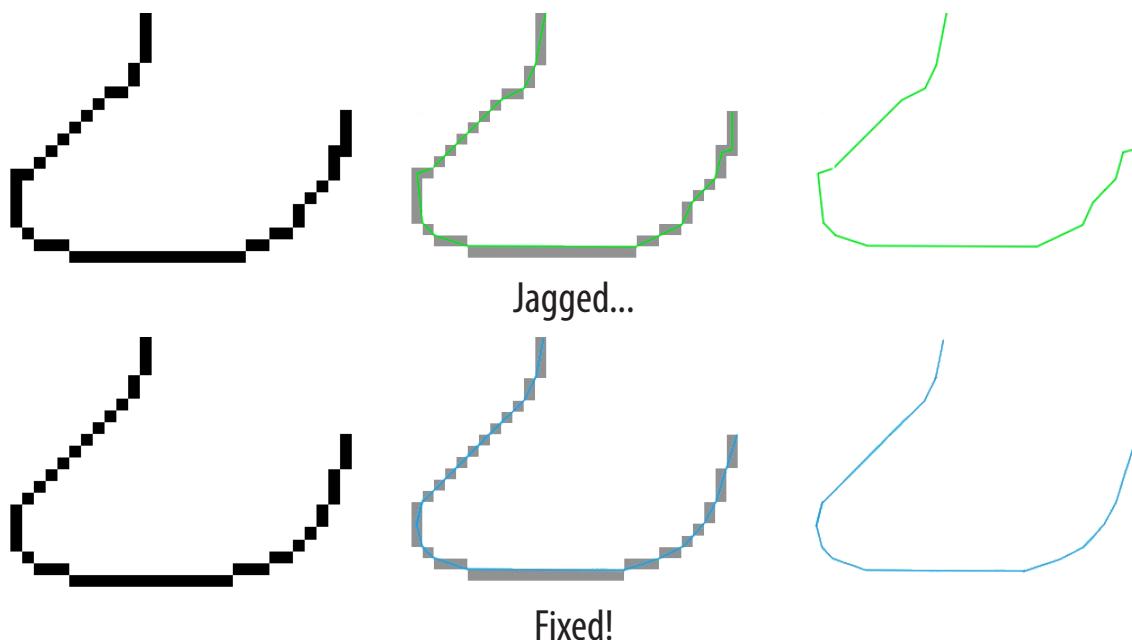
Pixel-Logic Bonus

Still unsure how to clean up lines? **No problem!**
Throughout the guide I'll provide extra tips, starting here!

As I've described, chiselling away at your lines is much more efficient than drawing the line. This works for every problem, and you can see below some examples to show it.



A beginner's tip : imagine your pixelart like HD lines in order to spot jaggies
So if you're not sure, draw over it and you'll see the mistakes.



Some programs help you make smoother lines with “pixel perfect” options. However the outcome isn’t perfect. Don’t rely on these options, pixel by pixel is still the way to go.

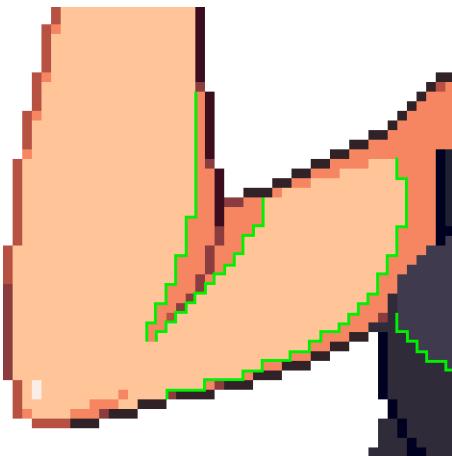


Lines are everywhere

Even without lines, any shape within your pixel art has **an edge**.



Guest artist: Anubisjr



When 2 shapes touch each other, they forms a line. Shadows also create “lines”.

This edge is just like all other pixel art lines.
When you shade a smooth surface your shading
shouldn't have jaggies either!



The Guided Fate Paradox (PS3)

Graphics with no line art, such as *Curses 'N Chaos* (PC/PS4), still have smooth-looking pixelart. Lineless pixel art is handy for backgrounds. For more examples, check [pg 30](#).



Outlines

The outline is a major attribute that defines a sprite's style.

You may have noticed that pixelart comes in many shapes and forms. Like any art!

Here are the types of outlines I identify:

No outline



Super Mario Brothers™ (NES), Metroid™ (NES), Sonic 3 and Knuckles (Mega Drive),
Castlevania SotN (PS1), Streets of Rage (Mega Drive), Cave Story + (PC), Mario & Luigi: Dream Team (3DS),

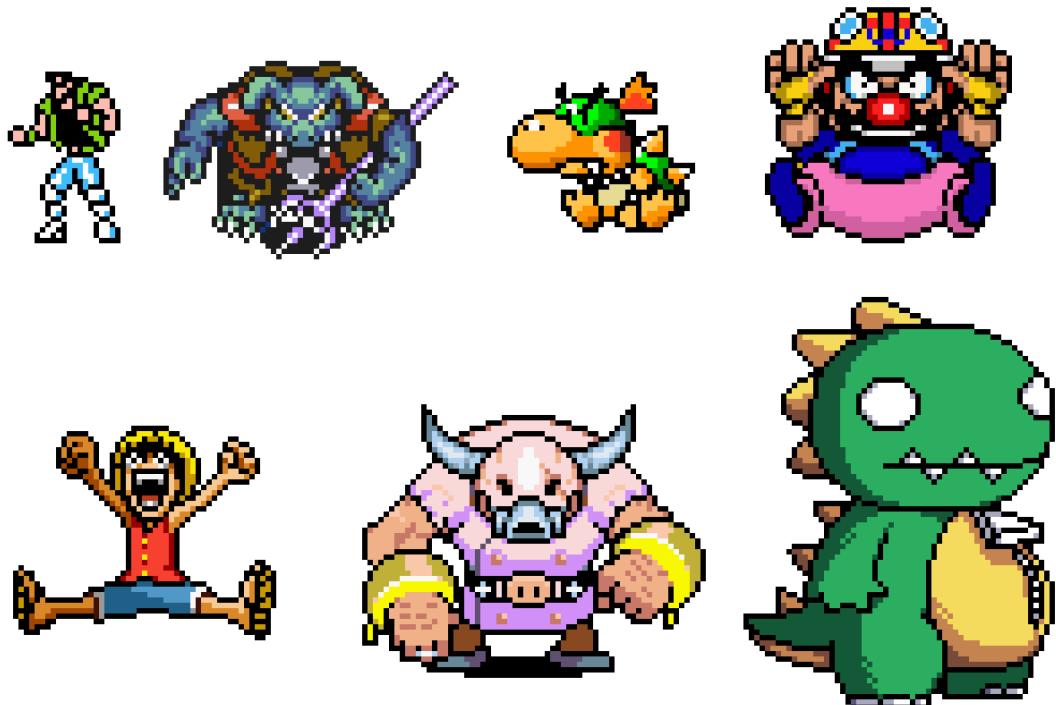


There is no outline to distinguish it from the background.

The shapes are usually **solid colours** and occasionally have lines inside it.

Don't be fooled; even without lines, **you still need to remove jaggies!**

Black inline



Shatterhand (NES), LoZ: Link to the Past (SNES) , Yoshi's Island (SNES),
WarioWare Twisted (GBA), Shonen Jump: Jump Ultimate Stars (DS) , Mother 3 (GBA), Scott Pilgrim (Xbox 360)



This type of contour uses **black outlines** but also has black lines **inside the sprite**.

This was very effective in the **8-bit era** as a way to circumvent the limitations. Today, it makes sprites rather muddy.

Well, not ALL sprites...!



Shovel knight (Multiplatform)

Black contour



WarioLand 4 (GBA), Kirby Superstar Ultra (DS), Mario & Luigi: Bowser's Inside Story (DS), Magical Taruruuto-Kun (Mega Drive), Chrono Trigger (SNES), Kirby Squeek Squad (DS), Boktai 3 (GBA), Riviera: The Promised Land (GBA)

With black contours, **only the outer edge has a black outline**, but the **inside is completely coloured** with little to no black. It helps your sprite stand out from backgrounds and look clean!



Mario & Luigi: Bowser's Inside Story (DS)

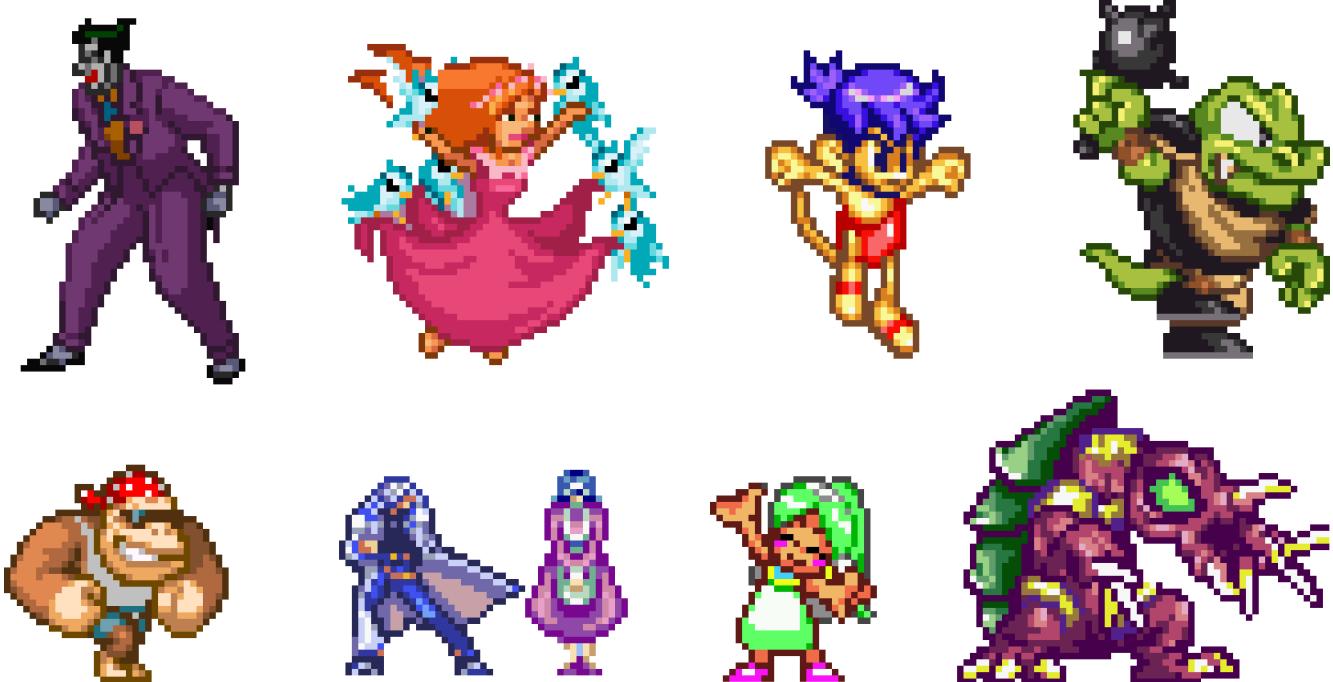
It's the style that is used commonly for moving sprites, and is very popular with modern **handheld games**.

They feature black outlines around the game's characters, in order to make them easier to see on the device's smaller screen.

Note: Your outline can be thick or thin, it is a **stylistic choice!**
Softer outlines will require more **Anti-Aliasing**.



Coloured outline



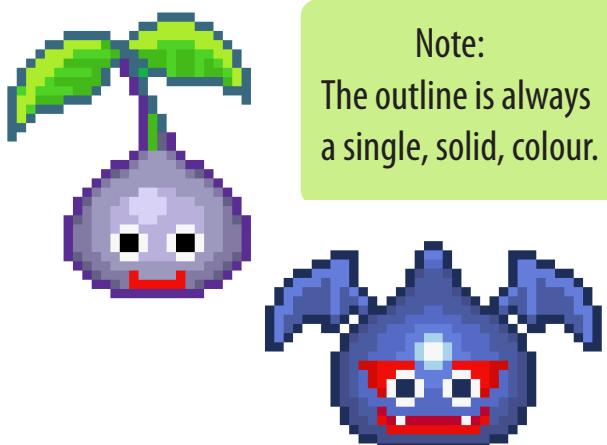
Adventures of Batman and Robin (SNES), Enchanted (GBA), Congo's Caper (SNES), Hamelin No Violin Damaki (SNES), DK King of Swing (GBA), Castlevania: AoS (GBA), Monster World IV (Genesis), Metroid Fusion (GBA)

The outline is coloured according to the colour it surrounds. Every part of an object has its own coloured outline.

The outline of a block will be the darkest shade of the inner block.



by Michafrar



Note:
The outline is always
a single, solid, colour.

Slime Mori Mori DQ (GBA)



Sam and Max Hit the Road (PC)

Shaded outlines



Shaded outlines are outlines with shading! It's the most common type of outline in pixel art, and works great with backgrounds.



Ristar (Genesis), Pulseman (Genesis), Alundra (PS1), Parodius Da (SNES), The Legend of Zelda™: Minish Cap (GBA), Super Pocket Fighter (Saturn), Shantae™: Risky's Revenge (DSi)



It blends perfectly with the environment.
Light or dark background, it doesn't matter!



by Michafrar

Another type of shaded outlines are called **Selective Outlines**.

On light backgrounds, these outlines look like broken lines, but on darker backgrounds that effect looks better. More on that in the chapter [Subpixeling on page 197](#).

Case example: Pokémon sprites



Pokémon™ Platinum s (NDS)

Pokémon sprites from the Gameboy Advance up to the Nintendo DS feature shaded outlines. They're timeless. The colourful outline makes them so great.

Pokémon sprites are a great example for shaded outlines.

Check them out.

It may be hard to see the outline fully without zooming in or with inner colour. Let's remove everything -but- the outline.

It's super effective!

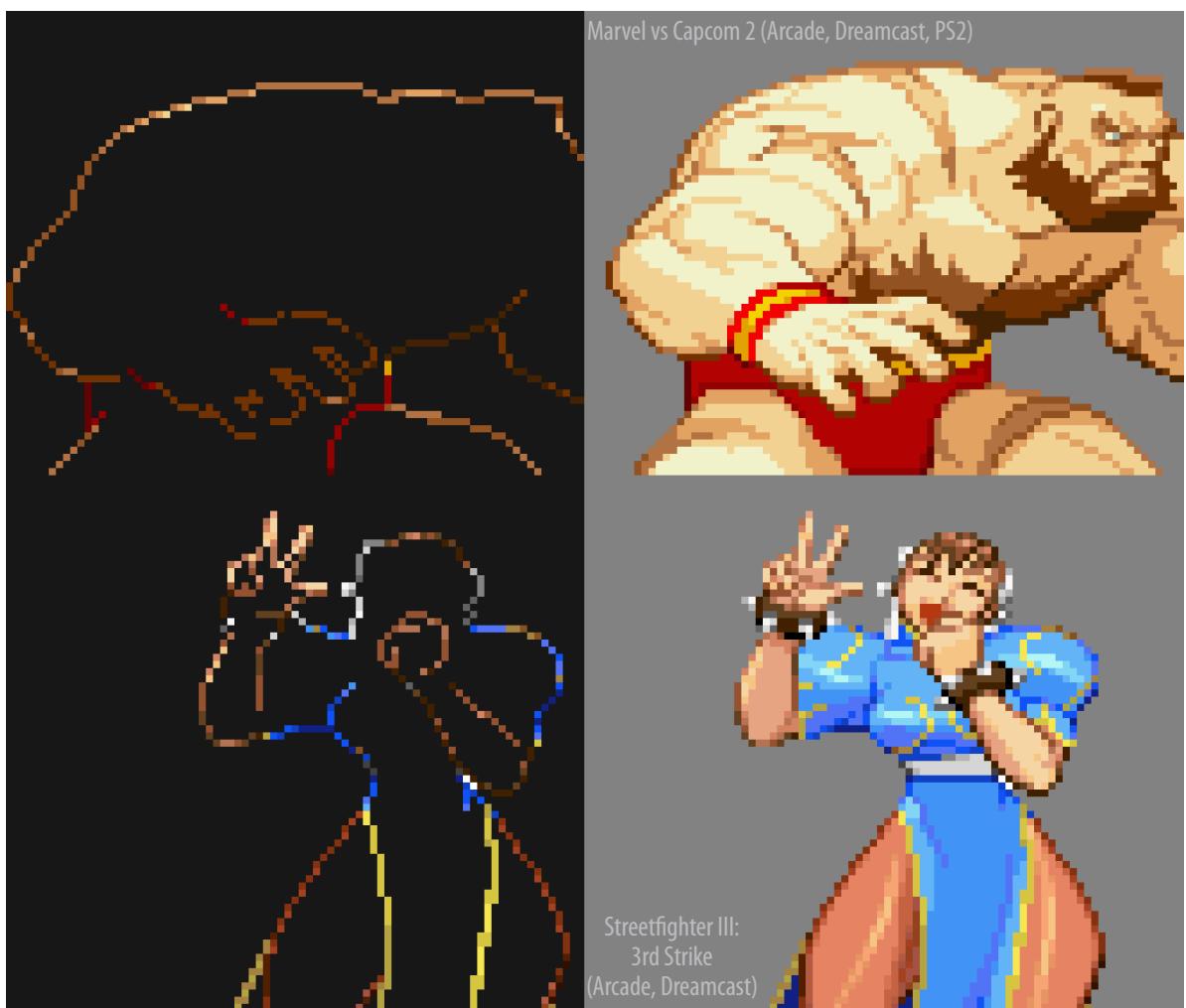
It's now obvious that:

- 1) **The line art is clearly shaded.**
- 2) **The light source is visible.**





Namco x Capcom (PS2)



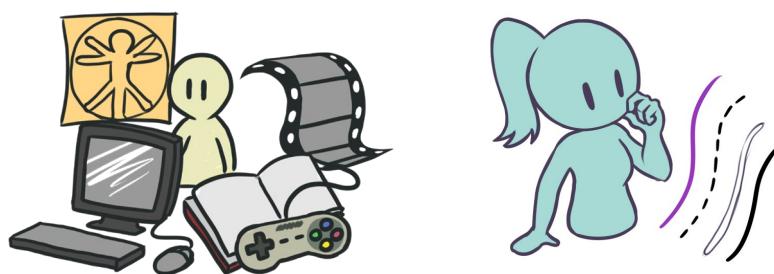
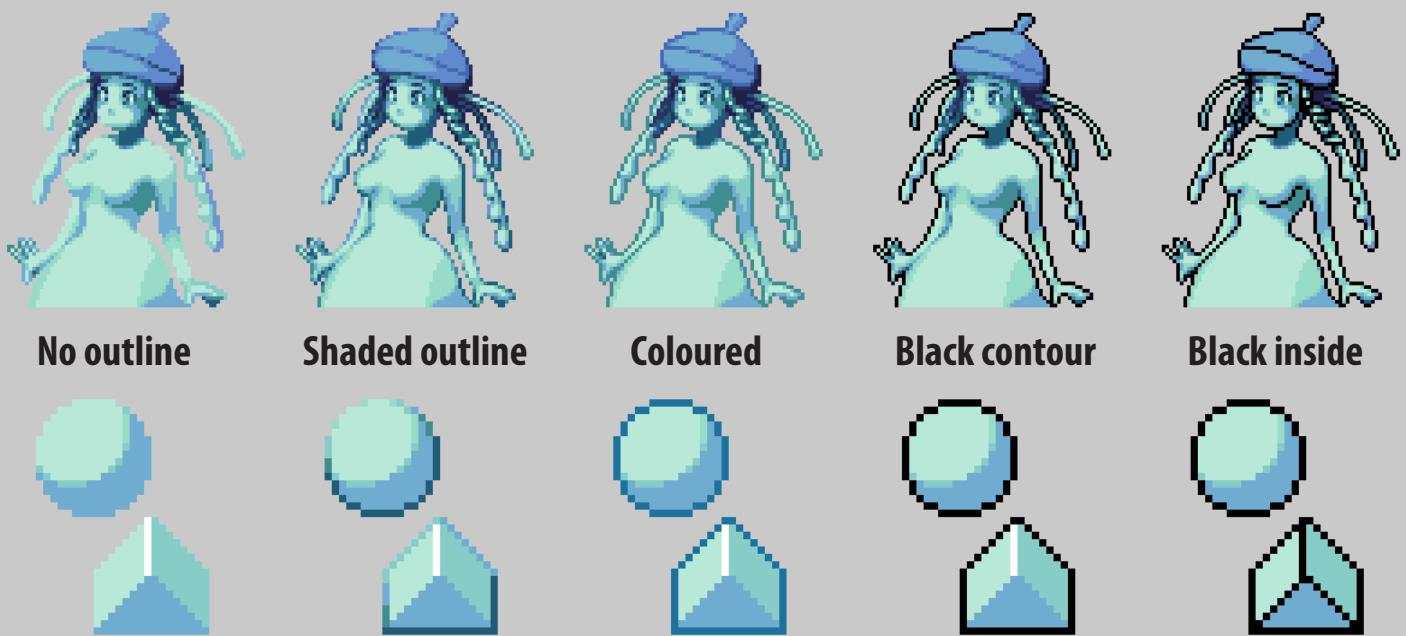
Streetfighter III:
3rd Strike
(Arcade, Dreamcast)

Conclusion

Here's a summary of the different types of outlines,

different outlines can completely change the style of a sprite!

Regardless of what technique you use, line art will be applied at any stage of the process.



Food for thought

- Introduction
- Lines & Curves
- Lines Are Everywhere

Types of Outlines

- No Outlines
- Black Inlines
- Black Contours
- Coloured Outlines
- Selective Outlines



Chapter

2

Anti-Aliasing

Introduction

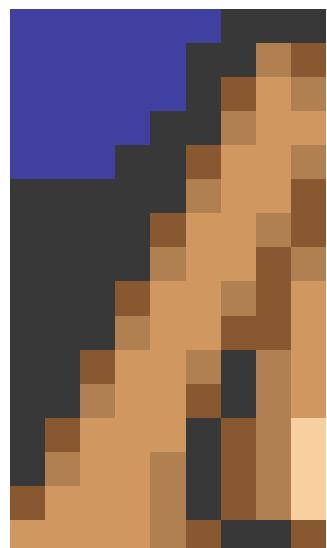
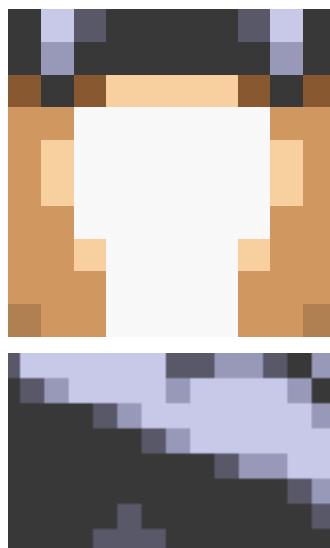
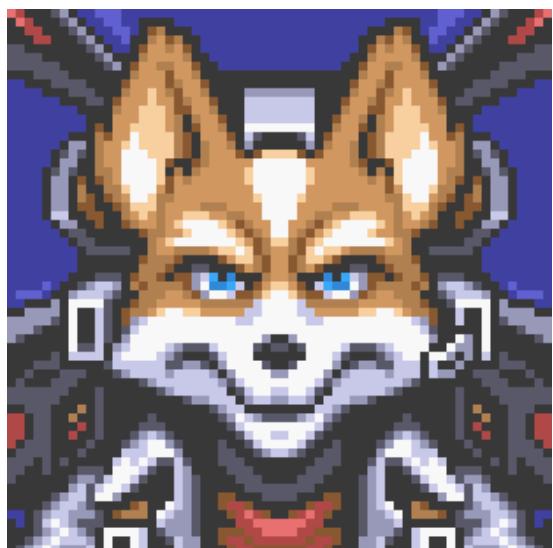
A picture is worth a thousand words. So for the next few pages... Zoom in!



Aliased Anti-aliased

Anti-aliasing helps you smooth out edges **by placing pixels in little corners**. Pay attention to where these little blocks are: they usually **blend** dark areas with light areas. They're sometimes found between 2 shades too, **smoothing** highlights from shadows!

Anti aliasing bridges the gap between 2 colours.



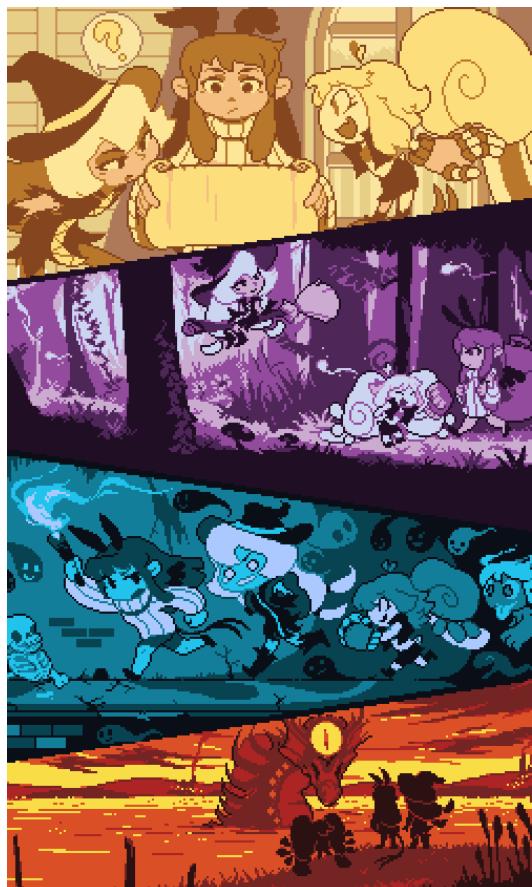
Starfox 2 (SNES Classic Edition)

Anti-aliasing is abbreviated as “AA”.

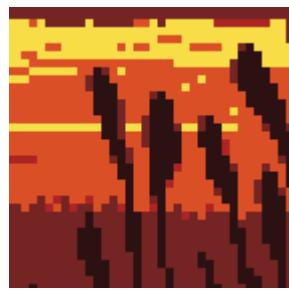


When is it necessary?

Anti-Aliasing is used to **smooth out those unavoidable jaggies**.



Temmie's work focuses on smooth and easy to read line work. Although there seems to be little anti-aliasing at first glance, she uses it quite strategically.



By guest artist Temmie Chang



Clarity

Characters, faces and eyes usually draw people's attention. It's best to make them clear, recognizable and easy to read.



Detail

This area contains a lot of small curves. Smaller curves are often more jagged. It requires more AA than bigger curves.



High contrast

If you have 2 highly contrasting colours, try blending them using some intermediary pixels.



Line weight

Anti-aliasing is used to add or remove some line weight. By adding AA, you can make things look thicker or thinner.

AA or no AA?

No matter the style, anti-aliasing is of **utmost** importance for pixelart.

Should I use anti-aliasing or not? Is it worth my time? **Let's compare.**



Blurry or sharp?



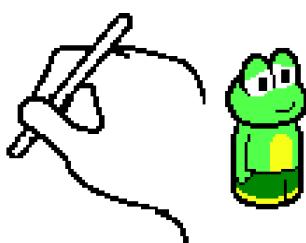
original graphics



no anti-aliasing

The sprite without AA feels blocky. The original graphics had an abundance of AA. In the game, the sprite was displayed on a white background. **Since sprites could have a total of 4 colours, they maximized AA.** The black sprite without AA feels harsh on a pure white background.

Pokémon Crystal (GBC)



original graphics



anti-aliased

Most of the graphics in this game are entirely aliased, sharp, and jagged. This was done to mimic Ko Takeuchi's art style. However, by adding slight AA the sprites have a softer look.

Rhythm Heaven/Paradise (NDS)



original graphics



no anti-aliasing

Removing the AA makes the portrait more readable, but at a cost: there's less detail. This was originally displayed on a small gameboy screen.

To get the most out of a gameboy palette, it's best to add AA.

Fatal Fury 2 (GameBoy)



original graphics



no anti-aliasing

For letters, numbers and typography, AA is always the best solution.

The Anti-aliasing also gives extra colour for flat colours.

Mother 1+2 (GBA)

Style & detail



heavy anti-aliasing



no anti-aliasing

AA will **bring out the colour** in your piece, but **heavy AA turns it blurry**. Too much is too much! As a result, colours will pop more around the edges. This really changes the tone and feel of your art. The oranges, reds and blues are much more noticeable. Since AA is placed pixel by pixel, you have total control over its effects!

by StevenM



original graphics



no anti-aliasing

This is where the lack of anti-aliasing becomes painfully noticeable. This style is all about soft and smooth shapes.

Without anti-aliasing, most detail is lost.

Kirby Super Star Ultra (NDS)



Anti-aliasing



no anti-aliasing

With a solid drawing and solid shapes, your pixelart will look appealing, with or without AA. But AA offers more details that you can use to your advantage. The **extra details make a big difference on faces or other intricate areas** (but not much elsewhere).

by Moawling



with anti-aliasing



no anti-aliasing

The original piece had anti-aliasing. But with all the anti-aliasing gone, the picture didn't lose much quality. It's hard to tell the difference.

AA is just icing on the cake here.

character by Nintendo sprite by Michafrar



L: Original graphics



R: Extra anti-aliasing

Here, the difference is only noticeable when zoomed in. When these portraits are displayed at a small resolution, you can barely tell the difference.

The shapes are clean enough to have minimal anti-aliasing.

Metal Gear: Ghost Babel (GBC)



original graphics



extra anti-aliasing

The kangaroo in the original already had anti-aliasing. Can you tell the difference? It's hardly noticeable. Simple styles don't need AA.

Scribblenauts (NDS)



original graphics



no anti-aliasing

This art was down-scaled and touched up manually to fit its limitations. **They used AA to preserve the detail of the original art.** Without it, it looks quite flat.

Advance Wars (GBA)



original graphics



with anti-aliasing

Oh no! The game's art style was clearly going for a crayon look. This sprites therefore need to be crisp and sharp.

Anti-aliasing isn't needed.

SMW2: Yoshi's Island (SNES)



original graphics



no anti-aliasing

These sprites are scaled down drawings that have been touched up by pixel artists. Without AA, there is very little difference.

Low contrast colours don't need much AA.

Fuka Kazamatsuri from Disgaea 4 (PS3).



original graphics



no anti-aliasing

Sometimes it's just a matter of what you like the most.

What do you prefer?

Mario Party Advance (GBA)

Remember that your base colours are **more** important when you have no AA.



by Shawn Martins

Conclusion

Anti-Aliased



PROS

- + Smooths curves on small sprites
- + Necessary for large sprites
- + Sub-pixeling animation

CONS

- Lots of work if overdone
- Blurs tiny sprites

Aliased



- + Small sprites are more readable
- + Limits your colours
- + Faster

- Creates jagged lineart
- Sharp & blocky

How to apply?

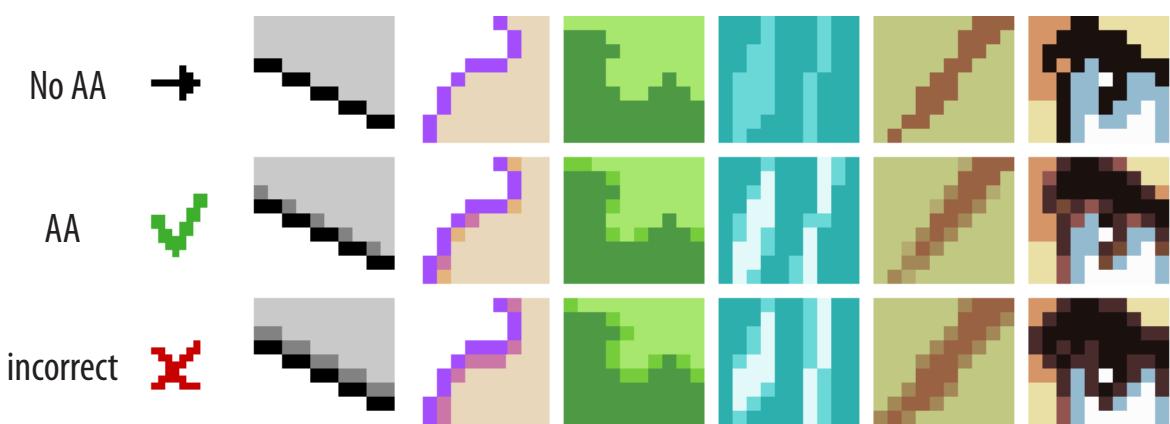
AA is simply putting pixels in little corners to make lines and shapes smoother.

It's kind of like **cushions on a couch!**



These examples should help you identify good AA from bad AA.

They range from simple to complex.



I recommend a mix of
1 and 2 shades.

Go look up some of your
favourite sprites that have AA.
Try and see how they do it.
See what suits YOU.



How many blocks do I add?

About half of the length of the line.
Too little is better than too much.



How many shades do I use?

One to start practicing.
Two for smoother results.
Three if you have enough colours and feel confident.
Too much AA blurs the line between pixel art and vector art!

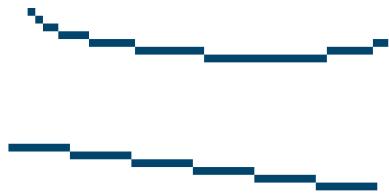
Which corners do I fill?

Find out on the next couple of pages!

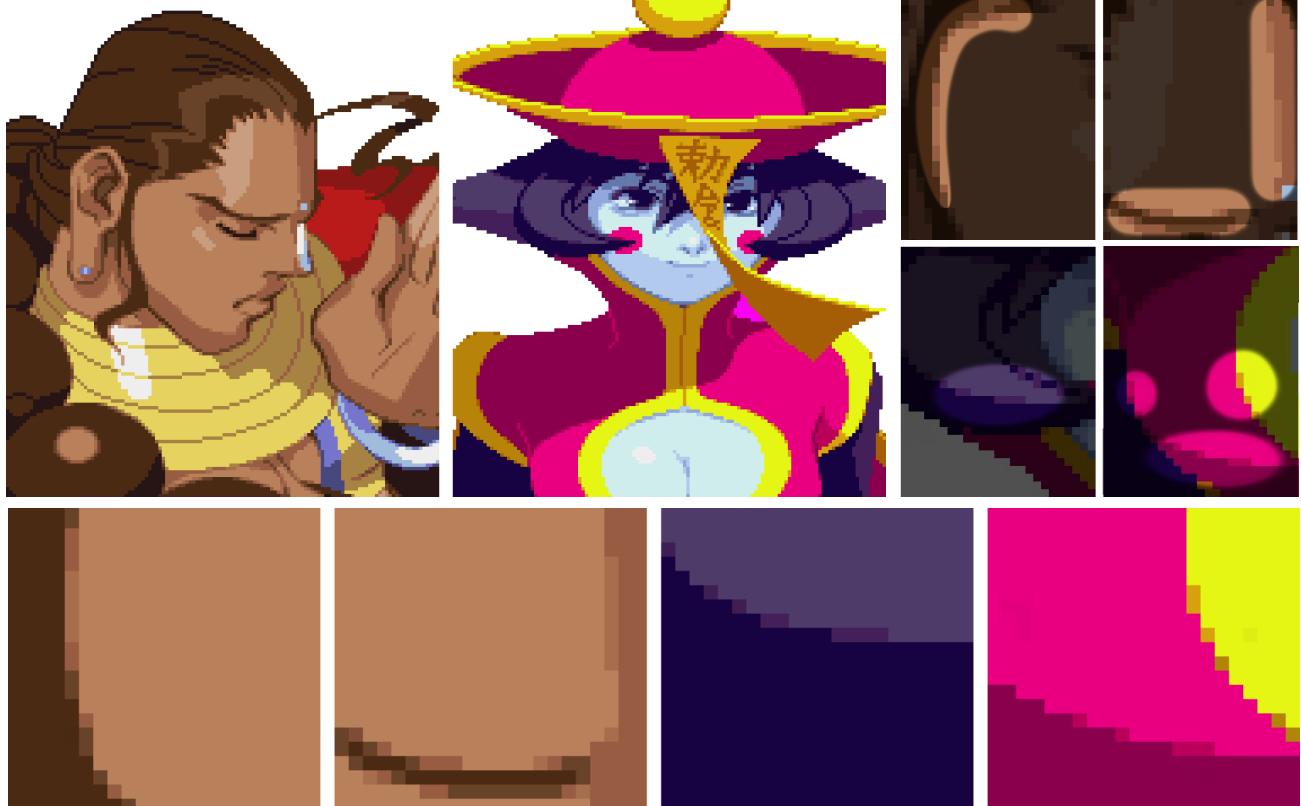
Flat curves

These are **flat curves**.

They're rarely found in small sprites, but quite common in larger pixel art. If you're not happy with the aliased look, you can still add AA.



Vampire Savior 2/Darkstalkers 3 (Arcade/PS1)



Focus on these areas.

longer steps = longer AA

Remember

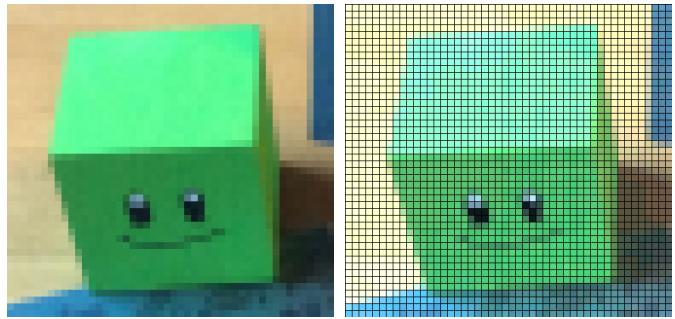
There are always exceptions. Longer AA isn't *always* necessary.

You can have shorter blocks. It's completely up to you!

Always make sure to zoom out and judge for yourself.



Digital pictures are not pixel art, but they are technically made up of pixels on a screen. The technical term for this type is a **raster** image, or simply put: "images on a pixel grid". But we can learn from **raster graphics** to understand Anti-aliasing better.



Let's zoom in on a very horizontal flat curve. We'll then compare it to a curve that is more diagonal.

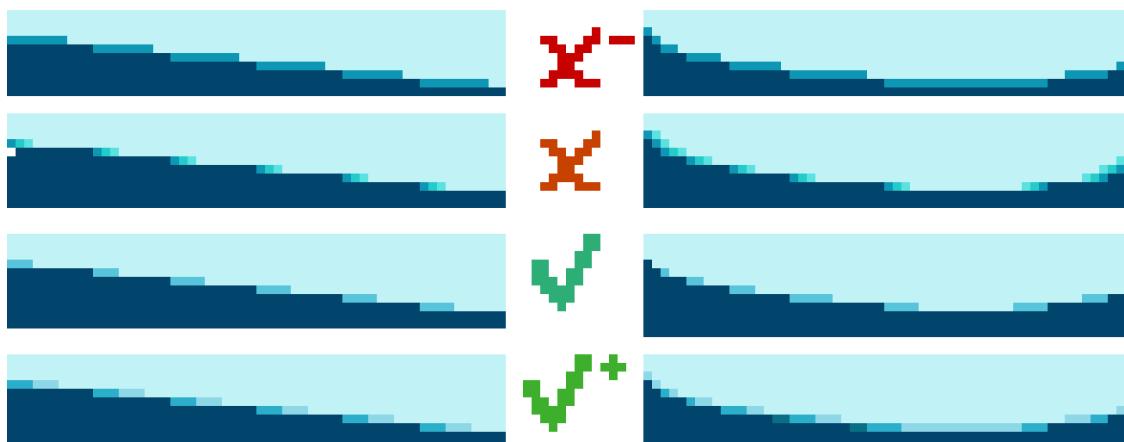
Notice how **the flatter the curve is, the more colours there are**.



Of course, pixel art would get too blurry with too many colours. It wouldn't resemble traditional pixel art anymore, it would resemble a regular image instead.

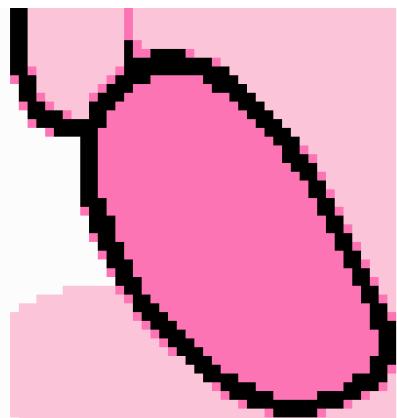
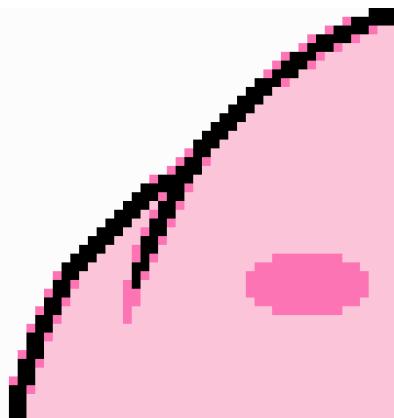
longer steps = more shades of AA

Summary



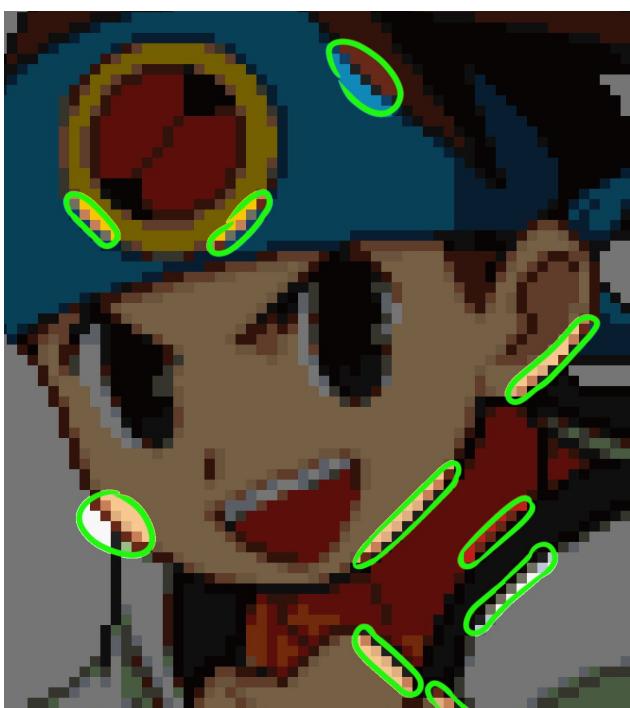
45° lines

Anti-aliasing on 45° lines is rare but there are exceptions! Here, NES limitations showcase the lack of AA nicely. With **fewer colours**, there is little to **no need for AA**.



Kirby's Adventure (NES)

Sprites with more colours, offer more variety:



Mega Man Battle Chip Challenge (GBA)

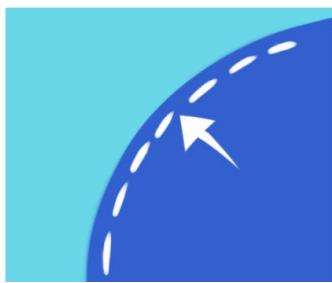


Kirby's Super Star Ultra (3DS)

The centre of the curve can be either **lighter or darker**; it depends on the type of curve.



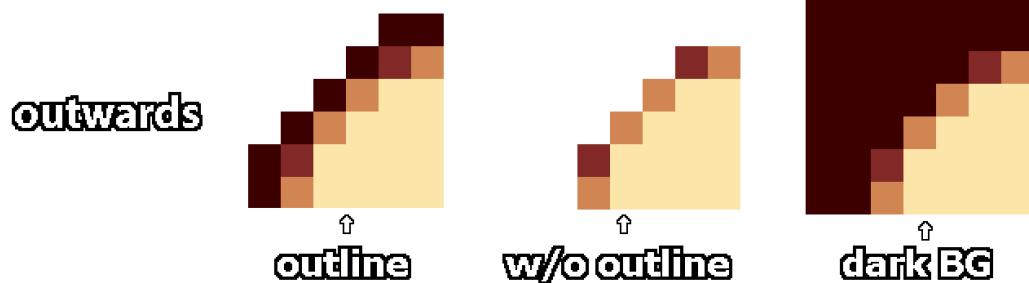
Convex curves



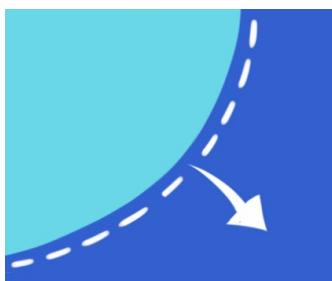
The centre has **light colours**.



The ends have **dark colours**.



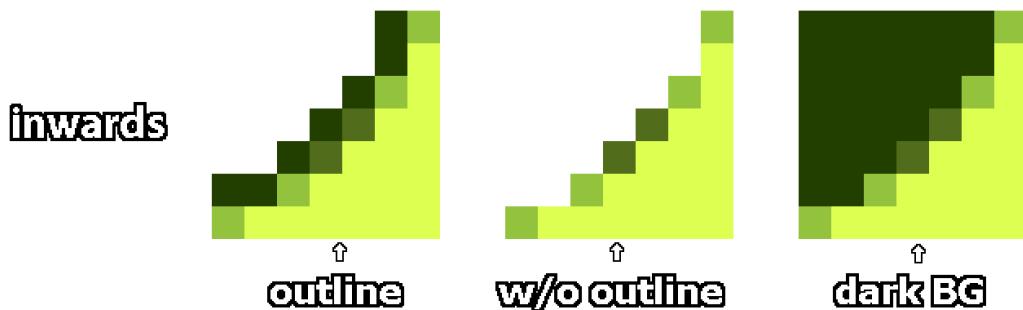
Concave curves



The centre has **dark colours**.



The ends have **light colours**.



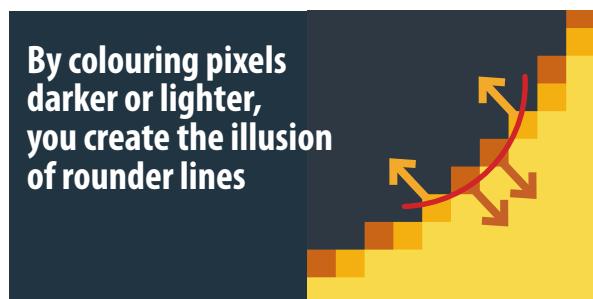
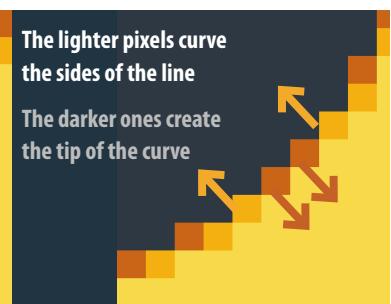
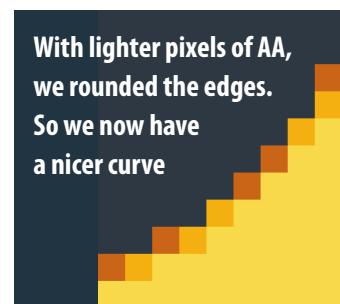
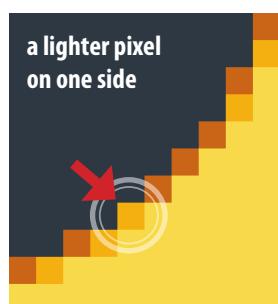
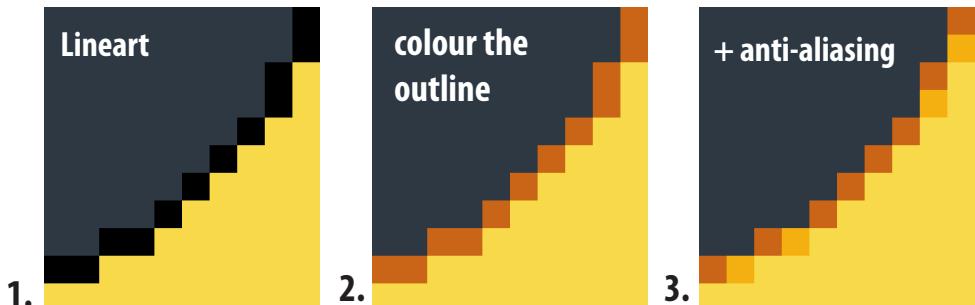
Darker or lighter pixels change the **thickness** of the 45° part.



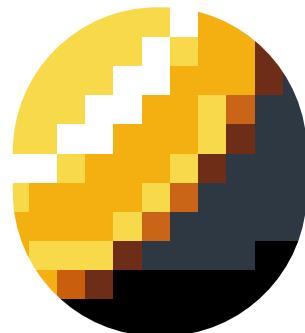
Pixel-Logic Bonus

Still unsure how to give a 45° line a slight curve? **No problem!**
Here is an example of a **curved outline**.

Let's zoom in on the 45° lines of this banana.



Look at the other side
of the banana. What
happens here?



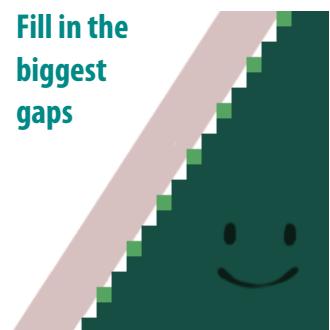
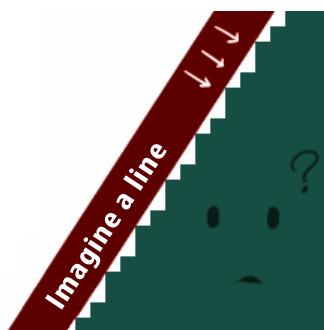
If the Banana has a
black outline, this AA
works too!

ATTENTION: This banana is on a dark
background. On a light background,
these pixels may stand out. It's best
to keep the outline colour solid.
[More information](#)
on page 197.



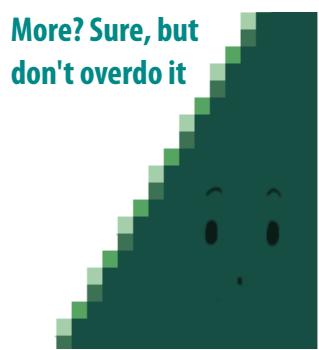
Jagged lines

What to do with a jagged line?
They are uncommon, but
they exist nonetheless.
Try this trick.

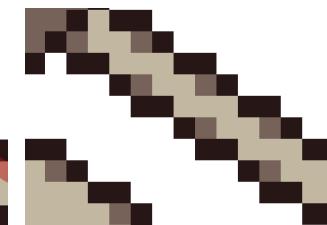
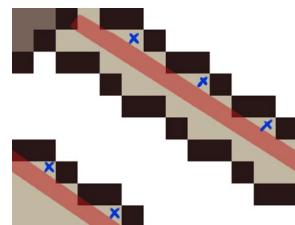
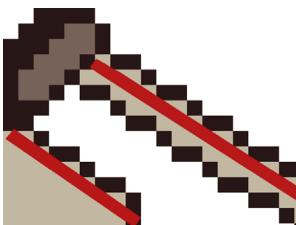
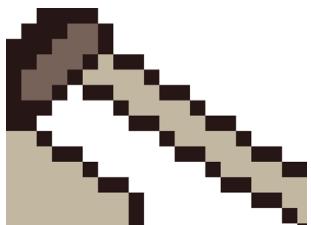


Wish to stop there? That's fine, the line is smooth enough.

Want to go even
smoother?
Try this.



This technique also works for
other types of jagged lines!



AA looks good on the inside of the sprite.



but it doesn't look
good on the outside.

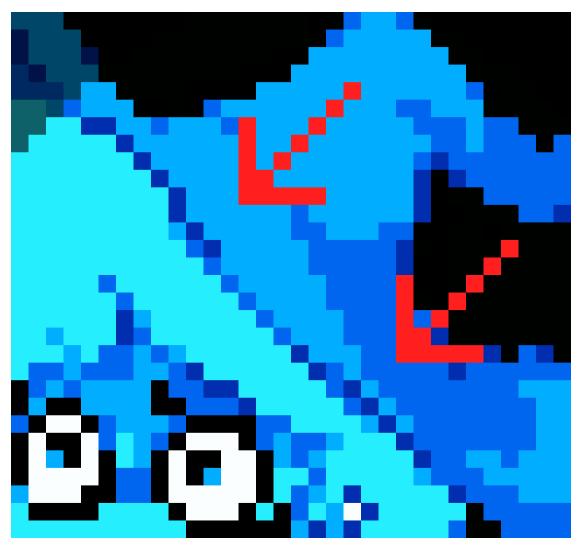
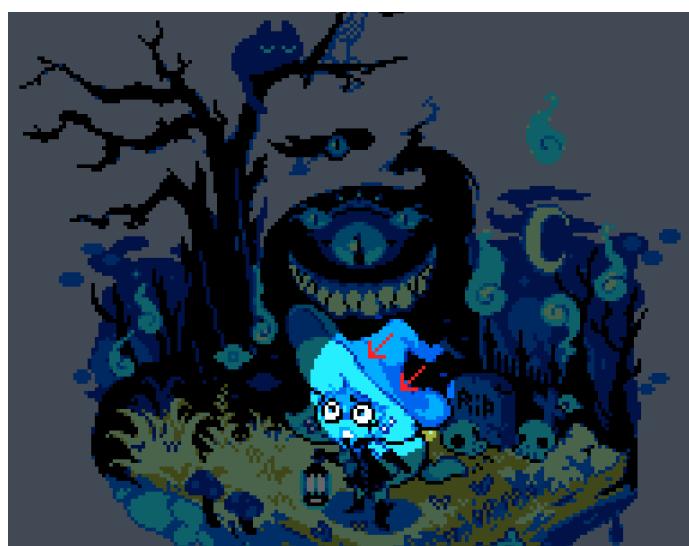


fuller lines
are better

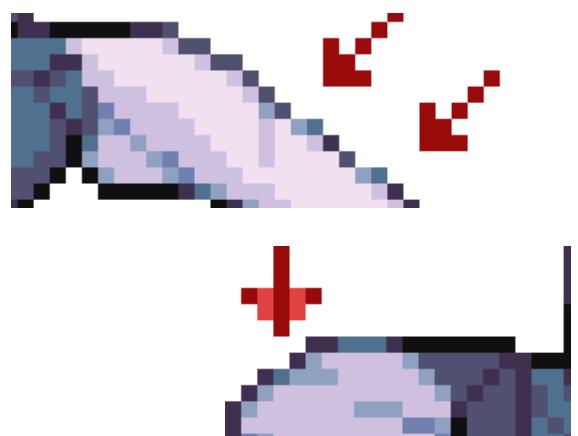
More examples



By AnubisJr.



By Temmie Chang



Darkstalkers 3/Vampire Savior (Arcade/PS1)

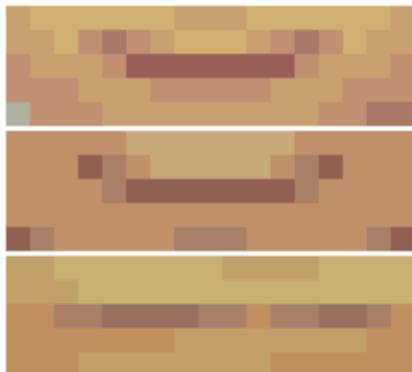
Line weight

Manipulating colours helps you **make lines look thicker or thinner**, even at 1 px!

Mouths usually tend to be just a simple line. So let's take mouths as an example!



Breath of Fire IV (PS1)



Dimples are **light**, lips are **dark**.

Dimples are **dark** and appear **thicker**.

Look! What feels thicker or thinner?

DARK = THICKER

LIGHT = THINNER



You can even add lighter lines on the tip of a curve to recreate brushstrokes
(see orange and cyan examples)

Just play around, but don't use too many shades!

Observe the lines on the following sprites. **Focus on their faces.**

Darker pixels makes lines appear thicker.
lighter pixels makes lines sharper and thinner.

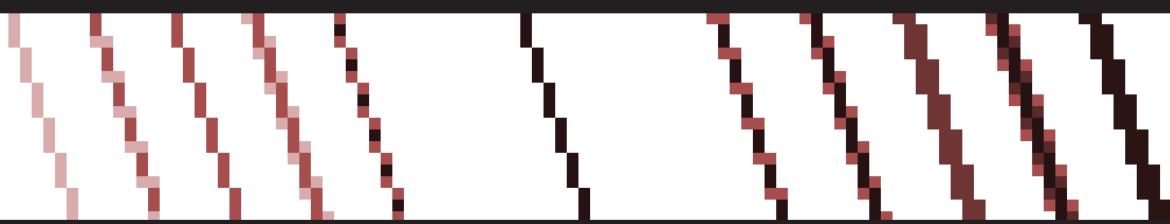


by AnubisJr.



Disgaea 4 (PS3)

Disgaea D:2 (PS3)



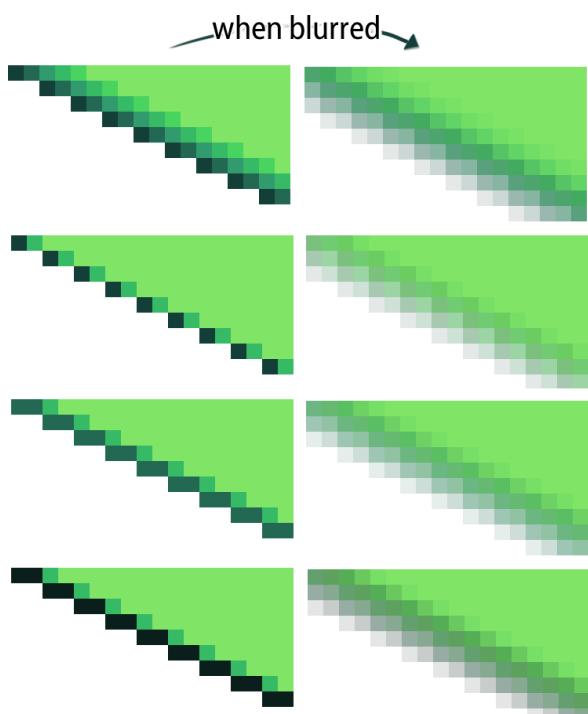
Look how easily a line can become **thicker** or **thinner**.
The colours and the pixel placements make all the difference!

Remember

There's no point overdoing AA. You can get the same result with less effort. In the example on the right, the blurred side is almost identical in all stages. So there's no need to overdo AA.

Just stick to 1 or 2 colours.

Line weight is complex. It's the basis of sub-pixel animation. [Find out more in the chapter: "Sub-pixeling".](#)



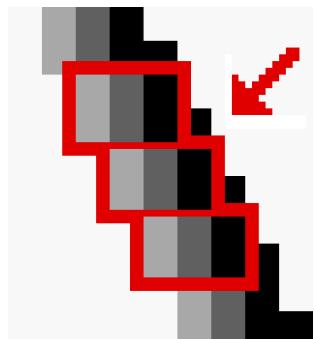
Banding

Banding is BAD.

This happens when two rows of pixels perfectly **hug** each other. Sounds cute, but it *really isn't!*
They are the same length and **stick to each other**.



Noobow ん～ぼ～ (Game Boy)

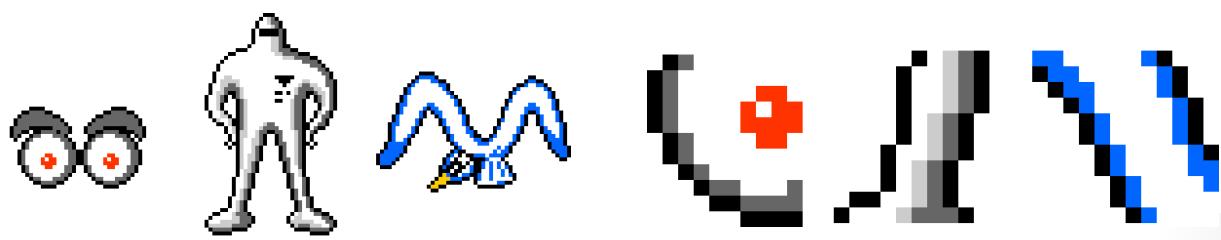
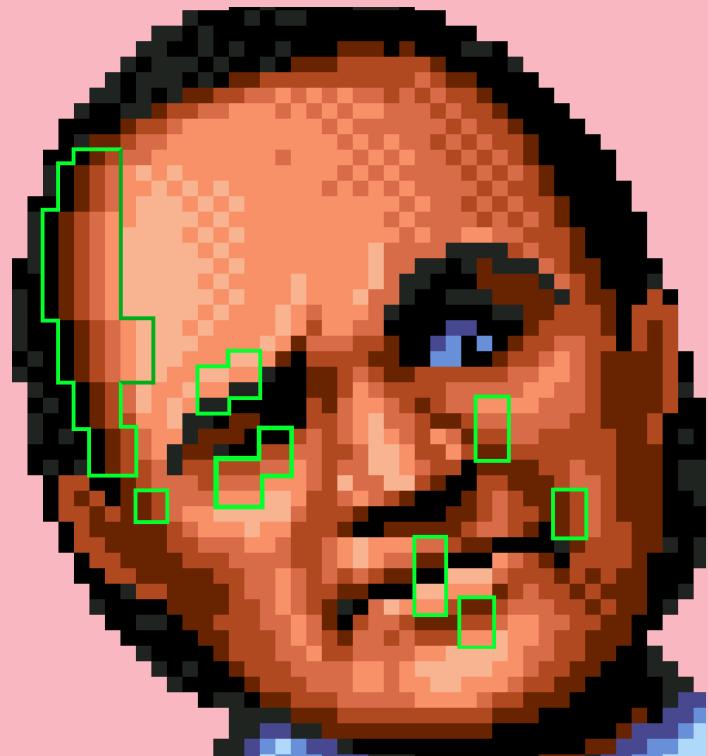


It can get worse:



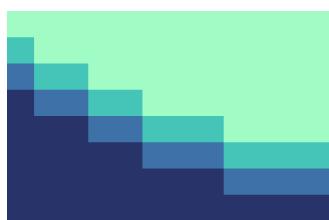
Ghostbusters (Genesis/Megadrive)

The worst part is, the highlighted parts are just the tip of the iceberg.
There's so much banding to be found here.

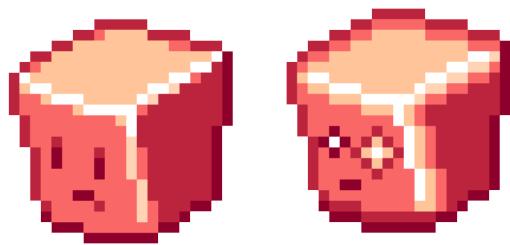


Mother 1 / Earthbound Beginnings (Famicom/WiiU)

Why is this so bad?

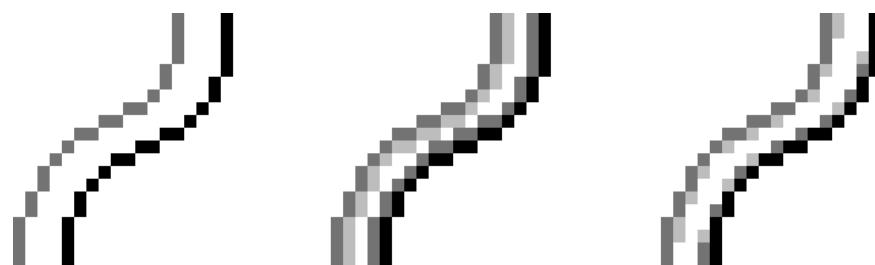
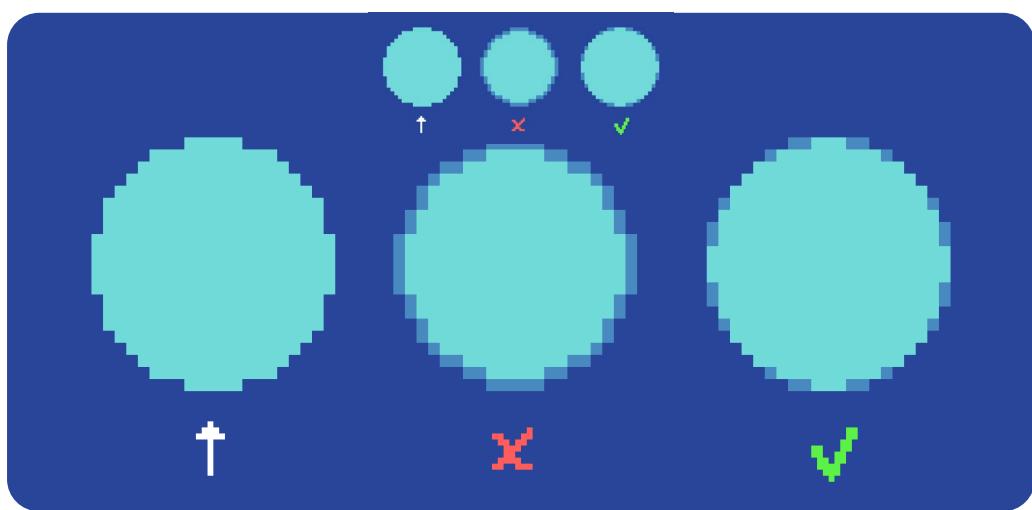


- It makes your curves look **blocky**.
- It makes lines appear **thicker** than you originally wanted them to be.
- It **blurs** your outline too much.
- It follows the outline perfectly, resulting in **pillowshading**.



“ Some beginners might be thinking:
“I don’t see a problem with it?” ”

This is because **you’re looking at it zoomed in**. When viewed at 1x or 2x size, it really bleeds into the sprite, and that’s when you notice banding.



by Michafrair

How do I fix it?

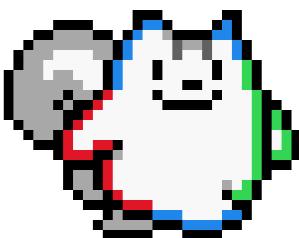
- Remove a pixel or two from the edge.
- Add a pixel or two to the edge.
- Use darker shades of Anti-aliasing.



Check the colour coded areas to see these fixes!



before



Noobow ぬ～ぼ～ (Game Boy)



after



before



Basketball Nightmares (Master System)



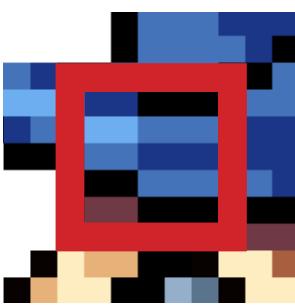
after

Even more banding?!

Parallel banding is a rare problem. It's when several bands of pixels are stacked on top of each other in parallel rows. There are many ways to fix this issue, so just keep moving pixels around.



by Michafrar



3 different
solutions!



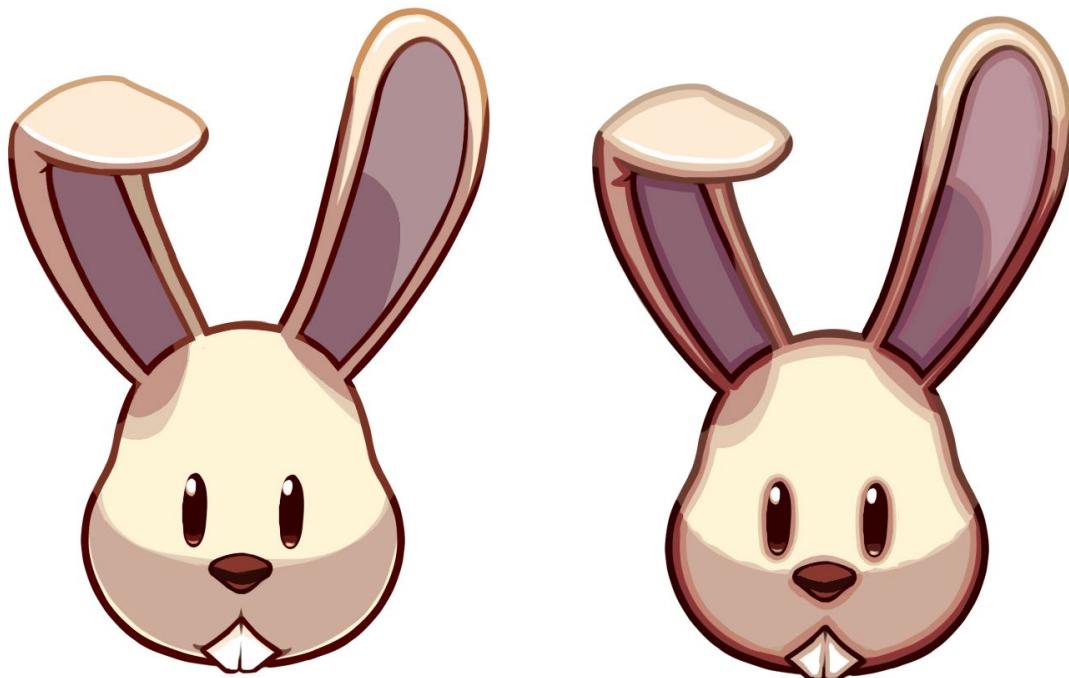
Banding is bad, but don't worry.
Sometimes it's unavoidable.
When you see it ... fix it!
Just try to eliminate it as much as you can!



Pixel-Logic Bonus

Still don't see what's so wrong about banding? **Let's examine.**

If banding were to occur in a regular drawing, it would look like this:



Note that this is just cell shaded. It would far get worse if it were soft-shaded.



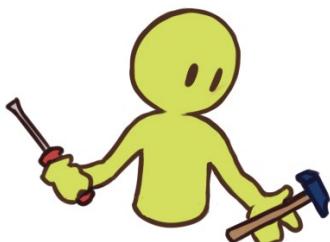
Another way to prove banding is a pain in the neck is **by blurring the image.**

Just...ew!

Conclusion

Anti-aliasing is **a big subject**. Don't worry if you feel overwhelmed. Most of these techniques **will become instinctive over time** as you make more pixel art.

Some people make pixel art without any AA and they do an incredibly beautiful job! Remember to **look up videogames** that inspire you and **see how they use AA**.



Food for thought

- Introduction
- To AA or not to AA?
- When is it necessary?

Techniques

- How to apply
- Flat curves
- 45 ° lines
- Jagged lines
- Line weight

Avoid

- Banding



Chapter Colour

3

Introduction

Colours are lots of fun but it can get tricky. They are the **most subjective** part of sprites as they build **the atmosphere of a game /picture**.



Batman (1989 , NES)



Shin Megami Tensei
(1992 ,SNES)



Mega man 6 (1994 , NES)



Super Metroid (1994 ,SNES)



Tales of Phantasia (1995, SNES)



SMW2: Yoshi's Island (1995, SNES)



Red Earth (1996 , Arcade)



Breath of Fire IV (2000 , PS1)



Left: Drawn to Life (2007, NDS)

Top right : Shovel Knight (2014, Various)

Bottom right : Mighty Switch Force (2013, WiiU/3DS)

Colour theory is a universal skill.

It can be applied to all kinds of arts: from painting and photography to Interior design. **We won't delve into much detail here**, because it's something already taught in schools and tutorials regarding colour theory are widely spread across the internet. Colours can make or break an image, so make sure you know your basic colour theory skills.

For Pixel-logic we will just **focus on aspects specifically for pixel art and game design**.

SOME SECTIONS HAVE COLOURS WITH LOW BRIGHTNESS.

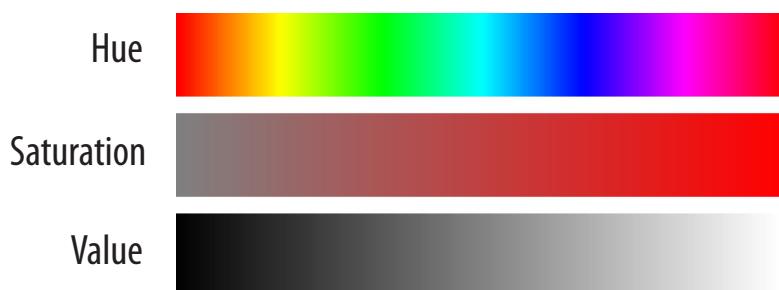
Colours are not displayed the same way on all monitors.
It's a common issue with art. **Please adjust your settings!**

How to pick colours?

Pixel art is a digital art. Unlike traditional media, making colours works **with sliders**. Here are the 3 factors that make up a colour for digital art. You can find them in all software.

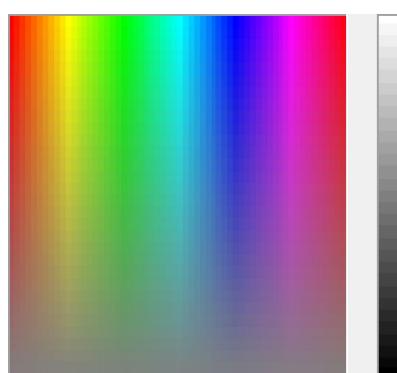
For this book, we will use Method 1 as the standard for future pages and explanations that refer to colour picking.

Method 1 - The 3 Colour sliders

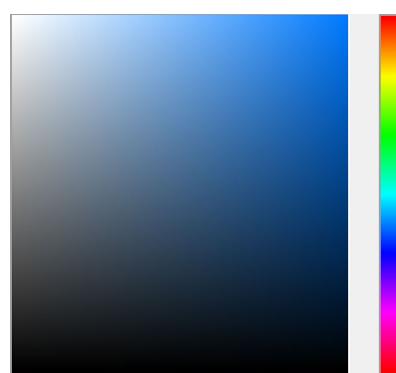


Note: Some programs use **Brightness** instead of **Value**. It's just a different name. When the third slider says **Luminosity** it goes towards white rather than the pure hue.

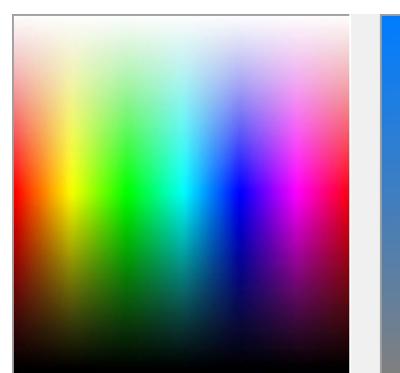
Most, if not all programs should have **extra colour pickers**. These 3 factors are not displayed the same way in each program!



Hue + Saturation / Value
MSPaint, GraphicsGale



Value + Saturation / Hue
Aseprite, Paint Tool SAI ,
Photoshop, Clip Studio Paint



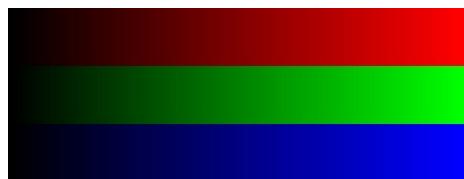
Hue + Value / Saturation
Pro Motion , Photoshop,



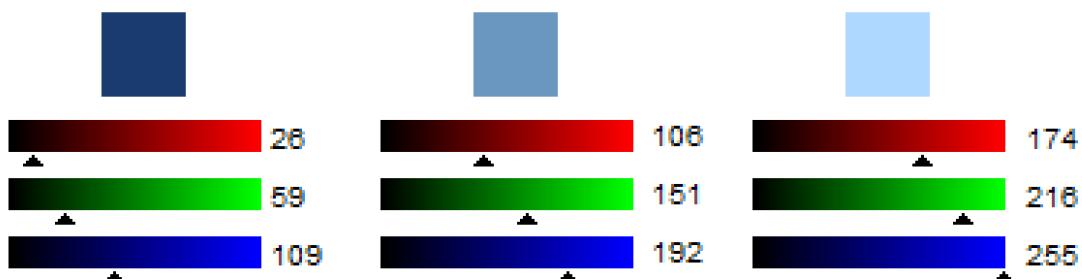
Some programs use triangles or circles for picking colours instead of a square. Don't worry: You'll always have what you need.

Method 2 – Red, Green, Blue

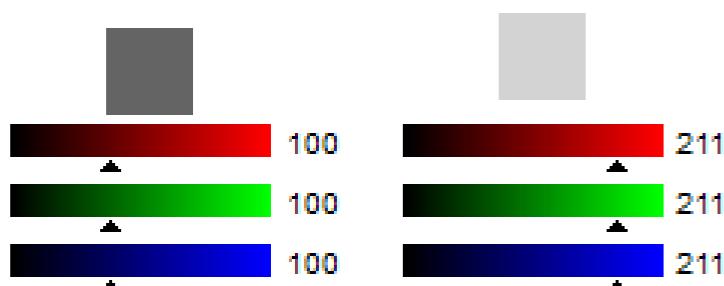
RGB, is an **additive** colouring method:



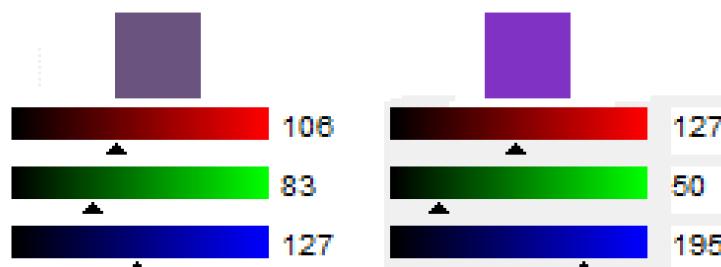
To obtain **lighter colours**, you **add more** of each value.



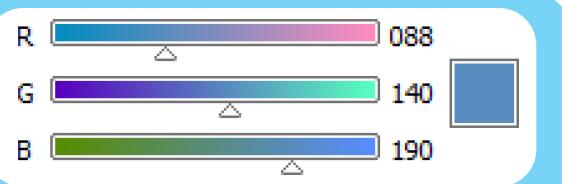
To obtain pure **greys**, give **the same value** to each slider.



To obtain **duller colours**, move the sliders **closer together**.



Some programs help you mix colours by showing a preview of what colours you can possibly make.



Why make palettes?

Having a palette doesn't necessarily mean literally having colours on the side. You can still eye-drop colours within your pixel art. Don't worry.

Saves you time



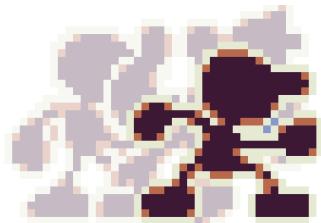
You save more time eye dropping the same colours, instead of recreating new ones or blending them.

Keeps you organized



If you're using loads of colours, you might get lost. It's a hassle trying to find colours if you're working with big art.

Makes animation easier



The more shades you have, the harder it is to animate sprites. You don't want colours to flash when your pixel art animates.

Here, a palette is not really needed here, just eye drop!



Guest artist: Justin Cyr

However, this definitely requires a palette

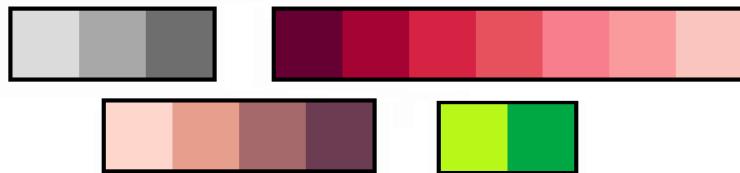


Guest artist: Ahruron

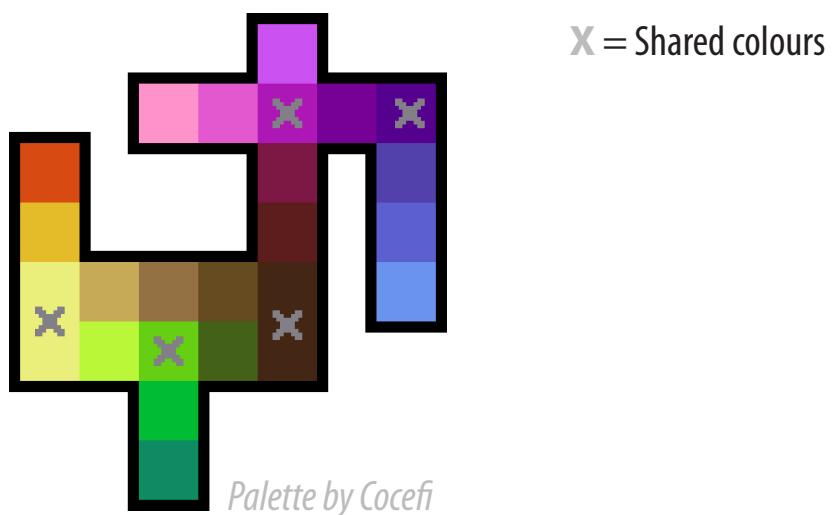
Some programs will automatically generate a palette for you, so you don't have to!

Colour ramps

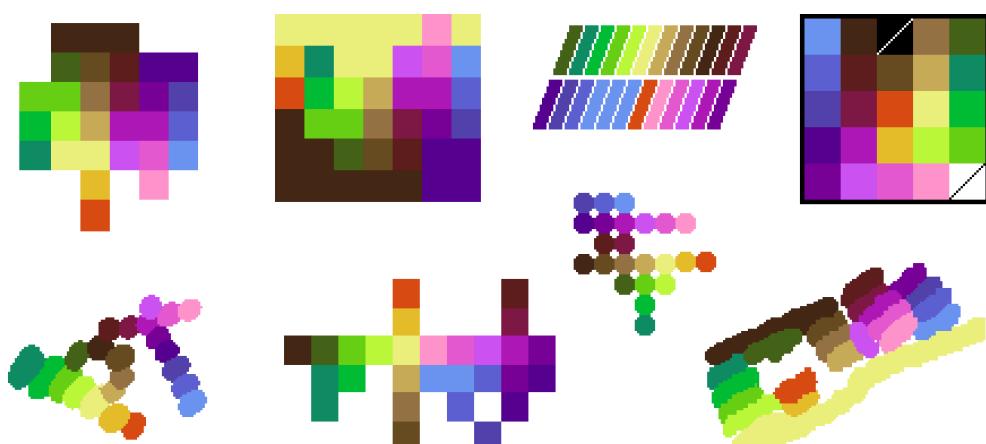
These are ramps. Simple!



Pixel art and having a low amount of colours go hand in hand. A good way to do that, is by reusing the same colours across different shades. You're not obliged to do this, but it can create some interesting harmonies.



You might think: "This is confusing to me". It doesn't matter how you display your palette.

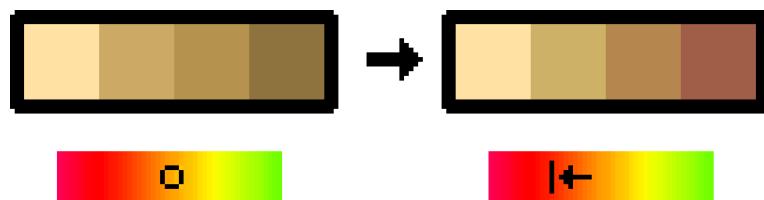


As long as YOU know how to use it. See?
You can still mix ramps!

Hue shifting

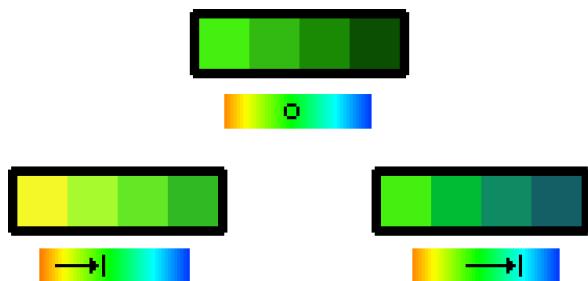
Hue shifting, also known as “coloured shadows” can also be applied to any other visual art. It makes your art more colourful and appealing to look at.

Method 1 - Regular hue shift



Light brown, used for every shade.
The shadow is boring black.

With every shade, they become more red.
The shadow is now **warm red**.

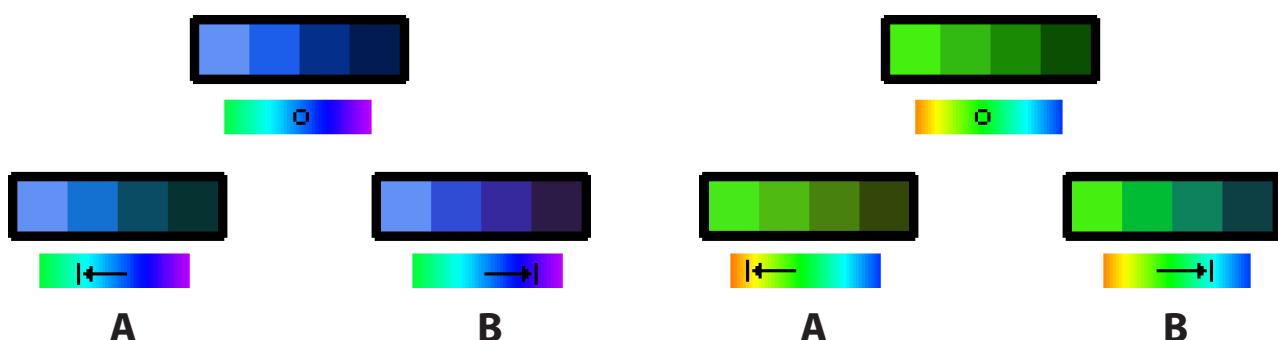


You can give green different moods by giving highlights and shadows different colours.

Do this by **shifting the hue sliders**.
It's up to you how much you shift hues.

You can hue shift left or right on the colour slider.
The **A** ramps hue shift towards yellow slightly, whereas the **B** ramps hue shift towards purple.

The A ramps look a bit odd. The B ramps are probably what you're familiar with.

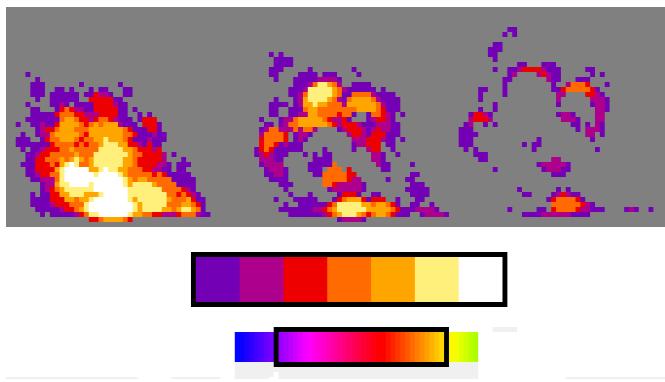




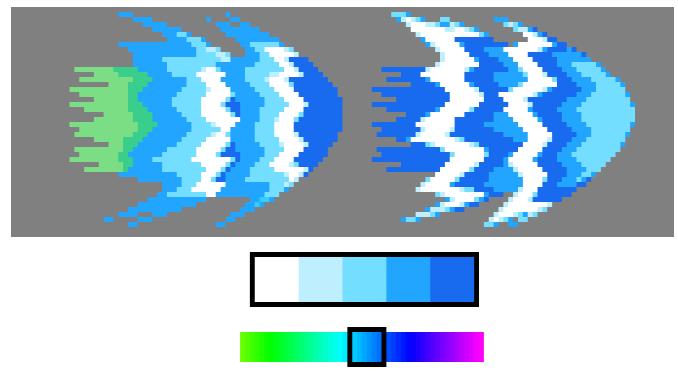
Sonic Rush Adventure (2007 , NDS)



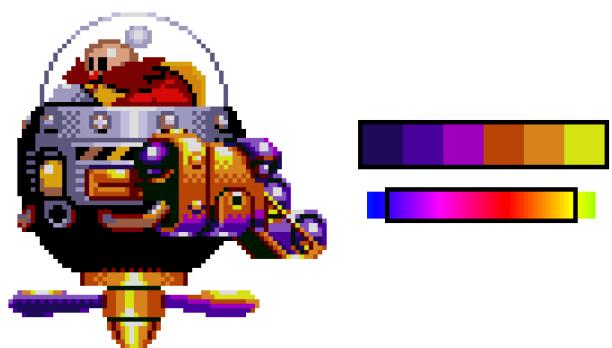
Seiken Densetsu 3 (1995 , SNES)



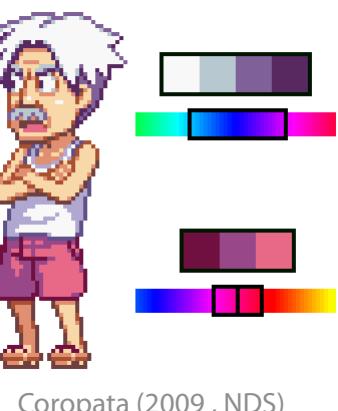
Sonic Rush Adventure (2007 , NDS)



Mighty Gunvolt (2014 , 3DS)

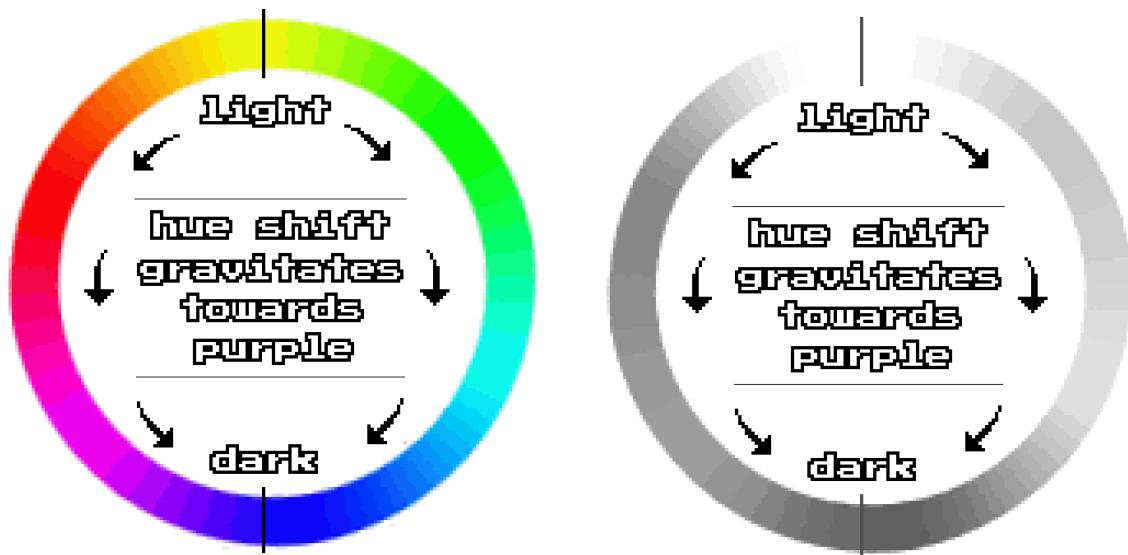


Sonic 3 (1994 , Genesis)



Coropata (2009 , NDS)

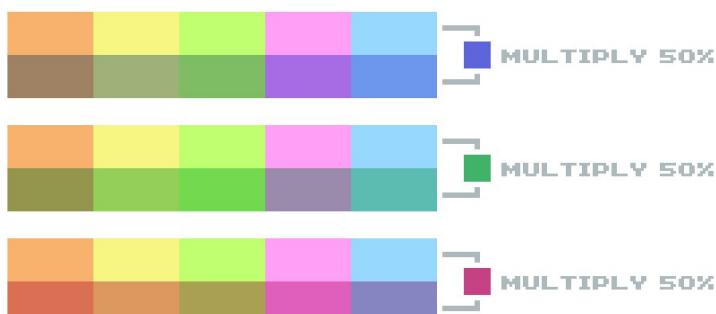
Yellow is the brightest colour of the rainbow. Purple is the darkest. **This is why generally people often hue shift from yellow to purple.**



You can have subtle hue shift or drastic hue shift. It's a matter of preference.
Even in greyscale you can notice the principle in action!

Method 2 - Multiply layers

Instead of manually hue shifting every colour ramp, you can experiment with shadows by using multiply layers. You can find them in more complex software.



Palette by Cocefi

Once you found some cool combinations just eye-drop away!

The examples just show blue green and magenta, but you can use other colours!



Pixel-Logic Bonus

Hue-shifting isn't the only thing
Playing with saturation is important too!

Saturation shift isn't just like hue shift. Hue is used to create an atmosphere or feeling.

Saturation is used to highlight a particular area of your shading.

Don't think of colours like numbers. Just experiment, and see what suits you.



All colours are the same saturation

Mixed saturation

Saturated shadows-
Desaturated highlights

Desaturated shadows -
Saturated highlights

1 shade is heavily saturated

The lighter shade is **vibrant**.
The darker shade is **dull**.

The lighter shade is **dull**.
The darker shade is **vibrant**.



Guest artist: Ahruron

Conclusion

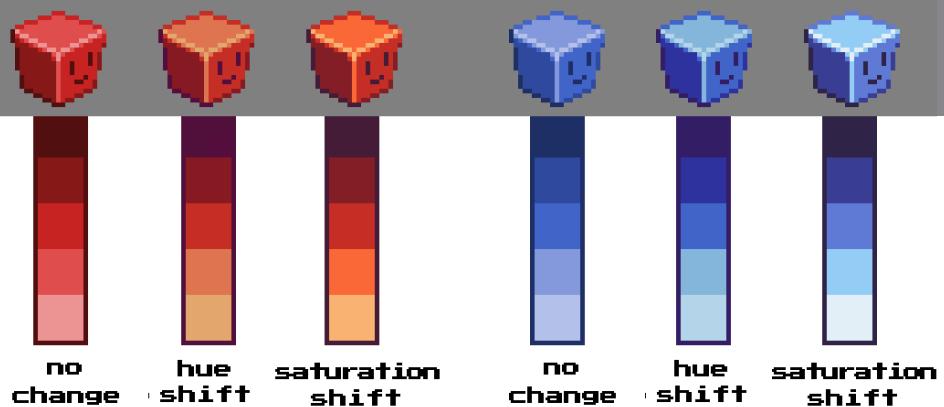
Take a look at this crab, in all its versions. See the differences?

Small colour choices can have big effects!



These are just a few methods to alter colours.
The key is to experiment and study other pictures you like.

Hue and saturation are ESSENTIAL to shading and anti-aliasing.



Black tones

You can do so much more to add style to your sprites!

Quite a few artists and games **add a colour tint to the black or choose a dark grey**.



Fire Emblem (GBA), Mega Man 7 (SNES), Breath of Fire IV (PS1) Mario Party Advance (GBA), Legend of Zelda™: Link to the Past (SNES),
Mario & Luigi: Dream Team (NDS), Earthbound (SNES), Chrono Trigger (SNES), Breath of Fire IV (PS1)

There isn't a technical reason why pixel artists or games choose to do this.
It has got nothing to do with limitations. It's purely aesthetic!



Super Mario Kart (SNES)

SMW2:
Yoshi's Island (SNES)

SMW2:
Yoshi's Island (GBA)

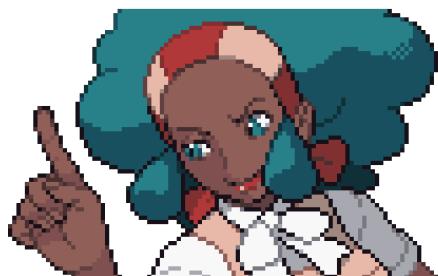
Mario & Luigi:
Superstar Saga (GBA)

Mario Party
Advance (GBA)

Mario & Luigi:
Partners in Time (NDS)

Yoshi's Island DS (NDS)

Black tones are not limited by game or style.
Even within the same game or **within the same style**, you can have **subtle differences**:



dull purple



pure black



dark brown



dull cyan



Pokémon Black & White (2011, NDS)

Can't see the subtle differences? **Let's brighten them up a little bit.**



Even though your monitor does not display these colours, remember that your pixel art is being shared online, on different platforms or different systems. **Brightness will vary from each device.**

Using greys

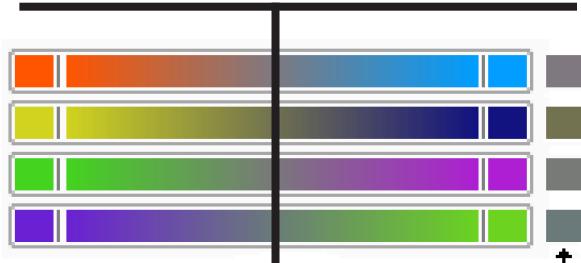
Greys are like the "Ditto" of colours. They can easily camouflage their way into a sprite without you even realizing it.

... Especially with a limited palette. It works well with palettes that have special lightsources atmospheres: night time palettes, fiery red environments, toxic green glow and so much more!



When you blend 2 complementary colours, you obtain almost a pure grey. It makes grey perfect for blending. Not pretty, but useful!

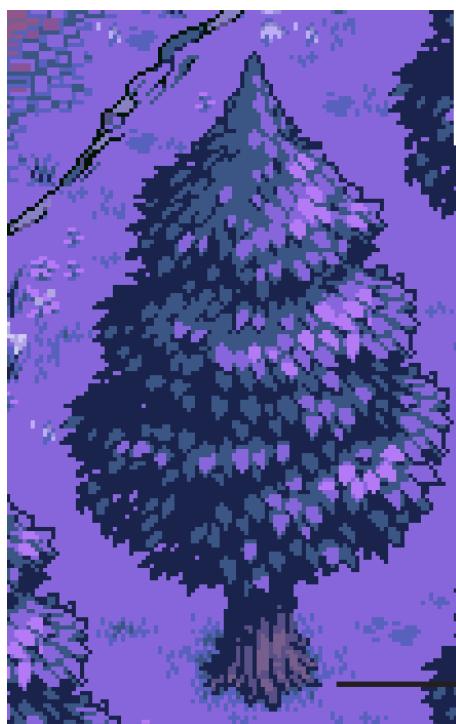
Greys cancels out colours.
It makes them neutral.



=

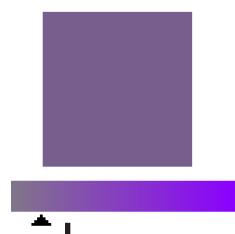


The Chaos Engine (1993, Amiga CD32)



This is a tree from *Boktai: The Sun Is In Your Hand* (2003, GBA). The overall mood and lighting of this scene is purple, and as such all the colours appear different than their usual hues.

The tree trunk **looks brown**, but under a night-time light. It's **actually a grey with hints of purple**.



If you de-saturate colours, you can easily fool people's eyes and mimic colours under a different light! That's why greys can easily blend in.

Use greys to substitute colours.

Picking colours I

Guest writer: Cocefi



Black tones

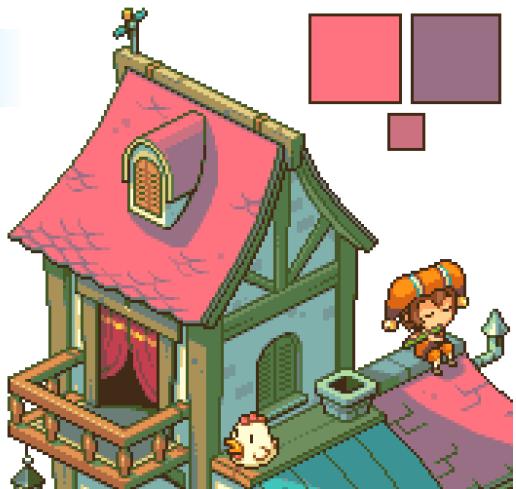
Try avoiding pure blacks unless it's truly necessary. You can use dark brown, deep purple, dark green or even dark grey instead!



Shadows

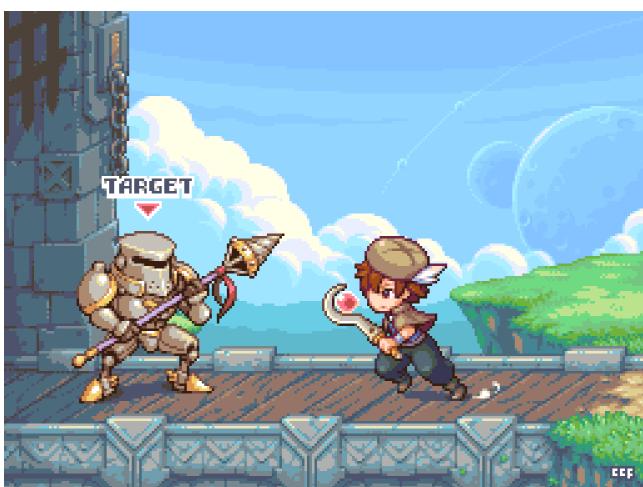
Give shadows a colour tint too. Whenever possible, compliment the shadow colour with the highlight.

The soft pink roof has a dull purple shadow. Cocefi's highlights tend to have bright saturated colours. His shadows are a little bit desaturated and hue shift.



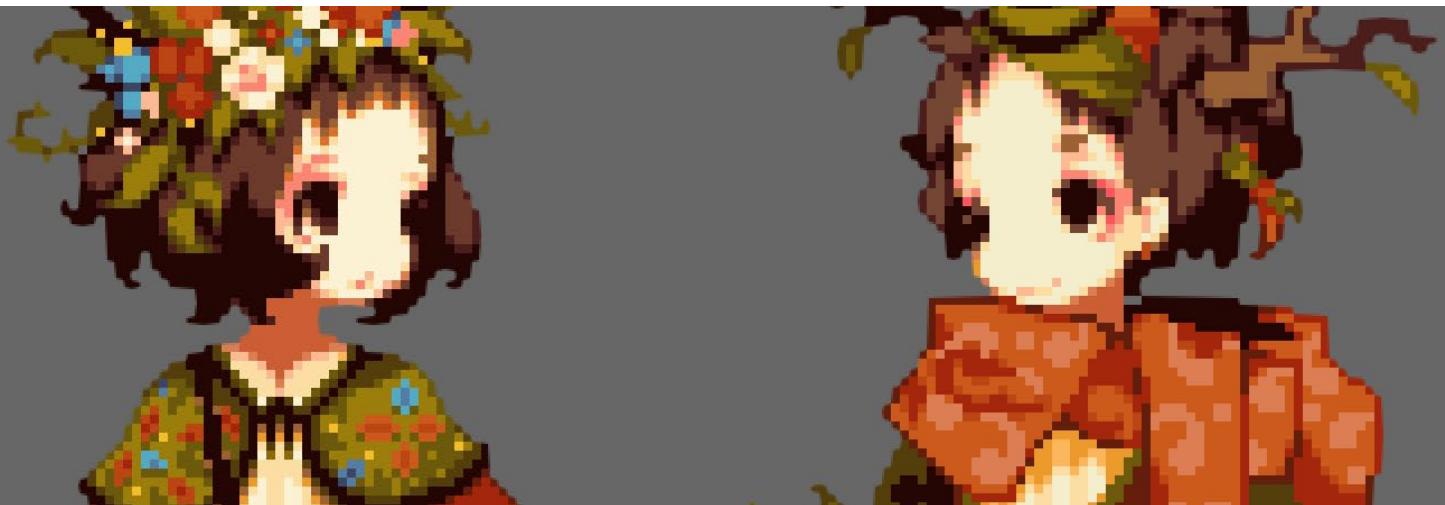
Experimenting

Don't be afraid to try weird colour combinations. There's a lot of Trial & Error involved. Make sure to fiddle around with the Hue/Saturation sliders, not just brightness for shading.



Picking colours II

Guest writer: Syosa (しよさ)

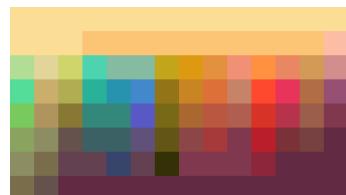


My favourite colour is a dark purple (R,G,B)=(84,58,84).

I can make so **many colour ramps** and gradients **from one single colour**.

Reusing the same shadow colours makes pixel art looks more beautiful, I think.

When making colour ramps by the colour system (red, yellow, green...). I put **dark colours and light colours together as much as possible**. This is because it is easier to get an overall harmonised hue.



The **amount of colours** on your colour ramps **depends on the size** of your pixel art.

For small sprites, one ramp of 2-3 colours is enough, even if you have lots of different colours. You can't tell the difference between 2 similar colours at that size. It doesn't have any impact.



Changing colours during progress

I change colours constantly. Take some time to look back. Look at pixel art by others then look at your own picture again. If I still feel uneasy after looking back over the colours, I change them all one-by-one.



Colour correction

This really depends on what the pixel art will be used for.

For prints and crafts

Colours can be severely restricted, so fix it accordingly.

Syosa is referring here to the CYMK print limitation that comes with printing digital work. Colours will change in according to this palette, so be wary when using RGB for print.

For web use

I embed the image in a **sRGB** ICC profile which allows me to see and deal with the effects of colour-change within browser.

For games

Sometimes the colours do not match with those of other images, so even when the colouring of the image is fine in itself, I sometimes still end up adjusting it.

Syosa's advice was translated from his native language: Japanese.

Translation: Alexander Hicks

Picking colours III

Guest writer: Jinn



Colours and mood

While body language and facial expression can set the mood, painting with warmer or colder colours can increase the mood! Greys tend to be neutral colours.



Using **blues, purples and teals** can give you the impression of a **colder/sadder emotion**, while **reds, oranges and yellows** can give a **warmer/happier emotion!**

Don't be afraid to play with your colour ramps!

Diversifying your colours will make your work more interesting to look at. It will break the monochromatic look. You can achieve this by using different hues in the same ramp.



Just make sure the colours will still blend well together. Experimentation is the key!

Contrast

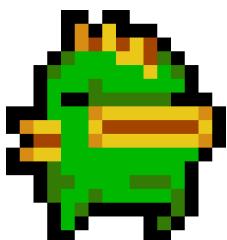
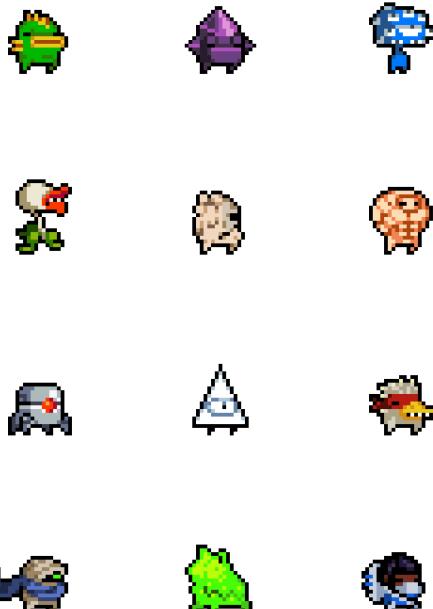
Guest writer: Paul Veer



Readability is the #1 priority when choosing colours. I like to choose colours that **add a lot of contrast to sprites**. I always try to have **1 main colour** for each character I design. This colour either :

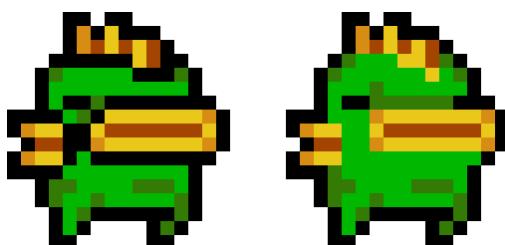
- makes up most of the character
- or highlights the most important features

I then use **a sub colour** to add extra features; usually a colour that contrasts a lot with the main colour. Contrast can be used to **make a character stand out from the background**. This is specifically aimed towards games. This isn't an issue with a static illustration, though.



Fish is **mostly green**. I use a **yellow to highlight** his mouth and fins to emphasize his fish-like appearance. The brighter yellow contrasts well with the green.

If a **black outline defined those details, the sprite would be muddy and less readable. A precious waste of pixels and space!**

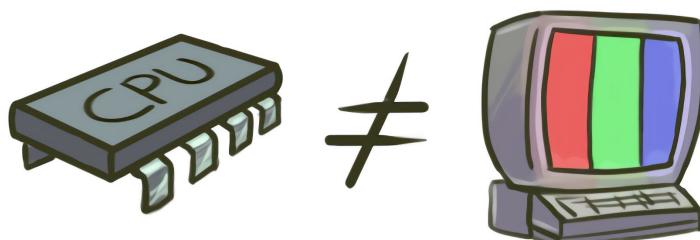


Paul introduced a very important concept: **Readability**, which will be the subject of [Chapter 4](#).

Different limitations

Pixel art is born from limitations and colours can be affected by these limits. Today, there are almost no restrictions, but artists still like to challenge themselves! Sometimes it can create beautiful effects.

However, when the general public talks about "bit"-graphics,
they confuse the console's processing power with the colour display.



Consoles with the same microprocessor power don't have the same colour rules.

This confusion lead popular culture to refer to graphics from consoles before 1990 as **8-bit**, and **16-bit** for graphics after 1990 .

Most people see the lack of colours, but they aren't aware of the exact rules and limitations.

Look up the limitations of each console, or computer for more info. You'll be surprised!

Even as of 2015, modern day **.GIF** image files still have a colour limitation of 256 colours.

The format last updated in 1989 and is still 8 bits per pixel. 1 bit allows for 2 colours. In math, $256 = 2$ to the power of 8 ($=2^8$).

Double Dragon looks different on each 8-bit console



NES



Commodore64



Sega Master System



ZX Spectrum

Sprites with limited colours

Note: You don't have to limit your colours. It's a personal choice.

This section is for people who want to replicate old video games, hacking a 2D video game or like to have fun with limitations. 1 colour you should always include in the total colour count is transparency. For the sake of convenience, I will exclude transparency from the examples below.



**My sprite originally had 25 colours
(24 + transparency).**

There is 1 colour ramp for every main colour.
Yellow – Skin tone – Brown – Teal – Green – Grey



Reduced the colours from 24 to 20.

- Replaced the greys with the skin tones.
- The white shirt uses the skin tone. Not bad.
- Removed the darkest teal. It was barely visible.



**15 colours. This is the final version I decided to use.
16 colours is usually the limit for most sprites.**

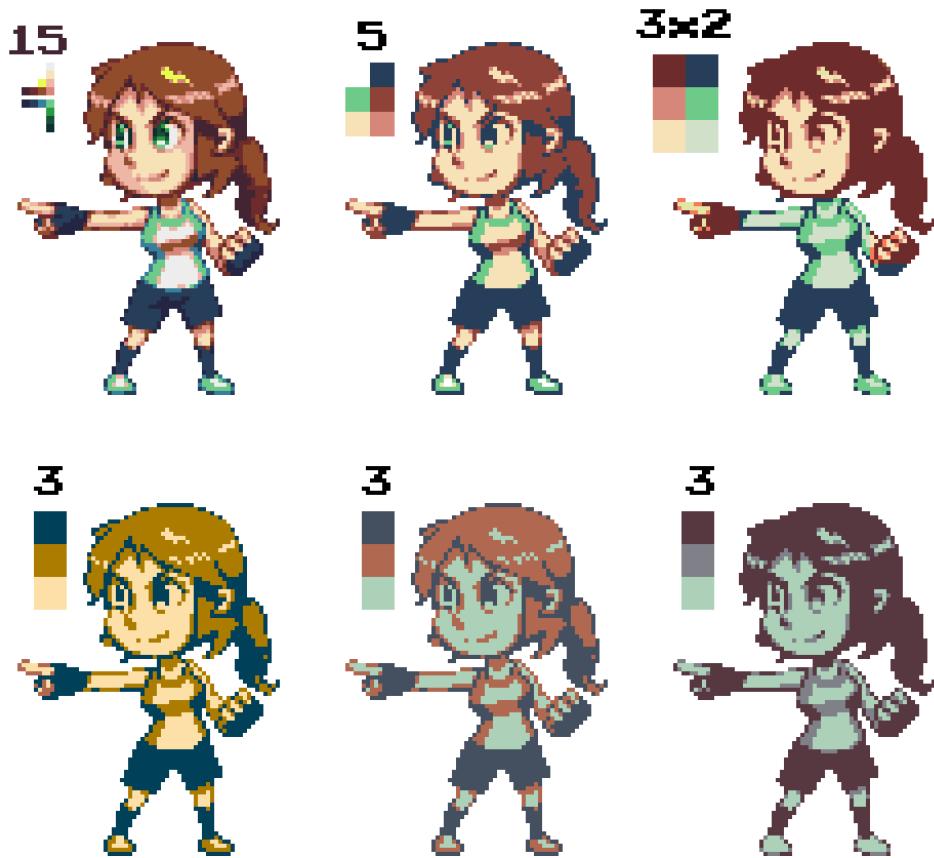
- Fused the skin tones with the brown hair.
- Green and teal now share the same highlight.
- Removed the orange AA: it was barely visible.



**10 colours. The sprite is still intact.
It doesn't look weirdyet.**

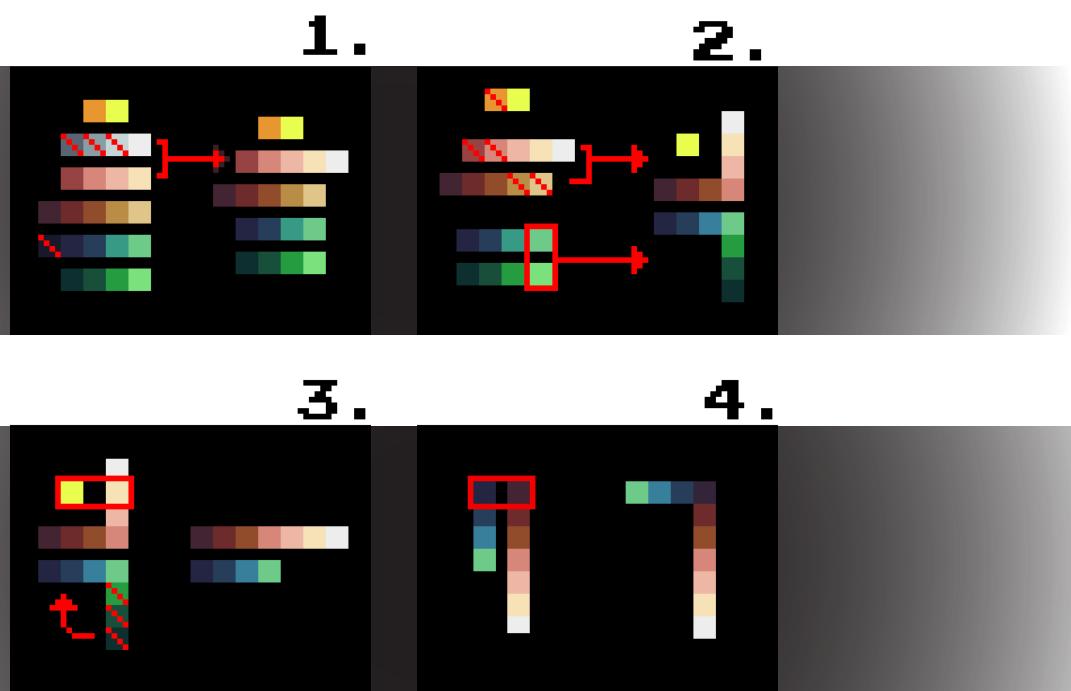
- Swapped the yellow out for a skin tone.
- Recoloured the greens with the teal ramp.
- Fused the darkest shades with each other

Beyond 10 colours this particular sprite loses its quality, colours and detail.



However, each sprite is different. There is no “one rule fits all” with colours.

Step by step summary



Scenes with limited colours

Guest writer: Jinn



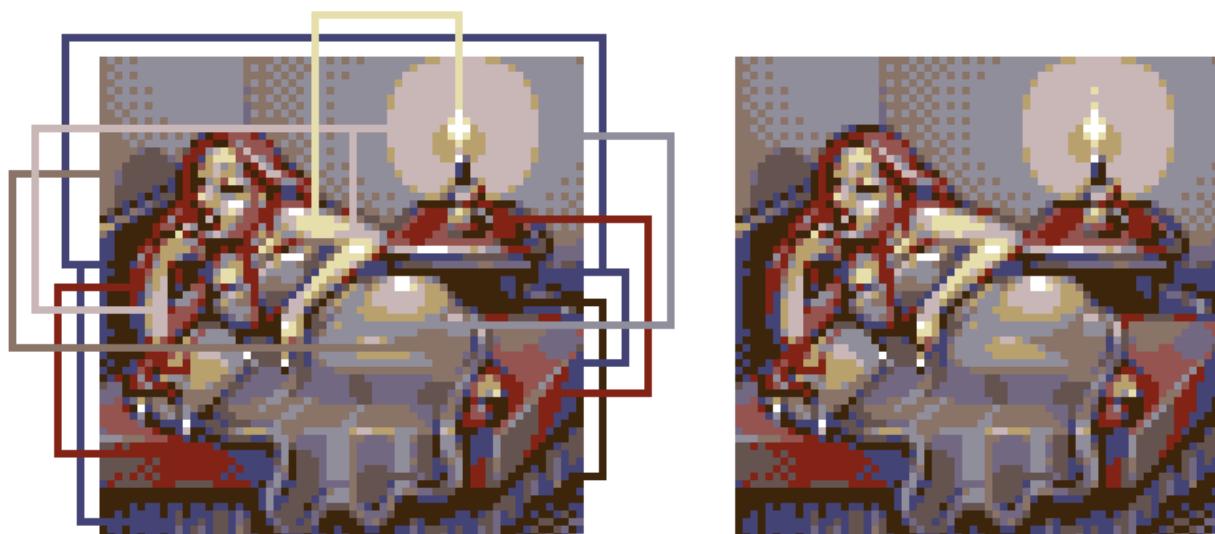
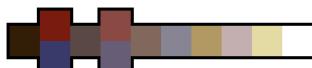
Re-use your colours to keep your palette small.

Colours can be re-used in the same piece without losing its value. You can place colours together that would otherwise belong to different ramps!

The **reds** on the **hair** = the **bed** and the **night stand**.

The **dark skin tones** = the **bedsheets**, the **pillow** and the **wall**.

The **light skin tones** = the **candle**.



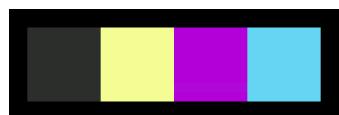
The key is to diversify your colours as much as possible. **Having different objects with the same colour touching directly will make them blend**. The sheets and bed have different colours, so they don't blend, while skin tone and sheets are the same colour, so they feel like a whole. The hair is purposefully red to separate the girl from the wall.

Extreme limitation

Guest writer: Cocefi

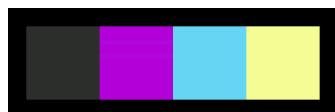


Sometimes for some extreme reason, we have to work with a severely limited ugly palette.



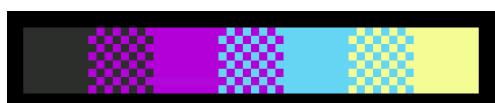
EWWW!

Luckily, we can make it more intuitive to use by rearranging the colours by how we perceive the colours in terms of luminosity. Some colours in the rainbow “feel” darker and lighter.



Groovy~

Guess you could call it *Xtreme* Hue-shifting. You can extend the palette further with **dithering** too. But be warned: excessive dithering can make a surface look textured or rough.



Conclusion

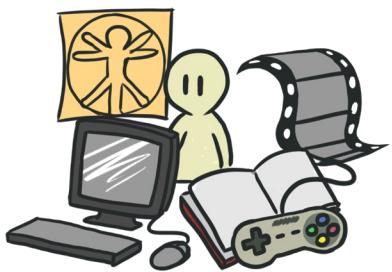
Colour is all about context. It doesn't just create the mood or atmosphere of your pixel art, it also defines the style. Colours can easily fool the eye, and with some practice, you'll be able to use them to your advantage.



Pokémon Heart Gold/Soul Silver (2009, DS)

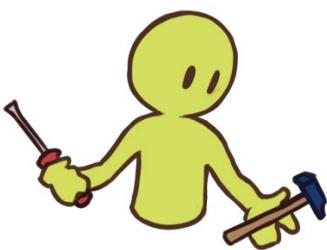
Colouring doesn't stop at this chapter. Many other aspects use colours to their advantage to get the most out of pixel art. Just make sure to refresh your colour theory and remember:

Experiment!



Food for thought

- Introduction
- How to pick colours
- Why make palettes?
- Colour ramps



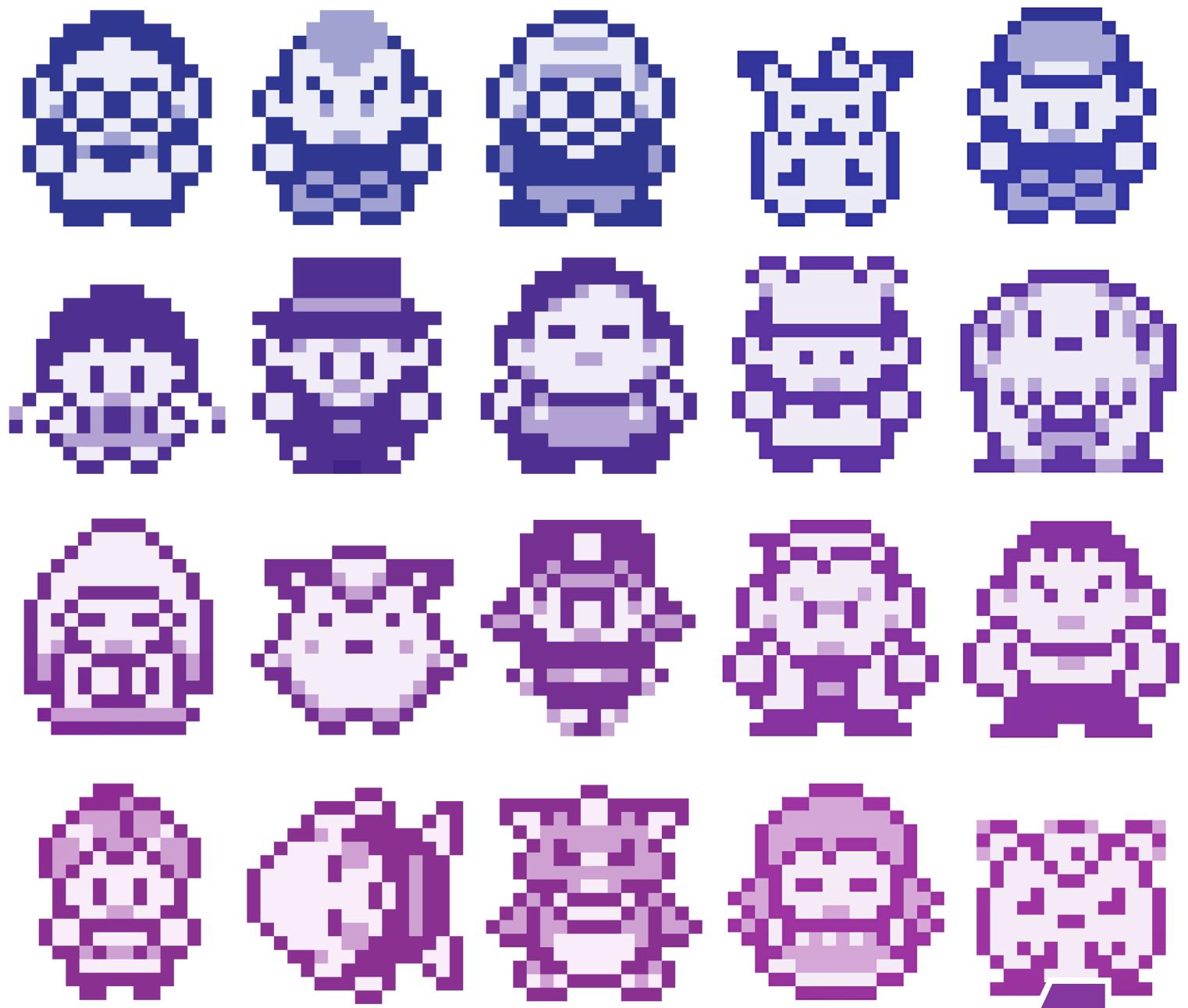
Practice

- Hue shifting
- Black tones
- Greys
- Choosing colours I-III
- Contrast



Limitations (optional)

- Different limitations
- Sprites
- Scenes
- Extreme limitation



Chapter

Readability

4

Introduction

Ever looked at a sprite and wondered:



"What is this supposed to be?"

It's easy to misinterpret small sprites because they lack detail.

The Legend of Zelda: a Link to the Past had some muddy sprites.

Agahnim's sprite is an infamous example of misinterpretation.



So is he wearing a hat or is it a face?



Readability means Clarity.

How easy is it for the viewer to understand what you drew?

How well does your pixel art convey what you're TRYING to tell your audience?

How well does your sprite read?

Size matters...



Is Mario smiling or shocked when you lose a life in Mario 3?
At 16x16 pixels, it's hard to tell he's shocked with his moustache.
It's easier to tell on a bigger canvas, though.

SMALLER sprites make it **HARDER** to convey things.

Super Mario Bros (NES)	Super Mario Bros 3 (NES)	Super Mario Bros 2 (NES)	Super Mario World (SNES)	Super Mario Land (GB)	Super Mario Land 2 (GB)



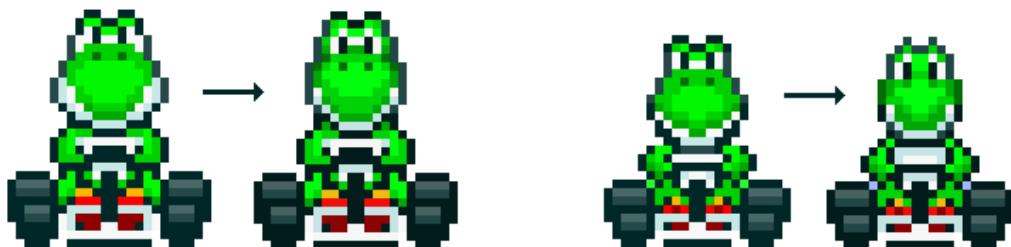
Big sprites need clean lines and solid drawings.
Small sprites need recognizable features for readability.
You can't squeeze details into tiny sprites, so make sure to adapt
character designs. The size of your sprite and canvas will
determine what your focus should be.

Guest artist: Syosa

...but pixels matter more!

Bigger sprites have few readability issues. Smaller sprites tend to be a bit trickier to interpret.

Makes sense right? But it's not that simple.



Super Mario Kart (SNES) had improved Yoshi sprites for the Japanese version. When he shrinks on screen, he gets less READABLE. Does he still look like Yoshi?

A screenshot from the Mario Kart 64 character selection screen. The screen is split into two main sections: 'INT' (International) on the top left and 'JP' (Japanese) on the bottom left. Each section contains a row of Yoshi characters in their kart forms. The 'INT' section has 8 karts, and the 'JP' section has 9 karts. The karts are arranged in a grid-like pattern, with the last few karts being smaller versions of the character.



**Even within the same canvas,
your sprites can **ALWAYS** be improved.**



Guest artist: Neorice/ Guido Bos (@Neoriceisgood)

Case Study: Cryamore



One of the most important decisions in the pre-development of Cryamore was the sprite size.



Original sprite model ~190px tall

PROS: Clean and detailed at high res.

More room to animate.

CONS: Time and effort for animation.



70% of her original model ~130 px tall

PROS: Moderate high res quality.

Frames are finished sooner.

Simplified facial expressions.

CONS: More readability issues, less HD.

Less detail for complex character design.



We were kinda setting the bar extremely high when it comes to ultra-high res HD sprites. [...] Frankly, it would've made no difference to just hand draw it at that point. Of course, we could just keep the HD sprites and reduce the frame count, but that would make things look ten times cheaper, [...] So, we sat back and took a constructive approach at the way we were doing things, detached from the emotional appeal of how much we were in love with this look.

Cryamore Dev-Blog (2015)

The smaller the sprite animation, the smoother the illusion of movement is. Just by the size being cut down, animations will look even more fluid. Smaller sprites also allow you swap costumes more easily!



[Persona 4 Arena \(Arcade/PS3/xb360\)](#)



[Cryamore](#)

[Tales of Destiny: Director's Cut \(PS2\)](#)

[Nameco x Capcom \(PS2\)](#)

[Disgaea 1 \(PS2\)](#)

[La Pucelle: Tactics \(PS2\)](#)

The line between binary art and pixel art starts to blur when sprites get too big. Games like *Persona 4 Arena* (PS3) and *Dengeki Bunko Fighting Climax* (PS3) are borderline binary art.



Pixel-Logic Bonus

**It's normal to edit a sprite over and over
Make multiple versions and have people
pick, if you can't make up your mind!**



This sprite from *Pokémon Red/Blue* (Game Boy) is meant to be a boy playing his Game Boy. The sprite is inside a 16x16 canvas. **However many people see this as a boy holding a cup.** Most of this object looks white. It has 2 black pixels and 2 grey ones to show the shadow of the rim.

Let's move the pixels around and see if we can fix it.



If we change the sprite drastically, we risk creating **new readability problems**. Right now it looks like the Game boy became his shirt, and his torso.



We can extend the cup and move it up covering the face even more, but **this could easily look like a beard or a flute**. It's too muddy.



We now have a flat grey shape with a white line of 4 px wide. **The white highlight makes the object more 3D**. But it still looks like a random box.



By simply adding a 2px line to define the Game boy's cartridge slot, it works! **This looks more like a kid holding a Game boy!**



**For small sprites, simplicity usually works.
Don't overdo details and stick to simple shapes.**

Why every pixel matters I

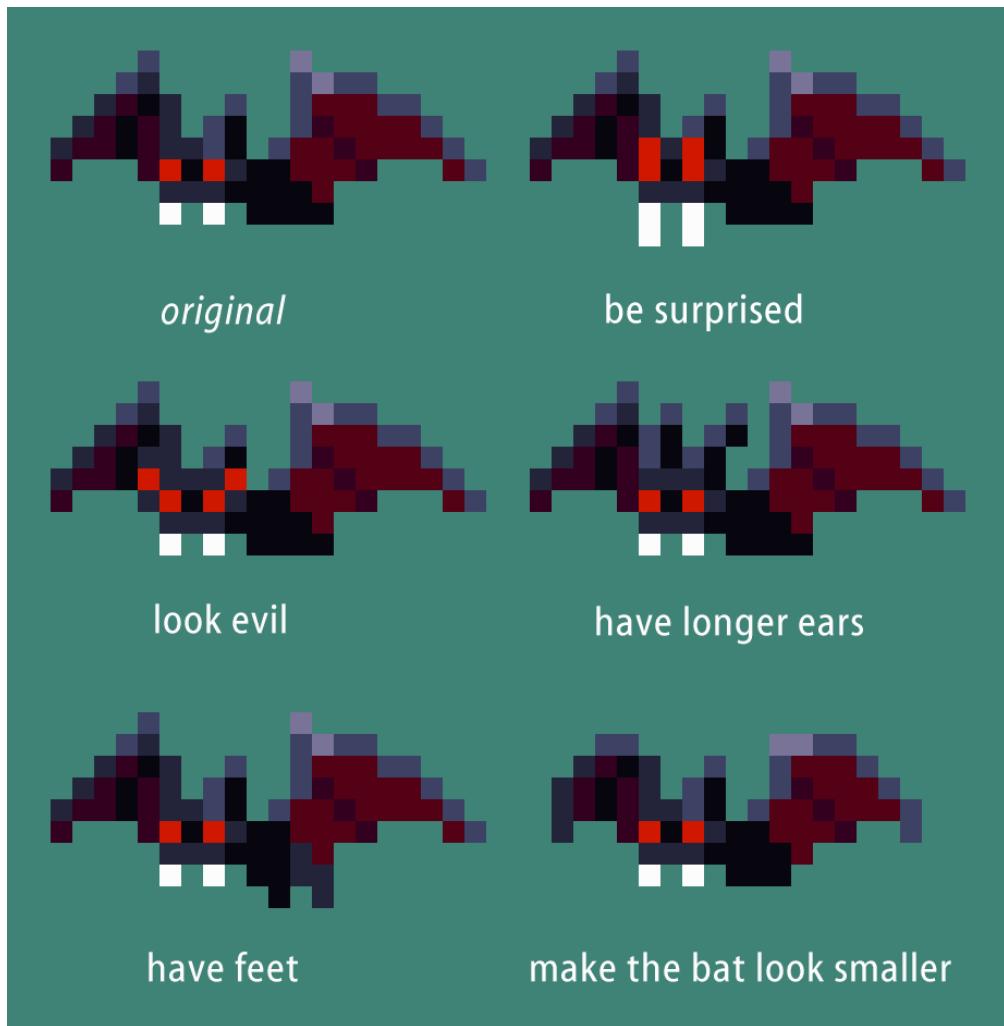
Guest writer: Glauber Kotaki



Very small resolutions can easily get problematic as every pixel, **including its colour**, makes a big difference in the whole piece. That's why **pixel placement plays an important role** so your viewers can understand your work.

One pixel might just change how people interpret it!

Changing just a few pixels can make this bat:



Why every pixel matters II

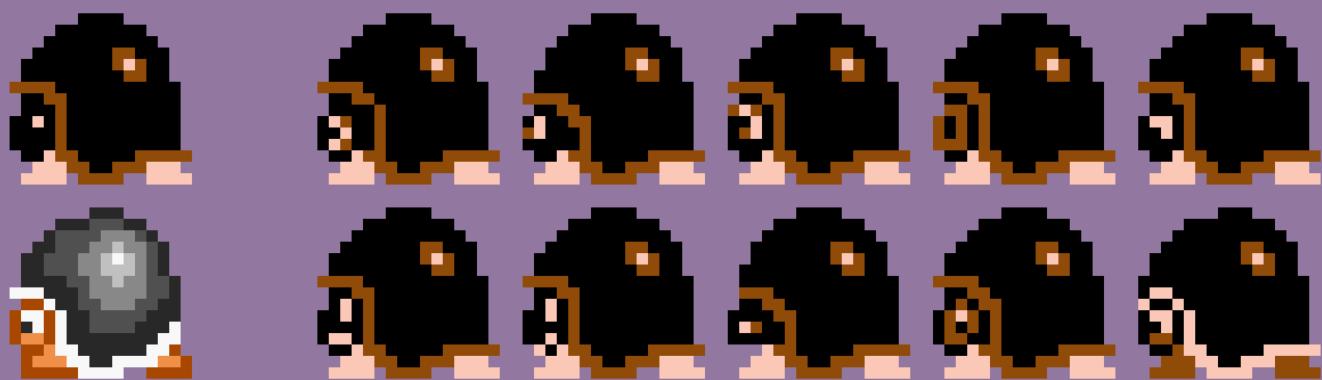
Older video-game graphics may look small, but the placement of each pixel is not trivial!

A tiny area like 6 by 6 pixels can offer you a large amount of variety!



Characters from Technōs' Crash 'n' the boys & River City Ransom (NES/Famicom)

The **Kunio-kun series** made each character look different by slightly adjusting pixels of only their eyes and hairstyles! Those 2 elements were enough to show diversity.



Buzzy beetle from Super Mario Brothers (1985, NES)

Even the smallest pixel can make a difference for low-res graphics. The **buzzy beetles from SMB** somewhat resembled shells with a big black pearl-like eye.



In the *Super Mario All-Stars* remake,
Buzzy beetles look more like the official concept art.

Recognizable features

Guest writer: Ellian



So you need to create a new sprite. What size does it need to be? Ask yourself a few questions:

Do I need to see their hands moving?

Do their mouths need to be visible or animated?

Must facial expression be readable?

Do they wear or hold an item?

Does the sword have a magical gem in it?

etc.



No matter how big or small the item is, on a small pixel canvas it needs to be recognizable!



The smallest part I want here is facial expressions. I don't care about hands or other body parts.

Try to figure out **the smallest part that needs to be visible**.

Once you've got that down, it's easy to figure out the **minimal** sprite size you can work with.

Don't focus on getting every detail into your sprite . Find out what makes the character unique and represent the concept the best. You'll often hear "**less is more**", and it tends to be true.

If you have the slightest doubt about your sprite being readable or not, **ask someone else**, and don't tell them what it's supposed to be! Even better, ask someone with little to no pixel art knowledge.

Easy to read symbols

A few pixels in height can make a **BIG** difference.



By Michafrar

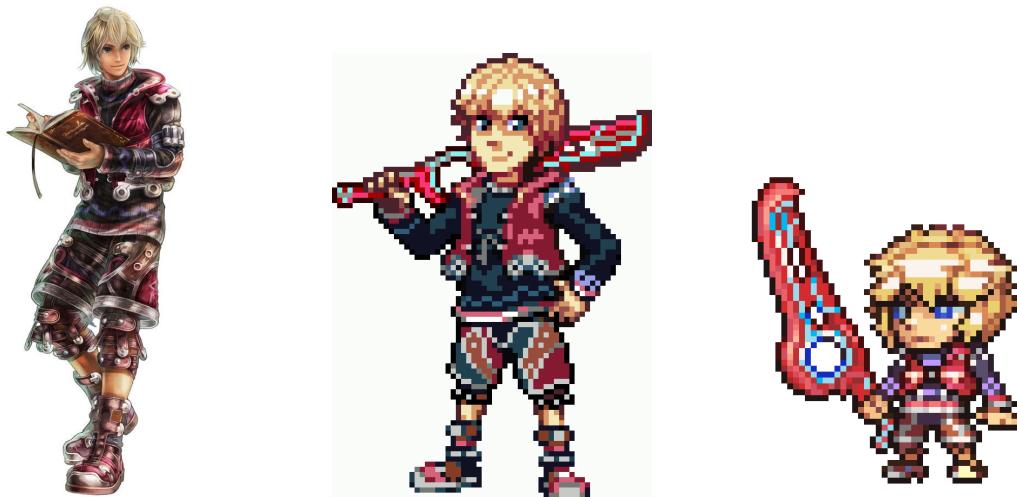
With less space, there is little room for many facial features or hands.

You still can add them, but they will make your work busy and muddy.

If you're using concept art, photo references or any sort of guiding,
be ready to sacrifice unimportant details if necessary.

Working in bigger resolutions seems easier, but anything is possible in smaller resolutions.

Choose what is essential, and don't worry if you can't fit in the details.



Original art by
Monolith Soft

fanart by
Michafrar

fanart by guest
artist Neorice

Symbols I - Hands

The next few pages will discuss **hands** and **eyes**. We'll tackle more in future chapters.

They are the trickiest to pixel at this size. You won't have enough space to pixel every finger!

1. Start hands by painting shapes. Line art is too hard to draw.



You have barely any space for line art! Drawing lines will confuse you even more.

Use flat shapes, then detail. Easy! It will help you picture the hands in 3D in your head.

2. Draw hands like mittens - then - add detail.



There is no point highlighting every single finger. You won't have the space to.

Focus on basic shapes. Even when you have fingers spread out, start with mittens.

3. Focus on the index finger and thumb. They define the hands.



An opposable thumb and an index finger define the human hand.

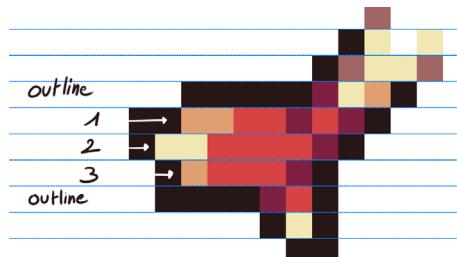
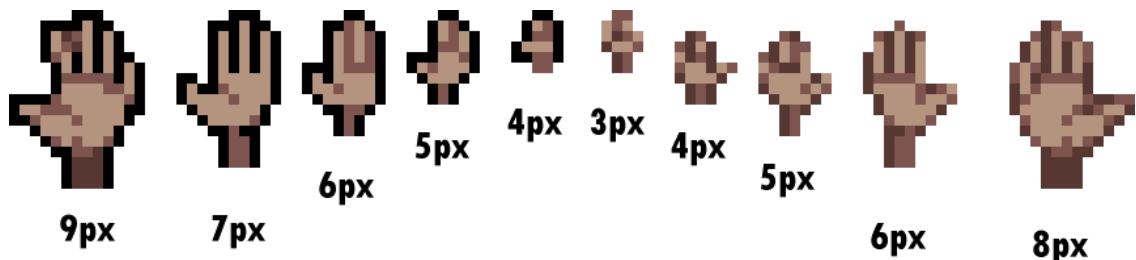
Those two fingers are enough to show gripping, pinching, pointing, and much more.

4. Draw only 3 fingers and a thumb if needed.



Cartoons sometimes draw 4 fingers to simplify animation. Pixel art too.
Only draw 5 fingers if you have enough space.

5. Use different colours to separate each finger.



You won't always have room to have all 5 fingers or draw an outline. Hands will stand out when you use different shades and colours. To tell where each finger is, you will have to play around with colour brightness. **Highlights and shadows help bring volume** to your otherwise flat hands!

6. Draw the hand, shrink it and use it as reference.



Working at small scale can be tricky because you can't "draw" spontaneously. If you're really having trouble or work under a deadline, draw the hand in your regular painting program and shrink it. Then use it as a reference. You can also study the **anti-aliasing** to help you out a bit.

Symbols II - Eyes

1.

Eyes are the main focus on character sprites.



Human beings are captivated by emotions and faces. For this reason alone, you should polish your character sprites, may it be animals or humanoids. People identify faces by looking for eyes. **They are generally the first thing people notice.**

Guest artist: Temmie Chang

2.

Sometimes there is no space for eyes!



Beyond Oasis (Genesis/Megadrive)

Sprites that don't have enough space for any facial features usually don't include eyes, as those would be smaller than 1 px. If so, **focus on the shadows cast on the face to create the eye area.** If you are unsure, look up some references of games.

3.

Glasses: keep it simple!



Ace Attorney Investigations: Miles Edgeworth (NDS)



Tales of the World: Narikiri Dungeon 3

You might have to sacrifice detail depending on sprite size. You either focus on

The glasses themselves
The top of the frame

and
and

exclude the eyes. OR
exclude the bottom side of the frame.

4. A few pixels make a big difference when zoomed out.



Guest artist: Anubis Jr

It's hard to tell at first glance, but a few pixels difference can have many outcomes. When zoomed in, some pixel placement may not make ANY sense to you. It may feel unnatural if you're used to brush strokes. When zoomed out, some pixel combinations may give eyes a completely different feel! **A-A and sub-pixeling really come in handy here!**

A white shine can also affect the outcome! Sometimes it's a single pixel, sometimes it's AA or sub-pixels.



By Michafrar

5. Eyes come in many styles, but don't avoid pixel detail.



Shock Troopers: 2nd Squad (Arcade)

Eyes usually define your style. **With pixels you can do whatever you want in term of eyes.** There are no limitations besides your canvas. You can further develop your style, but just like regular art, make sure to polish your technique.

6. Use **subtle** Anti-aliasing if needed.



Guest artist: Thernz

As seen in **Chapter 2**, AA can improve clarity. It has nice results!

Character design & Proportions

Head vs. Body



Super Back to the Future 2 (SNES, 1993, Japan exclusive)

Big heads have many advantages. They **give room for emotions and expressions** and clearly show who the character is. It's a stylistic choice so it may not be suited for every situation. **Heads are the main reference for human proportion and they easily vary!**



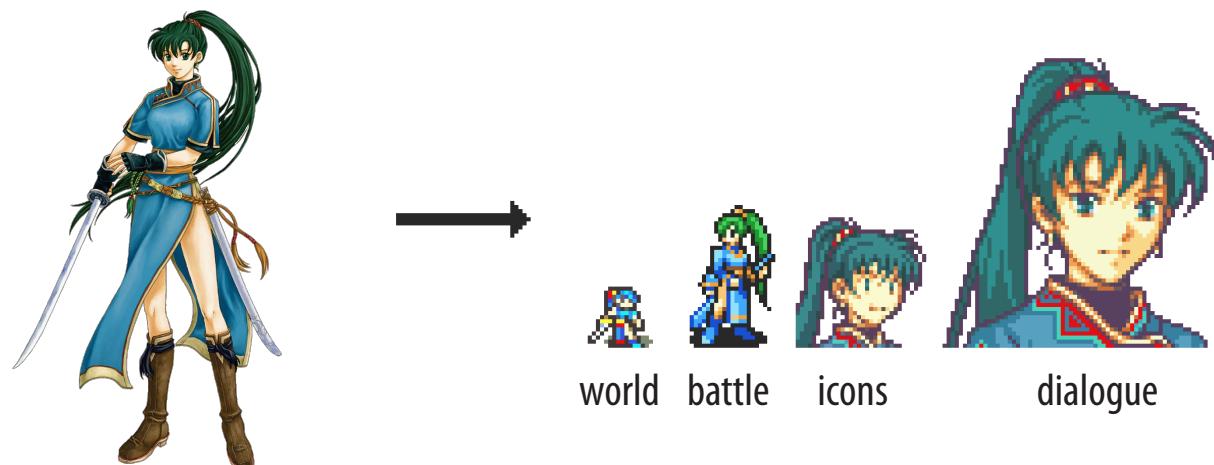
Castlevania: Aria of Sorrow (GBA), Castlevania: Dawn of Sorrow (NDS)

You may depict characters with **realistic proportions**. These sprites **focus on body language** instead. As a result, you should pay attention to volume, shading and anatomy within these restricted areas. Make sure to use silhouettes. Your characters have personality and act differently.

Give bodies personality by diversifying poses and body proportions.

Different proportions have different functions.

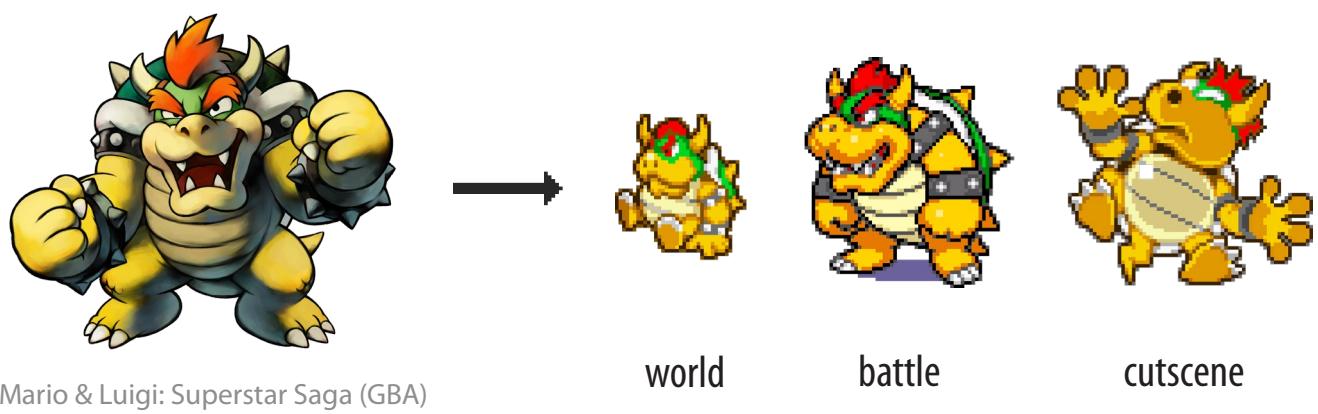
The proportions you choose depend mostly on what your sprite is used for. General artwork, user interface, icons, overworld sprites, dialogue sprites, different perspectives: you name it!



Lyn - Fire Emblem (GBA)



Riou - Suikoden II (PS1)

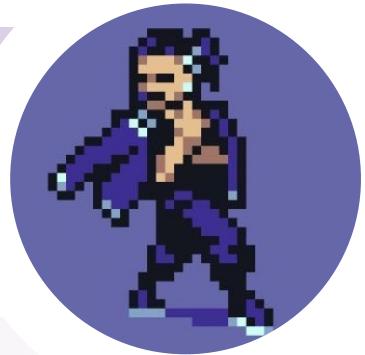


Mario & Luigi: Superstar Saga (GBA)

Pixelart finds a way to adapt all character designs to fit small areas.

Silhouettes

Additional writer: Glauber Kotaki



A clear silhouette shows important features like head, limbs, cloth, etc.

Anything that highlights the character's actions or functions is a good start.

This is also very useful if you're going to further animate it.



Streets of Rage 2



Streets of Rage 3

Streets of Rage - like most series do - would improve their sprites over time. The silhouette of the character *Signal* is better in the 3rd instalment as his stance, fist and hairstyle stand out.



Duelyst (PC)

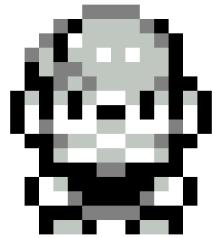
The silhouette shows little information, but it became **readable by using different colours in all sort of ways within the drawing.**

Drawing a rough silhouette and filling it up with details is a good practice. **Try not to overlay things. If that happens, use colour contrast to tell features apart.**



Chasm (PC, PS4)

Colour design



Additional writing: Paul Veer

Giving your characters a **main and secondary colour**, gives you nice side effects. Their design becomes more recognizable and more readable. Don't include unnecessary details on your sprites. **Break them down to 2 or 3 main colours like other recognizable characters.**



Nuclear Throne (PC, Steam)

Fish?

That's the **green** guy with the **yellow** lips and fins!

Rebel?

She wears a large **blue** scarf.

Robot?

He's defined by his **red** scary and ominous eye, separating top and bottom.

Well-known characters seen in many games have designs with vibrant colours.

Super
Mario



Sonic the
Hedgehog



Pikachu



Pick the right colours to represent your characters features. Wrong colours lead to confusion.



Nose or beak?

Swoopers from *Super Mario World* (SNES) are bats. However their nose was coloured orange, which makes it look like a bird with a beak. Later games fixed this problem.



Why were Yoshi's arms orange?

This isn't due graphical limitations. Probably so that the arms wouldn't blend with the main body, but alas, they look like the stirrup of his saddle. *Super Mario Maker* (WiiU) fixed it. This issue is similar to Link's infamous pink hair from *Zelda: LTTP*.

Light & Shadow

Guest writer: Glauber Kotaki



Drawing outlines can take a lot of precious space, so playing with dark and light tones instead might do the trick.

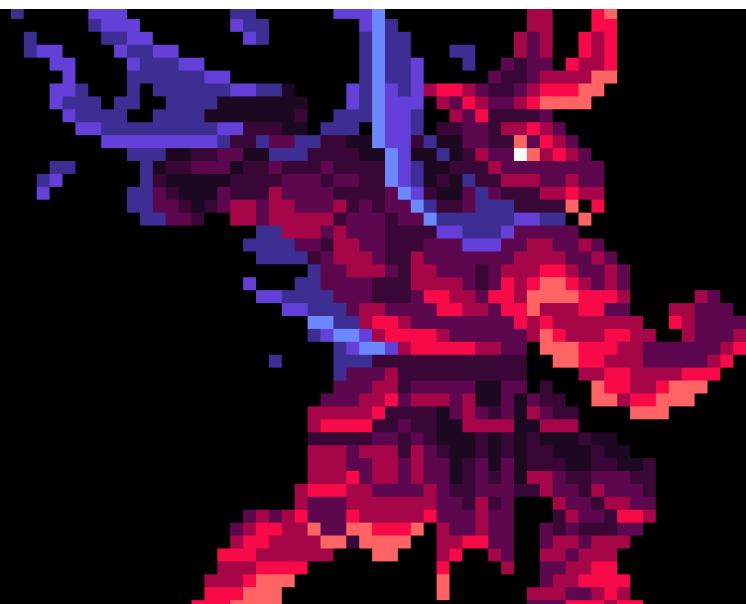
Light is used to **show important details**,
Dark pixels **fill the silhouette or they outline different features**.

Light and dark could change roles depending on your background colour or light source.
Use both together to form shape, volume and depth.



Chasm (PC & PS4)

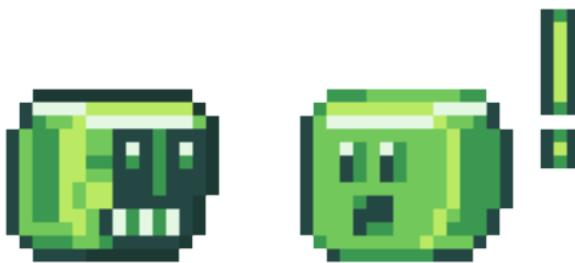
The darkest tones are used not only as shade, but to give depth and outline elements!
The brightest tones highlight edges and crucial details.



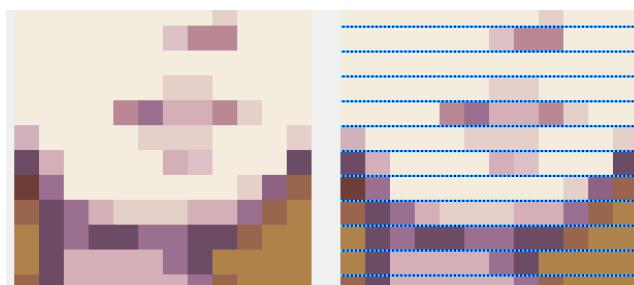
Using a different light source (e.g. in this example, from the bottom) to tell muscles and other body parts apart.

Duelyst (PC)

Spacing

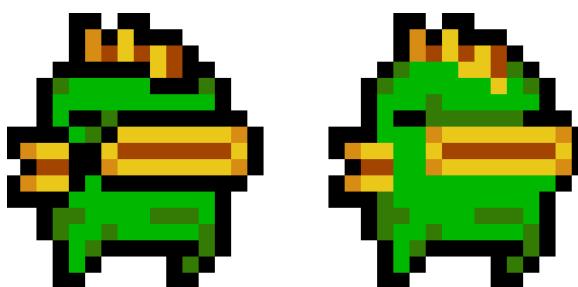


Spacing refers to **how far apart things are**. If two areas of the pixel drawing touch, the viewer may have a hard time telling what's going on. Spacing is using limited space to fit in as much information as possible. If you use up too much space in your sprite, **give it more room to breathe!**



Think of it like letter-spacing with fonts!

For example: a mouth needs space above and under it, so you can tell it's a mouth. If the mouth were to touch the chin, or even the nose, it would be unclear what it's meant to be.



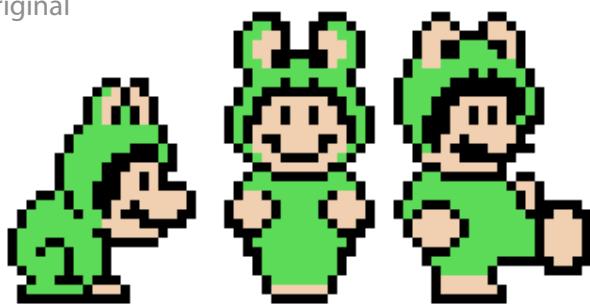
Nuclear Throne (PC, Steam)

One way is to get rid of in-lines.

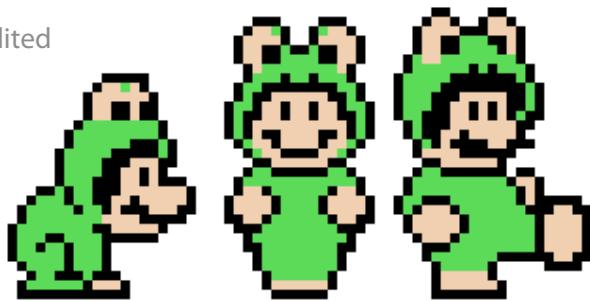
They can hinder readability as seen in [Chapter 1 \(page 9\)](#), [Chapter 3 \(page 79\)](#) and in this chapter on the previous page you just read! They're not bad per say, but can be annoying.

Another way is to re-arrange pixels.

Original



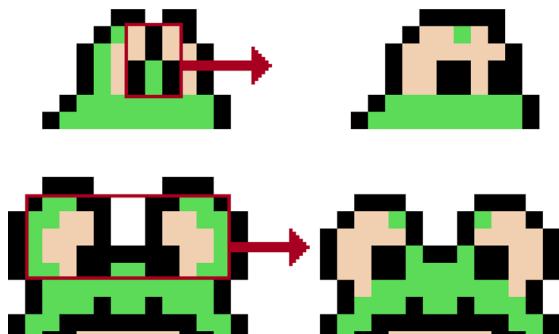
Edited



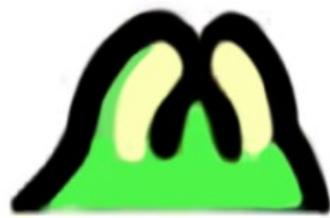
In *Super Mario Bros 3*, the frog suit is meant to have eyes on top of Mario or Luigi's head. The way pixels are spaced out makes it look like bunny ears instead! Except for one good frame: Mario kicking a shell is undoubtedly a frog head.

Let's use it as a reference to fix this.

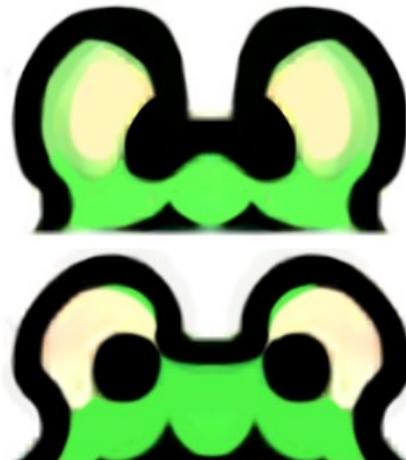
Not only did I remove the black inline, **I simplified the design**. The eyes are completely white with no eyelids. The pupils are now 2x2 pixels and don't blend in with the outline!



original



edited



Here is how we interpret the frog eyes if they were in HD

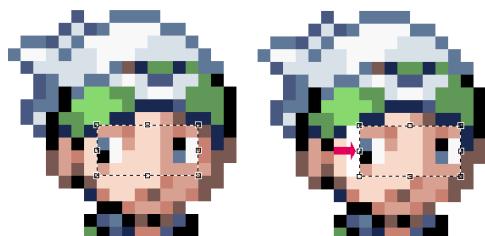
Moving areas and adding more space



Before the remakes of *Pokémon Ruby/Sapphire/Emerald* (GBA), the character "Brendan" created some confusion: **Does he have white hair or a white hat?** The back pose doesn't help the problem: his hair is painted blue and blends with the headband!



If we use the space between the eye and the sideburns, we create a tangent!



We can create more space for the hair **by selecting a part of the face and move it to the right**. Now the hair has 2px of width, enough for it to stand out. Make sure to try multiple versions!



When we move the eyes, the face changes too much. None of these versions feel like the original.



We have to think of a different solution: moving the ear to the left. This way the eyes stay the way they are.

The palette doesn't allow for a dark brown. So to paint the hair we have to use the darkest skin tone and make the hair more noticeable.



Sprites on backgrounds

Sprites should always stand out from backgrounds for game play purposes.

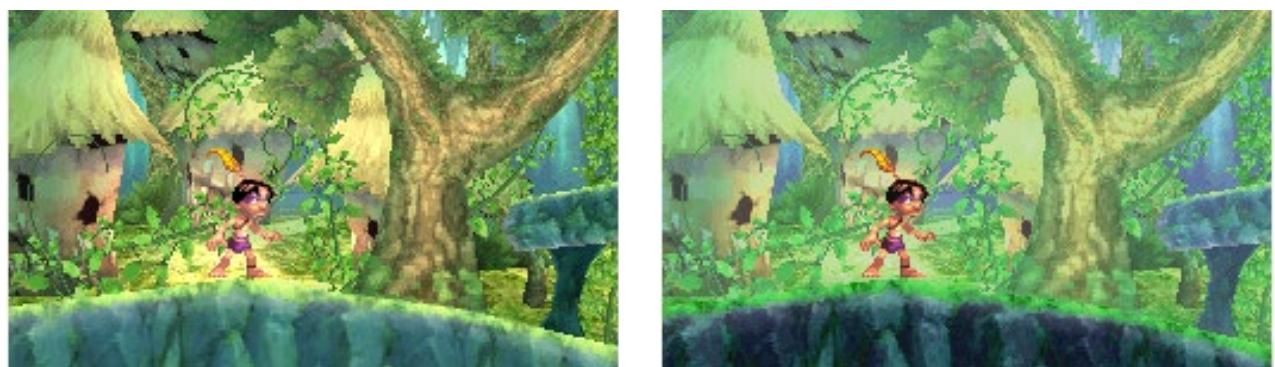
What do you want your audience to focus on?

If you are not making a game, **you still want to distinguish backgrounds from objects**. This happens in other mediums such as Photography. This is for Readability.

Adding Outlines



Correcting colours

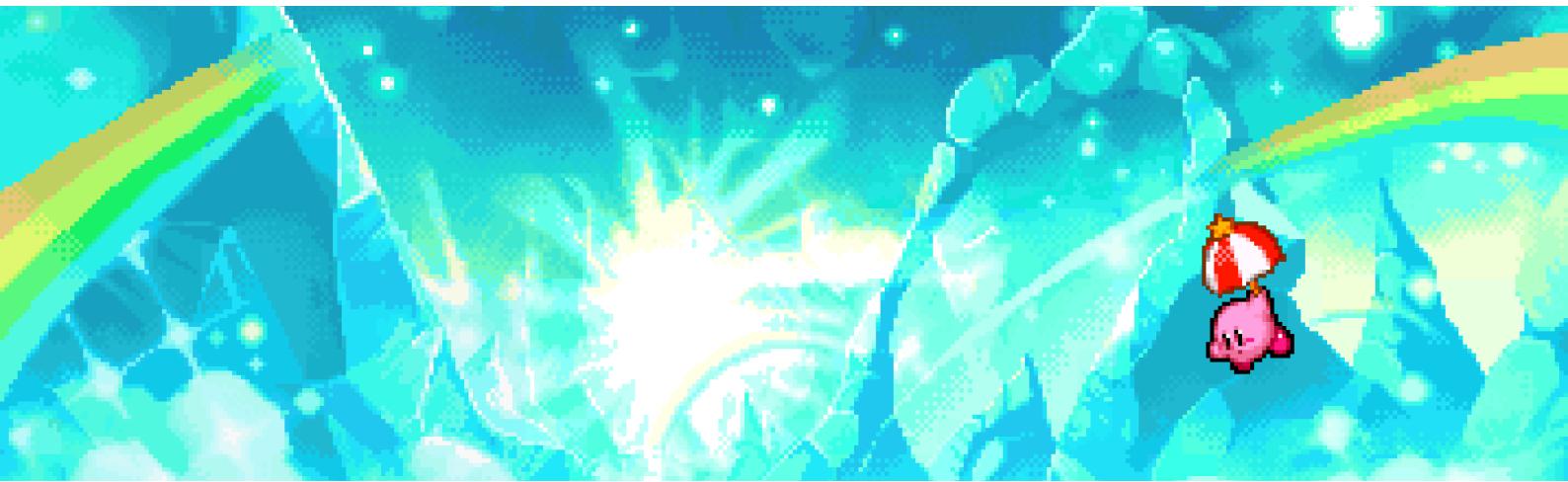


Focus (foreground is sharp/background is blurry)



Tak: Mojo Mistake (NDS)

Case Study: Kirby and the Amazing Mirror

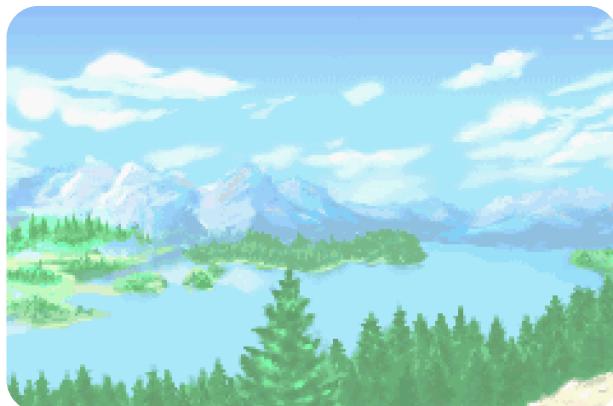


Kirby and the Amazing Mirror (GBA) made the decision to include highly detailed paintings as backgrounds. It's no surprise all 3 techniques were used:

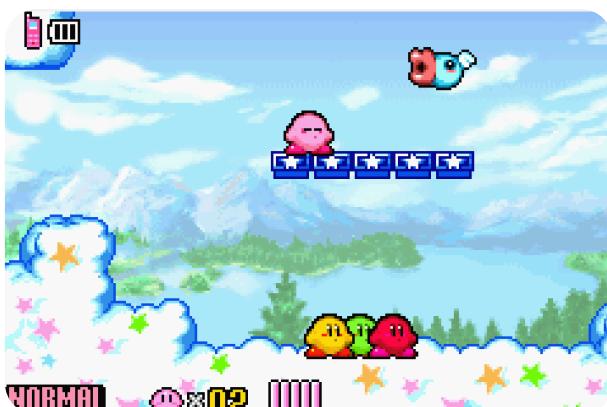
Objects and sprites have clear outlines to stand out.



The colours of the background are softer to compliment the foreground.



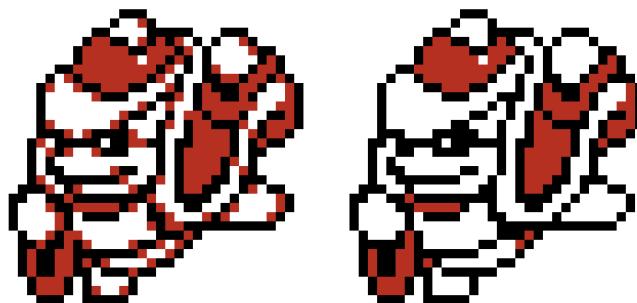
The background isn't in focus and appears more painterly.



Anti-aliasing & Dithering

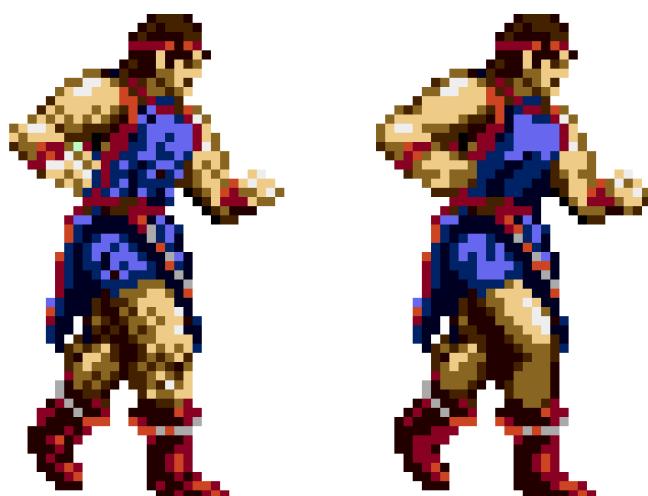
Sometimes advanced techniques such as AA and dithering might not get used, as they take up valuable space.

As seen in [Chapter 2](#), AA can slightly improve readability *when used moderately*.



From Kirby's Dream Land 2 (GB)

The original King Dedede sprite (left) has subtle AA to clean up the curves. The sprite on the right is just as good, but lacks colour and it's easy to misinterpret blobs of pixels.



From Jewel Master (Genesis)
Left: Original. Right: Edited.

Dithering (checkered shading) is pretty useless on small scale sprites. **Dithering works well on larger pixel art or textured surfaces**. It makes your sprite look rougher and less smooth.

This will be detailed in the chapter titled: "[Dithering](#)".
A less common technique nowadays, but useful for colour limitations.

How to spot readability issues

Use preview thumbnails.



By Michafrar

When working on a picture, make sure to zoom out a lot. To prevent this you can also just have a permanent preview of what your work looks like at its true resolution.
(1x- 100% size)

This example is within Graphics Gale.

Blurring the picture.



By Michafrar

Sprites will most likely look blurry on different devices, or even the human eye will blur pixels when viewed from far away. Blurring can also help you find banding.

If it looks bad when blurred, you have to go back and fix it in the pixel version.

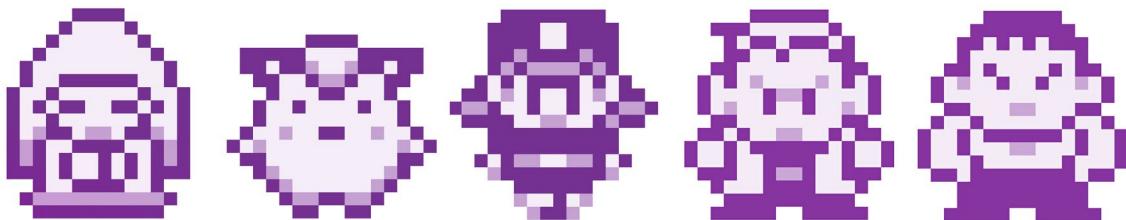
Waifu2x

The screenshot shows the Waifu2x web interface. At the top is the title "waifu2x". Below it is a URL input field with "en/ia/rn" and a file selection button. A note says "Single-Image Super-Resolution for anime/fan-art using Deep Convolutional Neural Networks". Underneath is an "Image" section with "URL:" and "FILE: Browse... No file selected.". A note specifies "Limits: Size: 3MB, Noise Reduction: 2560x2560px, Upscaling: 1280x1280px". At the bottom are "Noise Reduction (expect JPEG Artifact)" options with "Medium" checked. A note below says "When using 2x scaling, we never recommend to use high level of noise reduction, it almost always makes worse, it makes sense for only some rare cases when image had really bad quality from the beginning".

[Waifu2x](#) allows you to upscale any picture, not just pixel art. It upscales your work, reduces the noise level and carefully optimizing your work for higher resolutions.

When curves don't look right, you might want to go back and fix those jaggies! It's...also really cool.

Conclusion



Big or small, pixel art can occasionally create confusion. With limited space we sometimes have to have to sacrifice detail to keep things clear and readable.

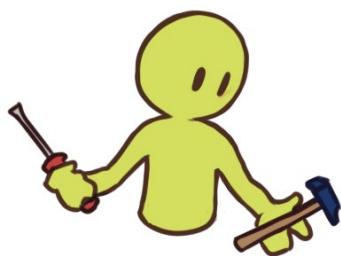
Remember that every single pixel matters.

If you're unsure of how readable your sprite is, **don't be afraid to go back and fix things!**
Working small is a challenge, but it will make you realise how important every pixel is.



Food for thought

- Introduction
- Size matters...
- ...but pixels matter more!
- Why every pixel matters I
- Why every pixel matters II
- Recognizable features



Tips and tricks

- Easy to read symbols
- Symbols I - Hands
- Symbols II - Eyes
- Spacing and tangents
- Anti-Aliasing & Dithering
- How to spot readability issues



Art design

- Ch. design & Proportion
- Silhouettes
- Colour design
- Light & Shadow
- Sprites and backgrounds



Pokémon Red/Blue/Green/Yellow (GBA)

The background of the image is a pixelated landscape. A large, bright orange sun is positioned in the upper left, casting a warm glow over the scene. In the distance, there are green and brown rolling hills. Closer to the viewer, there are dark purple, craggy mountain peaks. The overall aesthetic is reminiscent of early computer graphics or video games.

Chapter

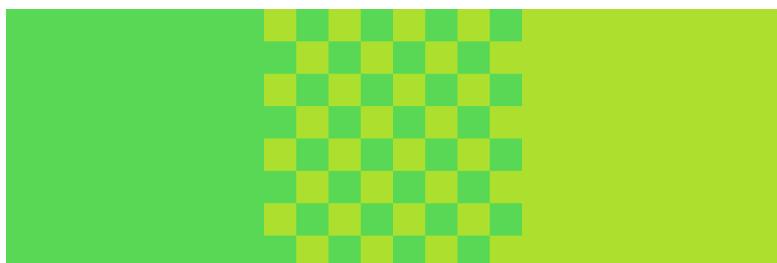
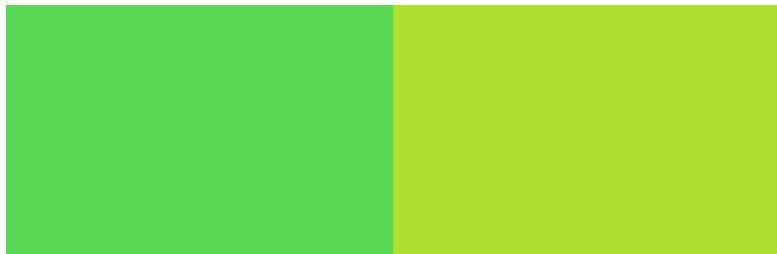
Dithering

5

Introduction

Dithering is a technique where you make **gradients using limited colours**.

You use patterns to mix colours.



With only a few colours you can create the illusion of 3 colours or more!

Dithering is often associated **with the early days** of pixelart.

Older computer graphics got the most out of their colour limits with dithering techniques.

~ 56 unique colours.

Full colour



Pixel art? ❌

7 unique colours.

Smooth



Pixel art? ✅

4 unique colours.

Dithering



Pixel art? ✅

When to use dithering?

Too much dithering causes your pixel art to look **ROUGH** and **GRAINY**.

It gives pixel art an unnecessary gritty texture.

BUT

Large **cel-shaded gradients without dithering** result in **FLAT** and **STRIPED** areas.

Over time, game graphics added more and more colours. Dithering is less common now. It requires a lot of space to be used properly, so that's why **it's rarely found in sprites** but **occasionally in backgrounds**. It also harms readability, as seen in [Chapter 4, p.111](#)



To understand how often and to what degree dithering is used, **study game art and learn from your favourites**. You'll learn a lot from just observation. Try shading with clean shapes first, though.



Street Fighter Alpha 2 (Arcade)

When should I use dithering?

- **Gradients** that would otherwise use too many colours to do manually.
- **Things that don't animate**. Seriously: do NOT animate dithering.
- **Textures** ([page 125](#)).
- **Extreme colour limitations**.
- **Backgrounds**: skies, space, vast areas that may otherwise look empty or flat.

This is a sprite from *Monster in My Pocket* (NES). The fully dithered version on the top left is the original as it appears in the game within NES limitations. The others are modified versions.

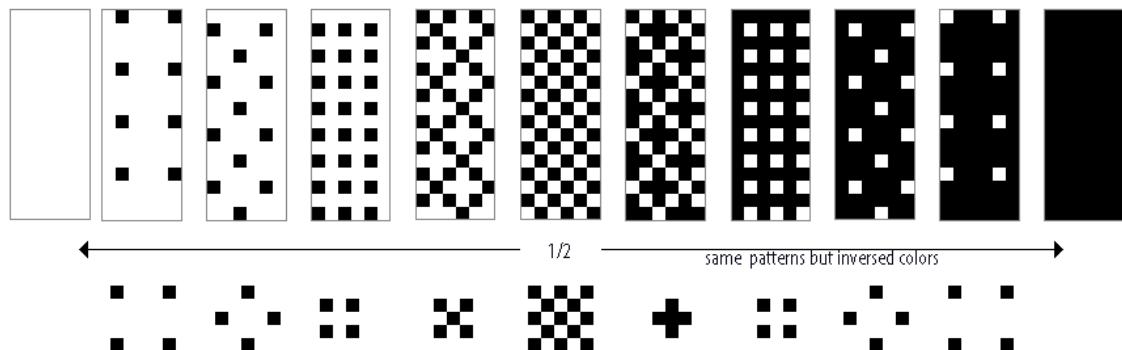


DITHERING	PROS	CONS
	<ul style="list-style-type: none">+ Good for limited colours+ Skies or vast backgrounds	<ul style="list-style-type: none">- Rough and gritty- Time-consuming- Unnecessary texture- Not suitable for sprites- Useless for high colours- Hinders animation- Wobbling frames
SMOOTH SHADING	<hr/> <ul style="list-style-type: none">+ Small sprites and tilesets+ Readable sprites+ Better for animation+ Soft painted or cel-shaded feel	<hr/> <ul style="list-style-type: none">- May look flat- Doesn't do gradients well

Checkered dithering

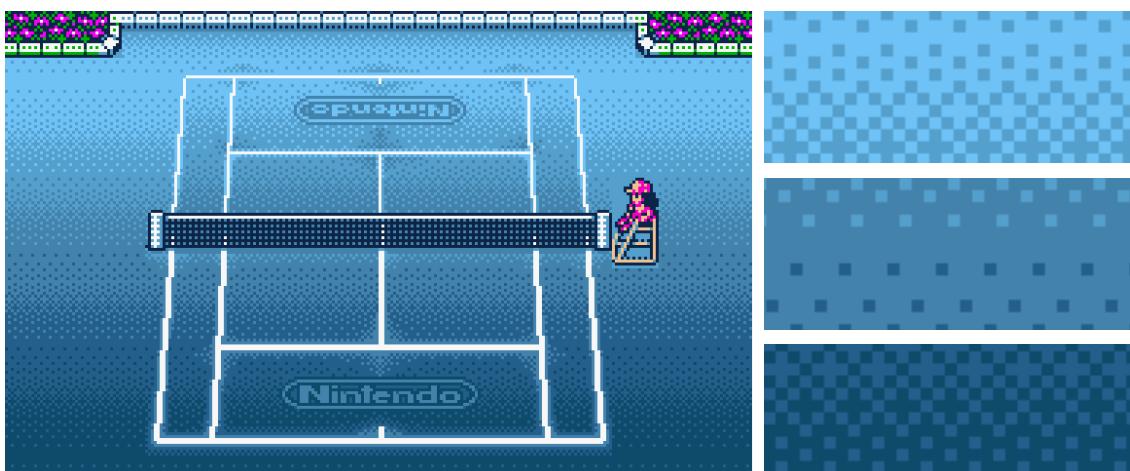
These are the most common patterns you will find as they offer the most variety.

Below are all the levels of brightness made out of checker patterns.

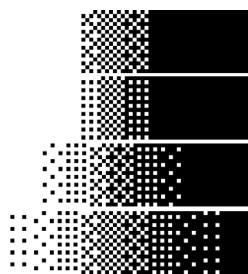


Should you get lost, **remember each level has a pattern.**

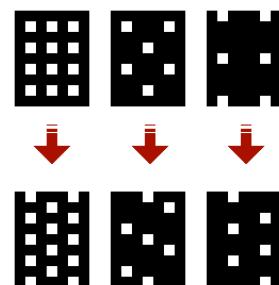
Checkers, crosses, squares, diamonds, etc.



Mario Tennis (Game Boy Color)



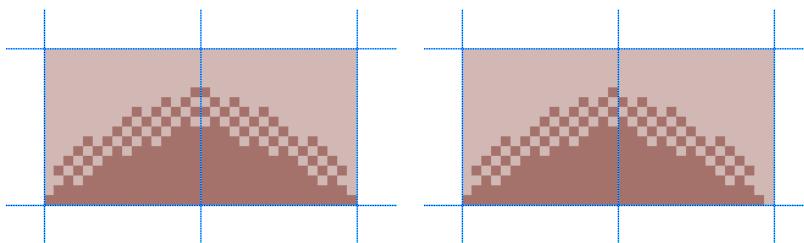
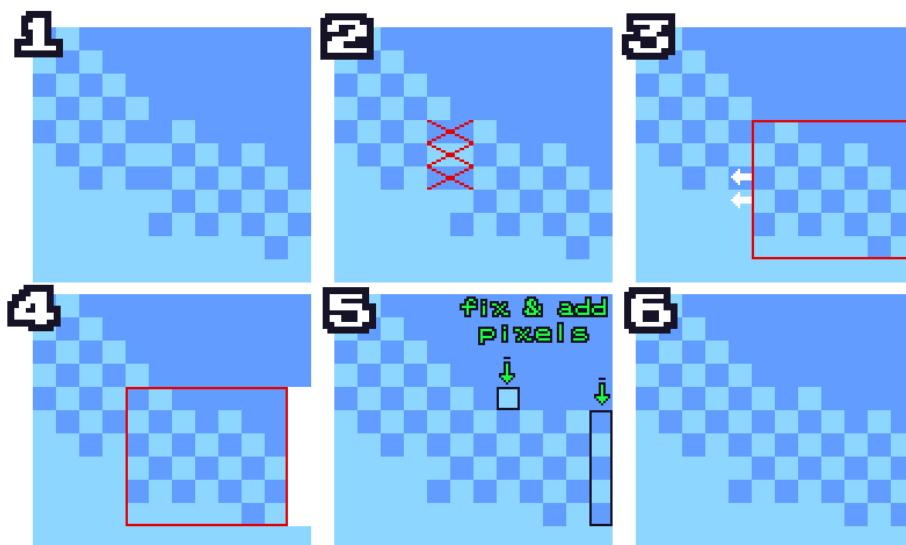
You can choose how many levels of dithering you want between 2 shades. It all comes down to preference or the length of the gradient or how many shades you have.



If you get to work on larger areas, you can freestyle the dithering a little bit, as long as you never have a wide pixel (2x1 or 2 pixels that touch each other).

Dithering for curves

Curves can be trickier to dither, so make sure to fiddle around to see how it looks. Sometimes **you may get double pixels** and that looks bad. When this happens, **you can select and slide the dithering you've already got**, rather than redo it.

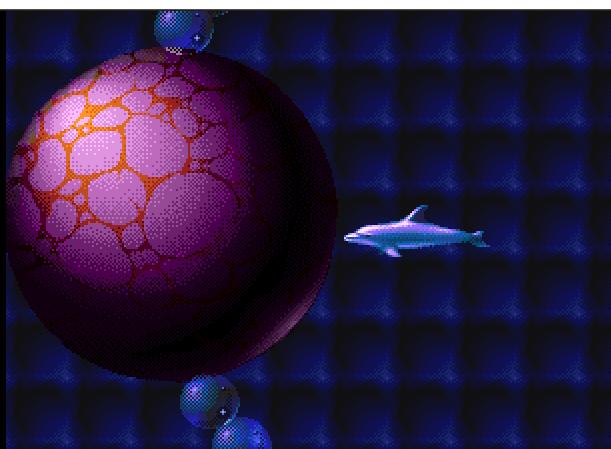


1 tile, duplicated and mirrored

2 tiles, one being slightly different

If your dithering is part of a tile set, double pixels may be unavoidable. This is because tile sets are always an even number of pixels.

If this happens, make sure to have 2 different tiles.



Ecco the Dolphin (Genesis/Mega Drive)

Contrast

When you have no colour limitations, you should use dithering with caution. It's best to avoid it.

Your goal is to have dithering seamlessly blend colours without noticing them.

If the difference between 2 colours is too high (high contrast), you probably shouldn't dither.



With low contrast, it feels softer.



Pokémon Mystery Dungeon 3:
Explorers of the Sky (NDS)

with high contrast, it's quite harsh!



Earthworm Jim (Genesis/Mega Drive)



Sonic Advance 2 (GBA)

Checkered dithering is most useful for gradients covering large areas.

Keep the contrast low, so the dithering will be smoother.

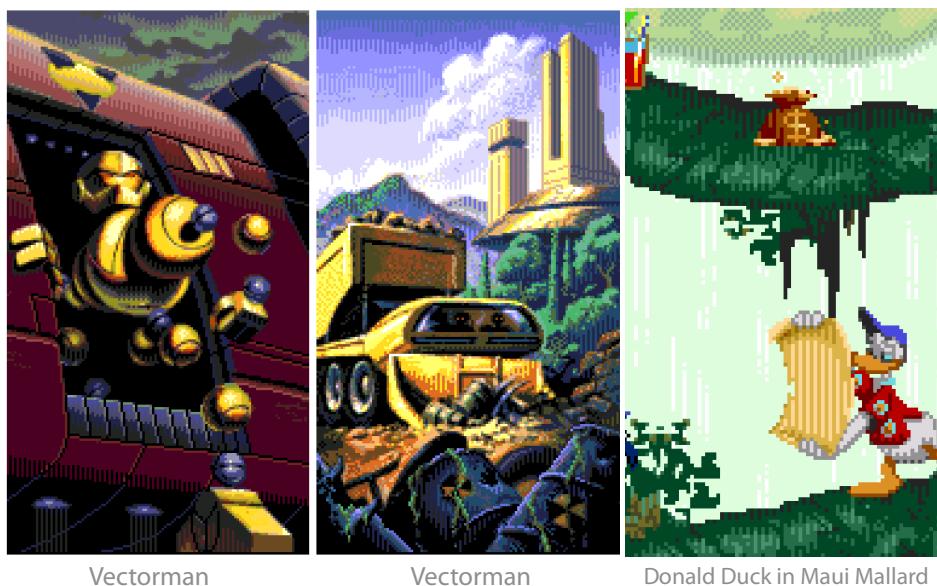


More patterns

Parallel lines



A type of dithering found in Genesis/Mega Drive games, but can be used today for stylistic purposes.
For CRT TV's, they are more effective "50-50" type dithering than regular checker patterns.

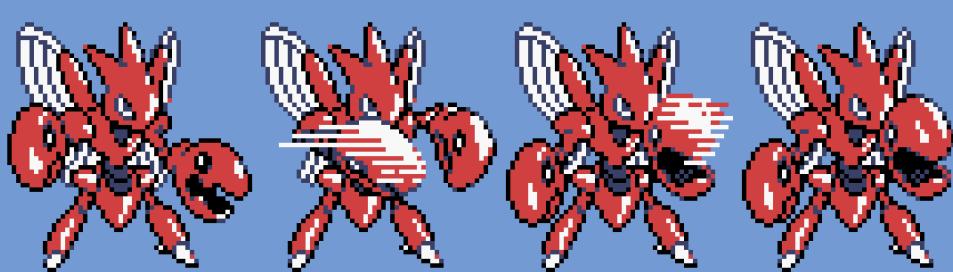


Vectorman

Vectorman

Donald Duck in Maui Mallard

Lines can be used as smears or blur with limited palettes. Lines work better for blur than checkerboards do. This only works for limited animation, NOT smooth animations.



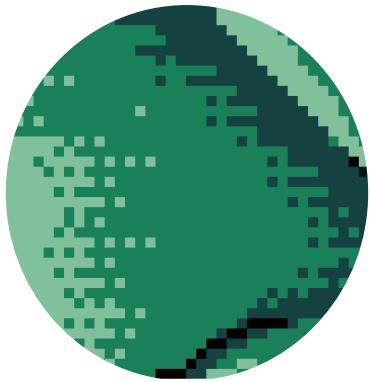
Pokémon Crystal (GBC)

Checkers are more suited for gradients. Parallel lines were suited for buffer-shades and opacity tricks on old CRT televisions. For more examples, [check page 131](#).

Discontinued lines



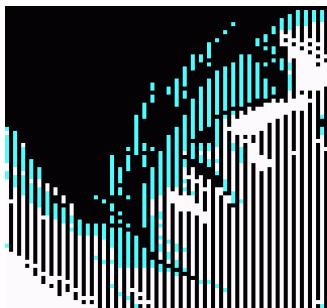
A variant of the parallel lines. The only difference is that this shows more values and levels of gradients. It also adds a neat effect.



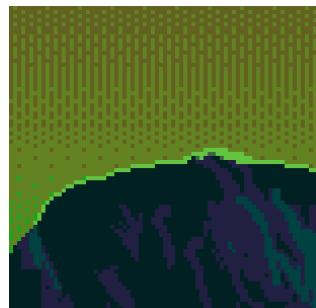
Beyond Oasis / The Story of Thor (Genesis/Mega Drive)



Pokémon Mystery Dungeon
3: EoS (NDS)



Strip Poker: aSGoC (PC DOS)



Earthworm Jim
(Genesis/Mega Drive)



Ecco the Dolphin (Genesis/Mega Drive)

Dents



A variant of checkered dithering or parallel lines. It uses only 1 line of checkerboards. They resemble dents or teeth. This dithering is useful for textures if you have little space. **This type isn't suited for gradients**, though!

Intertwined dithering



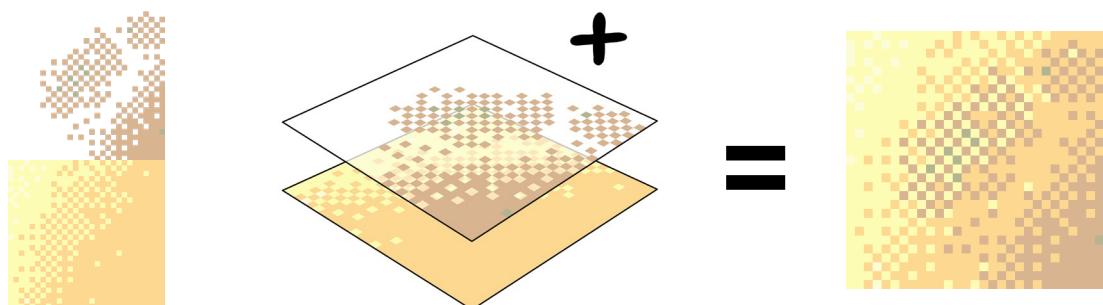
Kolibri (Sega 32X)

Intertwined dithering (woven, overlapped, etc.) has dithering patches entering other patches. The gradient sometimes overlaps with other gradients. Different patches of checkers are weaved together.

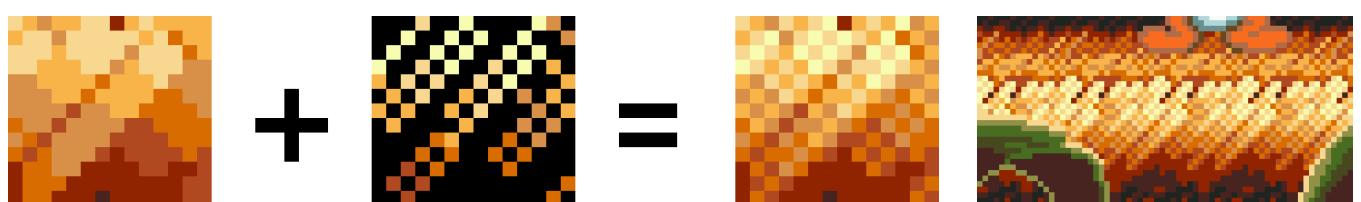


Ecco the Dolphin (Genesis/Mega Drive)

If you have trouble doing this manually, make 2 layers of dithering, and have them overlap!

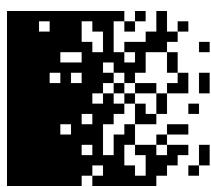


You can still do this manually, but having 2 layers makes it easier not to get lost!



World of Illusion (Mega Drive)

Random dithering



Randomized dithering doesn't follow any patterns. You still need to make sure the gradient seamlessly flows from light to dark. Random dithering can be obtained by randomly placing pixels here and there. However, it's usually the result of filters, photo-manipulation or spray-paint tools.

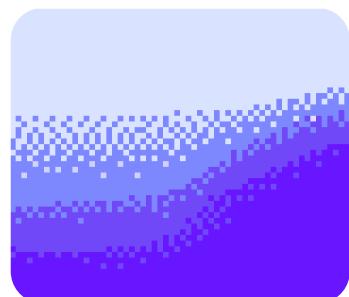
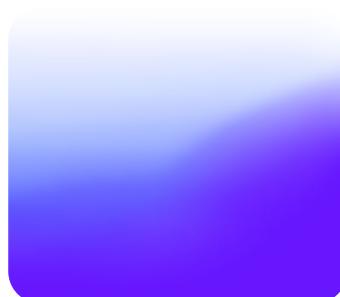


Kirby's Dreamland 3 (SNES)

This isn't really handcrafted pixelart, so
it's still advised to manually fix it.

It can appear quite lazy, so use it in
clever ways and on big canvases.

This is a gradient reduced to 4
colours with automatic dithering.
It still needs a lot of work and
it looks like random noise.



Of course, random dithering can be done by hand. You can create this effect from scratch, if you wish. You start by painting several shades of colours and finish by blending the edges with random noise.



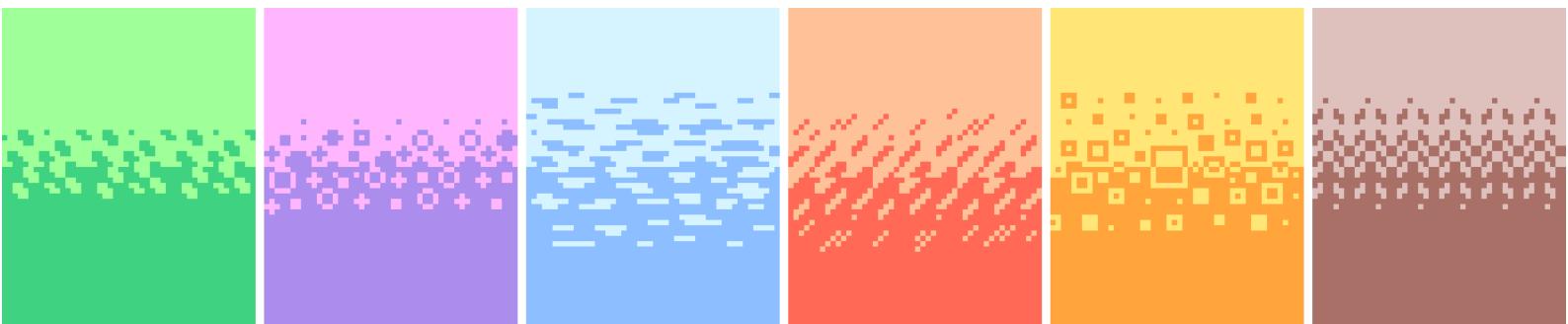
By Guest artist YAA

In most cases, random dithering isn't recommended.
Try to make patterns or tiles out of them ([see page 125](#))



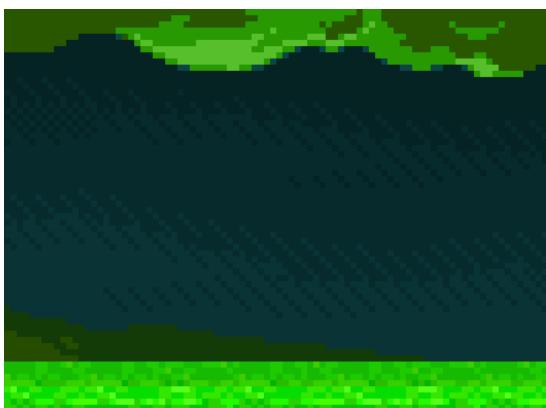
Stylised dithering

Now here's where things get interesting!



Get creative!

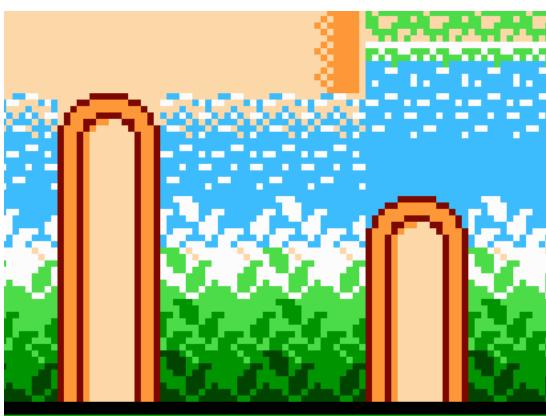
The previous forms of dithering were quite rough. With stylised dithering, **you can apply your own textures to create gradients without that gritty feel!** Remember, that you need space to use these.



By Michafrar



Shovel Knight (PC)



Kirby's Adventure (NES)



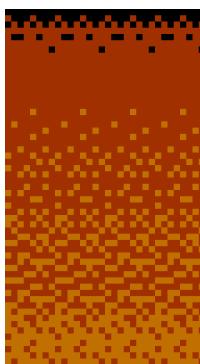
Street Fighter Alpha: Warriors' Dream (GBC)

Stylised dithering is a great way to get started and have fun with textures!

You can even take random dithering ([page 124](#)) and turn them into repeating tile sets to avoid them looking chaotic. This randomness is **controlled**, rather than **loose**.



Crash 'n' the boys: Street Challenge (NES)



by StevenM

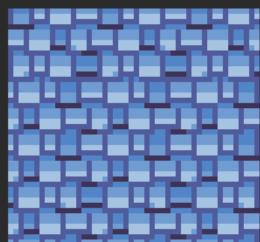


Don't confuse textures with gradients!

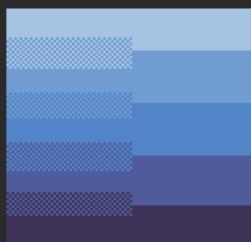
Gradients are the transition from light to dark. Textures are the feel of the material.
Stylised dithering can be a combination or both, or just regular gradients.

Textures don't always need a gradient (from light to dark)!

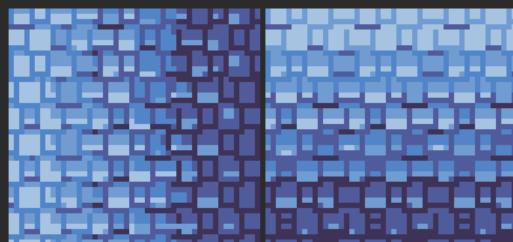
Of course, dithering can show texture, but only for patches, not as gradients.



texture



gradient

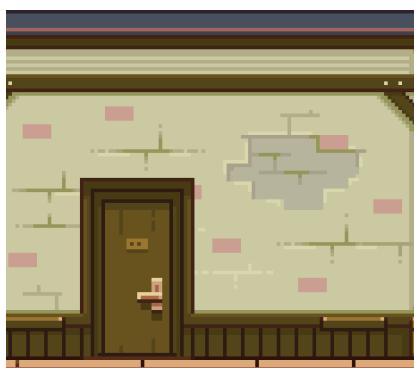


texture with gradient

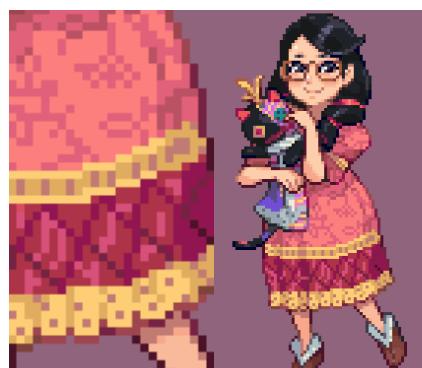
These graphics below **have textures**, but **no dithering nor gradients**.



By Michafrar



Guest artist:
Neorceisgood



Guest artist:
Anubis Jr

Case Study: SMW2: Yoshi's Island



Yoshi's Island is bursting with stylized dithering. On this screenshot alone, you can find many examples.



Another thing to notice is that *Yoshi's Island* chose to have smooth cel-shaded gradients for the sky. There is no dithering and it holds up well. The contrast is low, so the bands of colour feel soft.



More than just gradients

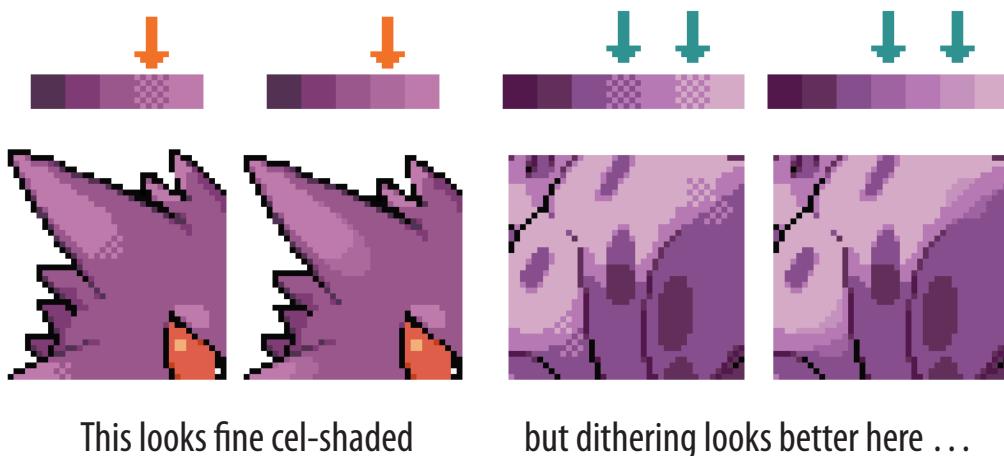
Blending through cel-shading

A modern way to dither is to blend cel-shading. Even with unlimited colours at your disposal, dithering can imitate soft shading. Think of this like small portions of soft shading in an otherwise cel-shaded drawing.



Pokémon Fire Red/ Leaf Green (GBA)

The highlight of Gengar's horn (on the left) blends into the darker main shade, rather than being cel-shaded. You can do the same technique, but just using a buffer-shade in your colour-ramps.

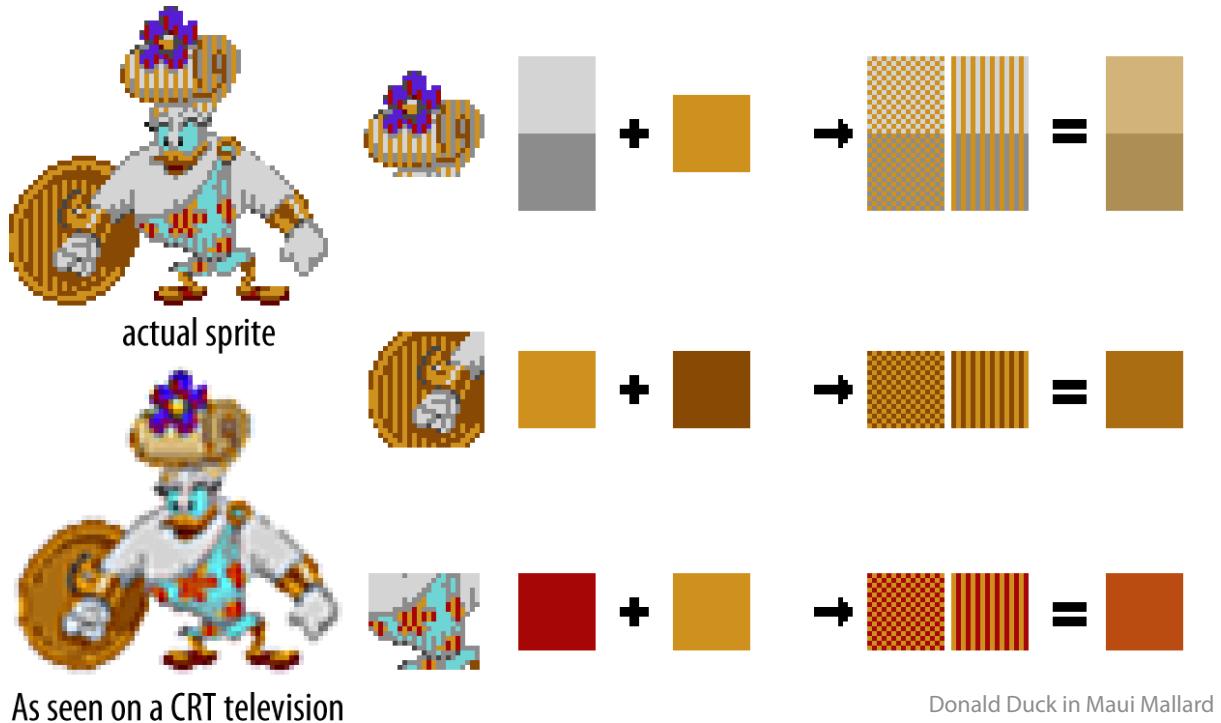


Mixing colours

Dithering can help you blend colours, especially on blurry displays. You'll only use this technique if you're working with limited colours, though.



Let's see this technique in use with some parallel dithering used in this Mega Drive sprite. The results don't look pretty by modern standards, but it did look nice on CRT TV's.

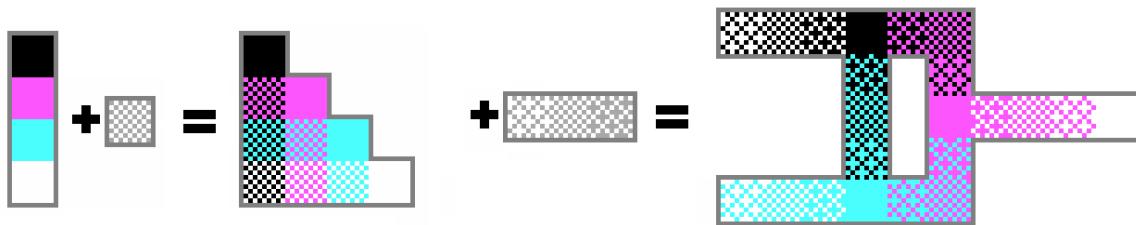


Computer graphics after this point would have more colours and even transparent (alpha) layers, so **this technique is extremely rare nowadays**. However, older graphical displays such as the 4 colour CGA mode hugely benefited from having extra values by blending together cyan, magenta, black and white !



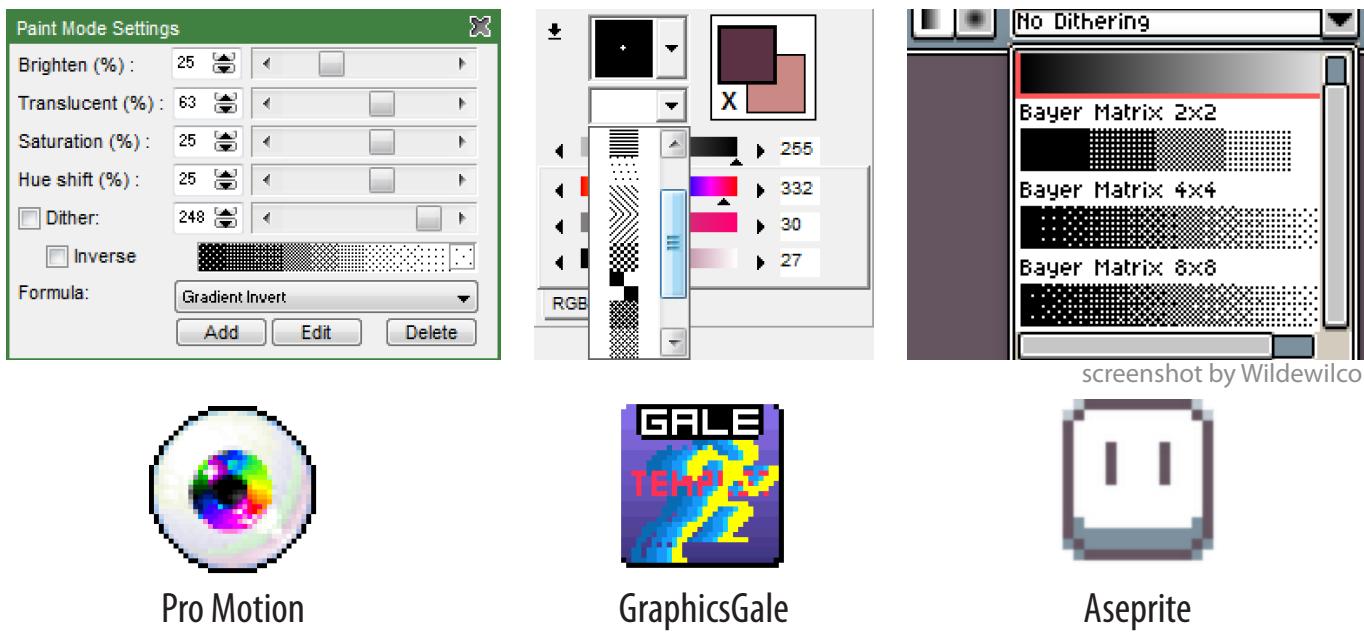
Space Racer (PC DOS)

We briefly discussed this in [chapter 3 \(page 84\)](#) where with 4 colours you can easily obtain more values!



Brushes for dithering?

When dithering is too time-consuming, there are ways to use dithering-brushes!
Some of these programs use dither patterns or brushes that help you speed things up.
No need to “copy-paste” all those checkers.



screenshot by Wildewilco

Aseprite (input: CTRL+B) and other programs allow you to make brushes too.

More interestingly, game artist and game developer **Dan Fessler (@DanFessler)** studies HD Index painting for Photoshop which makes dithering easier to manipulate.



Article: danfessler.com/blog/hd-index-painting-in-photoshop

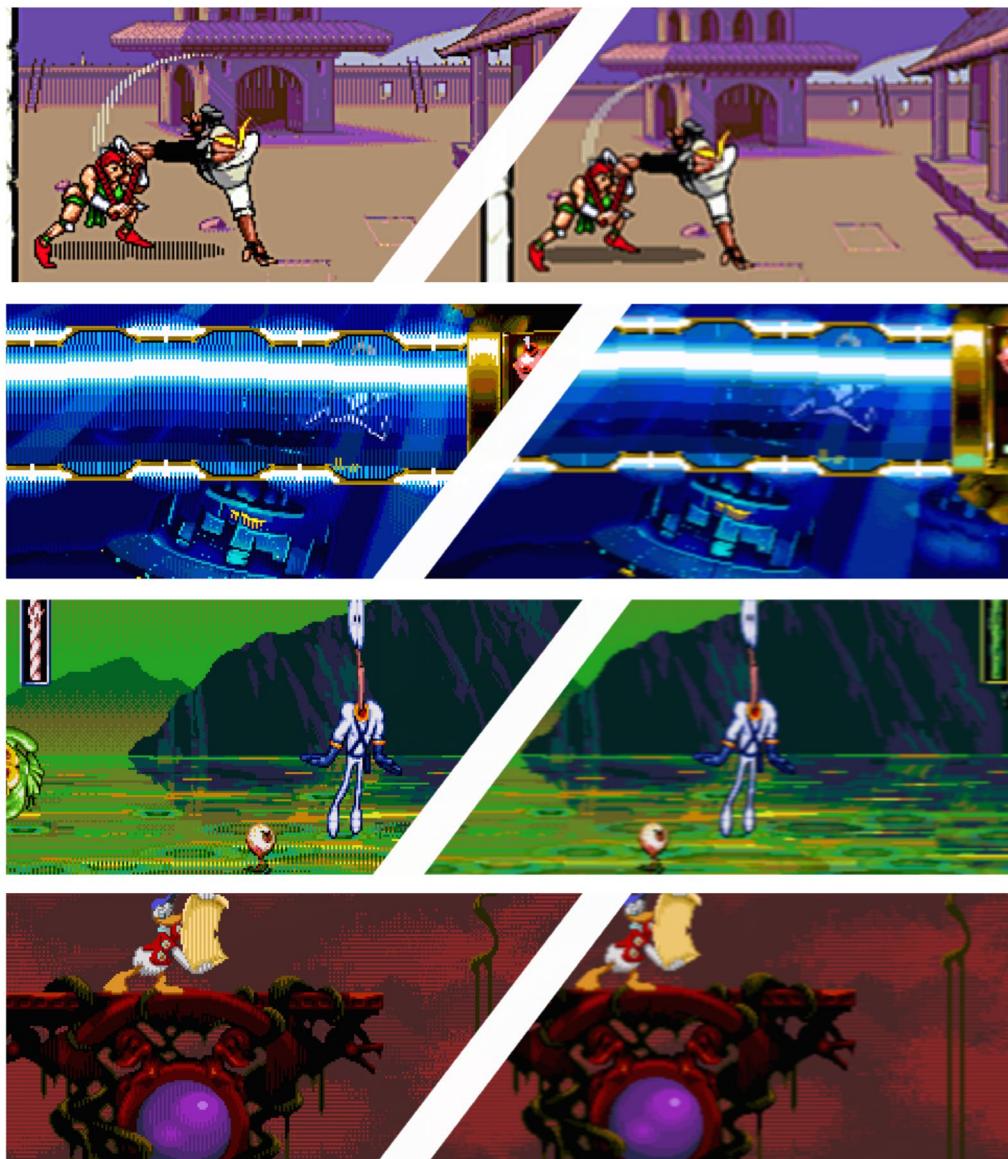
Preview video: youtu.be/7Q36EyvaYG8

Support the indie game Chasm! www.chasmgame.com

Remember pixel art is about control, so make sure to manually fix your results!

Before transparent layers...

The Sega Genesis (Mega Drive) heavily relied on lined dithering. **It blends colours when playing the console on lower quality outputs** (co-axial cables, RF outputs or composite cables)



Top to bottom:

Comix Zone, Earthworm Jim and Donald Duck in Maui Mallard (Genesis/Megadrive)

The Super Nintendo, had dithering in the earliest games, but later games used proper alpha layers.

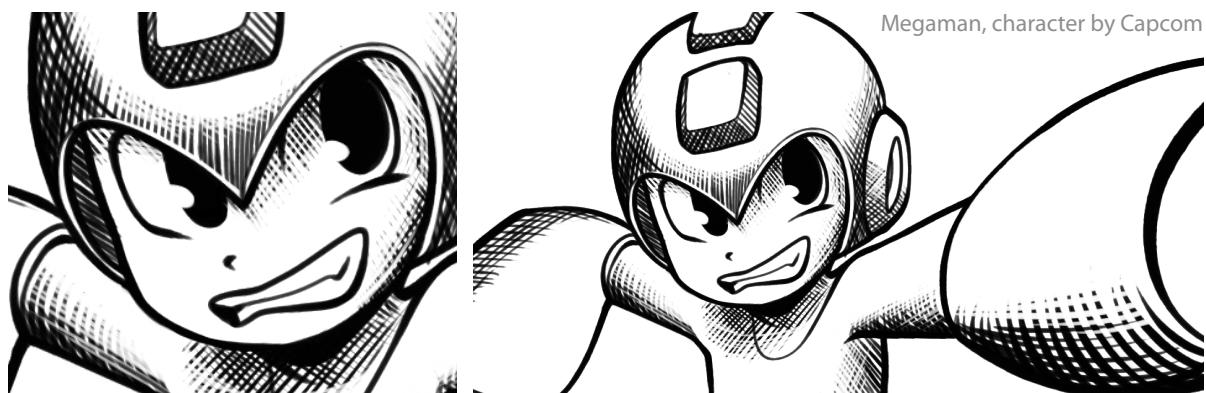


Super Mario World (SNES)

Dithering isn't new

Dithering can be traced back to **many older artistic methods**.

(Cross) hatching is the oldest form of **using patterns to show tone and value** by using just 1 colour. It can be found in pencil drawings, printmaking, etching, woodblock etc.



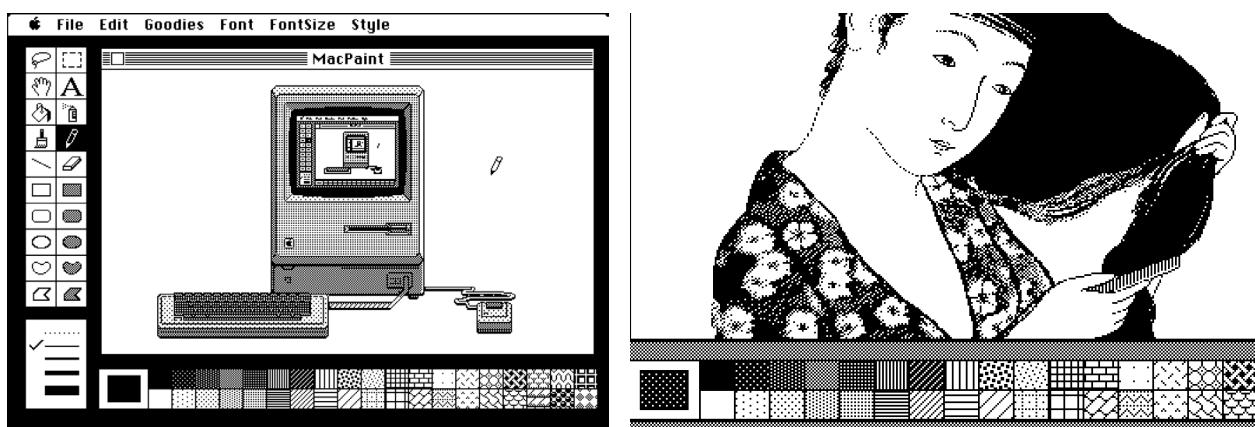
Megaman, character by Capcom

Pointillism also requires small distinct dots to create an image. Traditional art isn't limited to a grid, so **this way of mixing colours is organic and free-form**.



Paul Signac Entrée du port de Marseille (1911)

Monochrome graphics, such as MacPaint can only show 2 colours: black and white. Many pixel dithering patterns were used to show greyscale.



Works by Susan Kare(1984)

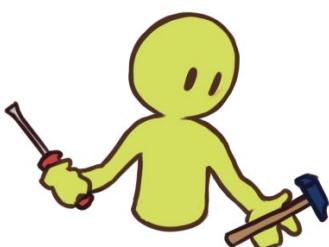
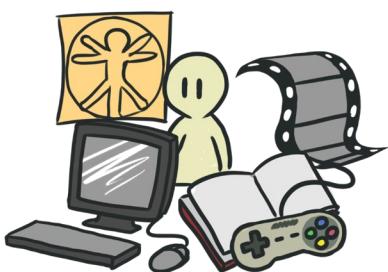
Conclusion

Many pixel artists choose not to use dithering.
It all comes down to preference.

You probably won't use it much. It can be quite time-consuming and tricky to get right. You can choose to avoid it and stick to clean, solid shapes.

Remember: LESS is *MORE*.

Dithering is a powerful tool nonetheless. There are some marvellous things to create with each pattern. **If you do choose to have dithering, use it with moderation.**
It shouldn't stand out or clash with other visuals in your project.



Food for thought

- Introduction
- When to use dithering

Techniques

- Checkered dithering
- Other patterns
- Stylised dithering

Trivia

- Brushes for dithering?
- Before transparent layers
- Dithering isn't new



Lord Monarch (MegaDrive)

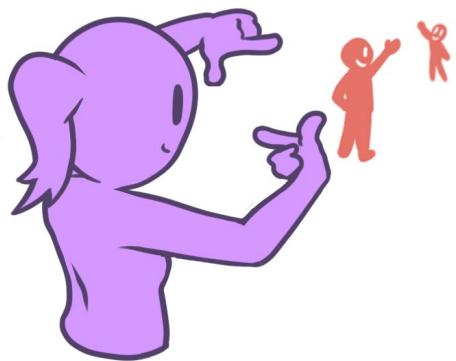


Chapter 6

Game Perspectives

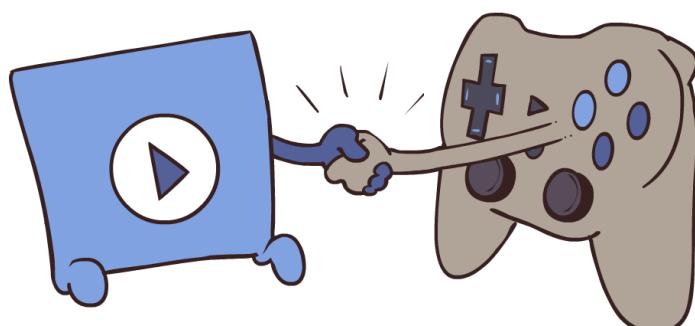
Introduction

Perspective is how the world looks, viewed by the human eye.
The further an object is, the smaller it looks. The closer it is, the **bigger** it looks.
It's an integral part of art and illustration.



**When creating pixel art illustrations, perspective is a necessary skill.
So when you're creating video games, you need to consider the following:**

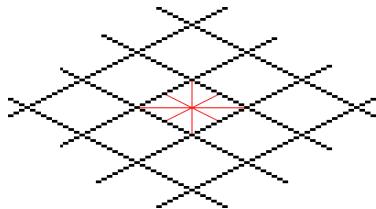
In most 2D games, there is no real perspective or vanishing points. As artists and designers, we need to think outside the box to create explorable worlds! Many of the game perspectives in this chapter are pseudo 3D projections, meaning that they *imply* 3 dimensions - **length, width & depth** - but are really just 2D fields.



Use a perspective that benefits your game-play.
Make sure the visuals of your world and characters work with your game design.

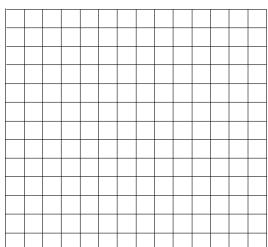
Perspective vocabulary

Here's a quick refresher on some perspective vocabulary that will be used frequently in this chapter.



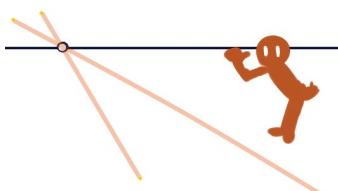
Plane

A 2D flat surface that shows length and width.
It's like an infinite wall, ceiling or floor.



Axis

A geometric line with a fixed direction.
Y-axis is up and down, X-axis is left and right,
and Z-axis goes back and forth.



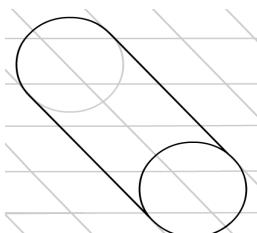
Vanishing point

Due to perspective, two parallel lines meet at a single point.
Like a road that extends towards the horizon and disappears
into a single dot.



Projection

The way a 3D view is drawn in 2D.
Think of it like how the world is shown on a map.



Orthographic

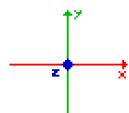
Flat views with no perspective.
Size does change whether it's close or far away.

We'll avoid math as much as we can, but we'll refer to Width as X, Length as Y, and Depth as Z when talking about dimensions or axis.

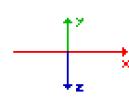
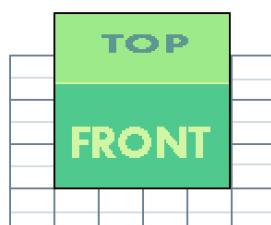


Orthographic projections

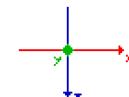
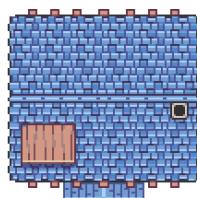
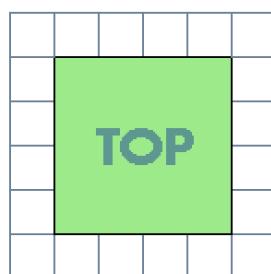
Side-scroller



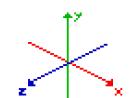
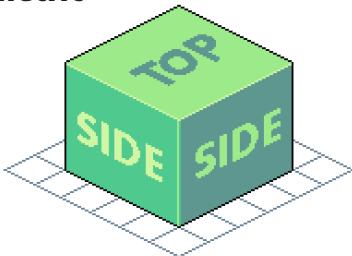
Top-Down



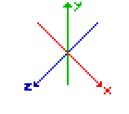
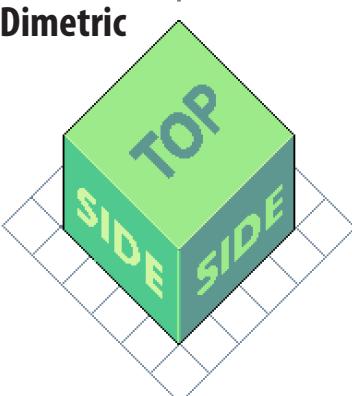
Top



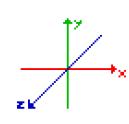
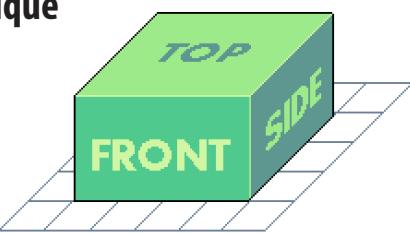
Isometric



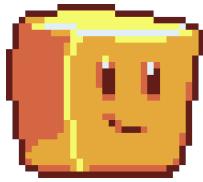
45° Dimetric



Oblique

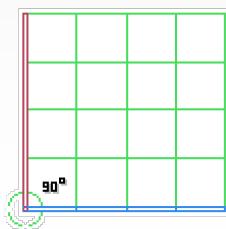
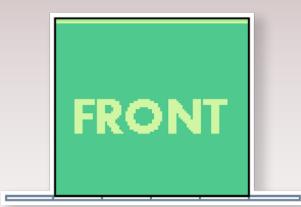


Multiview drawings

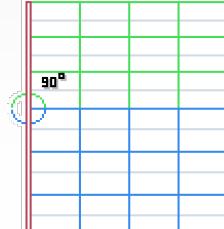


These are flat views with no perspective.
They're quite common in most 2D games.
Everything is perpendicular in a parallel 90° grid and the same scale.

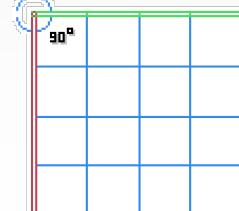
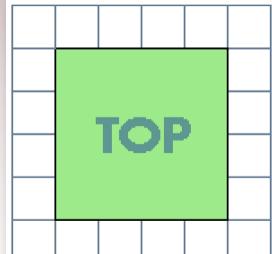
FRONT/SIDE VIEW



TOP DOWN VIEW



TOP VIEW



These views lack depth, so you can use *parallax scrolling* to add depth.
Only 1 or 2 planes are visible with game-play being on a 2D plane.



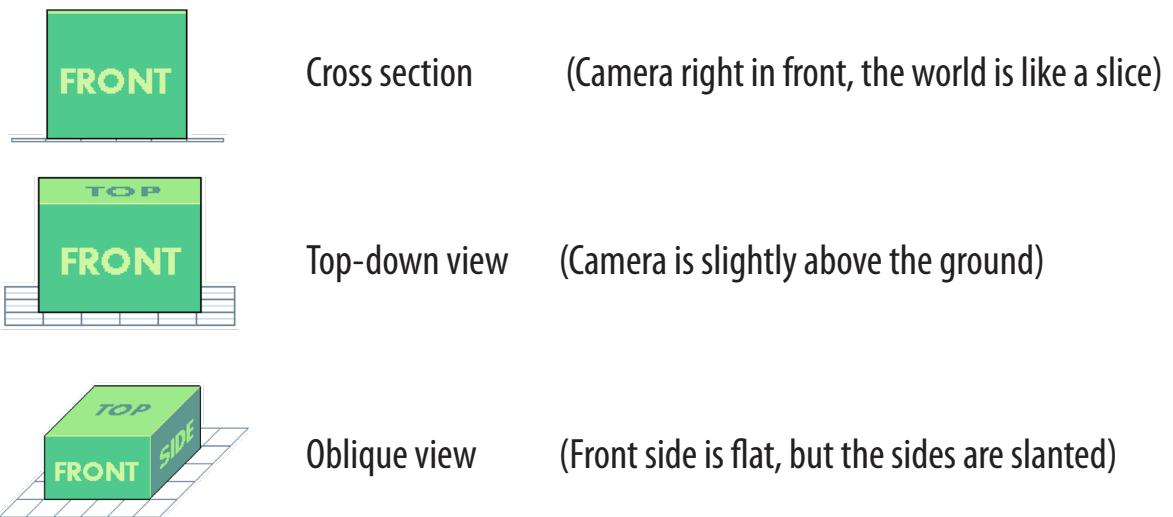
With only 2 planes visible, and no vanishing points, everything looks like a **square grid**. Vertical and horizontal lines all form 90° angles. **The geometry is just a guideline though**. You can draw things at any angle you want.

Side view

This is the **most common perspective for 2D games**. It's often associated with platformers and shoot'em ups as it focuses on vertical and horizontal movement on 1 single plane.

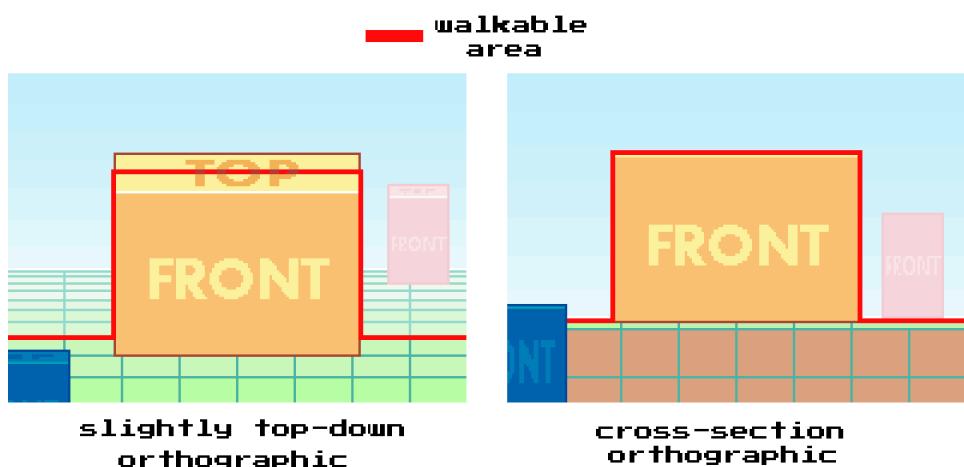


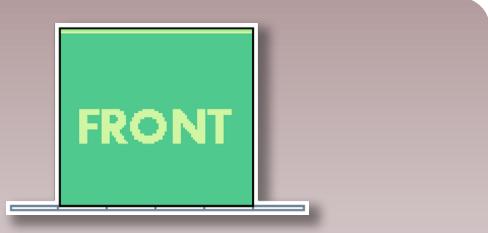
2D side-scrollers come in many genres but usually stick to similar views, not just one:



These views are ideal for corridor-type levels.

No matter the view, the line the character travels along does not change. Even when it looks like you can go up or down, you're always stuck to a single 2D path (exceptions exist).

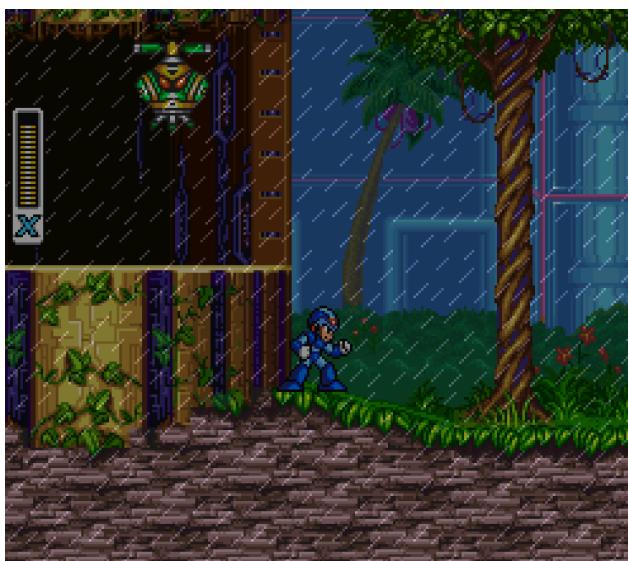




Castlevania Chronicles (PS1)



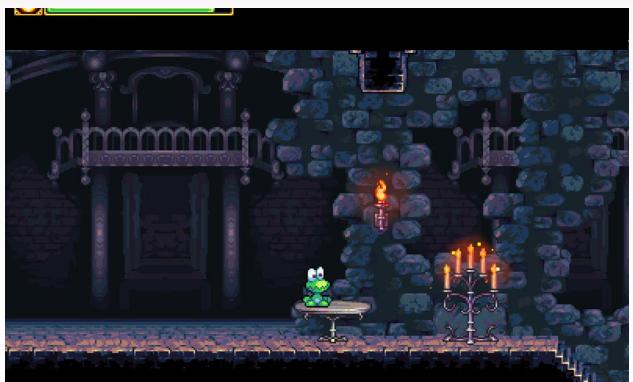
Shovel Knight (Multi-platform)



Megaman X2 (SNES)



Donkey Kong Country 3 (SNES)



Frogatto & Friends (multi-platform)



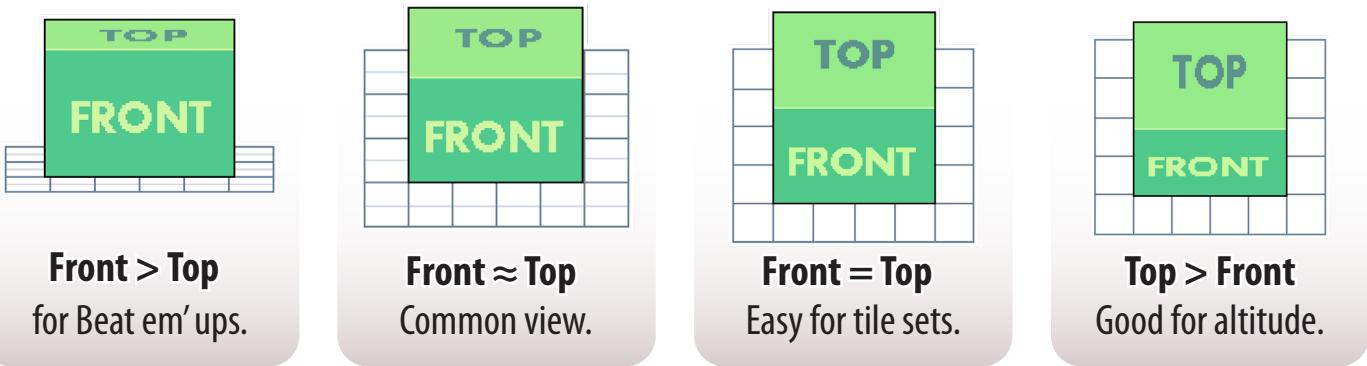
Ristar (MegaDrive)

Top-down view

The grid is made up of squares tiles which makes creating worlds and environments a breeze.
It's often associated with free-roaming overworld and it's suitable for exploration.



You can have different variations of top-down angles.
It depends on how high, or low you want the camera to be.

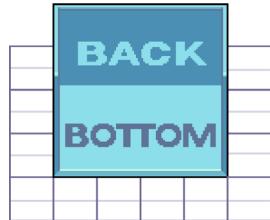
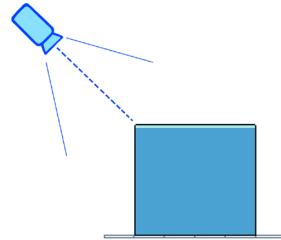


Mercs (Arcade)

Top: Mother 3 (GBA)
Bottom: Advance wars (GBA)

Top: Pocky & rocky (SNES)
Bottom: The Story of Thor 2 (Saturn)

Top down games usually view the world from above, at 45°.

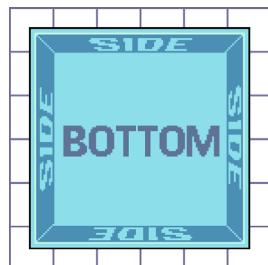
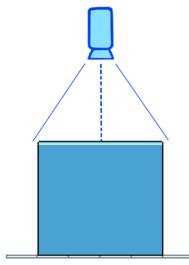


Zombies Ate My Neighbors (SNES)



Mario & Luigi: Superstar Saga (GBA)

However some dungeon crawler games (like 2D *Zelda* titles) look into a room with a camera placed directly above. This top view isn't orthographic anymore and resembles a 1-point perspective view. As a result, the room is correct while the objects are not. They appear in a top-down angle instead.



LoZ: Link to the Past (SNES)

Goof Troop (SNES)

The *Zelda* perspective problem



Overworld



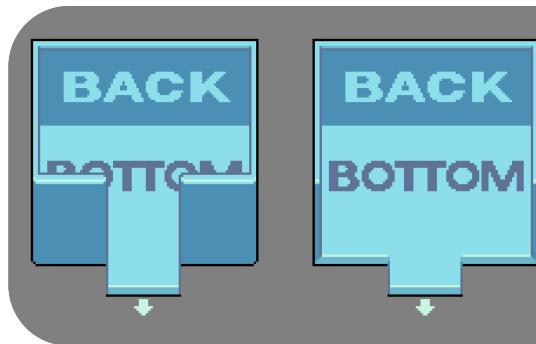
Dungeon

Oddly enough, *outside the dungeons*, *Zelda* games adopt the traditional top-down view. This looks vastly different from the 1-point perspective used in dungeon rooms.



All objects are viewed at a 45° tilted camera, yet the room is at 90° . Everything looks correct when sprites are near the north wall (**A**). When sprites are near the south wall (**B**), they don't make sense. Technically the character should appear like (**C**) but you wouldn't be able to see him very well.

By flipping the screen *upside down*, we can see why the sprites in **B** look very wrong, yet the perspective stays the same. It's as if Link is laying on the floor.



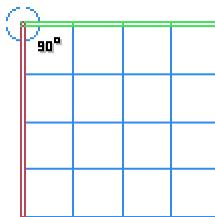
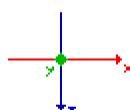
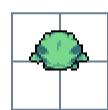
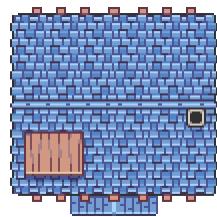
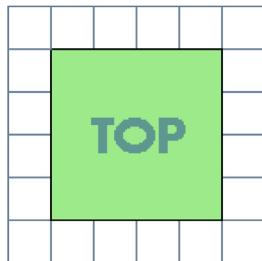
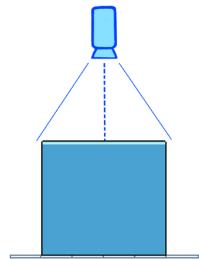
If walls are blocking the view, you can easily remove them and create an invisible "4th wall".

Some games include walls; others remove them to show more of the floor.



Top view

This is a sub category of top down views. This view is **EXACTLY 90°** (if you were looking straight downwards). This design choice is uncommon and only works for a particular set of game-play types. You can find real world examples of this style in geographic maps, blue prints and floor plans.



Twin Cobra II (Arcade)

Contra 3 (stage 2) (SNES)

Hotline Miami (PC)

A few Mode 7 games have maps in this view transformed in-game to simulate other views.

This view is good for aerial views, but it lacks depth. If you want to focus on height, the following views are better options:
Top down, dimetric and planometric oblique.



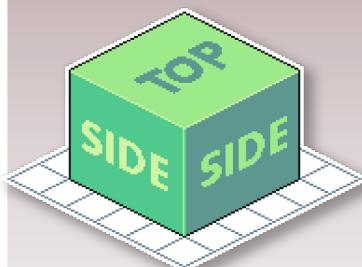
Paraline views



These are views that give a three-dimensional quality on a 2D screen.
This perspective shows 3 sides of an object, at all times.
Everything is in true measurements and seen from a **bird's eye view**.

Axonometric shapes*

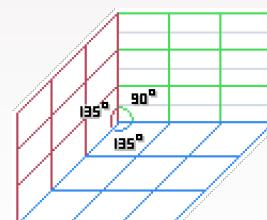
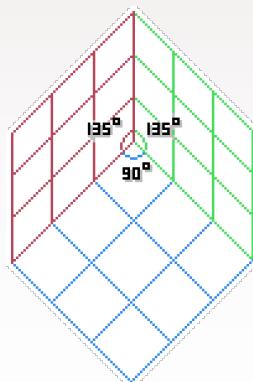
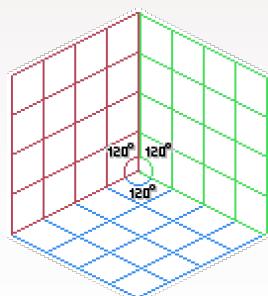
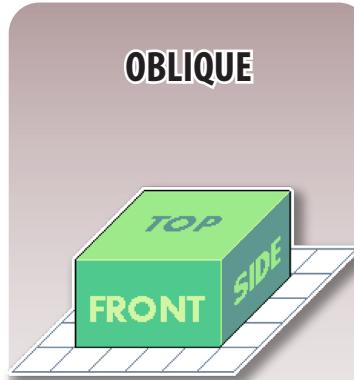
ISOMETRIC



45° DIMETRIC



OBIQUE



Focuses on **all planes (TOP + SIDES)**.

Isometric means **that all axes are equal**.

Focuses on **the horizontal (TOP) plane**.

Dimetric means **only 2 axes are equal**.

Focuses on **the vertical (FRONT) plane**.

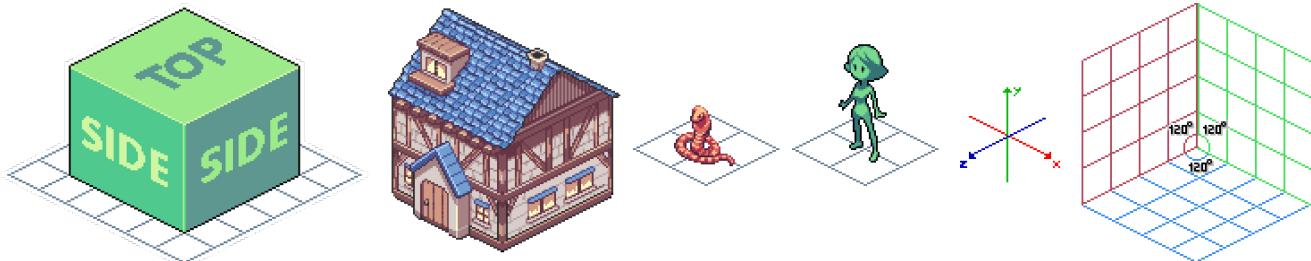
Oblique means **the front is flat, the rest is slanted**.

*There are more axonometric views, such as "trimetric" so if you'd like more in depth reading, look up books by Francis D.K. Ching.

Isometric view



Isometric pixel art is often associated with diagonal movement, since the grid is diamond-shaped at multiples of 30° angles. However, **you can't have exact 30° lines in pixel art**, so everyone uses stairs of 2 pixels. This is technically 26.5° , but it's the closest thing to 30° lines. **Constructing worlds is much easier with this "2 pixel" method.**



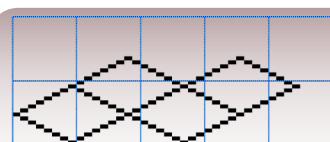
Top : Landstalker (Megadrive)
Bottom : Harry Potter 1 (GBA)

Final Fantasy Tactics Advance (GBA)

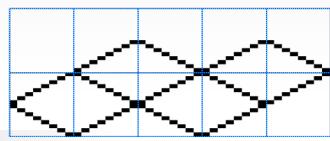
Top : Solstice (NES)
Bottom : Kingdom Hearts: CoM (GBA)

The unique aspect here is that **the grid is made of diamond tiles**, not squares.

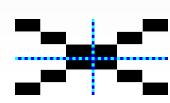
This makes it harder to fit into square grids and align them.

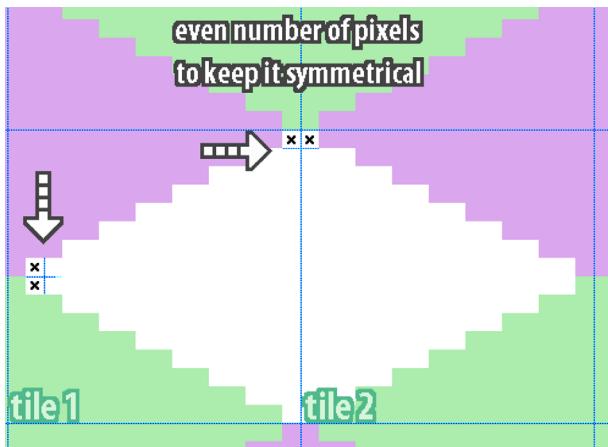


These tiles don't line up in square grids but they're nice for free-form pixel art. The way the lines connect looks clean.



These tiles align perfectly and suited for game development and tile sets. Unfortunately the areas where lines cross each other are chunky (double pixels)- so- not so nice to look at.



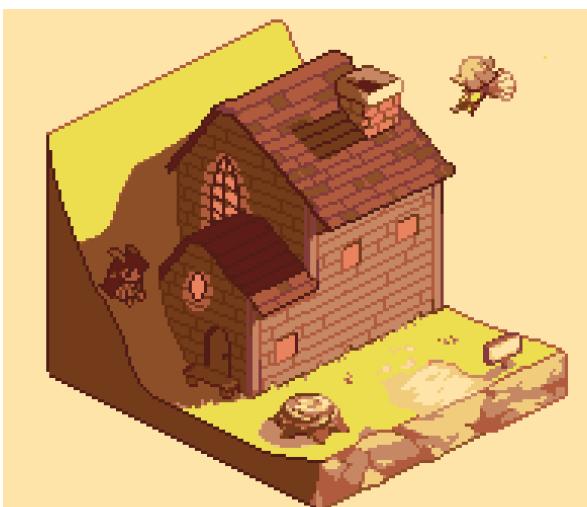


Instead of lines, it's easier to **use lineless shapes** to draw each diamond, like a checker board. Use this method to avoid chunky cross sections!

One diamond is spread across 2 square tiles.
Every other adjacent diamond goes across 4 tiles.

Try making a checkerboard to practice!

It doesn't matter if you prefer tile sets or not. **You will always need a grid to help guide you.** If you use free-form backgrounds for games, you will have to turn them into a playable map. It can look more unique, but can be a nightmare to program if you have to turn it into a map. Make sure whatever you draw can have proper collision.



A free-form isometric piece
Guest artist: Temmie Chang



The tiled isometric backgrounds of
Luminous Arc (NDS)

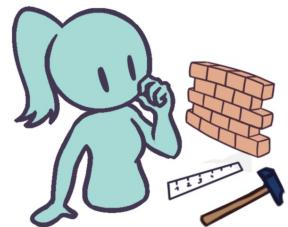
Within an isometric grid, you can build all sorts of items. Not everything has to be necessarily blocky. Cubes and cylinders can have a load of personality and come in all shapes and sizes.



Kingdom Hearts: Chain of Memories (GBA)

Making objects

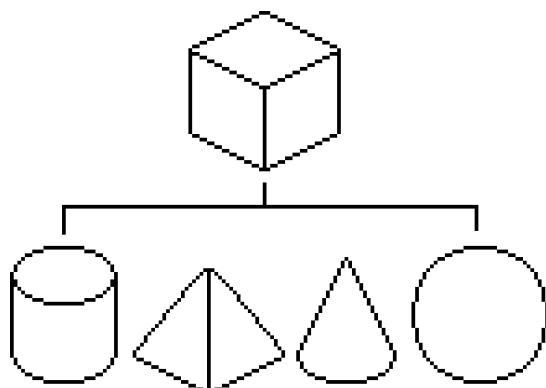
When making objects, you can approach them in two ways:
You can eyeball them, or you can construct them.



When you eyeball them, you:
Visually estimate measurements.
Can easily deconstruct objects
into simple geometric shapes

When you construct them, you:
Will be slower but way more precise.
Use guidelines and get the most
accurate results.

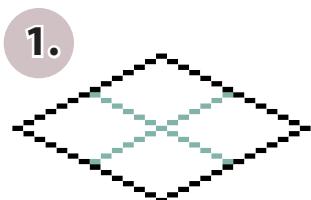
Sidenote: Eyeballing is only as good as the artist's knowledge, it's advised to construct first so you get a good grasp of how to eyeball.



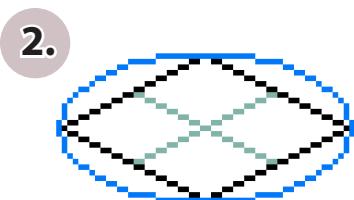
With just a simple cube, you build all sorts of objects!

A **cylinder** can be turned into a tree stump or a barrel.
A **pyramid** can be turned into a roof or a tent.
A **cone** can be turned into a tree or a tower.
A **sphere** can be turned into a mushroom or a bowl.

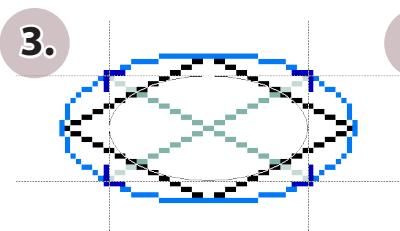
Drawing a circle on a horizontal plane



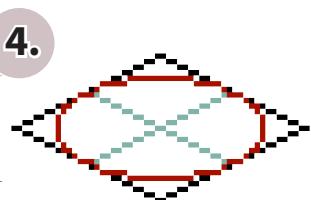
1. Draw the medians.



2. Oval around the square.

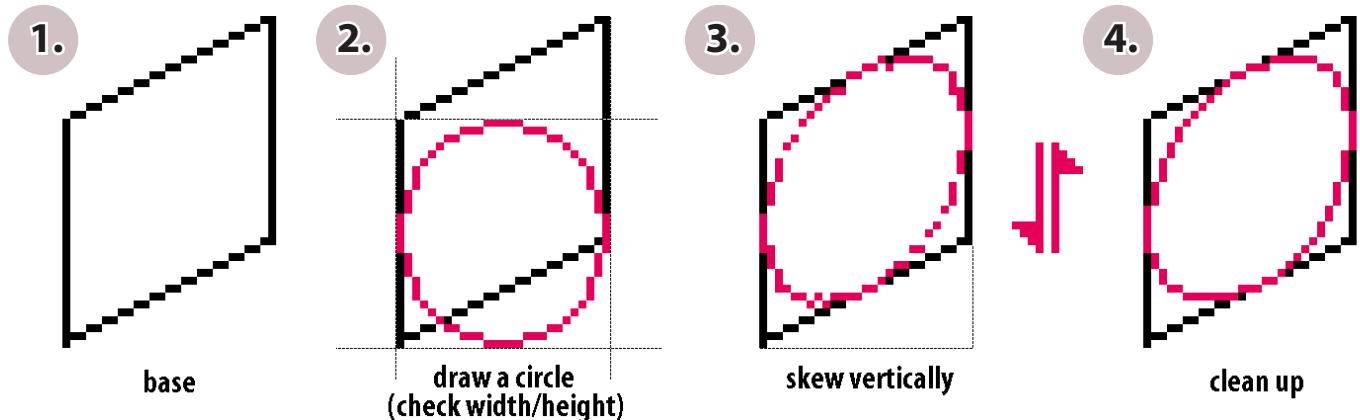


3. Draw the circle *within*.

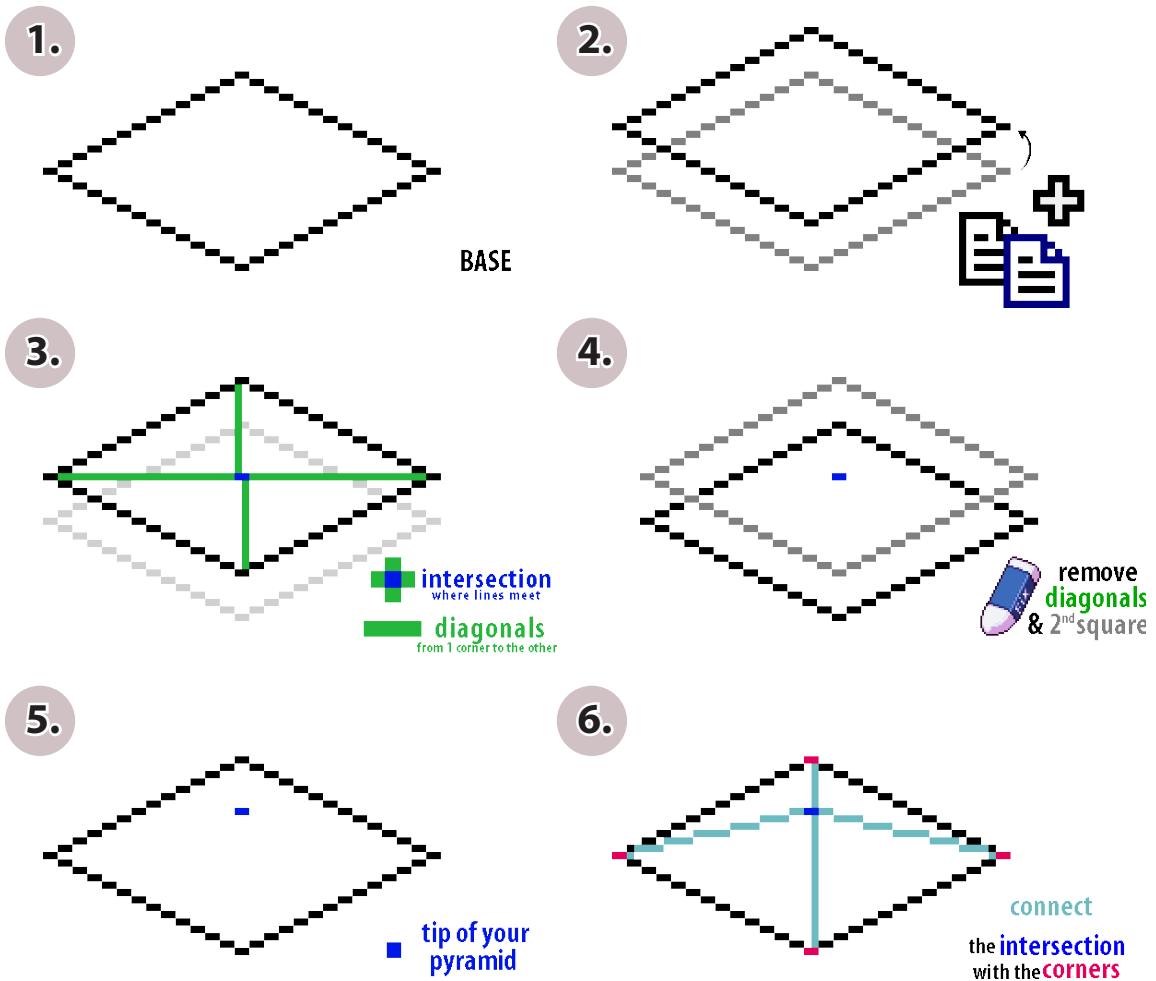


4. ... and voilà!

Drawing a circle on a vertical plane



Finding the tip of a cone/pyramid

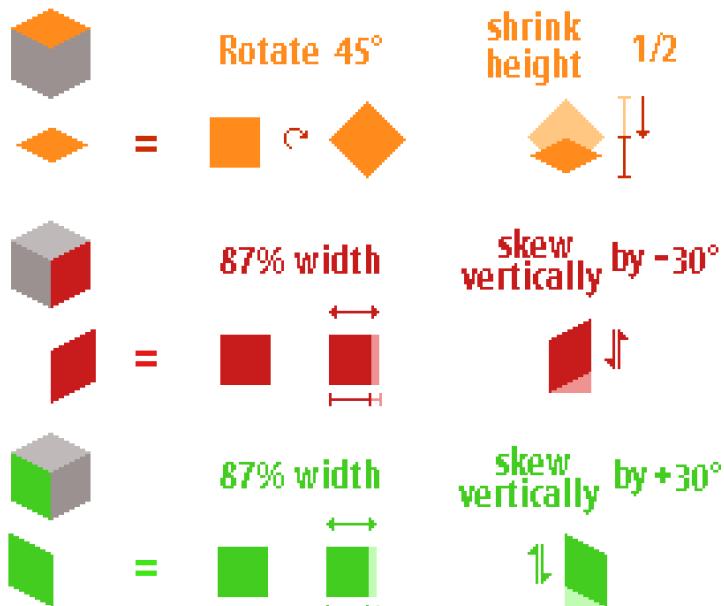


Converting sprites to an isometric view



1. Have your side scrolling sprite ready (use lines to guide you if needed).
2. Skew it by **30° (0.5)**
3. **Adjust the sprite** by moving parts around to add more depth.
4. **Clean up and fill in the gaps.** Fix any remaining mistakes.

Important: Don't skew the object the opposite way.
Skew it in the direction the object (or character) is facing.



Why 87%?

If you simply skew your square, it won't have equal sides! With the help of trigonometry, you can find out how to keep the diamond as it is. The length you need is cosine of 30°, because you're skewing it upwards at 30°.

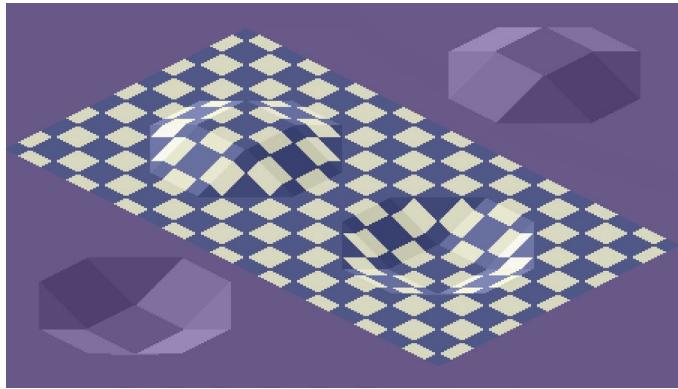
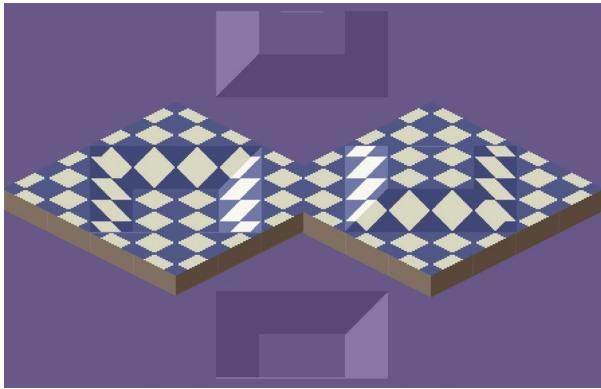
$$\cos 30^\circ = \text{about } 0.866/1$$

That's roughly 87% of the original length, but once skewed it will be back to normal!



Terrain

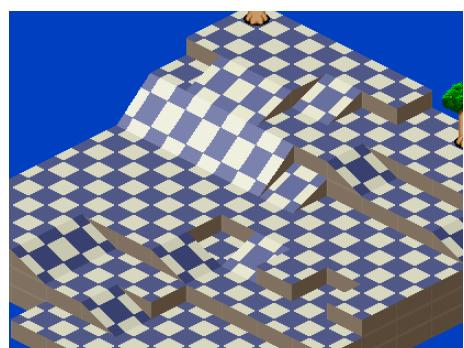
Most isometric fields have flat areas. You can have different altitudes, but you'll often have cubical platforms, towers or plateaus. Flat terrains are the easiest to program and draw. Not many 2D videogames have slopes. This example below from *Kirby's Dream Course* is a good reference for isometric slopes.



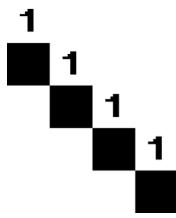
Captured using *Kirby's Dream Course Editor v. 1.13b* by Devin Acker.



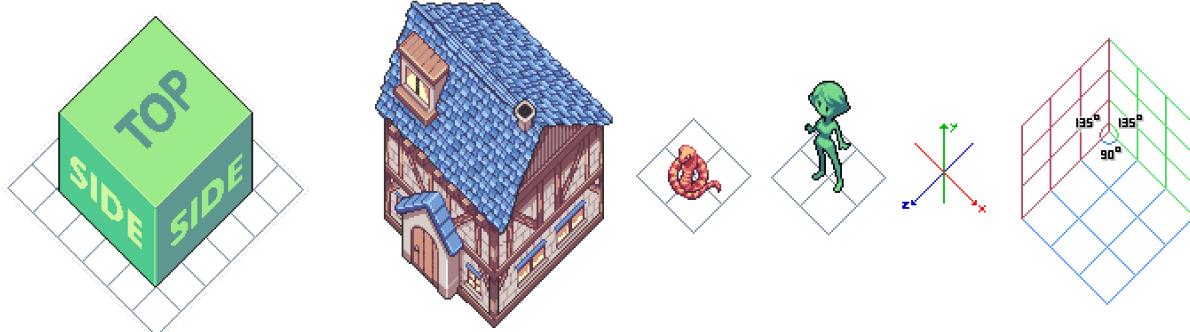
In grid based RPGs like *Final Fantasy Tactics Advance* 2, these slopes will only appear in 4 directions since the game-play only has 4 directions.



45° Dimetric



This is a very uncommon view. It works well if a map has high structures that you don't want your artwork to get in the way of gameplay. The same techniques of isometric art apply, but instead of 30°, only 2 sides are 45°, so essentially your guidelines are series of single 1x1 pixels. The vertical axis is 90° but the other two are 45°.



Earthbound "Fourside" (SNES)



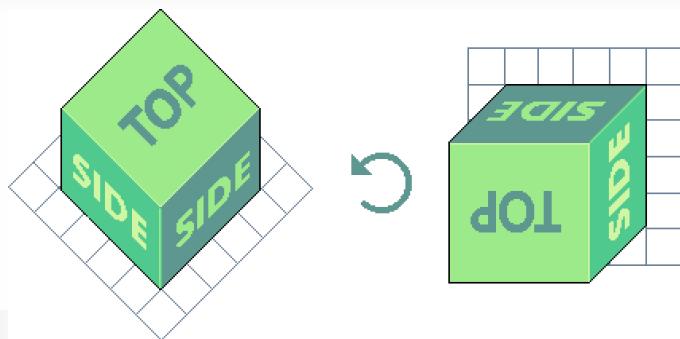
Boktai 2: Solar Boy Django (GBA)



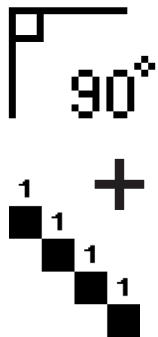
Nox (PC)



This view is sometimes considered **oblique**, because the top plane is orthographic. It doesn't look like an oblique view, until you rotate it! Other names include *axonometric oblique*, or *plan oblique* or even *military oblique* and commonly *planometric oblique*. A notable example is *Sim City*, on the SNES.



Oblique



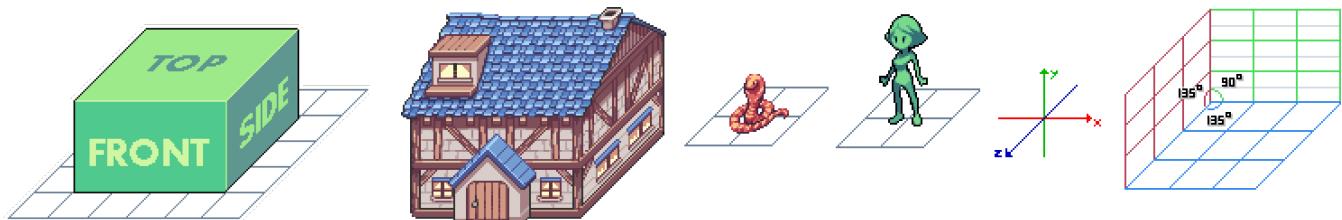
The front planes are **orthographic**, so flat and without perspective.

However, all other planes slant towards the side, and remain parallel. Usually, they are slanted 45° but occasionally it can be 2x1 lines.

Think “side-scrollers + 2 more planes”.

The front planes follow the orthographic rules of a 90° grid.

The top and side follow 45° grid lines of 1x1 pixels (but sometimes you *can* have 2 x 2 lines or 3 x 3 lines).



Earthbound (SNES),

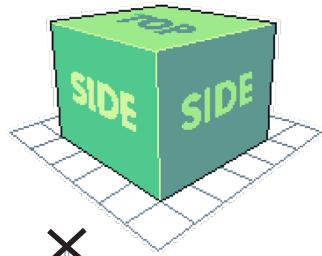
Double Dragon II (NES),

Pacmania (Arcade)

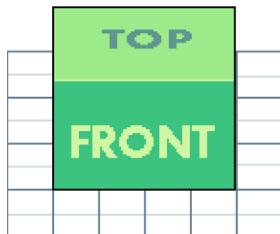
If you’re struggling with this view, you can use the skewing technique (mentioned previously on p.150) to turn top down maps into oblique ones. Simply slope the map vertically by 45° (or 1 unit) instead of 30°.

True Perspective

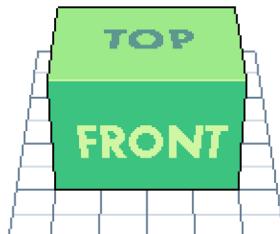
Pixel art not used for games generally follow the rules of regular art, perspective and painting.



No vanishing point,
all equal size.



True perspective with
vanishing point.



An object seen from a top down angle will also obey the normal rules of perspectives and has its shape skewed towards a vanishing point. No matter what viewpoint, the lines will be skewed. Games that have 3D environments with sprite textures can be manipulated to look like a traditional top-down view. This example below is from *Pokémon Black/White* (NDS).



Perspective



Orthographic (by user GuyPerfect).

True Perspective isn't unique to 3D games. In game illustrations can easily imitate perspective.



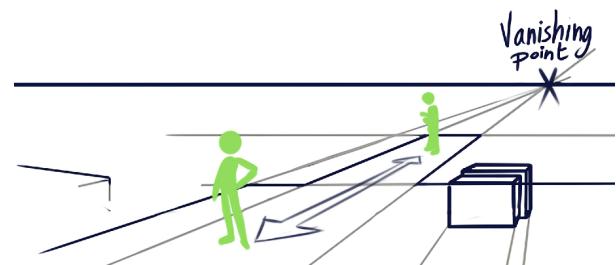
154

Cyberbots (Arcade)



Real Bout: Fatal Fury 2 (Neo Geo/Arcade)

2D games can have a perspective view, but it requires sprites to grow bigger and smaller in size as a result. It usually takes too much time and energy to do this manually, so newer games use engines to resize sprites automatically.



Indiana Jones and the Fate of Atlantis (MSDOS)

Here are some games that feature scaled sprites, manual and/or automatic.



Star Ocean 2 (PS1)



Saga Frontier (PS 1)



Contra - Level 2 (NES)



The World Ends With You (NDS)



Pixel-Logic Bonus

To further understand how 2D views trick your eye, here's some behind the scenes of 3D games that imitate top-down views.

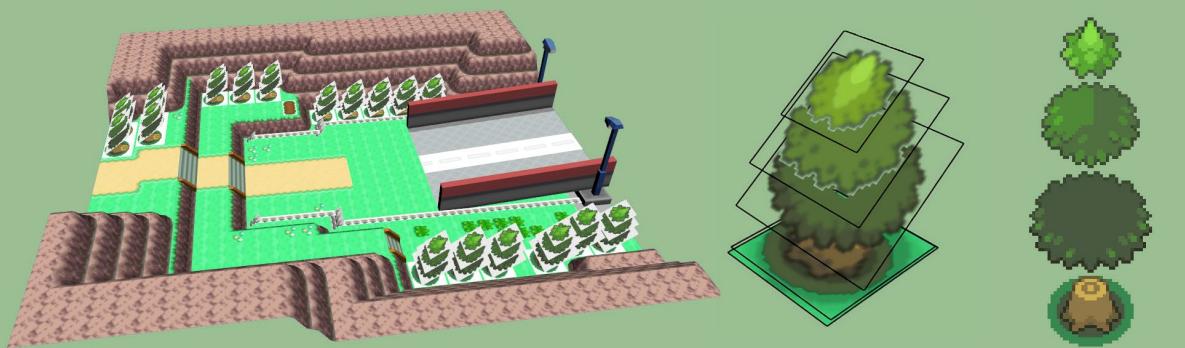
During an *Iwata Asks* about *The Legend of Zelda: A Link between Worlds* (N3DS), the director Hiromasa Shikata and his team reported that they went through a lot of trial and error with the top-down view. With this perspective in 3D, you don't actually see much of the character's face, but just the top of their head. You would have trouble telling it was the playable character Link. It was later revealed by Eiji Aonuma (producer of the series) that many objects in the game were set at an angle to improve visibility.

*A true top-down view actually has lots of problems.
If you make it truthfully, it doesn't look interesting at all.
So you have to fake it - but in a good way.*

Satoru Iwata



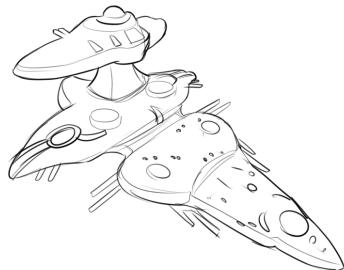
This technique isn't something new to game developers. It's been used in older games such as the *Pokémon* games on the Nintendo DS. This example shows that the fences and trees are made of sprites set at a 45° angle.



Clarity Issues



In *Chrono Trigger* on the SNES (and later on the PS1 and NDS), you travel the world in a top-down view. In the later portion of the game, a flying ship known as "*The Black Omen*" appears and floats over the land. The shape of this construction is quite peculiar. **It's easy to misinterpret.**



This is what the ship is meant to look like. The actual ship was never shown outside of the overworld and 1 battle screen on the deck. The ship is only visible from 1 angle (the front).

The easiest way to avoid any confusion is by simply **flipping the ship vertically**. With simple adjustments, it can no longer be mistaken for a tower.



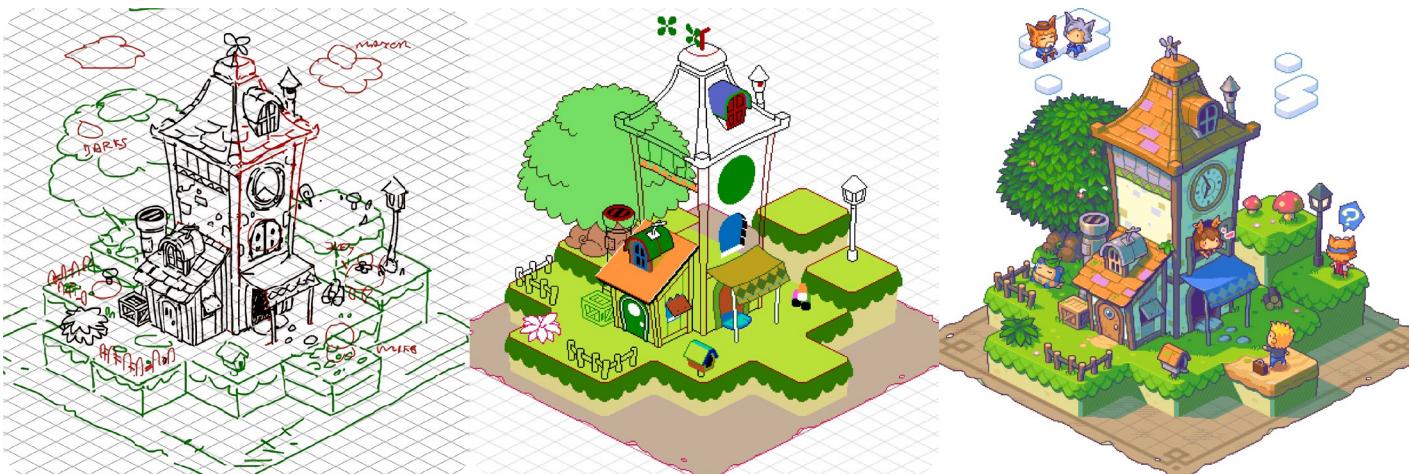
Remember to ask for feedback from others to avoid readability issues!

Using guidelines

Guest writer: Cocefi



When you build an isometric scene, **use a grid and guide lines to aid you.**
You can sketch it out in a different program first, or simply go directly into pixel art.



Even organic forms use geometric shapes as guides!

1.



Build a rough shape
with just a few ovals.

These are like the
skeleton of our
object.

2.



Follow the outer
shape of the ovals
... and you can
easily outline the
row of leaves!

If not, adjust the
ovals a bit.

3.



Block shapes within the tree.

4.



Define details and shading.

5.



Add highlights and shadows.

This isn't just a tutorial on how to draw trees. The point here is to **deconstruct**
shapes and help them guide you. **You can use this for ANY PERSPECTIVE!**

Showing scale

Most projections show the game world from a bird's eye view. 2D videogames usually have you look into a shoebox from the top, or from the side as they are the easiest camera angles to view. However to show a sense of scale requires thinking outside the box.

Why are there no low-angle shots and only in cutscenes?

In low-angle shots, it's near impossible for the player to know where they are walking. It's manageable in 3D since the player can easily move the camera back down. In 2D games you can only move left and right.

In 3D games you see low angle shots in *Shadow of the Colossus* (PS2), as the game is setting the mood and showing a sense of scale. This technique is more of a story telling device, so in 2D pixel art games you'll only see them in cutscenes.



Metroid Zero Mission (GBA)



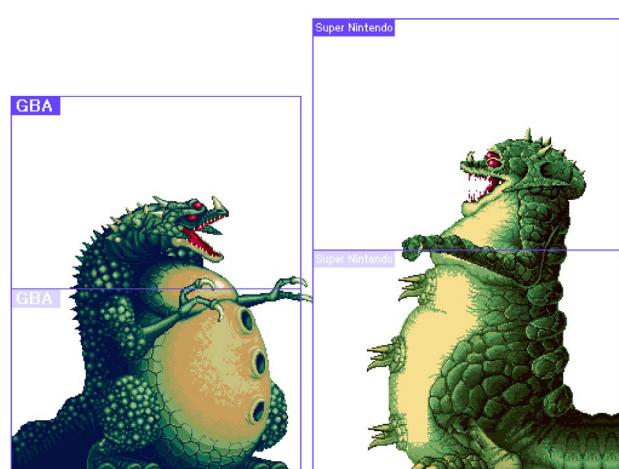
You can distinguish views into 2 planes to give a sense of scale.

The Legend of Zelda : Minish Cap (GBA)



You can use Mode 7 to scale up...

SMW2: Yoshi's Island (SNES)



...or spread graphics across 2 screens.

Metroid Zero Mission (GBA)

Super Metroid (SNES)

Conclusion

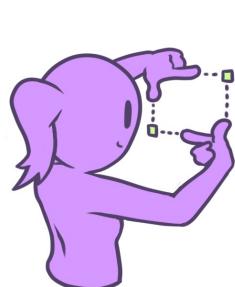
The way your audience experiences your world is a pretty big deal.

With games, the projection you use will end up defining the player's experience. Don't feel limited by the 7 projections discussed in this chapter. Remember that the player will look at this view of the world throughout the whole game. With illustrations, feel free to draw in any perspective you want. You have more freedom but you still have to follow the basic rules of perspective!



Quick info

Introduction
Orthographic projections



Types of views

Multiview drawings
Paraline drawings
True perspective



Extra info

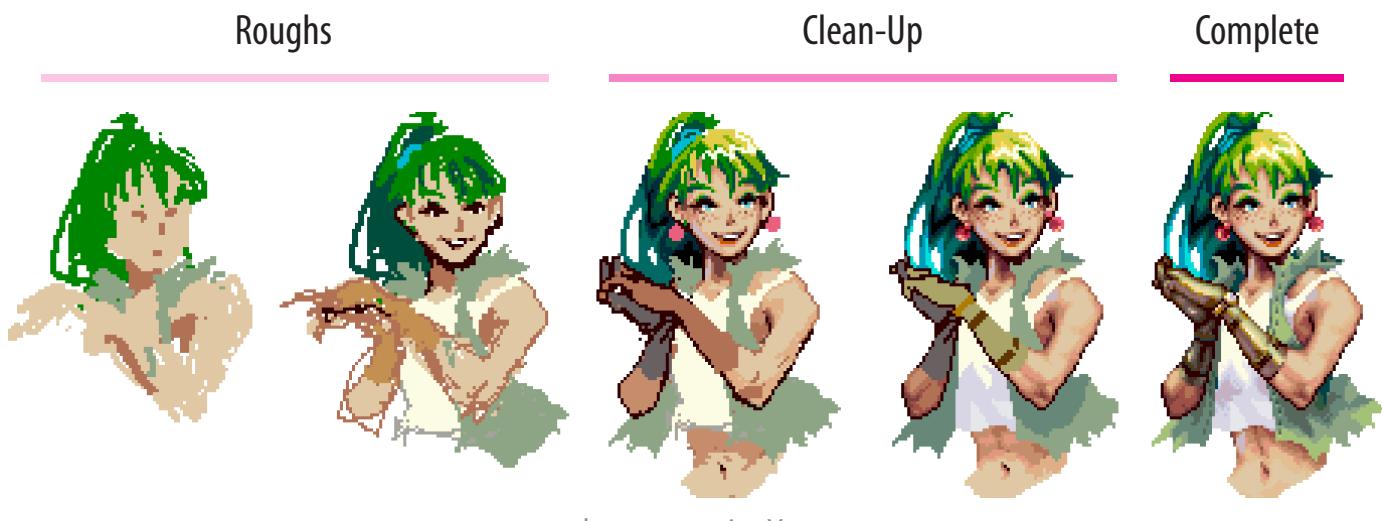
Clarity issues
Using guidelines
Showing scale

Chapter Clean-up

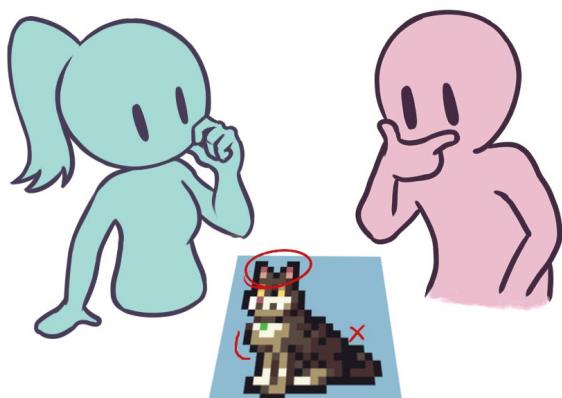
7

Introduction

Clean-up describes **all the finishing touches** and possible **improvements**. Even when you think you're done, there are a few adjustments you could make before calling it a day.



by guest artist: Yaa



If you are creating a video game, or simply making pixel art for leisure, you will most likely get feedback on your work. This may come in the form of tips or advice on how to fix certain things. It's important you also self-assess your work, in addition to others evaluating it.

You will grow more as an artist as a result!

If you'd like to catch up on clean-up tips, have a look back and check:

Introduction

[So to start?](#)
[Retro Hardware](#)

Anti-Aliasing

[AA or no AA?](#)
[Jagged lines](#)
[Banding](#)

Colour

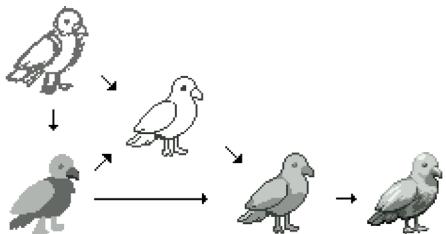
[Picking Colours I](#)
[Picking Colours II](#)

Readability

[...But pixels matter more](#)
[Silhouettes](#)
[Light & Shadow](#)
[Spacing](#)

More clean up tips will appear in the subsequent chapters!

From rough to clean



Some video games leave unfinished graphics in their data to use as place-holders. This gives an insider's look at each artist's method. Try to recall the diagram back in the [Introduction Chapter](#) and let's take a closer look at them.



Shape • Refine • Finish



In *Pokémon Black2 & White2* (NDS), this robot has an early beta version. The method used here seems like a mix of line work and shapes. Body parts have been moved around and the head has been shrunk.



In this example, the image has been redrawn once or twice at different sizes. The pixel art also underwent a few colour changes. The line-art here is sculpted and then refined at the end.

Pokémon Black2 & White2 (NDS).

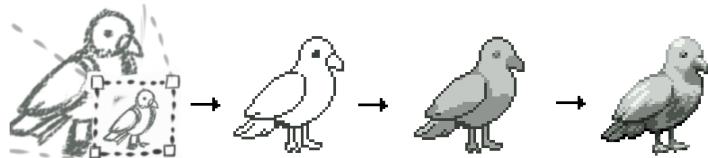


by Michafrar



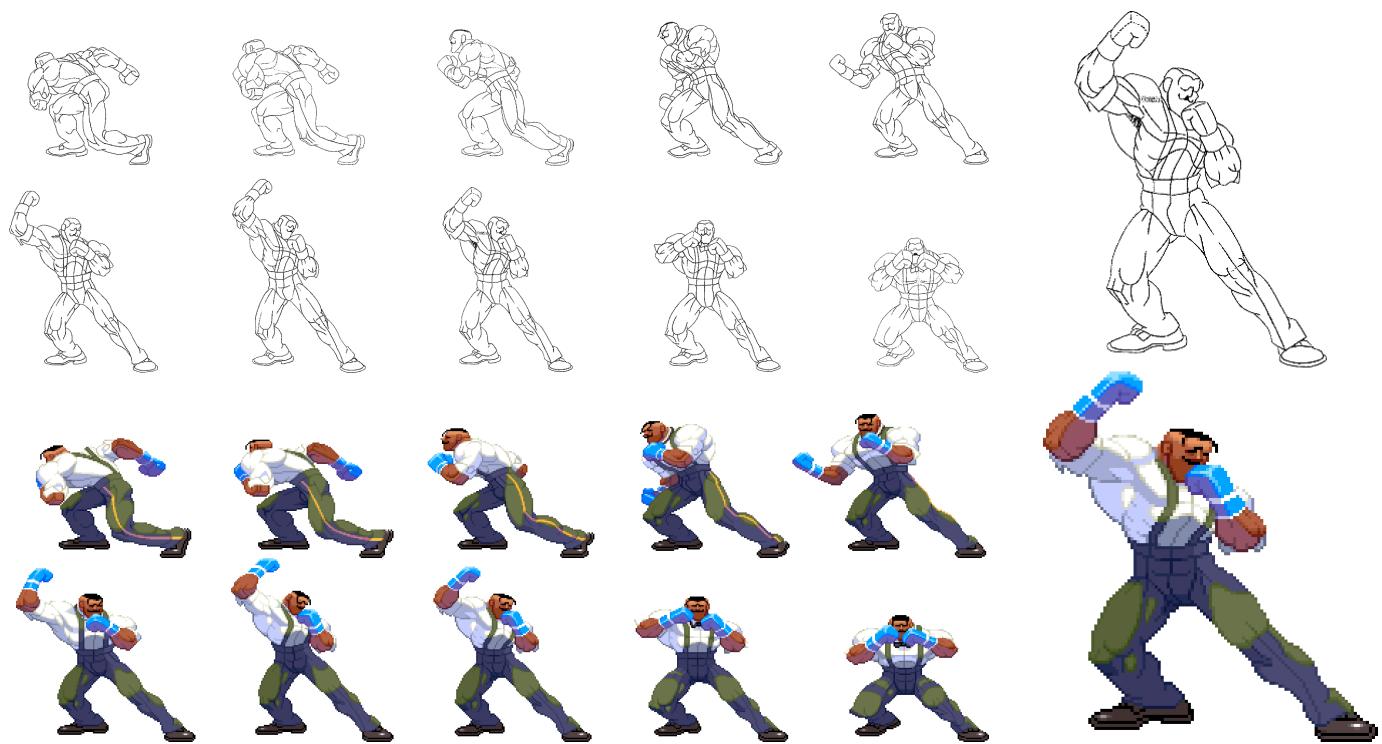
by guest artist: Yaa

These sprites were very rough in their early stages. They're in-between frames of a full animation. It's easier to use blobs of colours for in-betweens. That way, you work more with light & shadow, and less with lines.



Lines • Colours • Finish

Use a very rough sketch, and then finish it in pixel art.



Dudley from Street Fighter III (Arcade, Dreamcast)



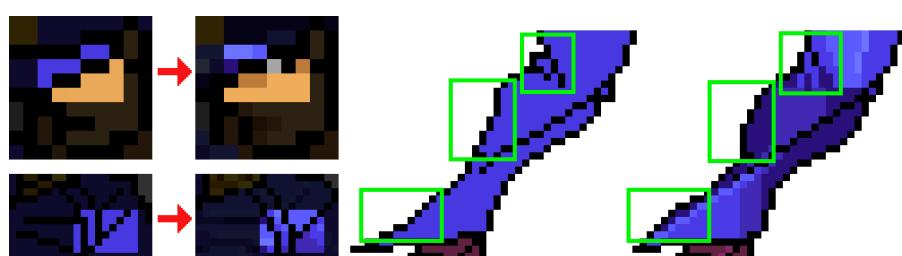
Early version

Final version

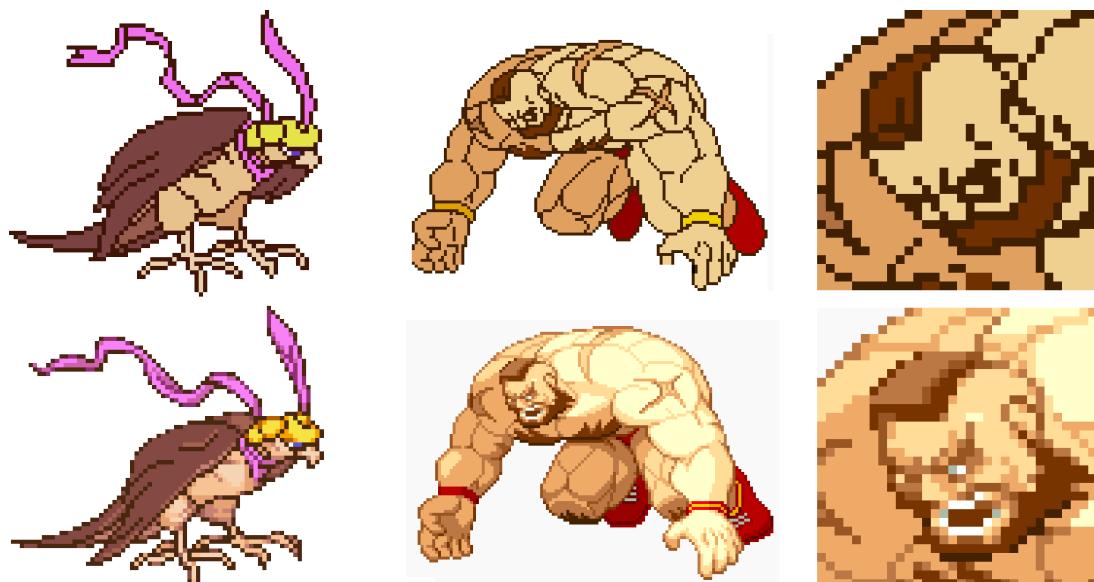
In *JoJo's Bizarre Adventure* (Arcade, DC, PS1), there is data of unfinished sprites. This game (like most other Capcom games) creates its graphics by digitizing paper drawings. The final version is simply shaded. There were quite some more changes made in the line-art stage. Some changes were subtle, others were completely different.

The final result can look completely different from the first line-art.

Don't worry if your work changes from your original sketch.



These sprites of *Petshop* and *Zangief* have seen multiple changes.
Both their heads have been **greatly cleaned up during the shading phase.**



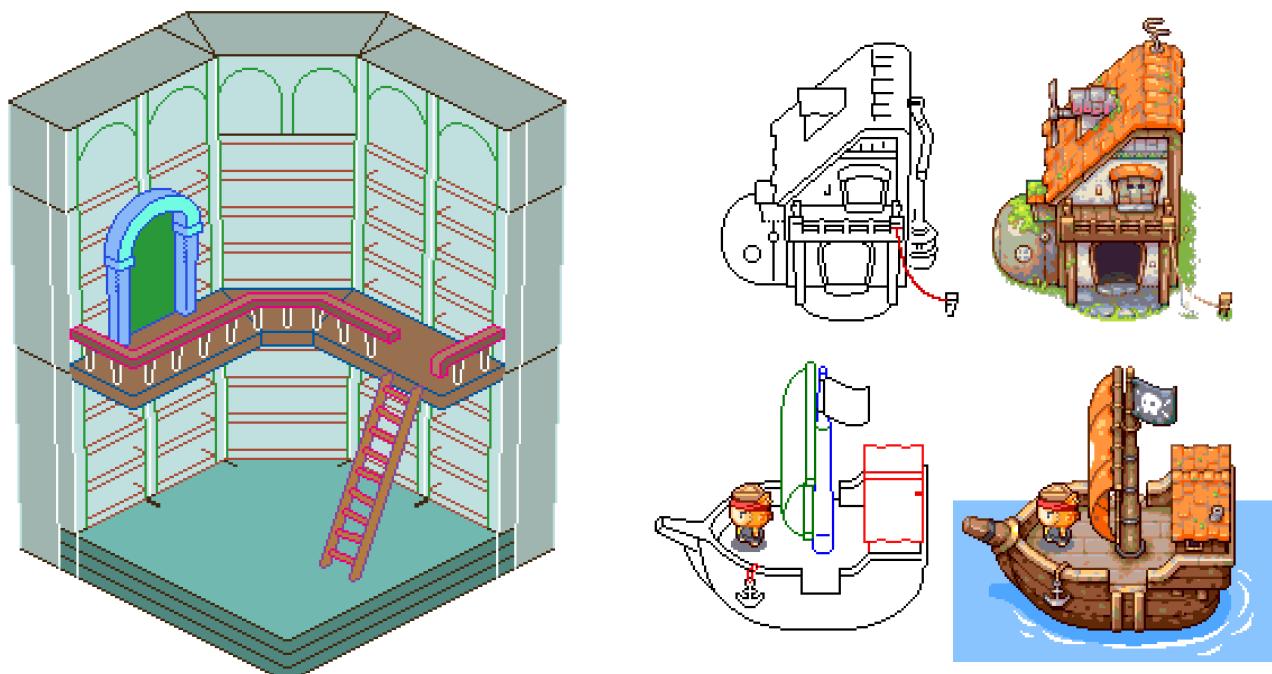
Jojo's Bizzare Adventure (Arcade; DC, PS1) and Street Fighter Alpha 2 (Arcade)

When the canvas is quite cramped, artists don't rely heavily on line art.

With pixel art, it's common for the final version to look completely different from the sketch, as you can see with Zangief.

If you have trouble getting detail in your line-art, try using shapes instead of lines

Line-art is primarily **useful when you are building a geometric structure.**



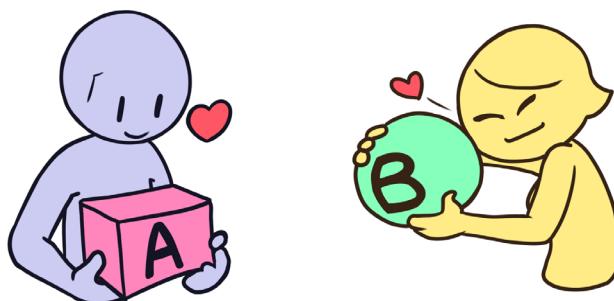
by guest artist Cocef

Adjusting your sprite



You can always make improvements in **the same** art-style. In the *Mega man X* games on Super Nintendo, the protagonist has no changes made to his default sprite. However, the character Zero is given brighter colours, improved stance, silhouette and cleaner shapes.

**Art is subjective. Everyone has their own favourites.
Not all changes are necessarily improvements to all of your audience.**



Magical Chase (TurboGrafx-16)

As you probably know, design changes are also made to suit tastes. We won't be discussing these however in this book.



Sonic 3(Beta) (Sega Megadrive)

Things to look out for when adjusting sprites:



Silhouette



Design



Colours



Pixel Shapes



Lighting



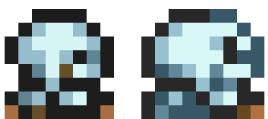
Readability

THESE ARE NOT A CHECKLIST. We'll be using these examples for ease in the following pages.
There are more than just these aspects beyond this book.

Examples from Video Games

Bonewalker from *Fire Emblem: The Sacred Stones* (GBA)

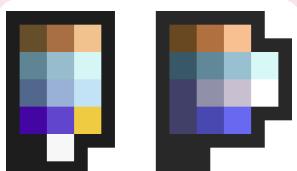
Adjustments



The bigger skull size allows more space for details and subpixels for the eyes and mouth.



The sword is more 3D and makes the silhouette more readable. Same goes for the cloth around his pelvis.



The palette isn't much different, but the highlights and shadows are more pronounced.



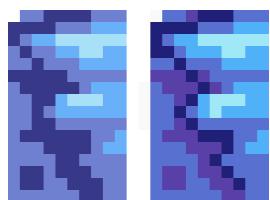
The stances of each pose are less stiff, more intimidating. They have more personality.



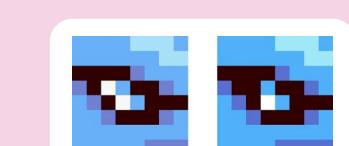
The silhouette is easier to distinguish and much wider.

Frostwind boss from *Drawn to life* (NDS)

Adjustments



A new dark line outlines the dragon's cheeks. They now stand out more. The old version had 1 big shape of indigo which isn't a bad choice, though.



With only 1 pixel difference the pupil looks smaller. That one white pixel is quite a change.



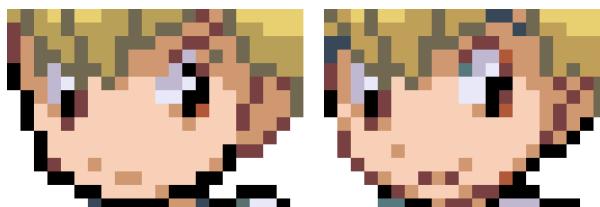
A darker shadow outlines the mouth. It's much sharper. There's also some A-A to soften the line.



The colours are more vibrant.



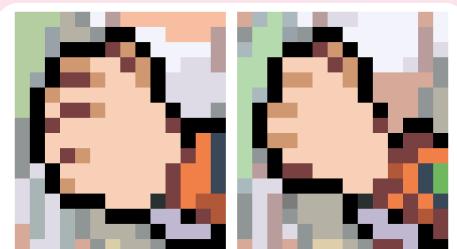
Diamond/Pearl (2006) Platinum (2008)



The face got a complete re-do. The right eye is cleaner and the eye socket is now 90°. The smile is wider and is more distinguishable from the nose. The jaw now has anti-aliasing and a smoother outline.



Barry's new silhouette is closer to his model sheet. His legs and arms stand out more and his hair is spikier.



The hands are smaller and more readable. The shapes of similarly coloured pixels are cleaner too. Much more simplified.



The 2008 sprite includes details that are more accurate to his model-sheet. Not just the stance but also hair, and collar.



rough sprite



final



beta



final

Pokémon sprites in general are a great example of adjustments during development.

Knuckles the Echidna's goal sign (Sega Mega Drive)

Adjustments



Sonic 3's Prototype

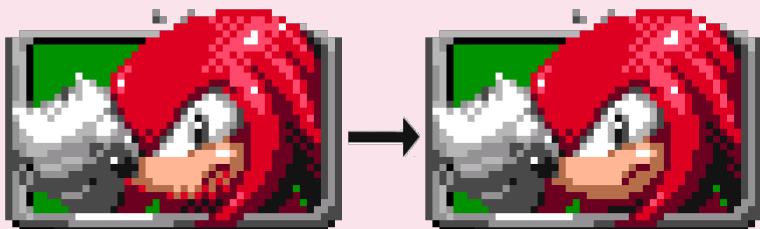


Sonic 3 & Knuckles



Sonic & Knuckles
locked onto Sonic 2

Between these versions, the only big difference is seen in the right portrait. The left and middle ones only have differences in highlights and hair shape. The middle one (used in the final game) has a shiny reflection in its eye. The eye is much sharper too. **Remember that 1 pixel can make a difference.**

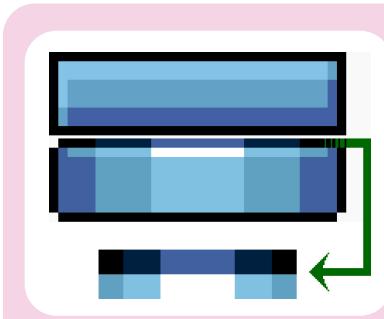


For some reason, the *Sonic 2* sprite of Knuckles has red dithering around his mouth.

This doesn't read well at all and looks like random noise (stray pixels). It looks fine without the red pixels, and doesn't really need dithering.

Drill platform from *Pulseman* (Sega Mega Drive)

Adjustments



Using different lighting makes the object appear more 3-D.

The outline is shaded too. The edges are rounded as well.

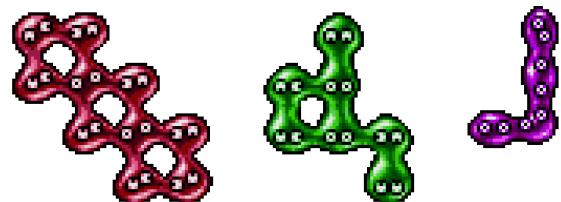


The shading in the old one didn't respect the light source.

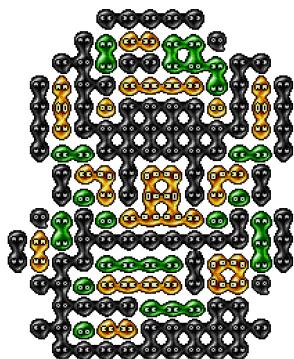
In the new one, you can see the platform cast a shadow onto the red piece.

Cleaner Shapes

At times, clean-up requires a little pixel precision. This is where shape language comes into place. Pixels of the same colour **clump together** into shapes. We will call them **shapes**. Others call them **clusters**, **clumps**, **chunks**, **blocks**, etc.



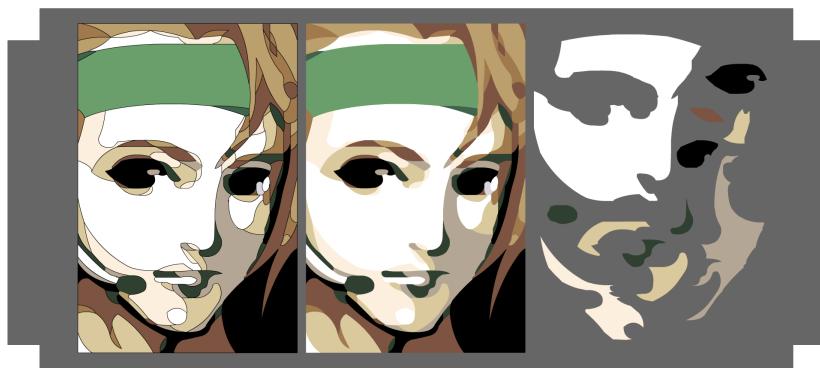
Puyo-Puyo (Super Famicom)



If you're familiar with the *Puyo-Puyo* games, try to imagine pixels like puyos clumping together. This happens when puyos of the same colour are next to each other. Maybe try seeing them as Rock Climbing chunks. It's a far-fetched comparison, but you'll find out why in a moment.



Vector art is very **similar in this regard** to pixel art. Vector art is made of geometric shapes that can be scaled infinitely. The shapes have no blur and can all be edited freely.



Vectorized portrait from Metal Gear Solid 3: Subsistence (PS2)



MGS3 (PS2)

It's as if every block of colour is 1 mosaic tile. When these shapes are clean and well crafted, they will make your sprite a bit more readable!

Another art-form which is all about shape language, is **Woodblock printing** and **Linocut printing**. It focuses on juxtaposing silhouettes. Some elements of *Notan* imagery occur in woodblock prints.

These prints use carved blocks of wood to copy silhouettes. These **look a lot like stencils** you would see in graffiti. When you layer several shapes over each-other, you obtain a fully coloured picture. This art-form is popular world wide, but is especially prolific in Japanese and Asian Arts.

Seymour Road Studios, UK



A final comparison we can make is based on notes from **Walt Stanchfield's Disney Drawing Classes**. In these notes, he talks about the term "**lazy lines**".

While talking to Dan Jeup one day, he mentioned "lazy lines".

He was referring to lines that didn't describe anything,

Things like shape, texture, softness or hardness.

It's like what you get when you trace some-thing, an overall sameness of line.

Walt Stanchfield

You say, now I am drawing the bridge of the nose :  Now the top of the nose : 

Now the front of the nose : 

Now the part under the nostril: 

Now the back of the nostril : 

Now the top of the nostril : 

Those are all separate parts of the face and must be kept in mind as you are drawing them. If you think of all that as being just one big shape it will end up as a lazy-line drawing:



Now I am drawing the top of the cheek. The part nearest the nose and the ear try to stay put, so you get a bulge of loose flesh between two ends that trail off to where they are attached more firmly.



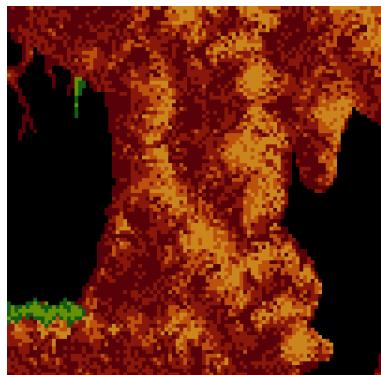
Lazy lines would not spell out all that action. They would simply be there, not describing what is actually happening in a realistic manner.



This may be about lines, but it's relevant to shapes and shading too! The same idea can be applied to **paintings** and of course ... **pixel art!**

It's not necessarily about how clean every individual shape is.

Just like with high definition art or traditional art, it's more akin to how well you apply brushstrokes and how it all pieces together in your final piece.



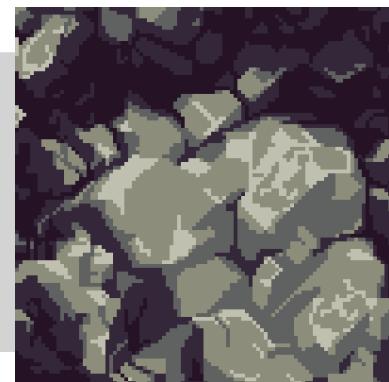
Lemmings (PC, Amiga & more)



Castlevania: Symphony of the Night (PS1)

Cleaner shapes convey the most information and will often look better. The graphics in *Lemmings* (left) are noisy and the graphics in *Castlevania* (right) are clean cut. When you make textures, **cleaner shapes are more believable.**

The PlayStation may have more advanced graphics, but when reduced to 5 unique colours, these rocks will **STILL** look more convincing.



This shape language doesn't rule out **Anti-Aliasing**. In fact, A-A can help improve your shapes slightly! A-A will not be your saving grace, though. It's only used to soften your lines and shapes, so ultimately it's all about drawing skills.



Castlevania X: Rondo of Blood (TurboGrafx-16)

Dithered artwork is also made of shapes, with dithering blending the cell shading.



1



2



3

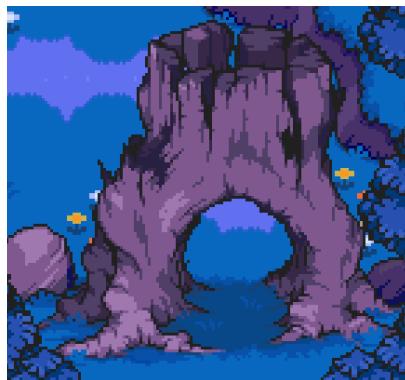
Odin's Sphere fan art by guest artist: Yaa

Your shading also **starts off as shapes: areas of light and shadow** (even when the final piece is detailed!).

...just like traditional art!

Clean shading is important for both simple and detailed works. You can't place shapes of light and shadow without much thought.

The left tree trunk has *a colour ramp of 4 shades* and looks more like cell shading. The right tree trunk has up to 8 shades in its colour ramp and is highly detailed.



Mother 3 (GBA)



Alundra (PS1)

Getting the hang of this is just like regular drawing; it will happen over time. You'll see how **certain pixel placement can convey light and shadow better than lines can.**

If you're really interested in the concept of defining shapes, check out this series by **Marco Bucci**. In episode 4, Bucci highlights this theory within painting, but it can also translate to pixel art!



Title: Good Shapes - 10 Minutes To Better Painting - Episode 4

Preview video: youtu.be/-ZknWKTpc90

Fixing the shapes of your pixel art is also subjective as each artist has their own preferences and hypotheses. It's highly encouraged to learn from others. If you're interested in the nitty-gritty, be sure to give the Pixelation.org community a look.

Multiple versions

Before you finish a sprite, you may not be entirely satisfied with the final look. **The final step can sometimes feel like a roundabout.** You might have to walk around in circles before finding the right exit. By making multiple versions of the same sprite, you can pick your favourite version.



In [Chapter 4](#), we discussed how a single pixel can make a difference. Changing some pixels won't create a *huge* difference, but they can still have a **subtle effect!**



When you aren't sure what looks better, **create multiple versions** and have other people vote on their favourite. If you're alone, take a break and compare them with fresh eyes to pick one yourself.

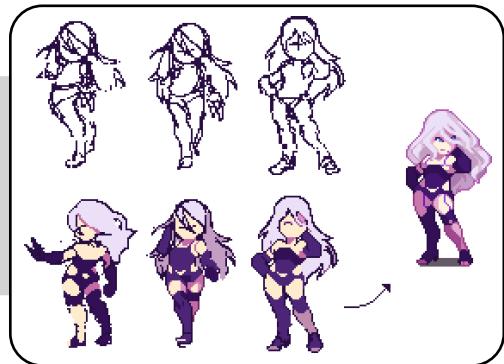


By guest artist: Steven McCarthy

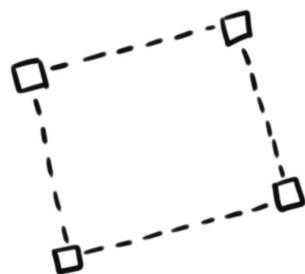
With little space, it can be tricky to pixel exactly what you want. Keep trying until you get a decent result. If nothing works, try to think outside the box and start fresh.

It's not always about the little differences. Not too sure about the entire sprite? Try doing multiple sketches so you can get a feel for the posture or the mood.

By guest artist: Martins



The Selection tool



Instead of redrawing pixels from scratch, you can select areas of your drawing and move them about. This can save you a lot of time. If you draw or animate digitally, you must be already familiar with this tool.

The lasso tool can also be useful, but sometimes it's too sensitive to control. Make sure the lasso tool is aliased!



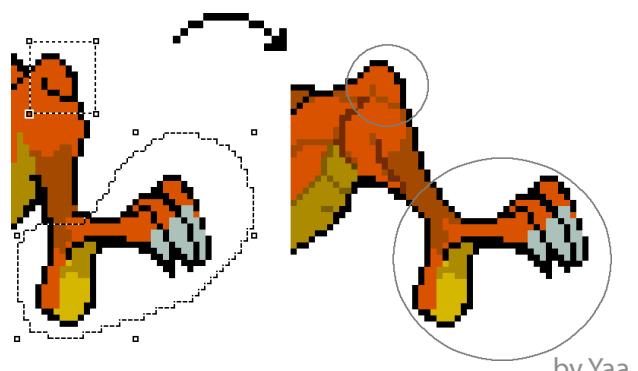
by Michafrar, character by Nintendo

You can move parts around and modify your sprite.

If your work isn't on-model, you can make **simple changes with the selection tool**. This seems quite obvious, but don't forget this tool exists. Remember to tweak and fix things as you go.



by Michafrar



by Yaa

You can easily fix things at any time, and move parts around:



Adjust



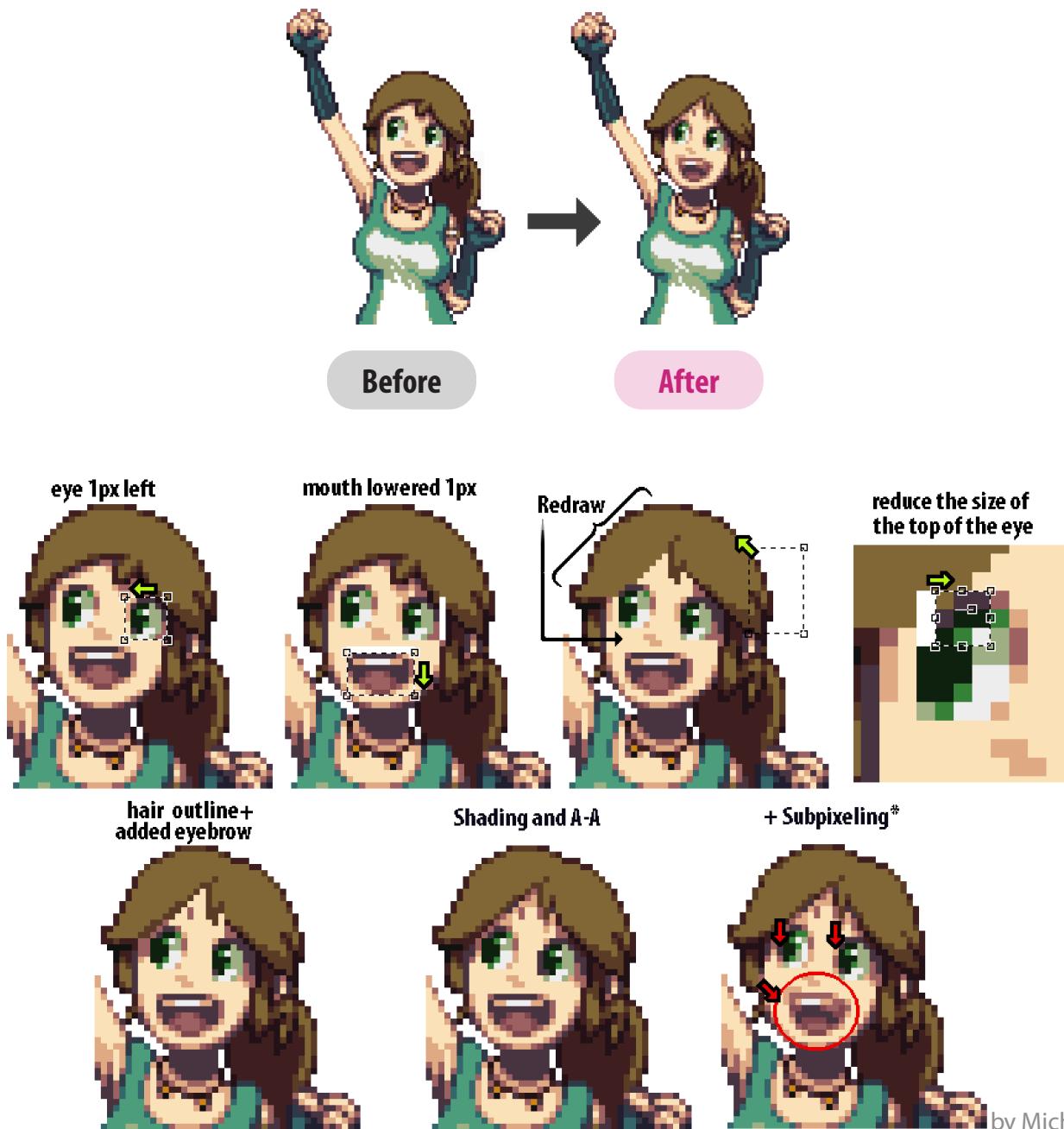
fill gaps

!

by Michafrar

Here's an example of a sprite that was improved by using the selection tool.

Both these sprites were made by me, at different times.



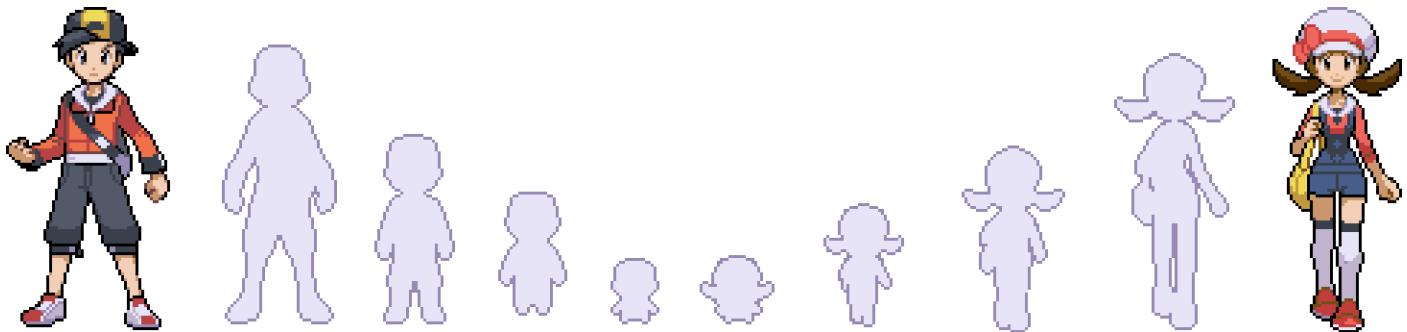
So how does one make those subtle changes?



Sub-pixeling has been brought up several times now. Even the tiniest changes can improve your sprites.

Look forward to it in Chapter 8.

Scaling & Rotating



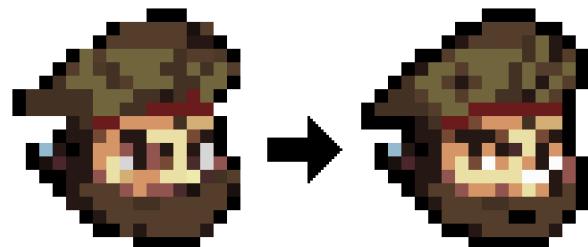
Pokémon Heart Gold & Soul Silver (NDS)

When you're tasked to shrink a sprite, you have to sacrifice details and pay more attention to readability. Have a look back at the chapter **Readability** and the pages "["Size Matters..."](#)"



by Michafrar

When you simply resize the sprite, you'll end up with a pixelated mosaic. Looks quite messy! **It looks like a lot of work, but you can totally clean it up.** Use the resized mosaic as a base, and redraw important features and lines.



You'll switch between **the eyedropper and pencil tool** a lot! So make good use of them.



by Michafrar



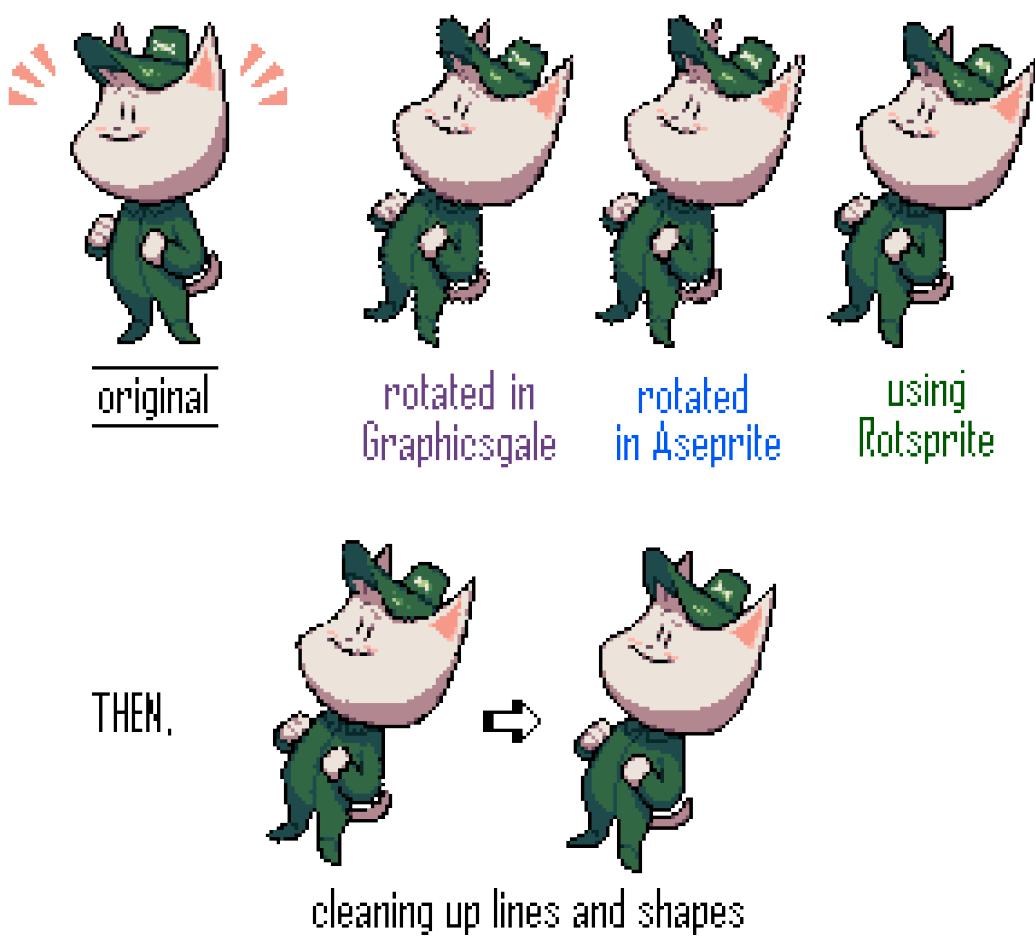
This is one of the best exercises to intuitively learn pixel art.

Modifying shrunken sprites will make you think twice about pixel placement. Try doing it yourself! It's good practice :D

The same clean-up can be performed on enlarged sprites, but it will be more of a drawing task.
It's often better to start big and go smaller, than the other way around.



However, clean-up is more often used for rotated sprites. You might rotate body parts or backgrounds more often than resizing them. The process is the same:
chisel & add pixels as you eye-drop & redraw over the sprite.



Sharpness



Gotta stay sharp when you're a tiny sprite! **Sharpness is more than just how fuzzy or clear an image is.** Colour, contrast and shapes also play an important role. If you use a "sharpen" filter, you can see how the colours and shape of an image are affected. However, we're here to do it manually. So ... no filters!

Only apply the advice on this page if you feel like they're necessary. **Here are some methods to keep your sprites sharp and readable, even from a far distance.**

1

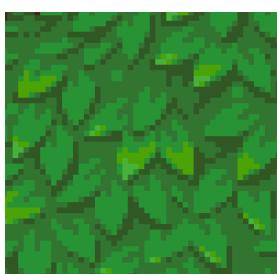
Play with more light & shadows, don't rely too much on line-art



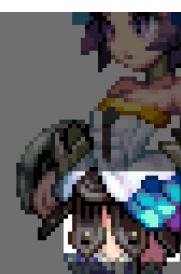
Hand 1 was drawn with line art, but it resulted in unreadable splotches of colour. It's easier to tell objects apart using clean shapes on **Hand 2**. Higher contrast also makes it more readable!

2

Add more highlights



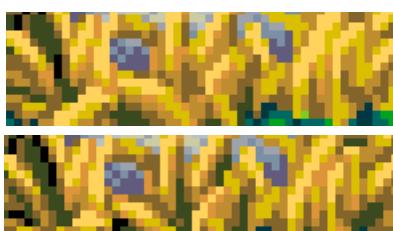
by Cocefi



By Yaa

3

Add darker lines to make things pop



By Yaa

Various possible tweaks

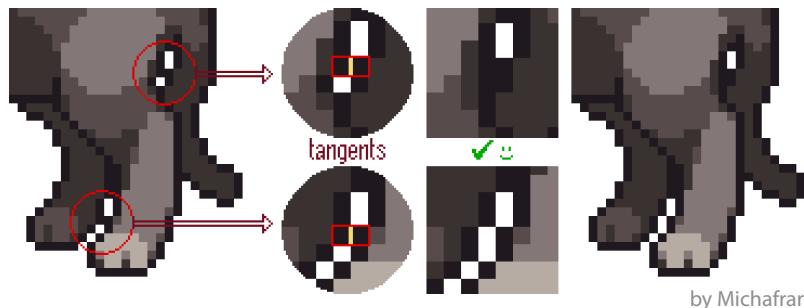
Contrast



Jackie Chan's Action Kung Fu (TurboGrafx-16)

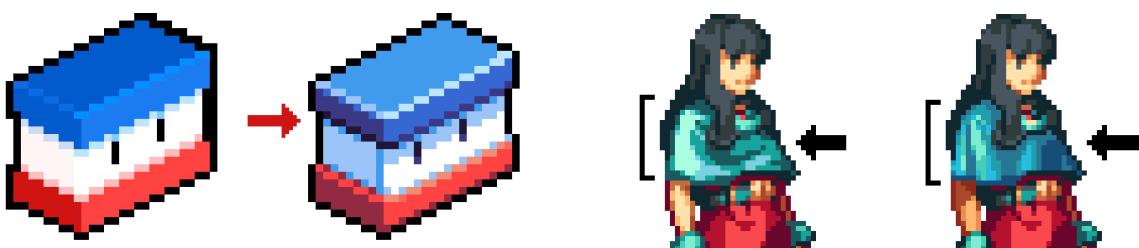
Without adjusting any pixels, you can change the contrast in colours. You simply do this by recolouring every ramp of a colour palette or by using colour sliders and then manually fixing them. Keep in mind: **Contrast can be multiple things: mood, hue, saturation and values.**

Tangents



This is the same principle seen in tutorials about comic books and storyboards. Tangent outlines can stand out. If you use this in animation, you can get away with this, so don't worry about those instances!

Light & Shadow



Touching up colours is usually not enough, you must also consider the following: **lightsources, highlights, shadows, and areas.** You will have to play with shapes, light and shadows to make the necessary fixes.

Character modelling & details



Sprite by Michafrar, Character by Nintendo



Changes can also involve referencing character model sheets or how designs are constructed. If you're adding/reducing detail it's always good to have source material to make judgement calls.

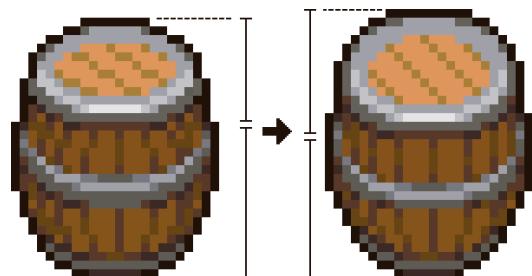
Proportions

With the **selection tool** (or lasso tool), you can easily move parts around. Pixel art is easy to edit, so the proportions of a drawing can be fixed even at the very end!



Sprite by Michafrar, Character by Nintendo

Perspective



When the perspective on your sprite doesn't look right on your first try, **you can always use the selection tool and edit parts**. With this adjusted barrel sprite, you see more of the top lid, and less of the cylinder. To ensure the objects you draw are within the same perspective, **simply place the sprites next to each other to spot any mistakes or differences**.

From start to finish I

For this sprite, I had to be time-efficient and decided to start from a drawn sketch. From there, I shrunk it to pixel art size. One sketch to get the personality and feel right, then another one to create cleaner line-art.

Instead of going straight to line-art, I will tackle this sprite area by area. Let's begin with the coat.



Character by RiddicTH



No matter which method you use, the process is usually:
Flat colours - Shading - Details

I didn't outline the face, because the canvas size is so restrictive and there is little room for detail. So just in case I keep the sketch on a layer. The hands were big enough, so those were possible to outline properly. It's not often you can pixel every single finger.

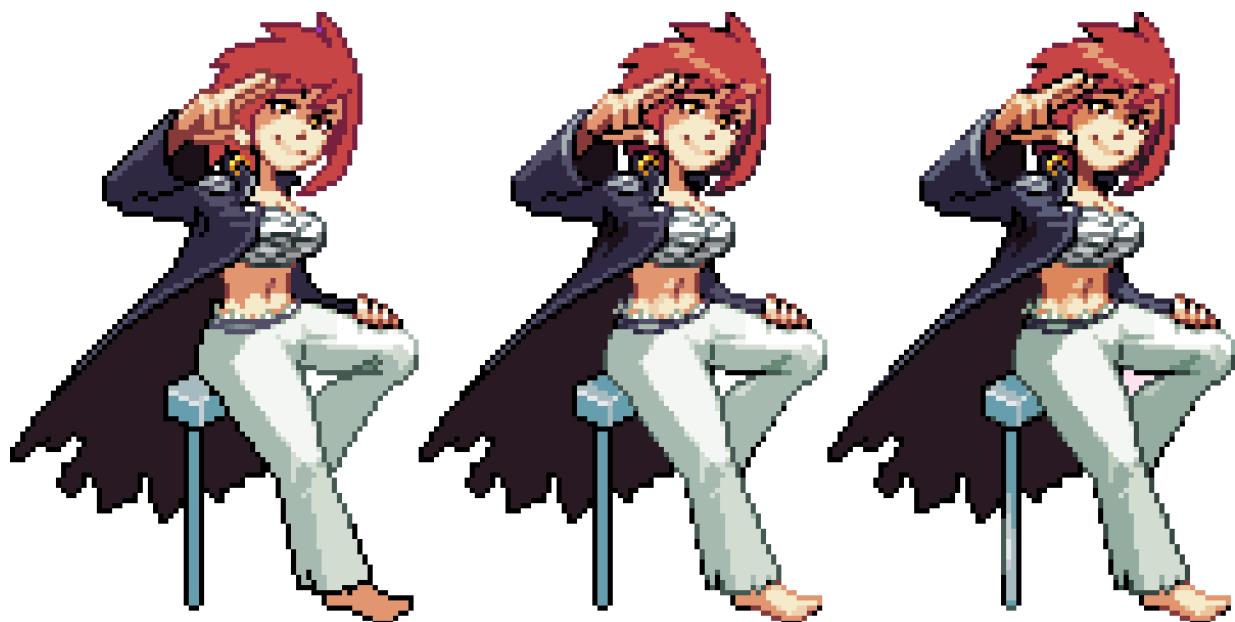


pixel art by Michafrar

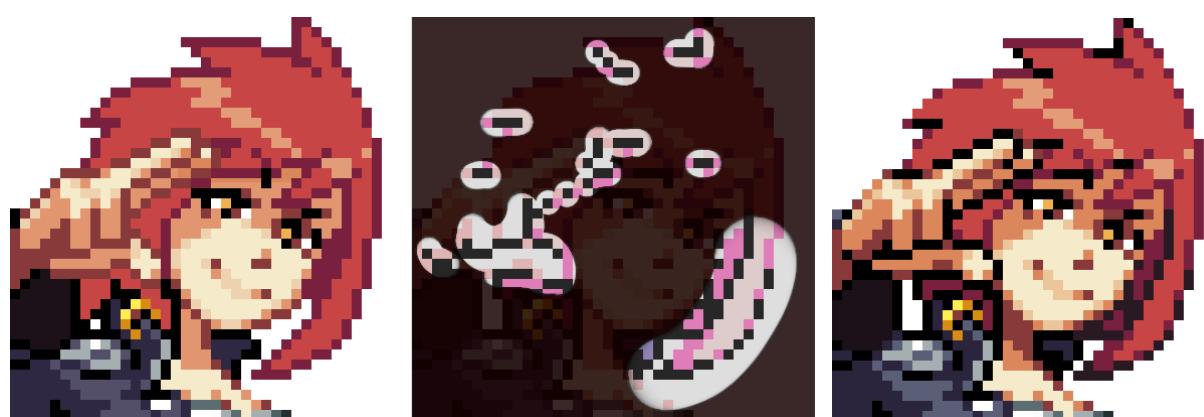
I made the corner of the eye more defined. The face takes a few tweaks to get right, though.



For this sprite I made multiple versions of her smile and decided to go with my favourite (which was mouth closed). Check back on the [Multiple Versions](#) section of this chapter!



In these final stages I decided to tweak the colours within the line-art to give a better sense of contrast, while also adding detail to the bottom of the drawing. With lighter line art at the bottom, it implies a sense of line weight that can be hard to see with a pure black outline. We look at this style of outline in [Chapter 1](#)!



To make the outline pop out, I added darker pixels to make it sharper. Remember the [Sharpness page in this chapter](#)?

From start to finish II

Guest writer: Shawn Martins



If you're used to sketching on a small canvas, you can directly make a rough **sketch with the pixel brush**. Once the sketch is complete, the base colours are laid out over the sketch.



They generally started by **detailing one area, in order to establish** the style, colours and lighting. Nothing is permanent, though. This is apparent when looking at the changes made during the process.



The legs went through **multiple changes**. Many different versions were made to make the pose more dynamic. As we've seen previously, it's quite common to **try out different designs before settling for a final one**.



Once the legs were complete, more **details were added** to the rest of the sprite. Once in a while, the artist **goes back to adjust** previously completed parts. This involves moving parts around with the selection tool, and redrawing parts from scratch. The necessary changes are up to the artist's judgement. Once they are satisfied with the final look, the sprite is complete!

From start to finish III

Featured Artist: Yaa



Yaa starts a scene with a very rough sketch directly in pixels. The light source is set from the start. That way it's easier to find colours the characters and objects, instead of starting from white and doing the background last.

Here are a few specific parts of the artwork, step by step.



Conclusion



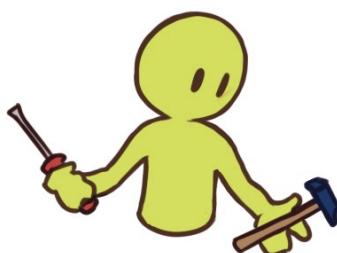
Drawn to Life (NDS)

The process of “clean-up” may not strike you as an obvious task at first. It’s quite subtle in execution, but can make a huge difference.

Clean-up in pixel art is **similar to the clean-up in 2D Animation**. They share same mind-set. You revise the original roughs and literally clean them up by going over them again with detail.

**All these adjustments and changes happen at any stage of your work.
All the techniques from the previous chapter play a role in clean-up.**

Most changes occur at the very end: when you receive feedback or auto-critique your work.
Don’t hesitate to improve your sprites, even when you think you’re done!

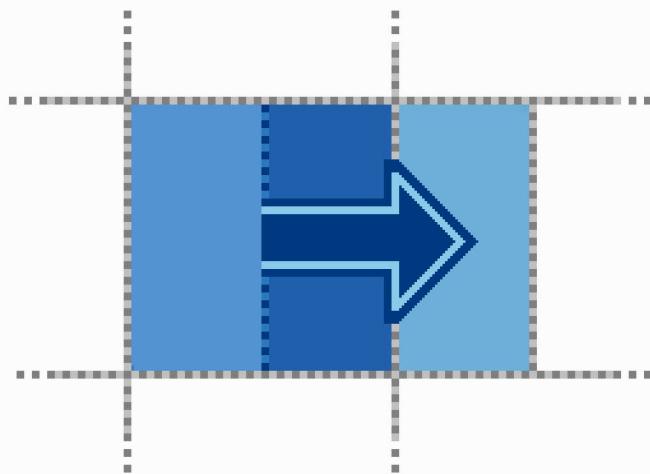


Food for thought

- Introduction
- From rough to clean
- Adjusting your sprite
- From start to finish I & II

Tips and tricks

- Cleaner shapes
- Multiple versions
- Selection tool
- Scaling & rotating
- Sharpen
- Various possible tweaks



Chapter 8

Subpixeling

Introduction

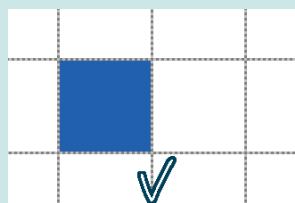


Super Metroid (SNES)

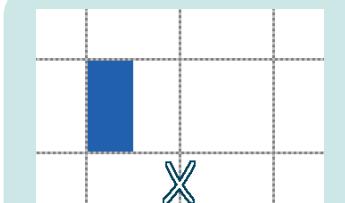
Metal Slug 3 (Neo Geo)

Darkstalkers 3 (Arcade, PS1)

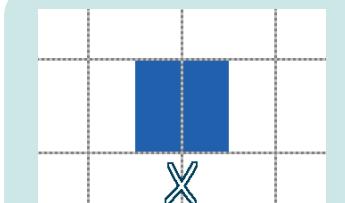
You've likely heard of subpixeling. It's often seen in **idle animations** and very **subtle movements**. Many golden era games used this technique. These graphics have inspired the artists of today.



This is 1 pixel.



A subpixel, but impossible



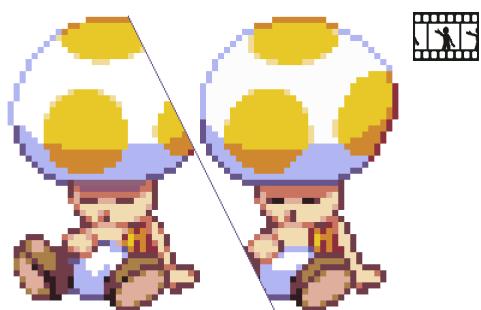
This is also impossible

The pixel is the smallest unit of resolution. We can NOT go any smaller, nor split pixels between two squares. So we have to pretend and *find a way to imitate it*.

Subpixeling is giving the illusion of something smaller than 1 pixel.
Subpixel means “under a pixel” or “smaller than a pixel”.



Subpixeling is an advanced and complex procedure. If you're having trouble, do not worry. It's not always necessary, but it's a fun challenge to hone your animation skills.



Sprite by Michafrar, character by Nintendo

When you see this icon, it means the image has an animated version. You can open these animations and flip through the frames. They can be found in the digital folder that comes with this chapter.



When & How



Subpixeling can be found in

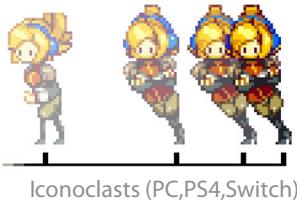
Still images



Animations

For non-moving images, subpixeling is a synonym to anti-aliasing and line weight. For animated sprites it is referred to as subpixeling animation. **Both rely on the same technique to create illusions: anti-aliasing.** In general, the term is used to talk exclusively about animation. Just so you know!

Easing in and out



Iconoclasts (PC,PS4,Switch)

In order to accelerate or decelerate animations, artists space out their drawings within each frame closer together or further apart. This can easily be adjusted. It's difficult to draw in-betweens closely together without unwanted wobble effects; to prevent this from happening, you subpixel the inbetweens instead.



Iconoclasts (PC,PS4,Switch)

Idle animations

When characters are idle, you can either choose to create bouncy animations, subtle motions – or a bit of both. Subpixels will get you that extra bit of detail you can't otherwise obtain by just free drawing or moving parts around.



Metal slug attack (Mobile)

Give life to still parts

When you animate large movements, some parts may remain motionless. Giving those areas subpixels will help it stand out less. If you animate in high definition, you may be familiar with line boiling techniques to avoid having things stand still.



LOZ: Minish cap (GBA)

Small resolutions

When you have a canvas of 32x32 pixels or less, it's harder to make readable sprites. Moreover, it's much harder to create believable motions in such a tight space. It's too tough to just move parts around.

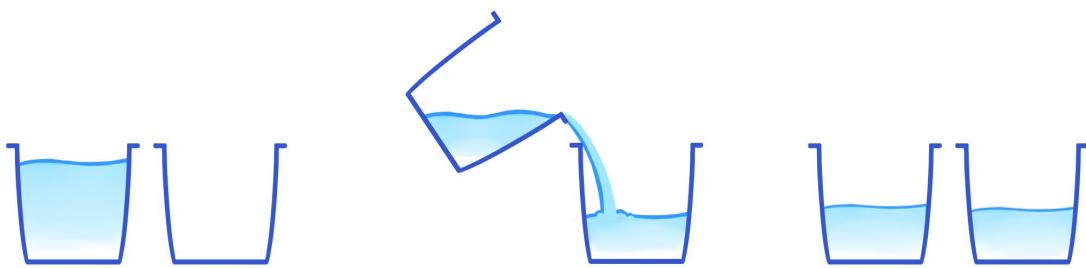


Sonic Mania (Various)

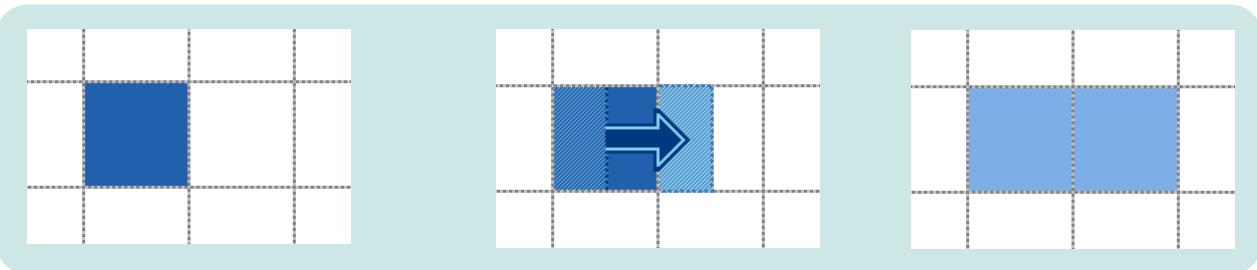
Wind effects, laughter, shaking, shivering, and staggering

Movements where the characters or objects barely move can easily benefit from some subpixels.

Shifting pixels



Pixels are like cups of water. We can pour some of the water into the next cup. Now, it's spread across 2 cups, **but the total is still 1 cup of water**. This is one of the principles of subpixeling.

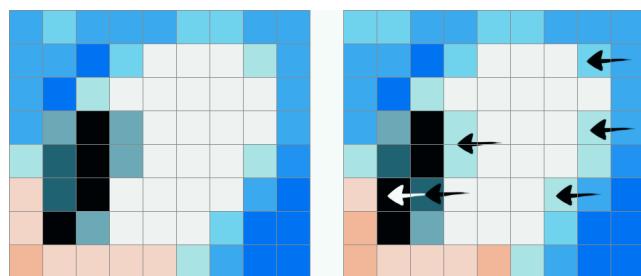
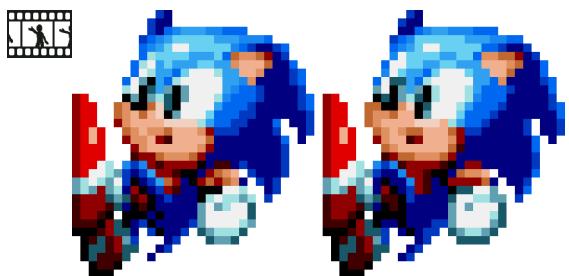
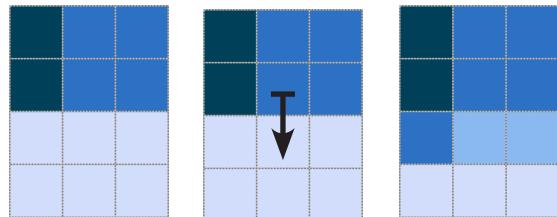


The amount of water in a cup = the brightness of the colour.
Moving the pixel $\frac{1}{2}$ px ahead, turns the next pixel darker or lighter.

**When animating in subpixels,
Value and Colour are carried over to the next pixel.**



You'll rarely have just a single pixel like in the example.
Pixels are always surrounded by other shapes, outlines,
or backgrounds. What you'll get instead is this. →



Sonic Mania (PS4, Switch, PC, XBO)

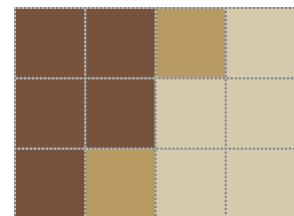
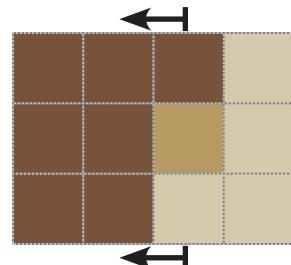
Not every single pixel's value needs to be shifted. Sometimes you can move over an entire pixel normally! You don't have to necessarily move every pixel on the canvas as that could create banding. Some parts can remain still, without any changes. Animation and readability matter more than overdoing subpixeling.



Pixel-Logic bonus

Pixel shifting is the basic principle of subpixeling.
Here are a few more explanations to help you out.

If cups of water don't cut it, try seeing subpixeling as cups of coloured liquids, like milk and coffee!



1 full cup can be poured differently, so you can have more liquid in 1 cup than in the other.

Subpixels aren't always $\frac{1}{2}$ pixels. They don't have to be shifted over exactly 50%.

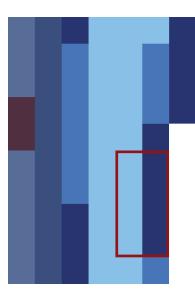
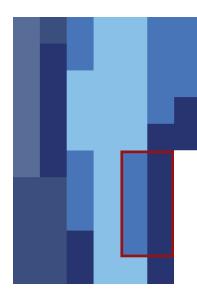
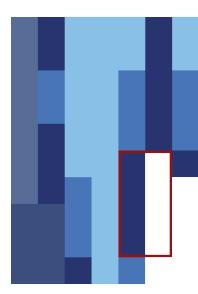
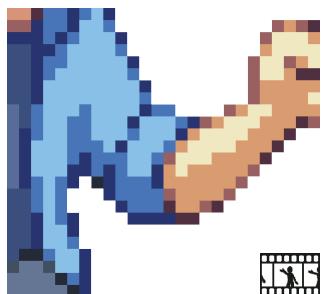
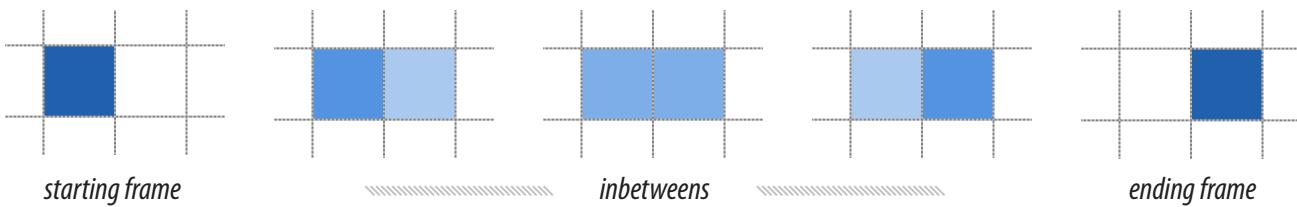


It's strongly advised to **re-use colours already found in your sprite** for subpixels.

Don't bother using math to determine what you need. Just pick a colour that is *sort of* in between. Feel free to create new colours, but remember to not lose track of them!

You can also call this technique swimming pixels, pixel transfer, or even pixel bleeding.

Maybe try viewing subpixels like ghost trails, or smears that smudge pixels as they move around.

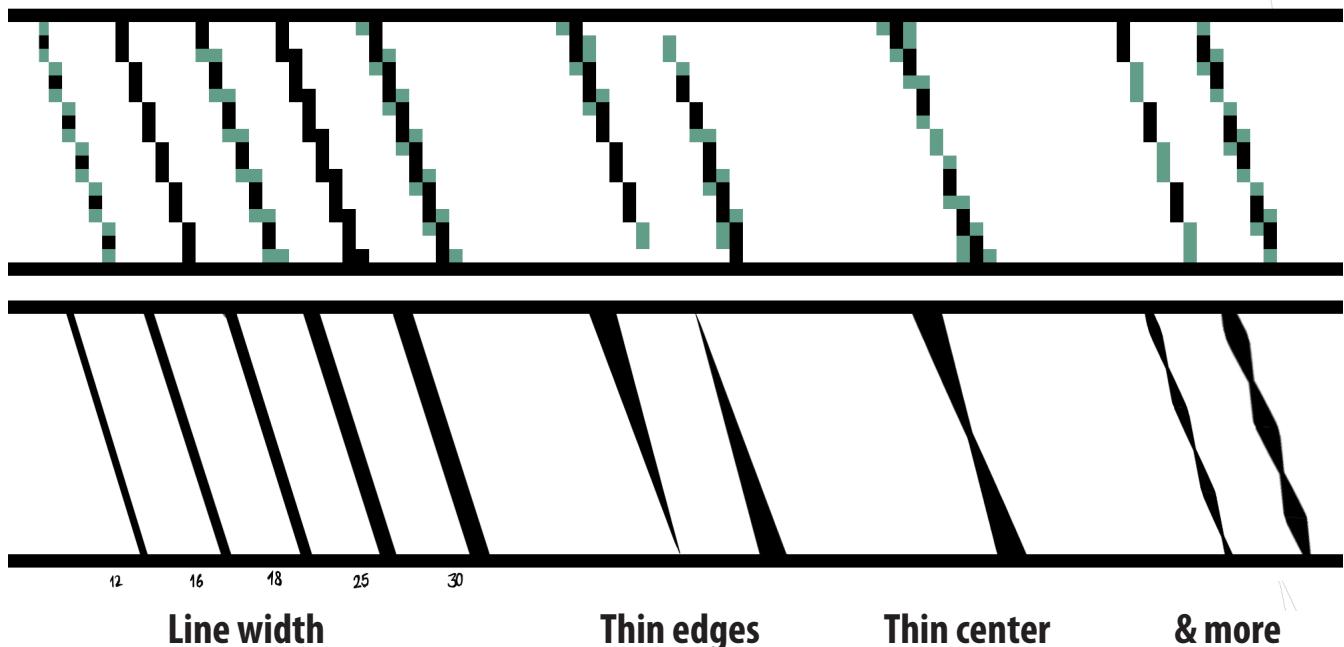


When a line or shape moves away, it can leave some AA behind. Like a shell of its former-self. It sometimes looks like a row of ghost pixels from the previous frame! Remember NOT to leave any light-coloured AA on the outline.

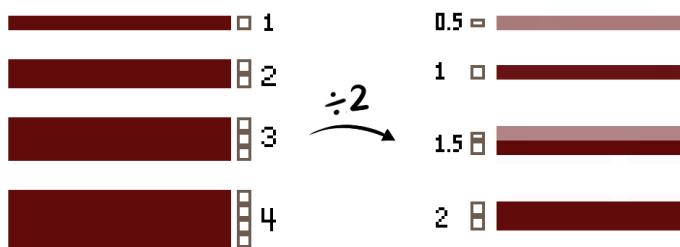
You'll find more about this on the page "*Motion*".

Line weight

We've briefly discussed *line weight* [in chapter 2](#), so feel free to refresh your memory. Subpixels allow you to do what you usually do in HD artwork. This type of **subpixeling really is just AA!**



We can prove that lines turn lighter when they're thinner, by shrinking these lines. Shape and edges become brighter in colour too.



However, things only become brighter when shading in a dark zone. This means that the opposite happens when working within dark shapes.

Conclusion

Light backgrounds



Dark backgrounds



Line weight within sprites

These examples should be clear enough to easily **study!** They have varying line width. Pay attention to the brightness (value) of all the anti-aliasing pixels.



Mario & Luigi:
Superstar Saga (GBA)



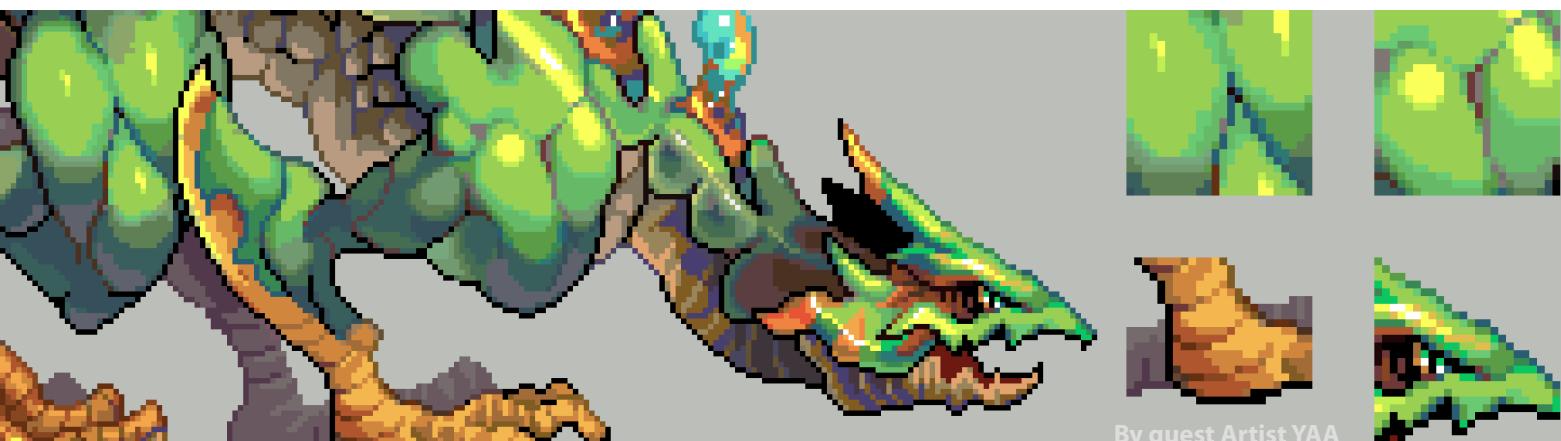
By guest artist Anubis Jr. Character by Nintendo



Metal Slug 6 (Arcade, PS2)

By guest Artist YAA

The Legend of Zelda: Minish Cap (GBA)



By guest Artist YAA



The Legend of Zelda: Minish Cap (GBA)

The thinner cracks in this rock end in lighter pixels. The deeper cracks use darker pixels.

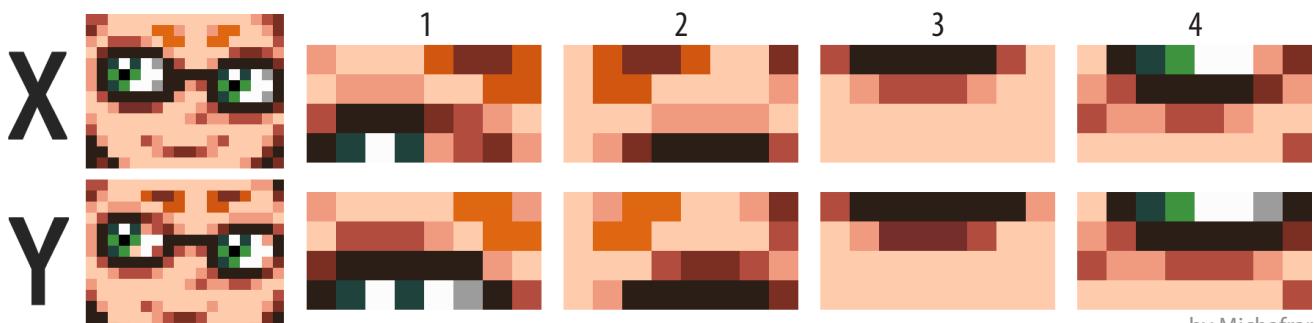


It's easy to mistake line weight for shading

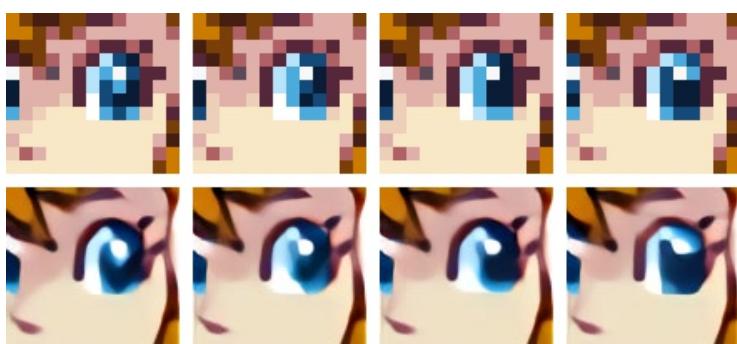
They may look like lighter shading or darker patches, and that's fine! In the end, the same anti-aliasing can be used for multiple effects.

Adding and removing width

In this zoom-in you can see how anti-aliasing acts like subpixels. Focus on the mask around the character's eyes to see the difference. **Version X** has a larger eye mask than **Version Y** does.



1. Top left eye has lighter AA in version Y, making the line thinner.
2. Top right eye has a lighter row of AA subpixels in version Y.
3. Bottom left eye has brighter AA in Version Y.
4. No changed in brightness, but the dark AA is shorter.



As we've seen many times before, every pixel can make a difference. Sometimes brightening or darkening the AA creates subpixeling and produces different results.

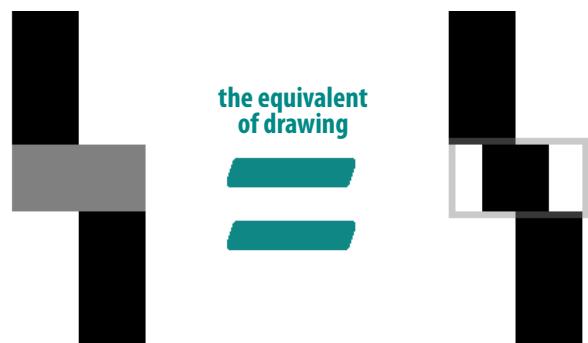
Upscaled with waifu2x_udp.jp

Split pixels

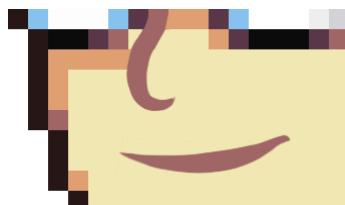
Split pixels are pixels spread across 2 blocks.

The complete pixel can't exist like this, so its value is divided into 2 pixels that each are 50% of its brightness.

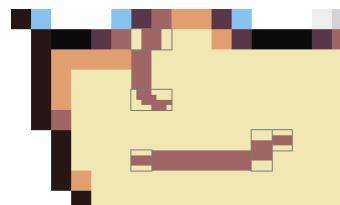
Let's put these split pixels to some good use.



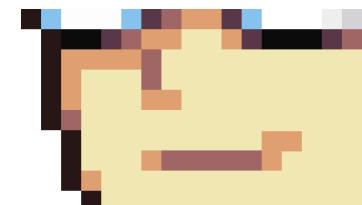
by Michafrar



If the lines were HD

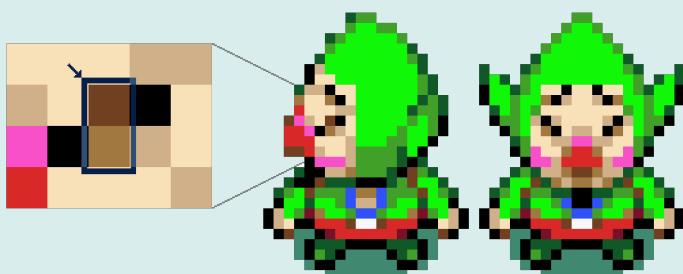
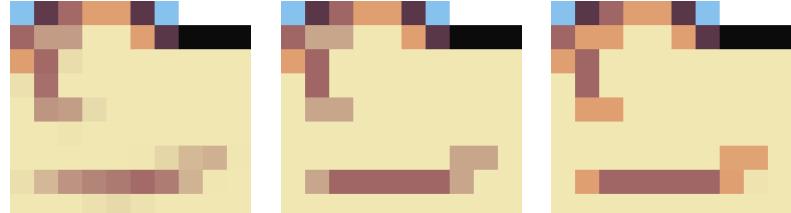


What you imagine



What you pixel

When we shrink these images back to their original size (1x), the results are almost identical! This **proves** that subpixeling matters. Try using split pixels for better line weight!



In some situations, you can slightly add more weight (brightness) onto 1 side of the split pixel. This is really just AA combined with split pixels.

The Legend of Zelda: Minish Cap (GBA)



There are often areas where split pixels can come in handy. They're not always necessary but can make for subtle changes. You can also see these split pixels recycle the colour grey which was already used in the palette.

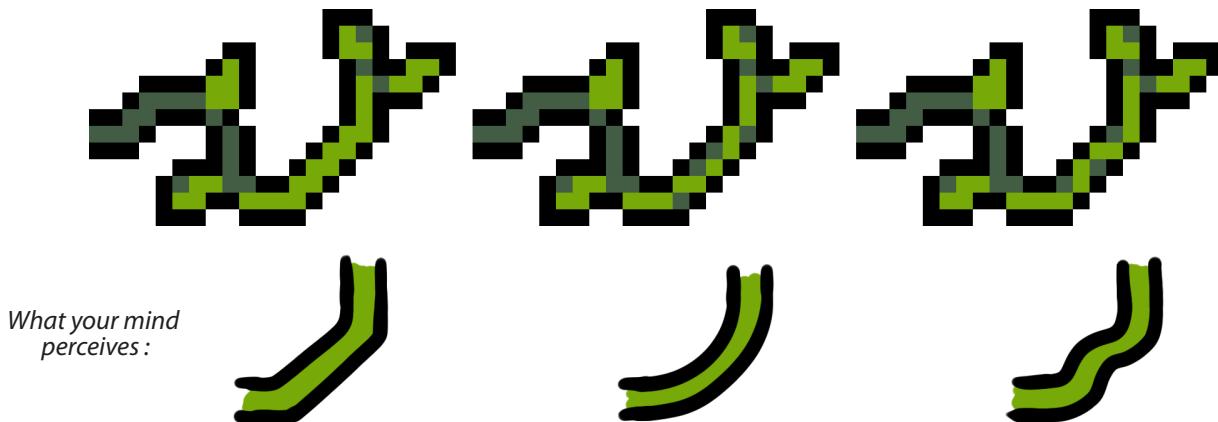
Pokémon Black & White (NDS)

Tricking the eye

Here's some illusions to trick the eye. These are extremely subtle, mind you.

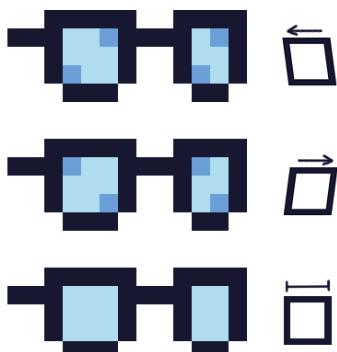
Bending shapes

On this green vine, the diagonal part has AA placed in different corners. These subpixels push a shape into a certain direction - **all while the outline is identical! Every pixel matters here.**



What your mind perceives:

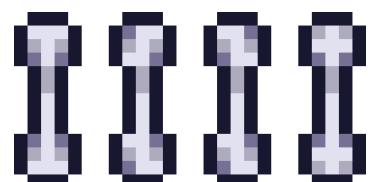
Skewing shapes



The direction and placement of your AA can skew the shape in all kinds of ways.



You are not likely to use this for still sprites, but it can offer extra subtleties within your animations.



Thinning out shapes



The Legend of Zelda: A Link to the Past (Super Nintendo)

Horizontal lines can appear thinner than vertical lines and vice versa. This effect is so subtle that it can easily be ignored.



Selective Outline

Selective outlines get often mistaken for shaded outlines with AA around the edges. That's sort of what they are, but they serve a different purpose. So why those gaps in the outline?



Coloured outline



Selective outline



Shaded outline

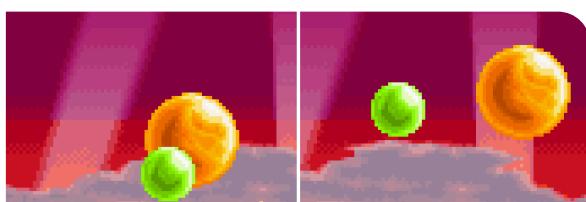
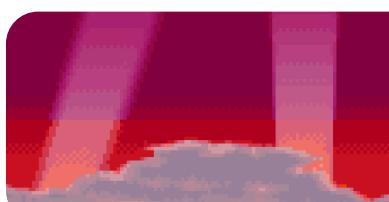


Darkstalkers 3 (PS1/Arcade), Super Gem Fighter Mini Mix (Arcade, Saturn, PS1)

Selective outlines make foreground objects blend nicer with their surroundings.

When 1 layer slides over another, this carefully placed AA will make transitions smoother.

Artists commonly abbreviate “*selective outline*” as “*sel-out*”.

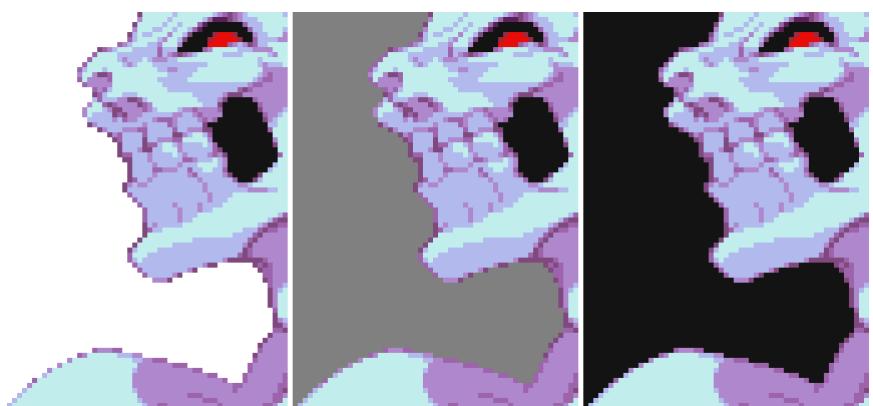


Klonoa: Empire of Dreams (GBA)

Selective outline is only **used on layers that have a transparent background**. If objects overlap in neutral coloured environments, they will look smoother with a selective outline. **It's all about context**.

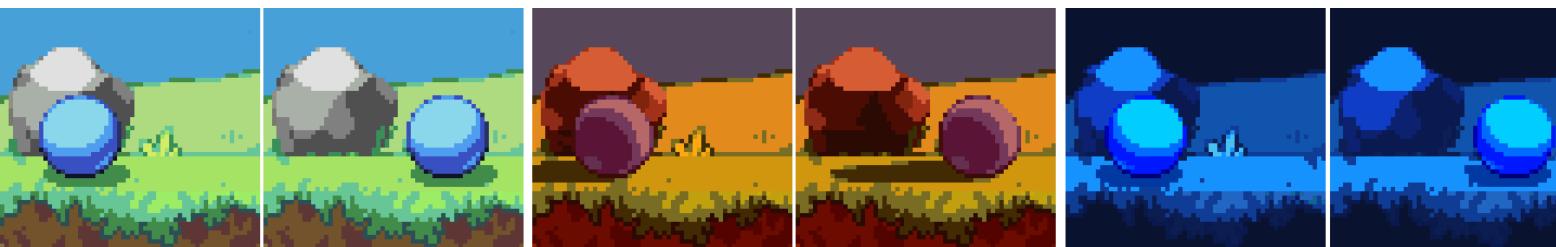
These broken lines will most often look best on **dark backgrounds**. On a light background, they will often look jagged.

If your object will **ONLY** appear on dark backgrounds, you can safely use selective outlines. In fact, it's best that you do!



Darkstalkers 3 (PS1/Arcade)

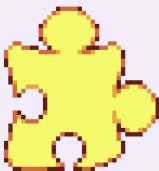
It gets tricky when backgrounds have both darker and lighter areas. This ball may look fine in front of the rock, as the selective outline blends well with it. These do not look particularly pretty in every situation.



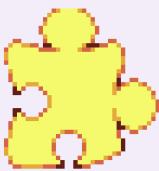
by Michafraar

Overview

**Heavier
selective outline**



**Lighter
selective outline**

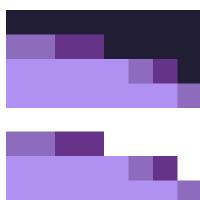


**What you can do
to avoid issues:**



- Make selective outlines that are fuller and less segmented.
- Avoid selective outlines altogether. Use other outlines.
- Use hints of AA and apply them to other outline types.

So what does subpixeling have to do with any of this?



Lighter or darker sel-out lines depend on the background you use. When sprites will often be in **dark environments**, you might want to **give them darker sel-out lines**: shaded outlines with darker pixels of AA to blend the edges with the background colour.



It's kind of like line weight in a way, but for outlines.
It will prove to be quite useful animating
these outlines with subpixeling.



Animating subpixels



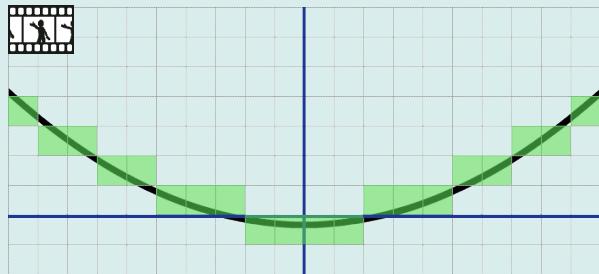
Ever looked at 3D animations with anti-aliasing turned off?
With 3D renders in raster graphics you can easily see how
the curves have warping pixel lines.

Notice how, frame by frame, the tip of the head shrinks, as the character moves downwards.



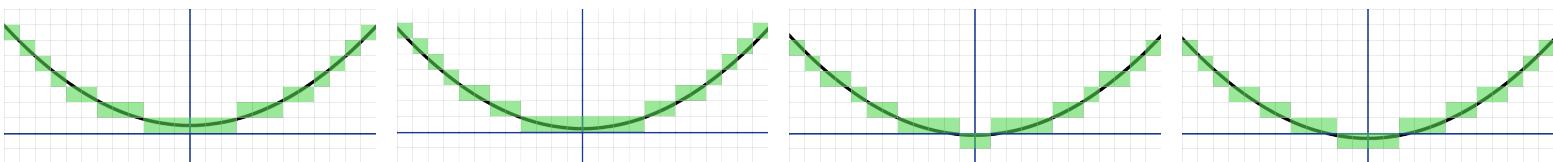
Pikachu 3D model from Pokémon X & Y (Nintendo 3DS)

So why does this happen? It's because of how lines move around in mathematical graphs. Here is a close-up of a curve. In math: what's happening here is $f(x): x^2 + n$



As the curve moves down, the tip expands.
Pixels on each row escape to the sides.

At one point the curve crosses a new row and new pixels POP UP and the cycle continues.



In animation, jaggies aren't an issue because you only see them for a split second. However, when your curve pops **a new row**, or shrinks down to **a lower row**, avoid transitions to single pixels.



Aim for **at least 2 to 3 pixels** when popping shapes and lines

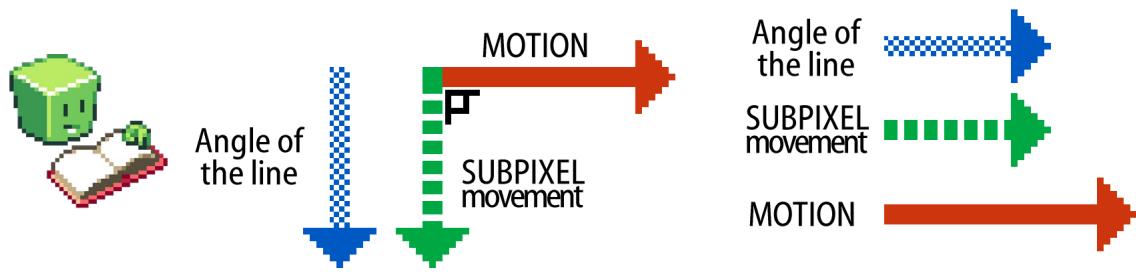
Subpixeling animation requires you to

duplicate a frame and edit it slightly.

Flip back and forth between frames to check how pixels shift!



This is the general rule for animating subpixels on lines, curves and shapes.



The direction of subpixeling follows the angle of the shape
regardless of where the general animation is heading.

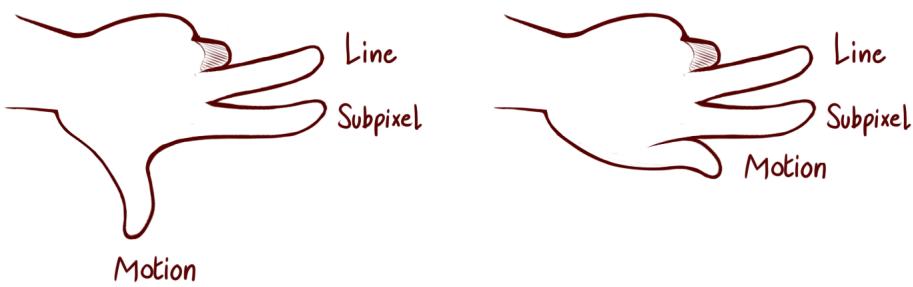
e.g. : if the angle is horizontal = subpixeling is horizontal
if the angle is vertical = subpixeling is vertical

You can see that this cape is curved horizontally, therefore it subpixels horizontally too.
It moves up and down, but it subpixels left and right on occasions.



Red Earth (Arcade)

If you get confused, remember this trick with your hands. The thumb is the main motion and it moves independently. The other 2 fingers usually point in the same direction.



**Pixels can go up or down but also left and right depending on the angle.
This works for full pixels or subpixels. Always focus on the angle.**

In the digital animation files (included in this chapter), you can see a collection of different animated shapes. Look for the "shapes" folder.



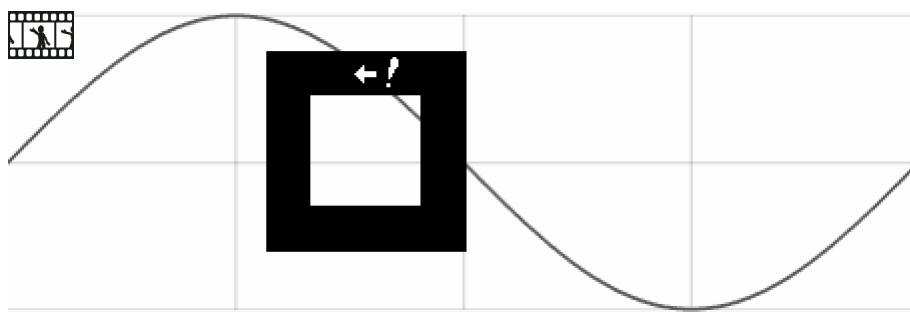
Pixel-Logic Bonus

Why does it look like pixels go up/down when we move them left/right?
Subpixels in motion are somewhat based on optical illusions.
Here are a few more examples to help wrap your head around it.

The animation looks like it is going one way, but some areas move in the other way.
It's actually an optical illusion.



This line moves down the screen



... or was it moving horizontally?

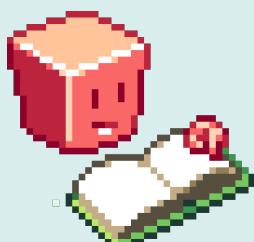
Let's see how pixels warp in practice, by looking at this sprite from *King of Fighters XII* (Arcade, PS3, XB360). The 2D pixel graphics from that game were created with help from 3D models. Remember that this subpixeling trick **only works for drawings spaced closely together!**



You can see the full body
moving up and down.



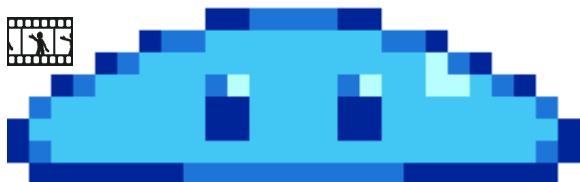
When we zoom in on the chest however, the lines,
shapes and shading appear to be moving left and right.



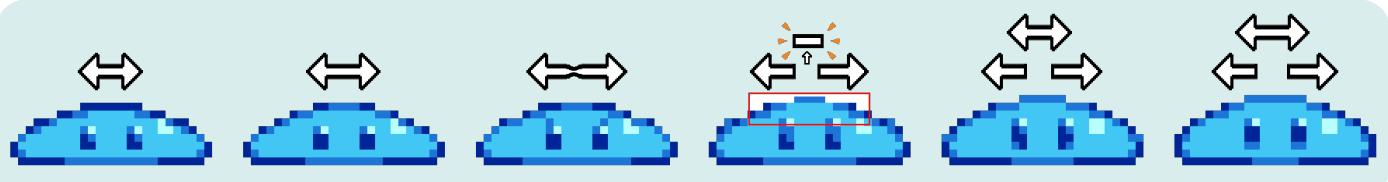
A name that helps explain the perpendicular motion could be *waving*; as a wave travels up and down but also forwards and backwards simultaneously. Artists often have their own term for techniques, so feel free to give it a name of your own. It could also be called *rippling*. Anything that helps you visualize this technique will do it: *swinging*, *dripping*, *sliding*, you name it!

Let's get moving

Anti-aliasing follows every movement in your animation. Subpixeling is pretty much sliding AA around to create the illusion of movement.



This blob has a selective outline, but also AA on the inside. When it bounces, the outline stretches as it goes up which leads to new rows appearing.

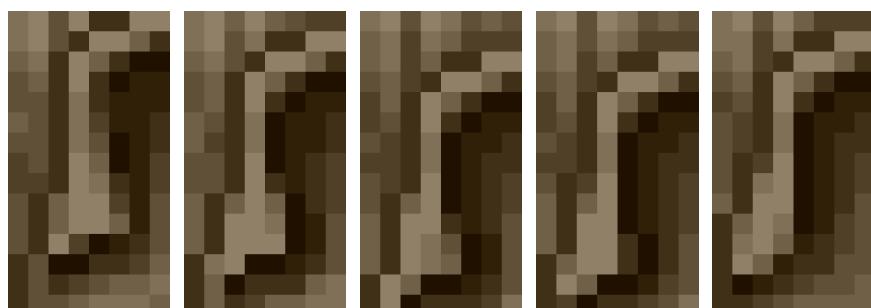


Usually you can move around full pixels (1px) in normal animations, no need for subpixels! As you introduce new colours to your work, you'll need to make new transition colours. That's why you will often encounter AA on edges of shapes.



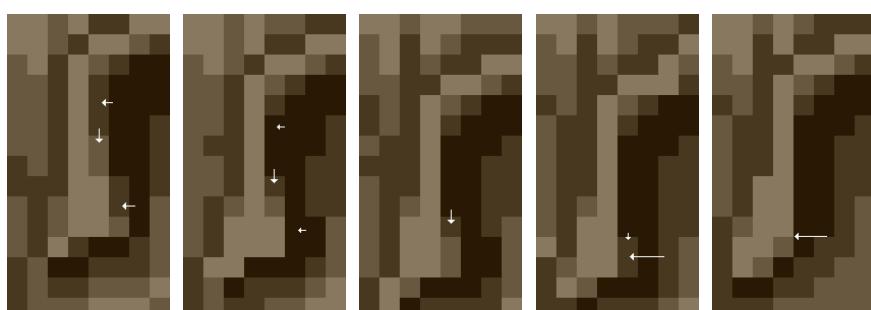
Metal Slug 3 (Neo Geo)

This elephant sprite is full of movement; there is so much going on! To make it easier to study, we'll take a closer look at just **the ear of the elephant**. There are a lot of colours and a lot of frames, so we'll simplify it with less AA to make it more readable.



Full colour – 5 frames of animation where the earflap moves left.

It's recommended to use as few shades as possible when subpixeling. The ideal number would be 1 or 2 shades of AA. It gives you *just enough* shades to create nice in-betweens for your animations.



Reduced colours – the arrows show the direction of the subpixels.

There's no need to create new shades in your palette, **just reuse existing colours** for subpixeling! Even without transition shades, you can still shift full, complete pixels with what you already have. Any extra colours just make transitions smoother.

Subpixeling isn't just about moving things back and forth. For these examples, search for Soldier A, B and C in the animation folder that came with this chapter. Let's analyse.



✗

You can't just pixel shift up and down three frames to make a character breathe. This result just looks stiff. Simple pixel shifts like these only works for in-betweens.



≈

It already looks better! This one is pixel shifted more than four frames and well timed. However, it's still artificial looking if the character just moves up and down.



✓

The pixel shifting is offset and body parts follow an arc. This animation also eases in and out. It slows down at the keyframes.



Not all pixels have to move to create believable motion.

With just enough subpixels, you don't need to animate every part of every frame. You can get away with some body parts not moving. Some pixels can shift, others can stay frozen or delayed.

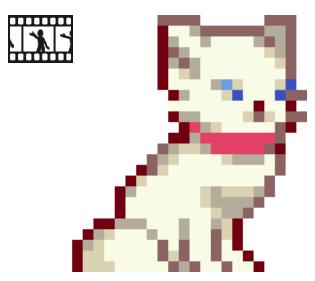
What matters most is the motion.



Likewise, not every body part needs to be pixel shifted.

Simply subpixelate areas that benefit from it. You don't have to add it to the entire sprite. This *Smasher Crab* has subpixeling on its legs and belly.

Its shell, however, moves normally like you would animate regular drawings. It's duplicated for every frame and simply slides around.



Finally, how much you subpixel is up to you.

Your characters can even have silhouettes that don't move. For the most subtle movements, you can have pixels swimming inside the sprite and the outline won't move a single pixel. Everything happens *within* the contours of the sprite.

A few animation terms have started popping up in this chapter. To truly understand subpixeling, you will need to understand the basics of **Animation**.

Case Study: Capcom



Not all smooth animations need subpixels per se. Many animations from the Capcom golden age didn't feature a whole lot of subpixels because of their large scale. Most of the movements are easily created by simple in-betweens and full (1px) pixel motion. However, there are often subtle movements with carefully placed AA, and THAT is where you'll find subpixels.

Darkstalkers 3 (PS1/Arcade)

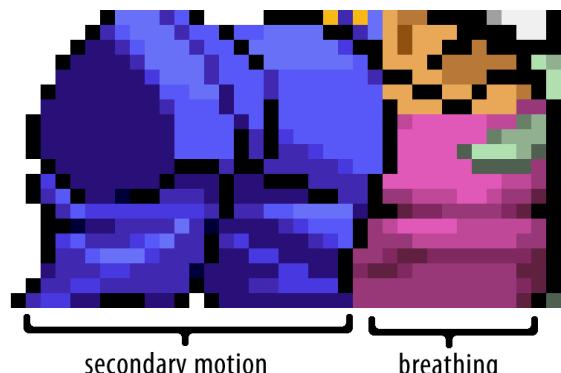


Whenever these graphics had subpixeling, they were somewhat ahead of their time. It's commonly known that Capcom animations were roughed out on paper first. Although the rough lines were digitized, it is unlikely these subpixels are a coincidence. This is just speculation, but by studying how line art is digitized in pixel grids, Capcom artists might have picked up on subpixel motions. These effects were totally intentional. Over at SNK Corporation, they even called this the "0.5 pixel" technique.

JoJo's Bizarre Adventure: Heritage for the Future (PS1/Arcade).



Notice how his chest moves up. The angle of the lines/shapes are horizontal which means the subpixels grow horizontally, despite the chest moving up.



You can see different subpixel techniques in the same sprite.
Not all motion is the same.

1. Chest (breathing) : pixel shifting + popping rows
2. Secondary motion (Wind): AA waving back and forth

JoJo's Bizarre Adventure: Heritage for the Future (PS1/Arcade).

Readability



Owlboy (PC/PS4/Switch)

The viewer usually focuses on the face or the eyes of a character at first glance. It's best to avoid subpixeling the facial features. If the eye shape morphs too much, it will stick out like a sore thumb. If you do subpixel it, it has to be extremely subtle.

When your character only moves by 1 pixel, it's still possible to **pixel shift** faces, but the in-betweens **will look very blurry** - even at fast frame rates.



Metal Slug 1/2/X (Various)

Avoid this!

You can shift subpixels on the in-betweens that appear on screen rather quickly. It's fine if these in-betweens look funky. After all, they appear on screen for only a split second. What you DON'T want to happen is having these frames appear on screen for longer. This means animating *pose-to-pose* in subpixels isn't always guaranteed to work. Animating *straight ahead* is often easier. This entirely depends on how confident the artist is. No matter what technique is used, you create subpixeling by duplicating frames. A good solution is to have inbetweens "favour" keys, i.e. much closer and similar to the keyframe. All of this will be detailed in the [next chapter: Animation](#).



The Legend of Zelda:
The Minish cap (GBA)



Scott Pilgrim vs. the World:
The Game (PS3,XBLA)

An easy way to keep things consistent is to:

have multiple frames where the face transitions between 2 positions,
but the head, body and everything around it pixel-shift.



Iconoclasts
(PC,PS4,Switch)

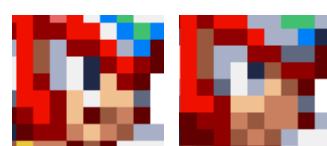


The chest and shoulders
shift by 0.5 pixel,
but the head does not.

Megaman X4 (Sega Saturn, PS1)

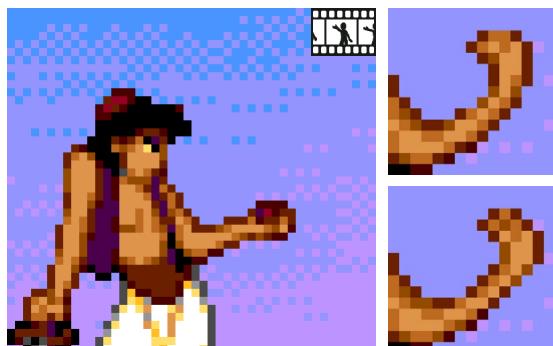


If we were to subpixel the face,
it would not look very readable.



Advanced pixel shifts

Subpixeling with arcs

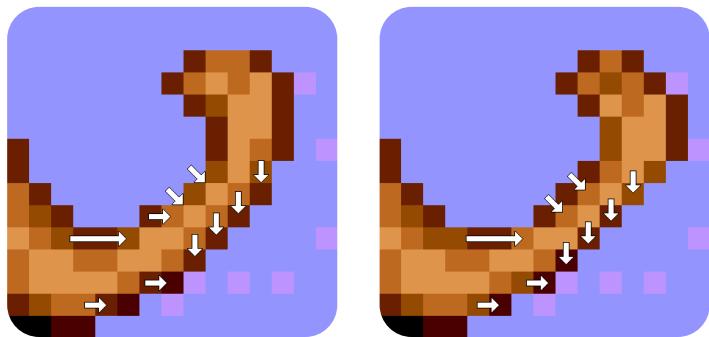


Here are frames #7 and #8 of this animation of Aladdin throwing an apple. *Frame 7 goes to frame 8 with subpixels.* This is an example of a diagonal subpixel movement. The direction is 45° but it's a **combination** of pixels being carried over **vertically and horizontally**.

Aladdin (Megadrive)

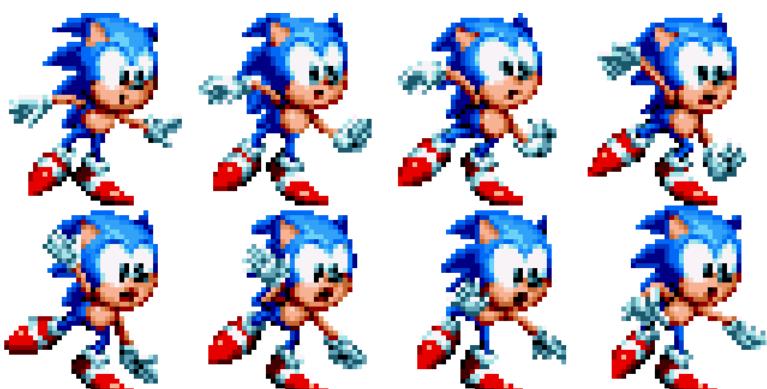
You can carry over pixels diagonally, but don't overthink it. It doesn't have to be mathematically correct.

Just move the AA roughly towards the direction you want. What matters is to shift the colours of the outline.



Wargroove (Switch, PC, PS4, XBO)

What you want to keep in mind is a general sense of direction and arcs. The keyword here is **GENERAL**. You can have delayed motions or change arcs. The animation above loops and contains 6 frames. The subpixeling here follows a circular motion. This all happens inside an area smaller than 3x2 pixels.



Sonic Mania (Switch, PC, PS4)

Intense pixel shifts

You can get a better understanding of more difficult subpixeling by studying **3D rendered sprites**. A lot of the pixel placement is automatically generated, so none of this is hand-placed. So it's up to the artist (and us) to untangle it all.



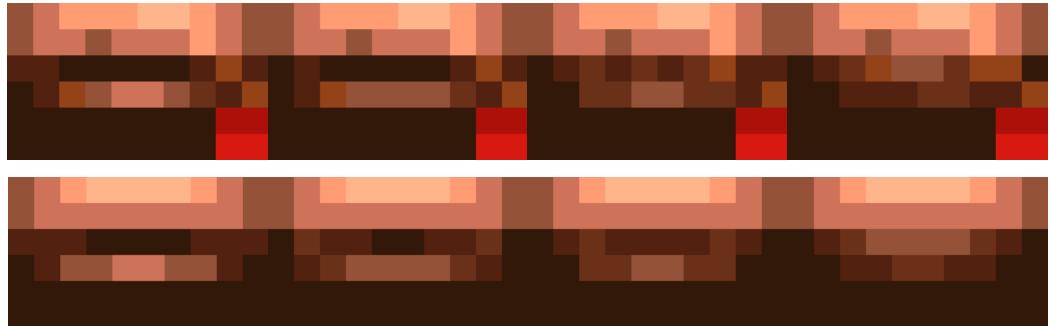
Donkey Kong Country (SNES)



3D original

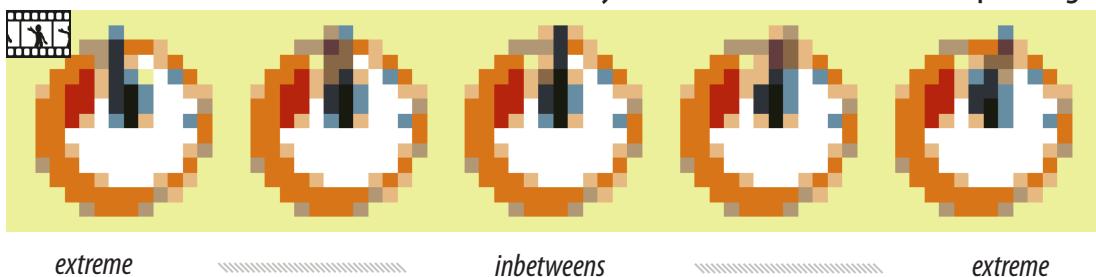


Simplified



It's important to set up extremes: those are keyframes where motion starts and stops.

The in-betweens frames are the ones where you'll have to fiddle with subpixeling.



extreme

inbetweens

extreme

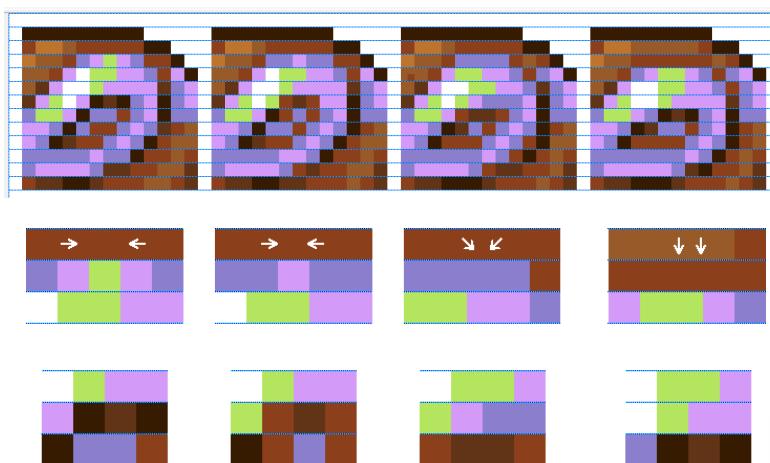


Street Fighter III (Arcade)

Certain 2D idle animations may look incredibly complicated or not even subpixelled by hand. They're still worth studying. **Identify the extreme frames first;** figure out what direction the in-betweens shift to later.



by guest artist Cocef



Even more intense !?



Metroid Zero Mission (GBA)

Occasionally, animations have silhouettes that HARDLY move.

If they do move, they will only move slightly. All of the movement takes place within the sprite itself. This means it's impossible for you to use the onionskin tool in animation programs.



This effect is simply pixel shifting colours. It's really just regular subpixeling.

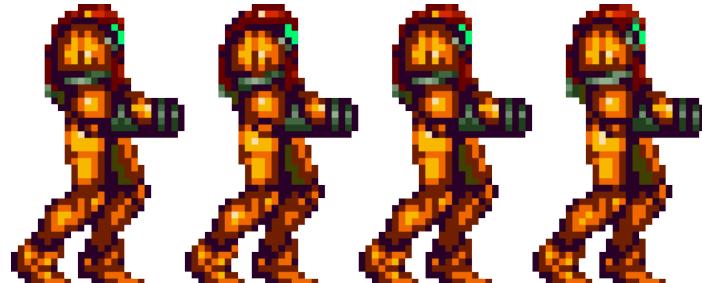


Shaking	Flinching
Sleeping	Laughing
Wind effects	Being stunned
Flickering lights	Shivering in cold
Wobbling & jiggling	Staggering motions



Mighty Switch Force 2 (WiiU/3DS)

You can't always use AA when you work with few colours. Instead have full pixels swim inside the sprite. The principle is the same as shifting subpixels, but with full pixels instead.



Super Metroid (Super Nintendo)

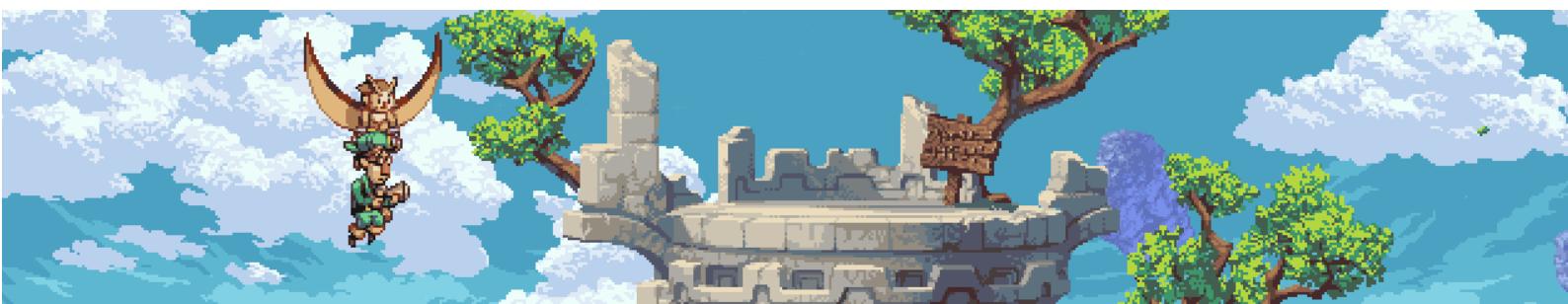


Sometimes fully complete **pixels travel across the sprite as if they're swimming**. You can still shift colours and pixels with AA but remember to use colours you already have within the sprite. Don't create new ones unless absolutely necessary.

Ash from Iconoclasts (Switch, PC, PS4)

Look for "**Ash**" in the animation folder that came with this chapter. You will find a complete breakdown of every frame and all of the subpixeling.

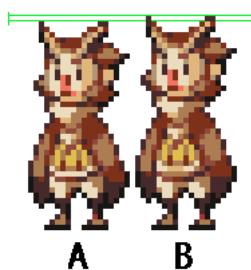
Case Study: Owlboy



Owlboy - released in 2016 - features the art and animation of Simon Andersen, a developer at D-pad Studio.

Owlboy is a visual marvel, and features numerous examples of subpixeling.

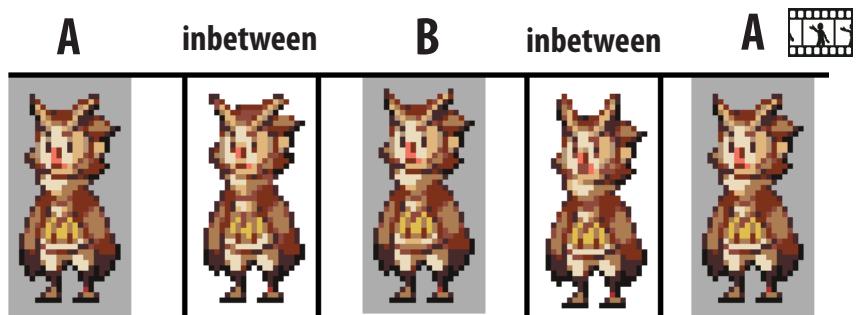
Let's analyse some of these easy (yet complex) animations.



The idle animation for Otus has 2 key frames.

A is the lowest point of the idle. B is the highest point. These are the extremes. Other than being **1 pixel higher**, frame B is almost identical to frame A. If this animation were **a mere 2 frames long it would be quite choppy**. Subpixeling is used to make this transition smoother.

I've now included the straight in-betweens. **Since the character only moves up by 1 pixel, it's harder to fit in an in-between.** That's why subpixeling is used. Notice how the nose changes shape.

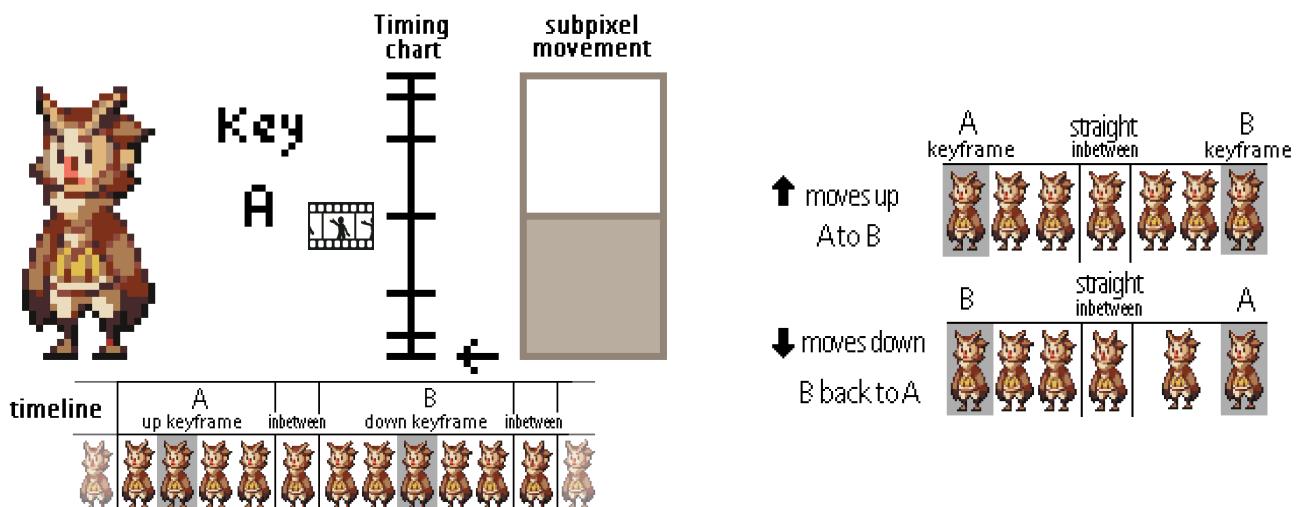


The full animation has even more in-betweens. These are not straight "in the middle" in-betweens. These ones favour the keyframes A & B. They are much closer and identical to these key frames.

This is called **easing** in traditional animation. We'll show this technique [in more detail in Chapter 9](#).



Here is a full break-down of how the character is animated.



Subpixeling only shows up in the smallest areas.
This sprite of *Mandolyne* is animated in a regular way but still features subpixels.

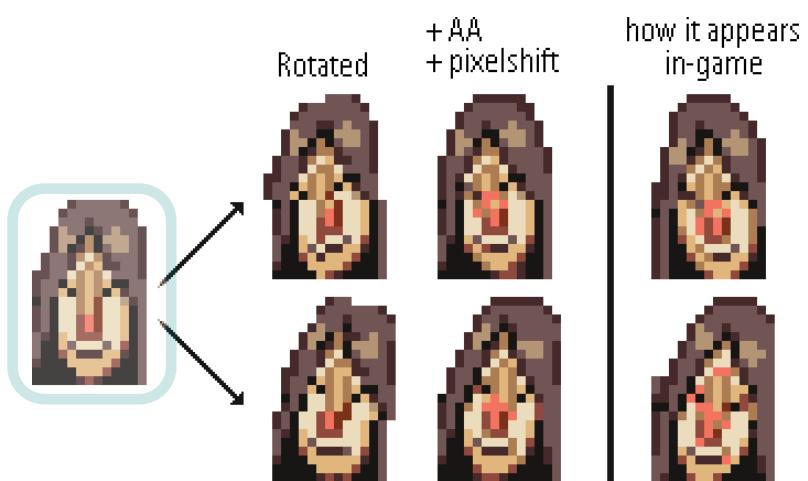
Notice how the button of her dress leaves a trail as it travels back and forth.



The collar has split pixels too!

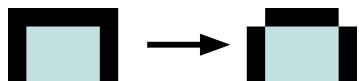


When her face tilts, carefully shifted pixels and anti-aliasing start to appear.
It's not known if a rotation shortcut was used by the artist, but it can be a useful trick you yourself can use. Take a look back at [the chapter about Clean-up](#).



A few more tips

Outlines can grow extra pixels



Sometimes you can add pixels or remove pixels on round corners in order to make animations move even more. It helps you add extra movement to your sprites. Use this with moderation!



Fire Emblem: Blazing Blade (GBA)

Quick but cheap subpixels

A **quick but unreliable** way to generate subpixels :

1. Reduce and lock the colours of the sprite
2. Resize 200%, no blur (nearest neighbour)
3. Select all, move the sprite by 1 pixel (horizontal or vertical)
4. Resize 50%, so it goes back to size 1x, but this time with blur enabled.



Wargroove (Switch, PC, PS4, XBO)

Remember: Pixel art is about having total control over your work. This method is quite cheap, and will not work unless you manually edit it. It's fine for beginners who want to understand pixel shifting better. **It's a good reference, however** it does not guarantee an inbetween for animations.

Subpixeling ≠ Moving shading



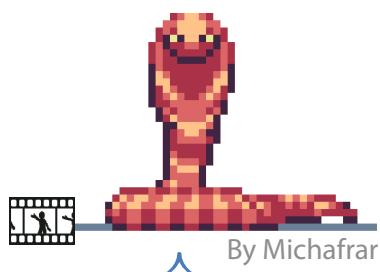
It's very easy to mistake subpixeling for "animated shading" but that is **incorrect**. If you think it is shading that simply moves around, it will only confuse you even more. It's about **movement**, not shading nor light.

Metal Slug Attack (Mobile)

DO NOT overdo subpixeling

You'll need to be really confident to pull off the most subtle motions. If you overdo it, things will look like they're melting or look like jelly. Moreover, subpixeling is time-consuming. Don't do it if you don't need it.

Conclusion



Duplicate frames and shift pixels around. That's subpixeling in a nutshell. It is the only technique for small-scale inbetrweens. It's possible to create subpixeling by just duplicating and shifting a single sprite.

It's a technique where by slightly changing the colour of surrounding pixels, to the human eye it looks like the pixels move by around 0.5 pixels.

Kazuhiro Tanaka

Designer for Metal Slug at SNK¹

Subpixeling is the least documented technique in pixel art.
Knowing this fact, take every opportunity to download sprites you find and study them more closely.
That is the best way to learn this technique.



Food for thought

- Introduction
- When & How
- Shifting pixels

Still images

- Line Weight
- Split pixels
- Tricking the eye
- Selective outline

Animation

- Direction
- Motion
- Readability
- Advanced pixel shifts
- A few more tips

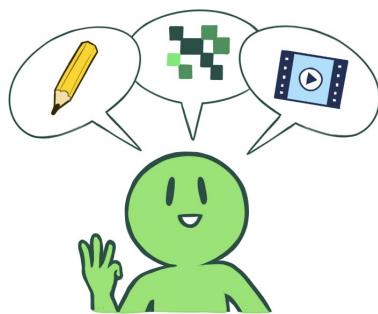
If you are just an illustrator, *Pixel Logic's* section on line weight will be most useful to you. If you are an animator, you may have noticed some terms and techniques have been mentioned briefly. Feel free to give this chapter another read once you've finished the book or started learning animation. Things will start to make more sense when you already know how to animate.



Chapter 9

Animation

Introduction

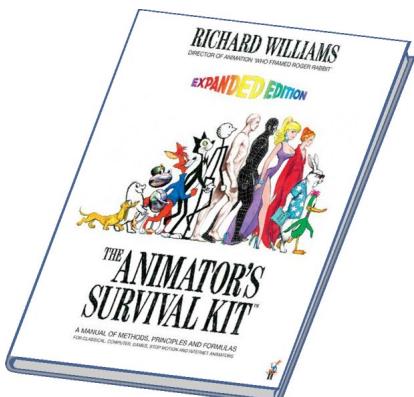


Being a 2D Animator is like being bilingual:
The two languages you need to know are: 1. drawing + 2. animation.
Add pixel art into the mix, and you've now got 3. You're now trilingual.

Animation is already a well-documented art form.

Modern animation is far older than pixel art, by at least a whole century. The 12 principles of animation we know today date as far back as the 1930's. In this chapter we will focus specifically on game animation.

Don't worry, though. We will give you a crash course on basic animation.

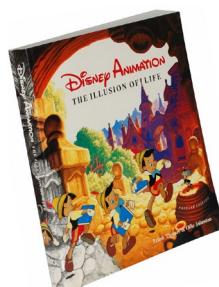


As many others, my first advice is to acquire the following book:

The Animator's Survival Kit by Richard Williams

The reason this is one of the best books is because R. Williams breaks down the basics of motion and acting. I highly recommend the iPad version of the book as it features animated portions.

Two animators that have inspired Williams are Ollie Johnston & Frank Thomas. These two classic animators wrote "*Disney Animation: The Illusion of Life*". They are two of the *Nine Old Men* who established the 12 principles of animation we know today, all the way back in the 1930's.



These two books teach everything in terms of traditional hand drawn techniques, but the principles it covers apply to every form. **If you want to improve at animation consider expanding your horizons. Don't just stick to pixel art.** Draw, paint and animate in other ways!

How to Study



If you ever feel lost, remember that animation is the **study of motion**. This isn't the textbook definition of animation but it will remind you what to focus on in case you struggle. This means studying the motion of creatures, objects and forces. This study will include both realistic and exaggerated motions. An animator is frequently studying real life, but also tends to find inspiration in previously animated media.

**Good animation relies on readable key frames.
Strong drawings are crucial.**

If your key frames are too alike, it's harder for the audience to see what's happening. More in-betweens will **not** fix animation. No matter how smooth the movement is, the motion won't look convincing. Efficient use of key frames will allow for a more appealing animation.

Pixel art already offers you little to no space for in-betweens, so you need to play your cards right.

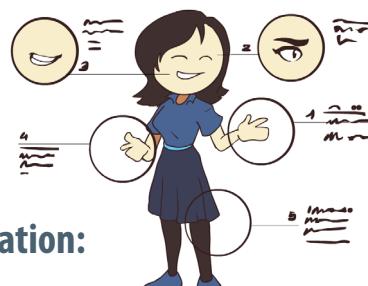
Fire Emblem: The Sacred Stones (GBA)



In the **READABILITY** and **CLEAN-UP** chapters, we saw how strong silhouettes are visually more impactful. With animation, this principle is even *more* crucial.

It's important for your sprite animation to look good, but even more for it to feel good.

Be analytical. You will rarely find an exact step-by-step tutorial for something you need. It may sound quite unfortunate, but it isn't. Body language, acting, expressions, styles; these are all great to study!



When you find a reference, be it real life, a movie, game or animation:

1. Browse frame by frame.
2. Find extremes. These are key frames where the drawings are in their most extreme position, usually just before a change in direction.
3. Use the extremes as guidelines. Draw the in-betweens and breakdown drawings yourself, rather than copying the exact footage frame by frame.
4. Stylize it (unless the poses are already overemphasized).

By doing this, you deconstruct how movement works; helping you next time you animate something.

Timelines in softwares

Timing is the speed of the actions happening on screen. In animation this refers to how many drawings or frames are used to show an action. However, timelines are a bit trickier with different framerates.



Animating on One's = every frame is unique, 1 frame is 1 drawing

Animating on Two's = frames are doubled, 2 frames are 1 drawing

Animating on Three's= frames are tripled, 3 frames are 1 drawing

... you can have fours, fives. The list goes on.

Depending on the software or theme used, these will look different, but you will always recognise them.

	1	5	10	15	20	25
One's	•	•	•	•	•	•
Two's	•	□	•	□	•	□
Three's	•	□	•	□	•	□

Adobe Flash/Animate

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
One's	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Two's	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Three's	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•

Aseprite

	1	2	3	4	5	6	7	8	9	10	11	12
One's	■	■	■	■	■	■	■	■	■	■	■	■
Two's	■	■	■	■	■	■	■	■	■	■	■	■
Three's	■	■	■	■	■	■	■	■	■	■	■	■

Aseprite (custom skin)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
One's	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Two's	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Three's	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

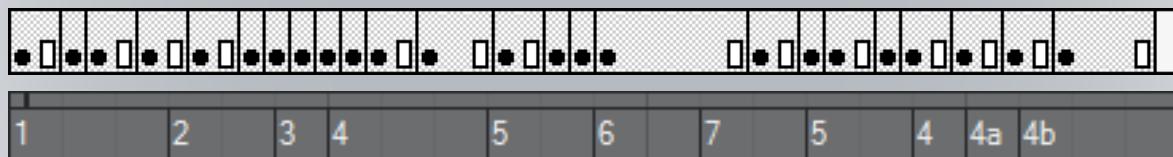
TV Paint

Timeline 1	0	1	3	5	7	9	11	12
One's	1	2	3	4	5	6	7	8
Two's	1	3	5	7	9	11	11	11
Three's	1	4	7	10	10	10	10	10

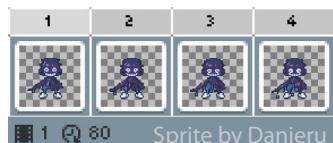
Clip Studio Paint

However, 2D animation is never this constant. Frames are on screen for different lengths of time.

Animation mixes one's, two's and longer frames.



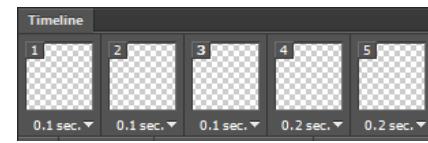
Some timelines focus on singular frames. They don't group the same image into 1 extended frame.



Aseprite



GraphicsGale



Adobe Photoshop



Pro Motion

With these timelines, you will have to set their length manually to turn them into "two's" or "threes". You don't extend their length by grouping the frames on a timeline, but by setting their length individually.

How fast drawings appear



Here are a few references to help both traditional animators and game developers. For example, if you have “two’s” at 24fps, they will feel like 12 drawings a second.

Video animation standard		Game animation standard	
24 FPS		60 FPS	30 FPS
One's	24 drawings per second	60 drawings per second	30 drawings per second
Two's	12 drawings per second	30 drawings per second	15 drawings per second
Three's	8 drawings per second	20 drawings per second	10 drawings per second
	6 drawings per second	15 drawings per second	Ø

The length of each frame



The way different softwares denote timing can vary. To help you, here are the numbers you need to know how long “ones” and “twos” are if you’re used to “24FPS” notations or “60FPS” gameplay.

Video animation standard		Game animation standard		
Terms used	at 24 FPS	drawings per second	at 60 FPS	Length in game
on One's	0.04 sec	60	0.02 sec	1 frame
	/	30	0.03 sec	2 frames
on Two's	0.08 sec	24	/	2 frames
	/	20	0.05 sec	3 frames
on Three's	0.12 sec	15	0.06 sec	4 frames
on Four's	0.17 sec	12	0.08 sec	5 frames
	/	10	0.1 sec	6 frames
		8	/	7 to 8 frames
		6	0.17 sec	10 frames

Remember: These numbers are rounded up or down to make them easier to remember.

0.01 seconds = $\frac{1}{100}$ th of a second = 1 centisecond. Milliseconds are $\frac{1}{1000}$ th of a second.

If your software asks for milliseconds or centiseconds, then use the numbers here below.

0.02 seconds 16 milliseconds	0.03 seconds 33 milliseconds	0.04 seconds 42 milliseconds	0.05 seconds 50 milliseconds	0.06 seconds 50 milliseconds	0.08 seconds 83 milliseconds	0.1 seconds 100 milliseconds	0.12 seconds 125 milliseconds	0.17 seconds 167 milliseconds
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Aseprite



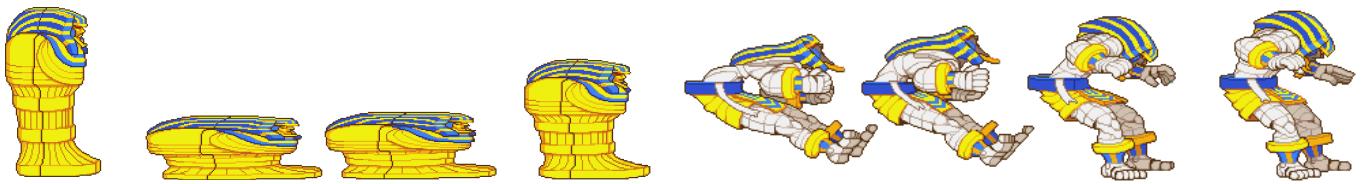
GraphicsGale



Pro Motion

Animation techniques

Squash and Stretch



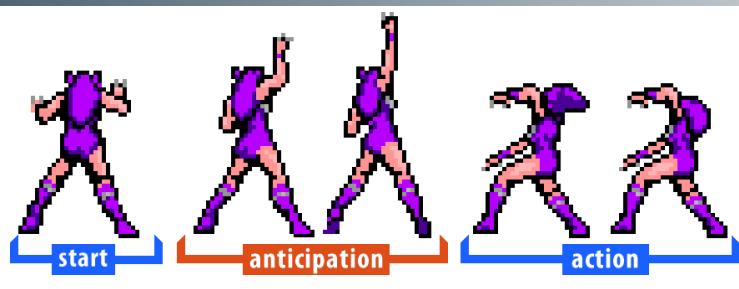
Darkstalkers Vampire Savior (Arcade)

This is the most intuitive one. Beginners know it well before they start animating. It makes animations livelier and shows the weight and motion of various creatures and objects. In fact, the bouncing ball is one of the first lessons animators learn to get the hang of squash & stretch techniques. The amount you squash & stretch depends on how strong or subtle the motion is. Another factor is how heavy the subject is. Make sure you know when to stick on-model, and when not to go haywire. Keep in mind: you need to conserve the mass of the object. If you squash something in height, you need to stretch it in width too. In short: conserve the volume.



Kirby Mass Attack (NDS)

Anticipation



Phantasy Star II (Mega Drive)

Anticipation is the “SET” part in
“Ready... Set... Go!”

It’s the moment you prepare an action, no matter how subtle or how extreme. You tell what you’re going to do, and then do it.



Ace Attorney: Phoenix Wright (NDS)

Anticipation is crucial for limited animation. Sometimes one frame is enough. What you show to your audience is energy building up.

“You don’t see it, but you **feel** it”

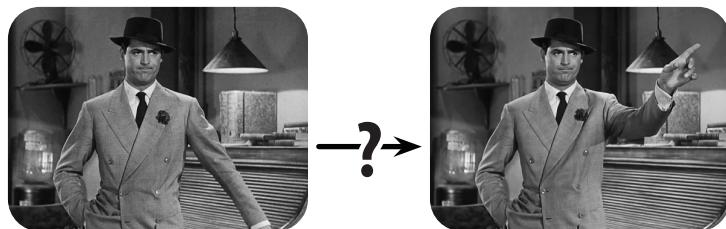
The movement **most often** goes in the **OPPOSITE** direction of where the main action is going.

Keep anticipation for videogames generally short or non-existent. You want animations to play as soon as you press the button. If the animation is just cosmetic or needs a wind up, be sure to add nice anticipation.



Castlevania Symphony of the Night (PS1)

Breakdown



This is also known as *the passing position*. A new key frame that makes the animation change its course. Think of it like alternative route or a mid-key frame. **To get from A to B, you can spice it up!** Take this scene from the live action film *His Girl Friday* from 1940. Actor Cary Grant is pointing. How do you imagine him to get from A to B? The quickest way would be to simply raise his arm.



Instead, the actor changes direction and creates an arc with his arm. This motion makes his pointing feel stern, bossier. **This is just one of many possibilities.** You can have ALL sorts of breakdowns.



Alucard's turning animation – Castlevania Symphony of the Night (PS1)



Rescued Prisoner of War – Metal Slug (Arcade, NeoGeo)

Breakdowns allow animators to add variety and unique traits to their animations. Instead of going from A to B, we go from A → X → B . In the *Animator's survival kit*, the eighth chapter of the book talks about flexibility. Williams goes into detail about breakdowns!

For more great resources on this subject, I highly recommend the **Gumroad workshops and videos by Toniko Pantoja**.

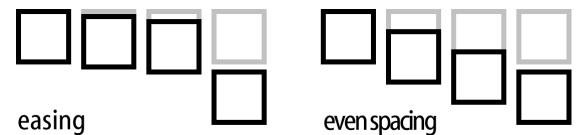
Gumroad Workshop:
gumroad.com/stringbing



Preview video:
youtu.be/wdPbiy-8BRo

Ease in and out

Easing animation in and out is exactly the same as with regular 2D animation. There's no big difference at first. Easing means that the in-betweens favour the key frame.

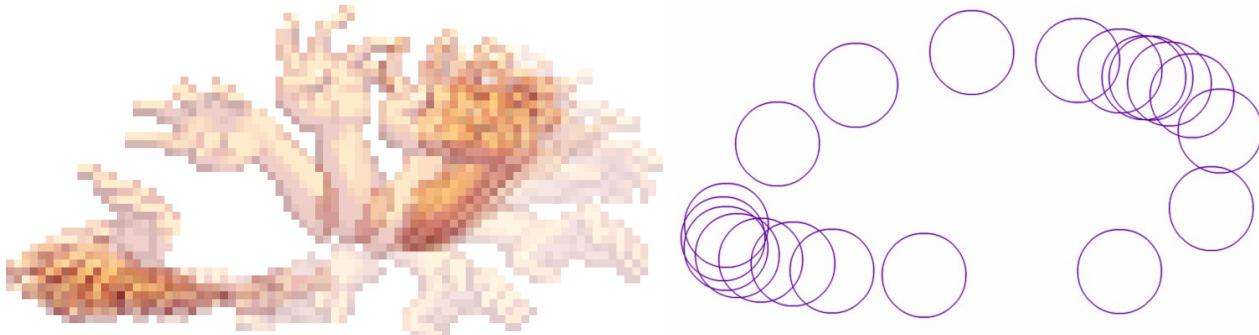


To put it shortly: it's acceleration & deceleration. Speeding up and slowing down.



Street Fighter III (Arcade, DC)

You can see that when all the frames are viewed at the same time, the in-betweens closer together are the ones that ease in and out. Slow-ins and outs are vital for good-looking natural movements.



Easing and subpixeling

"1 pixel" is the minimum distance to transform or drag areas around.

If you want to place in-betweens VERY close together, you use subpixeling.



Iconoclasts (PS4, PC, Switch)



Slow-in and slow-out animations have key frames so close together.
In fact, you can just copy paste the closest frame and modify it!
Subpixeling is for these particular frames.

Timing chart:

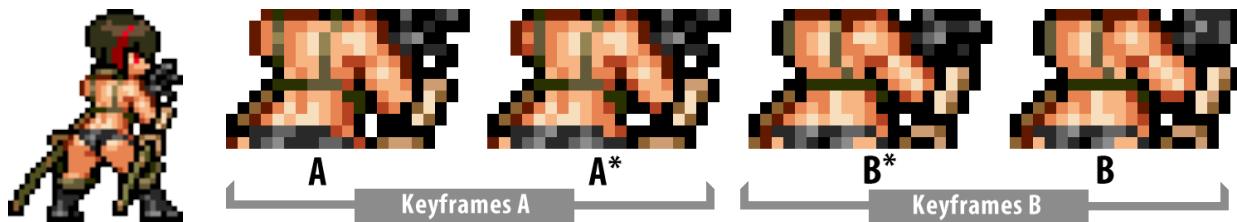




If the previous animation timing charts are hard to read, consider the following: In both instances, frame 2 favours 1, and frame 4 favours 5. They're closer to each other than to frame 3. When the spacing between both drawings is super close, *that's when* you'll need to subpixel.



Frame **A*** is a duplicate of **A** but edited with subpixeling. This inbetween helps ease in or out the character into the keyframe. Likewise, **B*** is a duplicate of **B** but slightly pixel shifted too.



Subpixeling will only be used for slow ins and outs, and for the most subtle movements. Rather than wanting to squeeze in subpixels everywhere, work on strong key frames FIRST.

Moving holds

Red Earth (Arcade)



These are movements where the action stops, but the character slowly keeps moving as they hold the pose. Moving holds are extremely rare in pixel art, because it would exponentially increase the number of unique frames! **More frames means more memory storage, so you will rarely see them in older video games.** Consider this technique a way to ease in to the maximum.

In the appendix you can find two versions of this *moving hold* animation.



Sonic Advance (GBA)

A regular *hold* is when the characters "holds a pose". This isn't an idle animation but simple the character coming to a halt. Nothing moves, so it's your job to emphasize other smaller parts moving on a body to keep it alive and moving.

For more info on holds, check out the "Follow-through" section.

Smears

Smears are in-betweens that mimic the effects of motion blur.



Elongated smears



Street Fighter III (Arcade, DC)

This is a stretched out in-between. They're used to show a blur of motion in a single frame. It connects two key frames together. These frames should not stay on screen for too long. They happen so fast that you can't always tell they exist. They're a visual trick.



Martial Masters (Arcade only)



Fire Emblem Binding Blade (GBA)



Owlboy (PC,PS4,Switch)



Iconoclasts (PS4,PC, Switch)



Street Fighter III (Arcade, DC)



Owlboy (PC,PS4,Switch)

It's best to have **smears animated on one's at 24fps** (or around 0.05 seconds).

You should **feel** them, **not see** them.

Multiples



Boogerman (Mega Drive)

Smears with after-images. They're an alternative version of elongated smears. These are smears that multiply objects. These work just as well as elongated smears. It's up to you to feel what works best.



Marvel vs Capcom 2 (Arcade)

They work better **with looping cycles** than stretched smears do.



Mario & Luigi: Bowser's Inside Story (NDS)



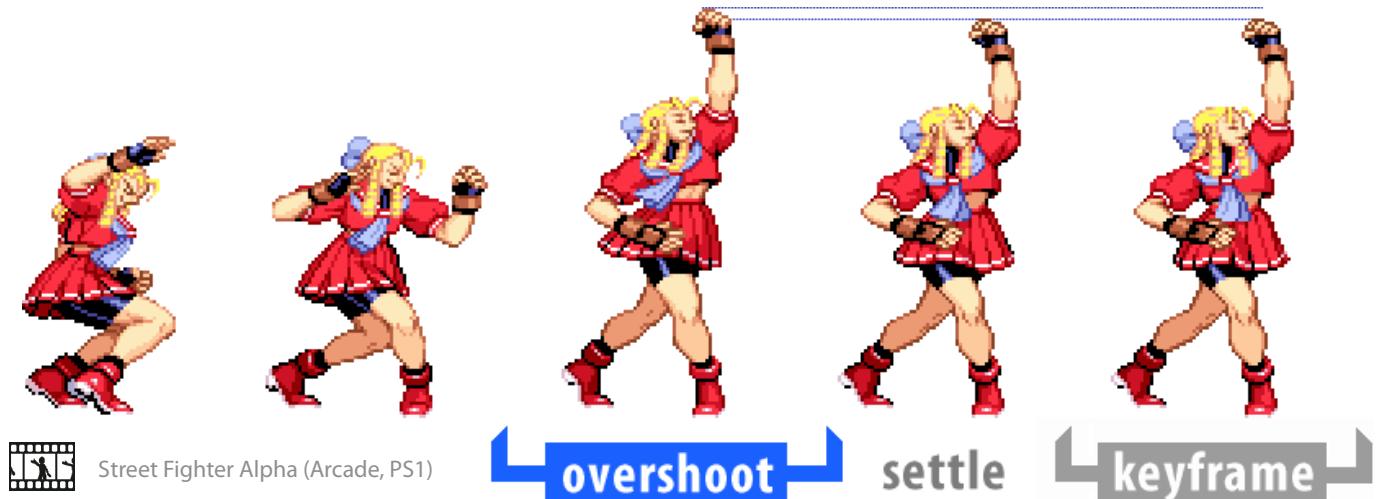
Dragon Force (Sega Saturn)

In chapter 5, we've seen games with **dithered** blurs on rare occasions. This method is **now obsolete** and would *only* work on CRT-television. It's not very efficient today, so try to **avoid** them.



The Mask (Mega Drive)

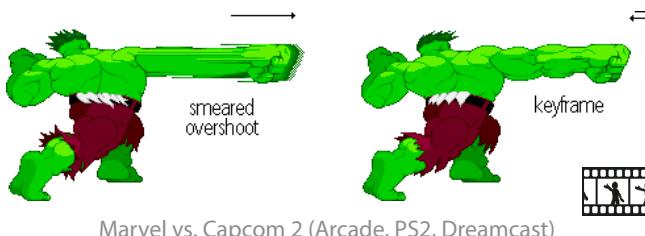
Overshoots



Overshoots are frames where the part you're animating goes past its destination, only to bounce back to the key frame. It's a type of **recoil**, like a stretched spring returning to its default state. Richard Williams calls these "*hard accents*", but in the modern industry we call this "*overshoot*". Sometimes a couple of in-betweens settle the character back to the key, other times the overshoot snaps with no in-betweens.

You can vary the impact. Sometimes it's enough to have an overshoot that moves a body part by just 1 pixel.

You may not see it, but you can feel it.



Some overshoots can be combined with smears. This smear will reach further than the key frame.



Exaggerated overshoots use **squash & stretch**. The entire body can overshoot too.



Remember that overshoots don't just happen in two dimensions. Perspective always applies, even with 2D objects.

Overshoots help give your motions a nice snap or pop.



Overlap & Follow-through

Overlapping action

Some parts of the body lead all the movement. As it moves, other segments will trail them. One part leads, the other ones follow.



Overlapping actions are all the parts or objects that follow with a delay. When the action is complete, parts will keep moving. This is the **follow-through**. These effects apply to **anything pulled** by an outside force. This isn't a secondary motion.



This character, *Alphonse*, has two distinct parts. They overlap at different timings. The arms and head lead the movement, while the torso follows with a slight delay. The legs simply don't move at all.

Owlboy (PC,PS4,Switch)

Overlapping motions can be more simple than the example above.
It's best to plan out your animation first, be it simple or difficult.

**Always start with your leading action,
and draw the following actions later.**



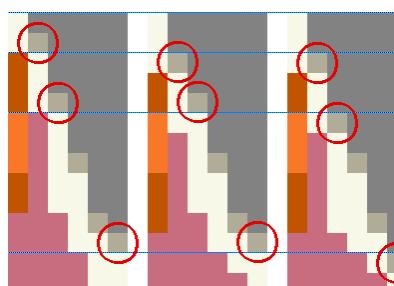
Metal Slug Attack (Mobile)



Martial Masters (Arcade only)

Overlapping pixels

It's easy to lose track of subpixeling, so therefore plan out your animation carefully.



Freedom Planet (WiiU, PC, PS4, Switch)

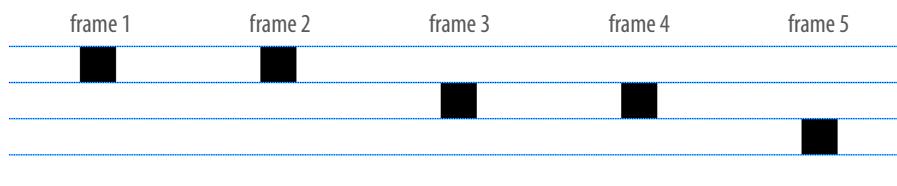
Furthermore, we can apply this animation principle to a tiny area with single overlapping pixels. When 1 pixel moves, the other ones take a frame or two to catch up. They are **delayed**.



Subpixels can extend the animation as well. They can be used as overlapping actions in pixel form.

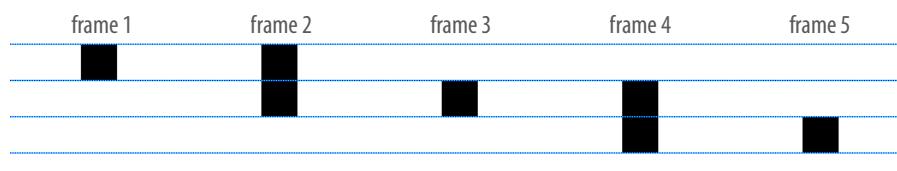
Mighty Switch Force 2 (WiiU, N3DS)

Having to delay pixels will increase the frame count and gives the impression of more movement. Like subpixeling, it gives you more space to animate with. In fact it's subpixeling with *whole* pixels!



Let's call these delayed pixels

Alternatively, you can extend pixels to bridge them together. However, this can stand out like a sore thumb. Always play back your animations to see if it feels right.



Let's call these stretchy pixels



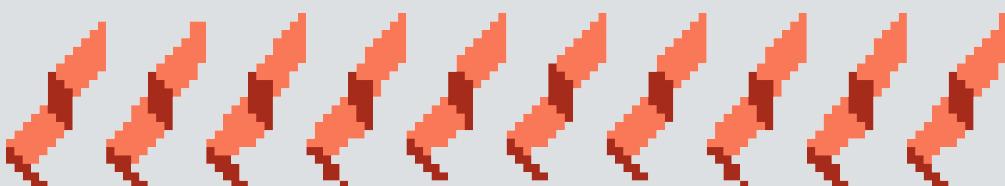
By Guest Artist Danieru



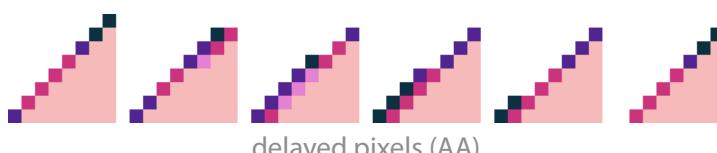
Metal Slug Attack (Mobile)



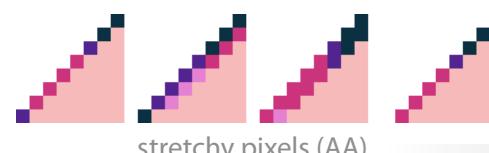
If you'd like to animate 45° shapes with subpixels it's best not to have AA. It's much cleaner to have overlapping pixels. The frames by themselves won't have clean 45° shapes anymore, but the transition will end up smoother.



If you have shapes with outlines or anti-aliasing, things will get VERY messy at 45°.

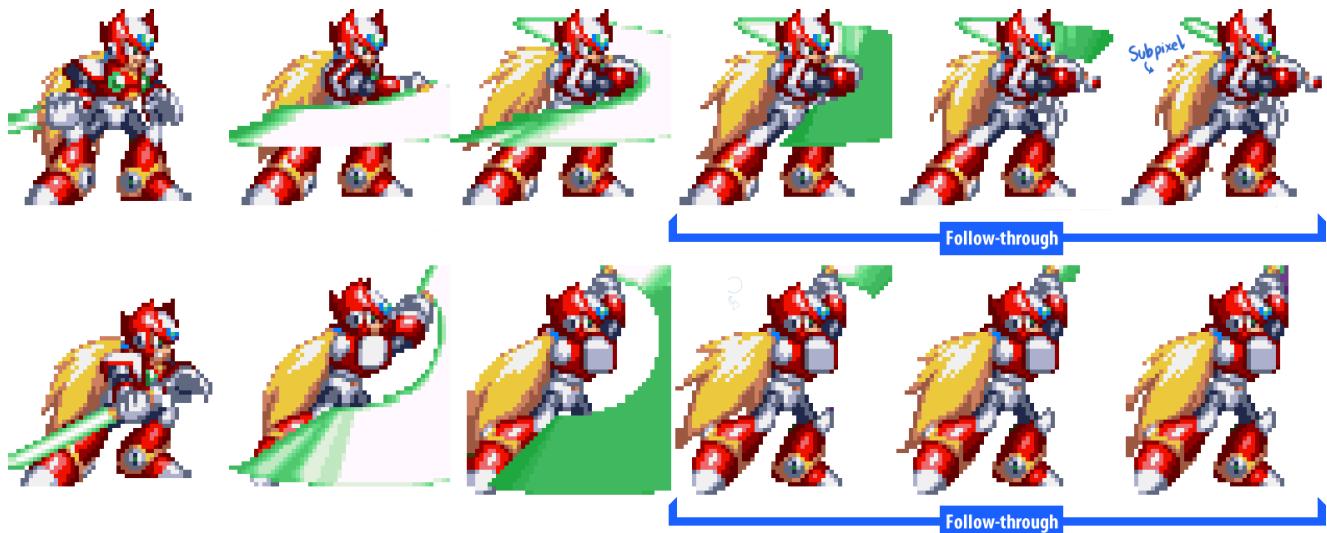


delayed pixels (AA)



stretchy pixels (AA)

Follow-through



Zero's hair follows through after he slashes. It reacts to his movement by settling back (Megaman X4 (Sega Saturn, PS1))

Follow-throughs add extra movement to your characters and objects. They make motions more realistic. If you work with limited frames, they can also **give the illusion of there being more movement than there actually is**. These parts continue moving after the action is complete, hence the name *follow-through*.



Batman (NES)

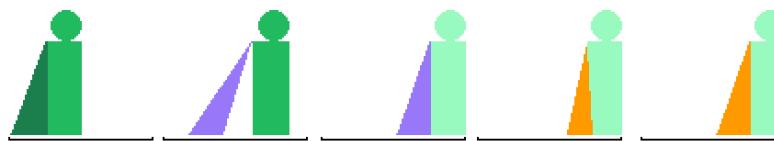
This Batman sprite even has a little bit of subpixeling on the follow-through of its cape. It's quite impressive for an NES sprite, but also uncommon. Follow-throughs may require some subpixeling to get a nice smooth ending. This will help make the "settle" phase of the animation even more convincing.



Summary

Overlap : DRAGGING

Follow-through : SETTLING



Main Action

Held drawing - Action has ended

Overlap

Follow-through

The Four Methods

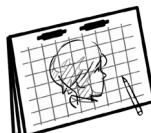
Like in the introduction chapter, there are several ways to start a still drawing. Pixel animation however knows 4 methods used to get from start to finish. These methods are about how pixel art is built, more specifically the rough drawings for every frame followed by the clean-up process.



Silhouette
animation



Recycling
drawings



Start from
Traditional



Simple
Lineart

Of course the two (or three) methods of traditional animation obviously still apply to pixel art.

Pose to Pose: planning your work with key frames, adding in-betweens to connect them.

Straight Ahead: animating frames as you go, improvising your way through the timeline.

Pose to Pose + Straight ahead: A mix of both methods

Silhouette animation

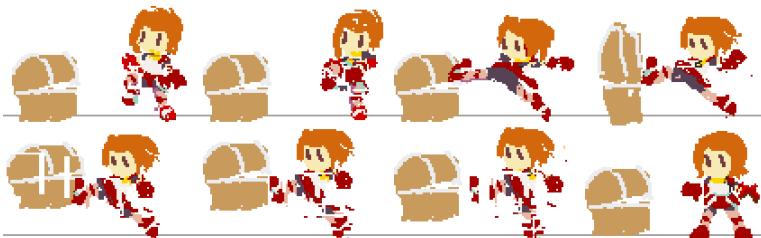
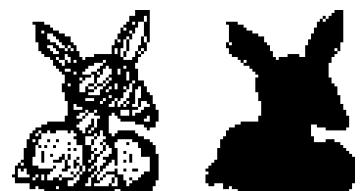


Silhouettes are useful for large movements



By Michafrar

The way you doodle your silhouettes is up to you. If you draw your silhouettes like a regular drawing, that's just as fine! This technique is **more so about the shape** than actually being a shadow. The final result is what matters.



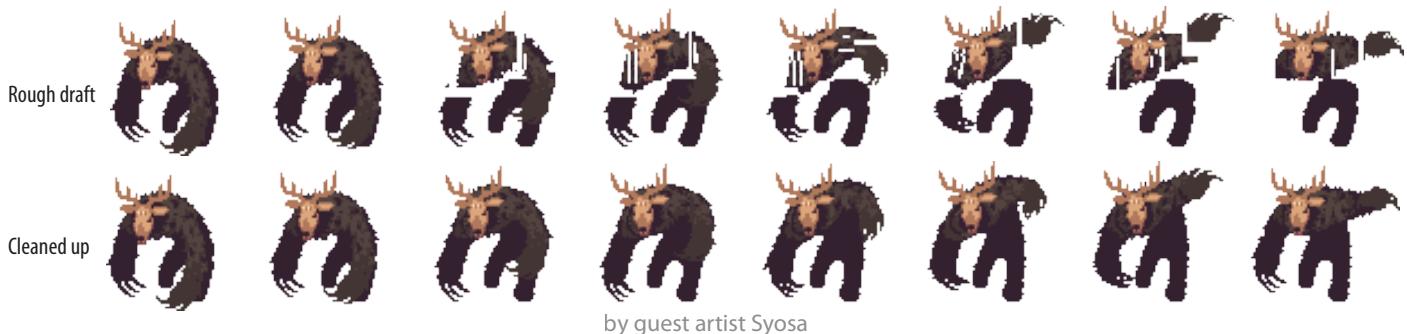
By guest artist YAA

Silhouettes can also be blobs of flat colours. This technique works well to plan out your animation. This helps you keep track of the colours on your character early on. You can modify, re-use or touch up parts at any time.

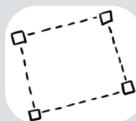
Recycling drawings



Recycling is useful **to keep a consistent style and for staying on model.**



by guest artist Syosa



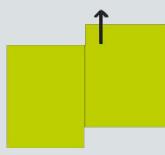
Once again, the selection tool is your best friend with pixel art. With this tool you can use and **COMBINE** the following techniques to help draw new frames:



Copying



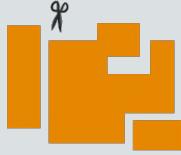
Resizing



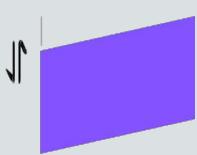
Sliding



Rotating



Cutting



Skewing

By analysing sprite sheets and animations online, you can tell that pixel art has frames that recycle a lot of body parts. You can tell some frames are copied and edited. There is no need to redraw everything



from scratch with pixelart. Once you have a solid base pixel drawing, that sprite itself becomes your main resource. Duplicating sprites and modifying them will save you time.

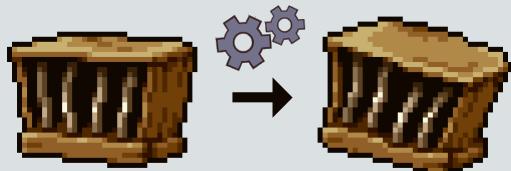


Mighty Switch Force 2 (WiiU/3DS)



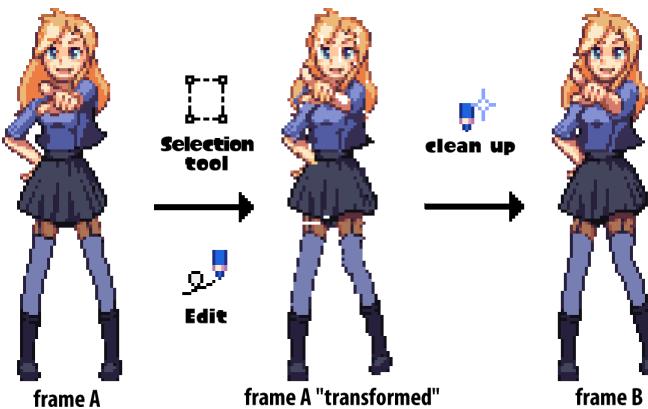
Metal Slug 3 (NeoGeo, PS2, Various)

Squashing, stretching or sliding parts around are the basics. Once you get the hang of these techniques, you'll be able to combine them. Instead of drawing a new frame, you can obtain really complex frames by skewing and rotating. Things will look rough, but that's because you still have to clean the sprite up.



Metal Slug 3 (Arcade, Neo Geo)

Every frame you draw is a resource. It's fine to duplicate and transform.



by Michafrar

HOWEVER the important part is to put enough work into frames by transforming and frankenstein-ing them in order to make them look distinct from another.



You can NOT just slide body parts around and leave it at that. If you don't edit them, your characters will look robotic or "tweened".

This method is comparable to the technique of
"Place and Trace" used in traditional 2D animation*.



Wargroove (PC, PS4, Switch, XBO)

Combine both the "silhouette" and "recycling" method to create rough inbetweens much faster. This does require more clean-up but you'll get a feel of the final animation a lot sooner.

“ I feel that with silhouette style animation, the whole thing should move all at once, much like the movements of a running horse. Reusing frames is convenient for showing small expressions and human gestures. I use both of these two techniques. Syosa/ しょさ ”

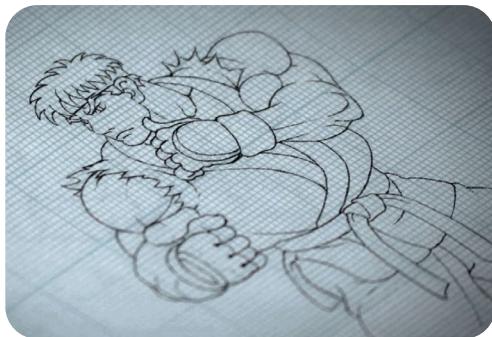


This technique goes hand in hand with the "Recycling frames" method.
You can combine methods!

With a little experience, it can speed up your work tremendously!

* **Place and Trace** (also called *shift and trace* or even *lift and trace*) is a technique where traditional 2D animators use a previously drawn frame as a guideline to draw inbetweens or new keyframes. This drawing is placed underneath a blank frame so it can be loosely traced or transformed. This technique helps objects, features and characters stay uniform.

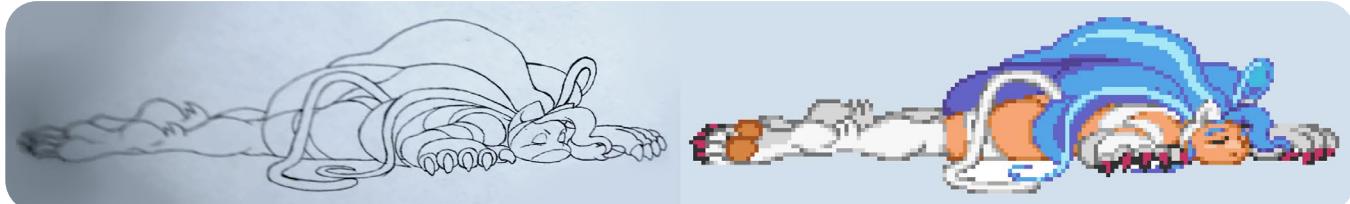
Start from Traditional Art



This refers to the traditional way of animating on paper or softwares like *Adobe Photoshop*, *Adobe Flash*, *TPaint* and *Toon Boom Harmony*.

Today, this technique consists of:

- **First**, drawing animation in higher definition.
- **Then**, shrinking the frames down to a pixel-friendly size.
- **Finally**, tracing or editing the frames of animation.



Left: Captain Commando (Arcade, SNES)

Top: Darkstalkers (Arcade, PS1)

Right: Street Fighter III (Arcade, Dreamcast)

Many refer to Capcom when talking about this technique.

In the past, 2D Capcom artists would use grid paper to animate the characters and then digitize and colour the frames on computers. Various studios would make use of this method. Some companies would employ the help of external 2D animators; others worked in-house. The way each studio digitized their animation frames was different, yet the main process remained the same. Earthworm Jim sprites were coloured first. By studying many of the scans and beta footage, you can tell drawings were altered during the pixel art phase.



Today, preliminary sketches are all done on computers.

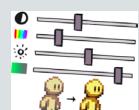
Here are some tricks to help digitize your work to pixels, no matter the software:



Shrinking without blur



Reducing colours



Up the contrast



Sharpen filter

Once the images are optimised, **it's all clean-up from there on**. After all, pixel art is about having control.

If you need to create extreme amount of animation, one possibility is to create 3D models first. The results created with these models are still considered pixelart, as it still requires the skill and knowledge of pixel art during the clean-up phase. A well-known game with this technique is *The King of Fighters XII*, but you can find it in older games such as *Sonic 2*, *Mickey Mania* and *Kirby Super Star*. The company *Arc System Works* use 3D models to create sprites with games such as *One Piece: Great Pirate Colosseum*, *Dragon Ball Z: Extreme Butōden* and the *Blazblue* series.



One Piece: Great Pirate Colosseum (N3DS)



If you're interested in finding out how to further digitize your work, check the wonderful site: [2Dwillneverdie.com](http://2dwillneverdie.com) that specialises in this method.

We've talked about the traditional method before. Have a look back at these previous pages:

Introduction

[Where to start?](#)

p 8

[Retro hardware](#)

p 11

Readability

[Symbols I – Hands #6](#)

p 98

Clean-up

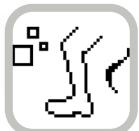
[From rough to clean](#)

p 164

[From start to finish - I](#)

p 182

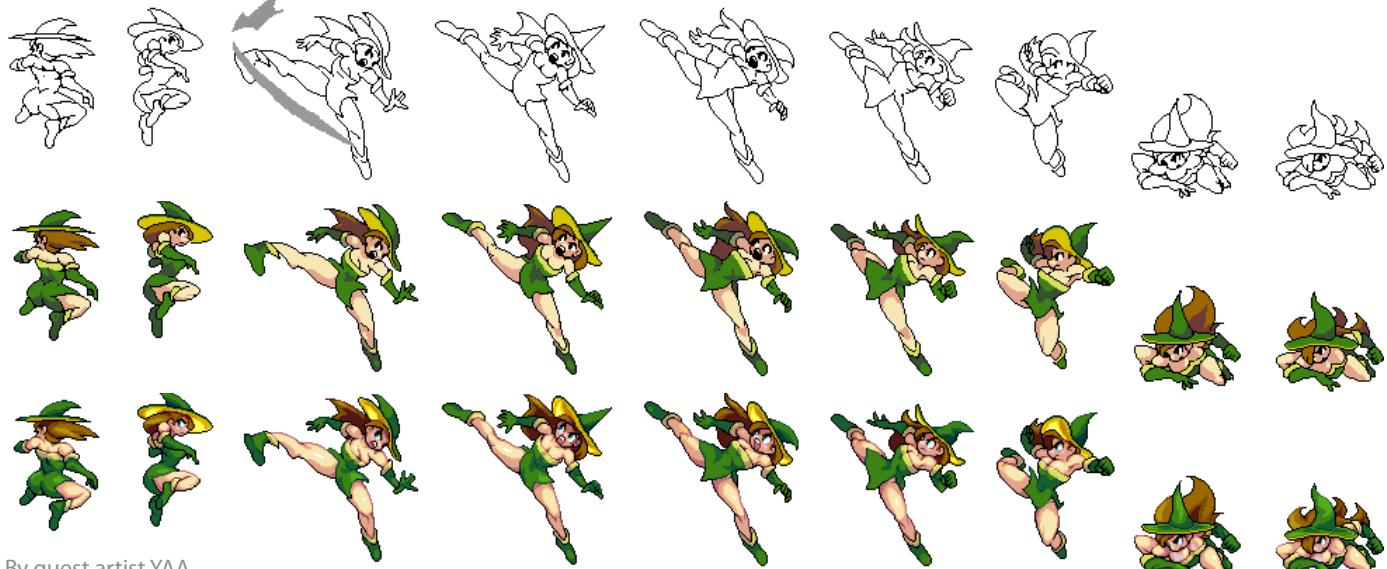
Line art



This technique is straightforward: it's the same as regular digital animation.

Whether you animate on paper or on computer you'll start with:

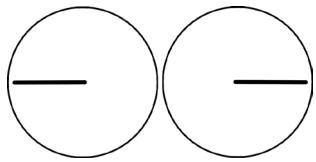
line art → colours → shading → clean-up



By guest artist YAA

Every frame needs to be shaded individually from scratch. This method may look fast at first, but it takes quite a long time. It's pixelart from start to finish. That's what sets it apart from the traditional method.

Limited frames



Two frames. That's the minimum. Sadly, we can't have arcs or ways to show how things go from A to B. The animation will just flicker. We need at least a third frame.

You need to convey the most amount of motion with lowest amount of drawings. This is the real difficulty.

For limited yet satisfying animations, *include these:*

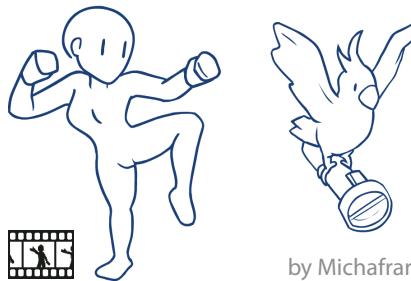
a strong keyframe of **anticipation**

an **overshoot** frame for snappy motions

if possible: a **breakdown**, aka "mid-point"

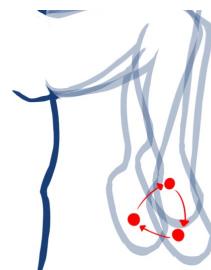
accurate **silhouettes** that portray the action.

The following advice is inspired by [Mariel Cartwright \(@kinucakes\)](#)

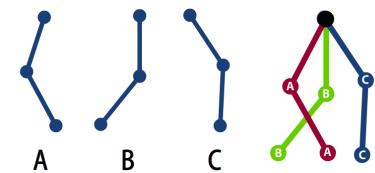


by Michafrar

The minimum amount of frames for a convincing loop a is **3 frames**.

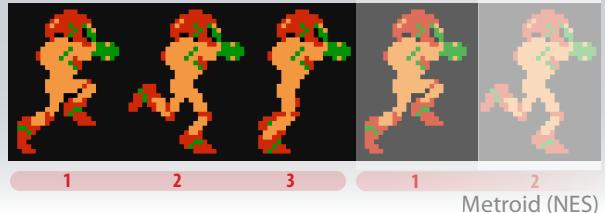


Rather than going back and forth, you can position objects in a circle



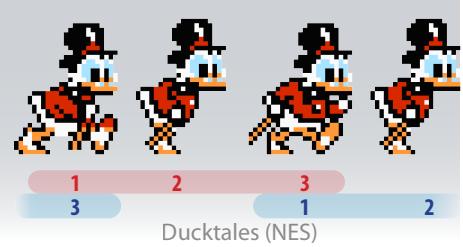
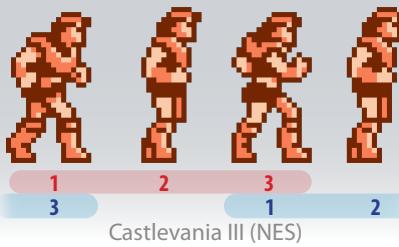
Overlapping actions can be narrowed down to 3 frames too

This minimum even works for run animations. You can have a 3 frame loop where the legs are interchangeable.



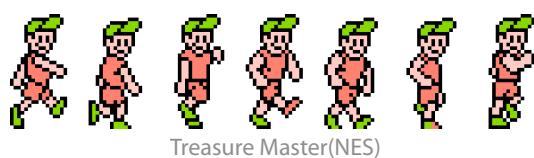
Metroid (NES)

You can also have 4 frames where one of the frames is reused (usually a breakdown). This way the animation can loop back.



Castlevania III (NES)

Ducktales (NES)

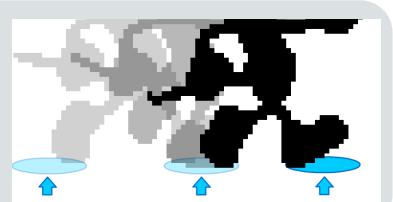


Treasure Master(NES)

Even with strict limitations you can get very expressive with looping animations!

Having a bit of trouble with walk cycles?

Try having a character go across the screen rather than having them walk in place. Keep track of where the foot has contact with the ground. Once you're done, reposition your frames back to the middle.



The Onion skin

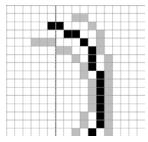
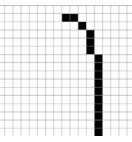
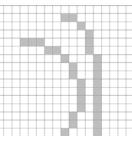
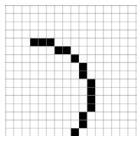
The Onion skin shows you the previous and next frames.
This helps you draw in-betweens - but with pixel art there's a catch...



OK!



- Frames are far apart -
The onion skin tool only works well
for line art and to predict in-betweens.



Frame A

Frame B

Onionskin

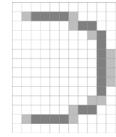
In-between



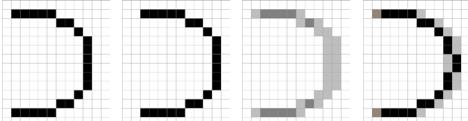
??



- Frames are closer together -
With a lot of colours, it becomes
a big mess! This is too hard!



Good luck with that ...



If you're lucky, your outline can be in-betweened like this.
BUT, if you don't use lineart to make pixel art animations,
the onion skin won't always be useful.

You can find the button in most software. Some software may call it a "light table".



Pro Motion



Light Table



GraphicsGale



GALE



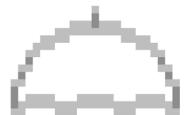
Onion Skin



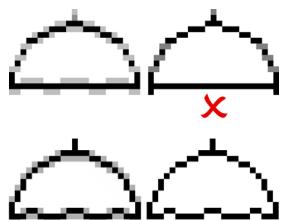
A pitfall to avoid



This goes without saying: watch how you use the onion skin. Let's subpixel this umbrella shape downwards.



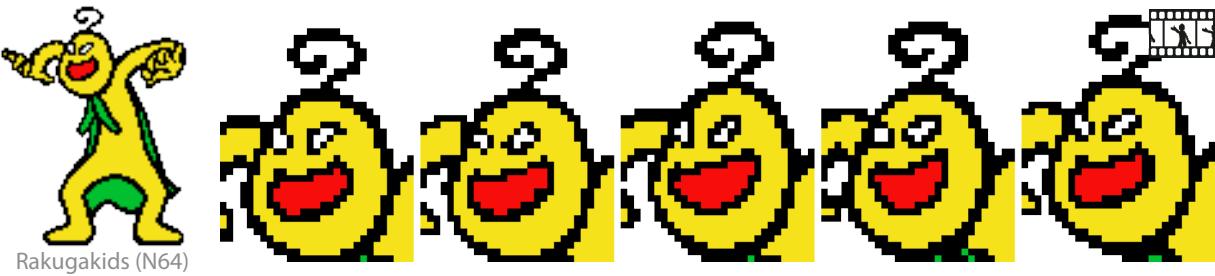
This onion skin gives you **enough info** to draw an in-between. Sadly, it's a misleading shape!



You literally can't draw between the lines, like with traditional animation. There's little to no space to do that.

The best solution is **to favour** (=to draw closer) the key frame so that your in-betweens keep their shape.

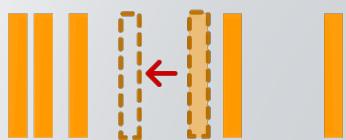
Line boiling



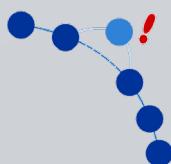
Boiling is the wobble effect of hand-drawn lines. This is often a result of frame by frame pixel drawings. With so many pixels tightly together, it's likely that some of them might "jitter".

Boiling is inevitable with traditional art, but can be avoided with digital arts.

Causes:



In-betweens favour the wrong frame.



Movement doesn't follow an Arc



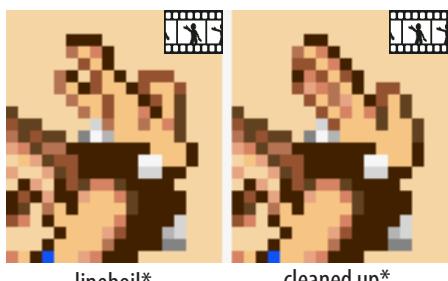
Subpixeling (if used) is not aligned well.

Solutions:

- Use the selection tool as much as possible. Slide parts around.
- Use Subpixeling to make sure frames transition smoothly with tight in-betweens.
- Be economical, utilize limited animation. The risk you take, however, is having choppy animation. Some artists and audiences find high framerate pixel art to be too sterile, too clean. Find a nice balance between old limitations, and modern possibilities. You don't have to adhere to anything.



Certain games try to mimic the handdrawn style, games such as *SMW2: Yoshi's Island* (SNES) and *Ragukakids* (N64). These games have intended line boil, they simply mimic the shaky animation. However *Yoshi's island* only uses the technique for backgrounds and objects. Character and enemy sprites are animated *without* line boil.



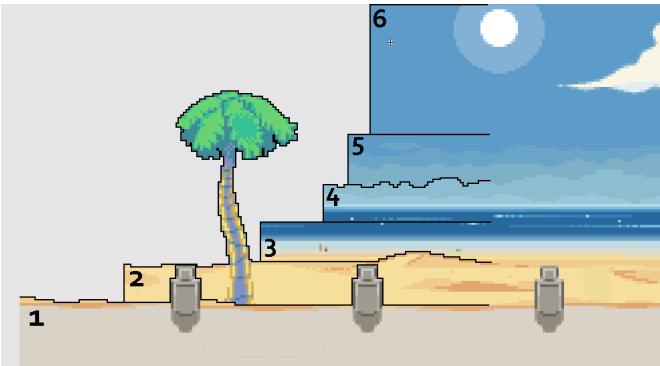
Line boil is particularly noticeable when characters are redrawn for every frame even though they are standing still. With traditional art, it's often used as a popular stylistic effect. With pixelart, it doesn't translate well because it's at a low resolution, so there is little room for boiling.

One odd frame can mess up the animation.*

*This example is strictly animated. Check the appendix to see it.

Parallax scrolling

To add more depths you can either use perspective for the background, or use parallax scrolling:
dividing your background in layers and moving them at different speeds:

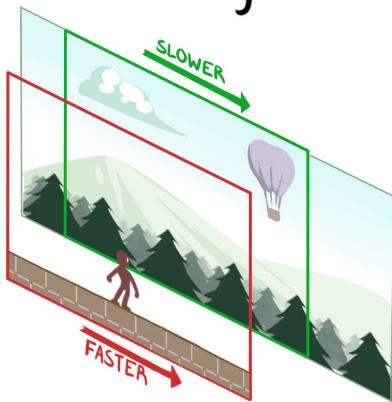


The **closer** a piece of landscape is, the **faster it moves**.
The **further away** it is, the **slower it moves**.
Skies or very distant objects like the sun, moon, stars, and mountains rarely move.

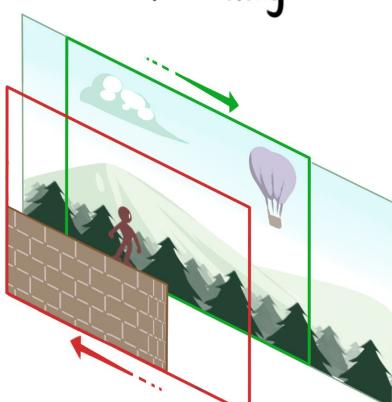
The landscape moves like in a car ride!

There are 3 distinctive types of parallax scrolling that give 3 unique effects.

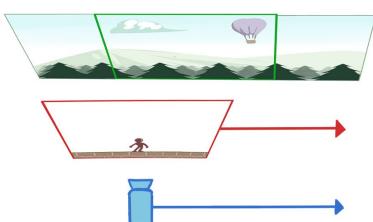
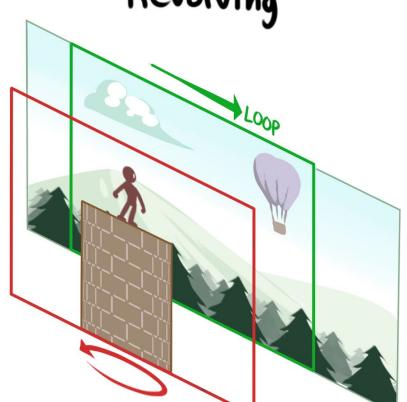
Following



Travelling



Revolving



All layers move in the same direction, but they move at different speeds.



Rayman (PS1)

Layers move in opposite directions
The scene makes the camera turn.



Ninja Gaiden (NES)

The background loops, the front is frame by frame - the camera revolves



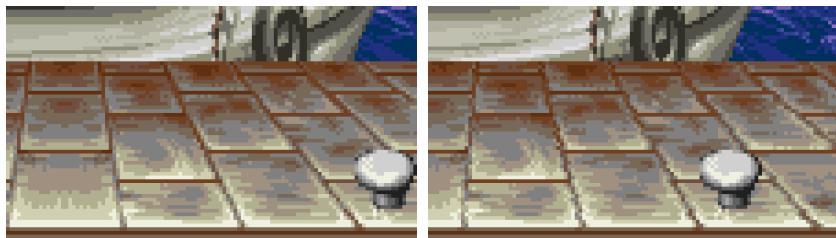
Mickey Mania (Megadrive)

Top down views

Parallax Scrolling isn't just for side-scrollers. They can easily be used in top-down views like in *The Legend of Zelda: Minish Cap* (GBA). Notice how the blade of grass travels over the leaf.



Stretching and skewing



Backgrounds can stretch and skew to create perspective. Each pixel scanline is moved at different speeds **with the help of programming code.**

Street Fighter II Turbo (SNES)



Focus on the distant background as the character swims up. Notice how the wooden ceiling moves down.



To achieve this effect, artists created both the floor and ceiling of the beams in a single asset. The beam is stretched as the character goes up and down, revealing either side.

Donkey Kong Country 2: Diddy's Kong Quest (SNES)

If you'd like to know about these coding techniques, watch the videos at Game Hut.

Jon Burton, director at Traveller's Tales reveals all his programming tricks there.

<http://www.gamehut.com/>



Conclusion

To some, pixel art is synonymous with animation. To others, it's synonymous with illustrations.
Whether you animate or not, give this a thought:

Animating is a transferable skill.

This means it's an ability that can be applied in other fields. It's a super valuable skill to know if you wish to create videos, computer games, or simply want to further your career. You don't *have to* excel at animation per se, but learning it will teach you some cool tricks that you can apply elsewhere!

Animation is also an expansive subject.

As much as this chapter can cover the topic, one book simply isn't enough! It's a diverse and complex subject with its own methods. To this day, artists continue to write about it, discuss it, and establish new styles. Pixel art animation is a sub genre of both art and animation. It requires you to combine your knowledge of each, so it's valuable for your own artistic growth to learn about the fundamentals of animation as a whole!

**Most importantly, have fun. Animating is hard work,
but can feel so satisfying when you see things come to life!**



Advance Guardian Heroes (GBA)



Food for thought

- Introduction
- How to study
- Timelines in pixel art

Key techniques

- Squash & Stretch
- Anticipation
- Breakdown
- Ease in and out
- Smears
- Overshoots
- Overlap & Follow-through

Animation concepts

- The Four methods
- Silhouette animation
- Recycling frames
- Start from traditional
- Simple lineart
- Limited frames
- The Onion skin
- Parallax scrolling

Epilogue

Afterword

After writing this book on-and-off for the past four years, it is hard to find good closing words. Pixel art is a marriage of the rendering of painting with the precision of sculpting. The defining feature of this art form is, and will always be the precision and control you bring to your art pieces. This is what makes it a medium and not a style. By now many of you have already understood this concept.

Drawing is a prerequisite. This means it's a skill you need to somewhat master before learning a new one. Animators are told that knowing drawing is a fundamental skill. Pixel artists need to be told the same. The art of pixels is nothing without a good sense of illustration and painting. To be a proficient pixel artist, you need to be good at drawing and painting. Most of the time if something doesn't look quite right with your sprites, the cause will most likely be related to the drawing, the shape or how well the drawing fits together. As an infant in order to run, you need to learn how to walk first. I would have included this paragraph in the beginning of the book, but I've been told this advice can be quite discouraging for newcomers. However, I feel it's a necessary speech to give newcomers, despite how harsh it may sound to non-artists who really want to give pixel art a try. Even minimalist styles or super low-res sprites will require some sense of colour and shapes.

Pixel art finds its roots in video games. As a result most sprites featured in this guide serve as study, reference and analysis. I strongly advise you to do the same. In fact, **I urge you to study and learn from video games and artists who worked for them.** It's easy to just browse pixel art online and only come across single artist creating gorgeous visuals. But you shouldn't strictly study from her/him/them alone. These artists had their own inspirations. It's worth checking out what made them learn how pixel art worked. If you simply study one artist's interpretation, you won't understand how they got there. Your work will end up being a derivative of a derivative, if that's all you know. You can still have your "one favourite artist", but always try to be on the look out for more artists and more games. Those are made with teamwork in mind.

Lastly, this book has no exercises, since art is a productive skill where it's hard to evaluate our work without a community or a classroom. If you want to train, it's up to you to find what inspires you and replicate some new elements. Anything that hasn't been talked about in this book is specific to other artforms (textures, shading) or video game development (tilesets, formats). It's up to you to continue your journey and find more resources and tutorials.

Stay curious. Once you find Pixelart you find interesting, save it, and ZOOM IN!

Guest Artists



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Dan

Twitter: [@DanieruArt](#)

Website : [linktr.ee/danieruart](#)

An online archive that catalogues sprites and backgrounds from video games. This website is where I started as a young rookie pixel artist. Thank you to Mark Brown (GMT), Dazz (Daniel Brown), Shane Gill (DYKG) & everyone who worked on the website!

THE SPRINTERS
RESOURCE

A big thank you to *The Spriters Resource*
www.spriters-resource.com

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Book: *Neo-Geo Hardware Specification* booklet, page 93, issued by SNK Playmore Corporation

Video: 新 サラリーマンライフ トップリポート ビデオゲーム開発室 ブームの仕掛け人たちニューメディア I N
ビジネス 情報武装するオフィス ほか at <http://p.twipple.jp/mznVY>

Video footage: *SEGA Documentary* 1993 Part II, at youtu.be/-M8Rlc6Ek0Q

Video footage: *Fatal Fury 3 Neo Geo CD* - Promotional commercial

Paul Signac Entrée du port de Marseille (1911) ; Pixel Works by Susan Kare(1984)

Iwata Asks: The Legend of Zelda: A Link Between Worlds, URL: <http://iwataasks.nintendo.com/interviews/#/3ds/a-link-between-worlds/0/3>

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