Smoke, Fire and Water

Creating natural effects in Flash
with procedural textures
(clouds made of maths)

What are procedural textures?

"A procedural texture is a computer generated image created using an algorithm intended to create a realistic representation of natural elements" - **Wikipedia**

Right…Um… Well, that explains it then.

- Essentially, a procedural texture is a texture made only with code.
- For example: you need some animated smoke. Instead of saying “here’s a picture of some smoke”, you say “this is how smoke looks - make me some”.
- The tricky bit is figuring out how to explain to a computer how smoke looks. But if you can do that, you can have all the smoke you want, with a very small file size.

So, how do we do that?

- Most procedural textures use a combination of noise functions and filters
- The most important of these is a thing called “Perlin Noise”.

What is perlin noise?

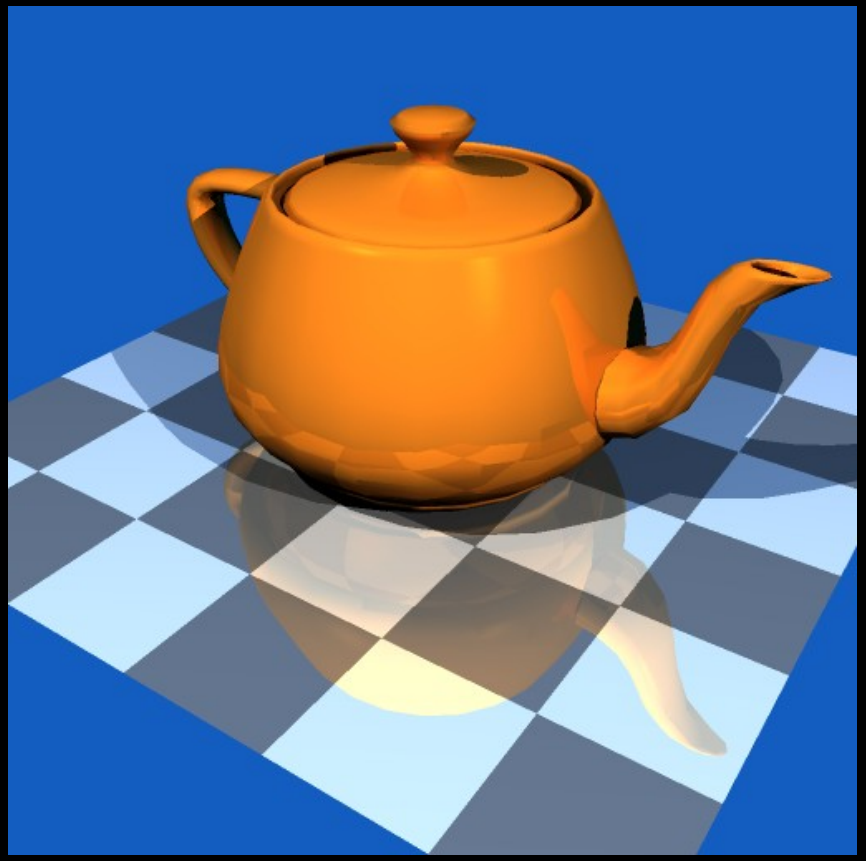
"Perlin noise is a function which uses interpolation between a large number of pre-calculated gradient vectors to construct a value that varies pseudo-randomly over space and/or time."

No, but seriously, what is perlin noise?

Perlin Noise is one of the most important graphical noise algorithms.

A noise algorithm is a way to create natural, rough looking textures.

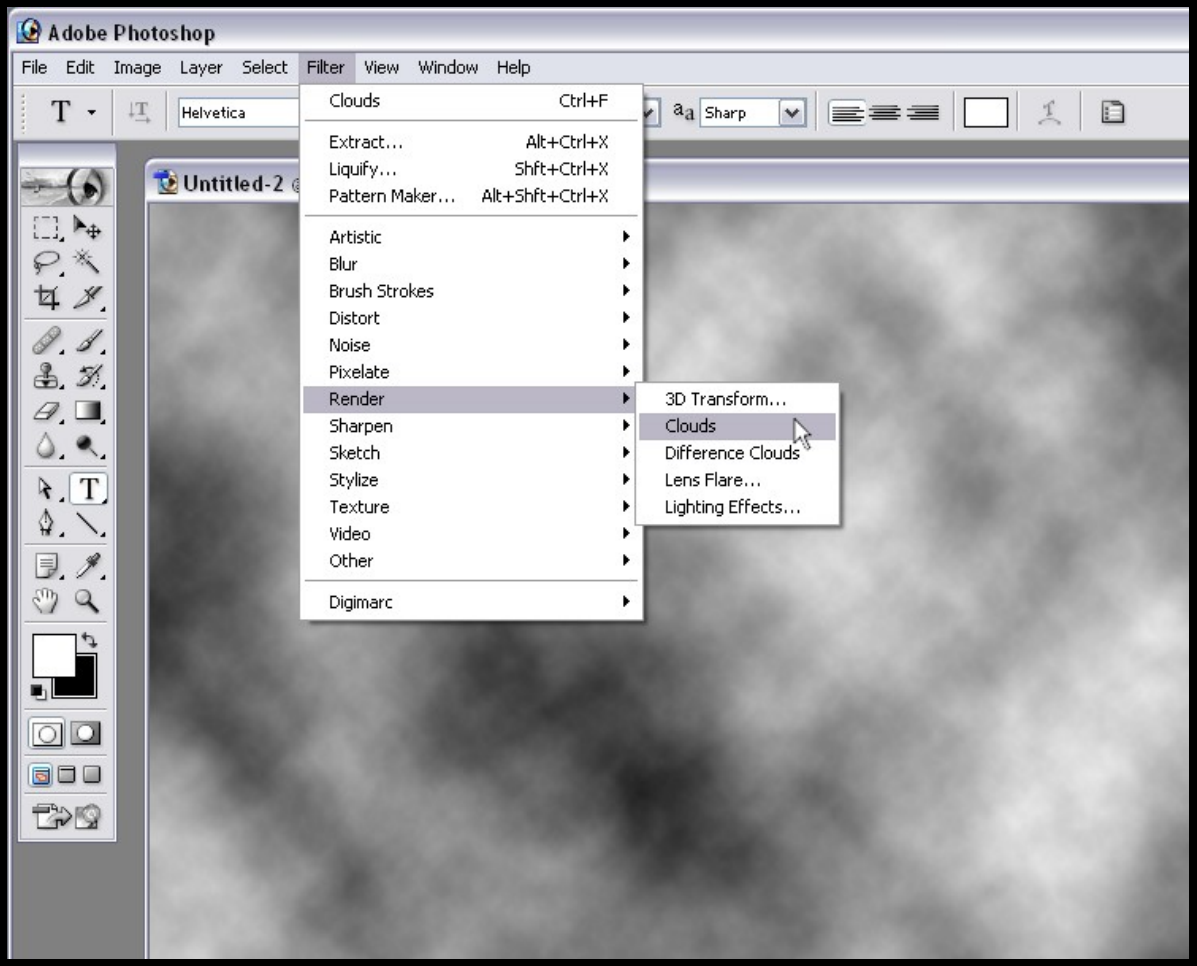
Without noise algorithms, computer generated images would look too perfect - like they were carved out of shiny plastic.



Shiny shiny shiny!

You may be more familiar with…

The photoshop “clouds” filter

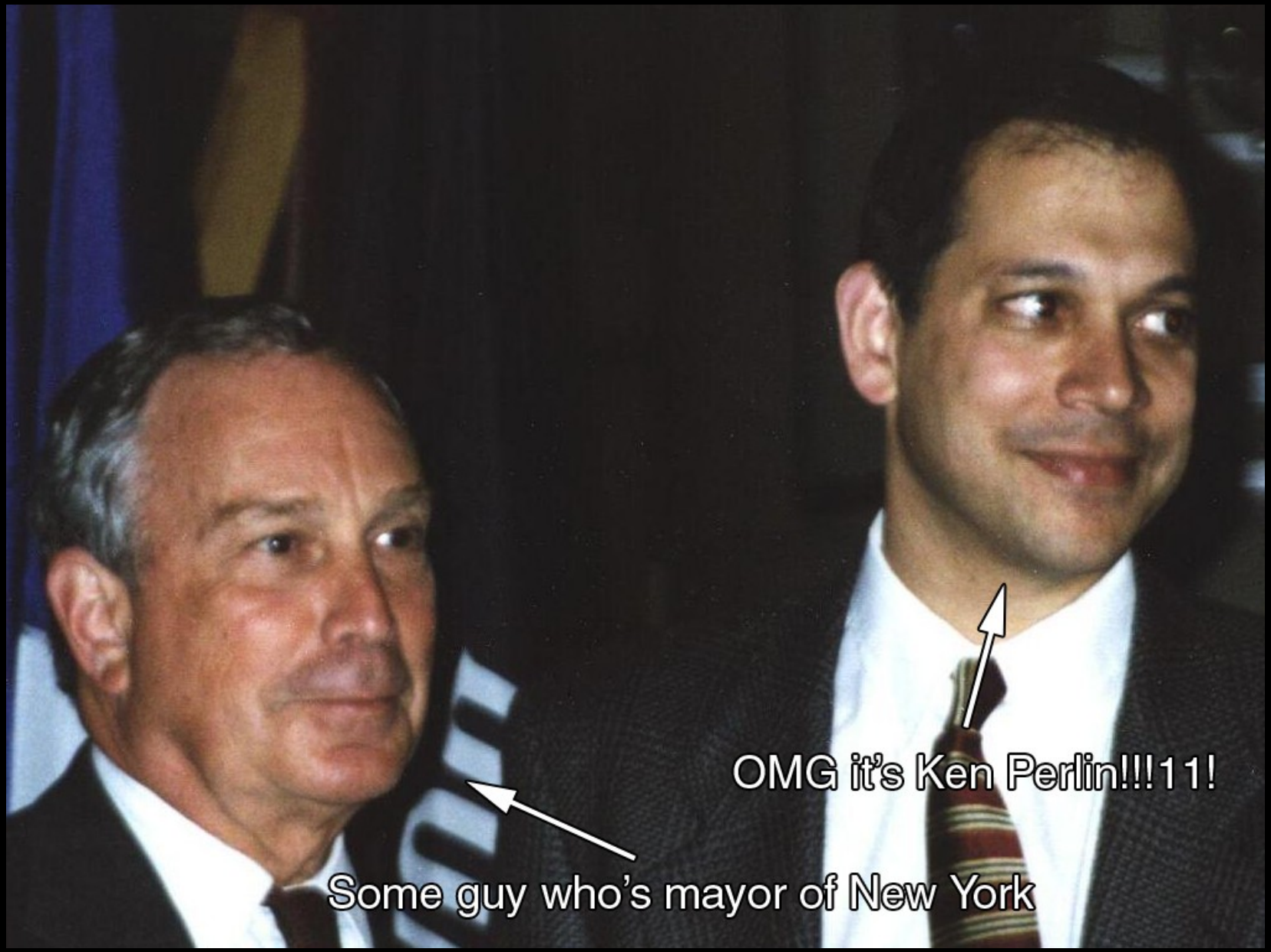


Noise is controlled randomness

- Noise itself is quite boring to look at. But we can use it as a starting point – it's like a brush to paint with.
- Until recently, flash has relied on either clean lined vector art, or large, static bitmaps.
- Because this technique was originally developed for old computers with small amounts of RAM, these textures are very, very small in terms of file size. Really tiny.

Why is it called Perlin Noise?

- Perlin noise is named after its inventor, Ken Perlin,
- He developed it in 1982
- It was originally devised as a way to make textures which took up small amounts of space on the rendering computers of the time (Perkin-Elmer and Gould SEL computers), which had very limited RAM.
- TRON, which it was developed for, was the first Hollywood film to feature shaded 3D graphics.


OMG it's Ken Perlin!!!11!
Some guy who's mayor of New York

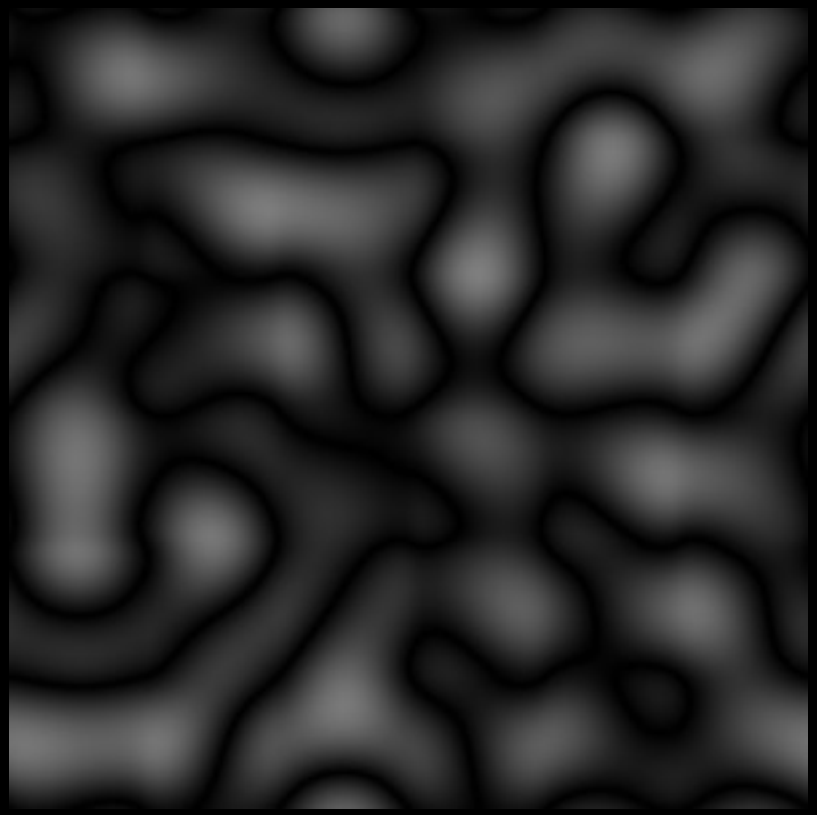
More about Ken Perlin

- Ken Perlin's work has had profound effects on 3D graphics, which can be seen in any modern film which features CG.
- He was the first person ever to win an Oscar™ for programming.
- In January 2004 he was the featured artist at the Whitney Museum of American Art.

[1]Tron is officially the Best Movie Ever.

How does perlin noise work?

We start with this – the simplest kind of perlin noise



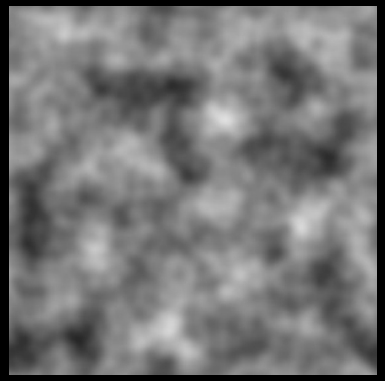
Simple perlin noise

Simple perlin noise with fractal turbulence

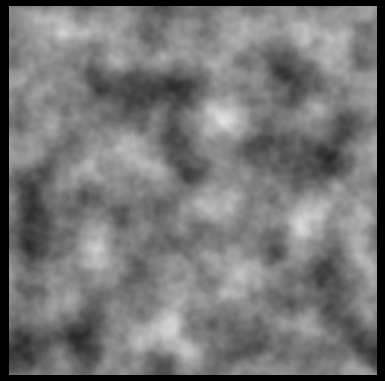
How does perlin noise work?

1 octave

2 octaves



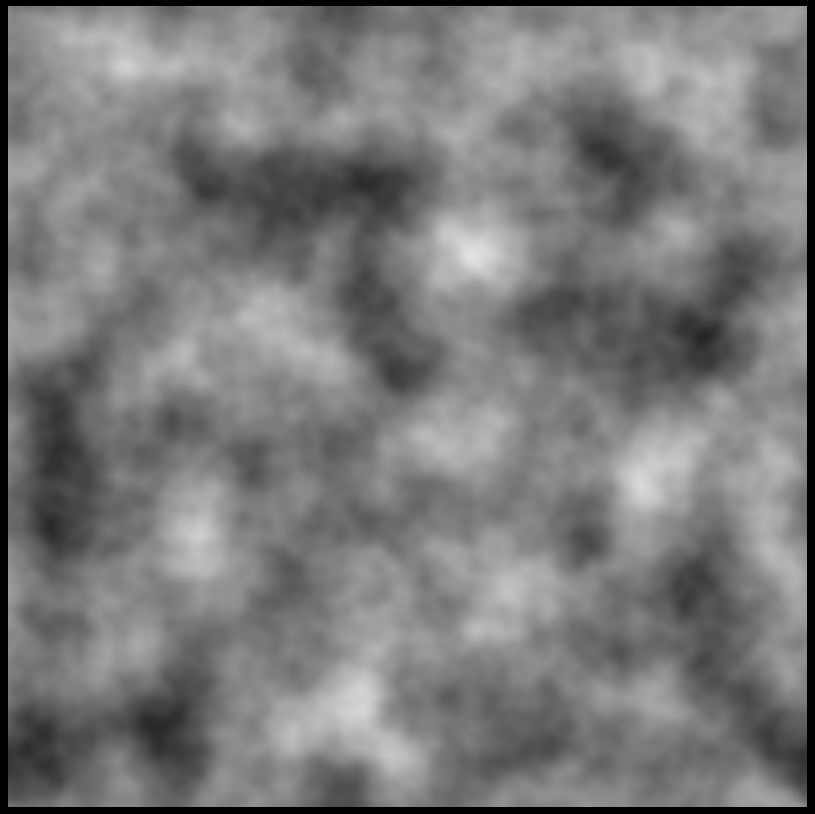
3 octaves



4 octaves

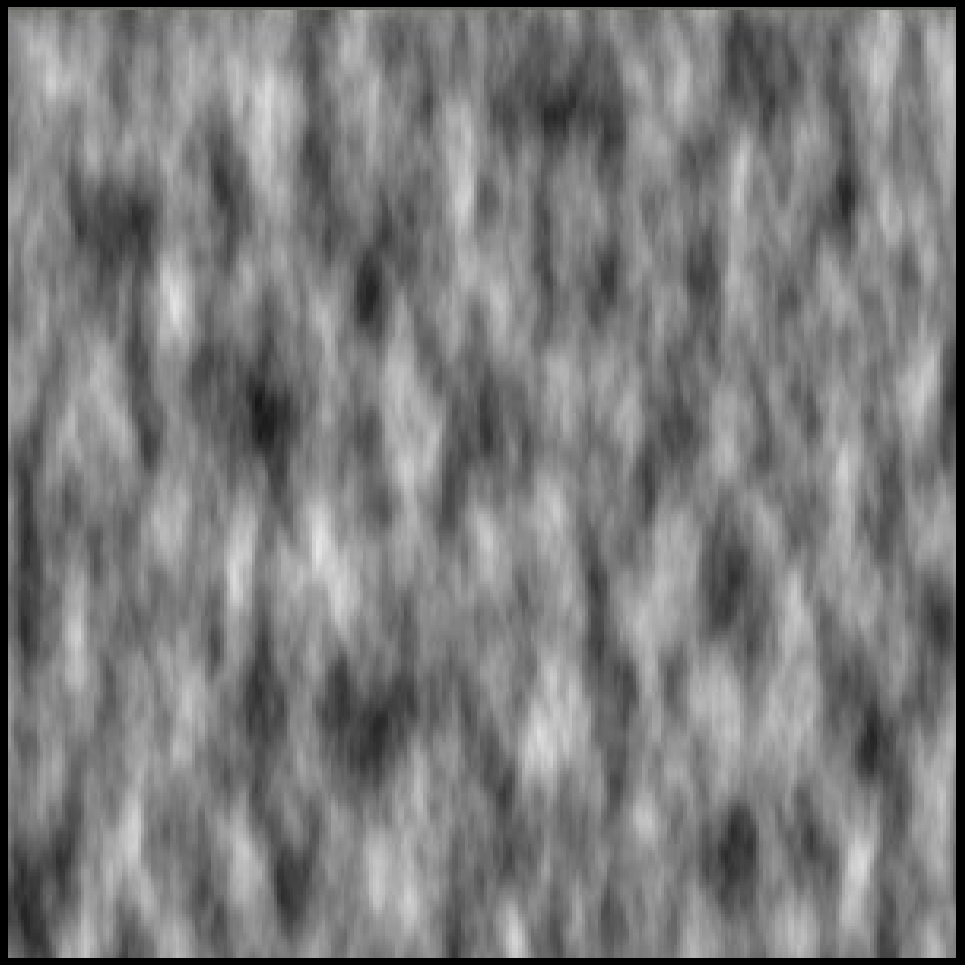
Then we add more octaves. An octave is the same image, but zoomed out to half the size.

How does perlin noise work?



We now have something which looks pretty much
the same as the photoshop clouds filter.

How does perlin noise work?



From here, we can stretch, colour and distort it to suit our purposes

Offsets

- Offsets allow us to change the way the octaves are layered onto each other.
- We can animate them in different ways to get different visual effects
- Offsetting at different speeds gives a good cloud effect
- Trig functions are also good for more complex animations, like smoke & water

Putting all that together…

- So, with basic text effects, we can now go crazy with other effects. We can use colour, filters, different types of blends – anything really.
- We can use other effects to create moving, realistic textures.
- Add particles, and some colour effects, and we can get convincing fire.

Why this is good

- Procedural textures have very, very low file sizes
- Flash has traditionally relied on hard lines – this lets us create new aesthetics
- We can use them to achieve a completely fresh look
- Now that you all understand how this works, you can design procedural textures in photoshop using the cloud filter!

Drawbacks/Limitations

- They are quite CPU intensive, so don't get too carried away
- Small patches are better – they get too intense at large resolutions (so they're good for banners/MPUs)
- If done badly, they can end up looking quite cheesy
- Because this is a relatively new technique, it can be labour intensive to implement