

# Genetic Programming Video Games

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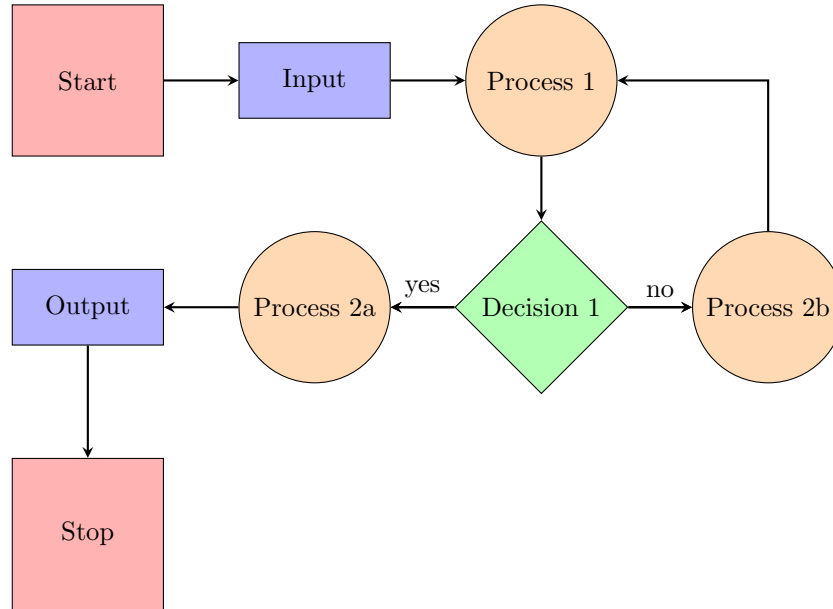
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## 1 Introduction

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## 2 Method



## 3 A Survey of Classic Era Arcade Games

Taken from (<https://www.ranker.com/crowdranked-list/the-best-classic-arcade-games>) site is a list of the most popular arcade games from the classic era. Though pretty much any list of popular arcade games from the era would do.

- Galaga
- Donkey Kong
- Pac Man
- Space Invaders (1 and 4 are synonymous)
- Ms. Pac Man (3 and 5 are synonymous)
- Dig Dug
- Gauntlet
- Asteroids
- Mario Bros (not an arcade game, also covered elsewhere)
- 1942
- Defender

- Street Fighter II
- Centipede
- Street Fighter
- Double Dragon (see 12 + 14)
- Joust
- Mortal Combat (see 12, 14 + 15)
- etc
- etc
- PONG
- SPY HUNTER

Ignore the strolling beat em up fighting games like Street Fighter and etc. Also ignore Mario Bros as really a console game. Both are well covered in other literature as well.

## 4 Patterns Found Across Many Games

## 5 Game Patterns

## 6 Entity Patterns

These games all have the following patterns in common.

- Player Can Move
- Flat 2D Space (asteroids?!)
- Either Player Reaches Goal To Win or Player Defeats (all) Enemies to Win
- Enemies Hurt Player on Collision
- More Enemies Than Players

### 6.1 Common Patterns

- Some Environment Blocks are visible and impassible, if so then only small fraction of space - Player has 3 Health - Enemies have 1 Health - Players Shoot Hurtful Projectiles - Enemies Shoot Hurtful Projectiles - Waves of Enemies - Stationary Player Respawn (Start) Point

## 6.2 Uncommon Patterns

- Some Environment Can be destroyed - if so then much more common - Player collects Items for Powers - Suppressed abilities, collectables unlock them - Enemies Grow or Space Shrinks either directly or indirectly (more on this later) - Enemies Reach Goal To Win (Player Lose)

## 7 Criteria for Quality Arcade Games

### 7.1 Requirements / Must

These can be coded into the wider system as they are necessary

- Complete (win or lose) a Level in over 30 seconds - lets say @16fps  $16 \times 60 \times 0.5$  = about 500 moves - Must Complete (win or lose) a Level in under 5 minutes - lets say @16fps  $16 \times 60 \times 5$  = about 5000 moves - Cannot win just by staying still and waiting - Or moving to safe place and waiting

### 7.2 Goals / Should

These can be set as evolutionary goals via fitness functions

- Should Complete (win or lose) a Level in under 3 minutes - lets say @16fps  $16 \times 60 \times 3$  = about 3000 moves - lets say @16fps  $16 \times 60 \times 5$  = about 5000 moves - Player completes a Level a fraction (say,  $1/2$ ) of the time - Could be, given 3 hearts, lose 1 heart per level on average - Should Move over range of Locations - Simple Statistical Measure - Likely cover the same ground more than once - Simple Statistical Measure - Should interact (get close too) enemies to succeed

- Enemy May sometimes Defeat Player by collision - Enemy Move towards and Away from the Player - Enemy Have Repetitive Behaviours which can be observed - Enemy Should interact (get close too) player at some point to succeed

- Enemy Rewards the Player on its Death

### 7.3 More Advanced Patterns

### 7.4 Environment Generation Strategies

- Use Randomised depth first search to carve out a maze - Randomly place few long walls - Randomly place single blocks

### 7.5 Player Characteristics

### 7.6 Required Characteristics

- Can perceive (nearly) the whole visible level, radius will do. Doesnt need to interrogate (say via ray casts). This is not a simulation the player sees the arena like a seagull or a drone. So can tell direction and distance to specific interesting elements like the goal once Goal has been onscreen Goal. - Is movable

## 7.7 Optional Characteristics

- Reaches a Goal coords to win - Has scalar health. When health reaches zero loses - Has scalar points. Reaches a Score to win - When low health finds and collects health - Avoids Damage

## 7.8 Enemy

## 7.9 Given/Unavoidable Characteristics

- Has start/anchor point Set Anchor()
  - Has limits/range/flaws to its perception
  - Has limits/range to its movement If Distance From Anchor  $\leq$  Range

## 7.10 Derived

- Interacts with the Player at least once on a playthrough - Hurts or Hinders the Player - Rewards the Player on its Death - Has predictable Repetitive Behaviour
- Vulnerable to Damage

## 7.11 Goal

Once entity has been in range of me they always know where I am.

# 8 Door-Key Challenge

## 8.1 Door

- Blocking and Changes to Passable - Requires External Message - collection of pickups - killing of enemies - visit location - etc
  - Key
  - Arena