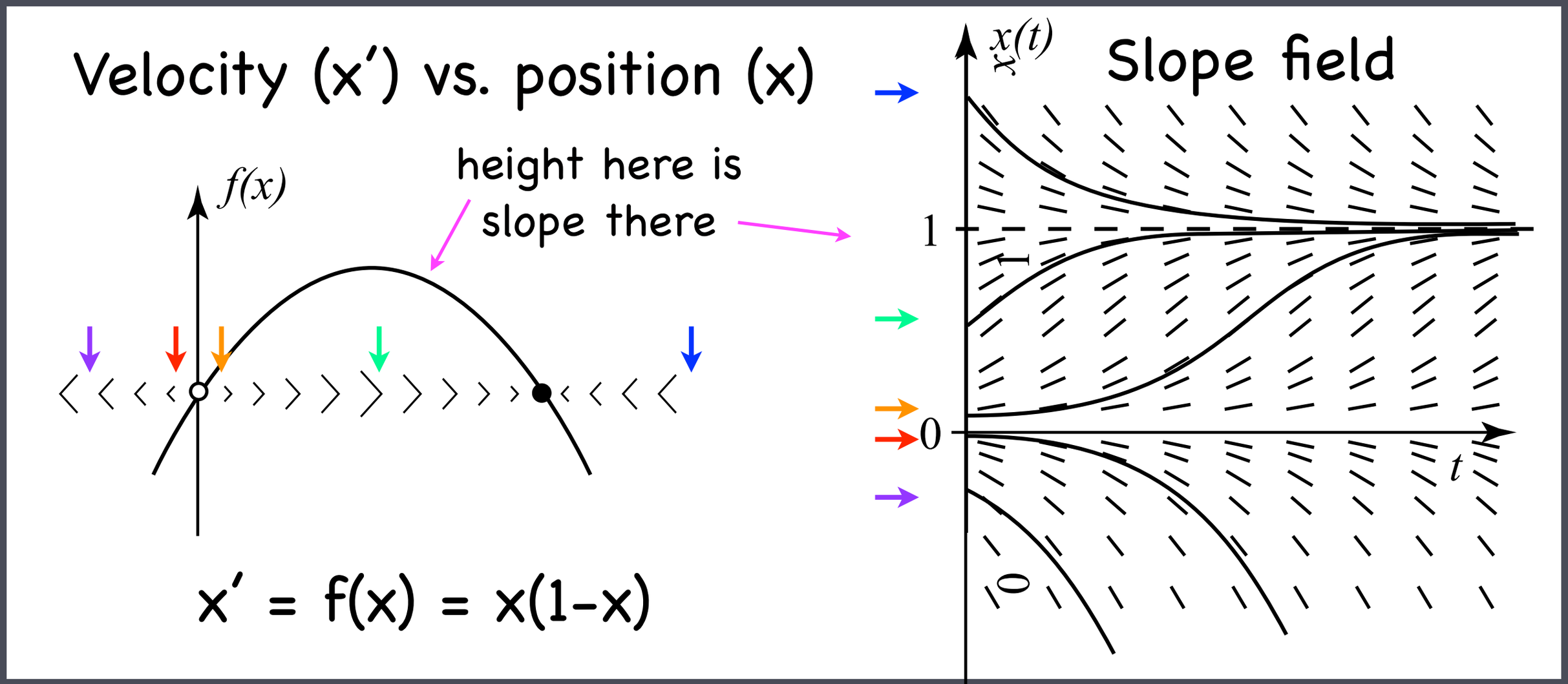
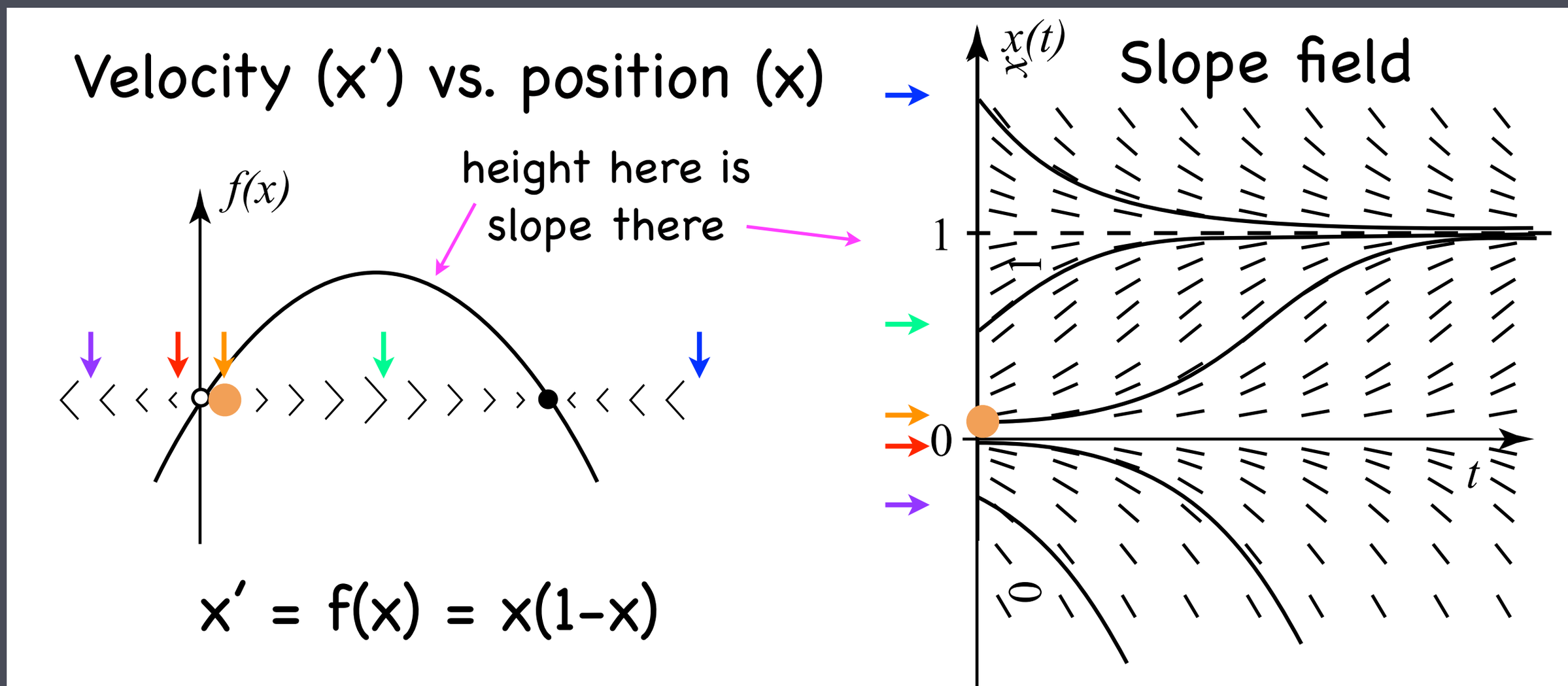
Today

- Defining the phase line.
- Qualitative analysis examples.

Velocity versus position



Velocity versus position

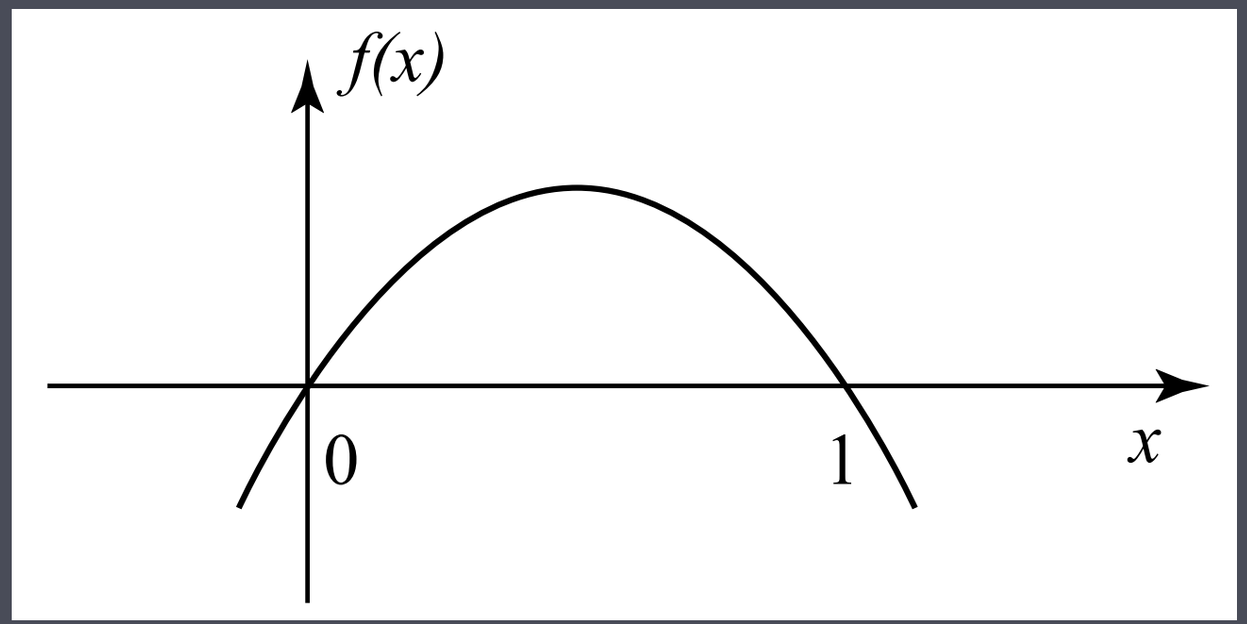


Stable steady state- all nearby solutions approach (filled dot)

Unstable steady state - not stable (empty dot)

Determine stability

$$x' = x(1-x)$$



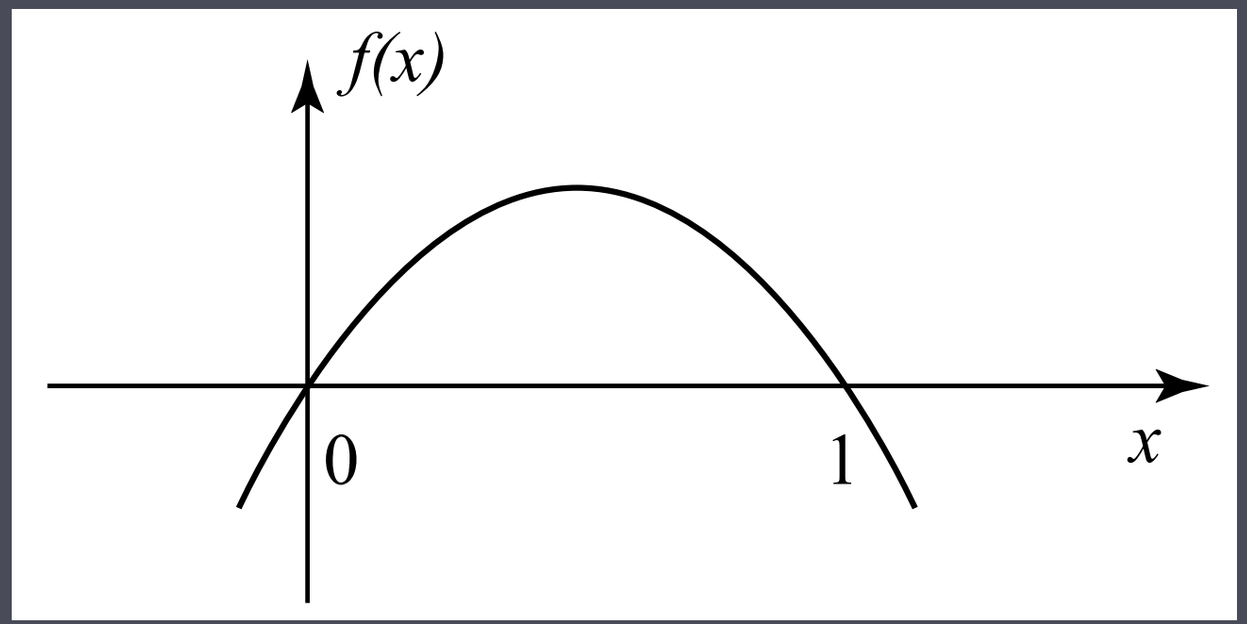
- If you start at x(0) = -0.01, the solution

(A) increases

(B) decreases

Determine stability

$$x' = x(1-x)$$



- If you start at x(0) = 0.01, the solution

(A) increases

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Determine stability

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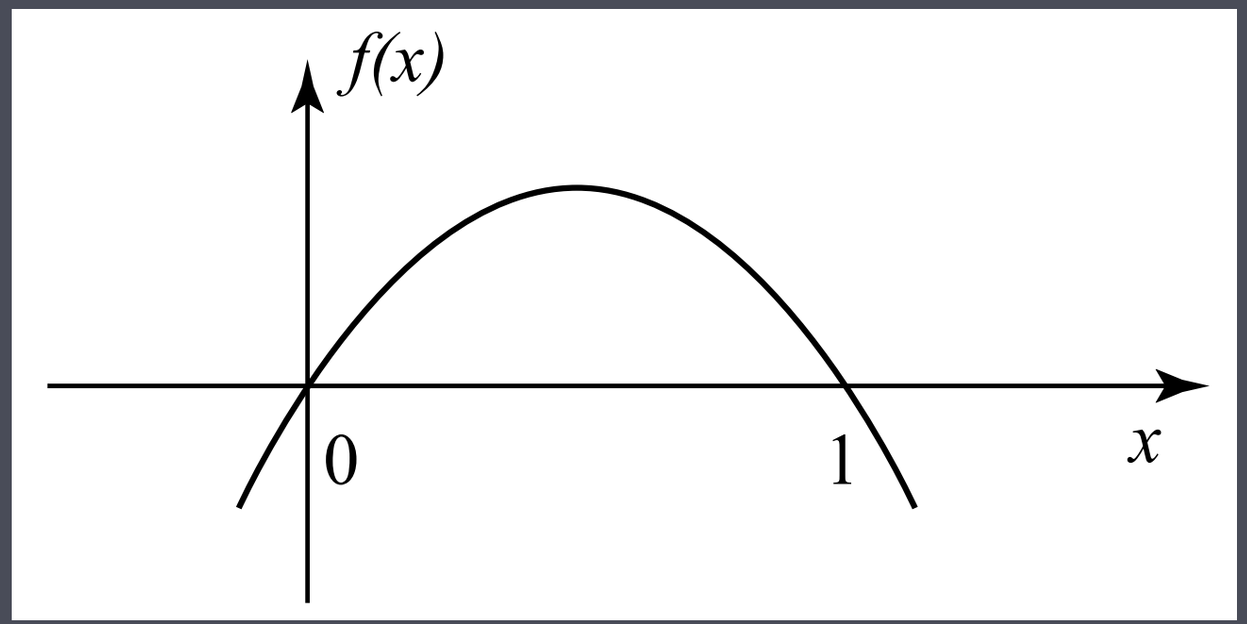

- If you start at x(0) = 0.99, the solution

(A) increases

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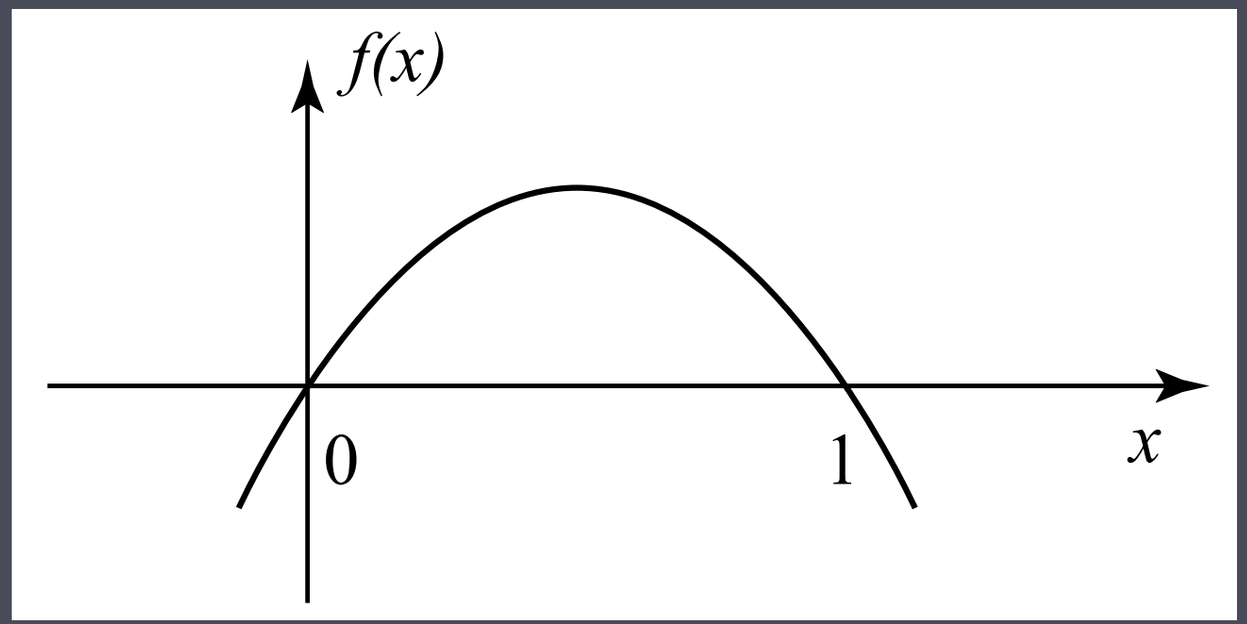
Determine stability

$$x' = x(1-x)$$



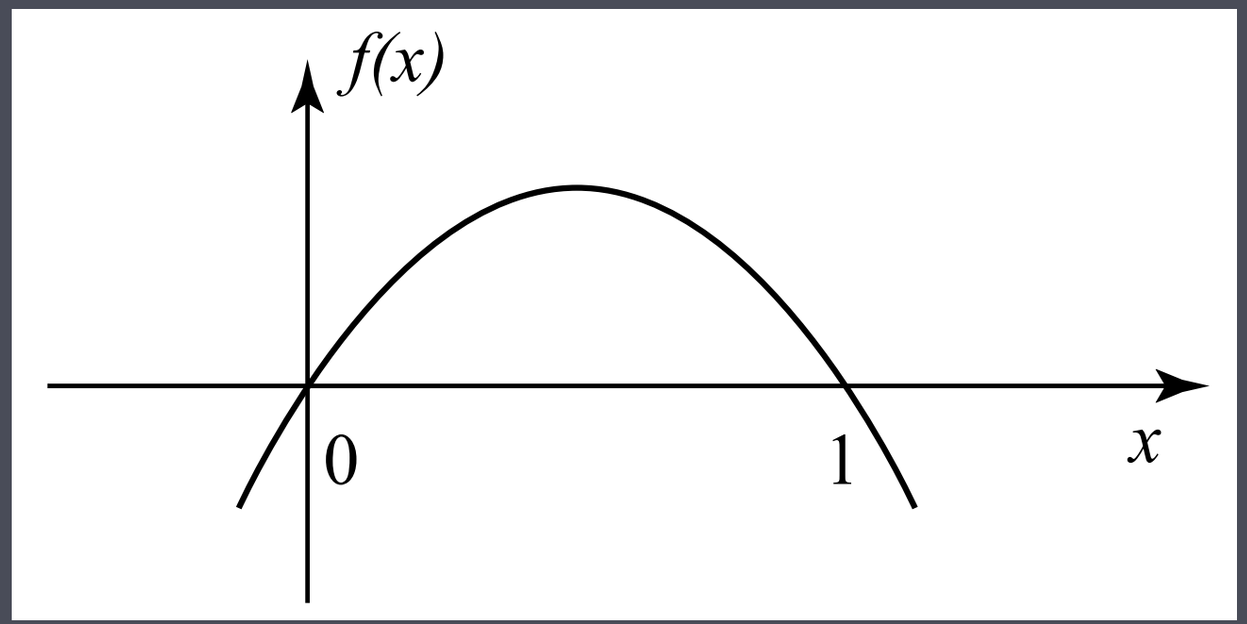
- If you start at x(0) = 1.01, the solution

(A) increases

(B) decreases

Determine stability

$$x' = x(1-x)$$



(A) Both x(t)=0 and x(t)=1 are stable steady states.

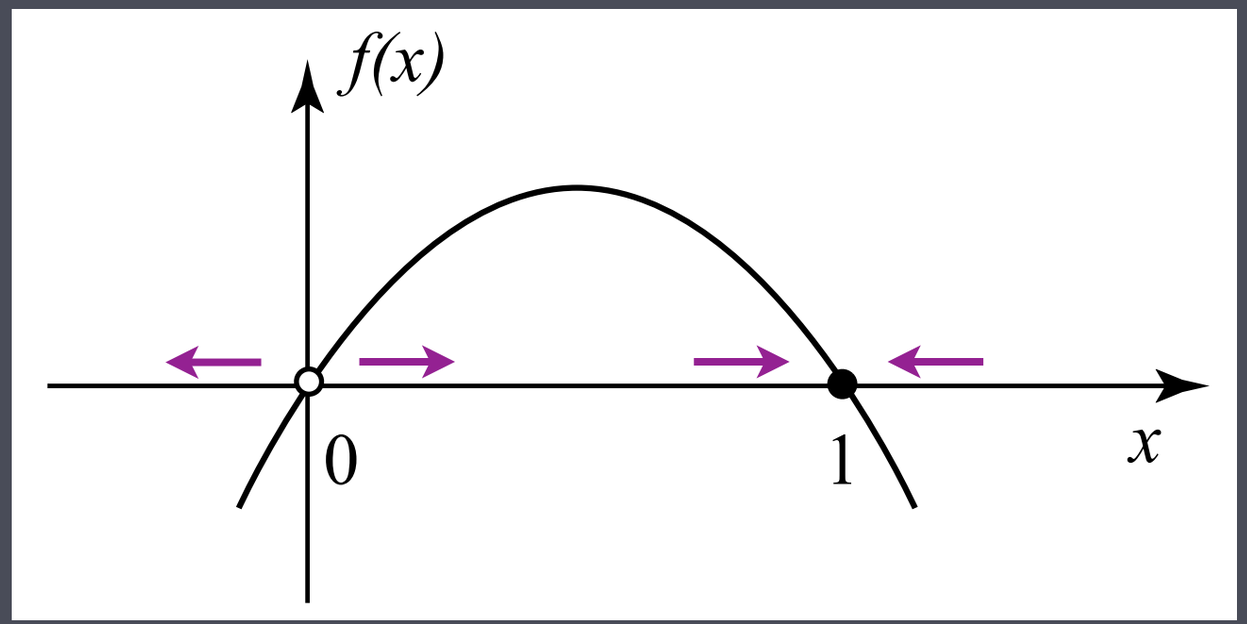
(B) x(t)=0 is stable and x(t)=1 is unstable.

(C) x(t)=0 is unstable and x(t)=1 is stable.

(D) Both x(t)=0 and x(t)=1 are unstable steady states.

Determine stability

$$x' = x(1-x)$$



(A) Both x(t)=0 and x(t)=1 are stable steady states.

(B) x(t)=0 is stable and x(t)=1 is unstable.

(C) x(t)=0 is unstable and x(t)=1 is stable.

(D) Both x(t)=0 and x(t)=1 are unstable steady states.

Stable - solid dot. Unstable - empty dot.

$$y' = -y(y-1)(y+1)$$

- What are the steady states of this equation?
- Draw the slope fields for this equation.
- Sketch the phase line
- For each steady state, determine its stability.
- What value does a solution starting at $y(0)=0.2$ approach for large t?
- Does that solution have any inflection points?
- Sketch it.