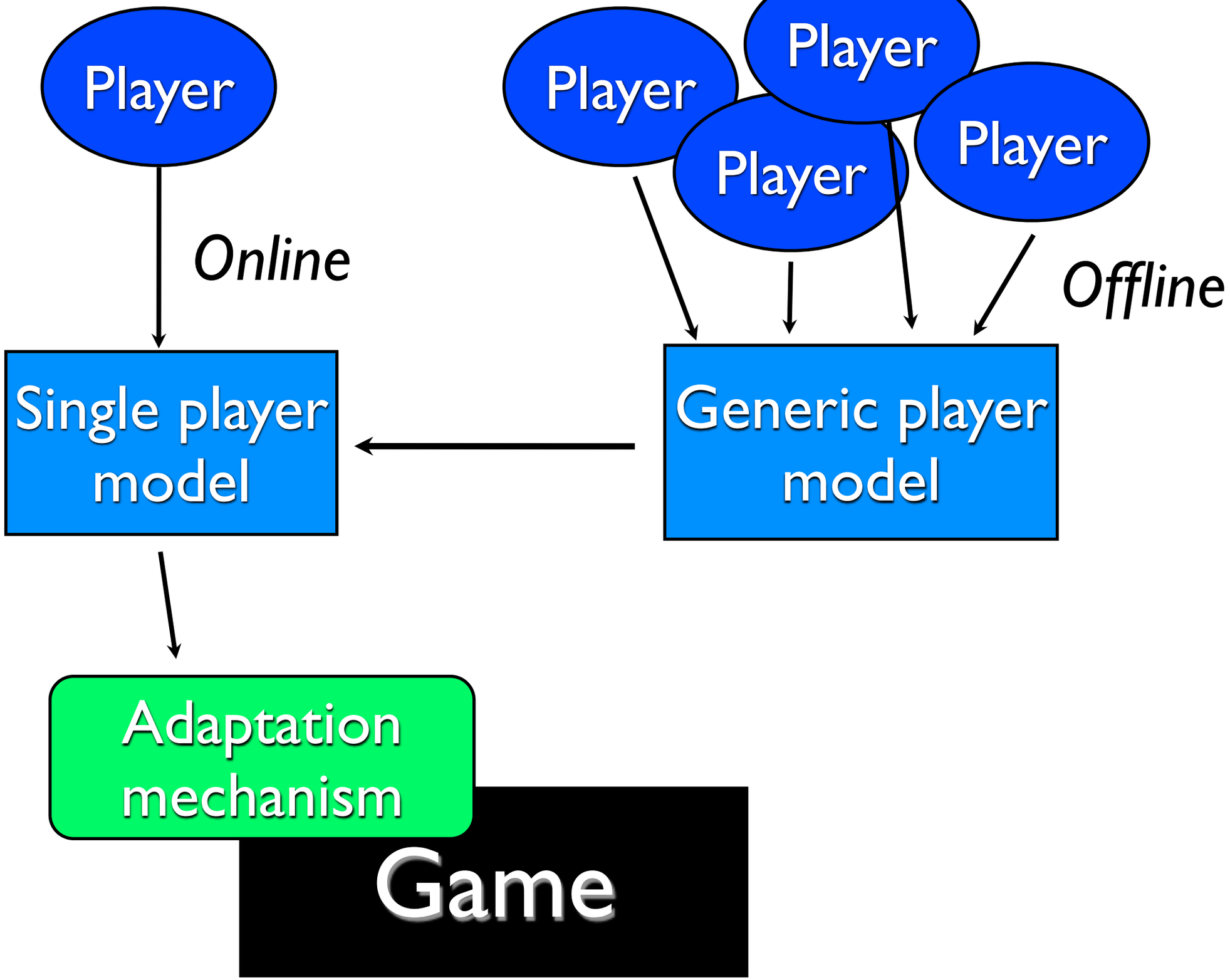
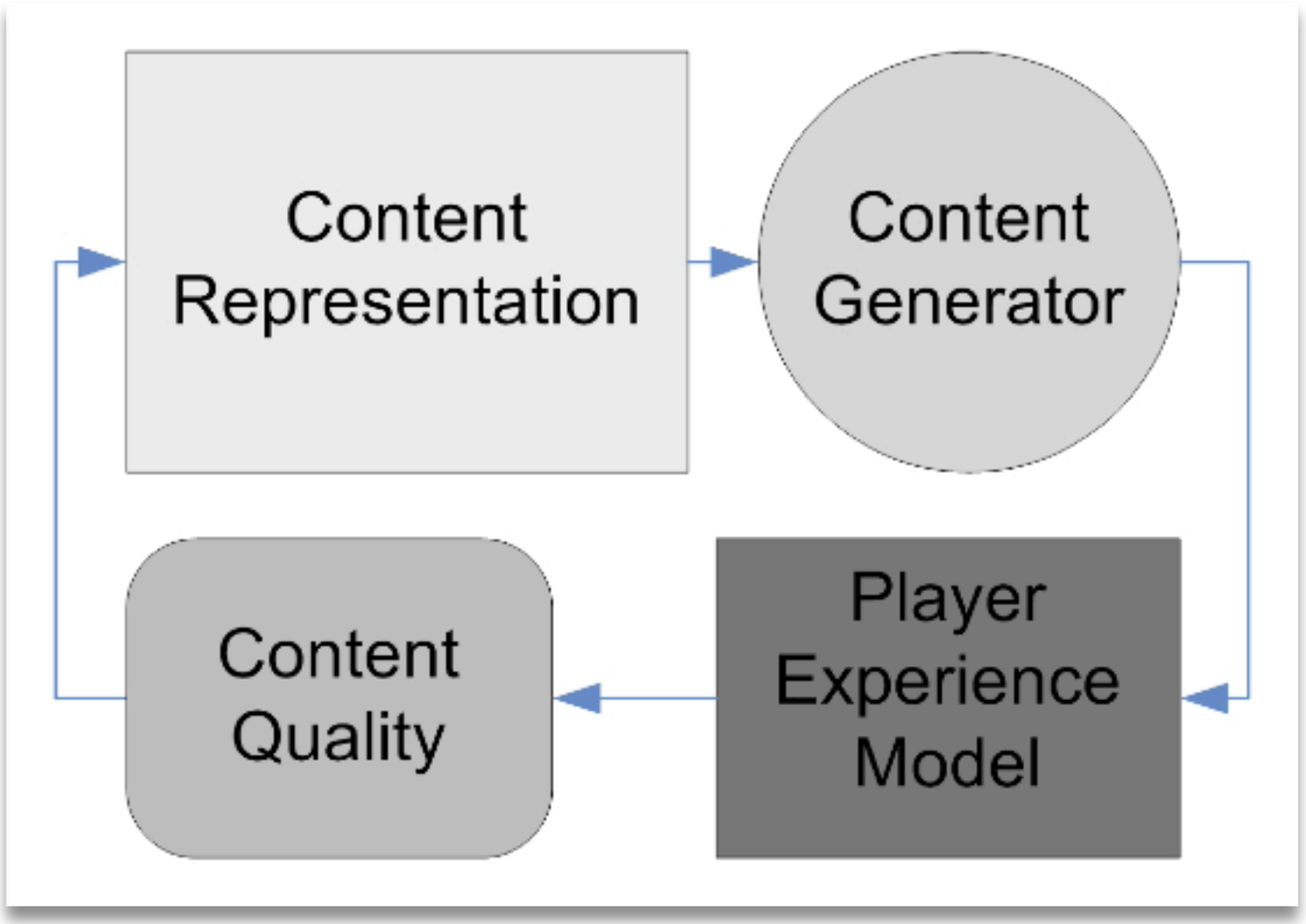
Procedural Content Generation

Adaptation


Player
Online
Single player model
Player
Player
Player
Player
Offline
Generic player model
Adaptation mechanism
Game

Adaptation through content generation



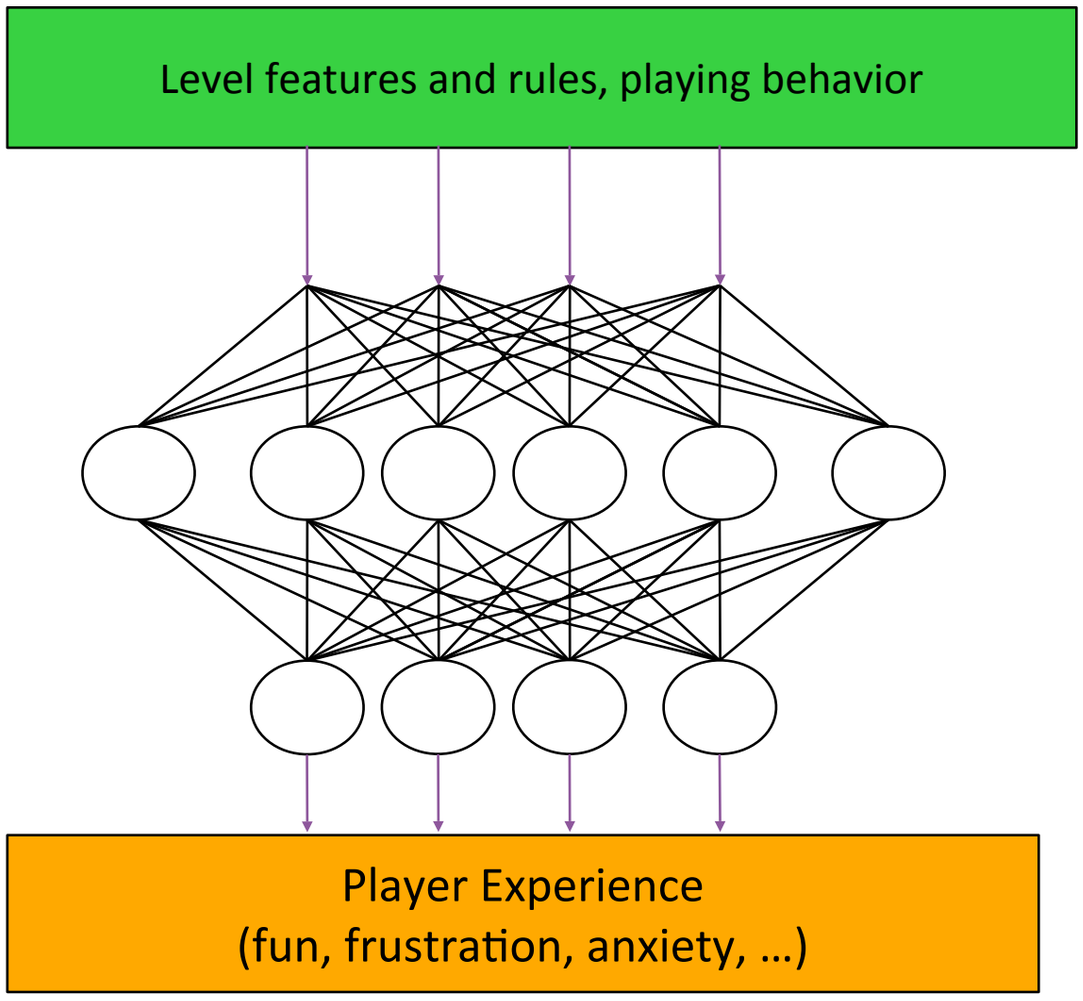
What can we adapt?

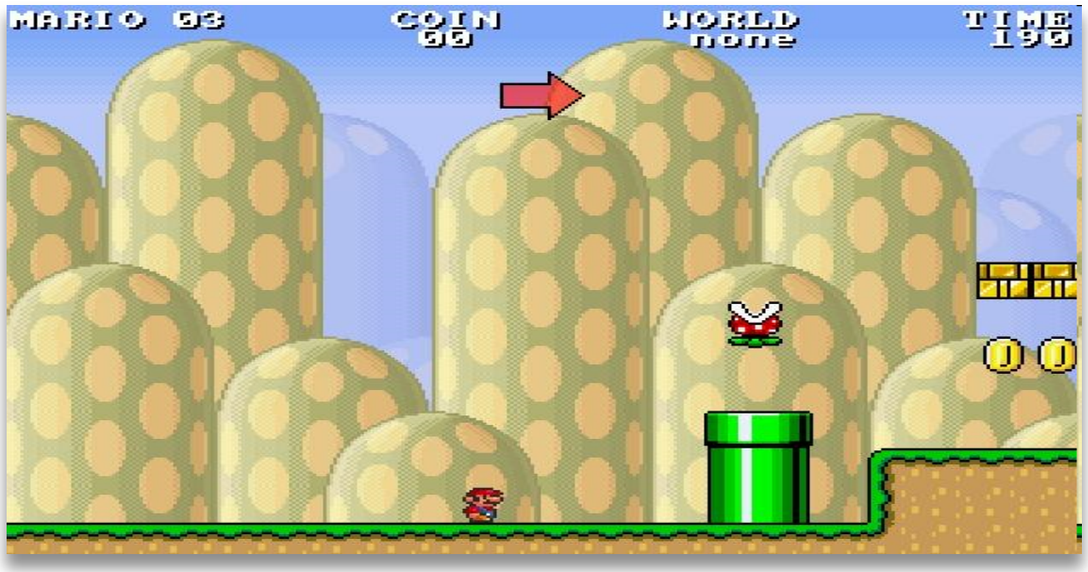
- Simple parameters (game speed, number of enemies, money)
- Levels, maps, tracks
- Quests, NPC characters
- Rules
- Reward schedules?

Addiction science ↑

Adaptive levels for Super Mario Bros

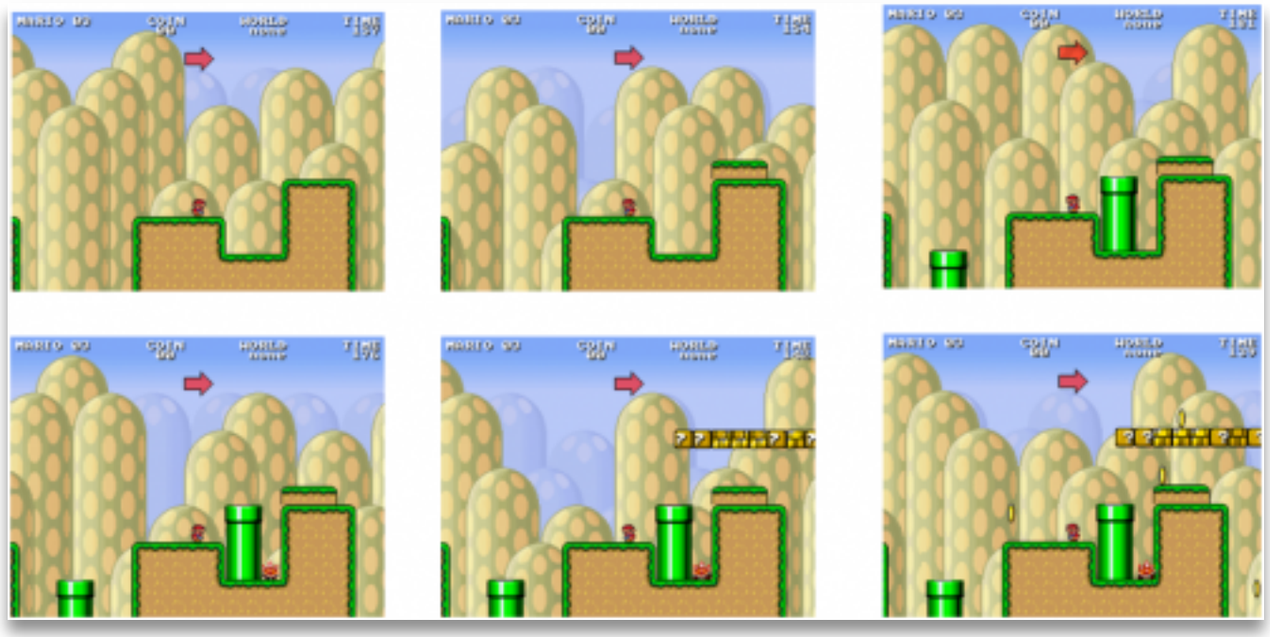
- Player experience model 73-92%
- Level generation competition organized





C. Pedersen, J. Togelius, G. N. Yannakakis., **Modeling Player Experience for Content Creation** *IEEE TCIAG,* 2010

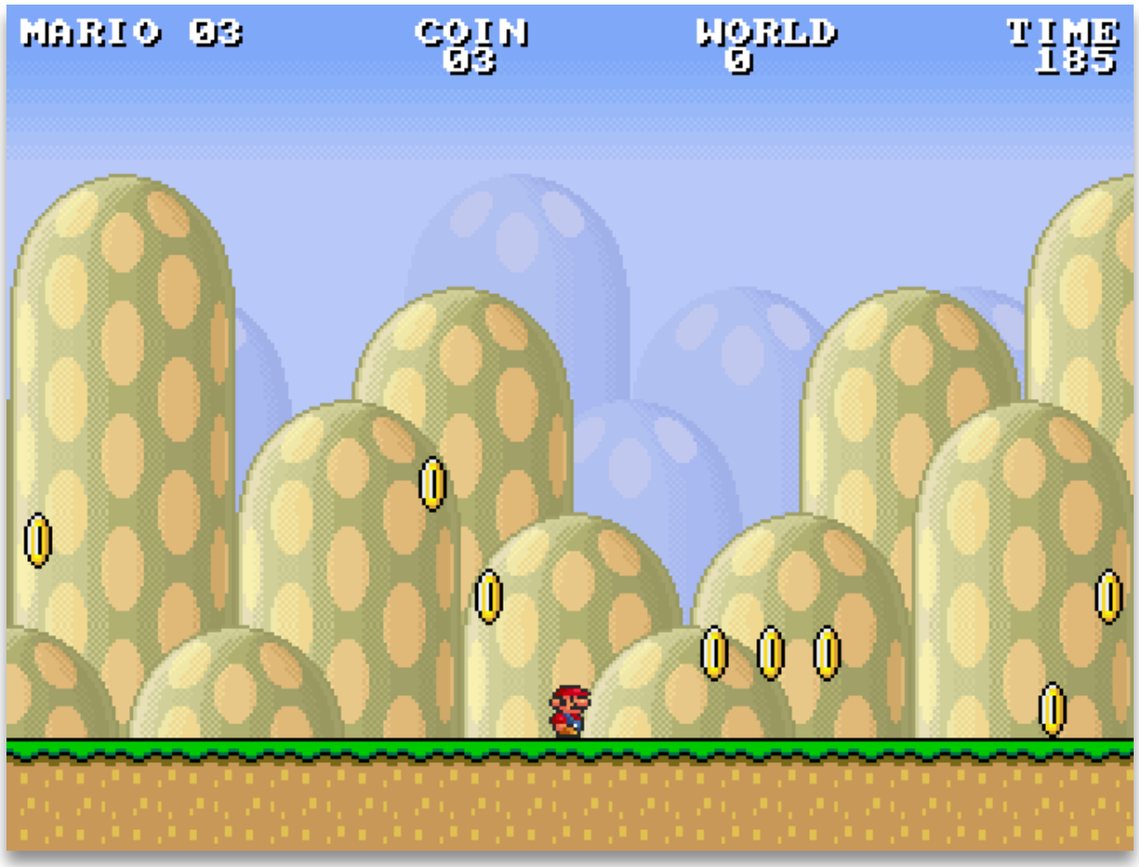
- Probabilistic multi-pass generator
  - Ground placement, Secondary hills, Pipes, Enemies, Blocks, Coins



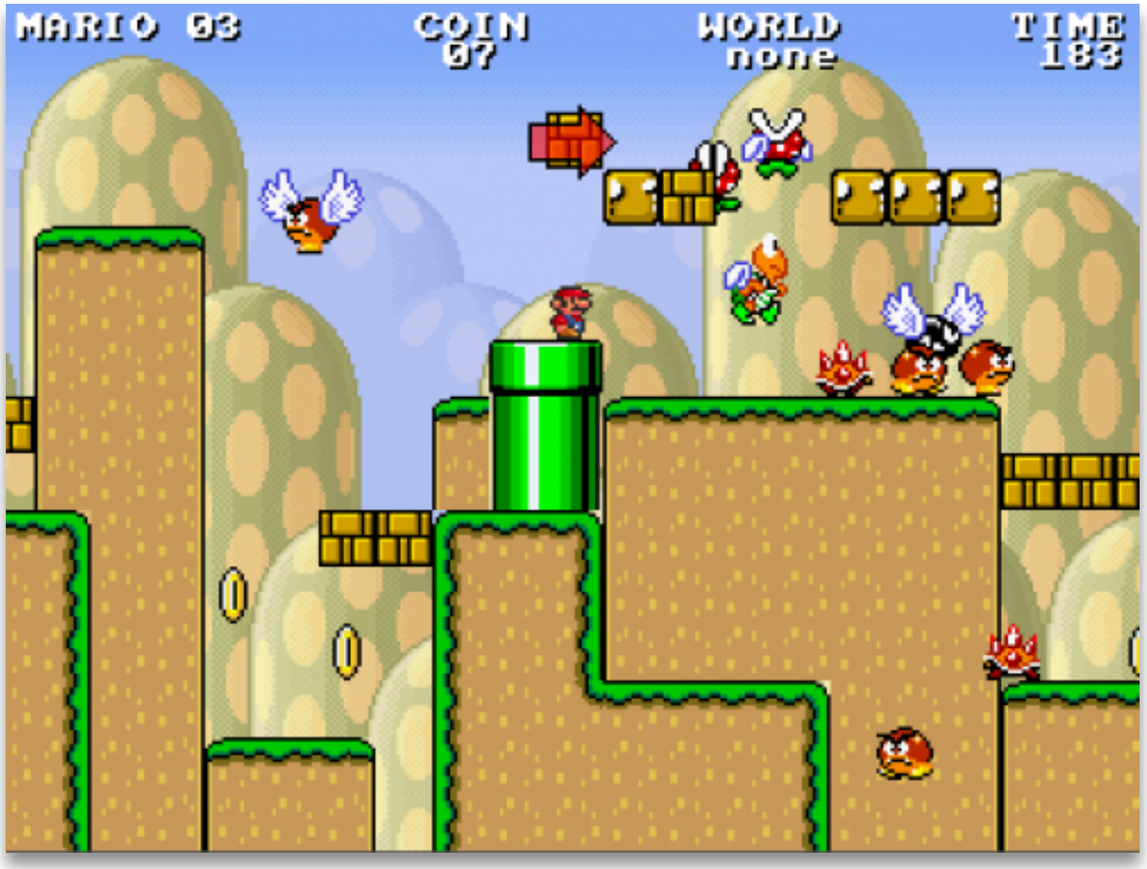
- The system has two types of parameters as input
  - probabilities that specify the frequency of events occurring
  - parameters that constrain the range of generated values.

- Create ground from left to right of a level
  - Begin gap (if not currently placing a gap)
  - End gap (if currently placing a gap)
  - Change ground height (if not currently placing a gap)
- Each of these events is associated with a probability
  - random() < pEvent
- Constraints are added to ensure that generated levels are playable
  - If the current gap exceeds the maximum gap size, immediately add ground
  - If the ground height is increased, constrain the maximum increase in height

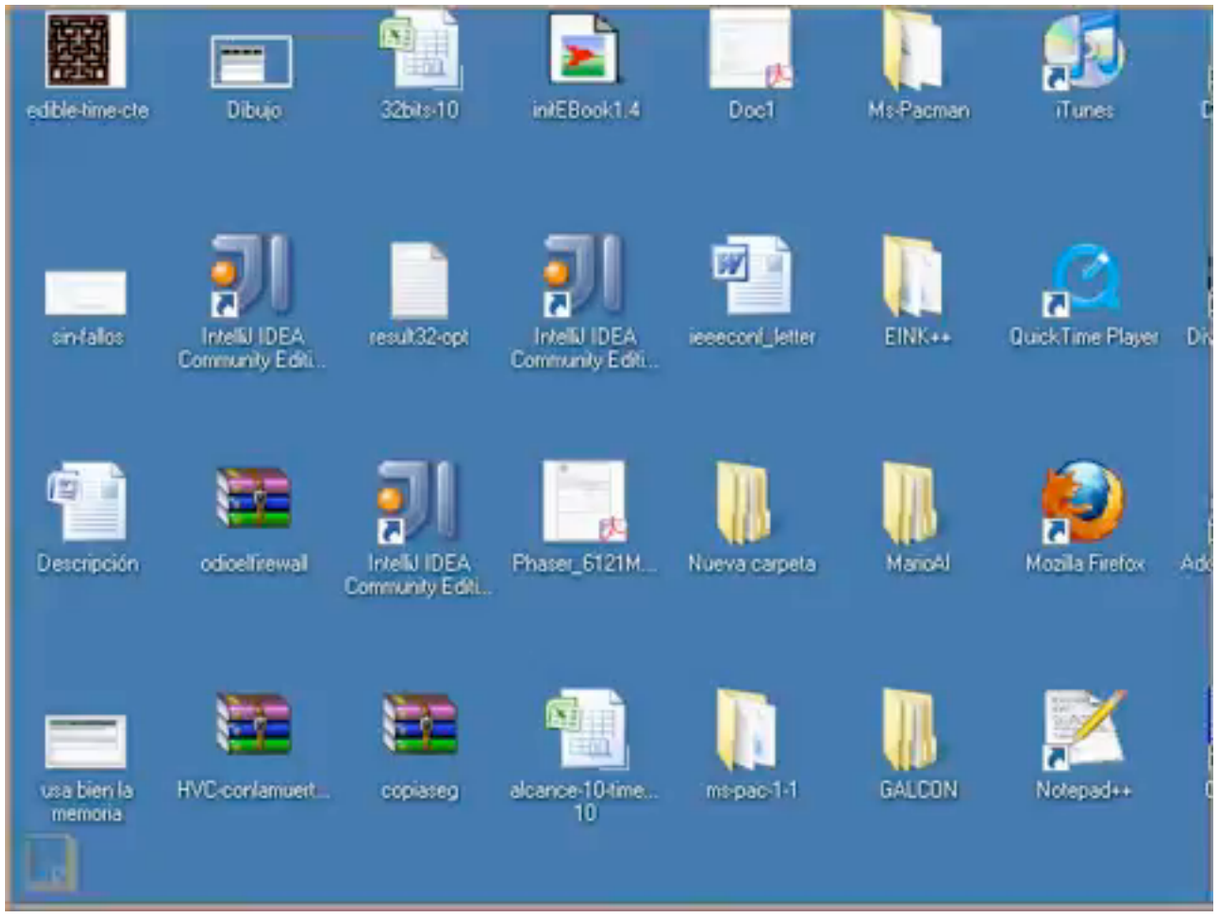
- Example output



Extremely easy



Extremely hard

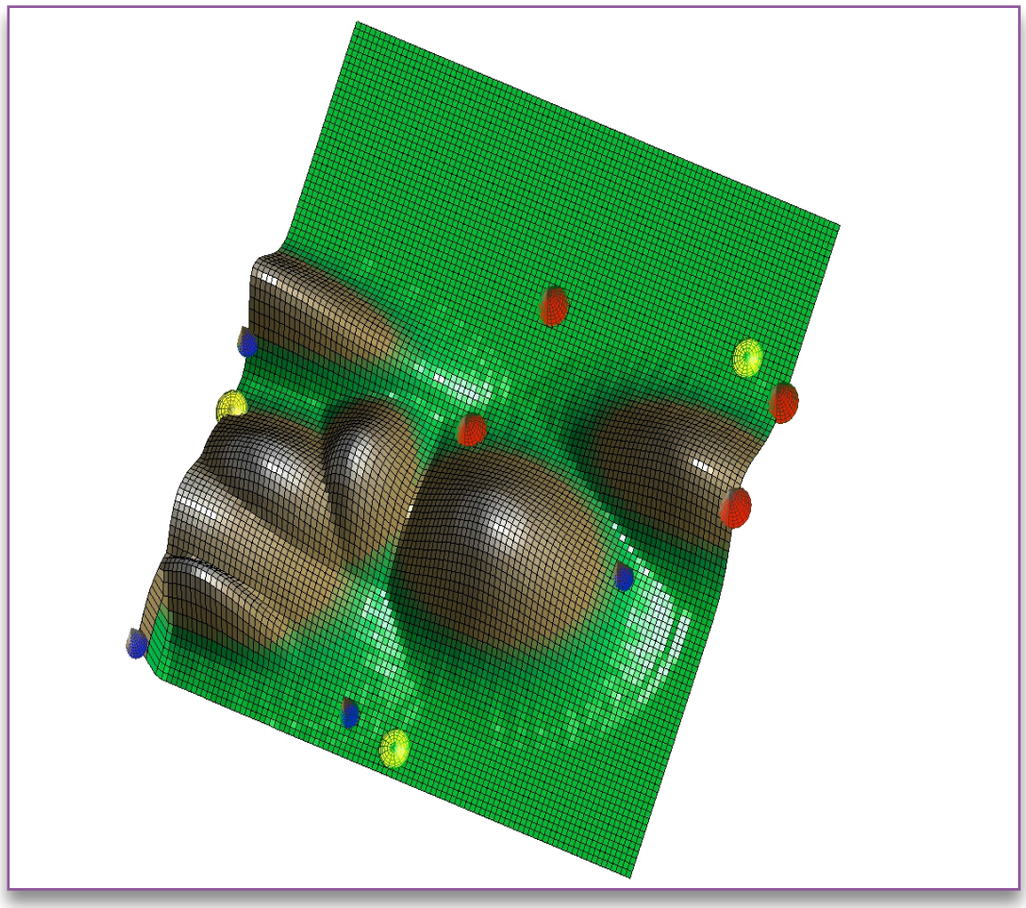

edible-time-cte
Dibujo
32bits-10
initEBook1.4
Doc1
Ms-Pacman
iTunes
sin-fallos
IntelliJ IDEA Community Editi...
result32-opt
IntelliJ IDEA Community Editi...
ieeeconf_letter
EINK++
QuickTime Player
Descripción
odioelfirewall
IntelliJ IDEA Community Editi...
Phaser_6121M...
Nueva carpeta
ManoAl
Mozilla Firefox
usa bien la memoria
HVC-conlamuert...
copiaseg
alcance-10-time...10
ms-pac-1-1
GALCON
Notepad++

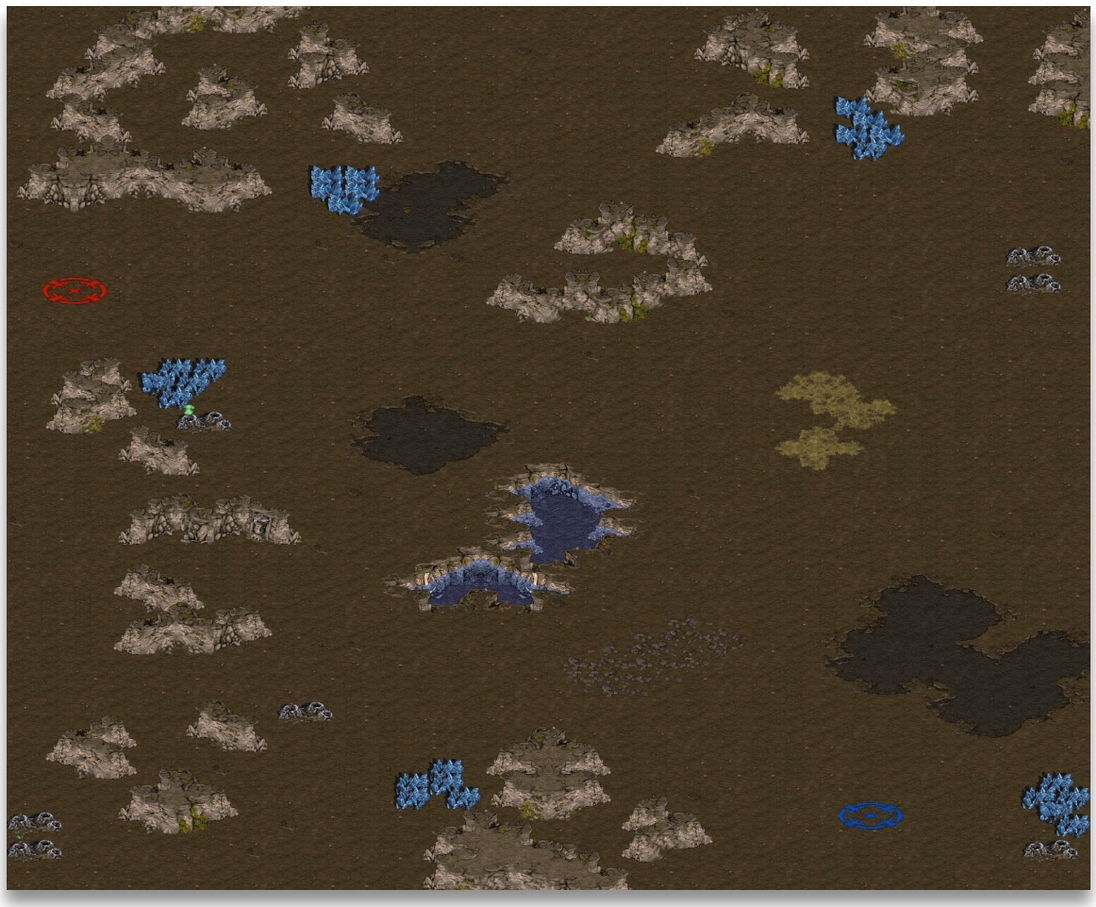
Evolving racing tracks

- Simulation-based fitness: player performance
  - Offline content generation
- Content representation: b-spline parameters

J. Togelius, R. De Nardi, and S. M. Lucas, **Towards automatic personalised content creation in racing games**, *IEEE CIG*, 2007.

Procedural map generation for RTS

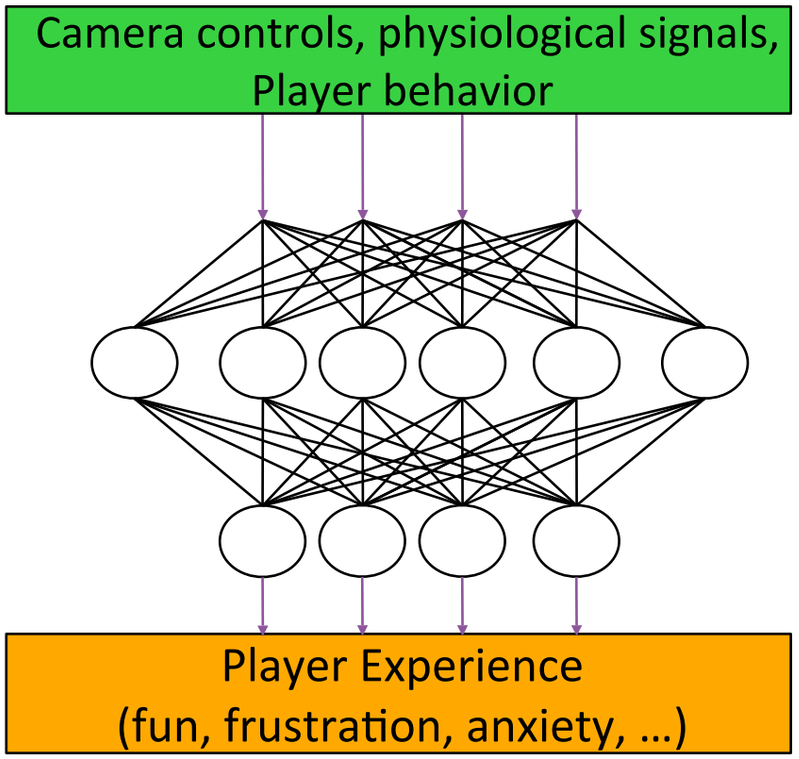


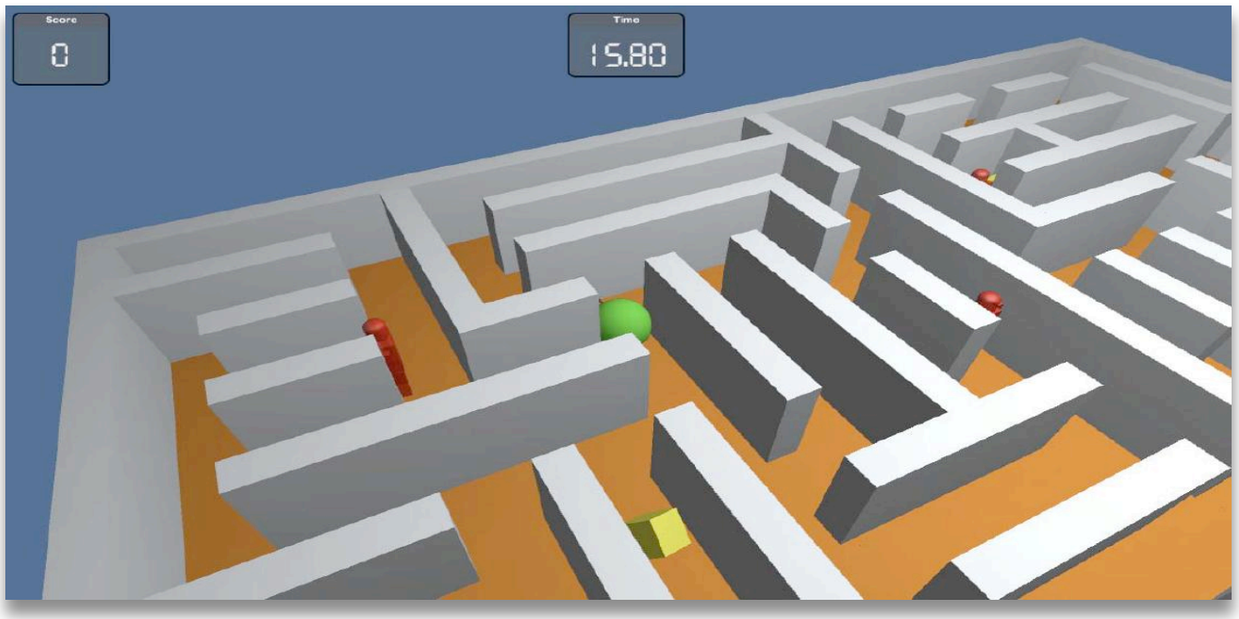


J. Togelius, M. Press, N. Beume, S. Wessing, J.Hagelback, and G. N. Yannakakis.,
Multiobjective Exploration of the StarCraft Map Space, *IEEE CIG,* 2010

Emotionally adaptive camera

- Player experience model (accuracy 76-88%)





G. N. Yannakakis, H. P. Martinez, and A. Jhala **Towards Affective Camera Control in Games** , *UMUAI*, 2010.

Camera in Game

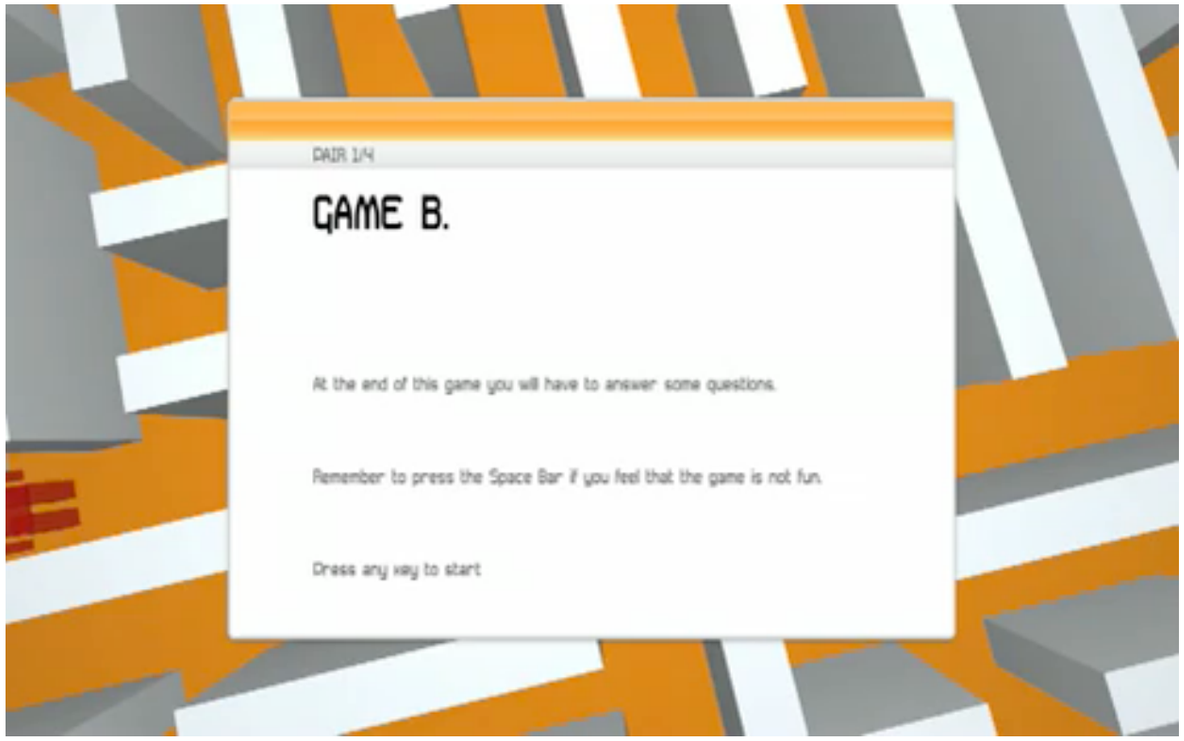
- Affective camera control

fixed camera profile

adaptive camera control

Camera in Game

- Affective camera control

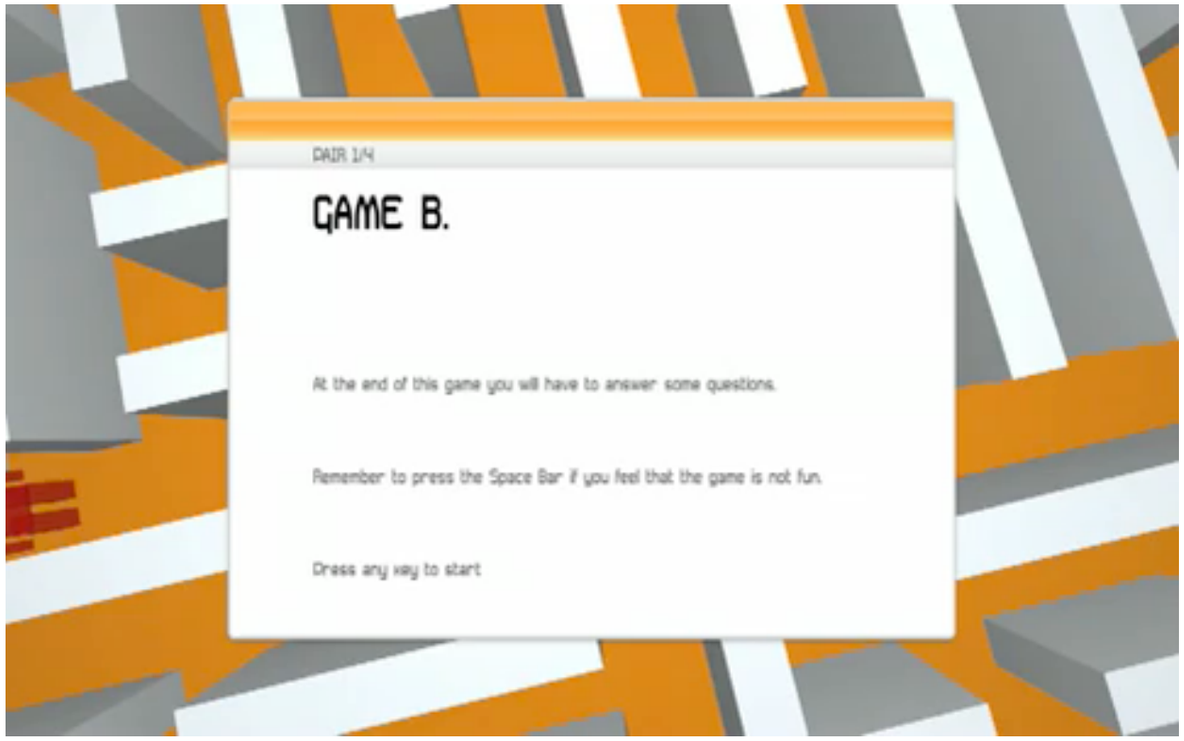


fixed camera profile

adaptive camera control

Camera in Game

- Affective camera control

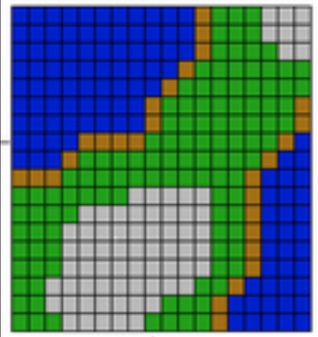


fixed camera profile

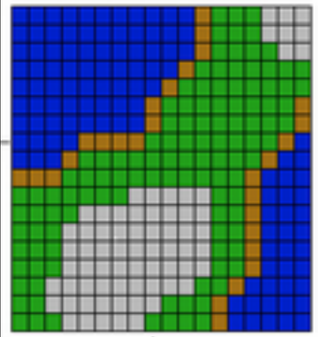
adaptive camera control

Procedural Content Generation

- Goal:
  - Create game content algorithmically
- Examples:
  - Level
  - World
  - Sound
  - Model
  - Motion
  - Plot
  -



Step 1 - The game generates the part of the world that surrounds the player for several hundred miles in each direction.



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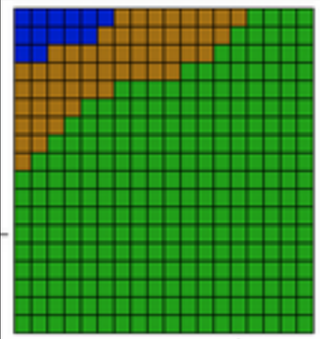
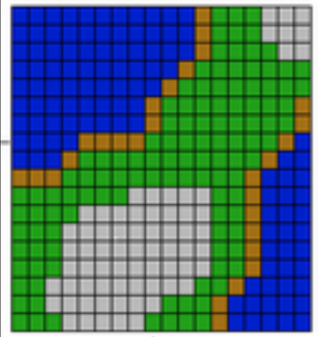


Step 2 - Then the biome information for the player's immediate vicinity is calculated (different colours being different biomes (blue being ocean)



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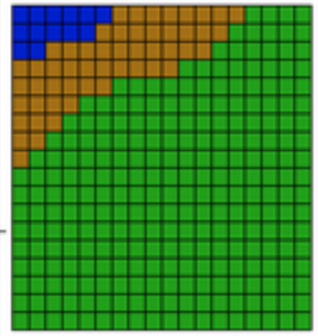

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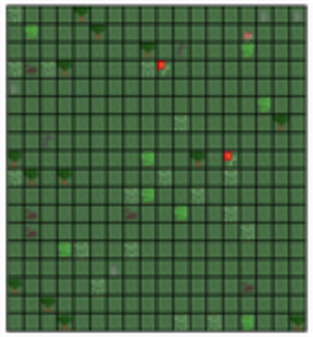
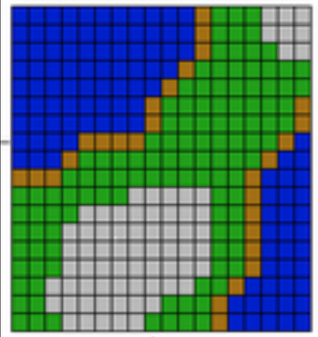


Step 3 - The engine recognizes that the player is in, say, a grassy biome and generates the overworld accordingly.



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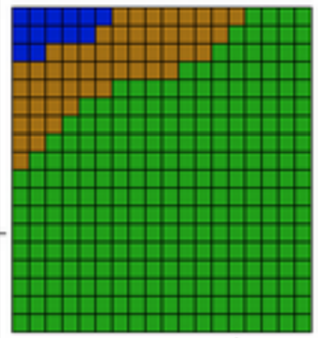

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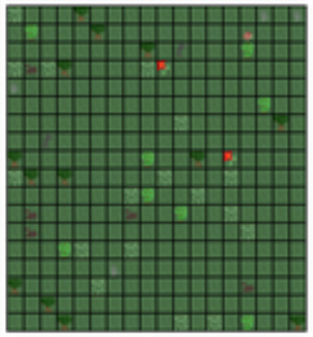

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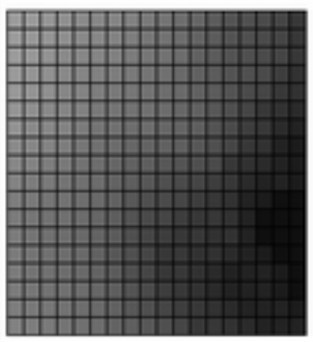
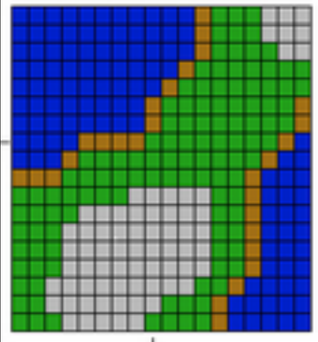


Step 4 - The engine also generates its heightmaps based off of the biome information.



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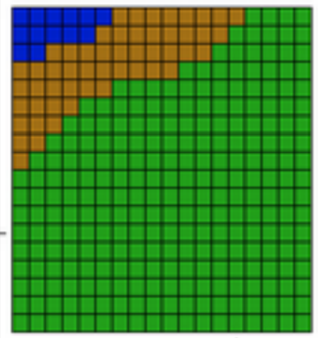

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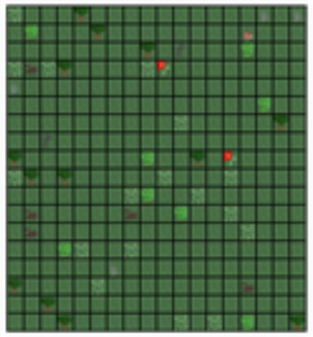

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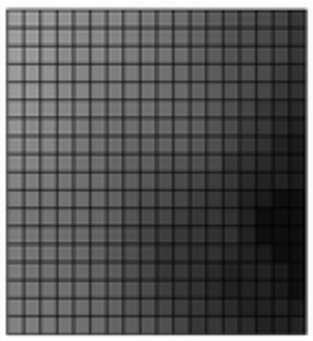

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Step 5 - The 3D overworld is constructed from all of this amalgamated data. Phew!

pXpos: 8
pYpos: 9

ssX: 17
ssY: 27

lsX: 64
lsY: 64

worldXpos: 4792
worldYpos: 9264

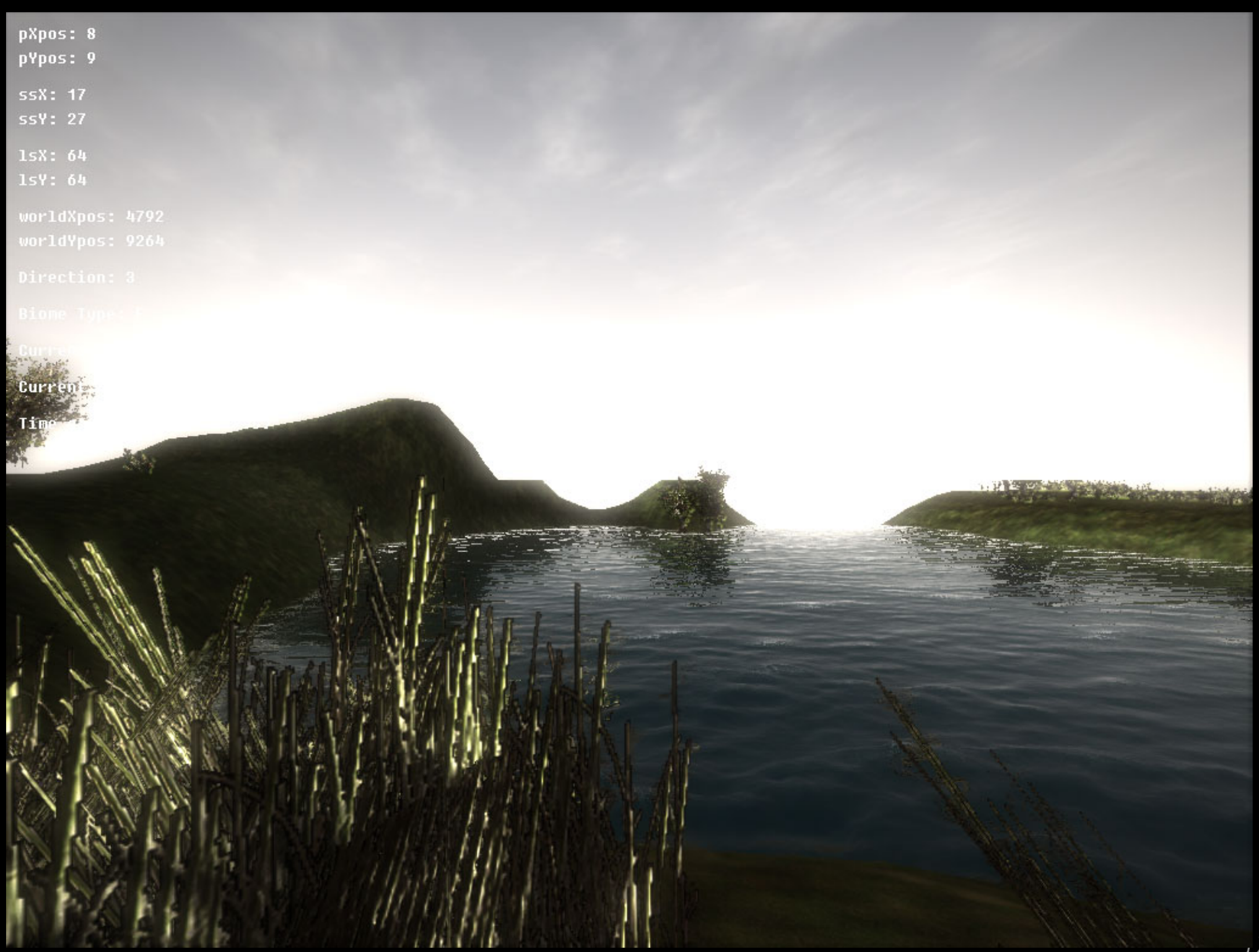
Direction: 3

Biome Type: 1

Curre

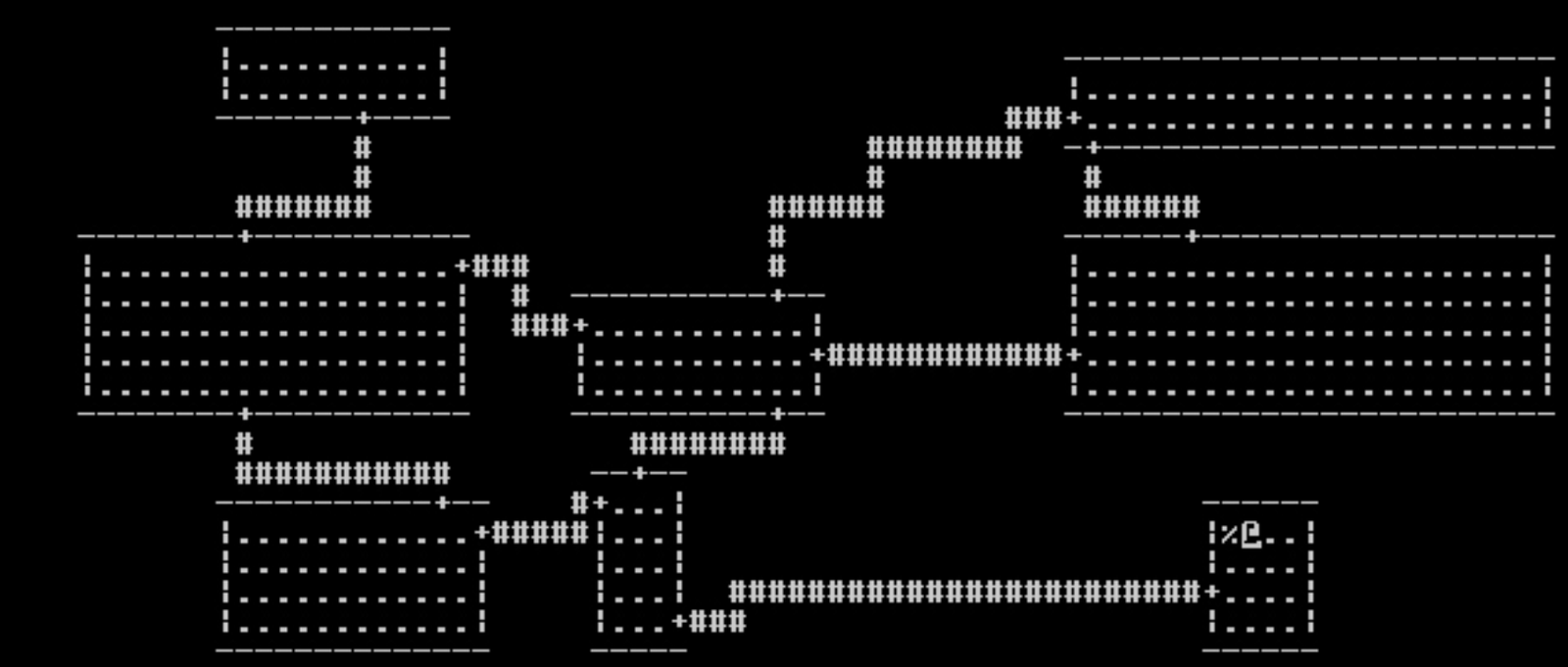
Curren

Time




76/100
100/100
55GP
CHA SPL INV WT MAP QST CST

- Rouge-like games



- Starflight
  - hundreds of worlds
    - Each contains several planets
      - each planet was assigned a number of characteristics (surface temperature, gravity, weather, atmosphere, hydrosphere)
      - Starflight 2 even included villages

- Elite (1984)
  - eight galaxies, each galaxy containing 256 planets
    - position in the galaxy, prices of commodities
    - even name and local details, e.g. unique descriptions for each planet
    - planned on having 282 trillion galaxies each of which has around 256 star systems
  - This seminal game is created by two undergraduate students

- Sentinel (1986)
  - 10,000 landscapes
  - generates each landscape from a small data packet: the 8-digit number given at the completion of a previous landscape

- Daggerfall (1996)
  - settlements and towns were hand-crafted
  - wilderness in between being generated by the game (off-line)

- Dwarf Fortress (2006)
  - Physics engine with ASCII graphics...
  - Player determines the map size, natural savagery, mineral occurrence, etc...
  - World generator uses a fractal algorithm to create a randomized elevation map
    - Then a temperature map, rainfall projection map, drainage value, vegetation value, and salinity
      - natural resources like wood, ore, and stone
      - geographic features like cliffs, gorges, waterfalls, ponds, lakes, beaches, oceans, and especially rivers.

- Spore
  - procedural model generation and animation
  - length and girth of a creature's bones, add limbs, eyes, ears, wings

MAY CONTAIN CONTENT
INAPPROPRIATE FOR CHILDREN

Visit www.esrb.org
for rating information

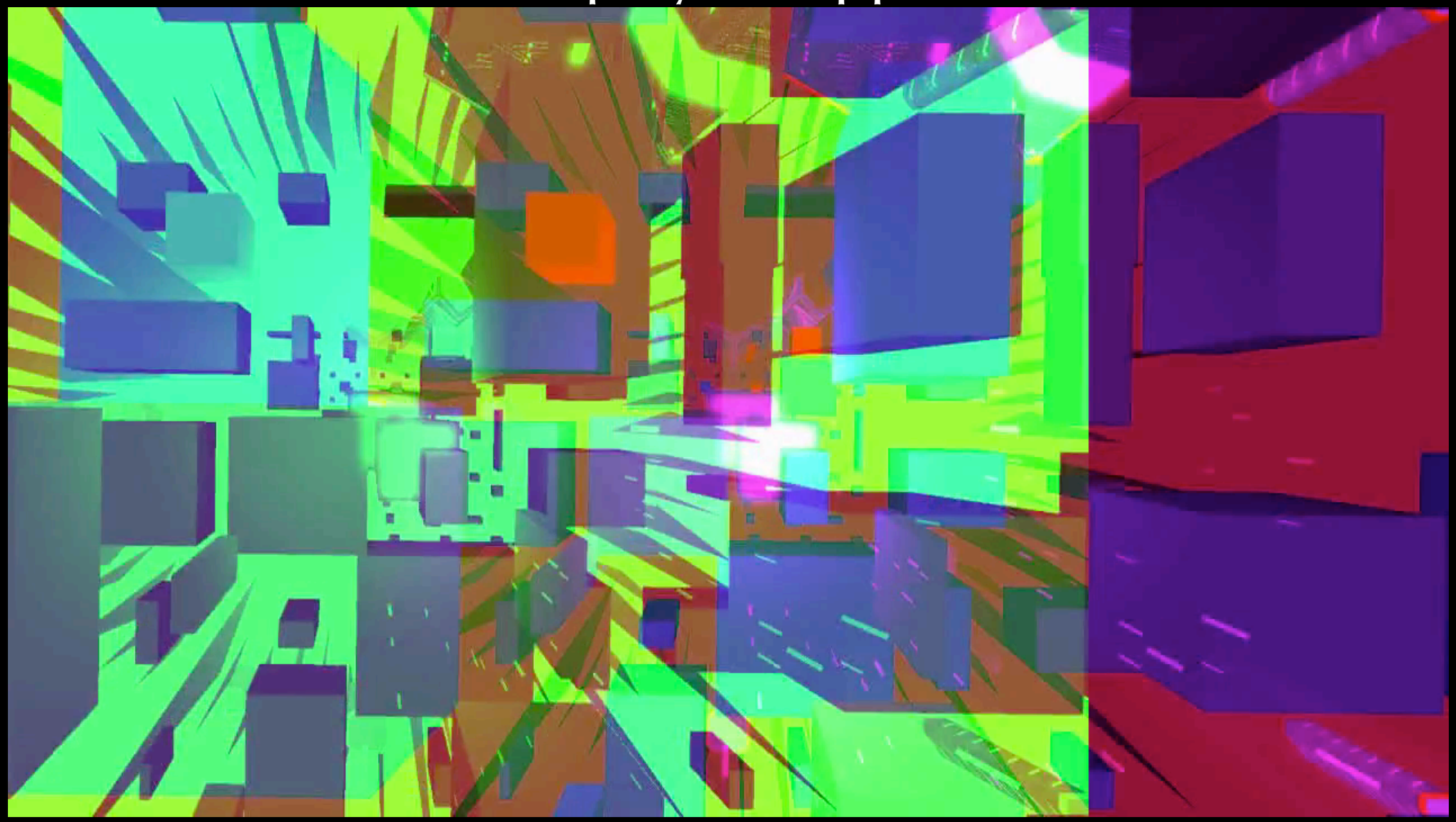
- .kkrieger
  - a first-person shooter video game
  - Takes only ~96K of disk space

- Aaaaa!
  - jumping game
  - Originally create by everything manually
    - skyscrapers, girders, walkways, signage, flying cars, and giant potatoes
-

- Aaaaa!
  - explore tools that
    - automated tasks
    - aided creativity


AAAAAAAAAAAAAAAAAAAAAAAAAAAA!!!
HUGS=3
MISSES=12
Scoring Plate Hit!
+250
250
500
750
750
SPEED
PROXY

- Ugly Baby
  - generate all of its level structure algorithmically, at runtime, based on player-supplied media



- Why have world borders at all? Procedural generation code hasn't changed much in the last 25 years. People are still stuck using fractals and diamonds and blobs to do everything, which becomes repetitive and quite simply looks like procedurally generated content. To any programmer looking at it, it virtually smells of procedural generation.

—Alex Norton

- Next?
  - Procedural Storytelling
    - game plots are little more than **dependency graphs**
      - a sequence of actions must be performed in a particular order
    - underlying plot is difficult but
    - human imagination can create a plot out of a sequence of events

–http://pcg.wikidot.com/

Final Project

- Create a game using 3.js
  - Requires a theme using procedural content generation
    - One of the following technique is required in the game
      - Motion planning
      - Camera planning
      - Physically-based simulation
        - » Rigid body, Flock/crowd, Deformable objects, etc.
      - Network
      - Shading
        - » Real-time rendering related methods, normal mapping, etc
      - Sound related programming techniques
        - » Stereo, real-time sound rendering, etc
- Due: 12/18/2013 midnight


BACK
TO
THE RETRO