Selbst-organisierende, adaptive Systeme
Übung 2 - Aufgabe 1

Gruppe 13

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Aufgabenstellung

Veranschaulichen Sie sich das Verhalten von chaotischen Systemen am **Beispiel des logistischen Modells** bzw. der logistischen Abbildung. *[…]*

a) Vervollständigen Sie dazu das **User-Interface** *[mit **Slidern** für **y0** und **R**]*

b) Platzieren Sie **Monitore** *[für **y-current** und **y-new**]*

c) Vervollständigen Sie den **Code** *[…]*

d) Testen Sie Ihre Implementierung mit verschiedenen Parametern von R. Können Sie **Bifurkationen** beobachten? *[…]*

Netlogo Code

Initialization

```
;; the initialization makes sure y-current and y-new are
;; set to y(0) and y(1), respectively
;; PRE: none
;; POST: y-current equals y(0); y-new equals y(1)
to initialize
  set y-current y0
  set y-new logisticMap R y-current
end
```

```
;; The transformation function performs exactly
;; one step in the logistic map
;; PRE: y-current equals y(t); y-new equals y(t+1)
;; POST: y-current equals y(t+1); y-new equals y(t+2)
to transformFunc
  set y-current y-new
  set y-new logisticMap R y-current
end
```

```
;; PRE R_ in [0, 4.0), y in [0, 1]
;; POST Result of logistic map
to-report logisticMap [R_ y]
 report R_ * y * (1 - y)
end
```

```
;; PRE R_ in [0, 4.0), y in [0, 1]
;; POST Result of logistic map
to-report logisticMap [R_ y]
 report R_ * y * (1 - y)
end
```

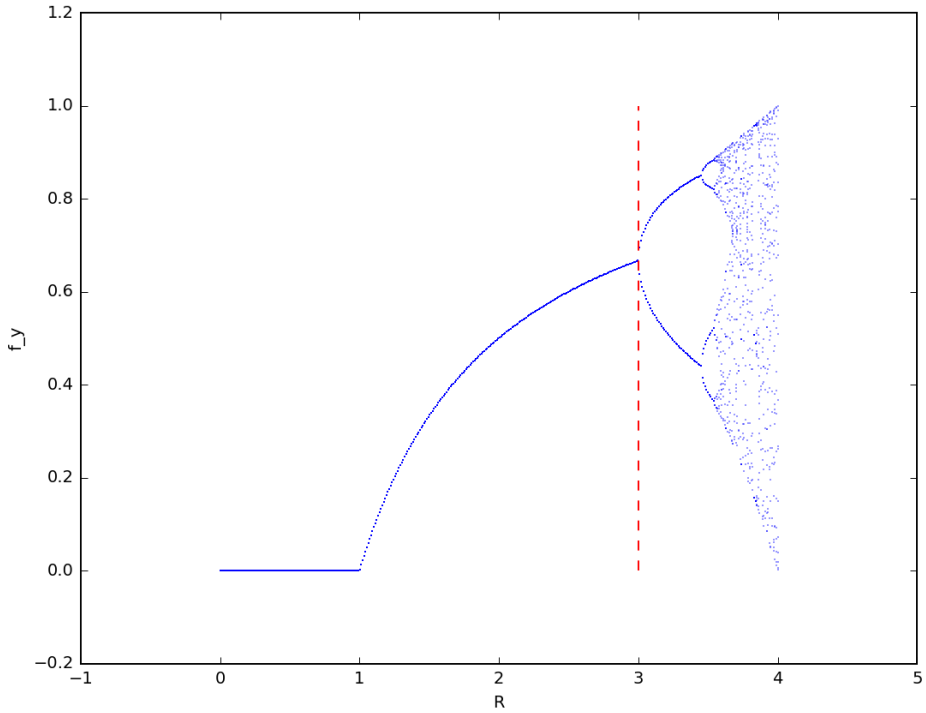
Note: Value `4.0` is excluded by the precondition! (However, this is not a mathematically illegal value.)

- Clamp R to [0,4.0) in method calls (leads to inconsistency!)
- Fail explicitly if R = 4 (is frustrating!)
- Limit the GUI slider to the last value before 4.0 according to the increment (boring!)
- “Adjust” precondition to $[0,4]$ (what we did!)

Demonstration

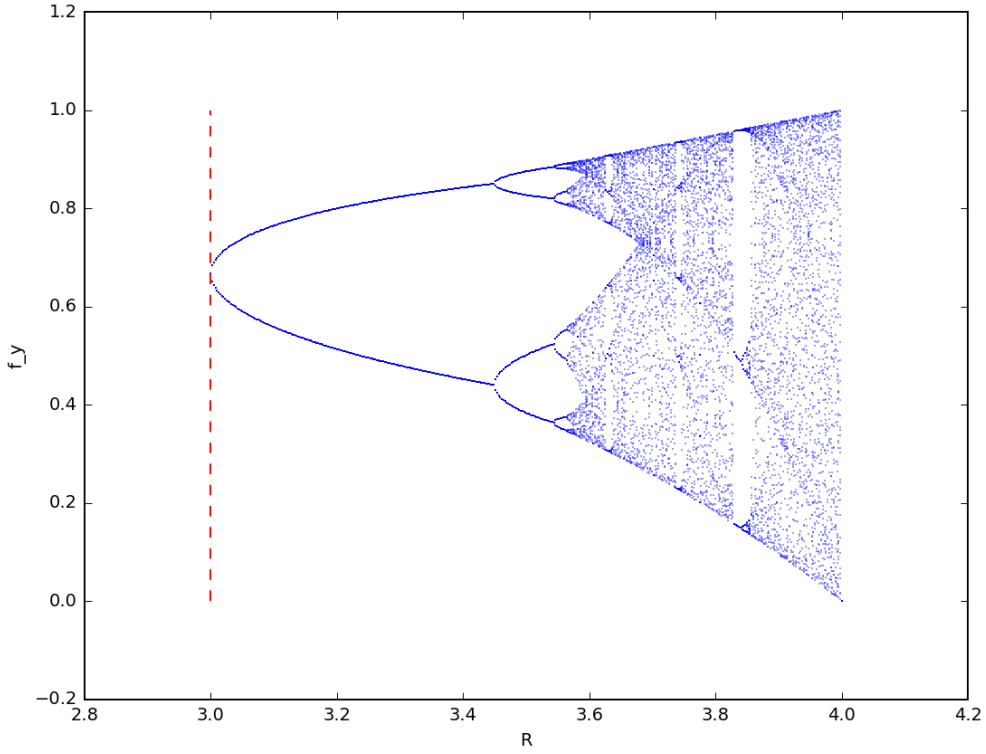
Behavior of Logistic Map for Different Values of R

Behavior for Different Values of R



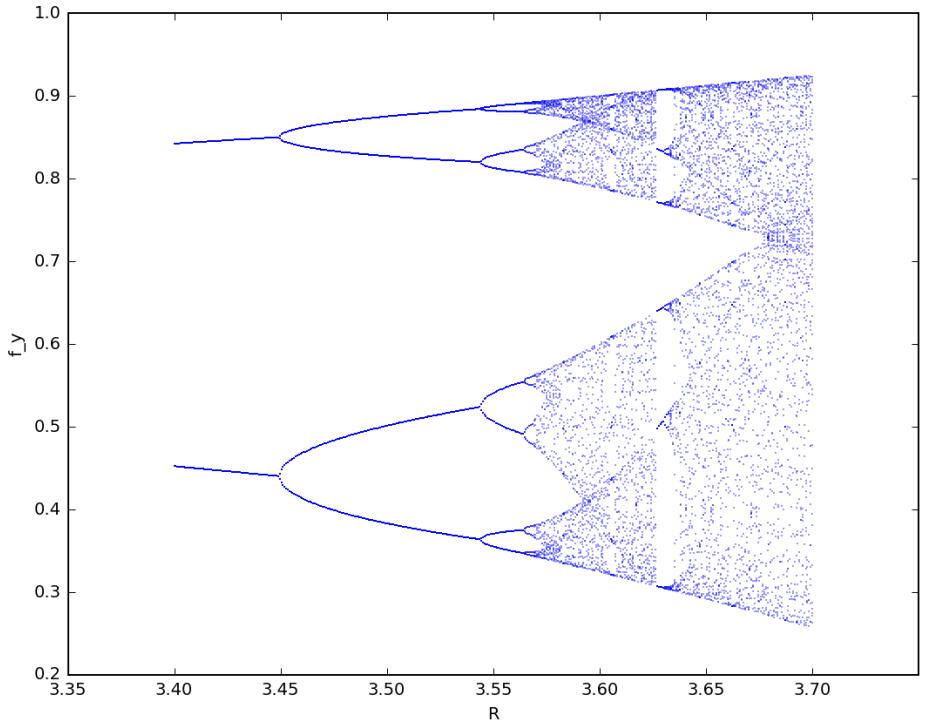
- Single fixpoint for $R < 3$
  - $f_y = 0$ for $R < 1$
- Speed of convergence
  - Quick for $0 < R < 2$
  - Quick with slight fluctuation for $2 < R < 3$

Behavior for Different Values of R
$3 < R < 4$



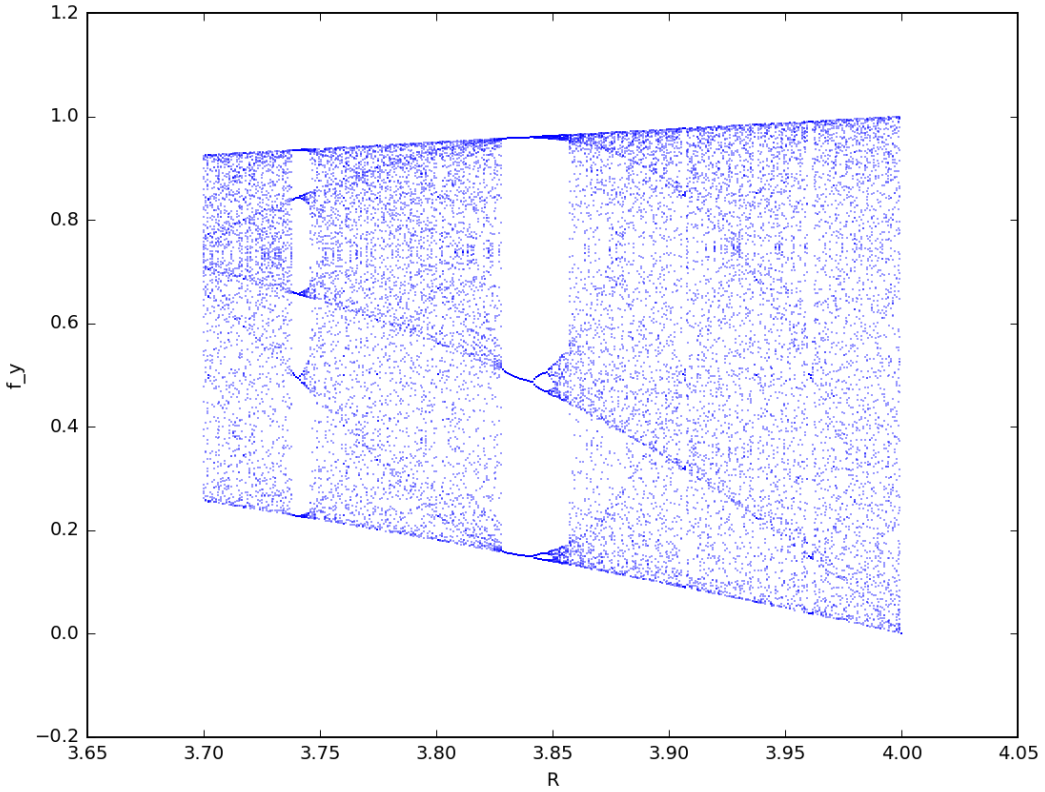
- For $R = 3$, y converges „dramatically slow”
- Bifurcation Appears for $R > 3$

Behavior for Different Values of R
$3.4 < R < 3.7$



- $2, 4, 8, 16\ldots$ oscillation points
- Chaotic behavior starts to appear
- Fun Fact: Parts of the plot are self-similar

Behavior for Different Values of R
$3.7 < R < 4$



- Certain „Islands of Stability“

Behavior for Different Values of R
$R > 4$

- For $R > 4$, y will exceed $[0,1]$ quickly (no plotting possible)