

Announcements

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

while repetition structure

- Counter controlled repetition

```
i = 0
while i < n
    expression_1
    expression_2
    ...
    i = i + 1
```

The diagram illustrates a counter-controlled while loop. It consists of the following parts:

- Initialization:** `i = 0`. The variable `i` is highlighted in red. A blue arrow points from the label "counter" to `i`.
- Condition:** `while i < n`. The variable `n` is highlighted in red. A blue arrow points from the label "number of repetitions" to `n`.
- Loop Body:** Indented lines representing statements: `expression_1`, `expression_2`, and an ellipsis `...`.
- Increment:** `i = i + 1`. The increment value `1` is highlighted in red. A blue arrow points from the label "increment the counter" to `1`.

Today

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

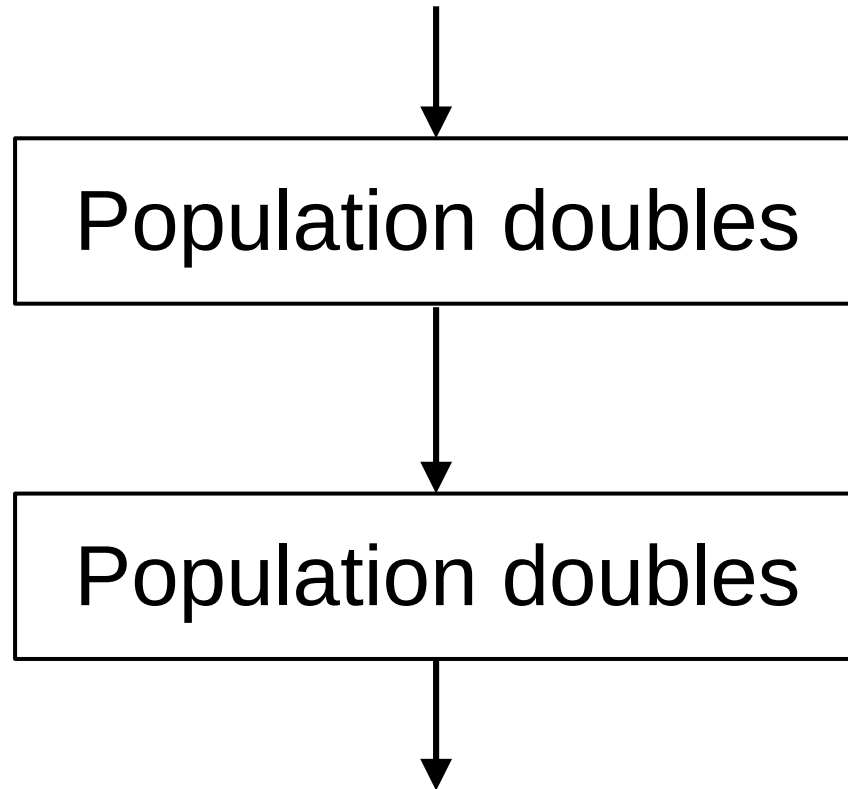
Art of modeling

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

What happens next?

Event sequence diagram

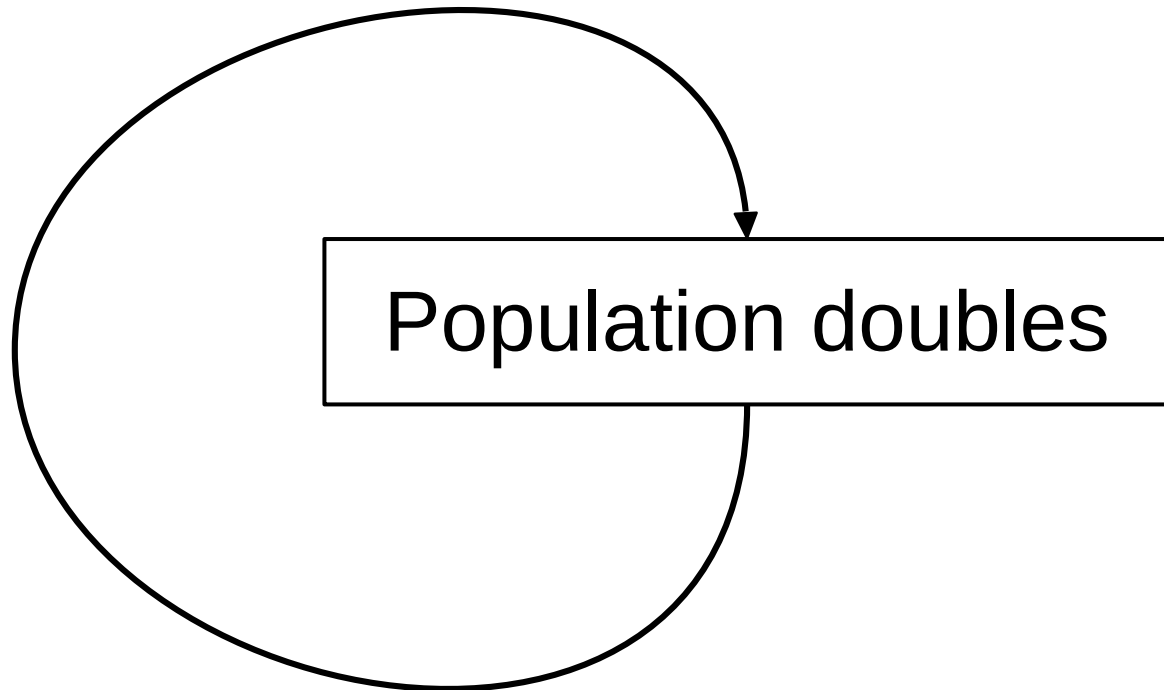
03_9_code_thu.py



What happens next?

Event sequence diagram

03_9_code_thu.py



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



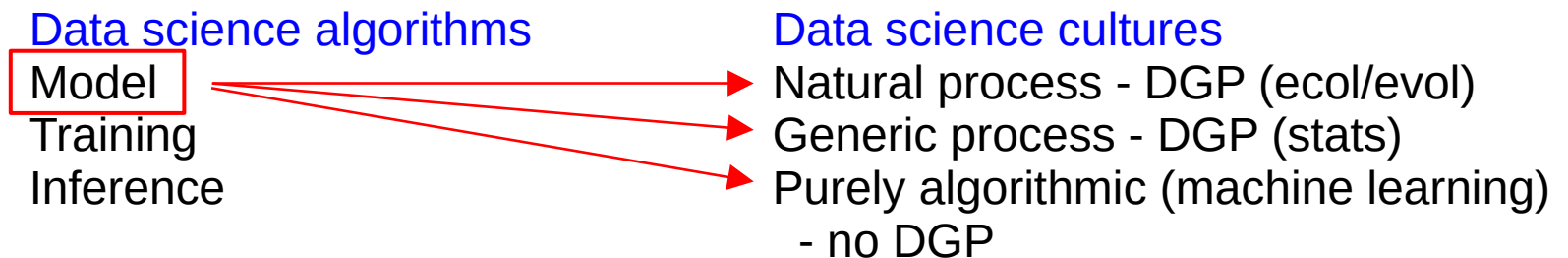
Jim Merrit celebrateurbanbirds.org

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

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

Data science algorithms

Model

Training

Inference

Data science cultures

Natural process - DGP (ecol/evol)

Generic process - DGP (stats)

Purely algorithmic (machine learning)

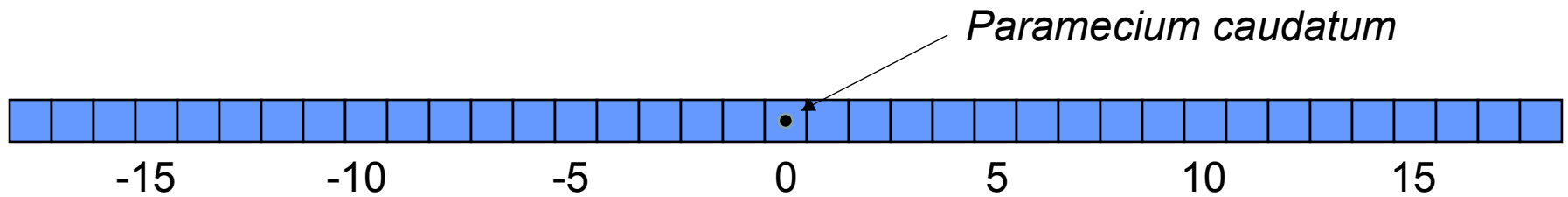
- no DGP

Data generating process

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

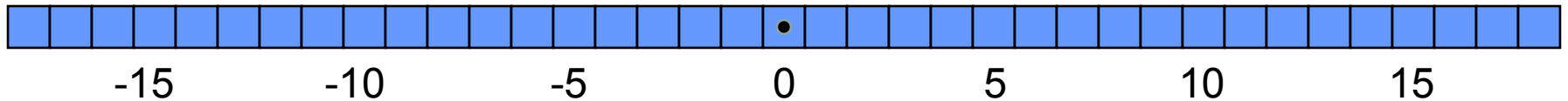
Design a model algorithm

e.g. animal movement (1D)



Design a model algorithm

e.g. animal movement (1D)



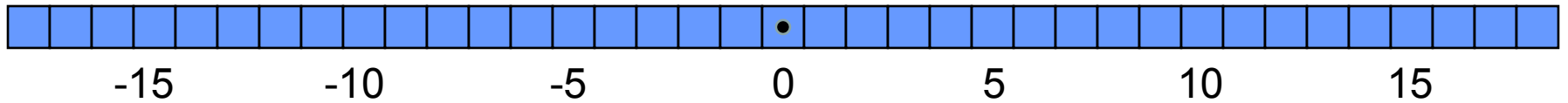
Subatomic scale of abstraction (reality)?

- particles, forces

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

Design a model algorithm

e.g. animal movement (1D)



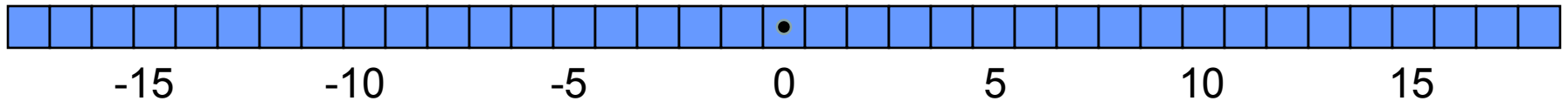
~~Subatomic scale of abstraction (reality)?~~

~~particles, forces~~

Too hard

Design a model algorithm

e.g. animal movement (1D)



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~~- particles, forces~~

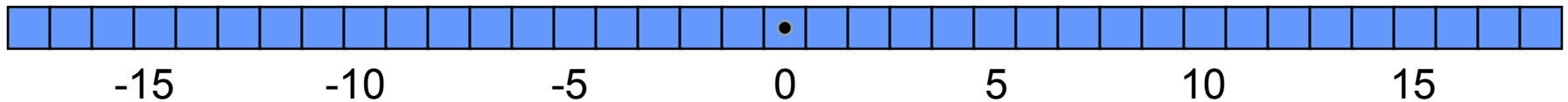
Too hard

Molecular scale of abstraction?

- cellular interactions

Design a model algorithm

e.g. animal movement (1D)



~~Subatomic scale of abstraction (reality)?~~

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Too hard

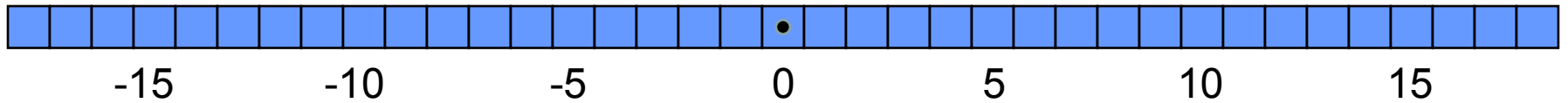
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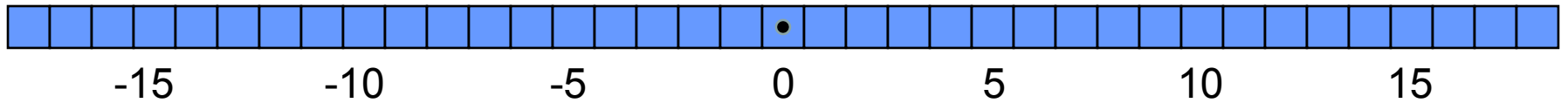


Individual scale of abstraction?

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

Design a model algorithm

e.g. animal movement (1D)



Individual scale of abstraction

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

Model a stochastic process

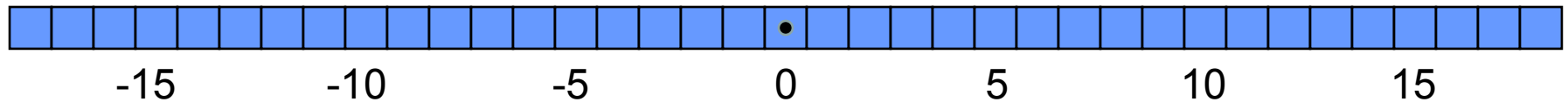
- Uniform distribution
 - numbers 0 to 1 with equal probability
- Simulate event with probability P
 - draw u from uniform distribution
 - if $u < P$, event occurs
- Uniform distribution in R:
 - `runif(n=1)`
 - draw one random number between 0-1

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

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

Where will the paramecium be at t ?

Pseudocode first.