Homework 4.2: Separation of time scales

Separation of time scales

1/1 point (graded)
Consider the following system of equations

$$\begin{cases} \frac{du}{dt} = f(u) - m \\ \epsilon \frac{dm}{dt} = -m + c(u) \end{cases}$$

where $f(u) = -0.5u - 2,\ \epsilon > 0.$

If dynamics of the variable m is very fast, then it means that ...
(Note that more than one option may be correct.)

- [ ] $\frac{1}{\epsilon} \ll 1.$
- [x] the variable m converges to its fixed point very rapidly.
- [ ] $f(u(t))$ can be approximated by $c(u(t))$ for all times t.
- [x] $\epsilon \ll 1$ and so $m(t) \approx c(u(t))$.
- [x] the system of two equations can be reduced to one: $\frac{du}{dt} = f(u) - c(u)$
- [ ] reduced equation is $\epsilon \frac{du}{dt} = -f(u) + c(u)$.

✔

Submit You have used 1 of 1 attempt

✔ Correct (1/1 point)

Stability of the fixed point

0/1 point (graded)
Imagine the reduced equation above is written as

$$\frac{du}{dt} = -au + b - tanh(u)$$

where a, b are real numbers. Which of the following is correct regarding the fixed points of the equation?

- ○ $ab > 0$ is a necessary condition to have a stable fixed point.
- ○ $b > 0$ guarantees the existence of at least one stable fixed point.
- ○ If $a > 0$, then the equation has always one fixed point which is stable.
- ○ If $b > 0$, then the equation has always one fixed point which is unstable.

For any $a > 0, b > 0$, there is an unstable fixed point.

If $a > 0$, then the equation has always one fixed point which is unstable.

✖

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✖ Incorrect (0/1 point)

Discussion

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