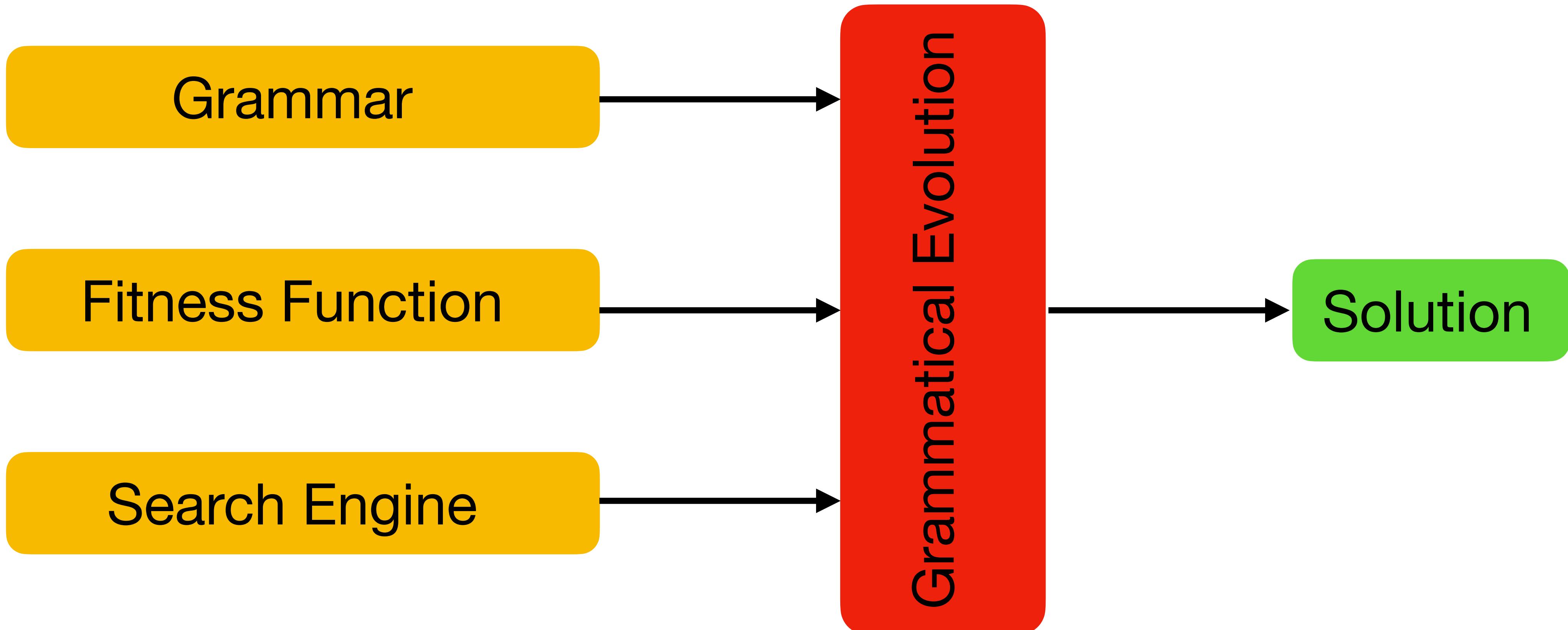


# CS6271

## 5.2 Implementing Grammatical Evolution

# Overview



# Overview

- Initialisation
- Crossover
- DEAP\_GE

# Initialisation

- Random
- Sensible
- Position Independent Grow

# Random Initialisation

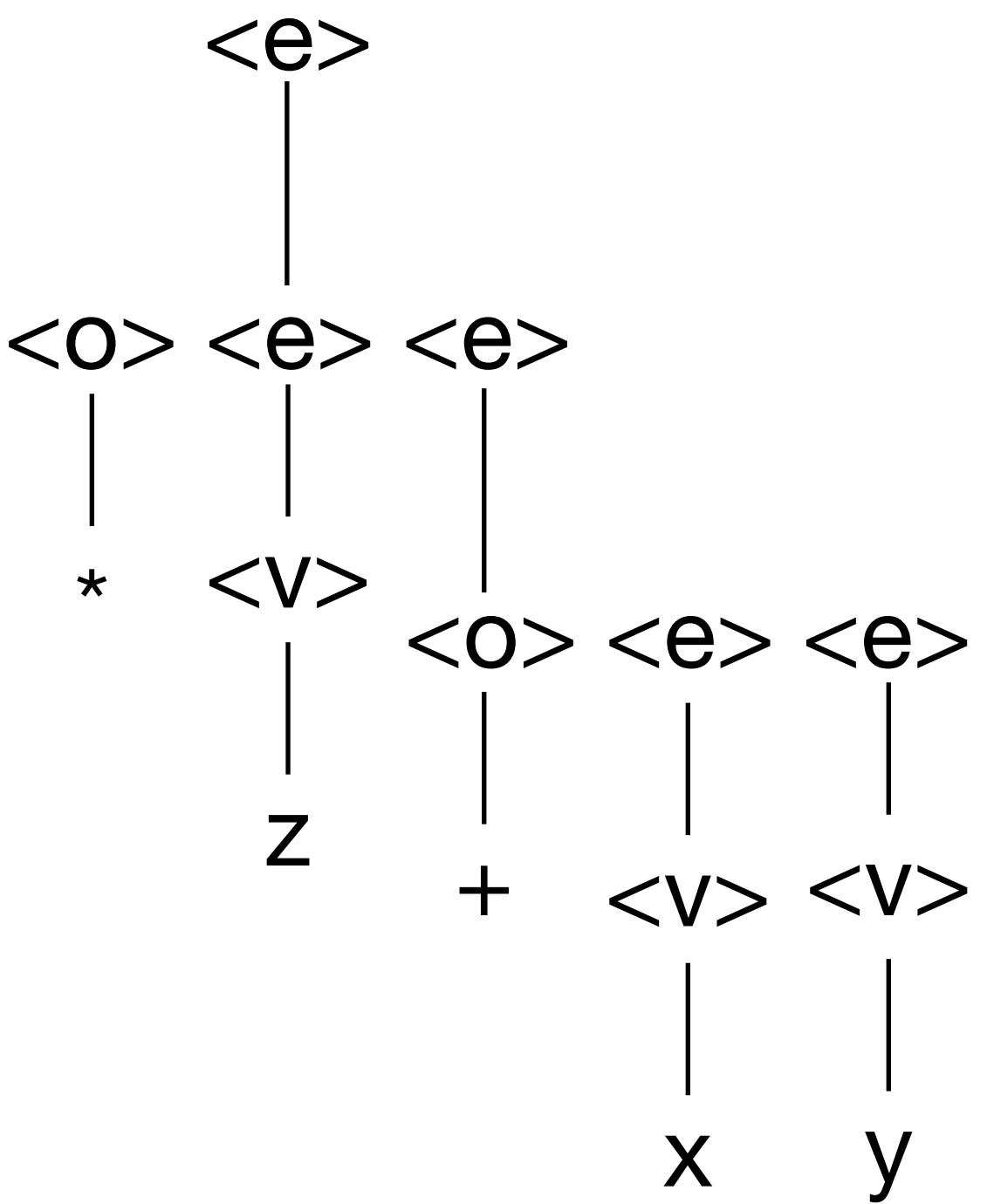
- 50% of individuals will choose
  - $\langle e \rangle := \langle v \rangle$
- $\langle v \rangle$  will always produce a single variable
- 50% of individuals will just be a single variable!
  - ~16.6% of individuals will be **x**
  - ~16.6% of individuals will be **y**
  - ~16.6% of individuals will be **z**

```
<e> := <v> | <o> <e> <e>
<o> := + | - | * | /
<v> := x | y | z
```

# Sensible Initialisation

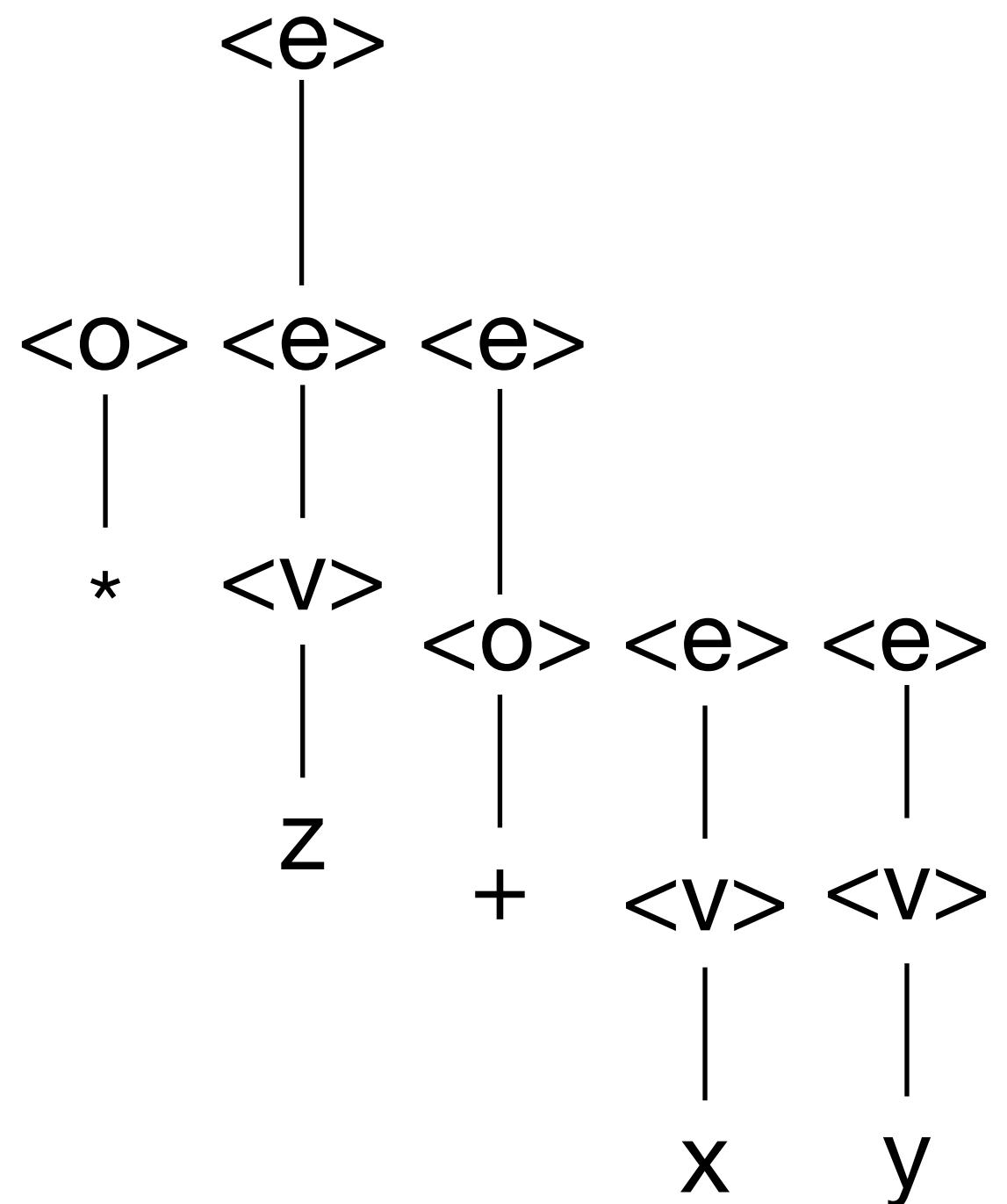
- GE version of Ramped Half and Half
  - Choose desired depth (**of derivation tree**)
  - Grow until desired size
  - $\langle e \rangle := \langle o \rangle \langle e \rangle \langle e \rangle$  [1 from 2 choices]
  - $\langle o \rangle := *$  [2 from 4 choices]
  - $\langle e \rangle := \langle v \rangle$  [0 from 2 choices]
  - $\langle v \rangle := z$  [2 from 3 choices]
  - $\langle e \rangle := \langle o \rangle \langle e \rangle \langle e \rangle$  [1 from 2 choices]
  - $\langle o \rangle := +$  [0 from 4 choices]
  - $\langle e \rangle := \langle v \rangle$  [0 from 2 choices]
  - $\langle v \rangle := x$  [0 from 3 choices]
  - $\langle e \rangle := \langle v \rangle$  [0 from 2 choices]
  - $\langle v \rangle := y$  [1 from 3 choices]

```
<e> := <v> | <o> <e> <e>
<o> := + | - | * | /
<v> := x | y | z
```



# Sensible Initialisation

- [1 from 2 choices]
- [2 from 4 choices]
- [0 from 2 choices]
- [2 from 3 choices]
- [1 from 2 choices]
- [0 from 4 choices]
- [0 from 2 choices]
- [0 from 3 choices]
- [0 from 2 choices]
- [1 from 3 choices]



# Sensible Initialisation

- Good spread of sizes
- Can introduce a left or right handed bias
  - Depending on when the depth is measured

# Position Independent Grow

- Variant of Sensible Initialisation
- Non-recursive
- Algorithm
  - Start symbol
  - Randomly select non-terminal to map

# Position Independent Growth

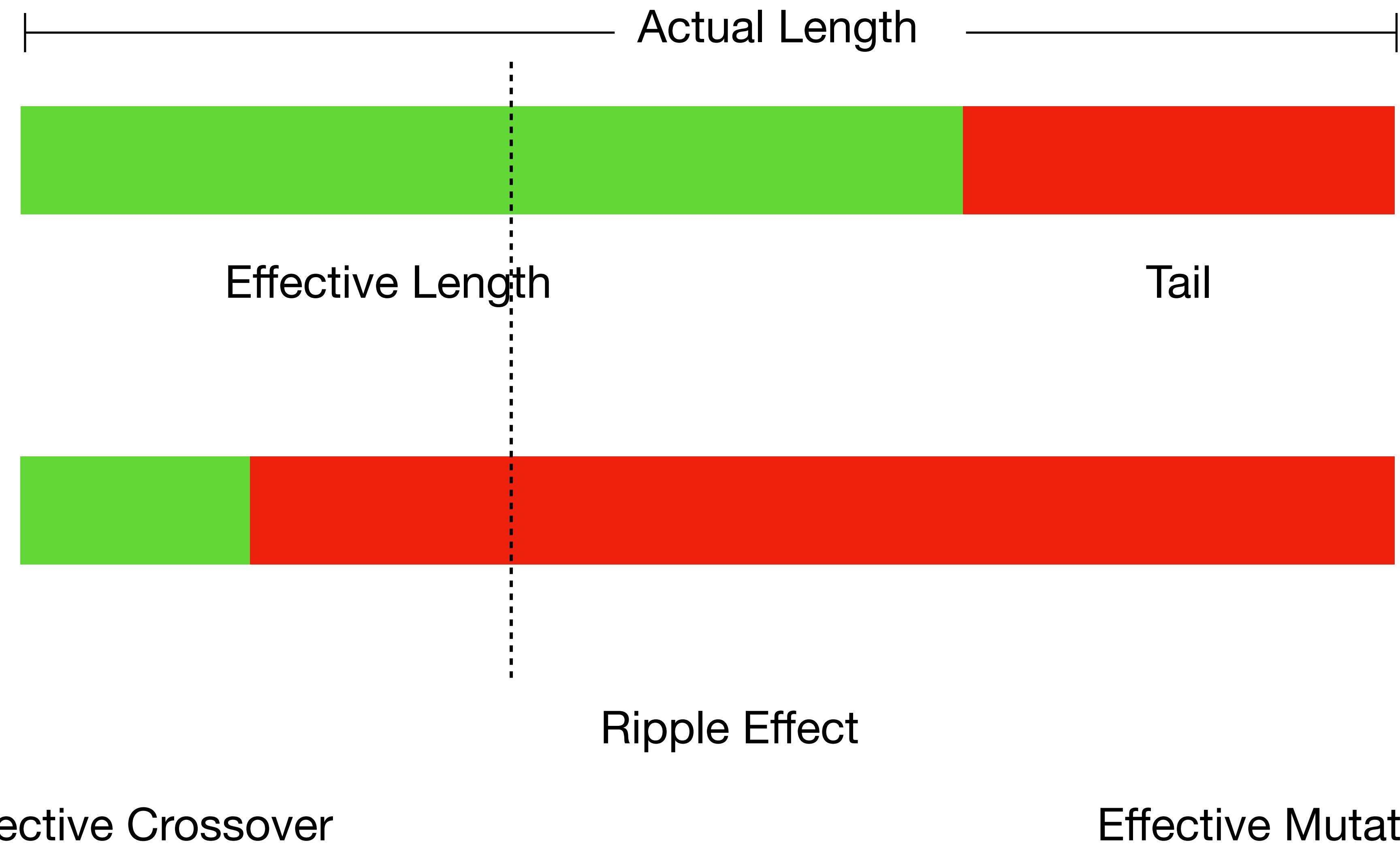
- 1. [ $\langle e \rangle$ ]
- 2. [ $\langle e \rangle, \langle o \rangle, \langle e \rangle$ ]
- 3. [ $\langle e \rangle, - , \langle e \rangle$ ]
- 4. [ $\langle e \rangle, - , \langle v \rangle$ ]
- 5. [ $\langle e \rangle, - , Y$ ]
- 6. [ $\langle e \rangle, \langle o \rangle, \langle e \rangle, - , Y$  ]
- 7. [ $\langle v \rangle, \langle o \rangle, \langle e \rangle, - , Y$  ]
- 8. [ $\langle v \rangle, \langle o \rangle, \langle v \rangle, - , Y$  ]
- 9. [ $\langle v \rangle, \langle o \rangle, Y, - , Y$  ]
- 10. [ $\langle v \rangle, - , Y, - , Y$  ]
- 11. [ $X, - , Y, - , Y$  ]

```
 $\langle e \rangle := \langle v \rangle \mid \langle e \rangle \langle o \rangle \langle e \rangle$ 
 $\langle o \rangle := + \mid - \mid * \mid /$ 
 $\langle v \rangle := x \mid y \mid z$ 
```

# Position Independent Growth

- Better balance of trees
- Simpler implementation

# Genome use



# Genome use

Actual Length

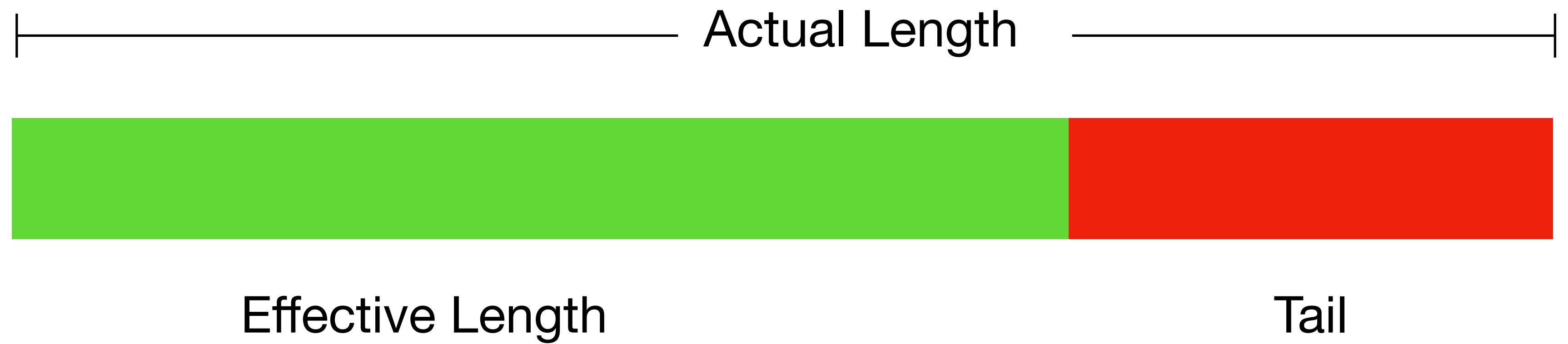


Effective Length

Wrapping

Invalid Individuals

# Genome use



# Implementing GE

- Initialisation
- Position Independent Grow
- Sensible crossover/mutation
- Read training data from files
- Maintain separate training and test data