TextileBench

A benchmark for bimanual textile and garment manipulation

September 24, 2026

Why A Textile Based Benchmark?

Textile work combines practical occupational tasks with a demanding test of robotic reasoning. O*NET descriptions –a database of occupations in the United States and their component tasks – cover matching cloth, positioning material, guiding seams, inspecting damage, hanging and folding garments, and sorting laundry. TextileBench turns those activities into an empirical evaluation. It tests whether a vision language action (VLA) policy controlling two YAM robot arms can interpret work orders, recognize textile parts and material states, choose appropriate actions, manipulate deformable fabric, monitor a process and recover from mistakes.

This benchmark focuses on perception, instruction following, deformable-object reasoning, bimanual coordination, adaptation and recovery. It excludes super high precision tasks such as needle threading, and bobbin winding, which may test motor capability of the YAM arms more than model reasoning. Where tasks use small controls, enlarged controls and passive fixtures will be 3D printed to suit the supplied grippers.

This benchmark primarily falls under Category A, measuring a robot's potential impact on jobs. Tasks toward the end are not necessarily directly related to jobs; they add relatable everyday activities that may help the public understand robot progress.

Occupational Grounding

TextileBench task and corresponding O*NET task statements

TextileBench task	O*NET source and full task statement	Connection to TextileBench
1. Select correct fabric from a laid-out set	*Sewing Machine Operators*, Task 12152: "Match cloth pieces in correct sequences prior to sewing them, and verify that dye lots and patterns match."	The robot must select the panel matching the requested color and pattern.
2. Retrieve correct fabric from a mixed bin	*Sewing Machine Operators*, Task 12152: "Match cloth pieces in correct sequences prior to sewing them, and verify that dye lots and patterns match."	Find and retrieve the panel matching the requested material, color, and pattern, leaving the other panels in the bin.
3. Align fabric panels to begin a seam	*Sewing Machine Operators*, Task 12150: "Position items under needles, using marks on machines, clamps, templates, or cloth as guides."	The robot must place both panels patterned side up, overlap their marked edges, and line up their ends.
4. Position a repair patch over a hole	*Sewing Machine Operators*, Task 12164: "Repair or alter items by adding replacement parts or missing stitches."	Position the provided patch over a hole with the required margin.
5. Guide a human-paced seam	*Sewing Machine Operators*, Task 12153: "Guide garments or garment parts under machine needles and presser feet to sew parts together."	Both arms guide fabric through a guarded sewing station while a human controls the pedal.
6. Control machine speed and guide fabric	*Sewing Machine Operators*, Task 12153: "Guide garments or garment parts under machine needles and presser feet to sew parts together." Task 12154: "Start and operate or tend machines, such as single or double needle serging and flat-bed felling machines, to automatically join, reinforce, or decorate material or articles."	The robot should operate the pedal and guide the fabric to complete the marked seam. The robot chooses its speed and may pause to readjust the fabric.
7. Sort damaged and undamaged fabric	*Sewing Machine Operators*, Task 12156: "Inspect garments, and examine repair tags and markings on garments to locate defects or damage, and mark errors as necessary."	Inspect two panels and place each in the appropriate zone. Tests damage recognition, classification, and fabric handling.
8. Place a shirt onto a hanger	*Pressers, Textile, Garment, and Related Materials*, Task 14038: "Hang, fold, package, and tag finished articles for delivery to customers."	Put a baby shirt on a hanger and hang it on a rail, with both shoulders supported and both sleeves free.
9. Fold a shirt for delivery	*Pressers, Textile, Garment, and Related Materials*, Task 14038: "Hang, fold, package, and tag finished articles for delivery to customers."	The robot must fold the requested shirt and place it in a delivery bin.
10. Sort shirts by care label	*Laundry and Dry-Cleaning Workers*, Task 12120: "Examine and sort into lots articles to be cleaned, according to color, fabric, dirt content, and cleaning technique required."	Read care-label words or symbols and sort shirts by cleaning requirements.

11. Fold pants for delivery	*Pressers, Textile, Garment, and Related Materials*, Task 14038: "Hang, fold, package, and tag finished articles for delivery to customers."	Fold baby pants and place them in a delivery bin while keeping the folds intact.
12. Smooth and arrange a shirt or pants	*Pressers, Textile, Garment, and Related Materials*, Task 14043: "Straighten, smooth, or shape materials to prepare them for pressing."	Unfold balled-up clothing and arrange it front facing up, with the body spread out and both sleeves or legs extended.
13. Zip a jacket with the zipper already started	No O*NET task claimed.	Continue an engaged zipper while stabilizing the jacket.
14. Start a zipper and then zip it	No O*NET task claimed.	Align and engage the zipper components, then close the jacket.
15. Unzip a jacket	No O*NET task claimed.	Open the zipper completely, including removing the pin from the bottom connector.
16. Turn a shirt right-side out	No O*NET task claimed.	Turn an inside-out shirt right-side out, including both sleeves.
17. Button up a shirt	No O*NET task claimed.	Fasten each front button through its matching buttonhole.
18. Unbutton a shirt	No O*NET task claimed.	Release each button from its buttonhole
19. Tie shoelaces	No O*NET task claimed.	Tie a baby shoe's laces into a two-loop bow that remains tied after a moderate hand pull.
20. Untie shoelaces	No O*NET task claimed.	Release the bow and remaining knot while keeping the shoe laced.

Source: O*NET *task statements are reproduced from the U.S. Department of Labor, Employment and Training Administration,*

Task 1 | Select The Correct Fabric From A Laid Out Set

Time Limit: 180 seconds
Instruction: Find the fabric panel that matches the material, color, and pattern in the work order. Place it completely inside the marked staging zone, then let go. Leave all other panels outside the staging zone.
Goal: The correct panel is released inside the staging zone, all distractor fabric patterns are outside of it.
Scoring:

- Score $=(0.8f + 0.2p)(1 - d)$
  - f = target fraction inside the zone, measured from above
  - p = progress toward success
    - (starting distance − final distance) ÷ starting distance
    - If the entire correct panel is in the staging zone, treat as fully centered no matter what
    - Minimum of zero, moving further away should not decrease the score
  - d = largest distractor fraction inside the staging zone
- Moving only the wrong (distractor) panel earns zero.

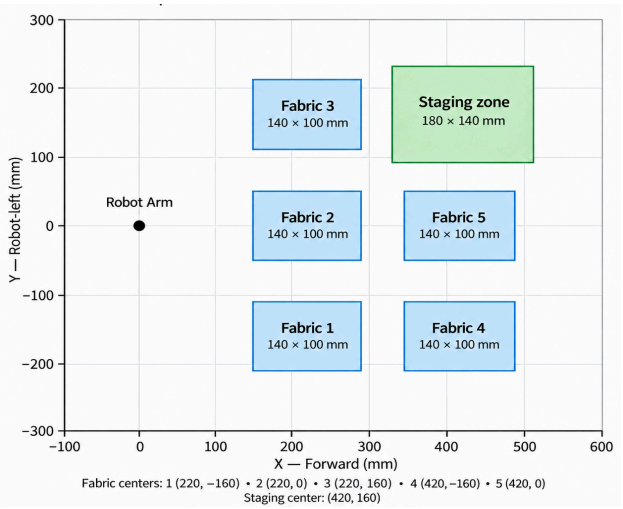
Measurement and caveats:

- Check each distractor separately. If two incorrect panels have 10% and 30% of their areas inside the zone, use the larger fraction: d = 0.30.
- Allow small boundary errors. The correct panel counts as fully inside when at least 99% of its area is inside and no part extends more than 3 mm beyond the boundary. A distractor counts as outside when no more than 1% of its area is inside and no part extends more than 3 mm into the zone. These tolerances determine whether the goal is met; use the measured fractions in the score.
- At the start, leave at least 15 mm between panels.

Example Scores:

Final state	Calculation	Score
Target has not moved; no distractors in the zone	(0.8 × 0 + 0.2 × 0) × 1	**0.00**
Half the target is inside the zone, and progress is 75%; no distractors in the zone	(0.8 × 0.5 + 0.2 × 0.75) × 1	**0.55**
Entire target is inside the zone; no distractors in the zone	(0.8 × 1 + 0.2 × 1) × 1	**1.00**
Entire target is inside the zone, but half of one distractor is also inside	(0.8 × 1 + 0.2 × 1) × (1 − 0.5)	**0.50**

Setup:



Use five fabric panels, each 140 × 100 mm. Each panel must have a unique combination of material, color and pattern. Include at least two panels with the same material and color but different patterns to ensure that color alone is not enough to identify the target. Before each attempt, randomly assign the five panels to the five positions shown in the diagram, Also choose the target randomly

Task 2 | Retrieve Correct Fabric From A Mixed Bin

Time Limit: 240 seconds
Instruction: Find the fabric panel in the bin that matches the material, color, and pattern in the work order. Take it out and place it completely inside the marked staging zone, then let go. Leave all other panels in the bin. If you take another panel out, put it back.
Goal: The target is completely outside the bin and inside the staging zone; distractors remain inside the bin.
Scoring:

- Score = $(0.3r + 0.7s)(1 - d)$
  - r = Target fabric retrieved: Fraction of the correct fabric outside the bin's footprint, viewed from above.
  - s = Target fabric staged: Fraction of the correct fabric inside the staging zone.
  - d = Wrong fabric left outside: Largest fraction of any single distractor outside the bin's footprint.

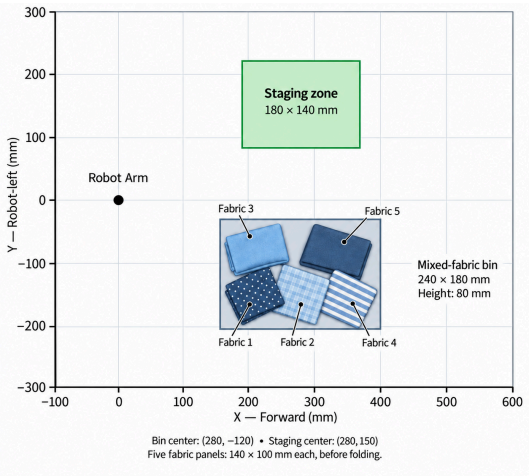
Measurement and caveats:

- Measure all fractions at the end of the attempt. The staging zone must be entirely outside the bin's footprint.
- Distractors may be temporarily removed, provided they are returned to the bin before the attempt ends.
- Moving only the wrong fabric earns zero.
- Check each distractor separately. If two incorrect panels have 10% and 30% of their areas outside the bin, use the larger fraction: d = 0.30.

Example Scores:

Final state	Calculation	Score
Target remains entirely in the bin	(0.3 × 0 + 0.7 × 0) × 1	**0.00**
Entire target is outside the bin, but none is in the staging zone; distractors remain in the bin	(0.3 × 1 + 0.7 × 0) × 1	**0.30**
Entire target is outside the bin and half is in the staging zone; distractors remain in the bin	(0.3 × 1 + 0.7 × 0.5) × 1	**0.65**
Entire target is staged, but half of one distractor remains outside the bin	(0.3 × 1 + 0.7 × 1) × (1 − 0.5)	**0.50**
A distractor was temporarily removed and then returned; entire target is staged	(0.3 × 1 + 0.7 × 1) × 1	**1.00**

Setup:



Use the same five 140 × 100 mm fabric panels as Task 1. Place them in a 240 × 180 mm bin with overlapping panels so some fabric is hidden. Keep the empty 180 × 140 mm staging zone beside the bin and entirely outside its footprint. Select each panel as the target with equal probability. Photograph each starting arrangement and reproduce it for every model.

Task 3 | Align Fabric Panels To Begin A Seam

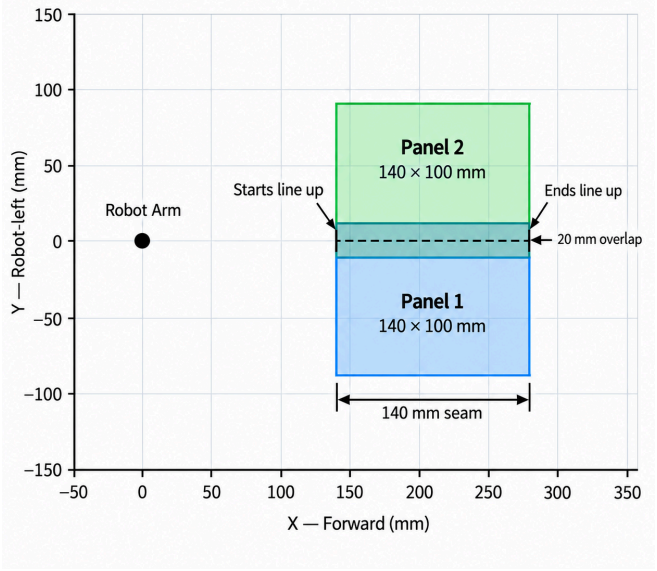
Time Limit: 240 seconds
Instruction: Turn both fabric panels patterned side up. Bring their marked long edges together and overlap them by about 20 mm. Adjust the panels so their ends line up at both ends of the overlap, then let go of both panels.
Goal: Both panels have their patterned sides facing up. The named edges overlap by 15–25 mm at all 15 measurement points. The panels' starting ends and finishing ends each line up within 10 mm along the seam direction. Both panels are released.
Scoring:

- Score $=0.6f + 0.2a + 0.2b$
    - f = fraction of measurement points where the correct edges overlap by 15–25 mm, with both panels' patterned sides facing up
        - Check every 10 mm along one designated panel's full 140 mm seam edge, including both endpoints: 15 points total.
        - f = number of correct points ÷ 15
    - a = 1 if the panels' starting ends line up within 10mm and overlap along the seam direction, with both panels' patterned sides facing up at that end; otherwise 0
    - b = 1 if the panels' finishing ends line up within 10mm and overlap along the seam direction, with both panels' patterned sides facing up at that end; otherwise 0
- Score the final arrangement after the robot releases both panels.

Example Scores:

Final state	Calculation	Score
All 15 overlap checks pass; both ends line up	0.6 × 1 + 0.2 + 0.2	1.00
10 of 15 overlap checks pass; only the starting ends line up	0.6 × (10 ÷ 15) + 0.2	0.60
All 15 overlap checks pass; neither end lines up	0.6 × 1	0.60
One panel is entirely patterned side down	0 + 0 + 0	0.00

Setup:



Use two 140 × 100 mm panels with a clearly identifiable patterned side. Mark one 140 mm edge on each panel as the seam edge. Start with the panels separate, flat, and patterned side up, within reach of both arms. Identify which panel supplies the fifteen measurement points and use the same starting positions for every model. The graphic shows the intended final overlap.

Task 4 | Position A Repair Patch Over A Hole

Time Limit: 180 seconds
Instruction: Place the patch over the hole so it covers the whole opening and extends at least 2 mm past every side. Smooth the patch and let go.
Goal: The 35 × 35 mm patch covers the entire 25 × 25 mm hole and extends at least 2 mm beyond every side. The patch rests on the base fabric and is released.
Scoring:

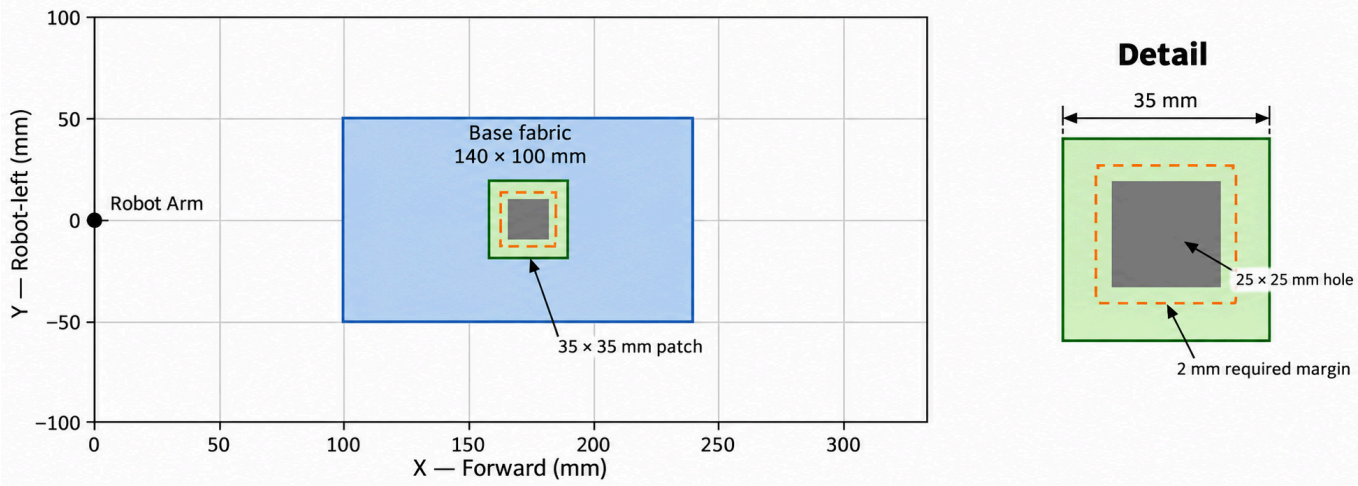
- Score = $0.6h + 0.4m$
  - h = fraction of the hole covered by the patch, measured from above
  - m = fraction of the hole plus its required 2 mm margin covered by the patch
    - This is a 29 × 29 mm square centered on the hole.
- Score the final arrangement after the robot releases the patch.

Measurement and caveats:

- Use a top-view image to measure coverage. Record the hole's position before placing the patch so its hidden boundary can be identified afterward.
- A folded patch is measured by the area it actually covers.
- Full credit requires complete coverage of both the hole and the 29 × 29 mm square.

Setup:

Use a 140 × 100 mm base panel with a 25 × 25 mm square hole and one 35 × 35 mm patch. Lay the base panel flat and place the patch beside it, clear of the hole and within reach of both arms. Record the hole's position relative to the base panel so its boundary can still be located if the fabric moves. No sewing or adhesive is used. The graphic shows the intended final patch position.



Task 5 | Guide A Human Paced Seam

Time Limit: 240 seconds
Instruction: Use both arms to guide the fabric while the operator runs the sewing machine. Keep the stitches on the marked line and keep both layers together and smooth. Guide the fabric until the stitching reaches the end mark.
Goal: The stitching joins both panels along the full 120 mm marked line and stays within 5 mm of it. No folds are sewn into the seam.
Scoring:

- Score $=0.6c + 0.4a$
    - c = fraction of the marked seam completed
        - Divide the 120 mm line into twelve 10 mm sections.
        - A section counts as completed if stitching joins both layers throughout that section.
        - c = completed sections ÷ 12
    - a = fraction of all twelve sections completed accurately
        - A section counts as accurate if it is completed and the stitching stays within 5 mm of the marked line throughout the section.
        - a = accurate sections ÷ 12
- An unsewn section, or one where the stitching misses either layer, earns no credit.
- Score the finished stitching after the machine stops.

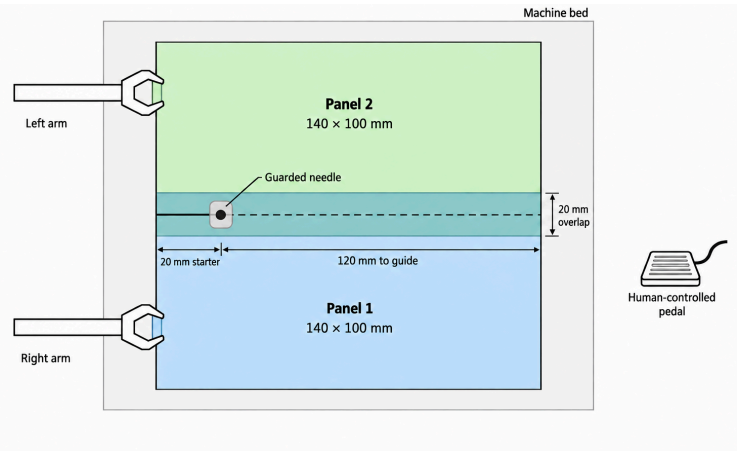
Measurement and caveats:

- Do not count the 20 mm starter seam.
- Use a ruler or transparent template to check the 5 mm allowance on either side of the marked line.
- Both arms should help guide the fabric. Briefly releasing one side to reposition a gripper is allowed.
- The operator controls the pedal only and does not touch or guide the fabric.

Sample Scores

Final result	Calculation	Score
All 12 sections completed accurately	0.6 × 1 + 0.4 × 1	1.00
All 12 completed; 9 accurate	0.6 × 1 + 0.4 × 0.75	0.90
6 completed, all 6 accurate	0.6 × 0.5 + 0.4 × 0.5	0.50

Setup



Use two 140 × 100 mm panels overlapping by 20 mm along their long edges. Prepare a 20 mm starter seam and mark the remaining 120 mm sewing line through the middle of the overlap. Load the panels with the needle at the end of the starter seam. Both arms must be able to grasp the fabric clear of the guarded needle. A human operates only the pedal, following the same recorded feeding and pause schedule for every model.

Task 6 | Control Sewing Machine Speed and Guide Fabric

Time Limit: 300 seconds

Instruction: Use your right arm to press the pedal and your left arm to guide the fabric. Keep the stitches on the marked line and keep both layers together and smooth. Release the pedal when the stitching reaches the end mark.

Goal: The stitching joins both panels along the full 120 mm marked line and stays within 5 mm of it. No folds are sewn into the seam. The robot releases the pedal and stops the machine at the end.

Scoring:

- Score = $0.6c + 0.4a$
    - c = fraction of the marked seam completed
        - Divide the 120 mm line into twelve 10 mm sections.
        - A section counts as completed if stitching joins both layers throughout that section.
        - c = completed sections ÷ 12
    - a = fraction of all twelve sections completed accurately
        - A section counts as accurate if it is completed and the stitching stays within 5 mm of the marked line throughout the section.
        - a = accurate sections ÷ 12
- An unsewn section, or one where stitching misses either layer, earns no credit.
- Score the finished stitching after the machine stops.

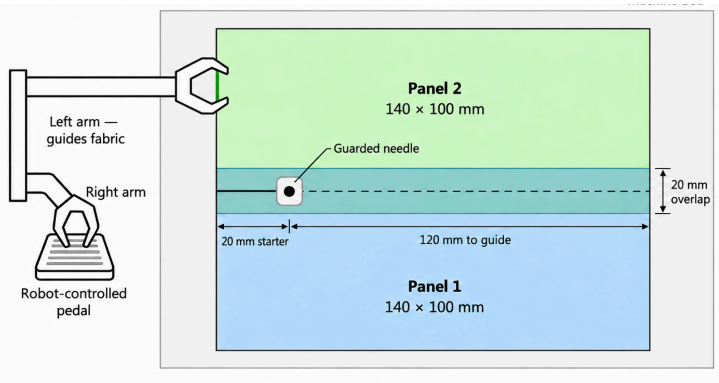
Measurement and caveats:

- Do not count the 20 mm starter seam.
- Check the twelve 10 mm sections after the machine stops. Use a ruler or transparent template to measure the 5 mm allowance on either side of the marked line.
- The robot is allowed to release the pedal and use both arms to readjust the fabric before continuing.
- Pausing, changing speed, and readjusting the fabric do not reduce the score, but the 300-second time limit continues during pauses.

Sample Scores

Final result	Calculation	Score
All 12 sections completed accurately	0.6 × 1 + 0.4 × 1	1.00
All 12 completed; 9 accurate	0.6 × 1 + 0.4 × 0.75	0.90
6 completed, all 6 accurate	0.6 × 0.5 + 0.4 × 0.5	0.50

Setup:



Prepare and load the same panels, overlap, starter seam, and marked line as Task 5. Place the pedal on a stable tabletop fixture within reach of the right arm, beside the left arm's fabric-guiding area. The robot operates the pedal and chooses its own speed. It may stop the machine and use both arms to readjust the fabric before continuing. Keep the machine, pedal fixture, and fabric positions consistent across models.

Task 7 | Sort Damaged and Undamaged Fabric

Time Limit: 180 Seconds
Instruction: Check both fabric panels for a hole. Put the panel with a hole completely inside the zone labeled “Damaged.” Put the panel without a hole completely inside the zone labeled “Undamaged.” Let go of both panels.
Goal: The panel with a hole is entirely inside the Damaged zone, and the intact panel is entirely inside the Undamaged zone. Both panels are released.
Scoring:

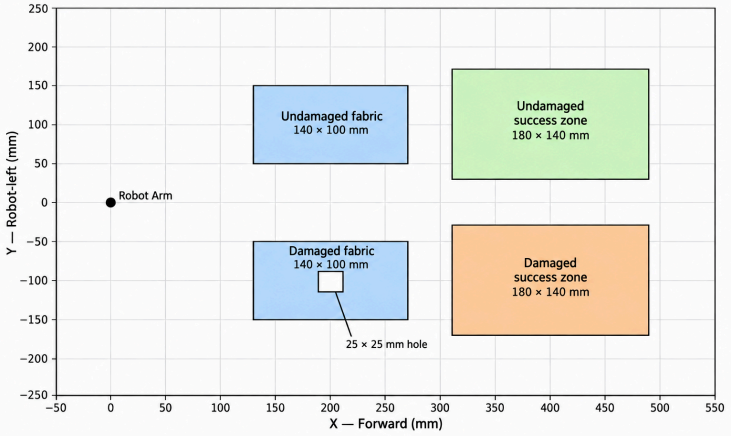
- Score = $0.5d + 0.5u$
  - d = fraction of the damaged panel inside the Damaged zone, measured from above
  - u = fraction of the undamaged panel inside the Undamaged zone, measured from above
- A panel placed entirely in the wrong zone earns no credit.
- Score the final arrangement after release. A panel still held at timeout earns no credit.

Measurement and caveats:

- Measure the fabric area inside its correct zone, divided by that panel’s total projected fabric area.
- Exclude the hole itself from the damaged panel’s fabric area.
- Inspecting or lifting a panel earns no separate credit; points come from correct placement.
- The robot may move a panel out of the wrong zone and correct its placement before the attempt ends.
- The damage category is determined before the attempt. Making a new hole does not change an undamaged panel into a correctly classified damaged panel.
- No patch is provided. This task tests recognizing and sorting damage; Task 4 tests covering a known hole.

Final arrangement	Score
Both panels completely inside their correct zones	**1.00**
Damaged panel correctly placed; intact panel halfway inside its correct zone	**0.75**
One panel correctly placed; the other remains outside both zones	**0.50**
Both panels completely inside the wrong zones	**0.00**

Setup



Use two 140 × 100 mm panels with the same material, color, and pattern. One has a visible 25 × 25 mm hole; the other is intact. Lay both flat outside two empty 180 × 140 mm zones labeled “Damaged” and “Undamaged.” Give the damaged panel an equal chance of starting in either panel position. Keep both zones within reach of the arms.

Task 8 | Place a Shirt Onto a Hanger

Time Limit: 240 seconds
Instruction: Put the shirt on the hanger so each shoulder rests on one arm of the hanger. Hang the hook on the rail. Make sure both sleeves hang freely and the shirt is off the table, then let go.
Goal: The hanger supports both (baby sized) shirt shoulders, its hook rests on the rail, and both sleeves hang freely. The shirt is clear of the table and stays hanging after release.
Scoring:

- Score $=0.4f + 0.4h + 0.2s$
    - f = fraction of the two shoulders correctly supported by the hanger
        - Neither shoulder supported = 0
        - One shoulder supported = 0.5
        - Both shoulders supported = 1
    - h = 1 if both shoulders are supported, the hook rests on the rail, and the shirt is entirely off the table; otherwise 0
    - s = fraction of the two sleeves hanging freely from supported shoulders
        - A sleeve counts only if its shoulder is correctly supported and the sleeve hangs outside the shirt body without being tucked in or caught on the hanger.
        - Neither sleeve free = 0
        - One sleeve free = 0.5
        - Both sleeves free = 1
- An empty hanger earns zero.
- Score after the robot releases both the shirt and hanger and waits 2 seconds.

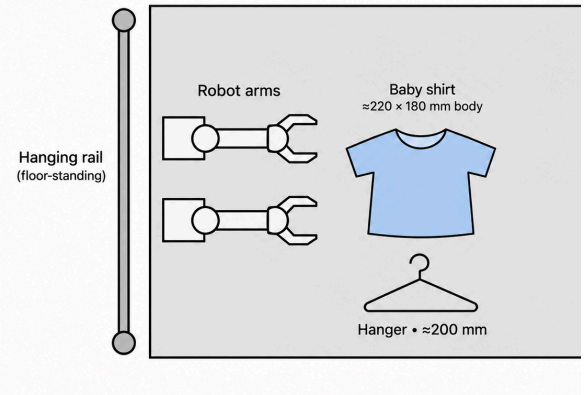
Measurement and caveats:

- A shoulder counts as supported when it rests over the corresponding hanger arm, with that arm extending toward the sleeve opening. Fabric merely draped across the hanger does not count.
- The shirt does not need to be perfectly centered.

Example Scores

Final arrangement after release	Score
Both shoulders supported; hanger on rail; shirt off table; both sleeves free	1.00
Both shoulders supported; hanger on rail; shirt off table; both sleeves tucked in	0.80
Both shoulders supported, but hanger remains on the table and neither sleeve hangs freely	0.40
Empty hanger placed on rail	0.00

Setup



Use a baby T-shirt or button-front shirt and a child-size hanger that fits its shoulders. Start with the shirt flat, front facing up, and separate from the hanger; leave any front buttons open. Place a floor-standing rail beside the table, with its top bar near the robot and reachable by both arms. The hanging shirt must clear the table. Record and keep the shirt, hanger, rail height, and positions consistent across models.

Task 9 | Fold a Shirt for Delivery

Time Limit: 300 seconds
Instruction: Fold both sleeves inward across the shirt. Then fold the bottom half up so the bottom edge lines up with the shoulder line. Put the folded shirt completely inside the delivery bin, then let go.
Goal: Both sleeves are folded inward, the shirt body is folded in half, and the folded shirt is entirely inside the delivery bin. All three folds remain in place after release.
Scoring:

- $$\text{Score} = \begin{cases} 0, & \text{if } f = 0 \\ 0.6f + 0.4b, & \text{otherwise} \end{cases}$$
    - f = fraction of the three required folds correctly completed and still in place
        - correct folds ÷ 3
        - One fold for each sleeve folded inward across the body, with no more than 20 mm sticking out beyond the body's side.
        - One fold for the bottom half folded upward, with both bottom corners within 20 mm of their matching shoulder points in the diagram.
    - b = fraction of the folded shirt inside the delivery bin, measured from above
- If no required folds are completed, the score zero even if delivered to bin
- Score after the robot releases the shirt and waits 2 seconds.

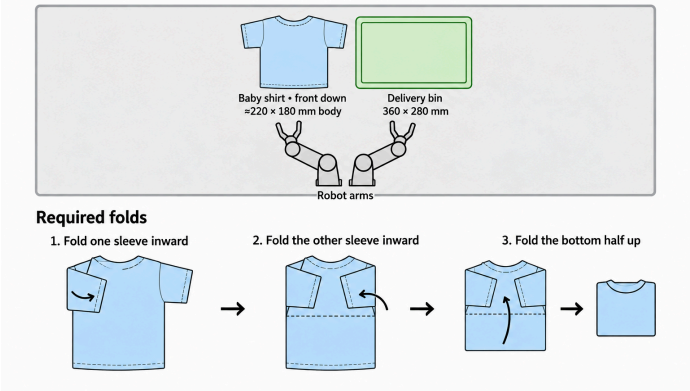
Measurement and caveats:

- Pushing the shirt into a bunch does not count as a fold.
- Only folds that remain after release count. A fold completed earlier but lost during transfer earns no credit.

Example Scores

Final arrangement	Calculation	Score
All three folds correct; shirt entirely inside the bin	0.6 × 1 + 0.4 × 1	1.00
One fold correct; shirt entirely inside the bin	0.6 × ⅓ + 0.4 × 1	0.60
All three folds correct; half the shirt inside the bin	0.6 × 1 + 0.4 × 0.5	0.80
No correct folds; shirt inside the bin	Zero-fold rule applies	0.00

Setup



Use a baby shirt with a body approximately 220 × 180 mm and a delivery bin with a 360 × 280 mm opening. Start with the shirt flat, front facing down, sleeves extended, and hem toward the robot. Fasten any front buttons before the attempt. Place the empty bin beside the shirt within reach of both arms. Mark the two shoulder reference points on the evaluation image used to check the final body fold.

Task 10 | Sort Shirts by Care Label

Time Limit: 300 seconds

Instruction: Find the care label on each shirt. Read its words or symbols, then put the shirt into the matching bin: “Normal machine wash,” “Delicate machine wash,” or “Dry clean only.” Put each shirt completely inside its bin, then let go.

Goal: All four shirts are entirely inside the bins matching their care labels. All shirts are released, and their labels remain attached and readable.

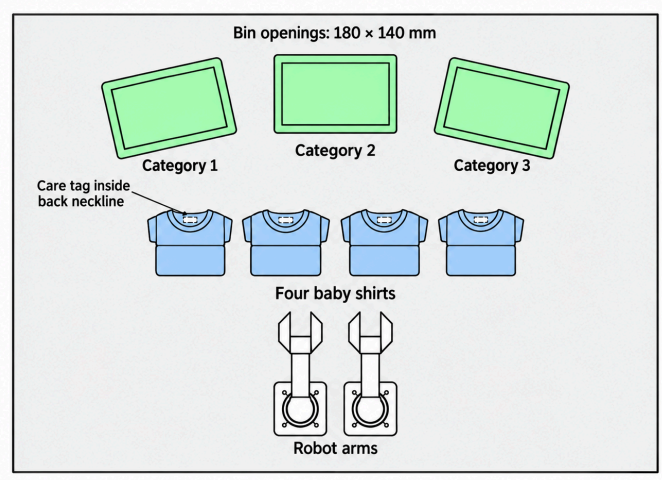
Scoring:

- Score = $\frac{f_1+f_2+f_3+f_4}{4}$
    - Each f is the fraction of one shirt inside its correct bin, measured from above.
        - Completely inside the correct bin = 1
        - Half inside the correct bin = 0.5
        - Entirely in a wrong bin = 0

Sample Scores:

Final arrangement	Score
All four shirts completely inside their correct bins	**1.00**
Three correctly placed; one in the wrong bin	**0.75**
Two correctly placed; two in the wrong bins	**0.50**

Setup:



Use four baby shirts with care labels attached inside the back neckline. Provide two labels using words and two using symbols, with an unambiguous recorded care category for each. Include all three care categories and choose the fourth shirt’s category with equal probability. Place three empty bins within reach and state their mapping in the work order: Category 1 is normal machine wash, Category 2 is delicate machine wash, and Category 3 is dry clean only. Use the same shirts, label assignments, and starting folds for every model.

Task 11 | Fold Pants for Delivery

Time Limit: 240 seconds

Instruction: Fold the pants lengthwise so one leg lies on top of the other, with the cuffs lined up. Then fold the legs upward so the cuffs meet the waistband. Put the folded pants completely inside the delivery bin, then let go.

Goal: One leg is folded over the other, with the cuffs and waistband ends aligned. Both cuffs are folded up to the waistband. Both folds remain in place, and the pants are entirely inside the delivery bin after release.

Scoring:

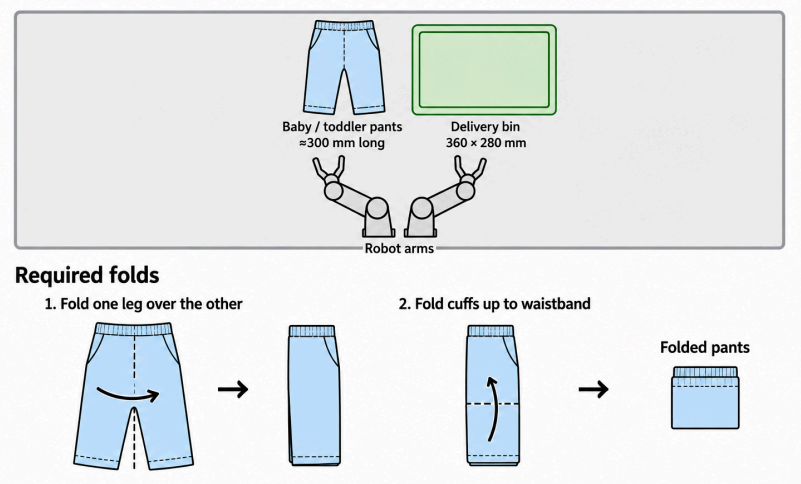
- $$\text{Score} = \begin{cases} 0, & \text{if } f = 0 \\ 0.6f + 0.4b, & \text{otherwise} \end{cases}$$
    - f = fraction of the two required folds correctly completed and still in place
        - One fold for placing one leg over the other, with corresponding cuff corners and waistband ends aligned within 20 mm.
        - One fold for bringing both cuffs up to the waistband, with both corners of each cuff within 20 mm of the waistband's top edge.
        - f = correct folds ÷ 2
    - b = fraction of the folded pants inside the delivery bin, measured from above
- If neither required fold is completed correctly, score zero.
- Score after the robot releases the pants and waits 2 seconds.

Measurement and caveats:

- Either leg may be folded over the other.
- Bunching or rolling the pants does not count.
- Only folds that remain after release earn credit. A fold lost during transfer does not count.
- The robot may unfold, reposition, and try again within the time limit.

Setup:

Use baby pants approximately 300 mm long and the same delivery bin as Task 9. Start with the pants flat and front facing up, with both legs extended, the waistband away from the robot, and the cuffs toward it. Close any fasteners before the attempt. Place the empty bin beside the pants within reach of both arms.



Task 12 | Smooth and arrange a shirt or pants

Time Limit: 240 seconds
Instruction: Unfold and spread out the balled-up clothing. Lay it front facing up and smooth out the bunching. For a shirt, spread both sleeves beside the body. For pants, straighten and separate both legs. Let go when the whole item is laid out.
Goal: The clothing is front facing up and fully spread out. No body section is folded over or tucked underneath itself. Both sleeves or both pant legs are extended and free of overlap after release.
Scoring:

- Score $=0.2p + 0.4b + 0.2l + 0.2r$
  - p = 1 if the clothing is front facing up; otherwise 0
  - b = 1 if the main body is unfolded, with no section folded over or tucked underneath itself; otherwise 0
  - l = 1 if the left sleeve or leg is extended to at least 80% of its relaxed length and lies clear of the body and the other sleeve or leg; otherwise 0
  - r = 1 if the right sleeve or leg meets the same requirement; otherwise 0
- Score after the robot releases the clothing and waits 2 seconds.

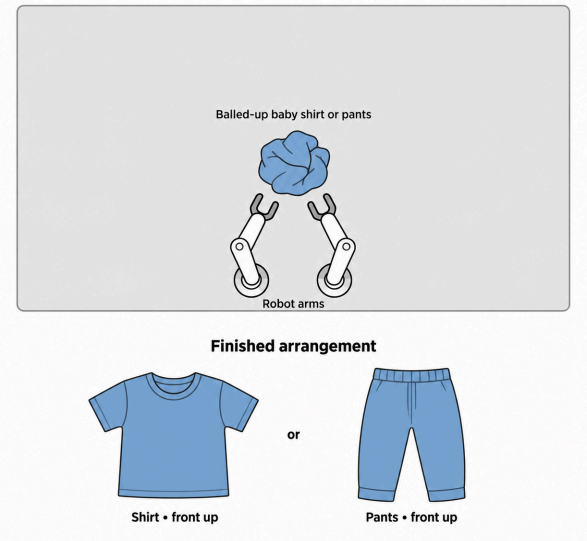
Measurement and caveats:

- Small wrinkles are allowed. Folded-over sections, tucked fabric, and bunched sleeves or legs do not pass their corresponding checks.

Sample Scores

Final arrangement	Score
Front up, body unfolded, both sleeves or legs extended and clear	1.00
Fully spread out, but back facing up	0.80
Front up and body unfolded; neither sleeve or leg passes	0.60
Front up, but body remains bunched and neither sleeve or leg passes	0.20

Setup:



Reuse the baby shirt from Task 9 and baby pants from Task 11. Test shirts and pants equally often. Start with one item loosely balled up within reach of both arms, without clamps.

Task 13 | Zip a Jacket with the Zipper Already Started

Time Limit: 240 seconds
Instruction: Hold the jacket steady with one hand and pull the already-started zipper to the top with the other. Keep the fabric out of the zipper, then let go.

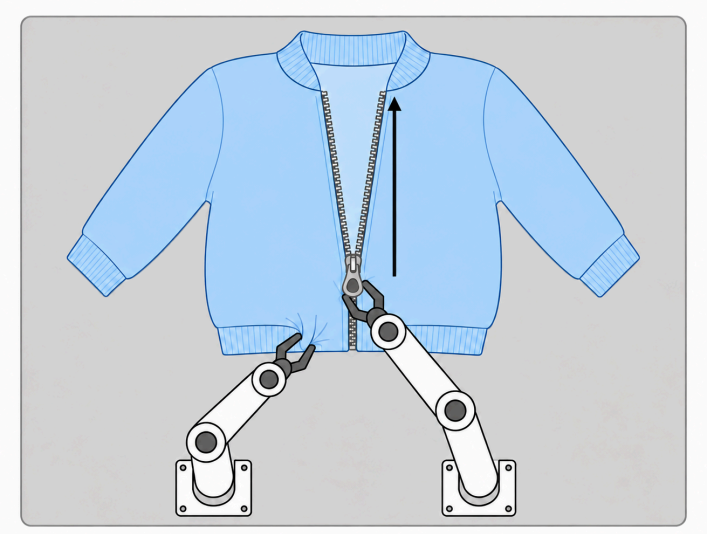
Goal: The zipper is closed along its full length, with the slider at the top. The teeth stay joined after release, and no fabric is caught in the zipper.
Scoring:

- $Score = \frac{Final\ Joined\ Length - Starting\ Joined\ Length}{Total\ Usable\ Zipper\ Length - Starting\ Joined\ Length}$
- An unchanged zipper earns zero
- If the zipper separates at the bottom or its teeth split open behind the slider, score zero.

Measurement and caveats:

- Measure the length of teeth actually joined, not just how far the slider moved.
- The robot may stop, regrasp, or move the slider backward to clear a snag before continuing.
- Moving the jacket around is allowed.

Setup:



Use a baby jacket with a separating zipper. Lay it flat, front facing up, with the hem toward the robot and no clamps holding it. Begin with the bottom pin fully seated and 20 mm of teeth joined. Record the zipper's usable length. An enlarged pull tab may be fitted for grasping; keep the zipper mechanism and any adaptations consistent across models.

Task 14 | Start a Zipper and then Zip It

Time Limit: 360 seconds

Instruction: Bring the two bottom ends of the zipper together. Push the loose pin all the way into the opening at the bottom of the other side. Hold the jacket steady and pull the zipper to the top. Keep the fabric out of the zipper, then let go.

Goal: The zipper is correctly connected at the bottom and closed along its full length. The slider is at the top, the teeth stay joined after release, and no fabric is caught.

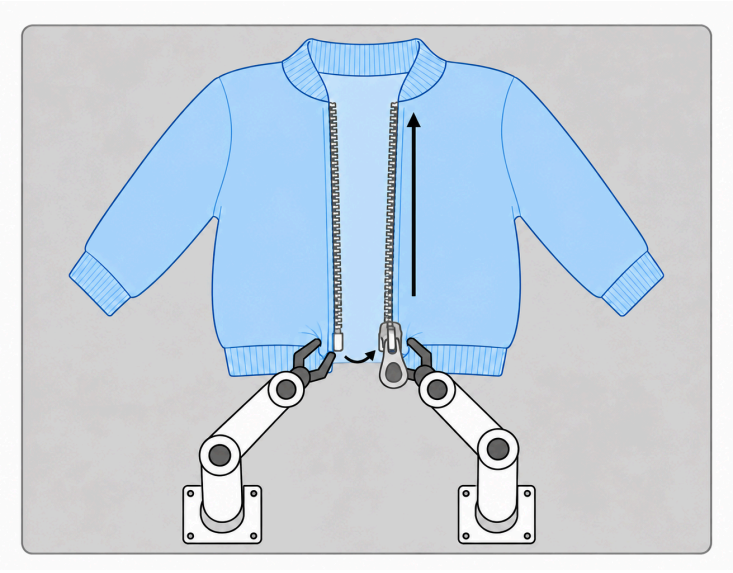
Scoring:

- $$\text{Score} = \begin{cases} 0, & \text{if } e = 0 \\ 0.3e + 0.7z, & \text{otherwise} \end{cases}$$
    - e = 1 if the zipper is successfully started; otherwise 0
        - The pin is fully inserted and at least 20 mm of teeth are continuously joined.
    - z = fraction of the remaining zipper closed beyond those first 20 mm
        - z = (joined length − 20 mm) ÷ (total usable length − 20 mm)
        - Limit z to 0–1.
- If the zipper has not been successfully started, score zero.
- If the zipper separates at the bottom or its teeth split open behind the slider, score zero.

Measurement and caveats:

- Measure the length of teeth actually joined, not just how far the slider moved.
- The robot may stop, regrasp, or move the slider backward to clear a snag before continuing.
- Moving the jacket around is allowed.

Setup:



Use the same baby jacket and zipper adaptation as Task 13. Lay the jacket flat, front facing up, with the hem toward the robot. Start with all teeth separated, the slider at the bottom, and the insertion pin fully removed from the connector. Place both zipper ends within reach of the arms. Do not clamp the jacket.

Task 15 | Unzip a jacket

Time Limit: 240 seconds

Instruction: Hold the jacket steady and pull the zipper all the way down. Pull the loose pin out of the plastic connector at the bottom so the two sides are completely separated, then let go.

Goal: All zipper teeth are separated, and the pin is removed from the bottom connector.

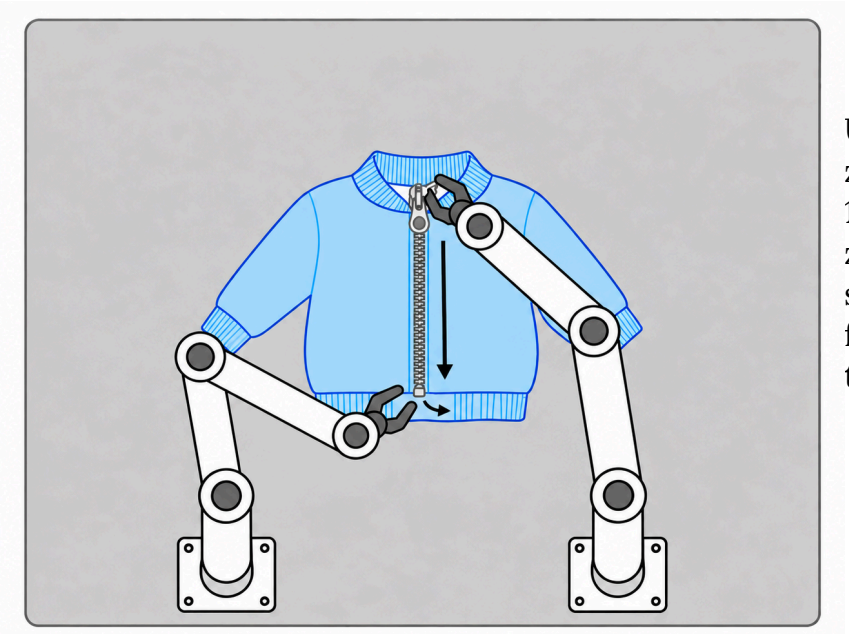
Scoring:

- Score = $\frac{Opened\ Zipper\ Length}{Total\ Zipper\ Length}$

Measurement and caveats:

- The robot may switch hands, regrasp, or clear a snag before continuing.

Setup:



Use the same baby jacket and zipper adaptation as Tasks 13 and 14. Start with the jacket fully zipped, the pin seated, and the slider at the top. Lay it flat, front facing up, with the hem toward the robot and no clamps.

Task 16 | Turn a Shirt Right-Side Out

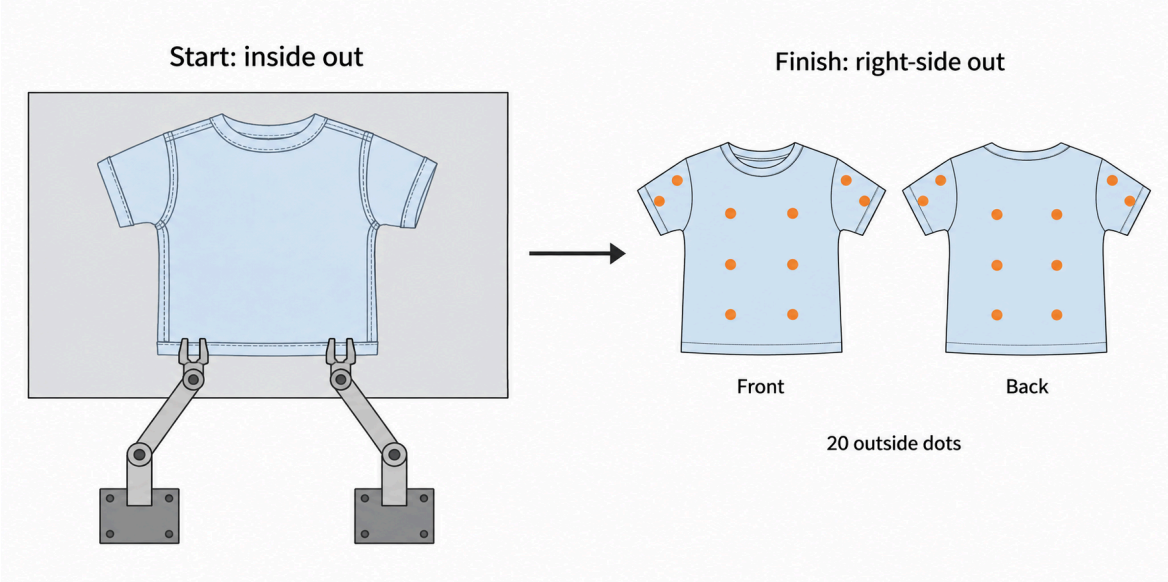
Time Limit: 360 seconds
Instruction: This shirt is inside out. Turn it right-side out, including both sleeves, then spread it on the table and let go.
Goal: The shirt is right-side out, with all 20 dots on its outside surface exposed.
Scoring:

- Score = $\frac{Number\ of\ Exposed\ Outside\ Dots}{20}$
    - A dot counts only when its fabric has been turned right-side out and the entire dot is visible.

Measurement and caveats:

- A dot seen through the neck, hem, or sleeve opening does not count if its fabric is still facing inward.

Setup: Use the same baby shirt as the other shirt tasks. Place 20 permanent, numbered dots equally spaced across its outside surface, distributed over the front, back, and both sleeves. Start with the body and both sleeves fully inside out, laid flat with the hem toward the robot. Do not clamp the shirt. Use the same shirt and dot arrangement for every model.



Task 17 | Button up a shirt

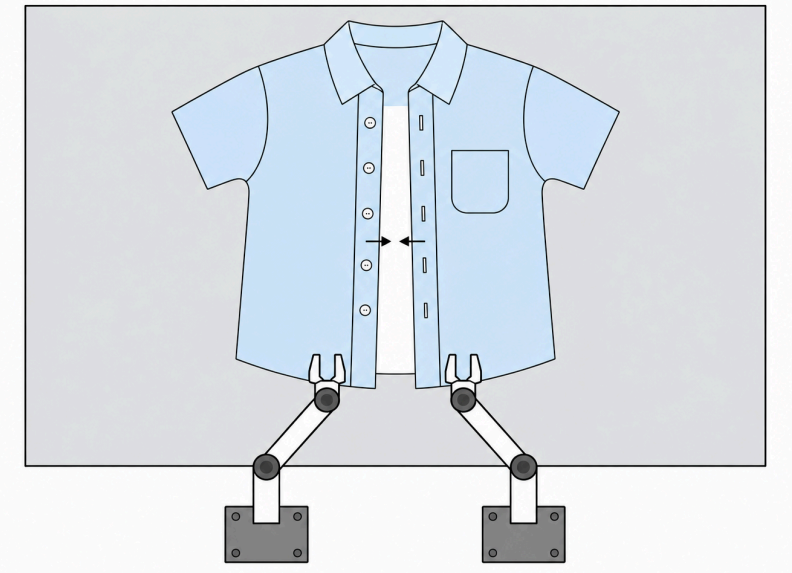
Time Limit: 420 seconds
Instruction: Button up the front of the shirt. Put each button through its matching buttonhole, then let go.
Goal: All front buttons are fully fastened through their matching buttonholes.
Scoring:

- Score = $\frac{Number\ of\ Correctly\ Fastened\ Front\ Buttons}{Total\ Number\ of\ Front\ Buttons}$
    - A button counts only when it is fully through its matching buttonhole and stays fastened after release.
- Wrong-hole and partly inserted buttons earn no credit.

Measurement and caveats:

- Only the buttons closing the shirt's front are scored. Exclude cuff, pocket, and collar-tip buttons.

Setup:
Use a baby button-front shirt. Start right-side out and front facing up, with all front buttons unfastened, both front edges lying beside each other, and the hem toward the robot. Do not clamp the shirt. Record the number of front buttons, button size, buttonhole size, and any adaptations, and keep them consistent across models.



Task 18 | Unbutton a shirt

Time Limit: 300 seconds

Instruction: Unbutton the front of the shirt. Take each button completely out of its buttonhole, then let go.

Goal: All front buttons are completely free of their buttonholes.

Scoring:

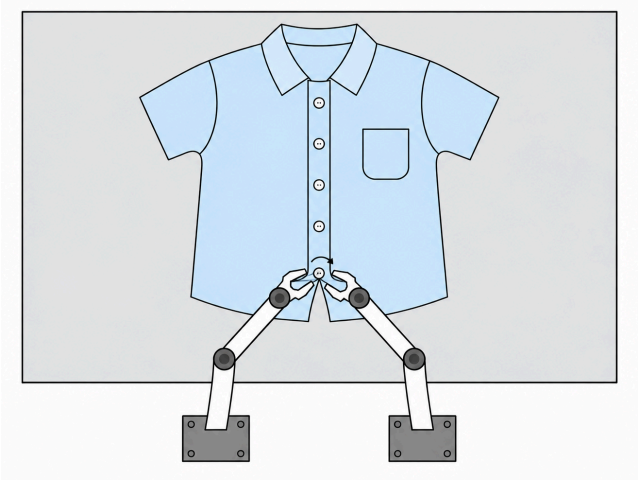
- Score = $\frac{Number\ of\ Fully\ Unbuttoned\ Front\ Buttons}{Total\ Number\ of\ Front\ Buttons}$
- A button counts only when it is completely out of its buttonhole.
- Partly freed buttons earn no credit.

Measurement and caveats:

- A button detached from the shirt or freed by tearing the thread or fabric that hold it on does not count

Setup:

Use the same baby button up shirt from Task 17. Start with all front buttons correctly fastened, the shirt right-side out and front facing up. Do not clamp the shirt to the table.



Task 19 | Tie Shoelaces

Time Limit: 420 seconds

Instruction: Tie the baby shoe's laces into a bow with two loops. Tighten it so it stays tied, then let go.

Goal: The laces form a complete two-loop bow that stays tied after release and a moderate hand pull.

Scoring:

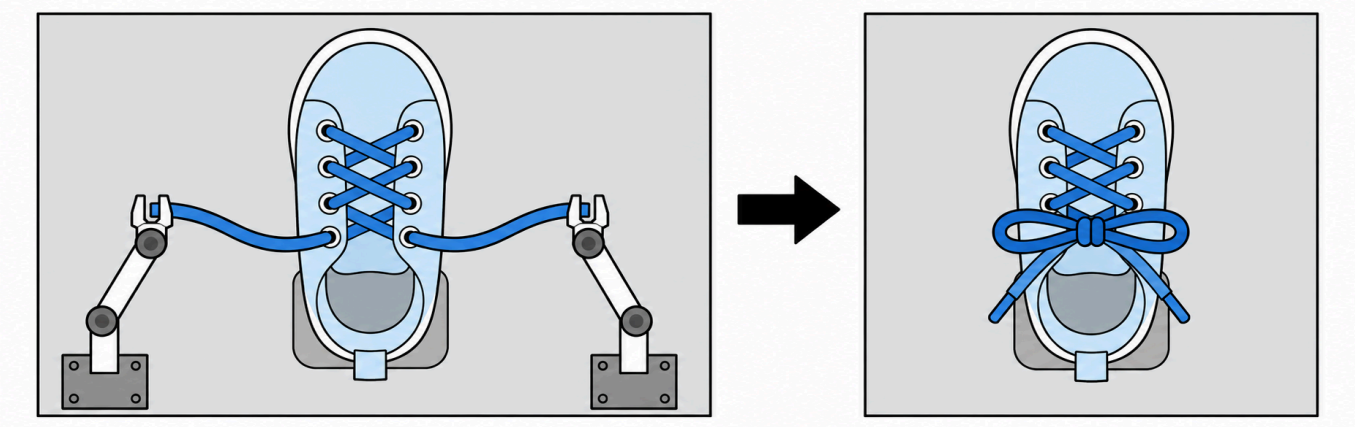
- $$\text{Score} = \begin{cases} 1.00, & \text{complete bow passes the hand-pull check} \\ 0.75, & \text{complete bow remains after release} \\ 0.25, & \text{first knot remains, but bow is unfinished} \\ 0.00, & \text{no knot remains} \end{cases}$$

- Award points based on the highest level satisfied
- The first knot means passing one lace under the lace under the other and pulling tight.

Measurement and caveats:

- For the pull check, gently pull the shoe's two sides apart by hand, as you would when checking whether a normally tied shoe is secure. Use one steady, moderate pull without jerking.
- Loop sizes do not have to match. No exact loop length or knot position is required.
- The lace must remain threaded in all eyelets; removing the lace from an eyelet scores a zero.

Setup: Use a baby shoe with its heel toward the robot, within reach of both arms. The shoe may be secured to the table or weighted inside to prevent it from shifting, similar to how a person's foot stabilizes a shoe while tying it. The mount or weight must not hold the laces, guide the knot, or block access. Use a soft, flat lace that the grippers can hold, with enough free length to form two loops. Start fully laced but untied, with equal free lengths laid on opposite sides of the shoe.



Task 20 | Untie Shoelaces

Time Limit: 300 seconds

O*NET: No task-level mapping

Instruction: Untie the shoe's laces completely, leaving them threaded through the eyelets, then let go.

Goal: No bow or knot remains, and the lace stays threaded through every eyelet.

Scoring:

- $$\text{Score} = \begin{cases} 1.00, & \text{bow and first knot completely undone} \\ 0.75, & \text{both loops undone; first knot remains} \\ 0.25, & \text{one loop undone; the other remains} \\ 0.00, & \text{bow remains tied} \end{cases}$$

- Award points based on the highest level satisfied
- Removing the lace from an eyelet gives zero.

Setup: Use the same baby shoe and lace as Task 19. The shoe may be mounted to the table or weighted inside to prevent shifting. The mount or weight must not hold the laces or block access. Start with a standard two-loop bow.

