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- Krita Blending Mode Manual Edits -

- (Subjected to changes depending on Krita development team and Krita users decision -

User Manual -> Reference Manual -> Blending Modes

Docs >> Reference >>Blending Modes

Available Blending Modes – New Only

- Binary
  - AND
  - CONVERSE
  - IMPLICATION
  - NAND
  - NOR
  - NOT CONVERSE
  - NOT IMPLICATION
  - OR
  - XOR
  - XNOR
- Lighten
  - Gamma Illumination
  - Soft Light (IFS Illusions) & Soft Light (Pegtop-Delphi)
  - PNorm-A
  - PNorm-B
  - Super Light
  - Tint
  - Fog Lighten
  - Easy Dodge
  - Flat Light
  - Dodge - Logarithmic
- Darken
  - Easy Burn
  - Fog Darken
  - Shade
  - Burn – Logarithmic
- Mix
  - Interpolation
  - Interpolation – 2X
  - Penumbra A
  - Penumbra B
  - Penumbra C
  - Penumbra D

- Modulo
    - Divisive Modulo
    - Divisive Modulo – Continuous
    - Modulo
    - Modulo – Continuous
    - Modulo Shift
    - Modulo Shift - Continuous
- Negative
    - Negation
- Quadratic
    - Frect
    - Frect-Helow Hybrid
    - Freeze
    - Gleat
    - Glow
    - Heat
    - Helow
    - Reeze
    - Reflect

Binary

Shortly for artists, they are staple for geometric art with using gradients, and can be used into aiding into texture creation with generated textures layers.

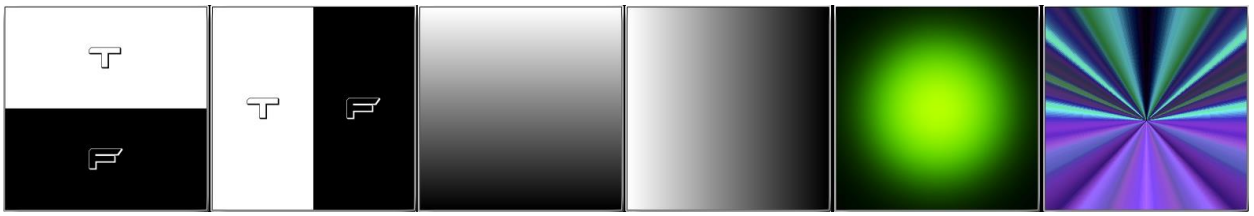
Binary blending modes are discontinuous, but has fractal attributes that follows other blending modes, that means they are best used to aid into creation of geometric art with only gradients. Other usage of blending modes is space objects creation with similar cloud layers (Only difference is that one has been spherize'd), pixel art floor creation, glitch art, and art based on sierpinski triangle. XOR, and XNOR can be used for image analysis of differences between images, and it can be used to reveal differences between two very similar images in a profound manner.

These operations are based on binary operations using binary values of integer values. *(These are not available on float images).* These blend modes assumes Base Layer or Destination Layer *(This means Destination/Base Layer is P)* is preliminary statement, and the Blend Layer or Source Layer is the truth value of the resulting statement of base layer (This means that Source/Blend Layer is Q). Another assumption to know is that white means TRUE, and black mean FALSE. These assumptions are based on findings that correlates with online binary calculator using AND, OR, XOR along with being consistent with binary blending modes found in other softwares.

The content below contains some visual explanation of how these blending modes work, and some mathematical explanation of how these blending modes work. Visual explanations comes first, for artists in mind, and mathematical explanation second for those who really wants to know how these blending modes work.

Visual Explanation of each Binary Blend Modes

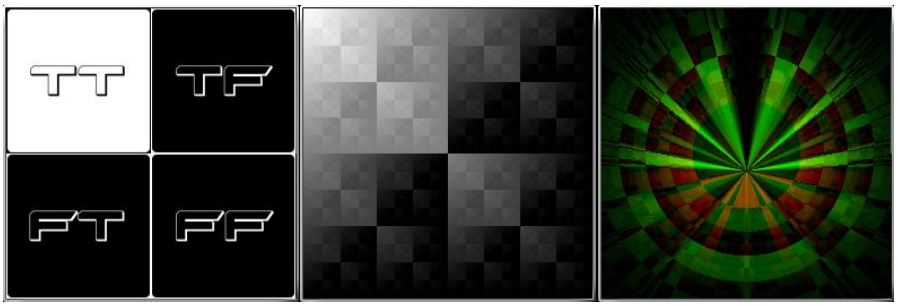
The series of images to demonstrate binary operation in action.



The images with T, and F forms will be used to demonstrate truth table of each binary operations.

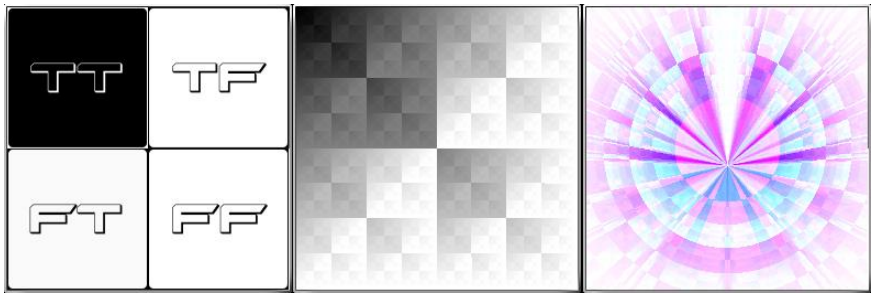
Visual Explanation of each Binary Blend Modes

AND



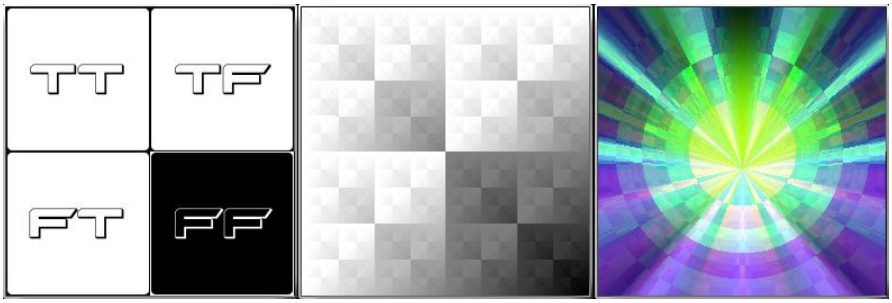
AND mode darkens the images at a binary level. AND operations usually return 0 often, so hence that darkening. It behaves similar to many other blend modes in the sense of how light and dark interacts.

NAND



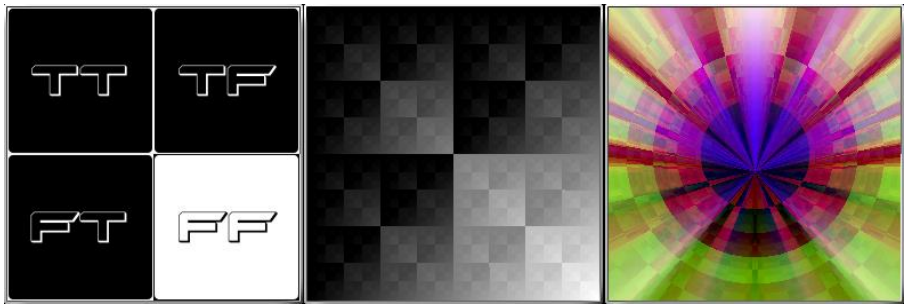
NAND is the inverse of AND at a binary level. The truth value are flipped, so it return 1 often, so hence the lightening. It behaves somewhat similar to the inverse of blended images.

OR



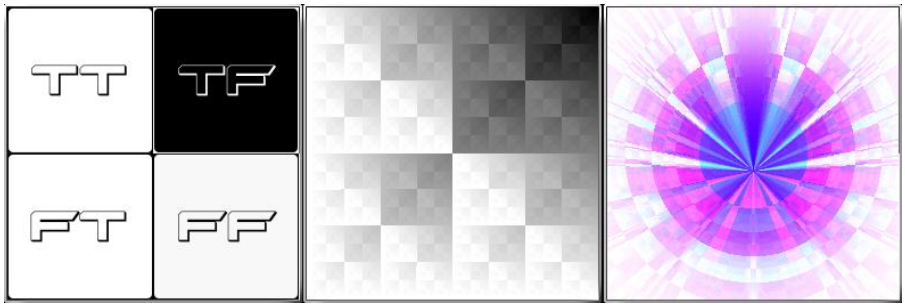
OR mode lightens the images at a binary level. OR operations usually return 1 often, so hence that darkening. It behaves similar to many other blend modes in the sense of how light and dark interacts.

NOR



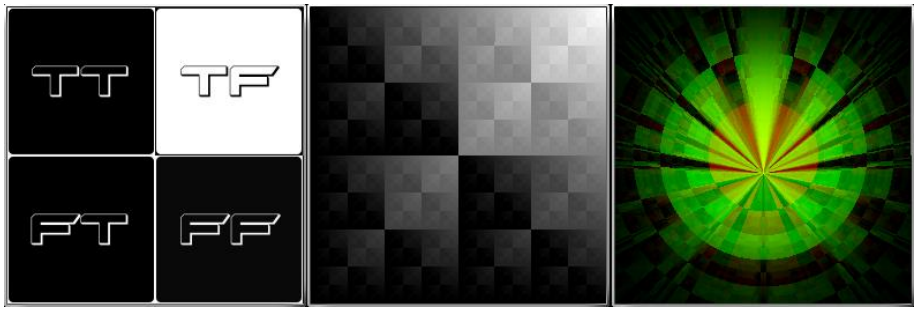
NOR is the inverse of OR at a binary level. The truth value are flipped, so it return 0 often, so hence the darkening. It behaves somewhat similar to the inverse of blended images.

IMPLICATIVE



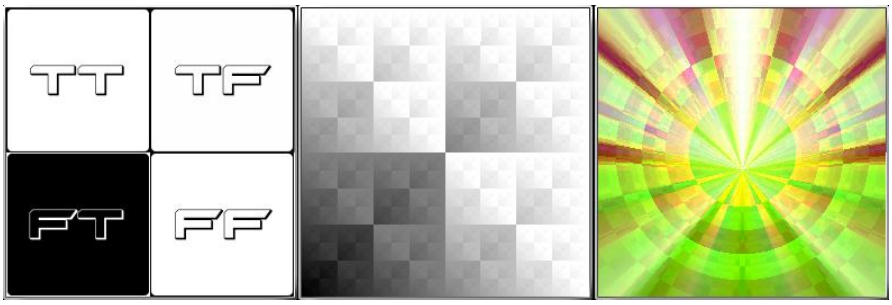
IMPLICATIVE is the conditional-based binary blending mode. If base layer is true on the binary level, and if blend layer is false on the binary level, then it is false. With only one false condition, it returns 1 often, and therefore lightens as a blend mode. Note that it looks similar to NAND with color rearranged.

NOT IMPLICATIVE



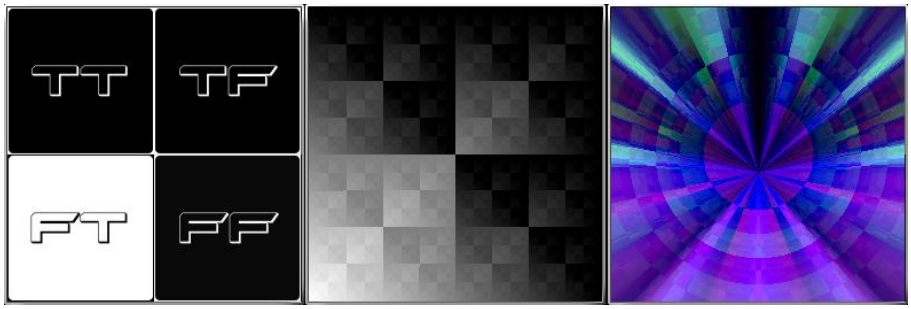
NOT IMPLICATIVE is the inverse of IMPLICATIVE blend mode. As IMPLICATIVE is a lightening blending mode, the inverse would return 0 often, so hence the darkening. Note that it can look similar to AND with color rearranged.

CONVERSE



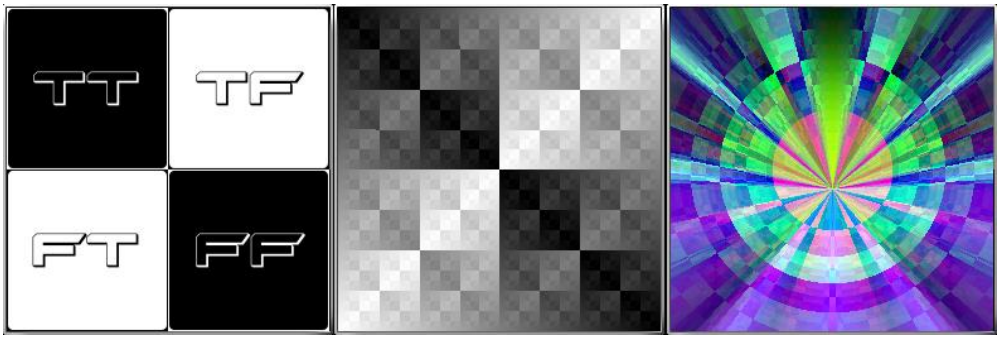
CONVERSE is the rearranged version of IMPLICATIVE blend mode. If base layer is false on the binary level, and if blend layer is true on the binary level, then it is false. With only one false condition, it returns 1 often, and therefore lightens as a blend mode.

NOT CONVERSE



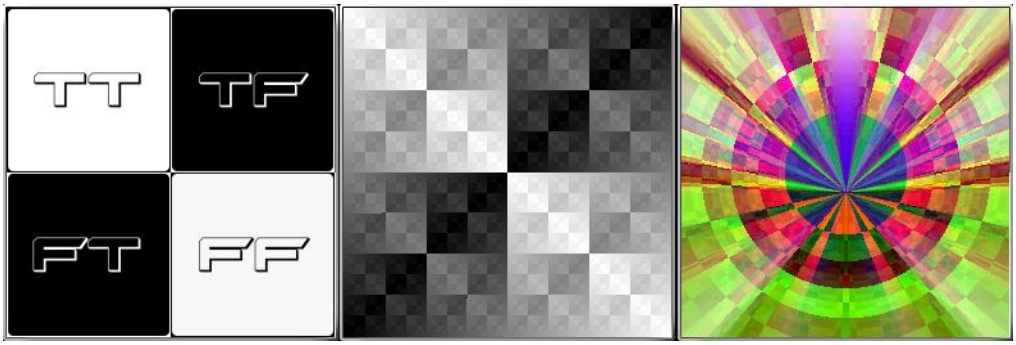
NOT CONVERSE is the inverse of CONVERSE blend mode. As CONVERSE is a lightening blending mode, the inverse would return 0 often, so hence the darkening. Note that it looks like the rearranged version of NOR blend mode.

XOR



XOR is essentially a blending mode which has a self-inverting property, and looks like a mashup of the other binary blending modes. XOR is the logical opposite of biconditional.

XNOR



XNOR is the inverse of XOR, and XNOR is essentially a blending mode which has a self-inverting property, and looks like a mashup of the other binary blending modes. Also, XNOR is equivalent to biconditional.

--Mathematical Reference –

Truth Tables

P is Base Layer/Destination Layer, Q is Blend Layer/Source Layer, ~ = Invert, 1 = T, 0 = F

P	Q	P AND Q	P OR Q	P IMPLIES Q	Q IMPLIES P (CONVERSE)	P XOR Q	P XNOR Q	~ (P IMP Q)
1	1	1	1	1	1	0	1	0
1	0	0	1	0	1	1	0	1
0	1	0	1	1	0	1	0	0
0	0	0	0	1	1	0	1	0

Basic conversion of standard decimal numbers to binary numbers

- 1 = 1
- 2 = 10
- 3 = 11
- 4 = 100
- 5 = 101

To convert from integer decimal to binary values

- Divide the base number by 2, and if there's a remainder, then the binary value for that placement is 1.
- Use the quotient found in the above process and apply the above process to here treating the quotient as base number.
- Repeat until the quotient is 0

To convert from binary values to integer

- Start with the right of the binary value. The placement number from that start is 0, and going on the right increases by 1.
- Multiply the binary value by 2^x where x is the placement number.
- If there is 2 digits, that means you have to add the result following the instruction for above for each digits.
- By doing this, you get your base-10 number.

Calculate binary operations with binary values

- Place your P value in binary
- The Q value has to be below P value, and the end digit meets the end digit of above
- Treat 0 as false, and treat 1 as true.
- Empty places are treated as 0
- Calculate value following logical proposition rules from above to bottom to get the binary value

Sources used to develop binary blending modes

- https://www.mushclient.com/mushclient/mw_blending5.htm
- https://www.getpaint.net/doc/latest/BlendModes.html
- http://jdejong.net/tools/bitwisecalculator.php
- Microsoft Excel BITXOR, BITOR,BITAND

Docs >> Reference >>Blending Mode>>Lighten

Gamma Illumination

The lightening variant of Gamma Dark. The end result is the inversion of Gamma Dark with inverted layers. It appears to be a less harsh version of Color Dodge that is somewhat soft and smooth.

Darker Gray [1- ((1-0.4,1- 0.4,1- 0.4)^[1 / Lighter Gray(1-0.5, 1-0.5, 1-0.5)]] =.65,.65,.65

Softlight(IFS Illusions) & Softlight(Pegtop-Delphi) & Soft Light(Photoshop) & Soft Light SVG

Add these paragraph

Pegtop-Delphi, and IFS Illusions formula corrects the problem of discontinuity found in Photoshop and SVG Mode.

The two different softlight formulas is:

Formulas:

f IFS Illusions(dst,src) = dst^2^(2*(.5*src))

f Pegtop-Delphi(dst,src) = (1 - dst) * dst*src + dst * [1 - (1 - dst) * (1 - src)]

Special note #1: Pegtop-Delphi blending mode documentation is available online, and IFS Illusions (dead software) formula is found in Wikipedia - blending modes.

Special note #2: Differences between all 4 softlight blending modes are only noticeable within 16-bit depth and higher images, and with using high-contrast images as the blend layer. Illusions darkens images on dark area of blend images significantly more than other current softlight mode, and Pegtop-Delphi offers higher contrast on lighter areas. But they are almost the one, and the same.

P-Norm A

P-Norm is a much smoother version of the Screen blending mode as it is rotationally symmetric. P-Norm A is slightly brighter than P-Norm B.

Formula:

$f\,(dst,src) = (dst^{(2+2/3)} + dst^{(2+2/3))})^{1/(2+2/3)}$

P-Norm B

P-Norm is a much smoother version of the Screen blending mode as it is rotationally symmetric. P-Norm B was created to allow users to choose a less harsher version of P-Norm.

Formula:

$f\,(dst,src) = (dst\text{^}4 + dst\text{^}4)^{1/4}$

Docs >> Reference >>Blending Mode>>Lighten>>Generic

Super Light

Super Light mode is a blending mode that's intended to be a mix of at least 3 different existing blending modes and retain some properties of all of them. (The value of the source code of the blending mode can be changed to something else, not sure what would be a good value.) It is a smoother, harsher version of Pinlight, but yet lighter than vivid light.

Note to Krita developers, and users who are able to alter values. This paragraph is subject to changed if there is a need to change the value of Super Light in case others see it as useful. The developer of the new blending modes highly suggest to change the value of 2.875 for experimentation of finding a useful parameter everyone can agree with. Multiple variants could also work.

Tint

Tint blending mode is generally used to heavily tint a painting. This blending mode is very useful if you are in need of a very strong tint effect.

Fog Lighten

The result of the blend layer with the base layer utilizing a fog-lighting falloff. A black and white gradient over a blend layer adds a light fog into a drawing. The end result is unaffected after a certain level of darkness in the blend layer.

Easy Dodge

Easy Dodge blending mode softly applies dodge effect with the base layer giving a soft overlay look. Far less harsher variant than Color Dodge mode.

Color Dodge - Logarithmic

Less harsh version of color dodge mode with a logarithmic falloff. Areas where both layers are darker retain property of smoother, and software blending modes than the regular falloff.

Flat Light

Flat Light is a blending mode which is a hybrid of Vivid Light and Hard Light, and has falloff closer to hard light. Provides strong contrast when base, and blend layer are closer to white or black. However, midtones are usually most apparent within flatlight.

Easy Burn

Easy Burn blending mode softly applies burn effect with the base layer giving a soft overlay look. Far less harsher variant than Color Burn mode.

Fog Darken

The result of the blend layer with the base layer utilizing a fog-lighting falloff. A black and white gradient over a blend layer adds a dark fog into a drawing. The end result is unaffected after a certain level of lightnessness in the blend layer.

Shade

Shade blending mode is generally used heavily shade a painting. This blending mode is very useful if you are in need of a very strong shade effect.

Color Burn - Logarithmic

Less harsh version of color burn mode with a logarithmic falloff. Areas where both layers are darker retain property of smoother, and software blending modes than the regular falloff.

Modulo Blending Modes

Modulo modes are special class of blending modes that utilizes the modulo mathematical expression. For graphic software, it is useful to use modulo operation based on the very next value possible after the maximum base value of 1.0 to preserve the input if the blend layer is set to white. Modulo reverts back to the value between 0.0 and 1.0 if the addition of two layers is greater than 1. That would mean that Modulo is a repeating blending mode. For artists, and painters, it can be used as an aid for generating wood textures, floor textures, background, and in special cases, pseudo-glitching. It can be used for manipulation of gradients.

Modulo

The simplest of all the modulo blending mode. The blend layer defines the max lighting possible, and if the base layer goes over the blend layer, the value becomes between 0,B where 0 and B are the max and min possible value, and B is the blend layer value added by the epsilon value. Epsilon is the min number possible after 0 for any color spaces.

eps = min value after 0

f (dst,src) = dst %(src+eps)

Modulo - Continuous

The continuous variant of Modulo blending mode. Unlike the regular one, there is no discontinuity here. It is continuous because the formula involves checking ceil(dst/src) value is even, and when src is at 0, it assumes the closest to 0 instead, and use the closest calculated color based on that number assuming it's even.

Divisive Modulo

Divisive Modulo is another class of modulo operation which utilize division to create repeating values when src is less than 1.0. This is useful for abstract art in general, and can be used for textures involving repeats. Unlike regular modulo, the blend layer value is not the limit. The limit is 1.0.

f (dst,src) = (1.0/src)*dst % 1.0 , where if src is 0, then (1.0/eps)*dst % 1.0

Divisive Modulo - Continuous

The continuous variant of Divisive Modulo blending mode. Unlike the regular one, there is no discontinuity here. It is continuous because the formula involves checking ceil(dst/src) value is even, and when src is at 0, it assumes the closest to 0 instead, and use the closest calculated color based on that number assuming it's even. If it a odd number, then values are inverted.

Modulo Shift

Modulo Shift simply shift the values of image, and all values are shifted to 0.0-1.0

eps = min value after 0

f (dst,src) = (dst+src) %(1.0+eps)

Modulo Shift - Continuous

Modulo Shift checks if ceil(dst/src) is even where if src =0, then assumes src is closest to 0. If it a odd number, then values are inverted. This mode is a continuous version of Modulo Shift.

Interpolation

Interpolation calculates the end result with the usage of cosine function. The end result is a blending mode that is similar to Allanon mode, but with more contrast. Essentially, a bit different than the average or 50% normal mode.

The formula for Interpolation is:

Formula:

f (dst,src) = ½ - ¼cos(pi*dst) - ¼cos(pi*src)

Interpolation – 2X

Interpolation - 2X applies interpolation to two copies of end result of interpolation. The end result is a much greater contrast to the Allanon mode.

Penumbra A & Penumbra B

Penumbra A & Penumbra B are blending modes that has a penumbra falloff making it useful for painting shadows, and lighting. It is based off soft burn and soft dodge formula from the Pegtop-Delphi website, and the formula for Soft Dodge is:

The formula for Penumbra A is:

Formula:

$$f\,(\mathrm{dst},\mathrm{src}) = \begin{cases} \tfrac{1}{2}\mathrm{dst} / (1 - \mathrm{src}) & (\text{for } \mathrm{dst} + \mathrm{src} < 1) \\ 1 - \tfrac{1}{2}(1 - \mathrm{src}) / \mathrm{dst} & (\text{else}) \end{cases}$$

The formula for Penumbra B is:

Formula:

$$f\,(\mathrm{dst},\mathrm{src}) = \begin{cases} \tfrac{1}{2}\mathrm{src} / (1 - \mathrm{dst}) & (\text{for } \mathrm{dst} + \mathrm{src} < 1) \\ 1 - \tfrac{1}{2}(1 - \mathrm{dst}) / \mathrm{src} & (\text{else}) \end{cases}$$

Penumbra C & Penumbra D

Penumbra C & Penumbra D are blending modes which has similar results to Penumbra A&B, but the main difference is that these modes are based off Arcus Tangent blending mode. In the case of Penumbra C, only the lower layer is inverted, and Penumbra D is layers swapped with Penumbra C.

Negation

Negation is a blending mode that's known for its role for supporting abstract art, and it is offered in a few other programs (Example: Paint.NET). Negation blend mode is essentially absolute of inversion of a layer subtracted by another layer. The result is color contradiction within some areas, and/or glows with some colors of some layers preserved.

The formula for Negation is:

Formula:

f (dst,src) = |1-dst-src|

Docs >> Reference >>Blending Mode>>Quadratic

Quadratic

Quadratic blending modes are series of blending modes which are similar to Dodge, and Burn with the difference that they have a quadratic falloff. To clarify - Glow, and Reflect has a negative falloff that follows quadratic form while Color Dodge has a negative slope. Helow, and Frect are similar to overlay, and other lightening mode, but with the difference that details of one or other layers are more so preserved, and therefore they can be used for matte painting.

Reflect

Reflect blending mode is basically Color Dodge with the difference that it follows a negative quadratic form, and reflect blending mode has higher amount of contrast than Color Dodge respective to the darkening area. Reflect is known for its role for supporting abstract art, and in theory can offer painters more control into how they add shading into their work, and especially if they don't find linear falloff of some blending modes adequate. Reflect can be seen in softwares like Affinity Photo, Adobe Fireworks, and Paint.NET.

The formula for Reflect is:

Formula:

$$f\,(\text{dst,src}) = \begin{cases} 1 \text{ (for dst=1)} \\ \text{src}^2/(1-\text{dst}) \text{ (else)} \end{cases}$$

Glow

Glow is reflect mode with variable dst, and src swapped. Glow is known for its role for supporting abstract art, and in theory can offer painters more control into how they add shading into their work, and especially if they don't find linear falloff of some blending modes adequate. Glow can be seen in softwares like Affinity Photo, Adobe Fireworks, and Paint.NET.

The formula for Reflect is:

Formula:

$$f\,(\text{dst,src}) = \begin{cases} 1 \text{ (for src=1)} \\ \text{dst}^2/(1-\text{src}) \text{ (else)} \end{cases}$$

Freeze

Freeze Blending Mode is a variation of the reflect mode (base+blend layers are inverted, and the result inverted again). This darkens instead of lightening. Use ScRGB for high-depth images if planning to use this mode for RGB images.

The formula for Freeze is:

Formula:

$$f\,(\mathrm{dst,src}) = \begin{cases} 0 \text{ (for src=0)} \\ 1 - (1 - \mathrm{dst})^2 / \mathrm{src}) \text{ (else)} \end{cases}$$

Heat

Heat is the same as Freeze Blending Mode, but with the difference that variables are swapped with Freeze. This mode darkens instead of lightening. Use ScRGB for high-depth images if planning to use this mode for RGB images.

The formula for Heat is:

Formula:

$$f\,(\mathrm{dst,src}) = \begin{cases} 0 \text{ (for dst=0)} \\ 1 - (1 - \mathrm{src})^2 / \mathrm{dst}) \text{ (else)} \end{cases}$$

Helow

Helow blending mode is a mixed blending mode where areas whose sum of layers is greater than 1 copies the result of the Heat Blending Mode. If not, then it copies the result of Glow. This produce a result which is equivalent to some lightening mode, but with the advantage that the blending is smooth everywhere, and sometimes produces much better result than many other blending modes. Helow preserves details of one and/or the other layer much more so than some other blending mode (with the issue of darker areas are not as well preserved at times) making it sometimes suitable for matte painting, but it can also be used to control light/shading without changing result based on the content of a layer. However, for matte painting , it is not always staple, but there is a few times where this may be staple for helping seamlessly blend images or to add shading+colors effects.

Frect

Frect blending mode is a mixed blending mode where areas whose sum of layers is greater than 1 copies the result of the Freeze Blending Mode. If not, then it copies the result of Reflect. This produce a result which is generally weaker than overlay, but it has the advantage of being smooth. Frect preserves details of one and/or the other layer much more so than some other blending mode (with the issue of darker areas are not as well preserved at times) making it sometimes suitable for matte painting, but it can also be used to control light/shading and colors without changing result based on the content of a layer. However, for matte painting , it is not always staple, but there is a few times where this may be staple for helping seamlessly blend images or to add shading+color effect.

Frect-Helow Hybrid

The average of frect, and helow blending modes. It sometimes leads to much better results than overlay and some other related blending modes. Similar to Interpolate – 2X blending mode.

Gleat

Gleat is like Helow in a way, but the blending mode that is used in different conditions are swapped. Useful in cases where you don’t want to limit colors like Photoshop Hard Mix, but you want some shading control in area where Gleat allows room for individual shades of colors.

Reeze

Reeze is like Frect in a way, but the blending mode that is used in different conditions are swapped. The end result are mostly similar to Photoshop Hard Mix with the twist that there’s a opening on shading. Useful in cases where you don’t want to limit colors like Photoshop Hard Mix, but you want some shading control in area where Gleat allows room for individual shades of colors.