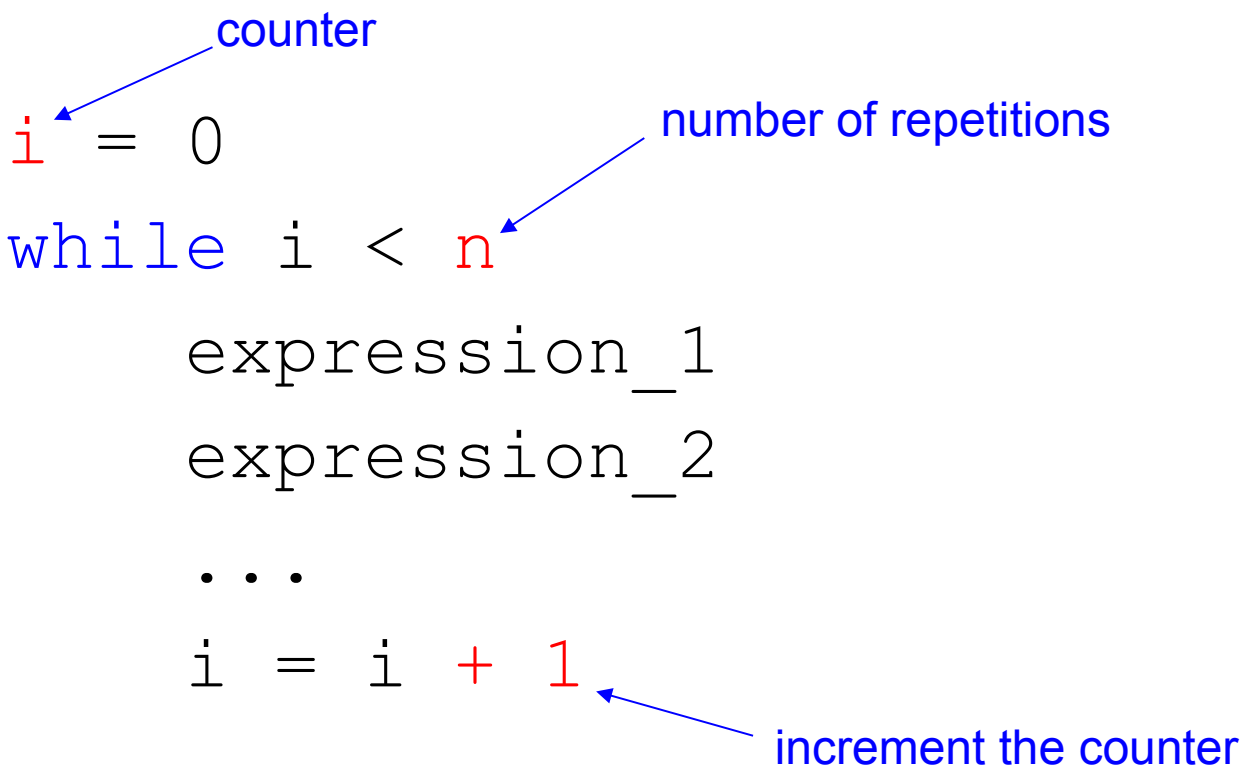
Announcements

- Solutions to problem set in your repo
- Git: main or master?
- EBIO picnic
- Counters from zero

while repetition structure

- Counter controlled repetition



Today

- A little art of modeling
- Modeling with repetition structures
- Data generating process

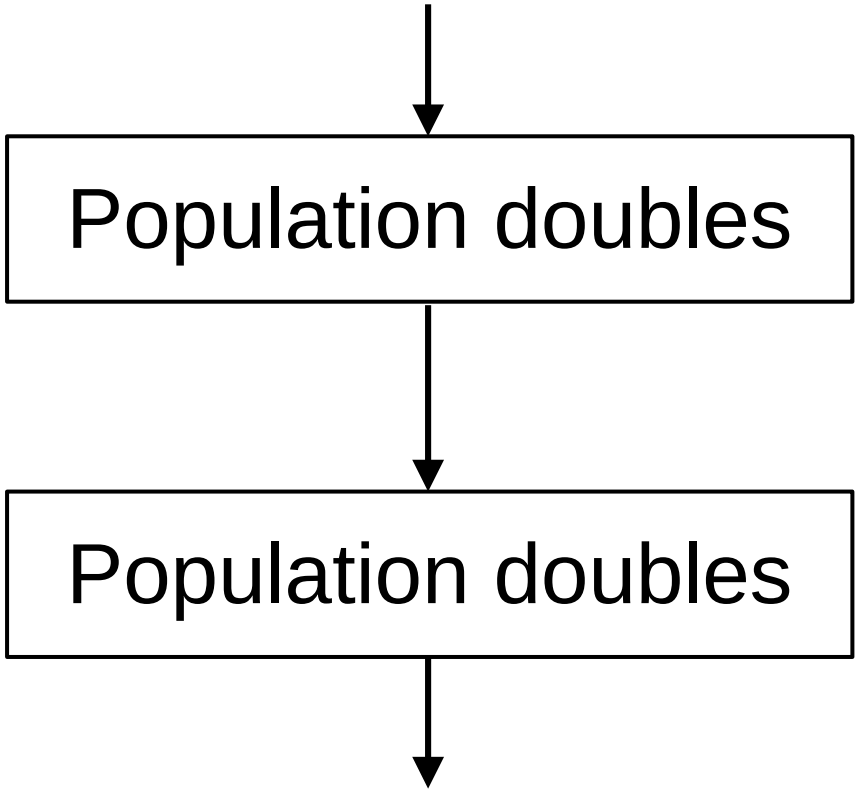
Art of modeling

- "What happens next?" thinking
- First this happens
- then that happens
- = algorithm

What happens next?

Event sequence diagram

03_9_code_thu.py



What happens next?

Event sequence diagram

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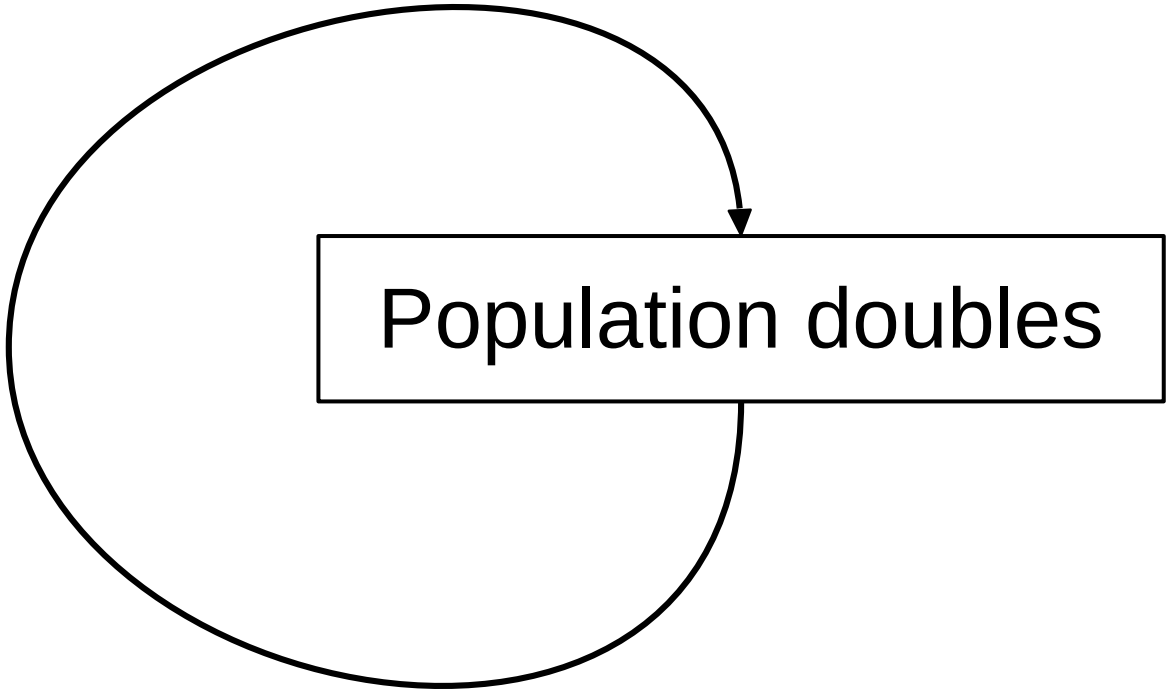


Art of modeling

- How much detail?
  - abstract, simplify
  - assumptions
- e.g. doubling population
  - decided to skip over births, deaths, processes per individual etc
  - timescale = generation

What happens next?

Event sequence diagram

Include births & deaths

Imagine: house finch

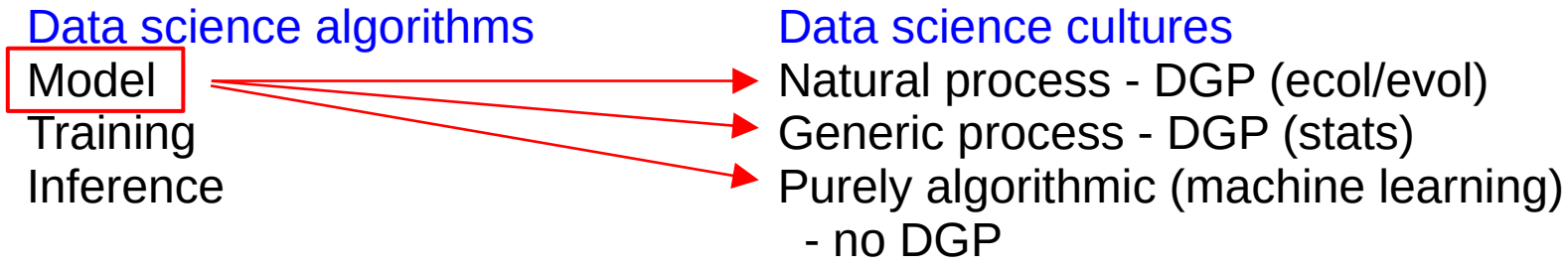
Jim Merrit celebrateurbanbirds.org

Where do data come from?

- Data generating process
- An actual physical process involving fundamental particles of the universe
- Includes
  - ecological/evolutionary process
  - observing process

Data generating process

- Key to scientific understanding
  - How does the system work?
- How to model the DGP?



Data generating process

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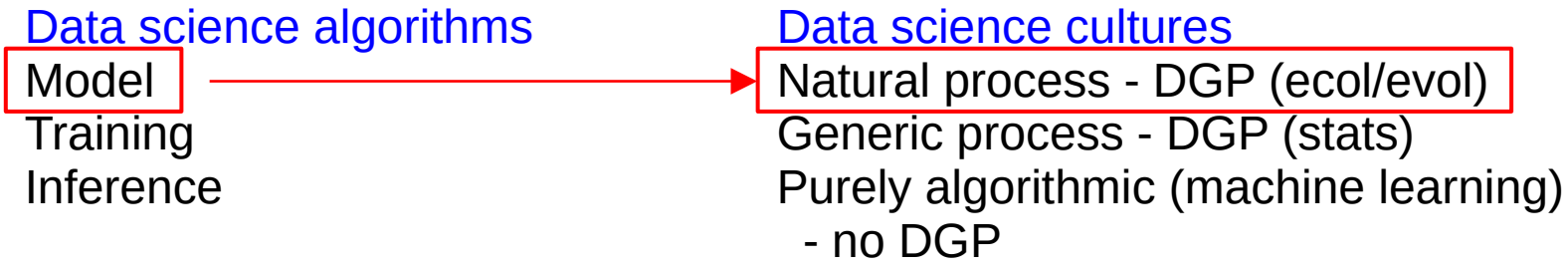
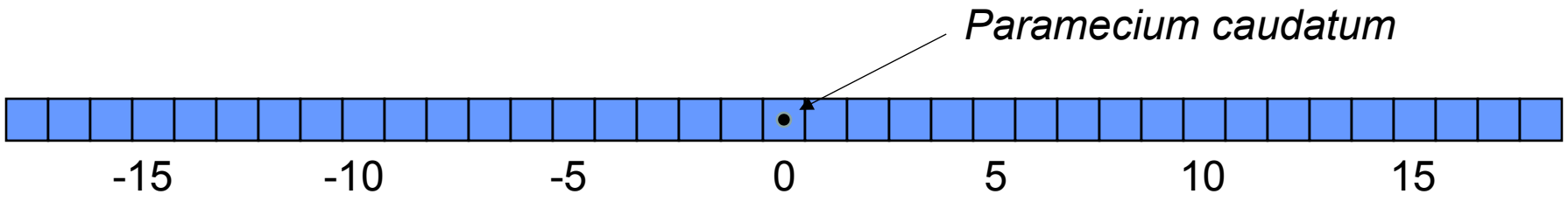


Data generating process

- Key to scientific understanding
  - How does the system work?
- How to model the DGP?
  - Simplify, abstract
  - Scales of abstraction

Design a model algorithm

e.g. animal movement (1D)



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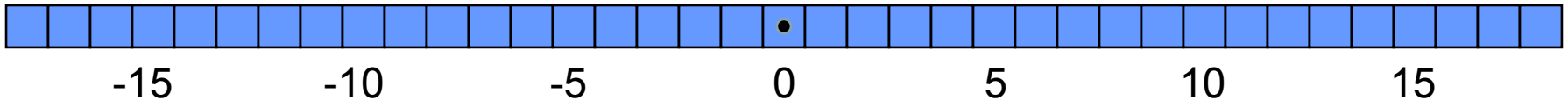


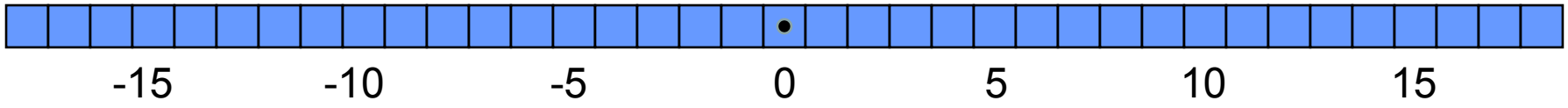
Subatomic scale of abstraction (reality)?

- particles, forces

... including all the ways these processes cause us to collect the data

Design a model algorithm

e.g. animal movement (1D)



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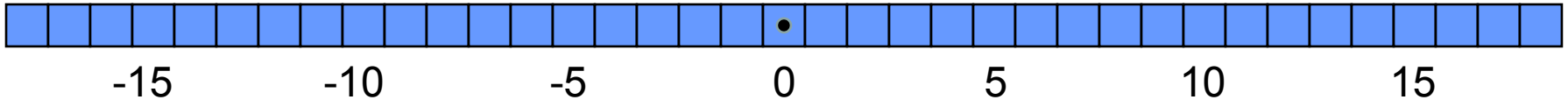
Too hard

Design a model algorithm

e.g. animal movement (1D)



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Too hard

Molecular scale of abstraction?
- cellular interactions

Design a model algorithm

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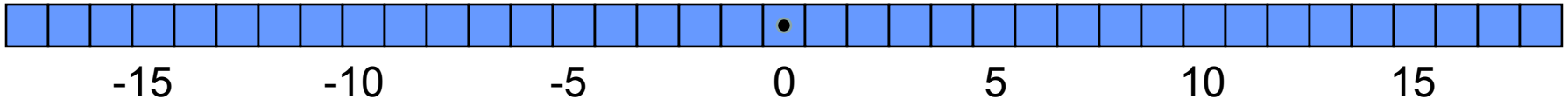

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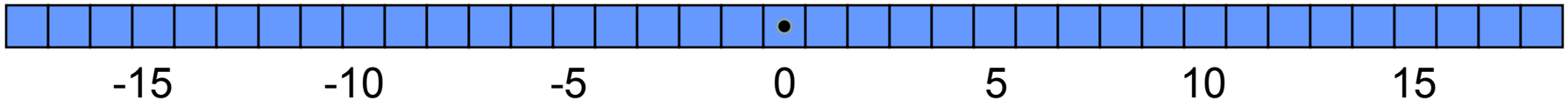
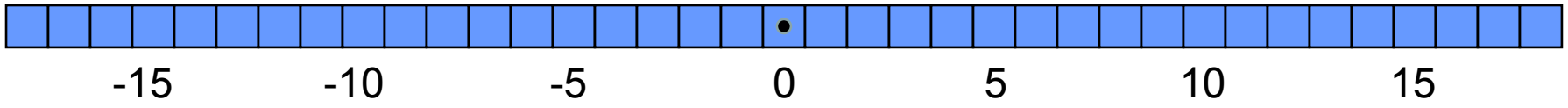


Individual scale of abstraction?

- behavior, feedback, motivation
- lots we don't know

Design a model algorithm

e.g. animal movement (1D)



Individual scale of abstraction

Δt: $P_{\text{move}} = 0.2$, equal probability left or right

Model a stochastic process

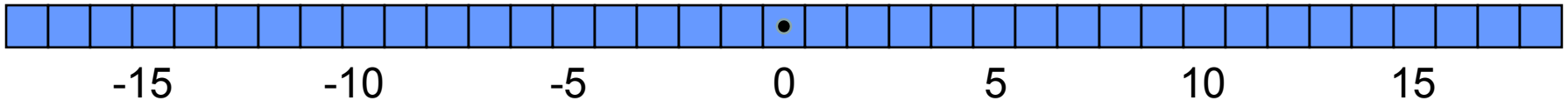
- Uniform distribution
  - numbers 0 to 1 with equal probability
- Simulate event with probability P
  - draw u from uniform distribution
  - if u < P, event occurs
- Uniform distribution in R:
  - `runif(n=1)`
  - draw one random number between 0-1

Stochastic processes

- Substitute for all the stuff we don't know
- Uncertainty about finer-scale processes
- Is the world deterministic or stochastic?
  - my view: depends on scale
  - individual scale is stochastic
  - individuals perceive the world as uncertain

Design a model algorithm

e.g. animal movement (1D)



Individual scale of abstraction

Δt: $P_{\text{move}} = 0.2$, equal probability left or right

Where will the paramecium be at *t*?
Pseudocode first.