

# 21 years of R/qtl

maintaining, supporting, and sustaining  
scientific software

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[kbroman.org](http://kbroman.org)

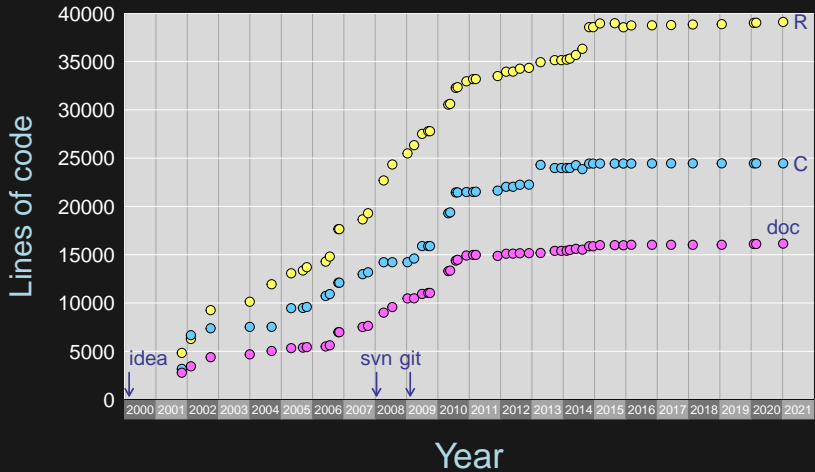
[github.com/kbroman](https://github.com/kbroman)

@kbroman

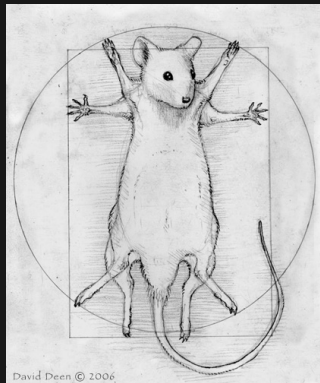
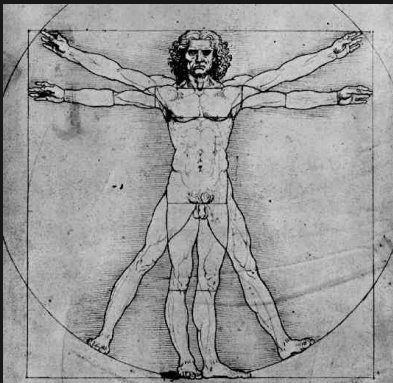
Slides: [bit.ly/pitt2021](https://bit.ly/pitt2021)



# 21 years of R/qtl

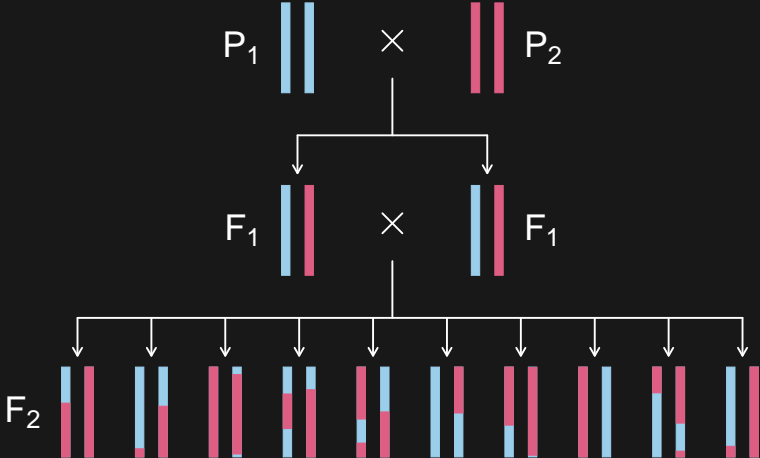




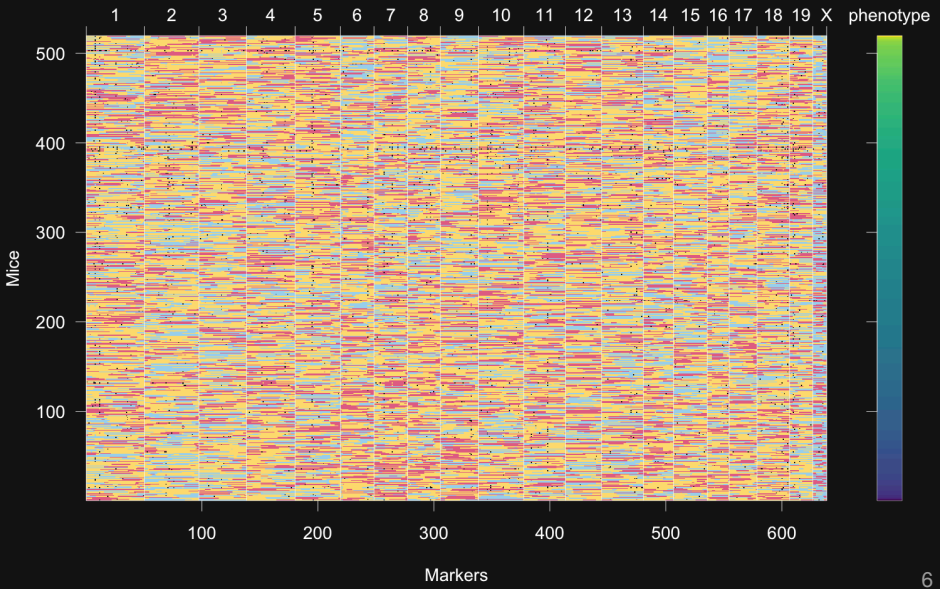


daviddeen.com

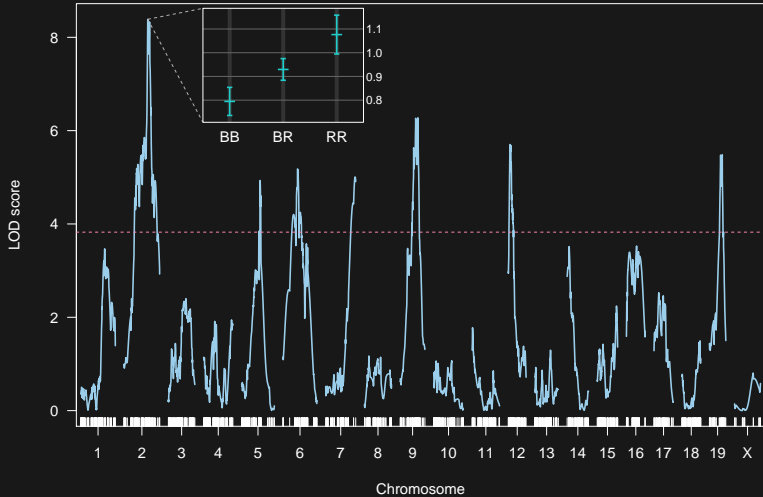
# Intercross



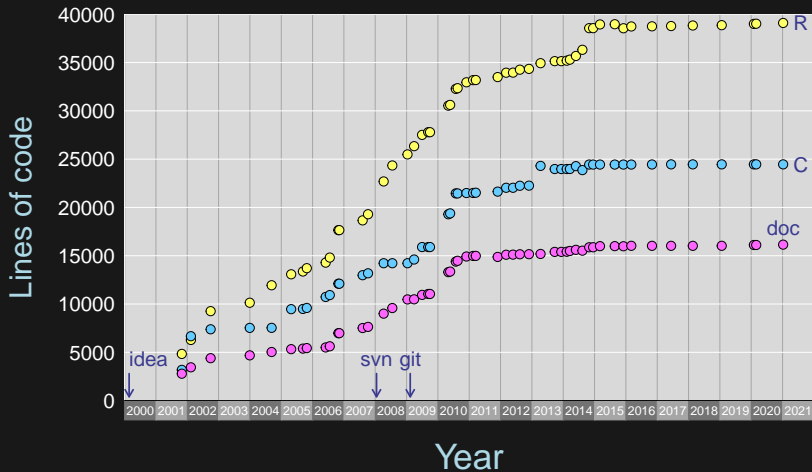
# Data



# QTL mapping



# 21 years of R/qtl



Why?

Good things

# Good things

- ▶ some of the code
- ▶ basics of the user interface
- ▶ diagnostics and data visualization
- ▶ quite comprehensive
- ▶ quite flexible

# Bad things

# Input file

	A	B	C	D	E	F	G	H	I
1	liver	spleen	sex	pgm	D1Mit18	D1Mit80	D1Mit17	D2Mit379	D2Mit75
2					1	1	1	2	2
3					27.3	51.4	110.4	38.3	48.1
4	61.92	153.16	m	1	BB	SB	SB	SB	SB
5	88.33	178.58	m	1	-	-	-	BB	BB
6	58	131.91	m	1	BB	SB	SB	SB	SB
7	78.06	126.13	m	1	SB	SB	BB	SS	SS
8	65.31	181.05	m	1	-	-	-	SB	SB
9	59.26	191.54	m	1	-	-	-	SS	SS
10	59.47	154.88	m	1	BB	BB	BB	SB	SB
11	65.63	184.12	m	1	-	-	-	SB	SB
12	38.64	133.05	m	1	SB	BB	SB	SB	SB
13	60.94	275.63	m	1	-	-	-	SB	BB
14	51.48	395.25	m	1	-	-	-	SB	BB
15	47.12	260.45	m	1	BB	SB	SB	BB	BB

# Stupidest code ever

```
n <- ncol(data)
temp <- rep(FALSE,n)
for(i in 1:n) {
  temp[i] <- all(data[2,1:i]=="")
  if(!temp[i]) break
}
if(!any(temp)) stop("...")
n.phe <- max((1:n)[temp])
```

[kbroman.org/blog/2011/08/17/the-stupidest-r-code-ever](http://kbroman.org/blog/2011/08/17/the-stupidest-r-code-ever)

Open source means  
everyone can see my stupid mistakes

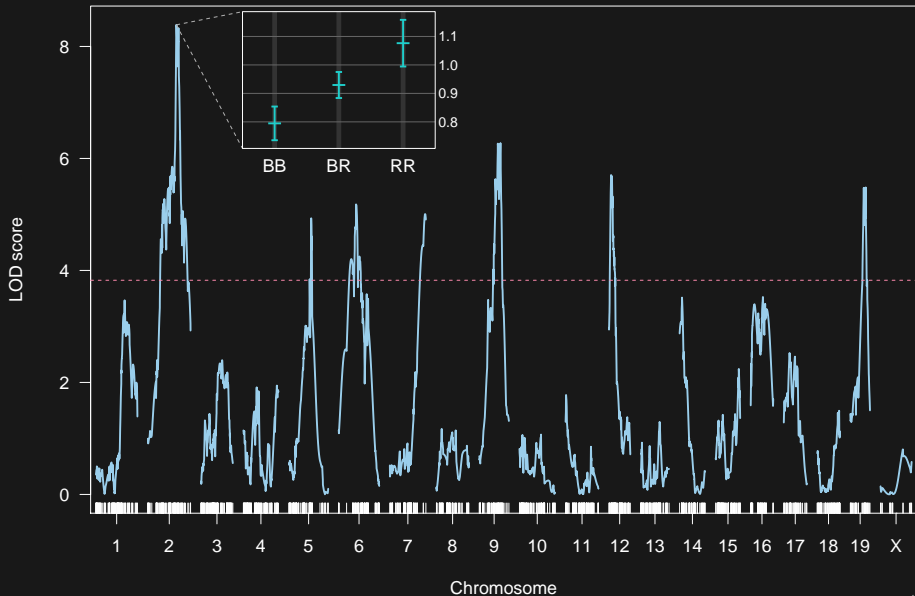
Open source means  
everyone can see my stupid mistakes

Version control means  
everyone can see every stupid mistake I've ever  
made

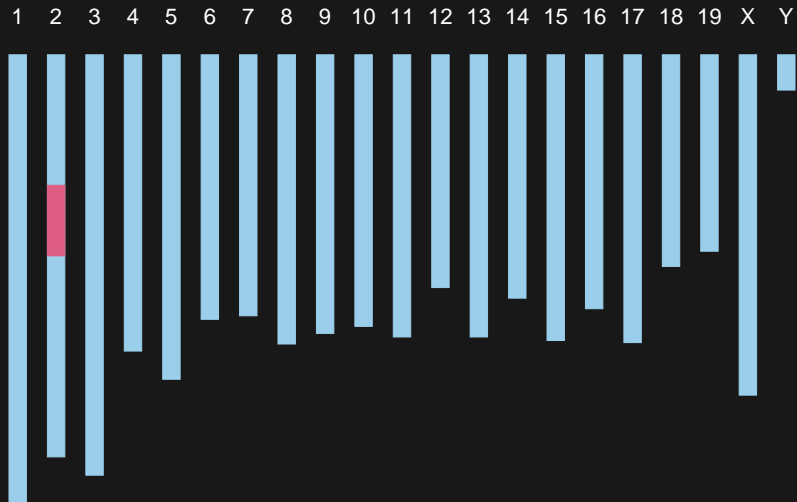
# Documentation

# Support

# QTL mapping



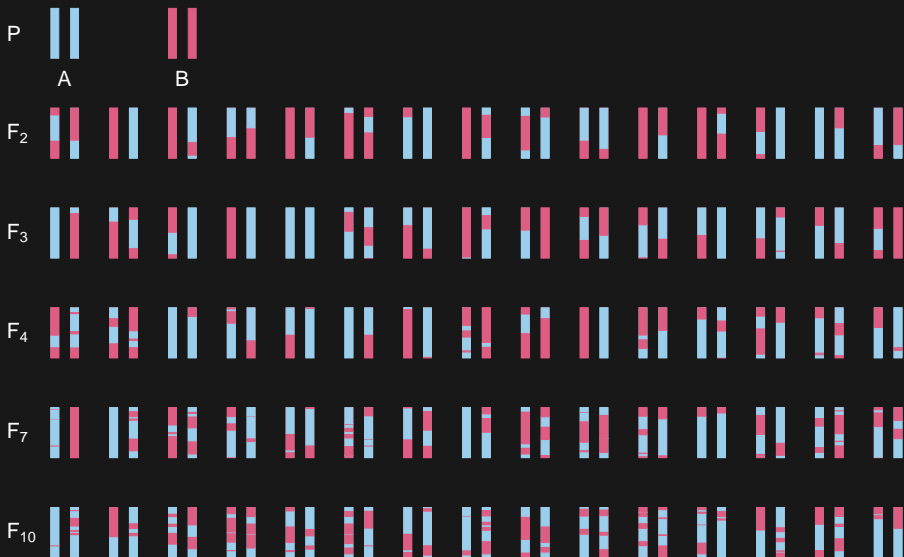
# Congenetic line



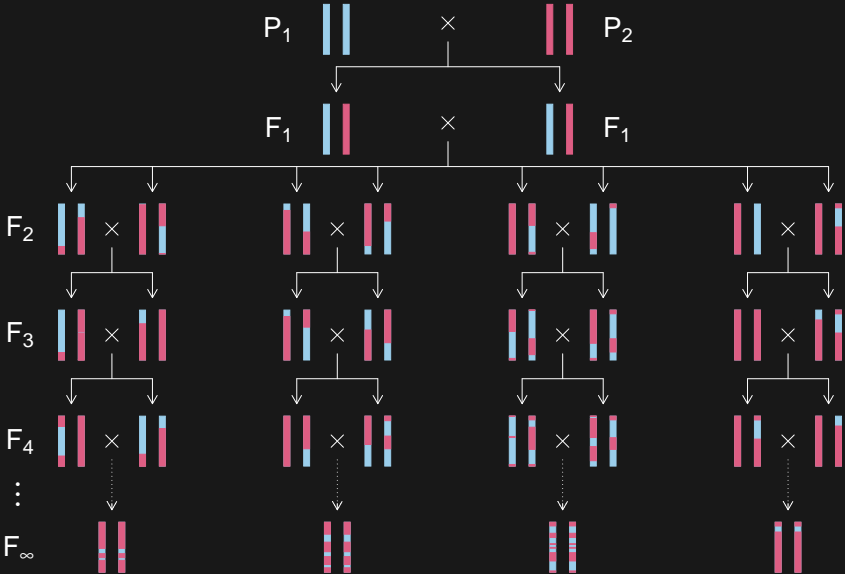
# Improving precision

- ▶ more recombinations
- ▶ more individuals
- ▶ more precise phenotype
- ▶ lower-level phenotypes
  - transcripts, proteins, metabolites

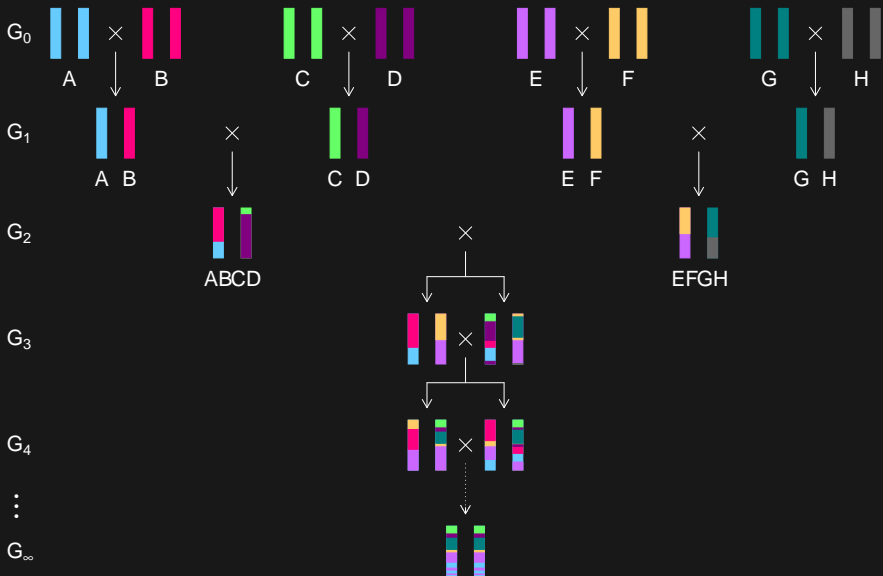
# Advanced intercross lines



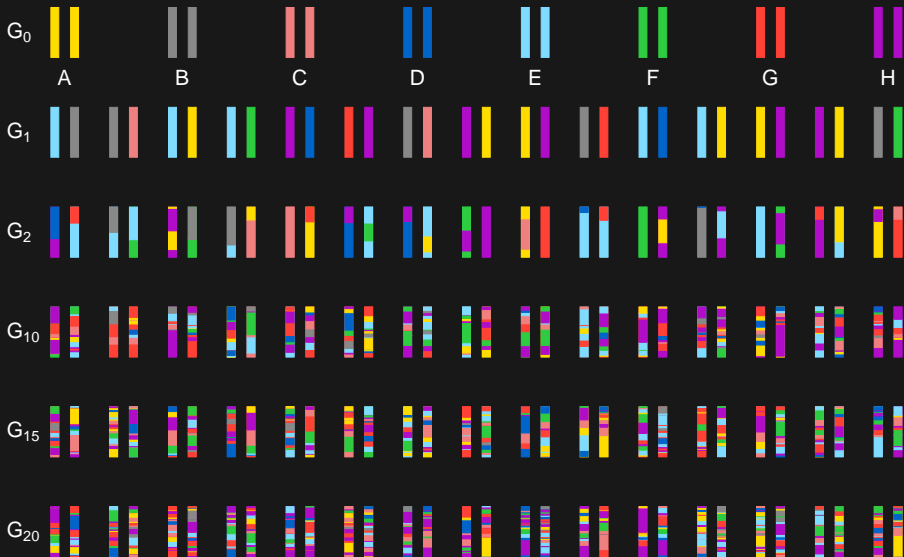
# Recombinant inbred lines



# Collaborative Cross



# Heterogeneous stock

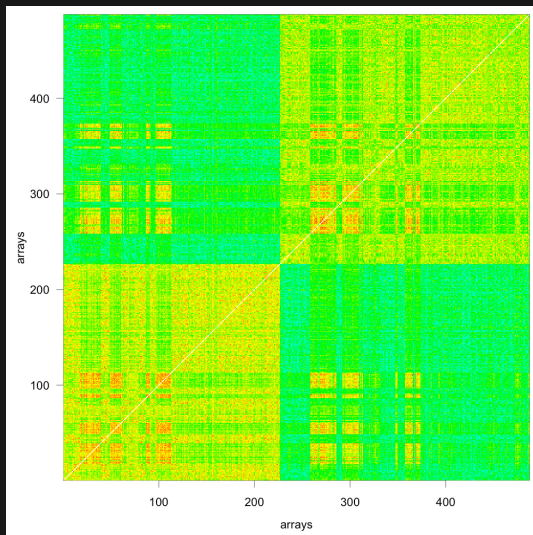


# Genome-scale phenotypes



Alan Attie

# Challenges: diagnostics



# Challenges: scale of results

genotypes

phenotypes

# Challenges: scale of results

genotypes

phenotypes

results

# Challenges: organizing, automating

genotypes

phenotypes

# Challenges: organizing, automating

genotypes

phenotypes

# Challenges: organizing, automating

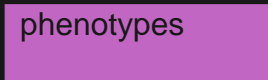
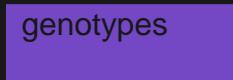
genotypes

phenotypes

# Challenges: organizing, automating

genotypes

phenotypes

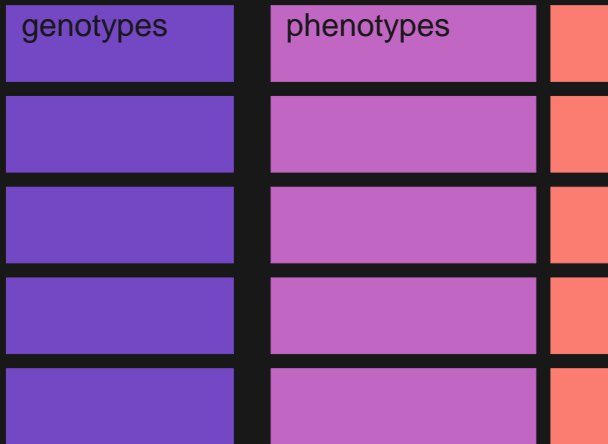


# Challenges: organizing, automating

genotypes

phenotypes

# Challenges: organizing, automating



# Challenges: organizing, automating

genotypes	phenotypes		

# Challenges: metadata

What the heck is "FAD\_NAD SI 8.3\_3.3G"?

What was the question again?



# R/qtl2

- ▶ High-density genotypes
- ▶ High-dimensional phenotypes
- ▶ Multi-parent populations
- ▶ Linear mixed models

[kbroman.org/qtl2](http://kbroman.org/qtl2)

## R/qt12: Let's not make the same mistakes

- ▶ C++ and Rcpp
- ▶ Roxygen2 for documentation
- ▶ Unit tests
- ▶ A single “switch” for cross type

## R/qt12: Let's not make the same mistakes

- ▶ C++ and Rcpp
- ▶ Roxygen2 for documentation
- ▶ Unit tests
- ▶ A single “switch” for cross type
- ▶ Yet another data input format
- ▶ Flatter data structures, but still complex

# Sustainable academic software

# Acknowledgments

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Rohan Shah

Laura Shannon

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NIH/NIGMS

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[kbroman.org](https://kbroman.org)

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