DES214 – Level Design Methods

PCG Components

DigiPen Institute of Technology

PCG Components

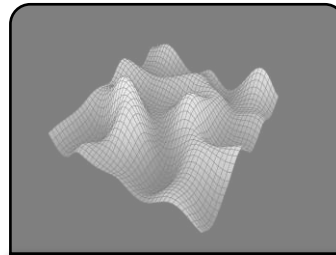## How to approach enemies and powerups in a PCG game?
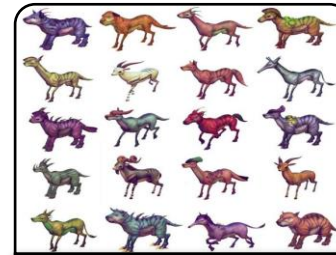
PCG Components

Tiles

Grammars

Distribution

Parametric

PCG Components

Parameter

A measurable value that defines a characteristic of a component or system.

Parametric PCG
- Enemy Stats
- Item Stats
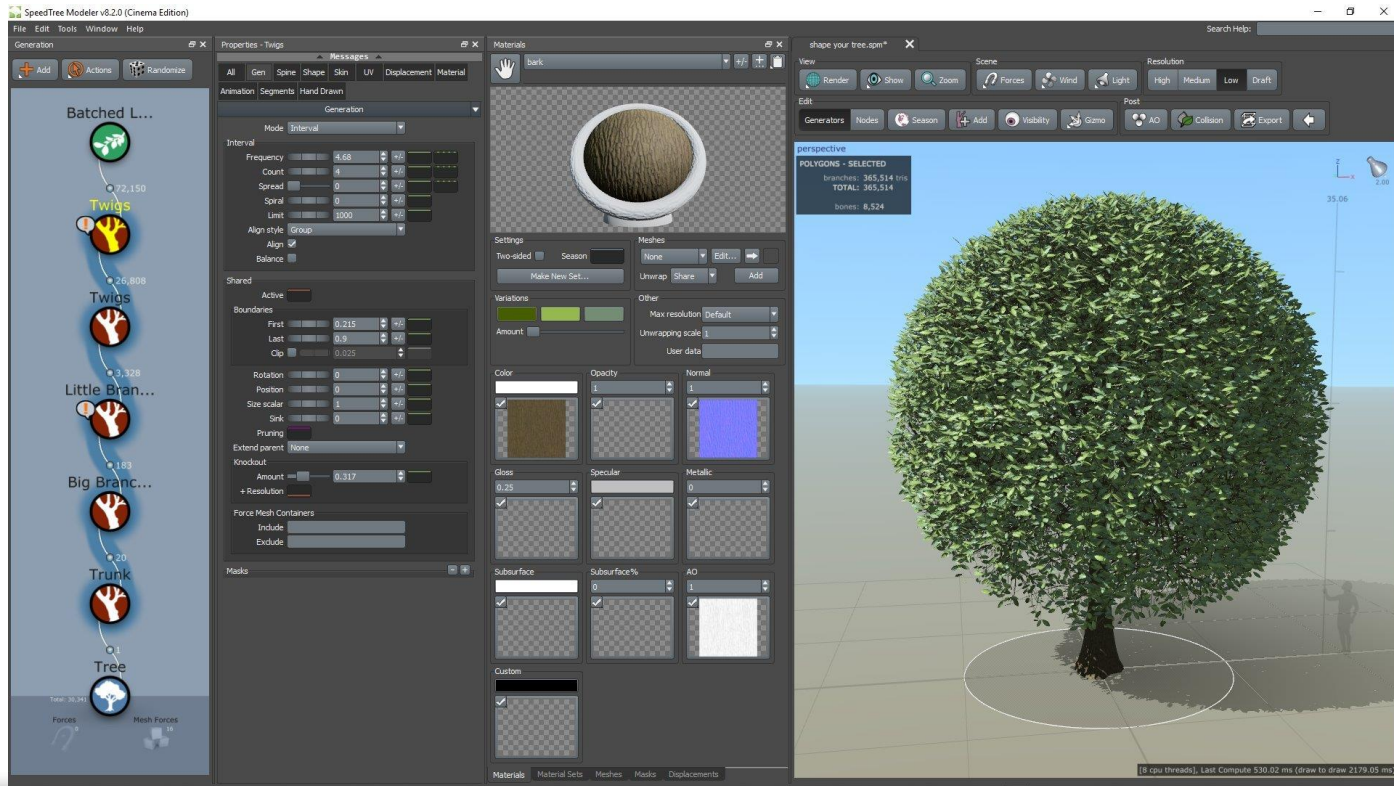- Powerups
- Character Models
- Environmental Props

PCG Components

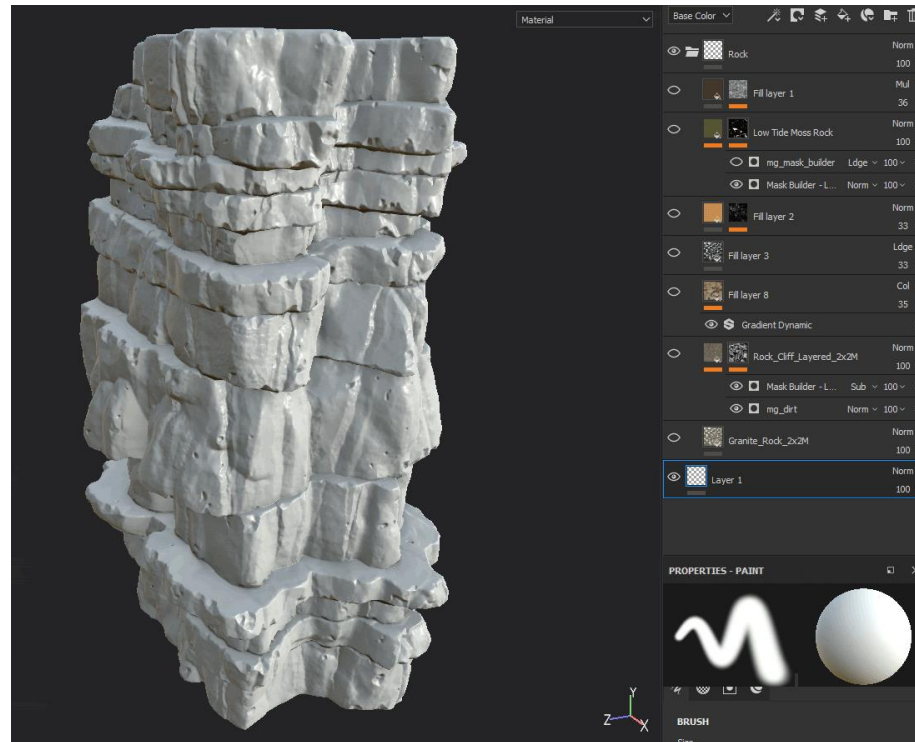**Character Avatar Customization – Example**

PCG Components

Asset Generation (Speed Tree) – Example

PCG Components

Procedural Texturing (Houdini) – Example
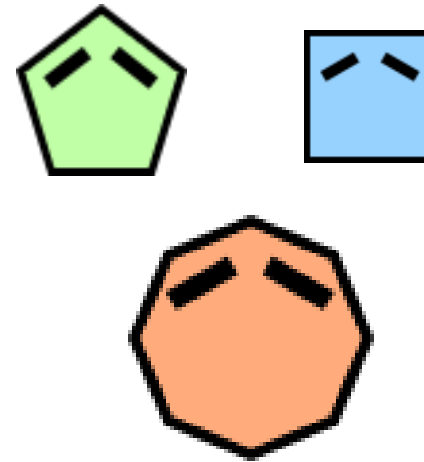
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PCG Enemy Stats

- Health
- Move Speed
- Fire Rate
- Bullets per Shot
- Spread Angle
- Bullet Speed
- Bullet Range
- Aggro Range

PCG Components

Enemy Stats – Base Enemy Sample

Health	3
Move Speed	3
Fire Rate	2
Bullets per Shot	1
Spread Angle	n/a
Bullet Speed	10
Bullet Range	10
Aggro Range	8

PCG Components

Enemy Stats – Fast Enemy Sample

Health	1
Move Speed	5
Fire Rate	1
Bullets per Shot	1
Spread Angle	n/a
Bullet Speed	10
Bullet Range	10
Aggro Range	8

PCG Components

Enemy Stats – Tank Enemy Sample

Health	10
Move Speed	2
Fire Rate	4
Bullets per Shot	5
Spread Angle	0.1
Bullet Speed	15
Bullet Range	15
Aggro Range	10

PCG Components

Orthogonality

Making each component as distinct as possible from others.
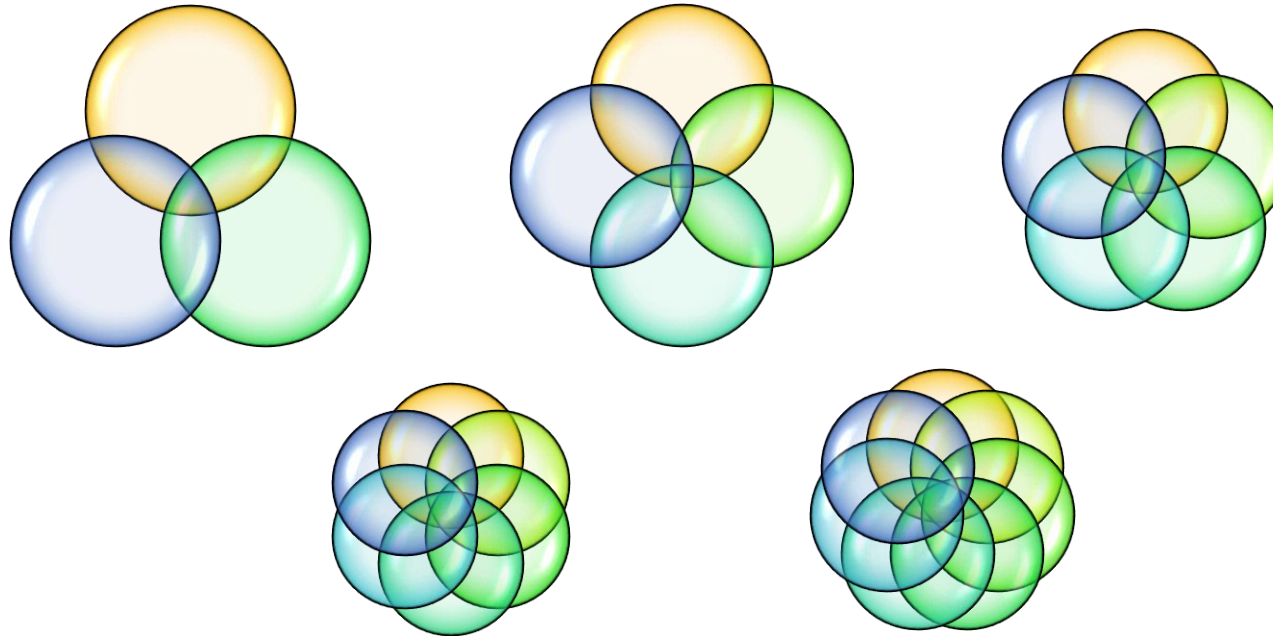
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Parametric PCG Enemy Design Goals

Challenge Control
We want be able to tweak the challenge a given enemy poses.

Variance
We want players to experience a variety of different enemies.

Readability
We want players to understand what makes a given enemy distinct.

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Recommendations

1. Have a difficulty rating for enemies.

A common way to do this would be to assign an enemy a certain number of "difficulty points"

The PCG then uses these points to pick traits that fit their budget of difficulty.

PCG Components

Recommendations

2. Identify heavily related traits and link them.

Some parameters might have a hierarchical / dependent relation to another.

Examples:
Move Speed & Bullet Speed
Bullets per Shot & Bullet Spread
Bullet Range & Move Speed

PCG Components

Recommendations

3. Avoid minor variations.

How different is an enemy with 10 health and 11 health?

Make sure that each increment is significant. Use the player stats as a base comparison.

0.25x, 0.5x, 1x, 1.5x, 2x, 3x, 5x, 10x

PCG Components

Recommendations

4. Consider adding special traits.

Ideas:
- Turret (0 Speed, High Range)
- Melee (High Speed, Short Range)
- Ghost (Can bypass walls and other enemies)
- Shield (Can't be hit from a certain side)
- Split (Spawns easier versions of itself when killed)

PCG Components

Case Study – Path of Exile Items

PCG Components

Case Study – Path of Exile Items

PCG Components

Case Study – Path of Exile Items

1. Item Group
   - Body Armor
   - Boots
   - Gloves
   - Helmet
   - Belt
   - Necklace
   - Ring
   - One-Handed Weapon
   - Two-Handed Weapon
   - Offhand

PCG Components

Case Study – Path of Exile Items

1. Item Group (One-Handed Weapon)
2. Item Type
   o Claw
   o Wand
   o Dagger
   o Axe
   o Mace
   o Sword
   o Sceptre
   o Rune Dagger

PCG Components

Case Study – Path of Exile Items

1. Item Group (One-Handed Weapon)
2. Item Type (Sword)
3. Item Level
   o Monster Level ±2

PCG Components

Case Study – Path of Exile Items

1. Item Group (One-Handed Weapon)
2. Item Type (Sword)
3. Item Level (lvl 55)
4. Item Base

   o Rusted Sword
   o Copper Sword
   o Sabre
   o Ancient Sword
   o Elegant Sword
   o Cutlass

   o Gladius
   o Elder Sword (lvl 57+)
   o Eternal Sword (lvl 63+)
   o Midnight Blade (lvl 69+)

PCG Components

Case Study – Path of Exile Items

1. Item Group (One-Handed Weapon)
2. Item Type (Sword)
3. Item Level (lvl 55)
4. Item Base (Gladius)
5. Item Rarity
   - Normal (No Mods)
   - Magic (1-2 Mods, 1 Prefix, 1 Suffix)
   - Rare (3-6 Mods, 1-3 Prefix, 1-3 Suffix)
   - Unique (Special Table)

PCG Components

Case Study – Path of Exile Items

1. Item Group (One-Handed Weapon)
2. Item Type (Sword)
3. Item Level (lvl 55)
4. Item Base (Gladius)
5. Item Rarity (Rare, 3-6 Mods, 1 Prefix, 2 Suffix)
6. Prefixes & Suffixes

PREFIXES		
Inc. Elemental Dmg	Mana Leech	Added Cold Dmg
Inc. Physical Dmg	Accuracy Rating	Added Fire Dmg
Life Leech	+1 Level of Gems	Added Lightning Dmg

PCG Components

Case Study – Path of Exile Items

1. Item Group (One-Handed Weapon)
2. Item Type (Sword)
3. Item Level (lvl 55)
4. Item Base (Gladius)
5. Item Rarity (Rare, 3-6 Mods, 1 Prefix, 2 Suffix)
6. Prefixes & Suffixes (Life Leech, …)

SUFFIXES		
Attack Speed	Inc. Stun Duration	+ Dexterity
Poison Dmg	Life Gain on Kill	+ Strength
Crit Chance	Mana Gain on Kill	Chaos Resistance
Fire Resistance	Cold Resistance	Lightning Resistance

PCG Components

Case Study – Path of Exile Items

1. Item Group (One-Handed Weapon)
2. Item Type (Sword)
3. Item Level (lvl 55)
4. Item Base (Gladius)
5. Item Rarity (Rare, 3-6 Mods, 1 Prefix, 2 Suffix)
6. Prefixes & Suffixes (Life Leech, Posion Dmg, +Strength)
7. Mod Levels
   - Life Leech
     - Remora's - (0.2 – 0.4)%, Min Lvl 50
     - Lamprey's - (0.6 – 0.8)%, Min Lvl 60
     - Vampire's - (1.0 – 1.2)%, Min Lvl 70

PCG Components

Example – Path of Exile Loot (Item Generation)

1. Item Group (One-Handed Weapon)
2. Item Type (Sword)
3. Item Level (lvl 55)
4. Item Base (Gladius)
5. Item Rarity (Rare, 3-6 Mods, 1 Prefix, 2 Suffix)
6. Prefixes & Suffixes (Life Leech, Posion Dmg, +Strength)
7. Mod Levels (Remora's, …)
   o Poison Dmg
     - of Poison - (21 – 30)%, Min Lvl 20
     - of Venom - (31 – 40)%, Min Lvl 40
     - Of Virulence - (41 – 50)%, Min Lvl 60

PCG Components

Example – Path of Exile Loot (Item Generation)

1. Item Group (One-Handed Weapon)
2. Item Type (Sword)
3. Item Level (lvl 55)
4. Item Base (Gladius)
5. Item Rarity (Rare, 3-6 Mods, 1 Prefix, 2 Suffix)
6. Prefixes & Suffixes (Life Leech, Posion Dmg, +Strength)
7. Mod Levels (Remora's, of Venom, ...)
   - +Strength
     - of the Brute - (8 – 17), Min Lvl 1
     - of the Bear - (18 – 27), Min Lvl 22
     - of the Gorilla - (28 – 37), Min Lvl 44
     - of the Goliath – (38 - 50), Min Lvl 66
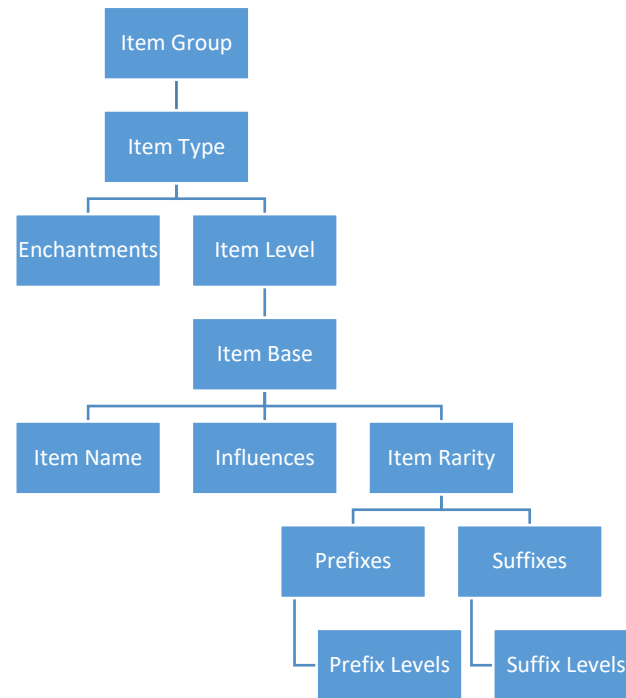   - of the Titan – (51 - 55), Min Lvl 82

PCG Components

Example – Path of Exile Loot (Item Generation)

1. Item Group (One-Handed Weapon)
2. Item Type (Sword)
3. Item Level (lvl 55)
4. Item Base (Gladius)
5. Item Rarity (Rare, 3-6 Mods, 3 Prefix, 3 Suffix)
6. Prefixes & Suffixes (Life Leech, Posion Dmg, +Strength)
7. Mod Levels (Remora's, of Venom, of the Bear)

PCG Components

Parametric Item Generation – Example

PCG Components

Take Aways

- Adding hierachical layers, allows for more depth to the PCG

- The generation graph should resolve in discrete steps from most important to least important traits.

- Designing modular systems this way makes it easy to add more layers / variations later.
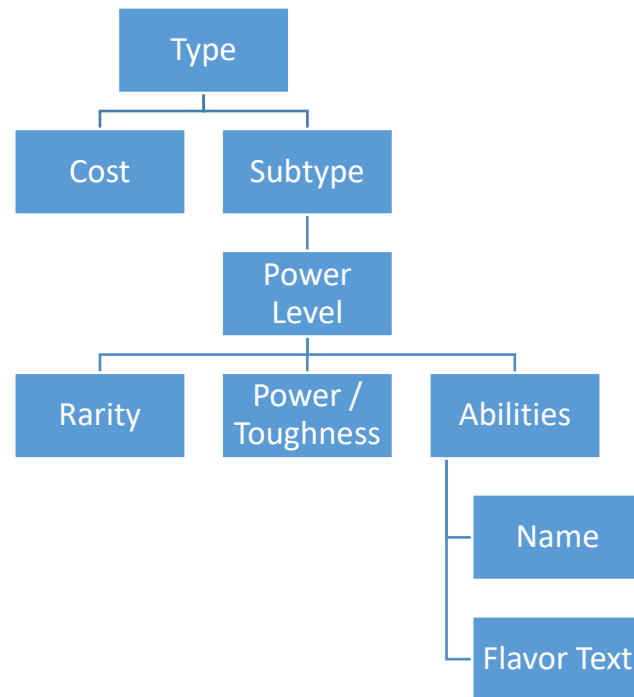
PCG Components

Though Experiment: How to PCG a MtG Card?

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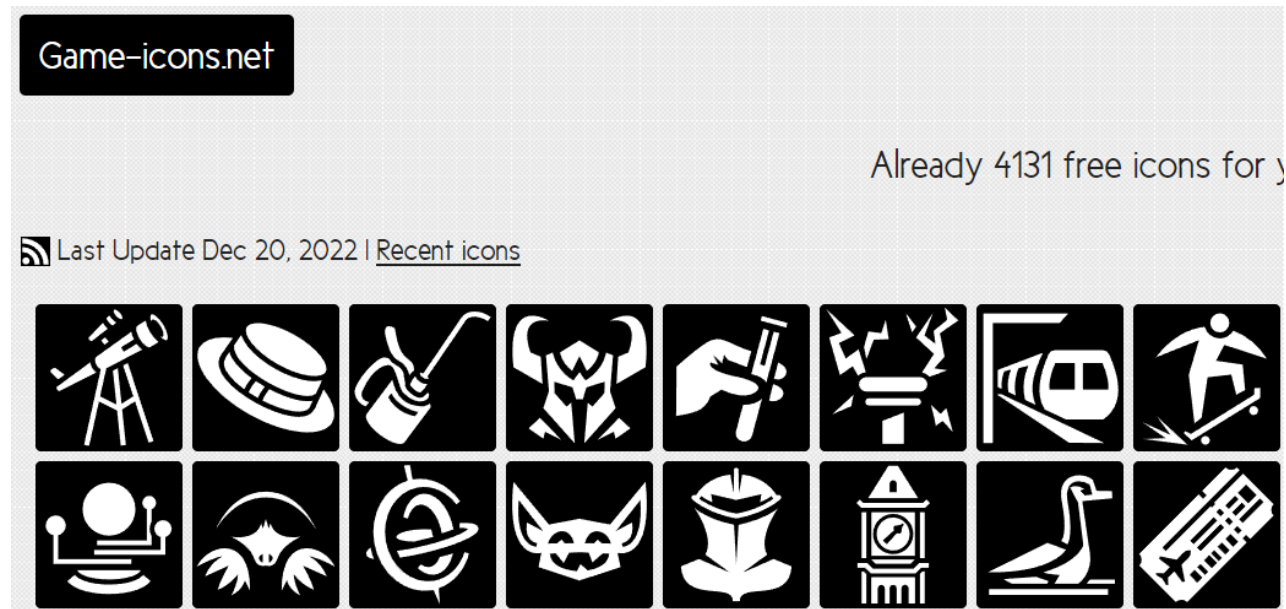
Though Experiment: How to PCG a MtG Card?

PCG Components

Leverage orthogonality to change up how the player solves problems.

PCG Components

Extra Material

Game-icons.net

Thank You!

Questions?

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