RoboJackets

FIRST - IGVC - BattleBots - RoboCup

2008 TE Sessions Supported by

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Rockwell Automation

The George W. Woodruff School of Mechanical Engineering

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LabVIEW Part 2: Motor Control

October 14, 2008

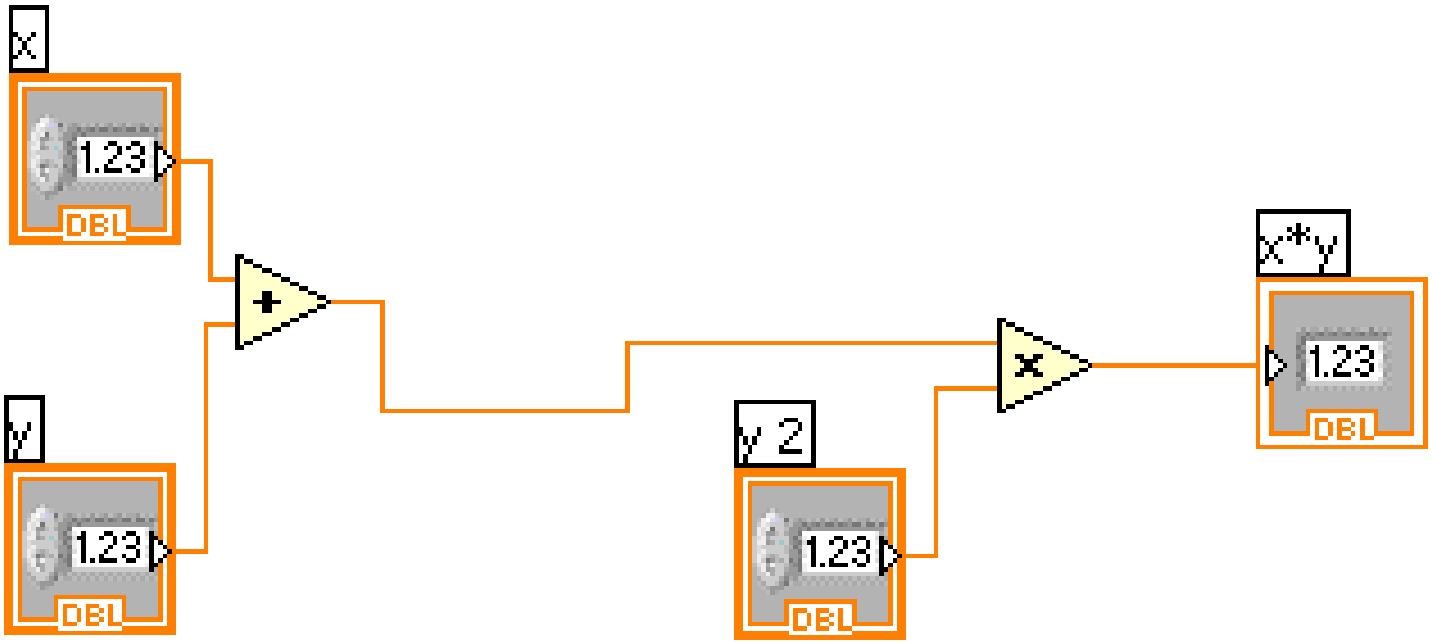
www.robojackets.org

Pop Quiz! (FOR CANDY!!!)

- What is a program in LabVIEW called?
- What are the two main components of the LabVIEW interface?
- What color is a boolean variable?

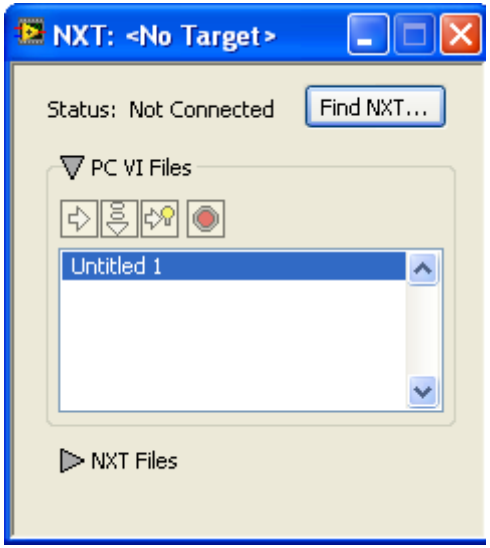
Pop Quiz! (FOR CANDY!!!)

- What order do instructions execute?
- What is the output of the following?



Pop Quiz! (FOR CANDY!!!)

- What does this mean? 
- What does this do? 
- What happens when I type <Ctrl+E>?
- Describe the buttons:



Goals for Today

- Brief review
- Open Loop Motor Control
- Feedback (encoders)
- Closed Loop Motor Control

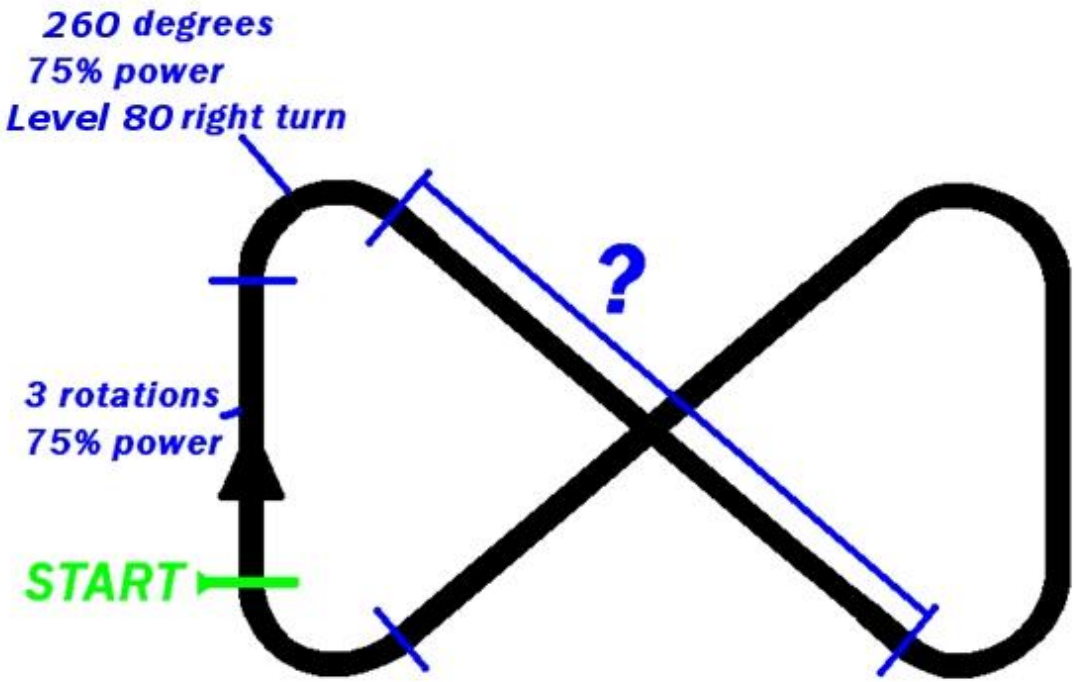
Open Loop Motor Control

Open Loop Motor Control

- Check out
  - **NXT Toolkit>> NXT Library>> Output**
- Demo of one block (rely on help)
- Each group pick a block
  - Try it out
  - Show the class
- Review output blocks

Open Loop Motor Control

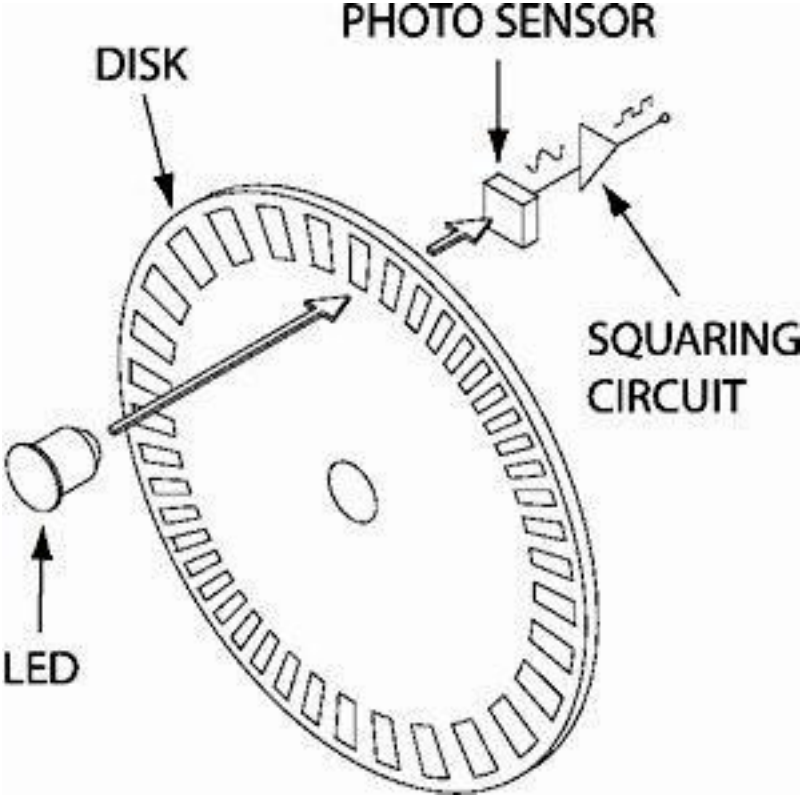
Activity!



- Teams judged on how close they get to their starting position and orientation
- Must complete 3 laps
- Coast between blocks

Feedback

Feedback (Encoders)

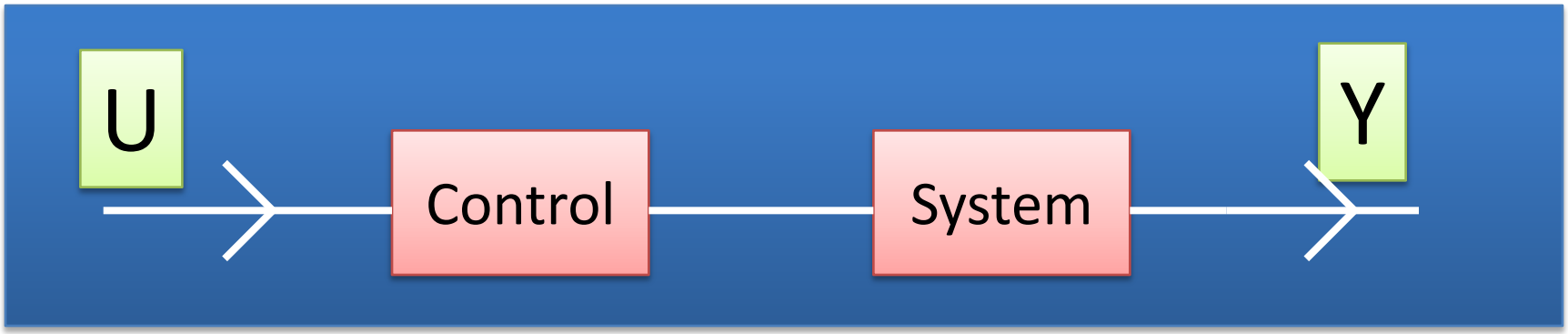


Feedback (Encoders)

- **Demo:** numerical output
- **Guided activity:** etch-a-sketch

Control

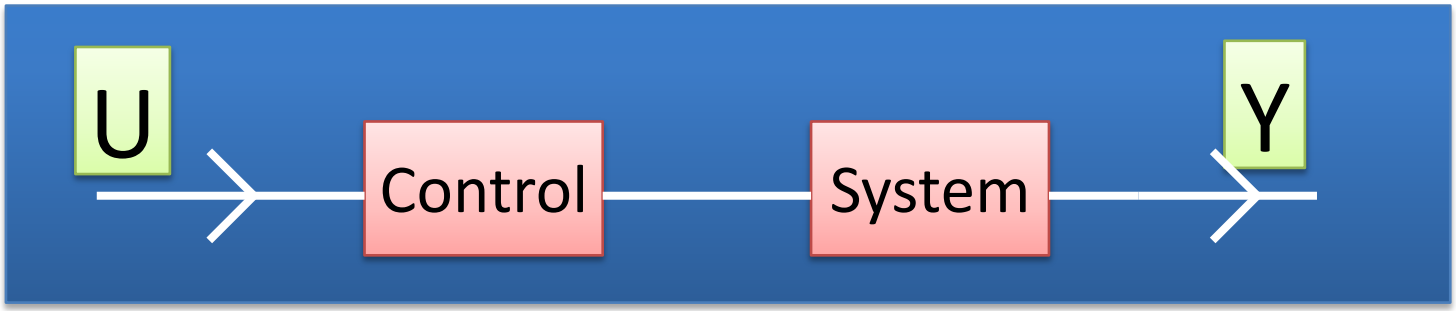
- What is a control system?



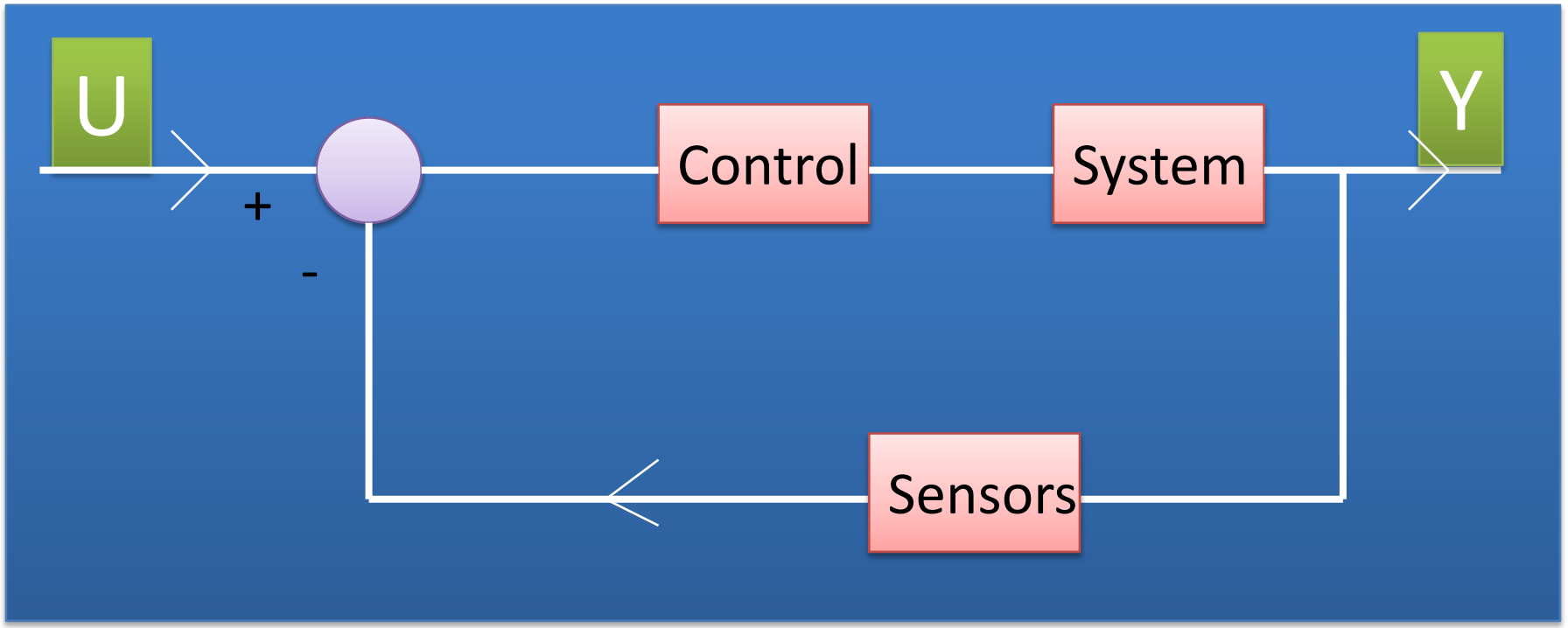
Control

Control - Thermostat

- Input (U) = Wanted Temperature (User)
- System = AC + Room
- Control = Microcontroller to turn AC on or off
- Output (Y) = Room Temperature

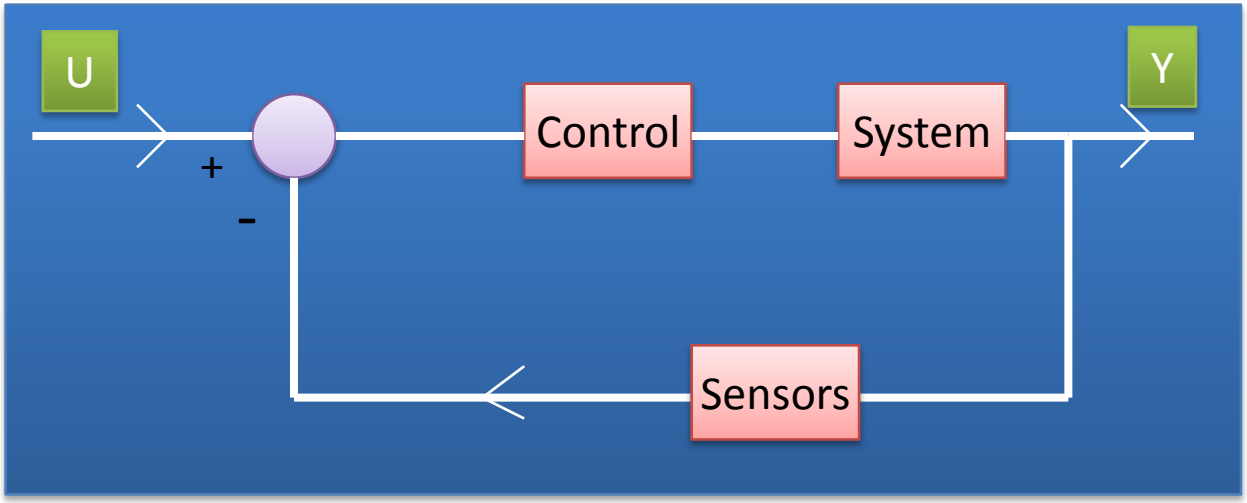


Closed Loop Control

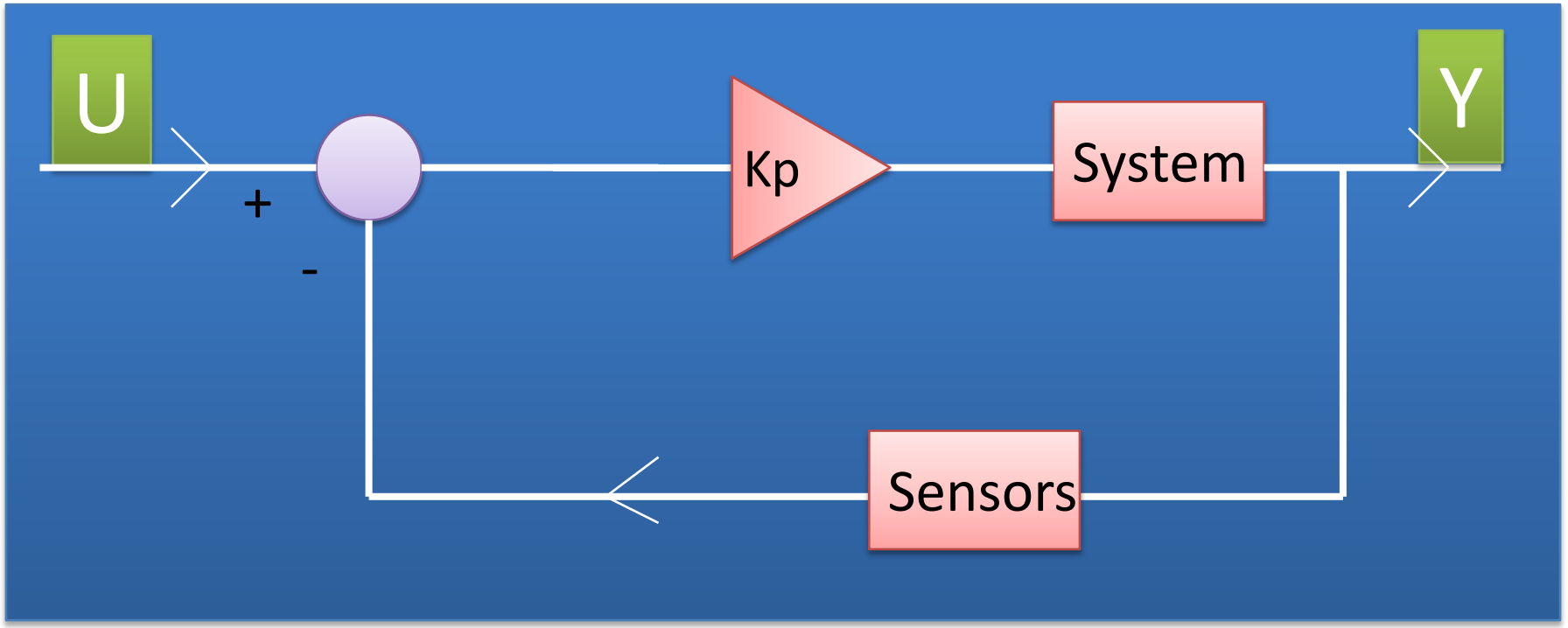


Closed Loop Control - Thermostat

- Input (U) = Desired Temperature (User)
- System = Room + AC
- Sensors = Digital Thermometer
- Control = Microcontroller to turn AC on or off
- Output (Y) = Room Temperature



Proportional Controller

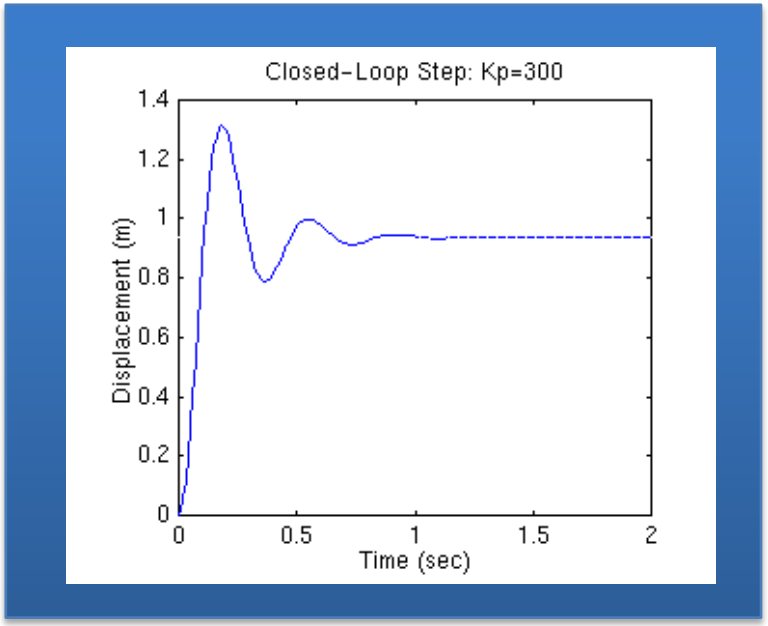


Proportional Controller

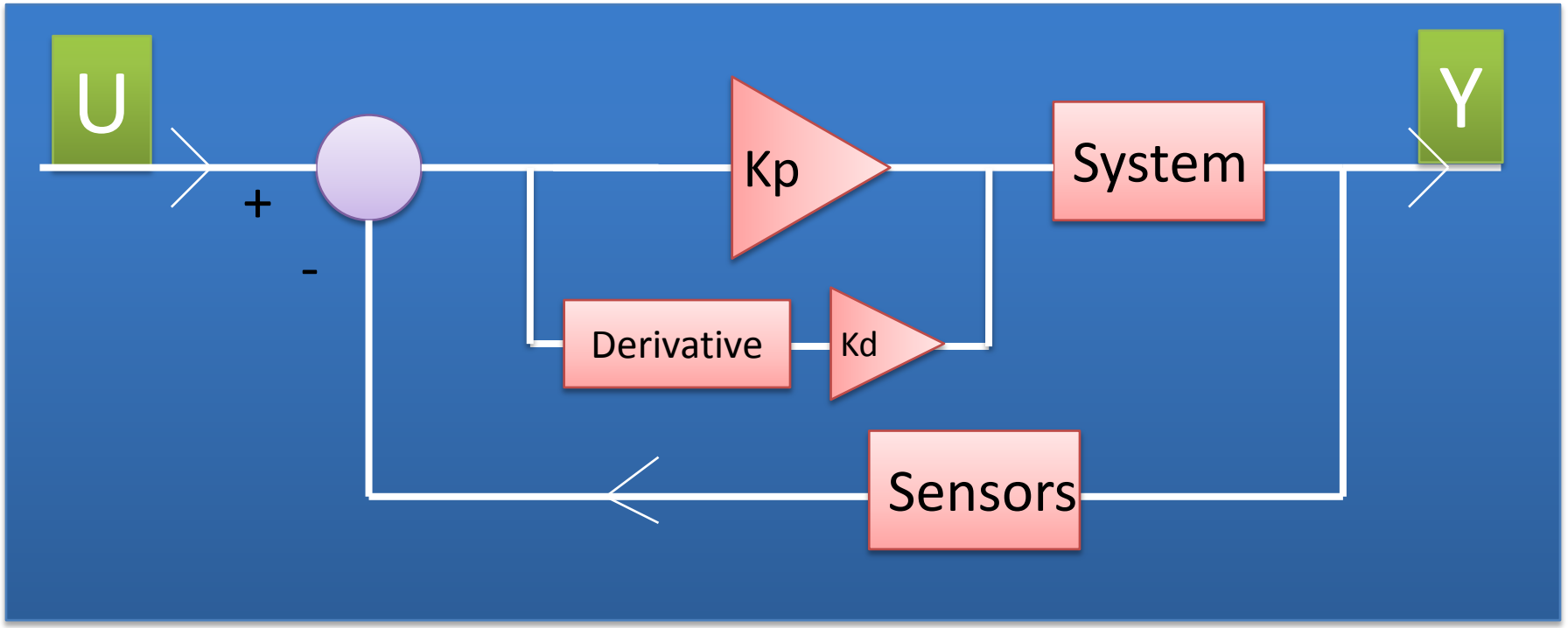
- To handle the present, the error is multiplied by a proportional constant Kp, and sent to the output.

Error = Desired Value – Actual Value

Output = Error * Kp



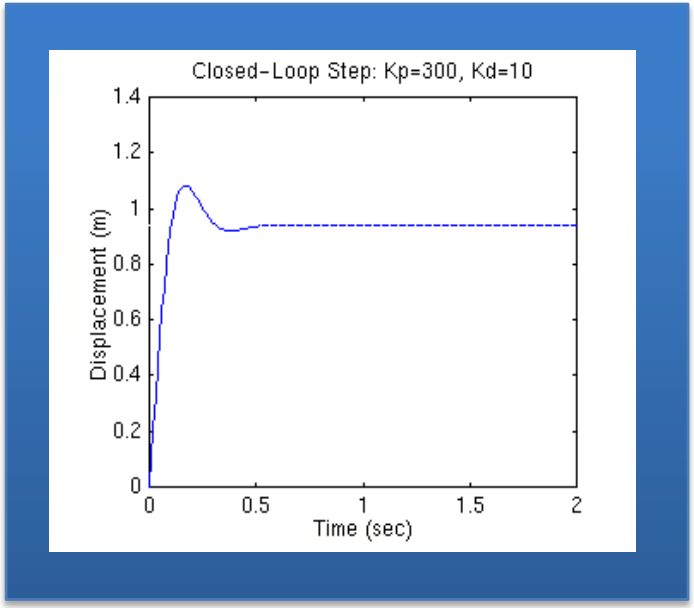
Proportional – Derivative Controller



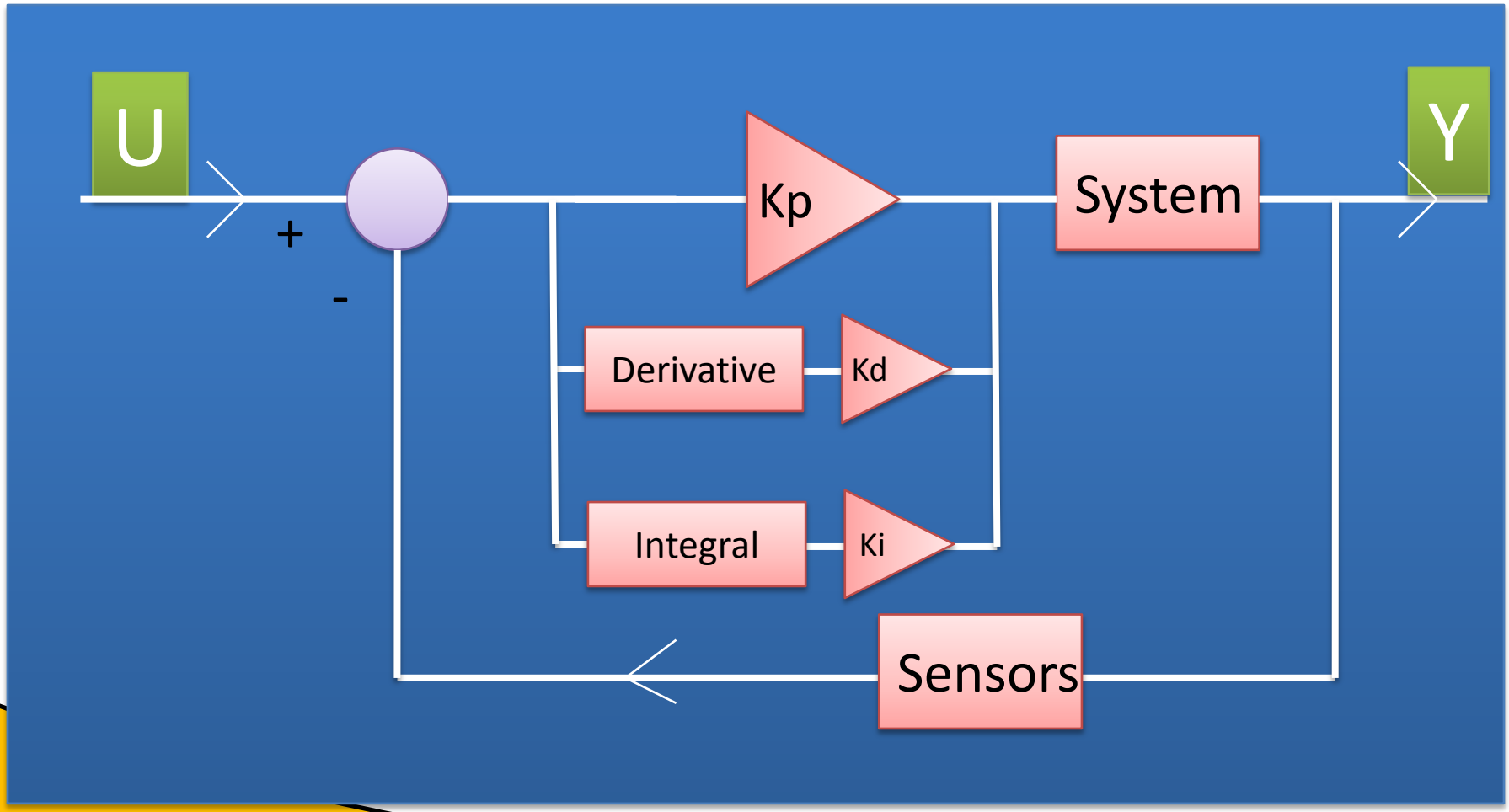
Proportional – Derivative Controller

- To handle the future, the first derivative of the error (its rate of change) is calculated with respect to time, and multiplied by the constant Kd, and added to the proportional term.

Output = (Error * Kp) + ((Change in Error / Time) * Kd)

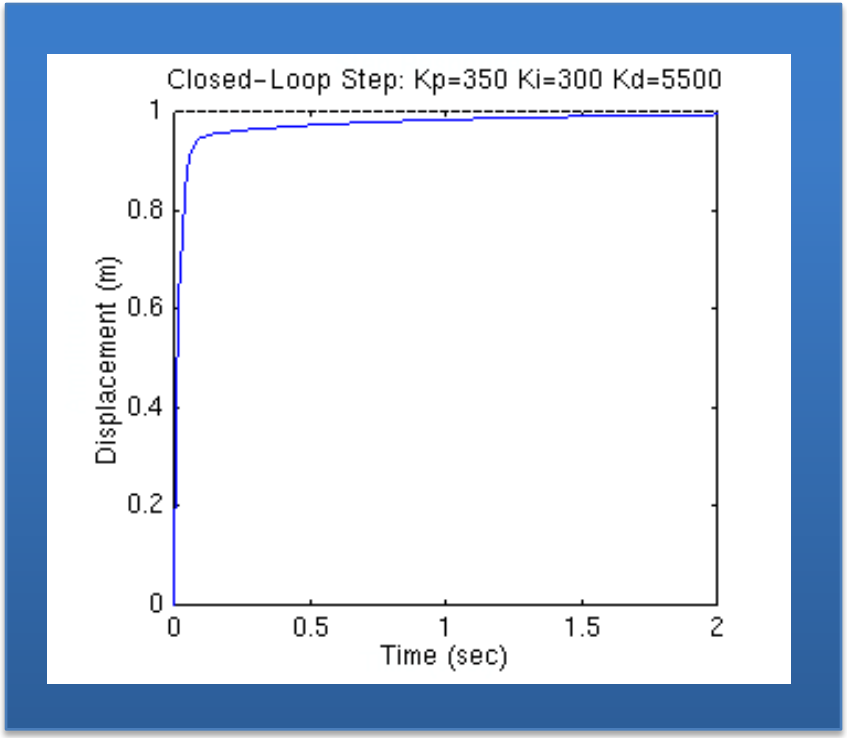


Proportional – Integral - Derivative Controller



Proportional – Integral - Derivative Controller

Output = (Error * P) + (Sum of the Error * I) + ((Change in Error / Time) * D)



Proportional – Integral - Derivative Controller

- **Tuning suggestion:**
  - **Start with just P control** (I = D = 0) until the system starts to oscillate, meaning it reaches the target, overshoots, reaches the target, undershoots and repeats this process.
  - **Increase I** until this oscillation stops; the control should be smoother now, but may be slow.
  - **Then increase D** until the system reaches its target at an acceptable speed (depending on the circumstances, overshoot may or may not be desirable).

Proportional – Derivative Controller

Demo/Activity

Legal

These slides and more are available at

http://www.robojackets.org

For more information contact the RoboJackets.
(contact info available via the web)

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