Convolution Matching Madness

Overview: This activity has students use familiar shapes, transparency film, and markers to explore convolution graphically in groups of 2-3 students.

Setting: In-class activity

Curricular elements: Gaming and tinkering

Prerequisites: Basic knowledge of convolution

Topics/concepts covered: Convolution

Learning outcomes:

- Perform convolution manually using graphical and/or numerical techniques
- Draw the result of convolution between simple signals
- Apply intuition about convolution to predict input signals when given an output

Expected time to complete: 3-10 minutes per round

Required hardware/materials:

- 2 copies of each transparent shape card per group (16 total cards per group)
  - Approx. cost: $0.50 per group
  - Suggestions: Print 4 shape cards per transparency film and cut in bulk.
- 2 title labels per transparent shape card (32 total labels per group)
  - Approx. cost: $0.25 per group
  - Suggestions: Print on Avery 8167 labels and place on front and back of corresponding shape cards above the graph portion.
- 1 copy of each mystery shape card per group, laminated (20 total cards per group)
  - Approx. cost: $2 per group
  - Suggestions: Use thick paper or cardstock for more durable cards. Print 4 mystery cards per page, cut in bulk, then laminate. To save money, the instructor could print one class set to be shared amongst groups.
- 1-3 transparent scoring sheets per group
  - Approx. cost: $1 per group

  - Suggestions: Print on transparency film. When deciding how many scoring sheets to print, consider how many rounds will be played and that a group can use a single sheet for 4 rounds. Alternatively, groups could have their scoring sheet "checked off" by the instructor after every 4 rounds, then erase and reuse it.

- 1 wet or dry erase marker per group
  - Approx. cost: $1 per group
  - Suggestions: Select fine-point markers in easily readable colors.

- 1 eraser per group
  - Approx. cost: $1 per group
  - Suggestions: Use paper towels for the cheapest option. Consider having a cleaner bottle or two available for the class—even dry erase marker can be difficult to remove from transparency film without water.

Total estimated cost: $5.75 per group, depending on quantity needed and resources available.

Required instructor interaction: Supervision with occasional guidance and final check-off

Common mistakes/pitfalls:

- The instructions may not be fully understood at first. Make sure to give a demonstration or practice round before starting the activity.
- Students may forget that the "sketcher" is not allowed to see the mystery shape. Give reminders when necessary to make sure the game is played fairly.
- Students may try to change their mind about their shape card selections if they realize their choices are incorrect. Encourage them to proceed with their original choices and remind them that picking the right shapes is only worth 1-2 points.

Method of assessment: Self-graded by student groups with a final accuracy check from the instructor

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In-Class Activity: Convolution Matching Madness

EE 360 — Communication Systems
Winter 2017

Overview:

Working in teams of 2-3, you will use convolution on familiar shapes to recreate the mystery shapes given to you as closely as possible. During each round, your team will try to recreate a mystery shape by picking two shape cards to convolve and drawing the result.

How to Win:

Win the game by getting the most points. There are 5 points available for each drawing: 1 for each correct shape card selected, 1 for matching the height of the mystery shape, 1 for matching the width of the mystery shape, and 1 for matching the shape of the mystery shape.

Materials Supplied:

- Two of each transparent **shape card**:
  - Delta
  - Square
  - Square + Delta
  - Delayed square
  - Wide rectangle
  - Tall rectangle
  - Triangle
  - Trapezoid
- One **mystery shape** with clearly labeled axes. This shape has been produced by convolving two shape cards.
- One transparent **scoring sheet** to draw your answers and tally points.
- Wet/dry erase markers
- Erasers

How to Play:

1. **Pick team roles.**
   - For each round, your team will need one **picker** (who picks the shape cards) and one **sketcher** (who draws the convolution). If you are a team of three, you will also have a **helper** (who helps both of the other players). Assign these roles however you wish.
2. **Picker: Study the mystery shape and pick two shape cards.**
   - Do not let the sketcher see the mystery shape! Ask them to turn around or close their eyes during this step.

- Draw a mystery shape from the deck. Spend a minute or two looking at the mystery shape, then decide which two shape cards you think can be convolved to make a picture that matches. Once you pick two shape cards, you cannot change your mind.
- If your team has a helper, ask them to check your work.
- When you're finished, write the mystery shape number in one of the open spots on your scoring sheet along with the names of the two shape cards you picked. Turn the mystery shape face-down and give the shape cards you picked to the sketcher.

3. **Sketcher: Perform convolution on the shape cards.**

   - Convolve the two shape cards together and draw the result on your scoring sheet.
   - The order of convolution is up to you!
   - If your team has a helper, have them assist you with calculations and checking your work.

4. **All team members: When you're finished, score your answer with the instructor.**

   - Show your scoring sheet and mystery shape to the instructor. They will check your work and assign points.
   - Discuss the solution as a team and ask questions if they come up.

5. **Swap roles and start a new round.**

   - Reassign roles, put your mystery shape on the bottom of its deck, and return your shape cards to the pile.
   - If you have filled all four spots on your scoring sheet, ask the instructor for a new one.

6. **When the instructor ends the game, add the points on your scoring sheet(s) and calculate your final score. The team with the most points wins.**

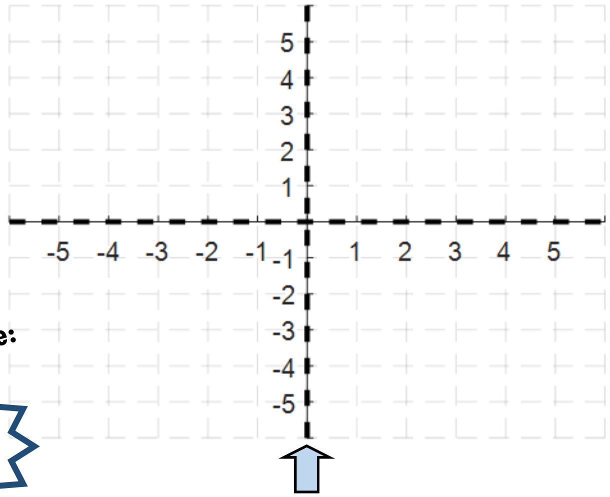
   - Be sure to write all team members' names on the scoring sheet and turn it into your instructor when you're done!

Names: ____

TOTAL POINTS WON: _____

SCORING RULES:

1 checked box ☑ = 1 point



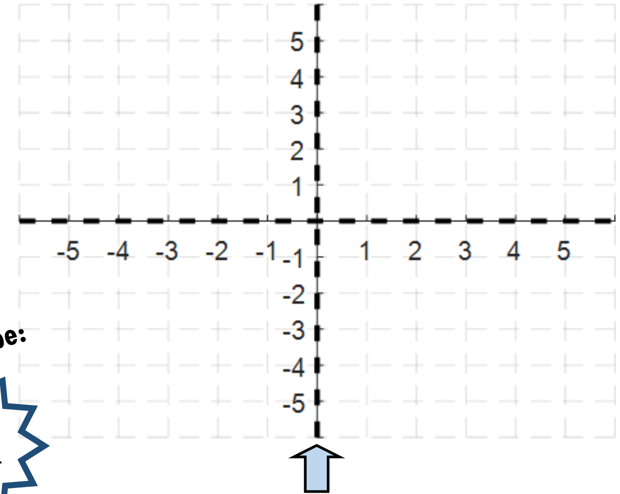
Mystery Shape: # ____

Check the boxes if your drawing has the right…

☐ Height ☐ Width ☐ Shape

Shape card used 1) ______________________________ ☐

Shape card used 2) ______________________________ ☐



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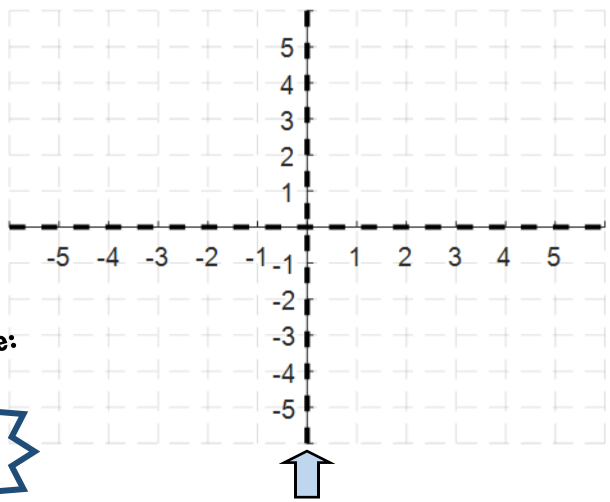
Shape card used 1) ______________________________ ☐

Shape card used 2) ______________________________ ☐



Mystery Shape: # ____

Check the boxes if your drawing has the right…

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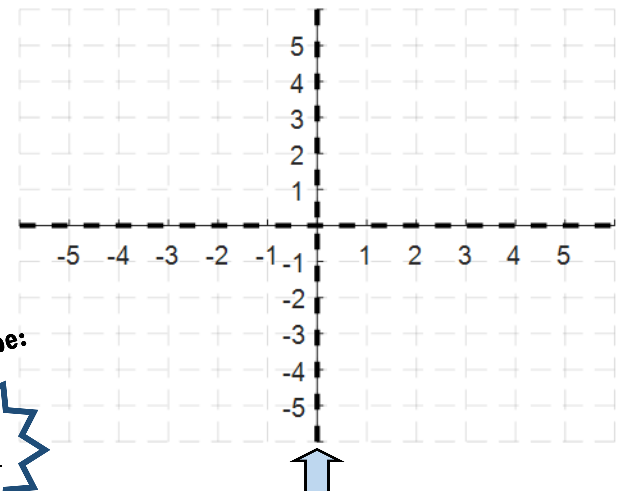
Shape card used 1) ______________________________ ☐

Shape card used 2) ______________________________ ☐



Mystery Shape: # ____

Check the boxes if your drawing has the right…

☐ Height ☐ Width ☐ Shape

Shape card used 1) ______________________________ ☐

Shape card used 2) ______________________________ ☐

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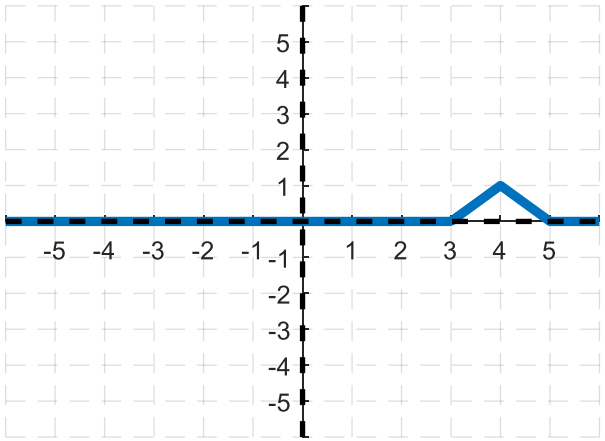
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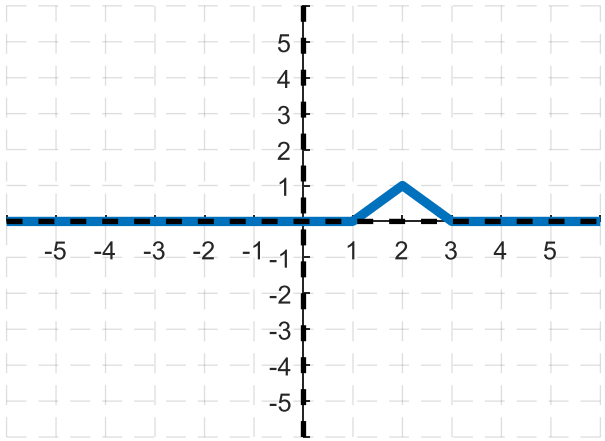
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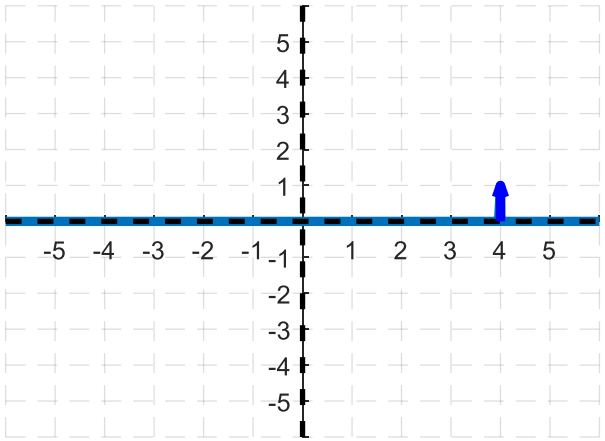
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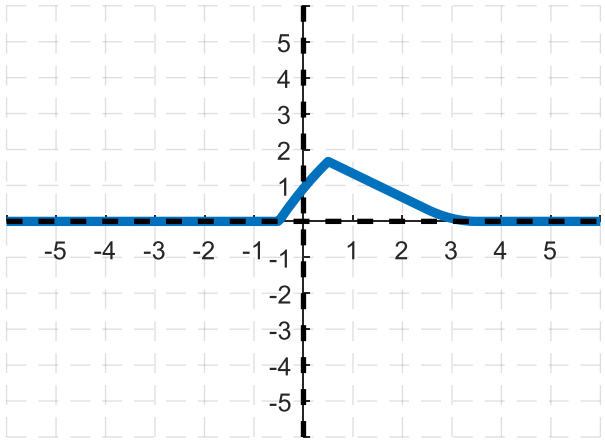
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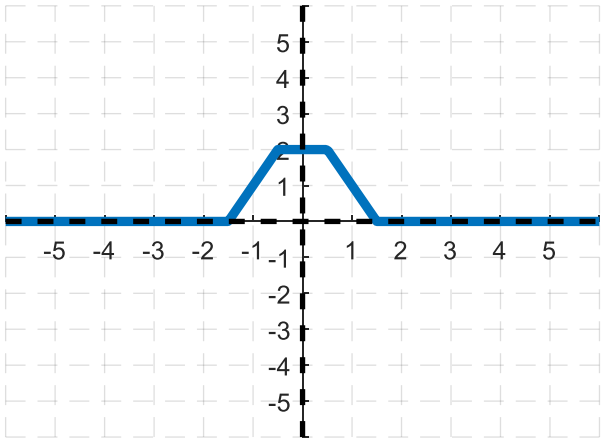
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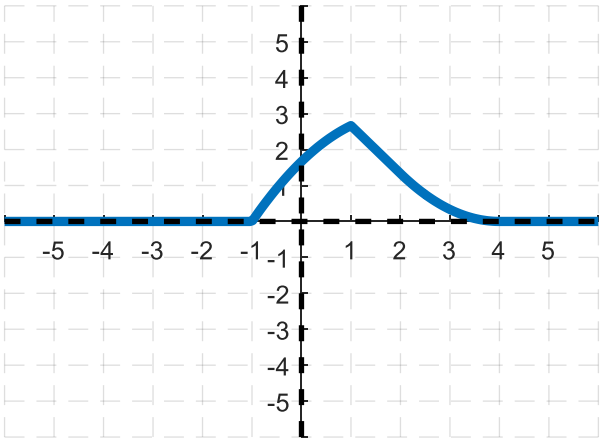
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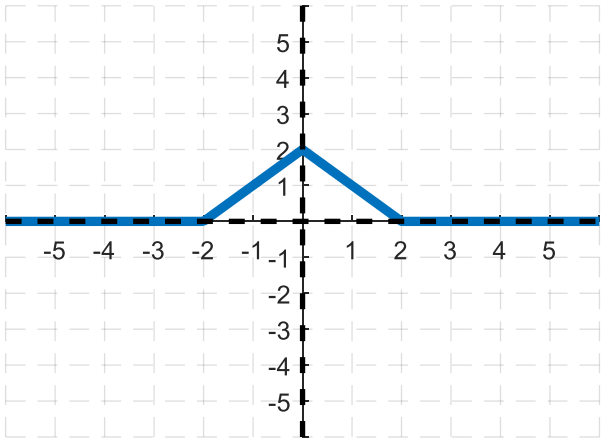
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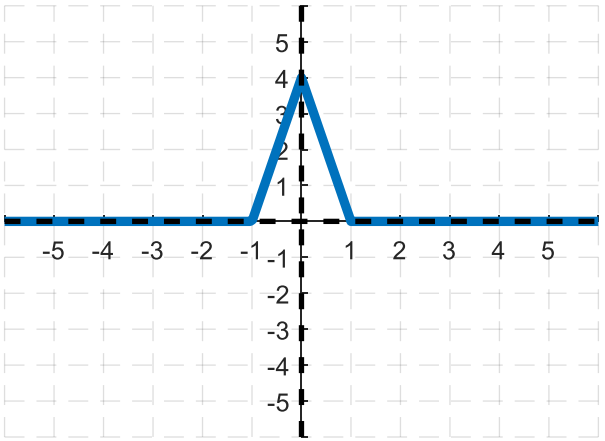
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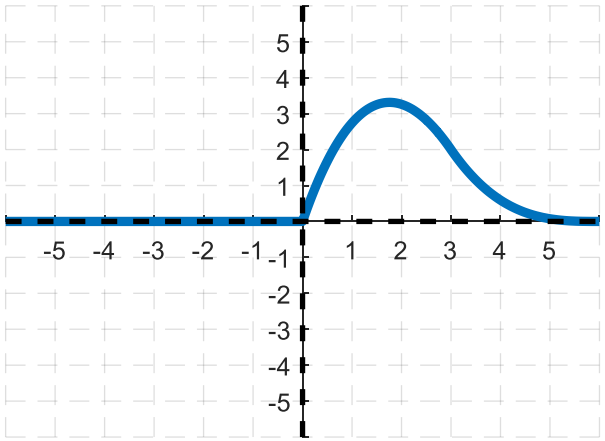
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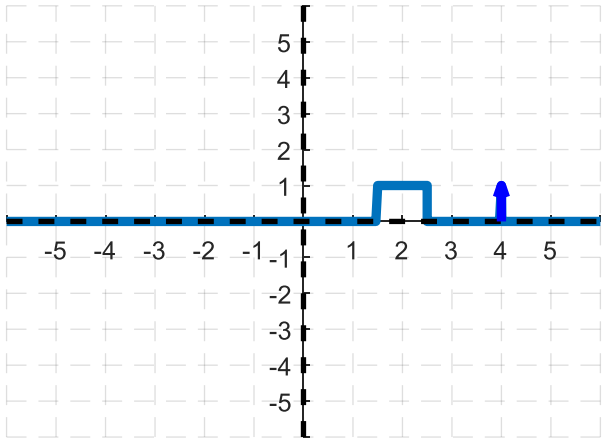
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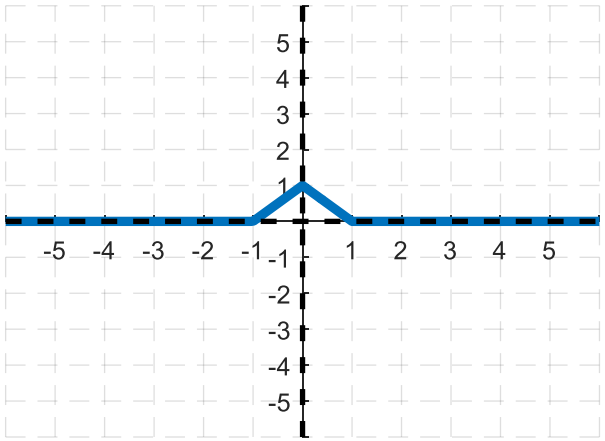
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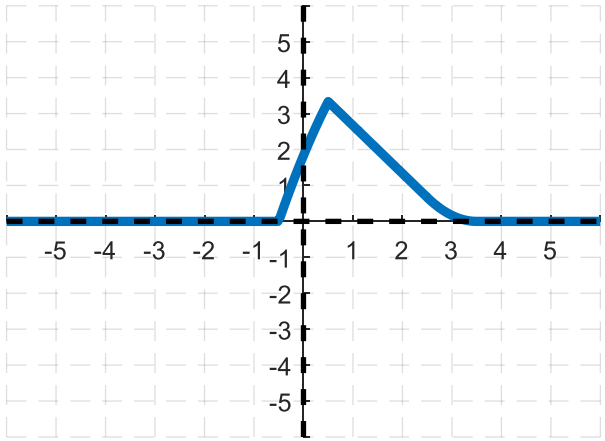
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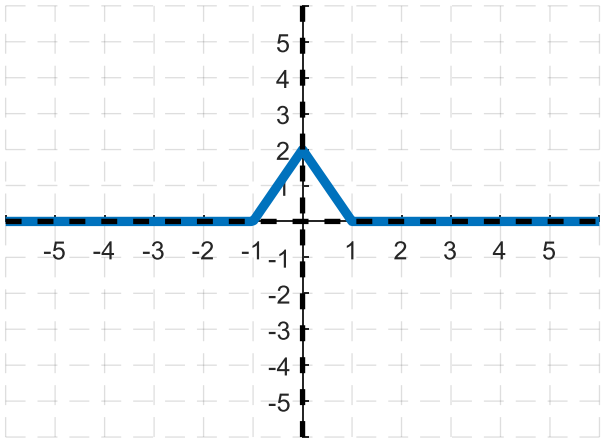
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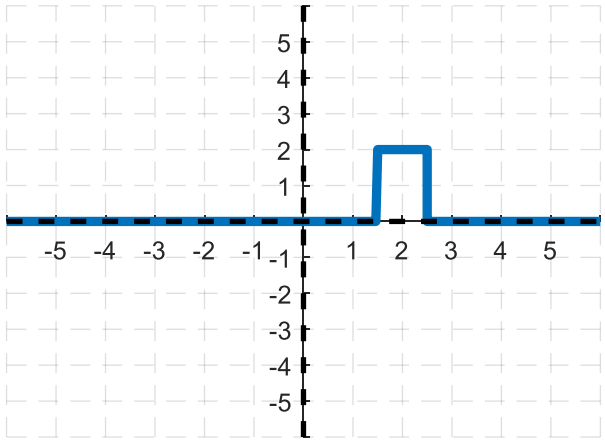
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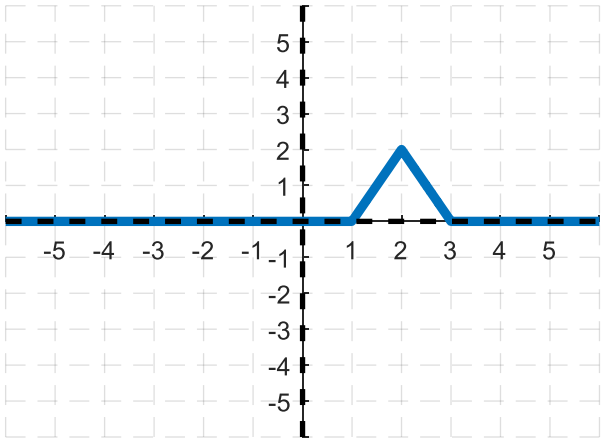
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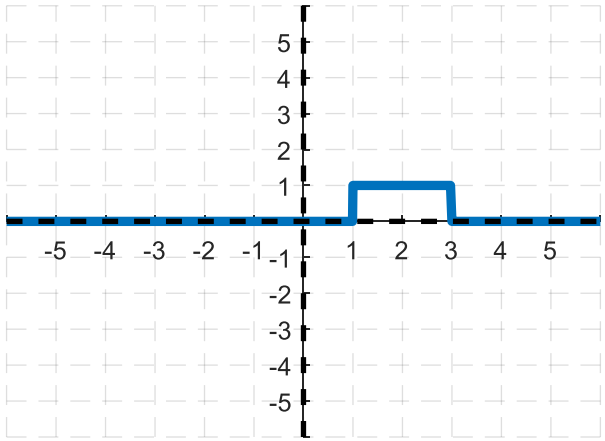
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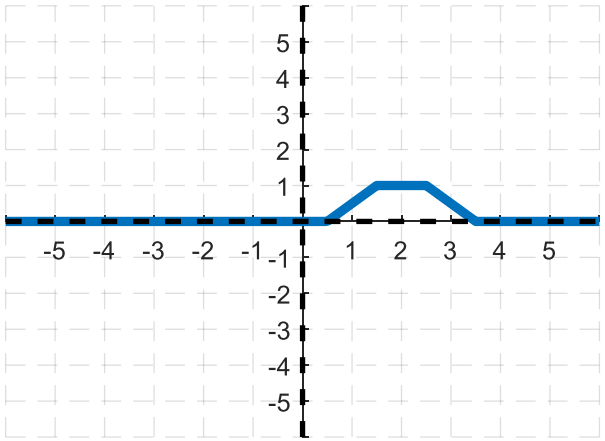
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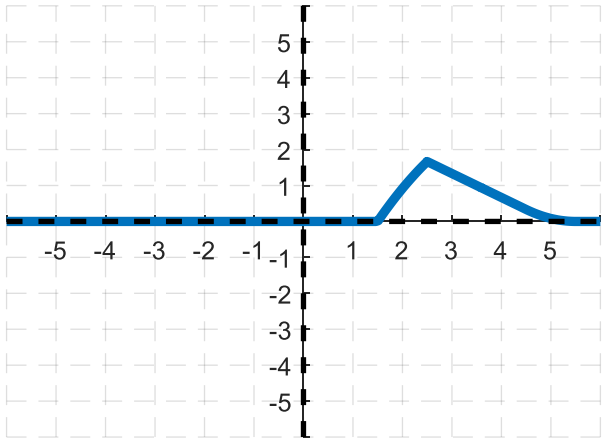
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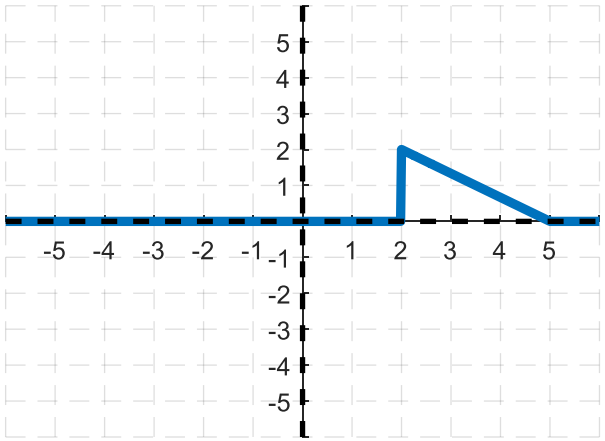
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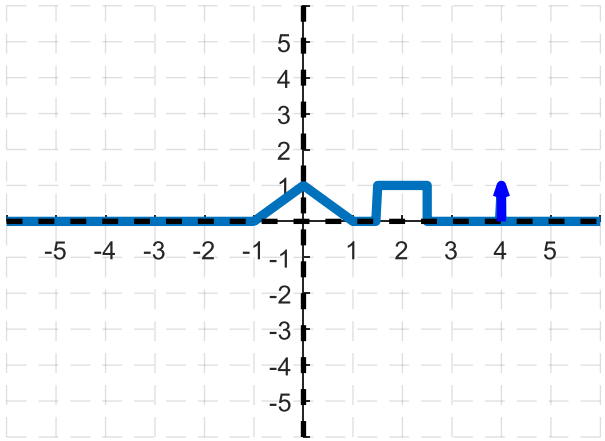
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Trapezoid	**Triangle**	**Square**	**Delayed Square**
Trapezoid	**Triangle**	**Square**	**Delayed Square**
Trapezoid	**Triangle**	**Square**	**Delayed Square**
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Trapezoid	**Triangle**	**Square**	**Delayed Square**
Trapezoid	**Triangle**	**Square**	**Delayed Square**
Delta	**Square + Delta**	**Tall Rectangle**	**Wide Rectangle**
Delta	**Square + Delta**	**Tall Rectangle**	**Wide Rectangle**
Delta	**Square + Delta**	**Tall Rectangle**	**Wide Rectangle**
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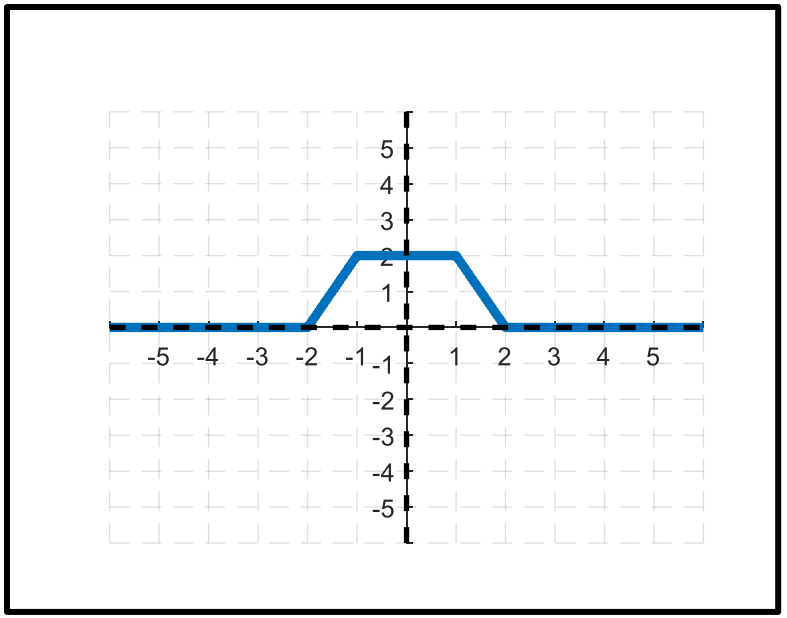
Delta	**Square + Delta**	**Tall Rectangle**	**Wide Rectangle**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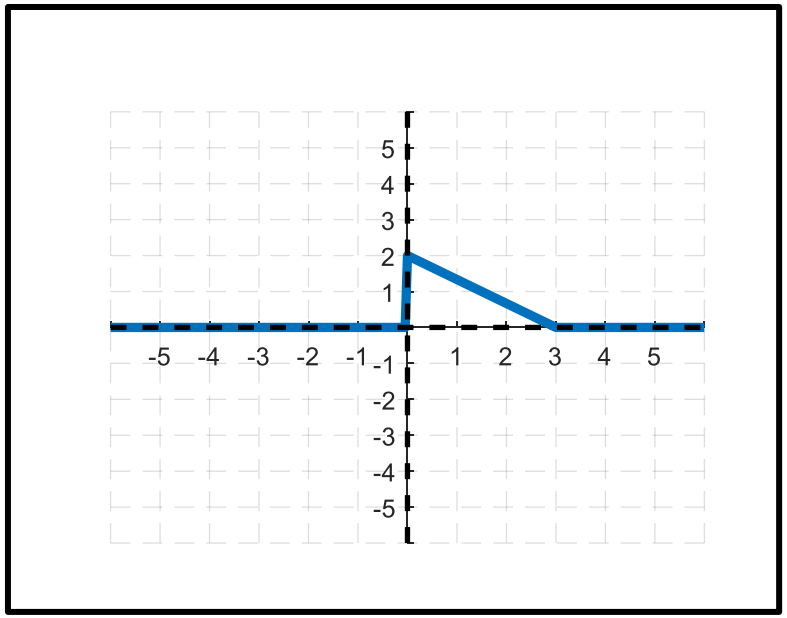
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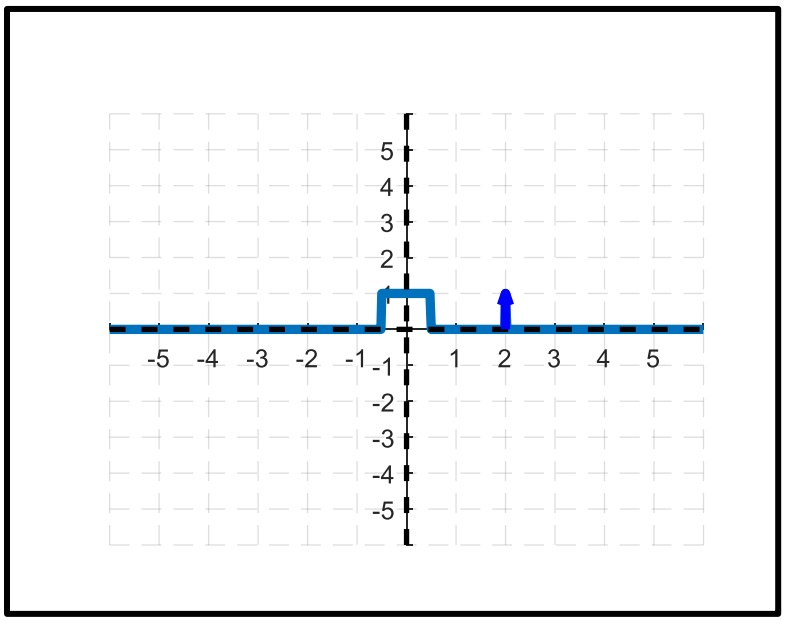
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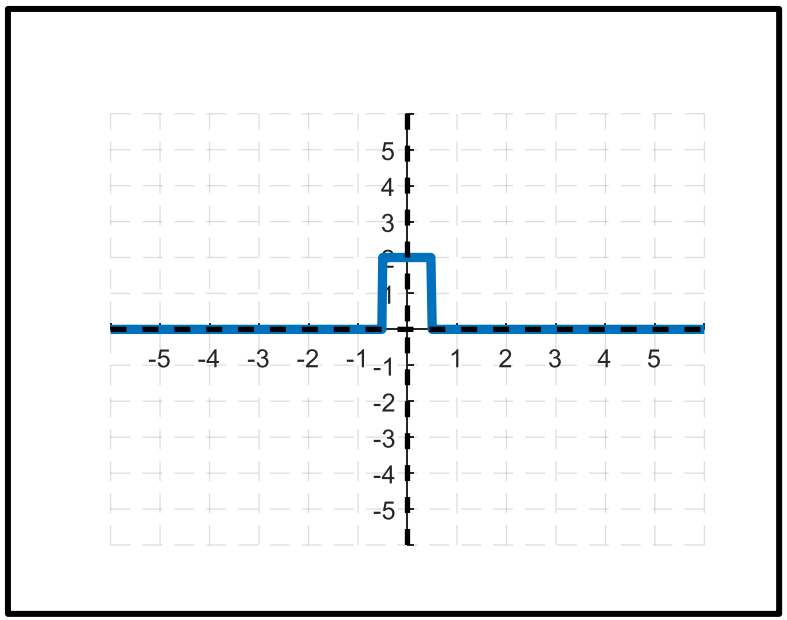
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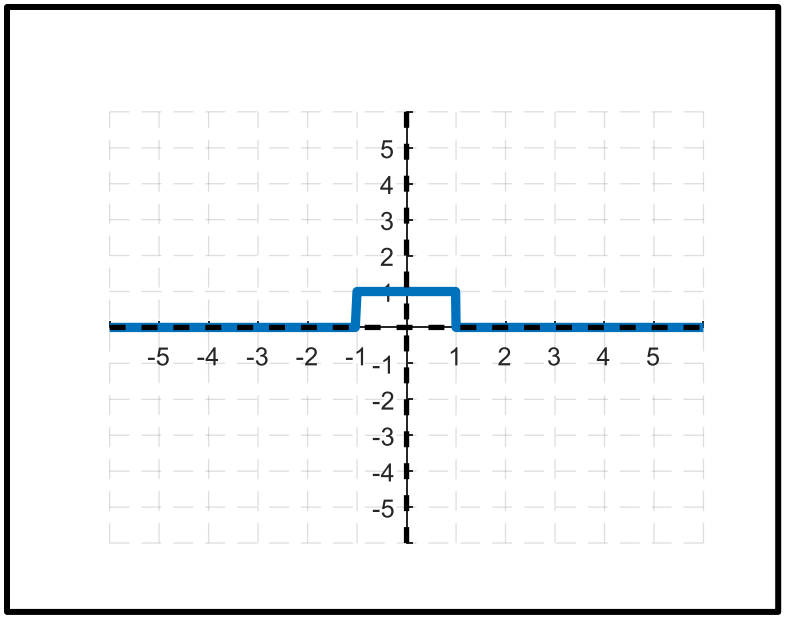
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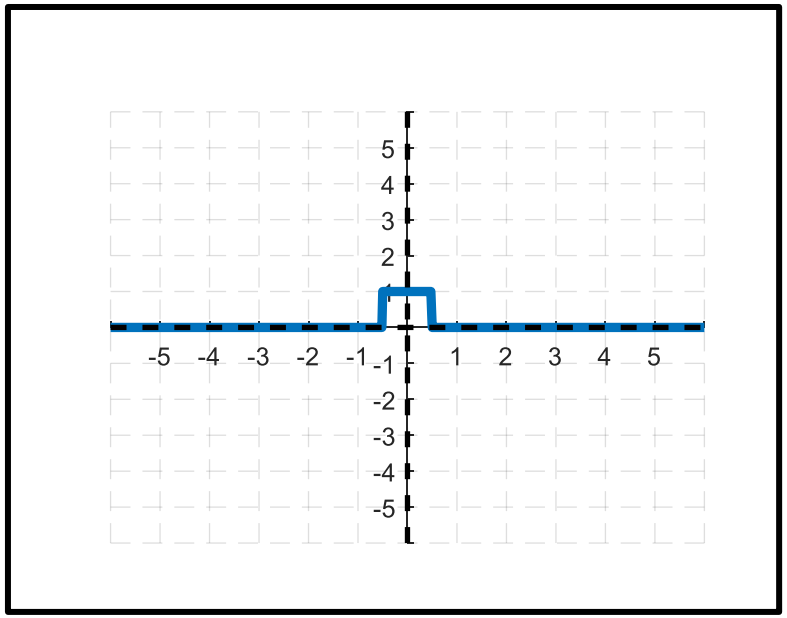
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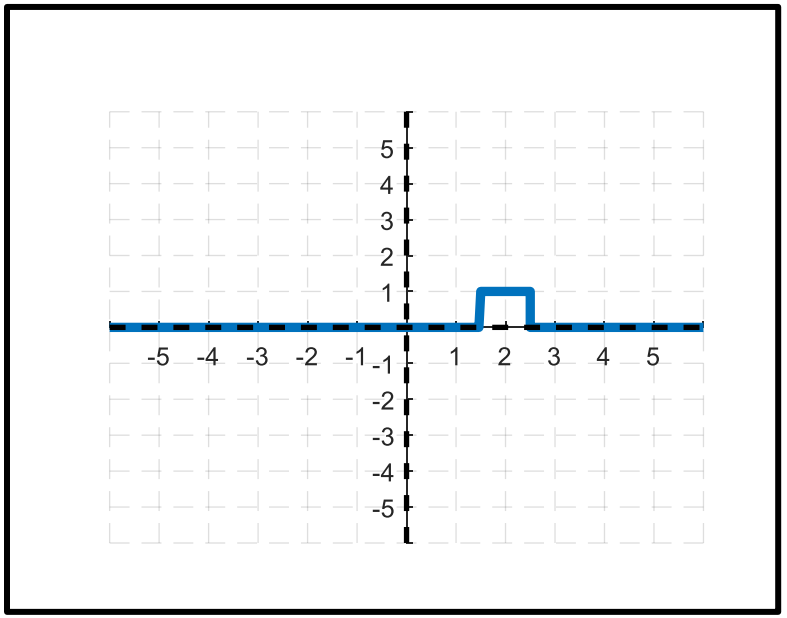
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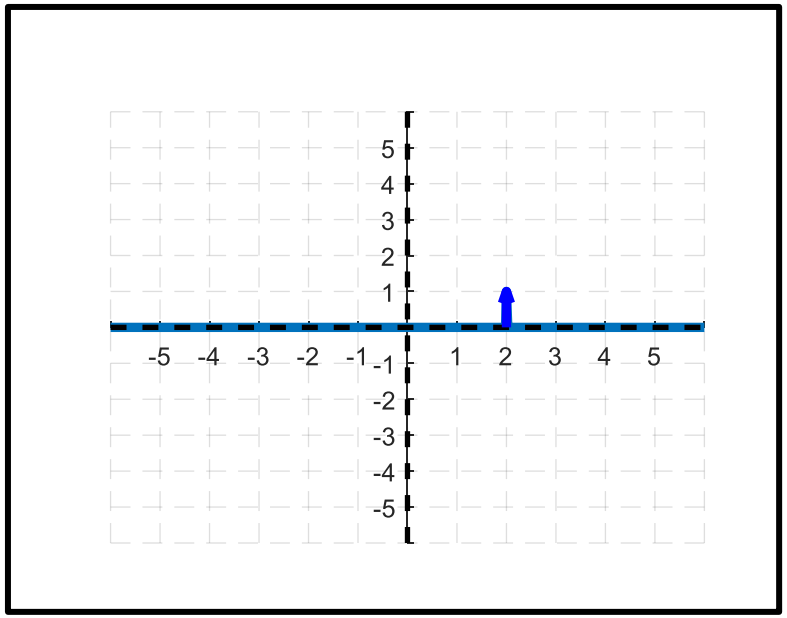
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