

GitHub

harry potter - Google Search

Black-Box-Testing-QAInsights.png 795x422 pixels

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Another Complicated way to do Kalman Filter and MCMC

Google Search

I'm Feeling Lucky

Google.ca offered in: Français

By : Kain & Li

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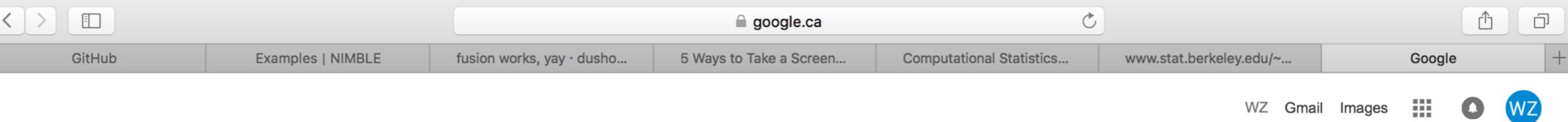
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# What is Nimble? Anyone know???

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**Some Contact Management Thing**

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## Some Data Storage Thing

Google search results for "Nimble" showing 13,900,000 results. The results are organized into three main sections:

- 1. quick and light in movement; moving with ease; agile; active; rapid:**
- 2. quick to understand, think, devise, etc.:**
- 3. cleverly contrived:**

**Section 1 (Top Results):**

- Nimble**  
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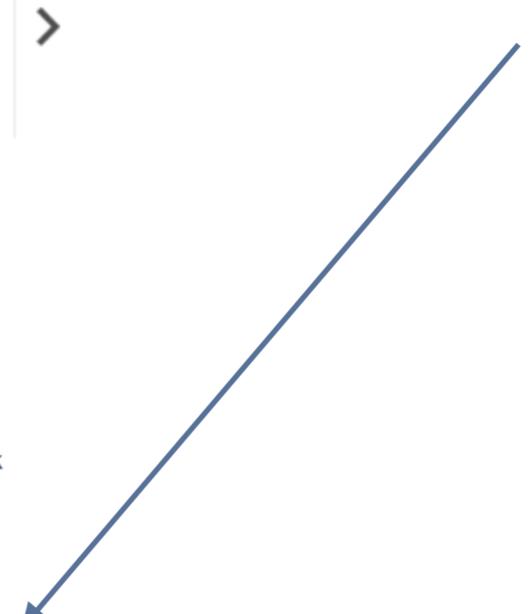
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A screenshot of a Google search results page for the query "Nimble". The results include:

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What we actually want  
(come on google)



# NIMBLE

An R package for programming with BUGS models and compiling parts of R.

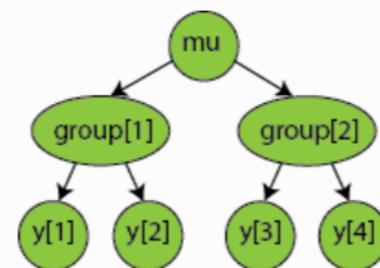
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[What is NIMBLE?](#)
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[Documentation](#)
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## NIMBLE

### Write statistical models in the BUGS language from R

NIMBLE adopts and extends BUGS as a modeling language and lets you program with the models you create.

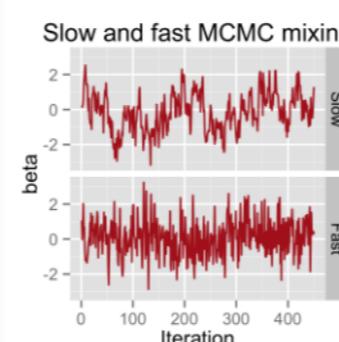
Other packages that use the BUGS language are only for Markov chain Monte Carlo (MCMC). With NIMBLE, you can turn BUGS code into model objects and use them for whatever algorithm you want. That includes algorithms provided with NIMBLE and algorithms you write using nimbleFunctions. NIMBLE extends BUGS by allowing multiple parameterizations for distributions, user-written functions and distributions, and more.



### Use and customize NIMBLE's statistical algorithms

NIMBLE provides MCMC, sequential Monte Carlo (particle filters), and more.

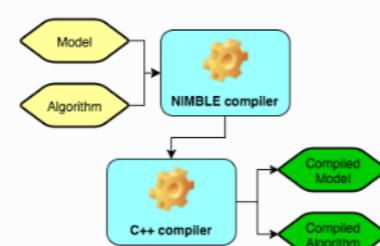
NIMBLE algorithms are written so they can adapt to different statistical models. For MCMC, NIMBLE can assign a default set of sampler choices, but you can customize the samplers from R. For example, you can choose what parameters to sample in a block, and you can easily write your own samplers and include them.



### Compile your models and algorithms for fast execution.

NIMBLE generates C++ code customized to your model and algorithms, compiles it, and lets you use it from R.

You don't need to know anything about C++ to use NIMBLE's compiler. NIMBLE provides R functions to call the compiled algorithms, and you get the output back in R. (You do need to have a

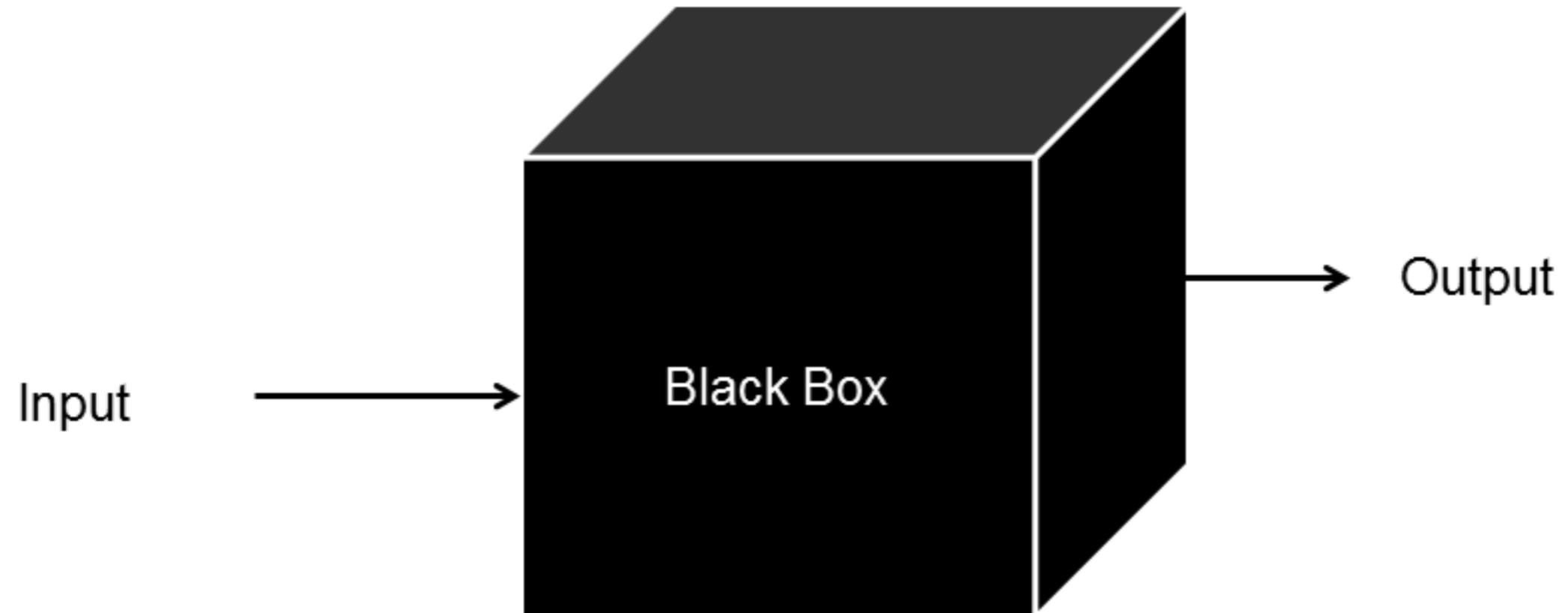


## News

Version 0.4-1 released!  
We have a post-doc opening.  
Version 0.4 released!

# Numerical Inference for stats Models for Bayesian Likelihood Estimate

To normal people,  
and some of you  
**(3 months ago, before taking this class),**  
**Nimble is a Black Box.**



*Internal behavior of the code is unknown*

**Sequential Monte Carlo  
Gaussian Quadrature  
Synthetic Likelihood**

**Kalman Filter**

**Data Cloning**

**GLMM**

**INLA**

**ABC**

**Your Idea**

**Your Favourite**

**Nimble  
Jags Wrapper  
Stan Caller  
MCEM  
PF**



**magicbox**

**WinBUGS    JAGS    Stan  
OpenBUGS    INLA    PyMC**

## Connecting the dots



+



=



If you think about it a little bit more ....



Nimbus 2000

~

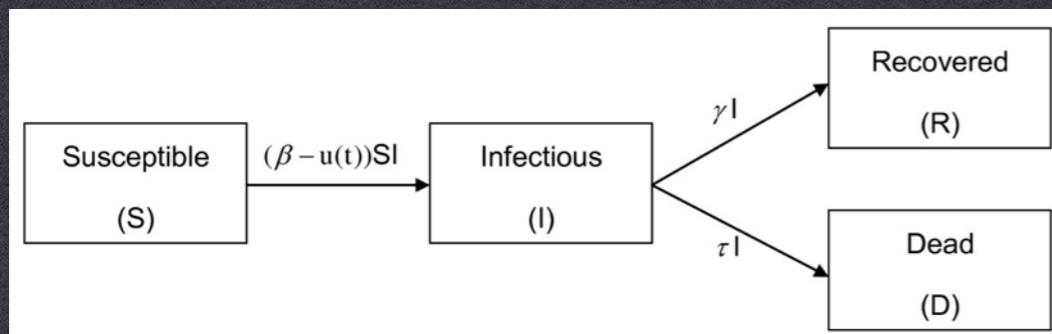
Firebolt

sounds like  
NIMBLE

What is the probability of that!!!

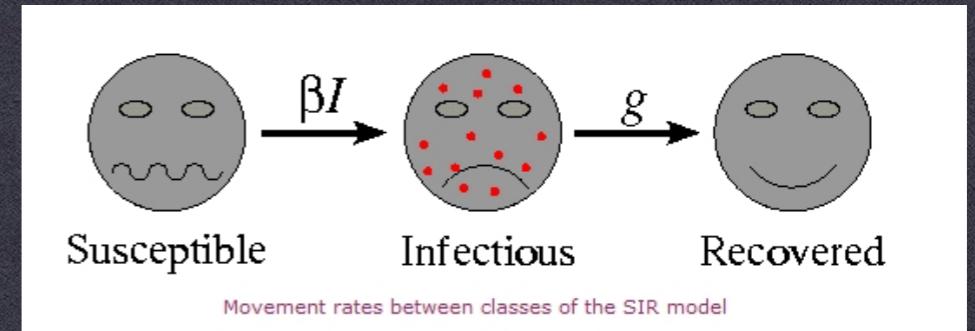
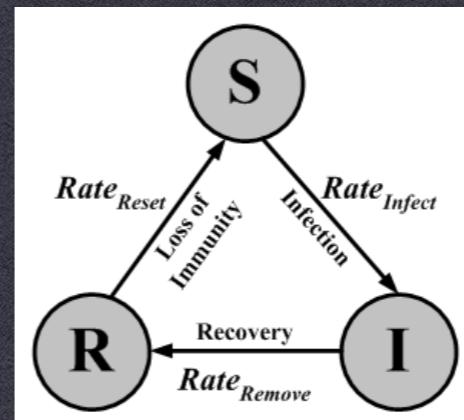
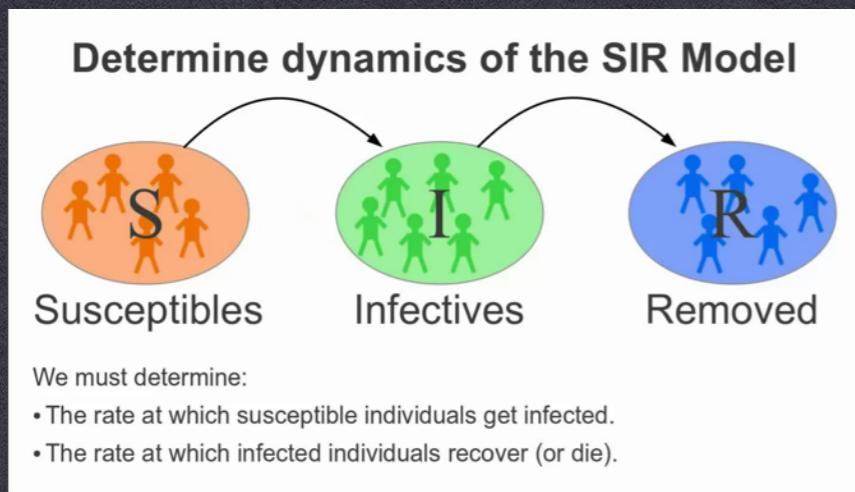
# REAL LIFE EXAMPLE

## The Infamous SIR MODEL

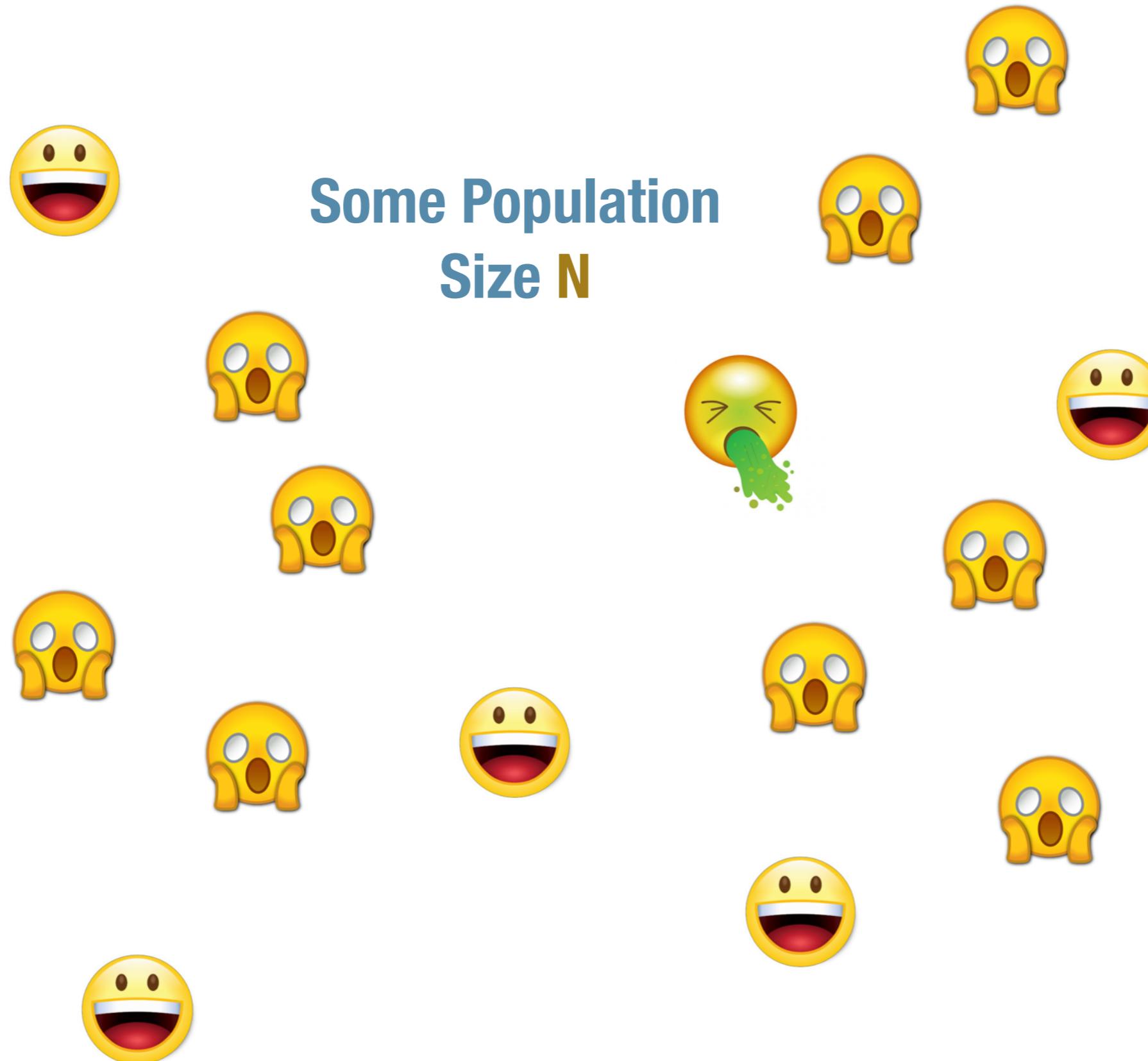


If you Google it

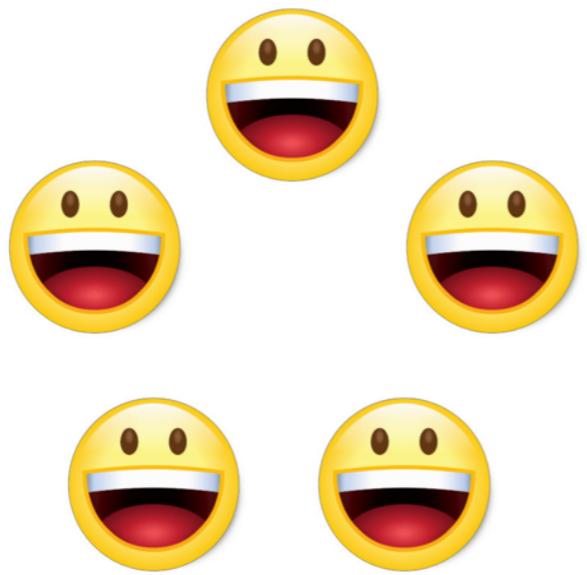
$$\begin{aligned}
 \frac{dS}{dt} &= -\beta \frac{SI}{N} - \nu S \\
 \frac{dI}{dt} &= \beta \frac{SI}{N} - \gamma I \\
 \frac{dR}{dt} &= \gamma I + \nu S \\
 N &= S + I + R
 \end{aligned}$$



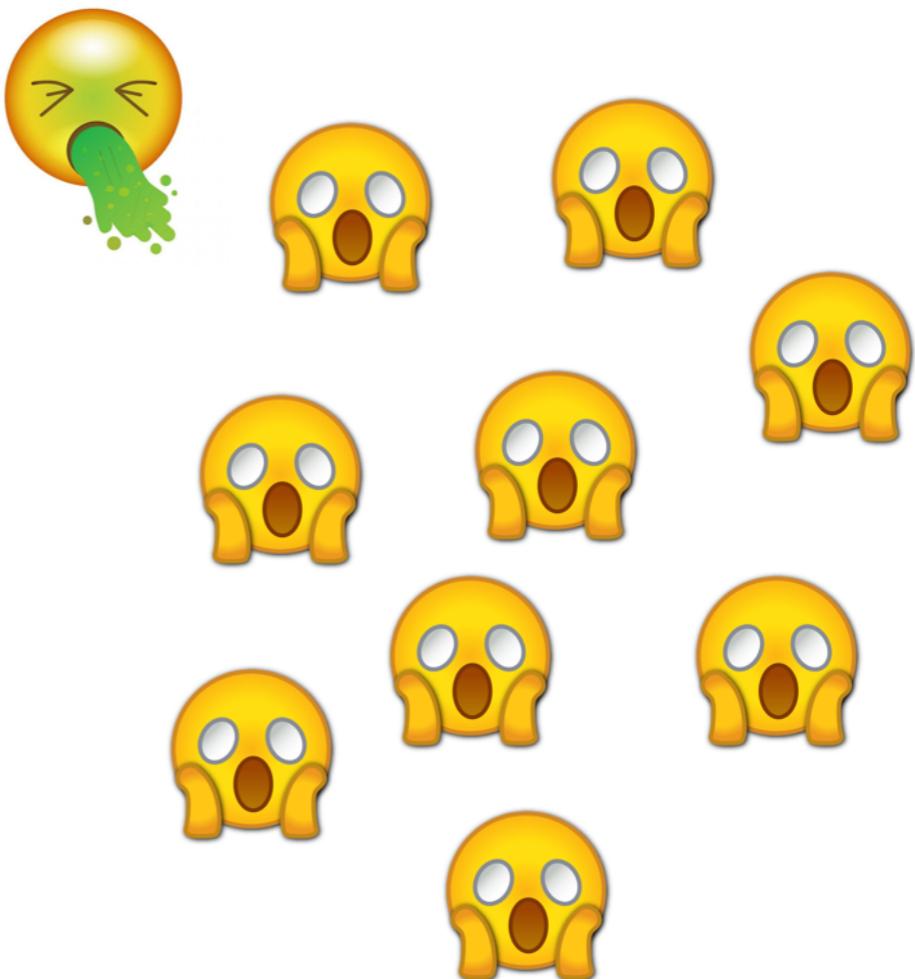
## Some Population Size N



Time 1



$N_0 \sim \text{Binomial}(\text{effprop}, N)$

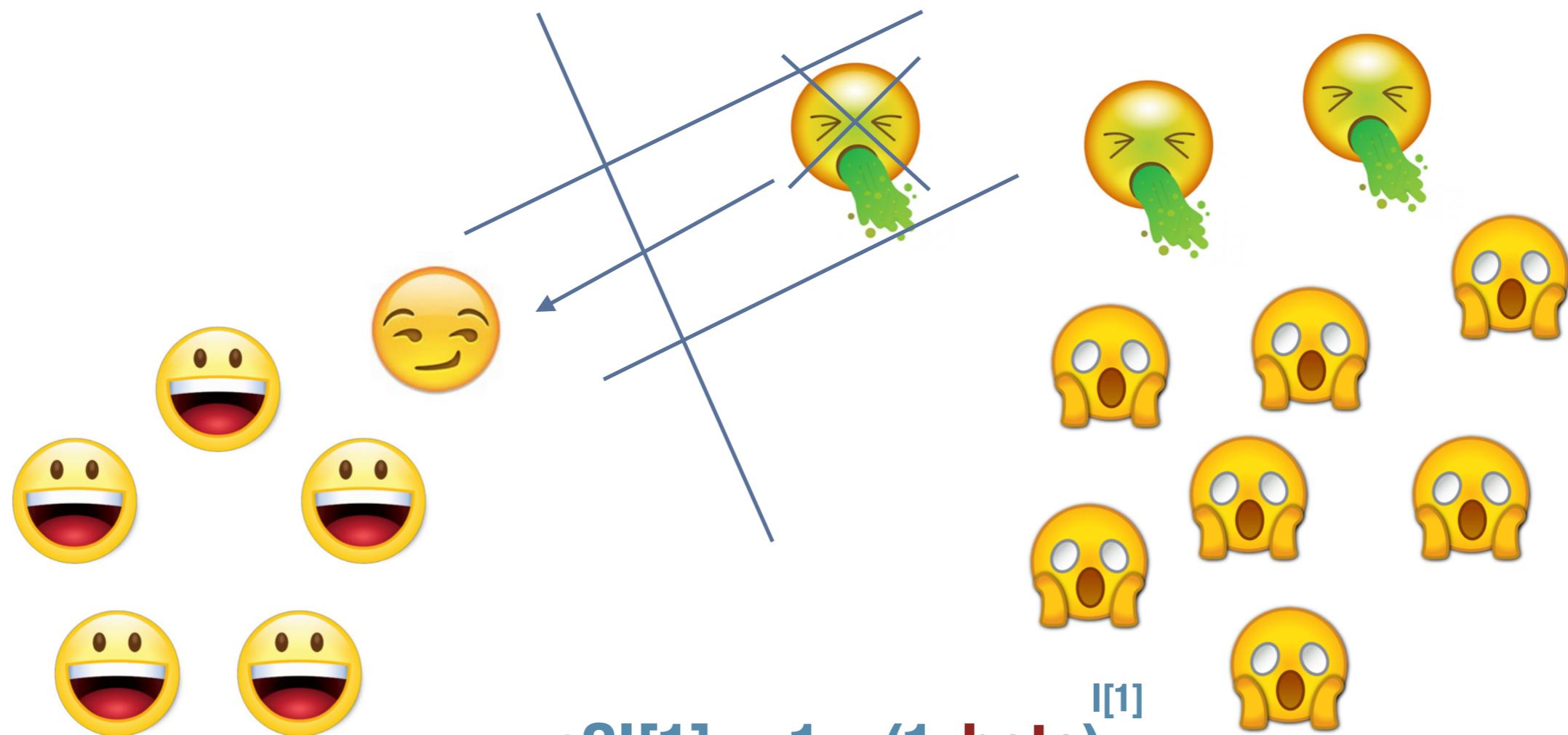


$$I[1] = 1$$

$$S[1] = N_0 - I[1]$$

Time 2

$$N_0 \sim \text{Binomial}(\text{effprop}, N)$$

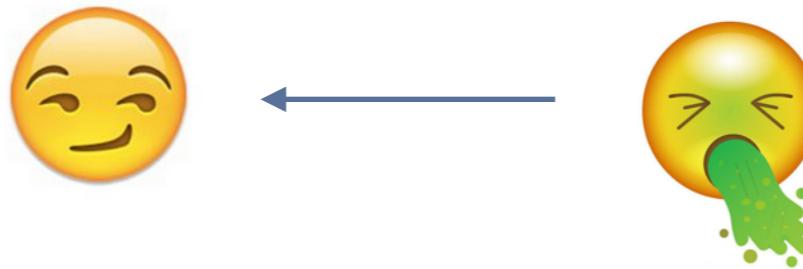


$$pSI[1] = 1 - (1-\beta)^{I^{[1]}}$$

$$I^{[2]} \sim \text{Binomial}(pSI[1], S^{[1]})$$

$$S^{[2]} = S^{[1]} - I^{[2]}$$

Time t



I[t-1]

$$pSI[t-1] = 1 - (1 - \beta)$$

$$I[t] \sim \text{Binomial}(pSI[t-1], S[t-1])$$

$$S[t] = S[t-1] - I[t]$$



$$I_{obs}[t] \sim \text{Binomial}(\text{reporting}, I[t])$$

# HOMEWORK

Already Provided:  
Simulator  
Source scripts



What you need to do

Complete the for  
loop Bugs code  
in nimCB.R  
and run NimbleCB.R

```
nimCB.R x
Source on Save | 🔎 | 🖊 | 📄
1 nimcode <- nimbleCode({
2   ##prior distributions
3   reporting ~ dunif(0,1)
4   effprop ~ dunif(0,1)
5   beta ~ dunif(0,0.1)
6
7   N0 ~ dbin(effprop,N)
8
9
10  I[1] ~ dbin(1,i0) ##hack to make sure you get at least 1 infectious
11  S[1] <- N0 - i0
12  pSI[1] <- 1 - (1-beta)^I[1]
13  obs[1] ~ dbin(reporting,I[1])
14
15  for(t in 2:numobs){
16    #Write your code here
17    ##only 4 lines of code |
18  }
19
20
21 })
```

If you are going to do it  
and run into trouble, feel free  
to email me @ [lim88@mcmaster.ca](mailto:lim88@mcmaster.ca)  
or FB message me if we are friends =P



2 Nimble  
2 Nimbus

MC  
MC

2 Fast  
2 Furious

# ESS (Effective Sample Size) Efficiency

**ESS gives an estimate of the equivalent number  
of independent iterations that the chain represents  
... (human words: The bigger the better)**

**Efficiency = ESS/run time**

**The Bigger and Faster guy wins**



**“I live my life a quarter mile at a time. Nothing else matters:...” (Toretto, 2001)**

# Results



```
> print(NimbleCB$timing)
      jags      nimble  nimble_slice nimble_compile
      1.103      0.444       0.489        15.117

> print(NimbleCB$summary)
, , beta

              mean     median         sd   CI95_low   CI95_upp     n      ess efficiency
jags      0.02002162 0.01998765 0.001042069 0.01805050 0.02214587 8000 4636.721    4203.736
nimble    0.01971684 0.01971859 0.001015840 0.01776498 0.02173398 8000 1857.813    4184.263
nimble_slice 0.01987158 0.01983412 0.001059173 0.01786280 0.02207397 8000 6368.528    13023.574

, , reporting

              mean     median         sd   CI95_low   CI95_upp     n      ess efficiency
jags      0.7942034 0.7941767 0.01423383 0.7657995 0.8215677 8000 8000.000    7252.947
nimble    0.7941798 0.7950333 0.01445057 0.7653739 0.8218682 8000 1740.477    3919.993
nimble_slice 0.7933654 0.7937981 0.01410362 0.7647034 0.8199006 8000 7671.756    15688.662

, , effprop

              mean     median         sd   CI95_low   CI95_upp     n      ess efficiency
jags      0.7995475 0.7999378 0.01265429 0.7740650 0.8231657 8000 8000.000    7252.947
nimble    0.7997403 0.7996030 0.01208927 0.7755943 0.8234183 8000 2000.929    4506.597
nimble_slice 0.8002278 0.8003495 0.01286927 0.7746506 0.8255620 8000 8740.990    17875.234
```

Real life  
More than 3 compartments  
lots of complexity  
need speed

