

GAM310 Theory 3: Games as Culture

What is PCG?

What is procedural content generation (PCG)?

j3-¿ **Procedural:** by computer program or algorithm, with little or no direct input from designer or user
j2-¿ **Content:** levels, maps, art, animations, stories, items, quests, music, weapons, vehicles, characters, ...

E.g. the Mandelbrot set: generated by iteration of the formula

L-Systems 0.4 [width=]lssystem 0.55

Fractals based on repeated replacement of characters in a string representation

A simple model of plant growth

Wave Function Collapse 0.4 [width=]wfc 0.55

Places tiles (2D or 3D) based on constraints on which tiles can be adjacent

An example of **constraint solving** (similar to e.g. solving Sudoku)

n-gram models 0.4 [width=]ngram 0.55

Gather frequency data for sequences of length n in some training data

A basic form of machine learning

E.g. can train on letters to generate names

E.g. can train on words to generate (nonsense) text

E.g. can train on tiles to generate levels

The role of PCG in games

Lessons from No Man's Sky

[width=0.5]nomanssky_{teamreviews}

If you overscope, pray that you don't have to cut any features that you announced on stage at E3...

PCG is not a substitute for gameplay

PCG is not magic — it doesn't (by itself) let an indie-sized team produce a AAA game

When talking about scale and PCG, it's easy to set unrealistic expectations

Big numbers

"Over 18 quintillion planets"

$2^{64} = 18\,446\,744\,073\,709\,551\,616$

What does this number even **mean**?

What it **really** means: "our random number generator uses a 64-bit seed"

They could have said "a near infinite number of planets"

They could easily have made it "over 340 undecillion" planets ($2^{128} = 340\,282\,366\,920\,938\,463\,463\,374\,607\,431\,768\,211\,456$)

Even bigger numbers

There are $52! = 80\,658\,175\,170\,943\,878\,571\,660\,636\,856\,403\,766$

$975\,289\,505\,440\,883\,277\,824\,000\,000\,000\,000$ ways of shuffling a deck of playing cards

When you shuffle a deck, it is almost certain that **no deck of cards in human history** has ever existed in that order

But how **interesting** is that particular shuffled deck?

How **different** from another shuffled deck?

Uniqueness "I can easily generate 10,000 bowls of plain oatmeal, with each oat being in a different position and diff

— Kate Compton

<http://galaxykate0.tumblr.com/post/139774965871/so-you-want-to-build-a-generator>

Uniqueness "‘Every Planet Unique’ might mean that each planet has a complex sci-fi backstory rich enough to fill a

— Michael Cook

<http://www.gamesbyangelina.org/2016/08/procedurallanguage/>

Lessons from Spelunky

[width=0.5]spelunky_{teamreviews}

PCG can complement solid game mechanics

PCG can **enable** new (discovery-based) game mechanics

No need to dazzle the audience with big numbers

Curation 0.4 [width=]curation 0.55

Human creators constantly ask themselves: **is this any good?**

Smart PCG should not **merely generate**: it should also **evaluate**

Authorship

In a game with **emergent narrative**, who is the author? Is it the developer, the player, or both?

In a game with **procedurally-generated content**, who (or what) is the author? Is it the developer, the player, the sy

Authorship "[We] create the systems (including some fixed content), and the choices made at that stage are influen

— Tarn Adams

<http://www.nullpointer.co.uk/content/interview-dwarf-fortress/>

The future of PCG.

¶ You are playing an "open world" game, something like Grand Theft Auto or Skyrim. Instead of going straight to

— Julian Togelius

<http://togelius.blogspot.co.uk/2015/10/what-if-videogames-had-actual-ai.html>

Whole game generation 0.4 [width=]tothatsect 0.55

E.g. ANGELINA (Michael Cook)

Generate **entire games** from scratch, possibly using ideas or themes provided by the user

Democratise game design — create games in **collaboration** with a non-skilled user

(i.e. make it so that you don't need to do a degree to learn how to make games...)

Deep learning 0.4 [width=]deepdream 0.55

Artificial neural networks (ANNs)

Already used for tournament-level game AI, image classification, language translation, ...

Generative Adversarial Networks (GANs)

<https://www.youtube.com/watch?v=G06dEcZ-QTg>

Computational creativity 0.4 [width=]paintingfool

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Open question: can an AI system be **creative**?

Beyond **mere generation**

Beyond generating **content** to generating **ideas**

Activity.