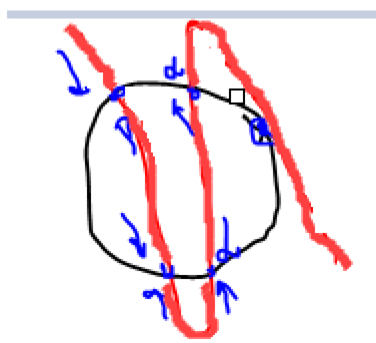
Which combination of changes in parameters–either increasing or decreasing the feedback connection strength, while either increasing or decreasing the threshold of a unit–can have the effect of enhancing the overall stability of a bistable unit with positive feedback?

In a bistable unit with positive feedback, a small change in the initial state gets amplified by the feedback loop, pushing the system towards one of its two stable states. This amplification can be beneficial for switching, but it can also lead to unwanted noise or fluctuations causing the system to jump between states unintentionally. Weakening the positive feedback loop reduces the amplification effect. This means a small change in the initial state will have a less dramatic impact on the system, making it less likely to be pushed over the threshold and switch states unintentionally. The threshold represents the critical point at which the positive feedback loop takes over and drives the system to a stable state. By raising the threshold, it takes a larger initial change to push the system past this point.

Two nullclines cross at five different points. What is the greatest number of stable fixed points the corresponding system can possess?

I think if the two nuclines form closed loops and intersect at stable equilibrium points, then we could have 5 stable fixed points. Each intersection point would represent a stable fixed point where both variables remain constant.



In an inhibition-stabilized circuit, the inhibitory neurons gain some extra excitatory input to reach a new stable state. In what direction do the following change (if they change at all)?

Quoted from book "if the inhibitory neurons are provided with inhibitory input —which would normally decrease their firing rate—the network feedback causes both the excitatory and the inhibitory neurons to increase their rate."

a. The firing rate of inhibitory cells.
   increase
b. The firing rate of excitatory cells.
   increase

Quoated from the book “If the direct external input causes the inhibitory neurons to reduce their firing rate, the local excitatory cells overrespond to reduced inhibition by firing a lot more. The increased excitatory activity is more than sufficient to raise the inhibitory rate beyond its initial level.”

c. The total inhibitory input to excitatory cells

Decreases. Initially, it decreases because inhibitory cells fire less. However, it eventually increases due to the overall higher firing rate of inhibitory cells in the new stable state.

d. The total excitatory input to excitatory cells.

Increases. The passage mentions "local excitatory cells overrespond" due to reduced inhibition, leading to a higher firing rate and more total excitatory input.

Quoated from the book “Following this increase in excitation and subsequent increase in inhibition, the excitatory units are firing at a higher rate while receiving more inhibition than before.”

e. The total inhibitory input to inhibitory cells.

We don't have information about a direct change of the inhibitory input source from the passage. But the overall inhibitory would be increased

f. The total excitatory input to inhibitory cells.

The passage mentions that it increases.

Suggest one way in which chaotic activity would be beneficial for the brain and one way in which it would be detrimental.

Chaotic activity can enhance computational capabilities and information processing in the brain. Chaotic dynamics allow for the exploration of a wide range of states and patterns, enabling the brain to quickly adapt to changing environments, learn new information, and generate creative solutions to problems. In neural networks, chaotic behavior can facilitate pattern formation, memory encoding, and the emergence of complex behaviors.

During epileptic seizures, electrical activity in the brain becomes highly irregular and chaotic. This disrupts normal brain function, leading to symptoms like tremors and loss of consciousness.