ANGELINA versus Terry Cavanaugh

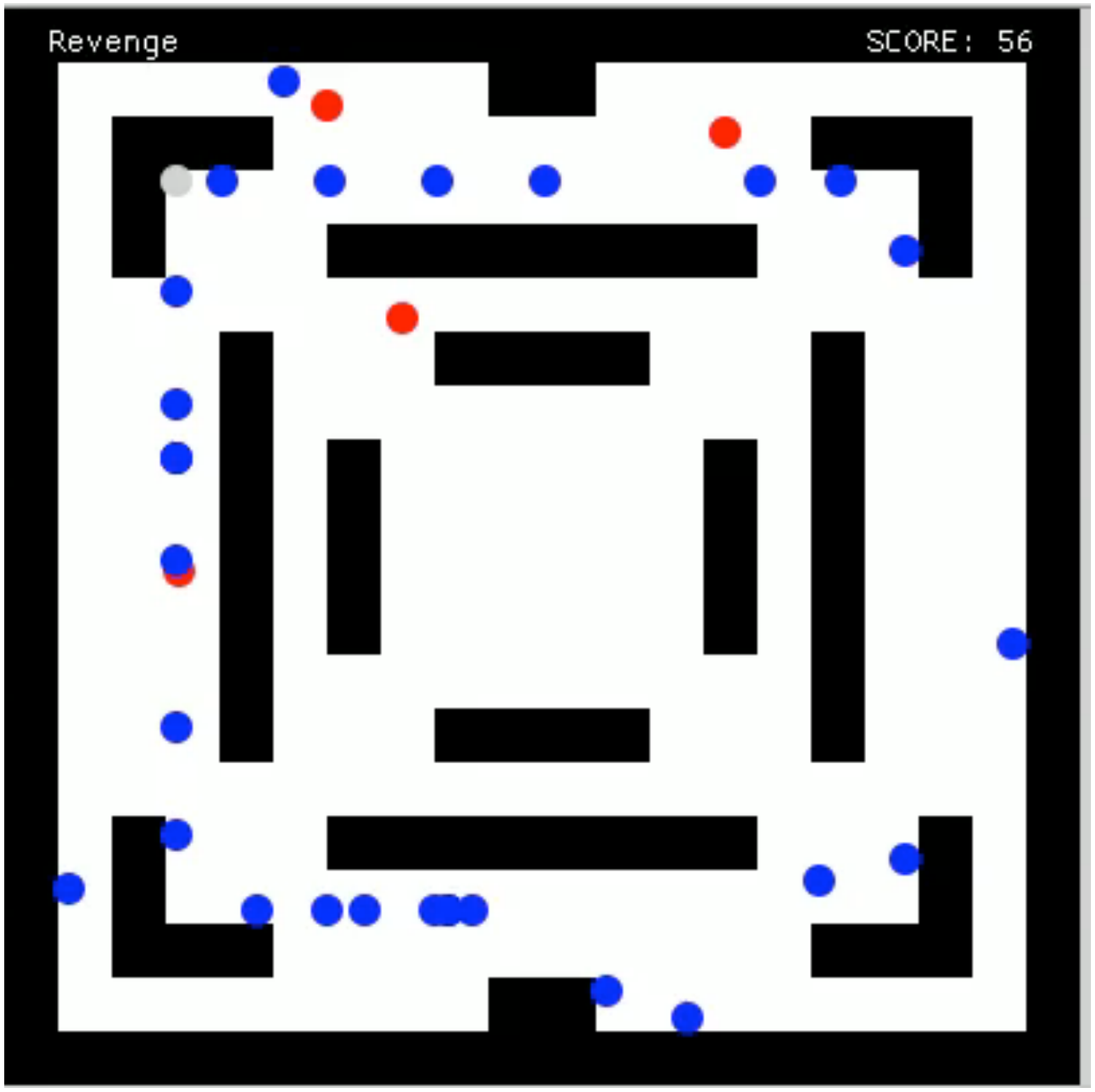
Or "Mechanic Discovery through Simulation"

Michael Cook
Computational Creativity Group
Imperial College, London

www.gamesbyangelina.org

Can you automatically design games?

Arcade Games



Play *Revenge* at www.gamesbyangelina.org/games

Arcade Games

Grammar-based Rule Generation

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- Define rule templates, e.g.
  <TYPE, TYPE, EFFECT, EFFECT,SCORE>
- Define a set of possibilities, e.g.
  TYPE = Player, Red, Blue, Green

Arcade Games

Grammar-based Rule Generation

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  <TYPE, TYPE, EFFECT, EFFECT,SCORE>
- Define a set of possibilities, e.g.
  TYPE = Player, Red, Blue, Green
- Good ratio of "good rules" :"rules".
- Rationalisation: designer involvement.

Platform Games

Play *The Conservation of Emily* at www.gamesbyangelina.org/games

Platform Games

Simulation-Assisted Parameter Search

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- Define candidate game variables to target, e.g. player.jumpVelocity
- Evolutionary search optimises powerups for e.g. reachability gain, level flow
- Reliant yet again on human assistance
- One-time powerup use a bit boring? We can do better!

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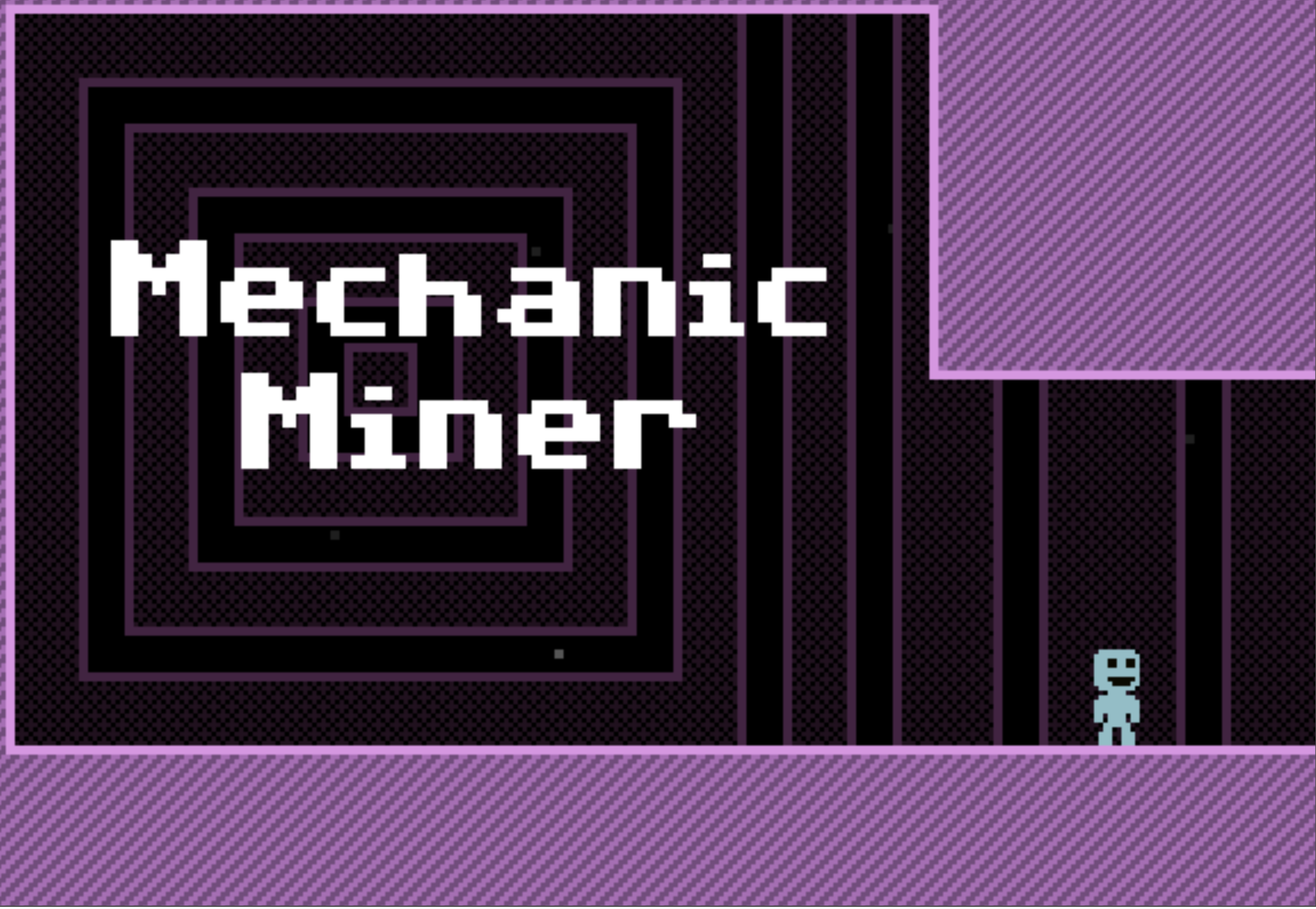
- Generate true ‘mechanics’

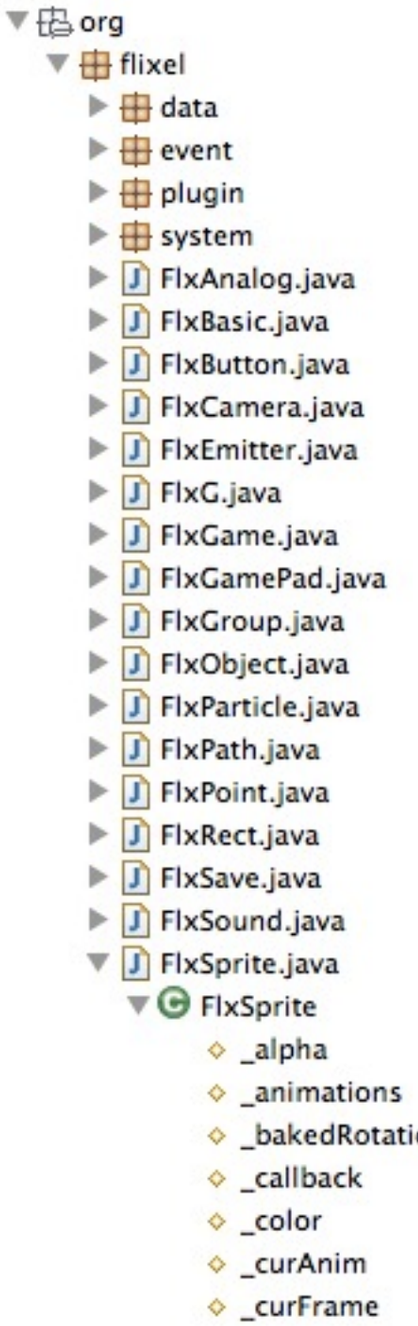
What Do We Want?

- Reduce reliance on humans
- Generate true ‘mechanics’
- Surprise us!


Mechanic
Miner

Mechanic Miner

Generation



Mechanic Miner

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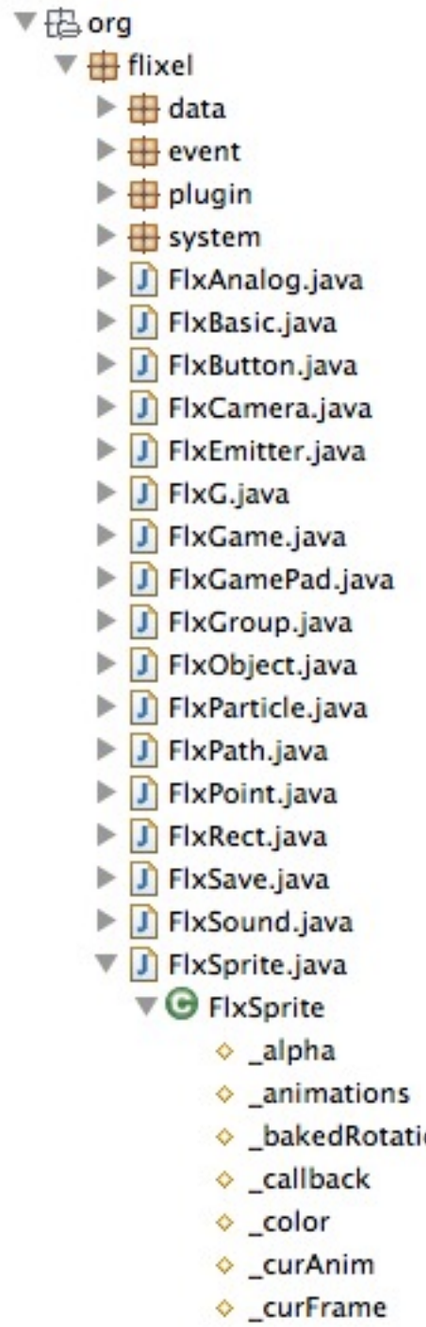
- Java Reflection lets us inspect code at runtime and reason about it,
  e.g. FlxSprite.getClass().getFields();



Mechanic Miner

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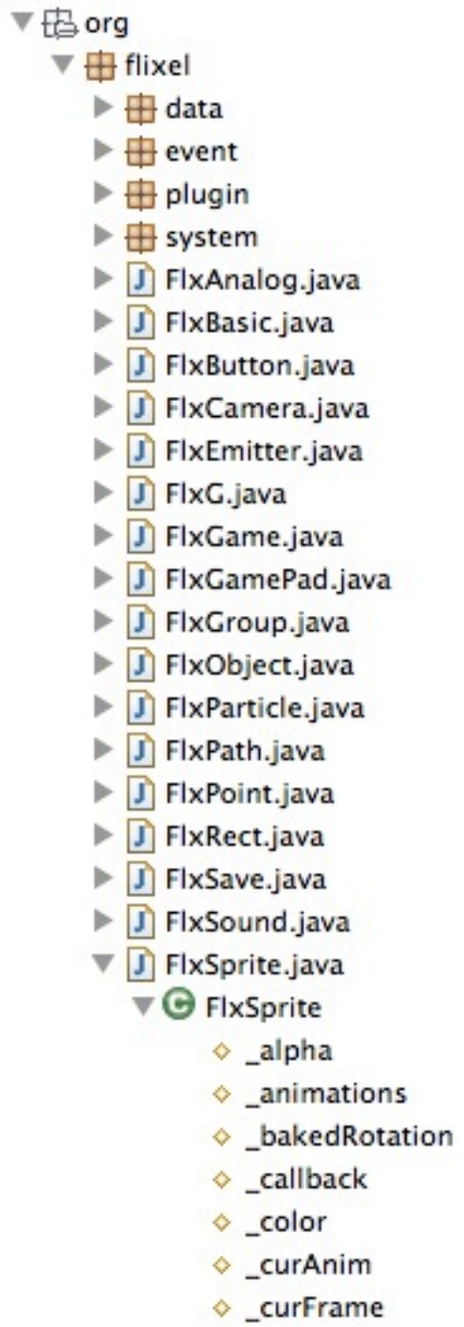
- Pick a field, attach a modifier (e.g. HALVE, INVERTSIGN) and you're good to go.



Mechanic Miner

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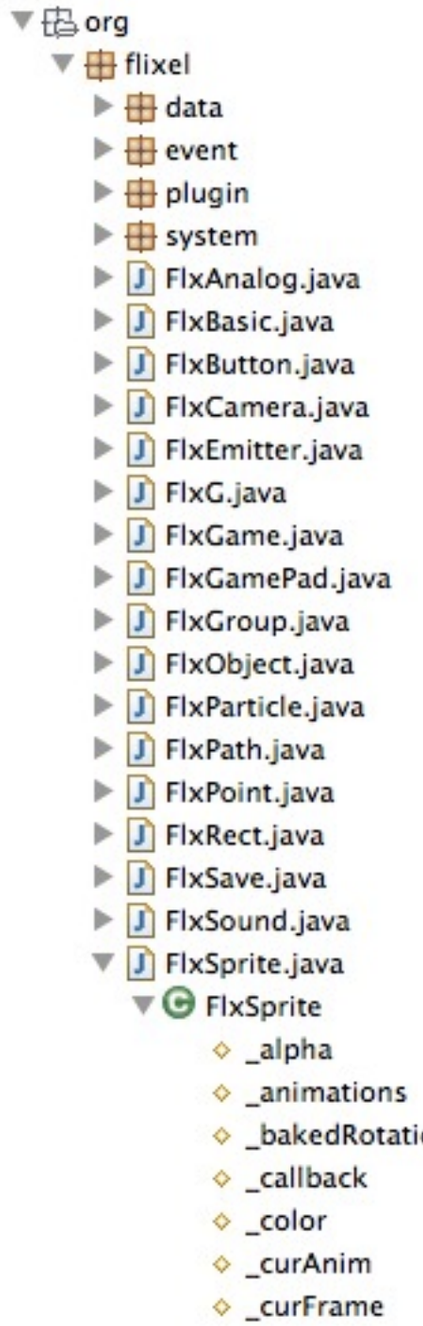
- Can reason about instance and static fields (after a headache)



Mechanic Miner

Evaluation

Take an ‘unsolvable’ level, and simulate playing it.

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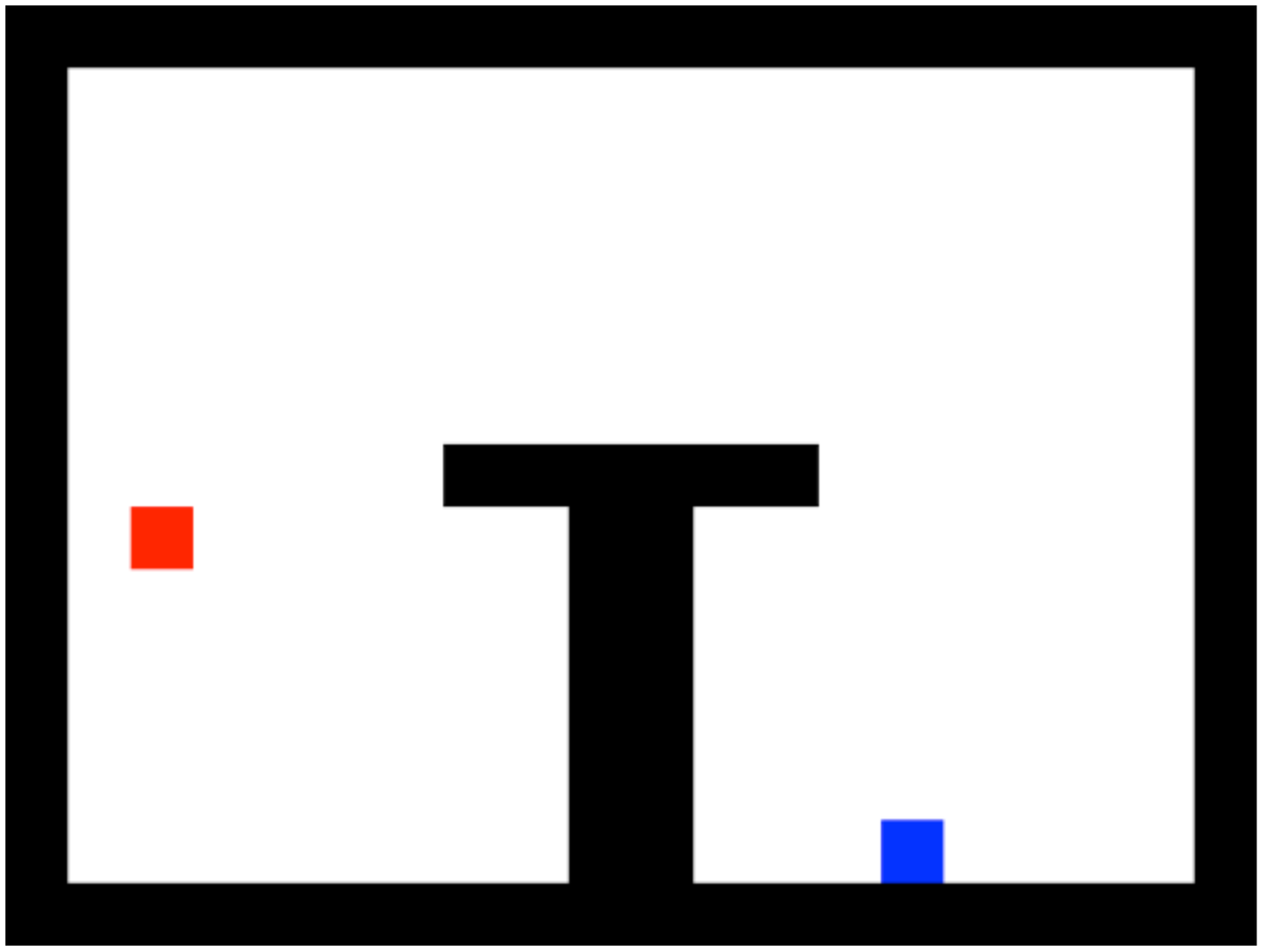

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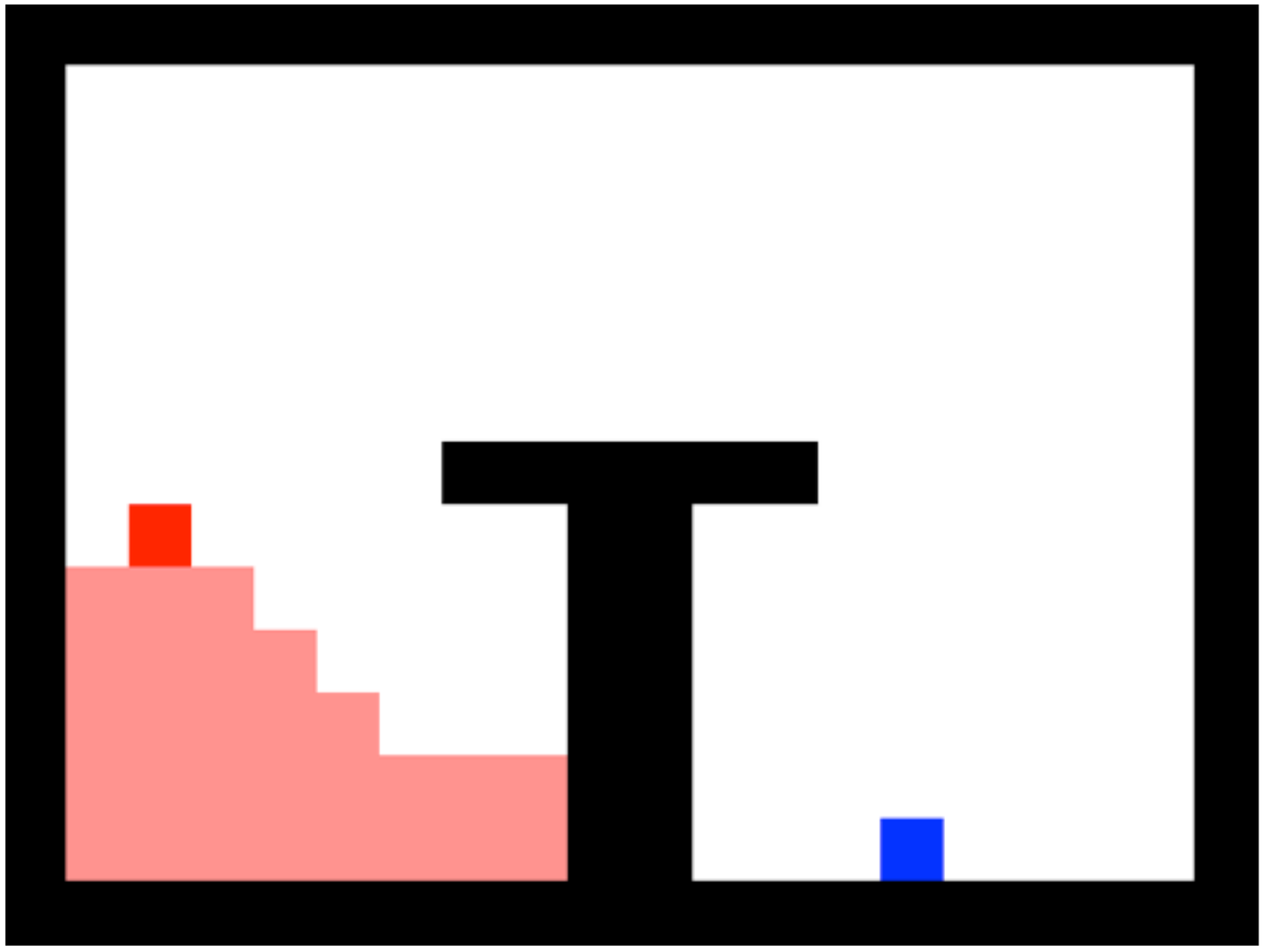

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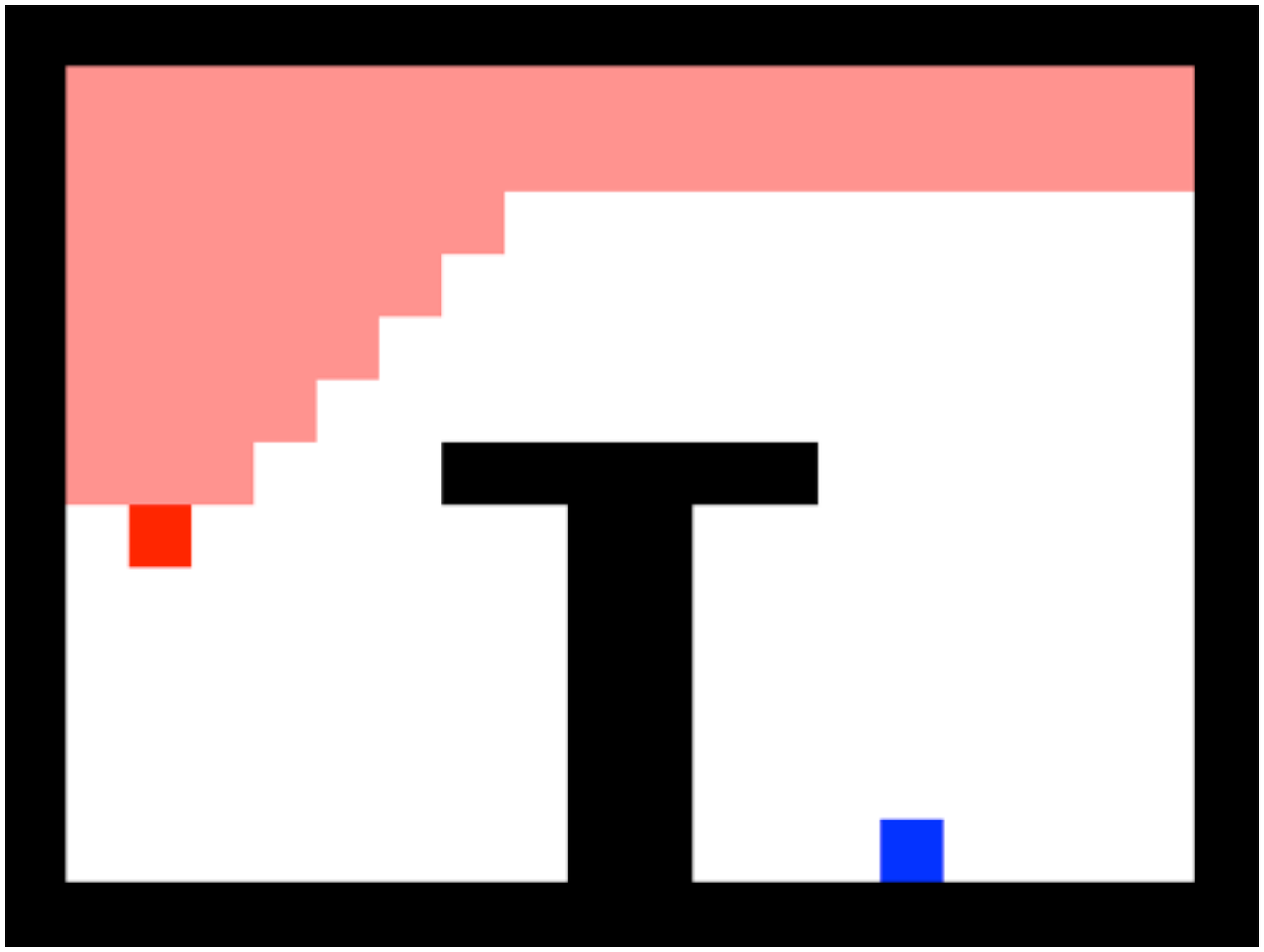

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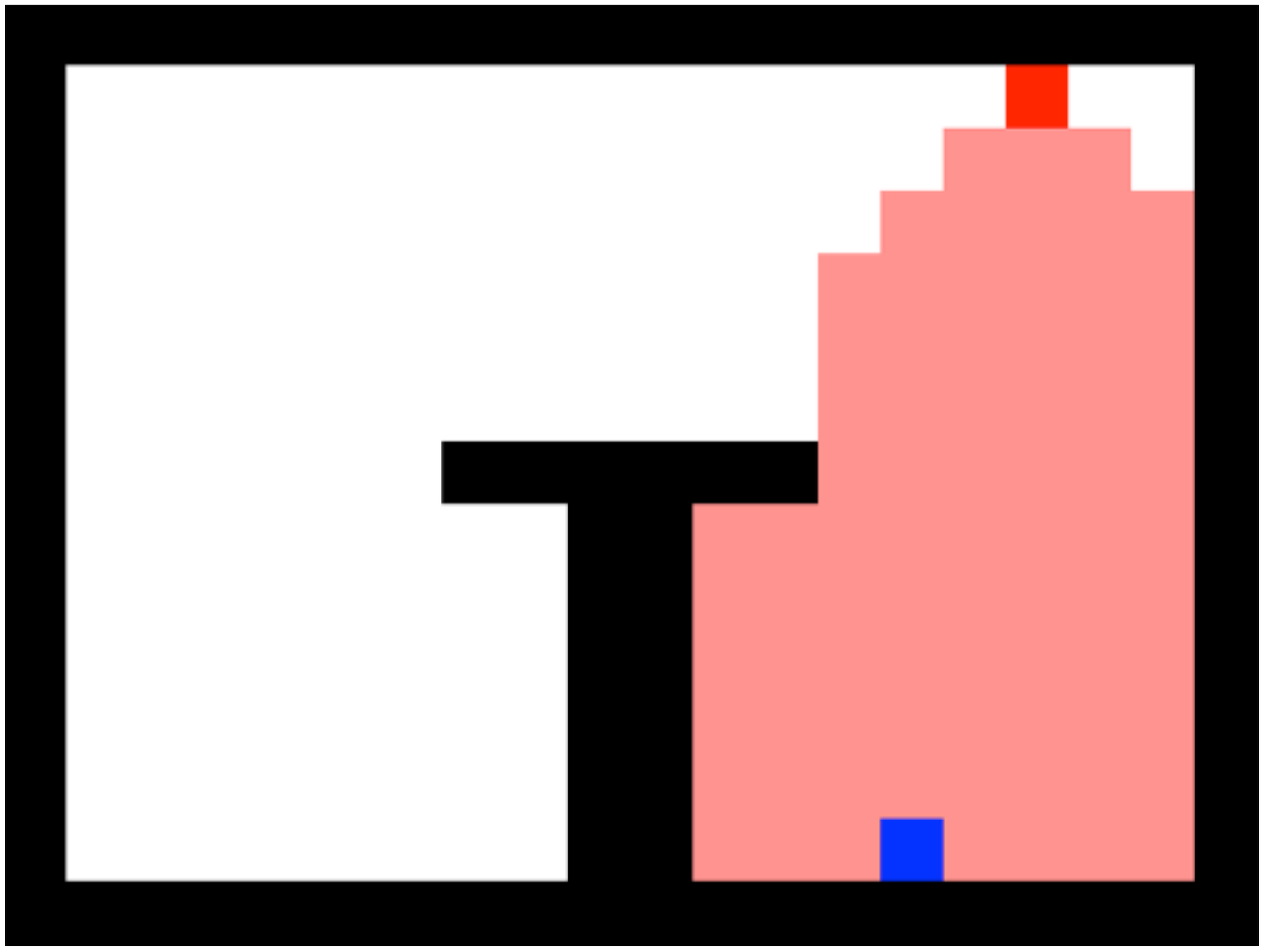

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Example Mechanics (hot off the press!)

(as well as 1000 game-breaking, exception-throwing,
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Mechanic Miner

Example Mechanics (hot off the press!)

```
INVERTSIGN Player.acceleration.y
```

```
HALVE Player.y

HALVE FlxGame.timescale
```

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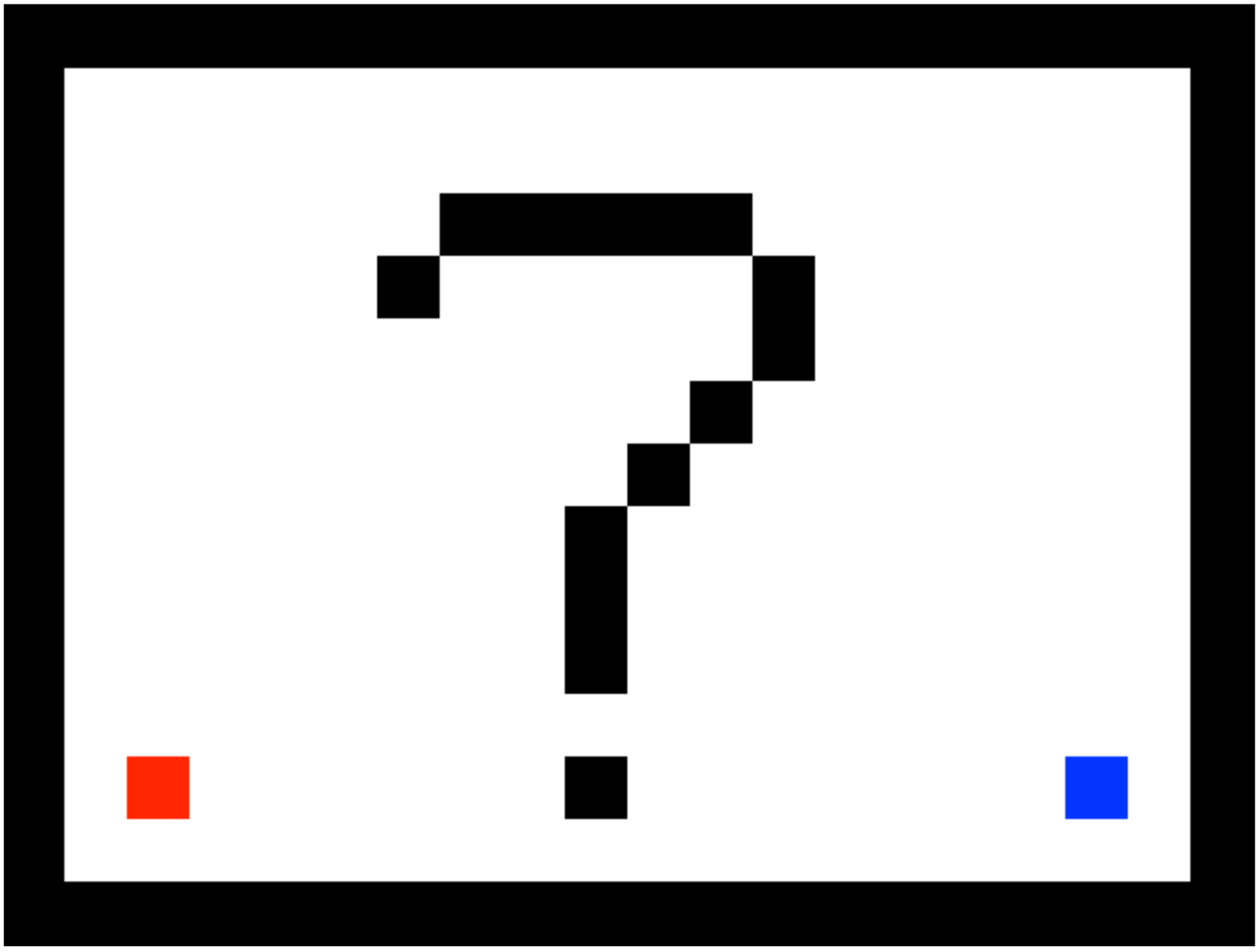
Mechanic Miner

Level Design



Puzzle Platformers

Sample Levels

Puzzle Platformers

Sample Levels

```
11111111111111111111
1                  1
1           X  11  1
1      1111111111  1
1                111
1                  1
1                  1
11111              1
11111              1
11111              1
11111      11      1
11111      11      1
1                  1
1        S         1
11111111111111111111
```

Puzzle Platformers

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```
111111111111111111111
1                     1
1                     1
1           X   11    1
1      1111111111     1
1                  111
1                     1
1                     1
1                     1
1                     1
11111                 1
1111 1                1
11111                 1
1111 1        11      1
11111         11      1
1                     1
1         S           1
111111111111111111111
```

```
11VVVVVVVV1VVVVVVV1111
1                     1
1               V     1 1
1         1     V       1
1   S     1     V       1
1         11111V        1
1         11111V        1
1         11111VVVVV    1
VVVVVVVVVVVV1           1
1      VVVVVVVVVVVVV    1
11        11111         1
11           X          1
11                      1
1                       1
1                       1
111111111111111111111111
```

Mechanic Miner

Exciting things!

- Levels that are solvable using mechanic A, but *not* using mechanic B.
- Levels that are solvable only by using mechanics A *and* B.
- Levels that require *x* steps of planning from the player.

Puzzle Platformers

Future areas...

- Richer code synthesis (component creation, mechanical constraints)
- Better fitness functions for mechanics and levels
- Integration into non-puzzle contexts, e.g. ANGELINA's Metroidvania games
- More game engines, more genres, more more.

Questions!

More on ANGELINA and play games:
http://www.gamesbyangelina.org

@mtrc **@angelinasgames**

More on Computational Creativity at Imperial:
http://ccg.doc.ic.ac.uk