

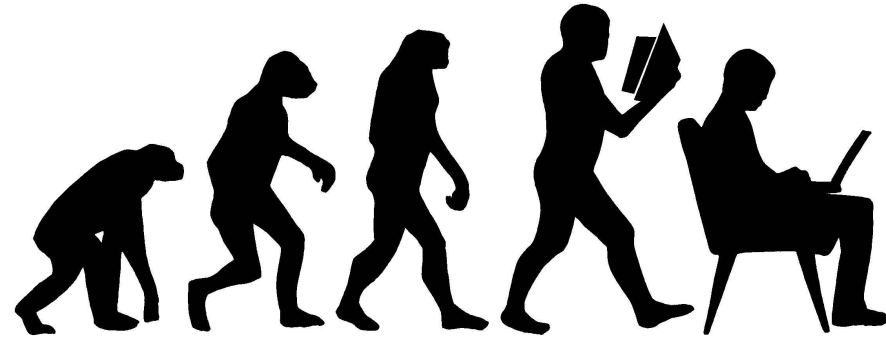


BetterKey: Keyboard Optimization using Genetic Algorithms

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Finding Best Keyboard Layout for Hand Positions

How the GA works



- Based on theory of evolution
- We initially generate randomized 10 organism
 - Balance between diversity + number of generations
- Over time, algorithm finds “most fit” organisms through breeding and mutating

Weights: two hands

1.75	2.0	1.5	1.25	1.25	1.25	1.25	1.5	2.0	1.75				
*	*	*	*	1.25		1.25		*	*	*	*		
1.0	1.0	1.0	1.0	1.25	1.25	1.0	1.0	1.0	1.0	1.0	1.75		
1.75		2.0	1.5	1.25	1.25	1.25	1.25	1.5	2.0	1.75			

Example Weight Distribution for two-handed typing

Weights: left hand only

2.25	2.0	1.75	1.75	2.0	1.5	1.25	1.25	1.5	1.75				
2.25		2.0	1.75	*	1.0	*	1.0	*	1.0	1.25	1.5	1.75	2.5
2.25		2.0	1.75	1.75	2.0	1.5	1.25	1.25	1.5	1.75			

Weights: right hand only

1.75	1.5	1.25	1.25	1.5	2.0	1.75	1.75	2.0	2.25			
1.75		1.5	1.25	*	*	*	*	1.75	2.0	2.25	2.25	
		1.75	1.5	1.25	1.25	1.5	2.0	1.75	1.75	2.0	2.25	

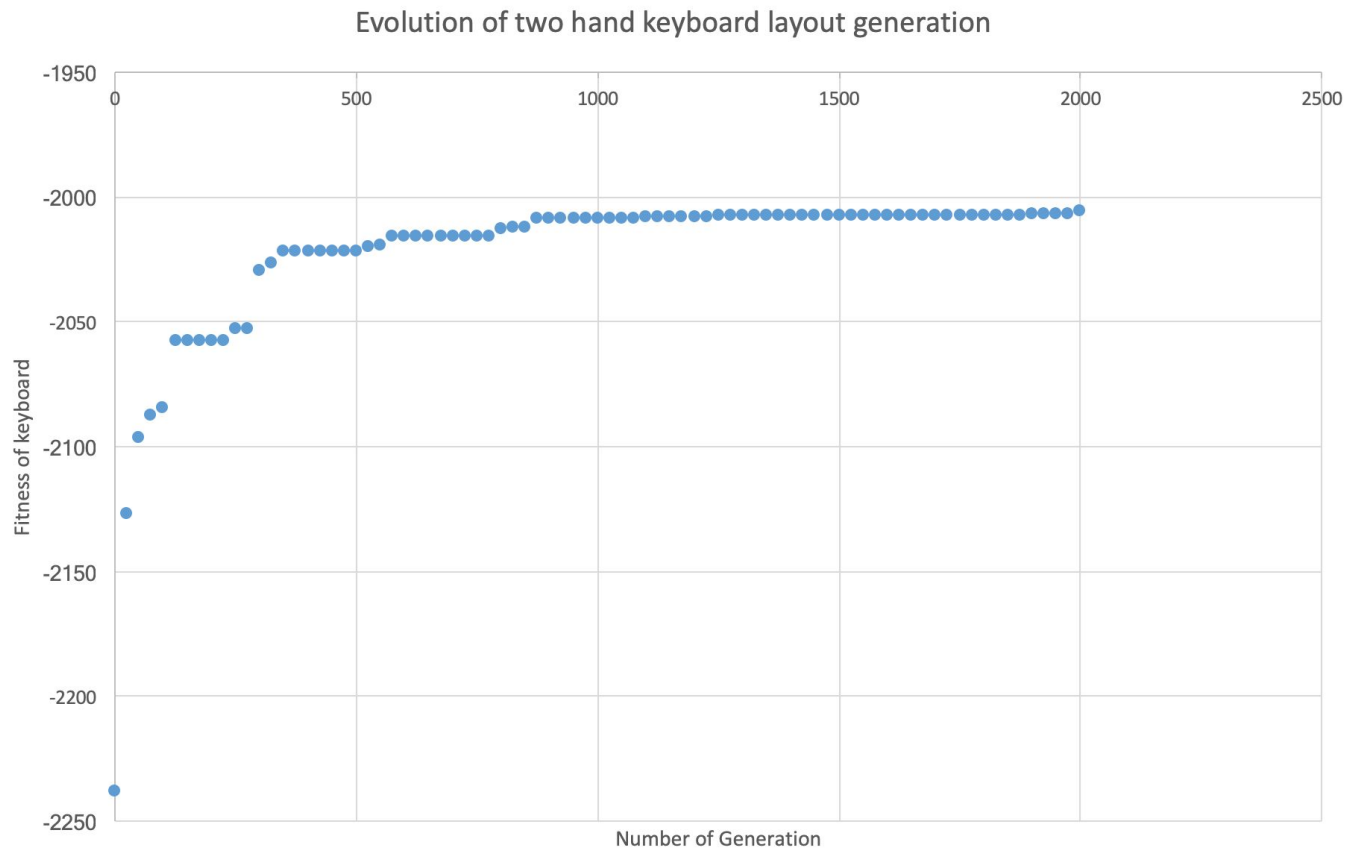
Weights: one finger only (pointer/thumb)

2.25	2.0	1.75	1.5	1.25	1.25	1.5	1.75	2.0	2.25		
2.25		2.0	1.75	1.5	1.25	1.0 [*]	1.25	1.5	1.75	2.0	2.25
		2.25	2.0	1.75	1.5	1.25	1.25	1.5	1.75	2.0	2.25

Weights: two fingers only (pointers/thumbs)

[illegible]

GA in Action



Two-handed keyboard fitness evolution (QWERTY: -2360.6, DVORAK: -2100)

Keyboards Designed

Generation: 2000

Number of organisms: 10

Start fitness: -2588.2475

Best fitness: -2005.5025

z	x	y	m	w	g	d	,	j	k	
*	*	*	*			*	*	*	*	
i	o	n	s	l	u	h	a	t	e	'
	.	q	b	c	f	p	r	v	/	;

Ideal 2-handed computer keyboard (QWERTY: -2360)

Generation: 2000

Number of organisms: 10

Start fitness: -3029.205

Best fitness: -2290.695

z	/	c	p	x	l	h	n	d	f	
			*	*	*	*				
;	k	y	a	t	i	e	r	u	.	j
	q	v	g	,	'	m	o	s	w	b

Generation: 2000

Number of organisms: 10

Start fitness: -2942.3775

Best fitness: -2296.3825

g	u	d	n	m	'	c	k	z	x		
b		l	h	*a	*t	*i	*e	f	.	j	;
	,	w	s	o	r	v	y	p	/	q	

Ideal Left/Right handed computer keyboard (QWERTY: -2868/-2745)

Generation: 2000

Number of organisms: 10

Start fitness: -3161.5275

Best fitness: -2471.0175

'	k	w	r	s	t	u	y	.	;		
j	z	g	m	o	*	e	i	l	p	,	x
q	b	f	h	n	a	d	c	v	/		

Generation: 2000

Number of organisms: 10

Start fitness: -2587.1075

Best fitness: -2164.395

j	,	r	l	a	d	n	c	b	x	
'	p	u	*t	y	f	*e	i	v	/	q
;	.	w	o	m	g	s	h	k	z	

Ideal mobile keyboard (QWERTY: -2904, -2379)

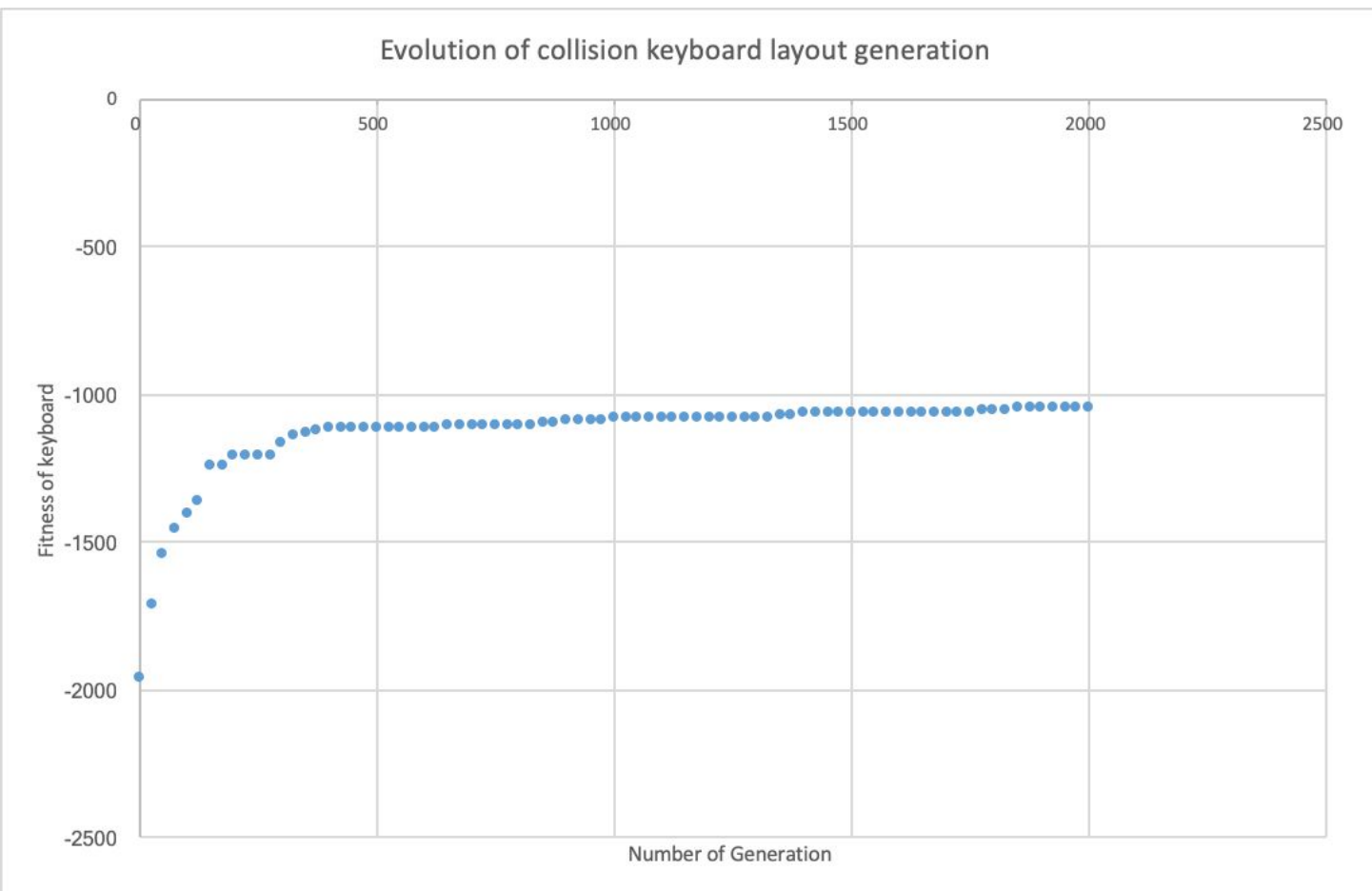
Typo Avoidance

What is a collision?

```
a
aa
aaa
aaron
ab
abandoned
abc
aberddeen
abilities
ability
able
aboriginal
abortion
about
above
abraham
abroad
abs
absence
absent
absolute
absolutely
absorption
abstract
abstracts
abu
abuse
ac
academic
academics
academy
acc
accent
accept
acceptable
acceptance
accepted
accepting
accepts
access
accessed
accessibility
accessible
accessing
accessories
accessory
```

```
carl card
carlo cargo
caroline carolina
carrier barrier
carrier carried
carries carrier
carry carey
cars carb
cars carl
cart carb
cart care
cart carl
cart cars
cas cab
cas cal
cas can
cas cap
case cake
case came
case cape
case casa
cases cakes
casey carey
cast case
cat cab
cat car
cattle battle
causes caused
cave came
cave care
cave case
cb ab
cbs bbs
cc ac
cc ca
cd ad
cd bd
```

Orthographic neighbors created from the dictionary



Collision fitness graph (QWERTY: -2590)

Generation: 4000

Number of organisms: 10

Start fitness: -2528.0

Best fitness: -1047.0

l	y	c	j	n	p	u	d	w	r				
g	.	k	z	/	,	'	x	q	;	s			
e		b	o	f	a	t	v	h	m	i			

(QWERTY: -2590)

Here, fitness is defined by number of collisions (mistypes where replacing letter is within 1 range in keyboard)