

KINDA RANDOM NUMBERS

RANDOM NUMBERS HAVE SOME ISSUES...

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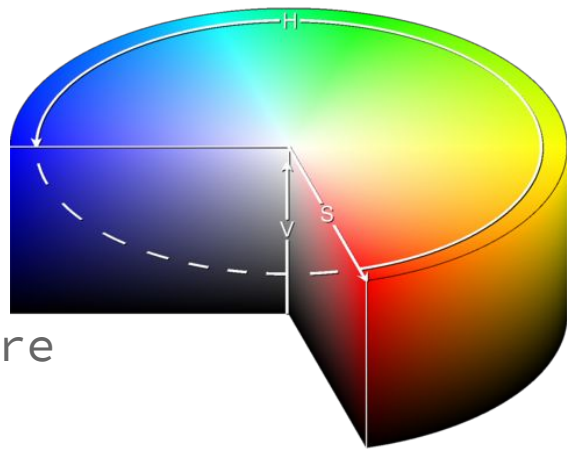
WHAT CAN WE DO?

- Ok... maybe this isn't actually an issue with random numbers... isn't this more of a design issue?

It is, but...

WE CAN FIX IT WITH A LITTLE MATH!

- What is the biggest issue? A lot of values are too dark. Luckily, instead of RGB we can use something called HSV!
- HSV has the nice property that we can still have randomness, but we can control how dark and light our colors are much more easily



LET'S TRY...

- There's an HSV to RGB algorithm
- Now we're randomizing the H parameter while S and V are fixed
- Not too dark now... but another issue. Too much purple and green in close proximity!

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ONE LAST IDEA...

- We fixed our issue with some colors being too dark, but how can we fix the fact that there are a bunch of the same color all in a row?
- Our random numbers are too random... Luckily, we can make them less random. Let's see how it looks after we fix the problem, then talk about how to fix it.

HOW DOES IT LOOK?

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- Colors distribution looks quite a bit more even
- Notice there aren't a bunch of greens or purples all in a row!

WHAT DID WE DO?

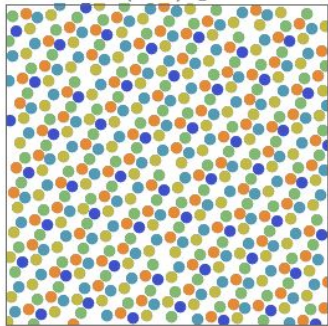
The problem with random numbers is (surprise) they are too random.

Sometimes we don't want total randomness, we want numbers that are “just random enough”

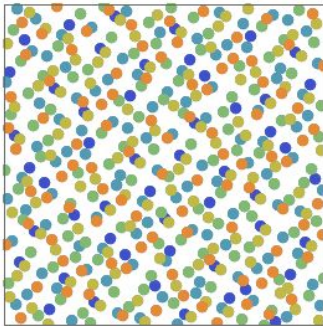
Those sorts of numbers come in sequences called “Quasirandom Number Sequences” or “Low Discrepancy Sequences” and there are many examples

SOME EXAMPLE QUASIRANDOM SEQUENCES

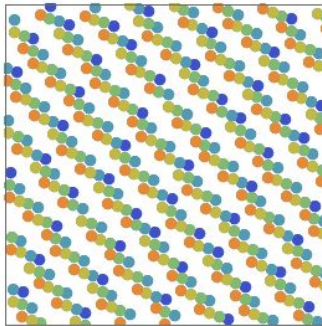
(New) R_2



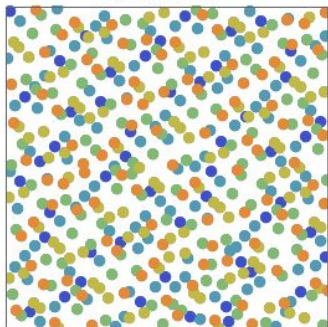
Halton



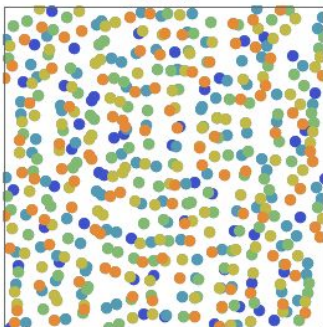
Kronecker



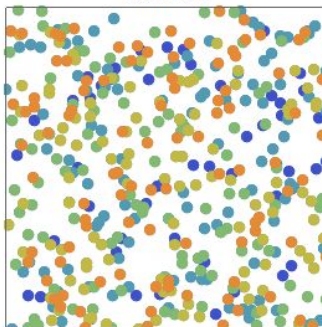
n=460
Niederreiter



n=460
Sobol



n=460
Random

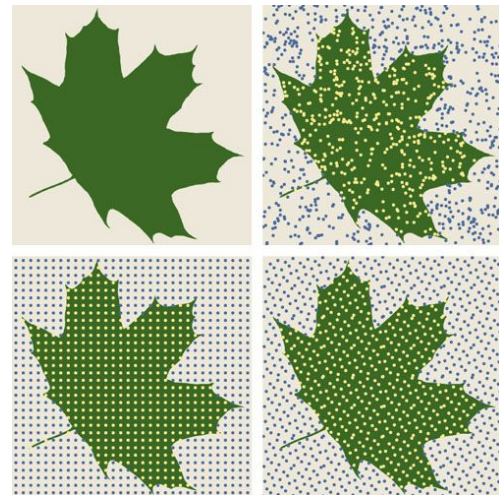
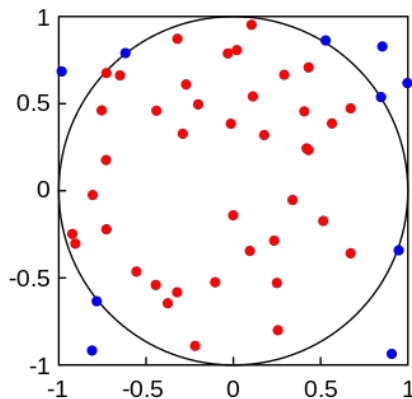
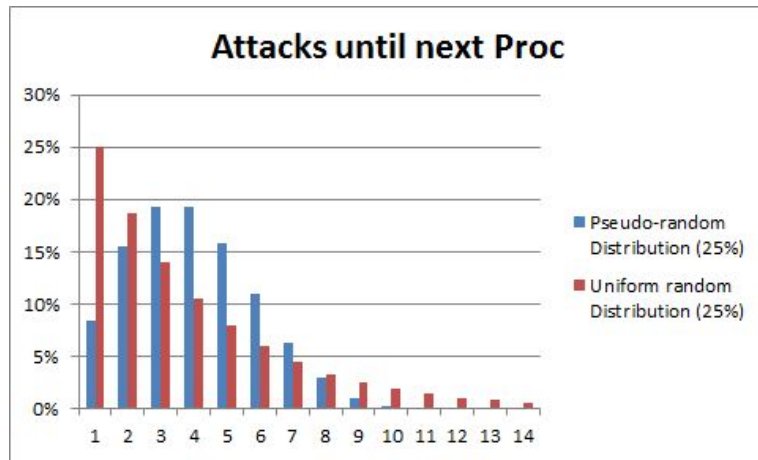


Look at the random sequence! It's completely bunched up in some places and completely empty in others.

What a mess.

OTHER APPLICATIONS

- Video Games
 - Critical Hits / “Procs”
 - Terrain Placement
- Digital Signal Processing
 - Via Dithering
 - Audio / Video / Images
 - Lots of things are “signals”...
- Numerical Integration



SOURCES

<http://extremelarning.com.au/unreasonable-effectiveness-of-quasirandom-sequences/>

<https://martin.ankerl.com/2009/12/09/how-to-create-random-colors-programmatically/>

[https://dota2.gamepedia.com/Random distribution](https://dota2.gamepedia.com/Random_distribution)

<https://bartwronski.com/2016/10/30/dithering-part-two-golden-ratio-sequence-blue-noise-and-highpass-and-remap/>