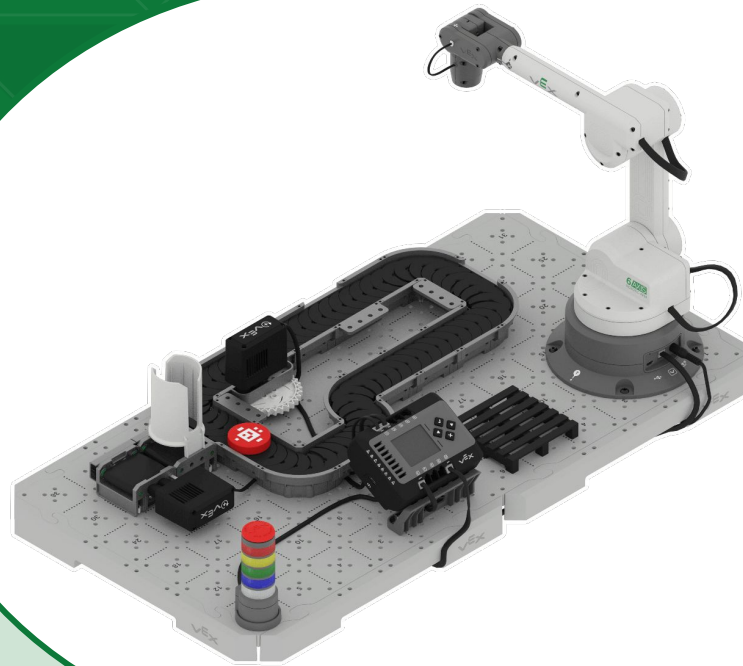


Troubleshooting a Smart Factory with VEX CTE

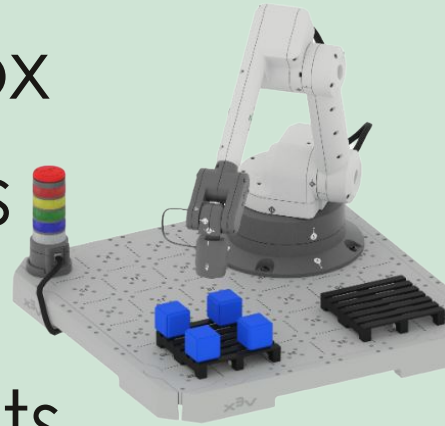
Audra Selkowitz

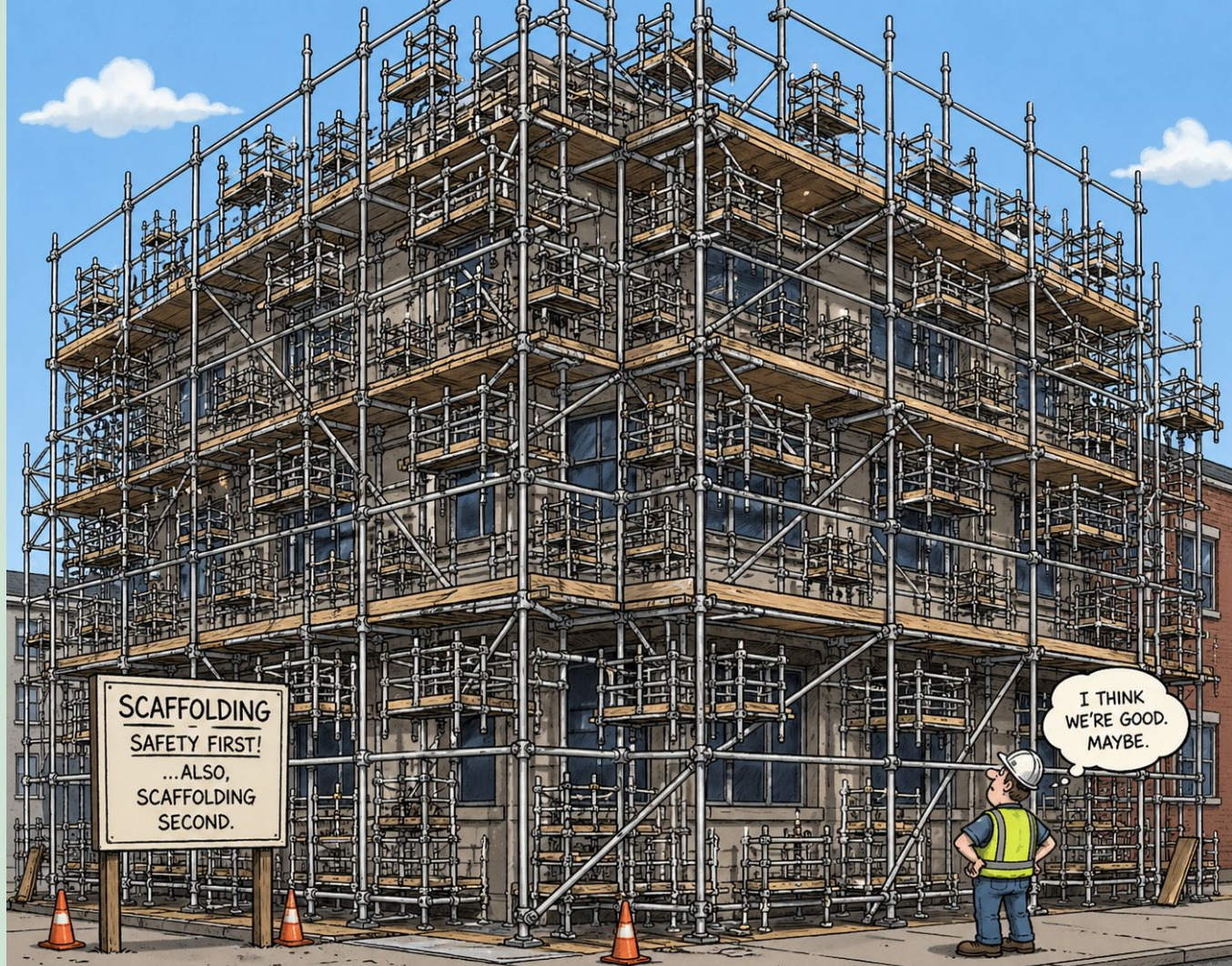
Senior Education Developer, VEX Robotics



Workshop Goals

- Learn about troubleshooting techniques and debugging strategies
- Build your troubleshooting toolbox
- Practice debugging CTE projects together
- Create your own bugged projects





SCAFFOLDING

SAFETY FIRST!

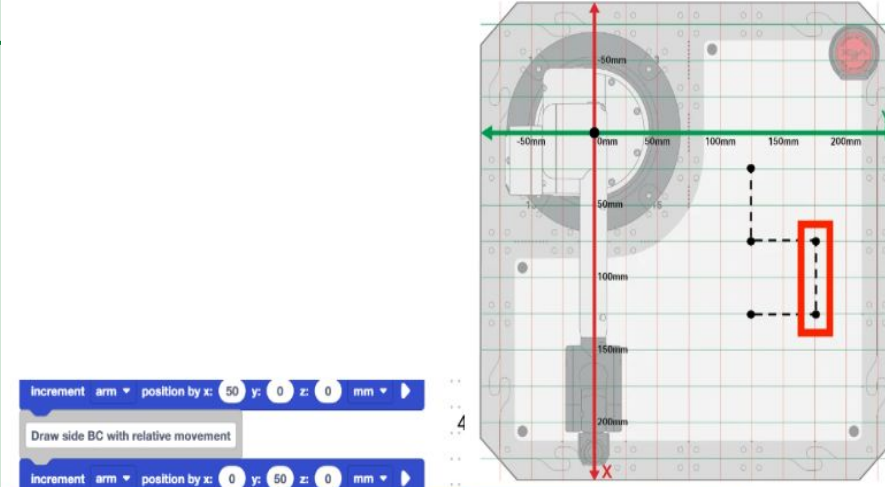
**...ALSO,
SCAFFOLDING
SECOND.**

I THINK
WE'RE GOOD.
MAYBE.



A Paradigm Shift...

“ ...bugs not as accidents to be solved but as objects-to-think-with and objects-to-share-with.”



The diagram shows a coordinate grid with X and Y axes. The X-axis ranges from -50mm to 200mm, and the Y-axis ranges from -200mm to 50mm. A red rectangle highlights a point at (175, 125). The Scratch code blocks on the left show a sequence of movements: 'Draw side BC with relative movement', 'Increment arm position by x: 50 y: 0 z: 0 mm', 'Draw side CD with relative movement', 'Increment arm position by x: 50 y: 0 z: 0 mm', 'Draw side DA with relative movement', and 'Increment arm position by x: 0 y: -50 z: 0 mm'.

5. Relative move by adding 50 from the x-coordinate. The new coordinates are (175, 175, 0)

6. Relative move by subtracting 50 from the y-coordinate. The new coordinates are (175, 125, 0)

A Paradigm Shift...

**“ The idea of designing bugs for learning
—or *debugging by design*—
makes learners agents of their own
learning and, more importantly, of
making and solving mistakes.”**

[-Yasmin B. Kafai](#)

“Mischievousness and fun as well as empathy and sensitivity...were **productive emotions** exhibited during bug design, and **shifts away from frustration to increased comfort, security, and a sense of control with bugs** were expressed retrospectively weeks afterward.”

Fields, Deborah A., et al. "Debugging by design: A constructionist approach to high school students' crafting and coding of electronic textiles as failure artefacts." *British Journal of Educational Technology* 52.3 (2021): 1078-1092.

21st-Century Skills

Foundational Literacies

How students apply core skills to everyday tasks

- 1. Literacy
- 2. Numeracy
- 3. Scientific literacy
- 4. ICT literacy
- 5. Financial literacy
- 6. Cultural and civic literacy

Competencies

How students approach complex challenges

- 7. Critical thinking/ problem-solving
- 8. Creativity
- 9. Communication
- 10. Collaboration

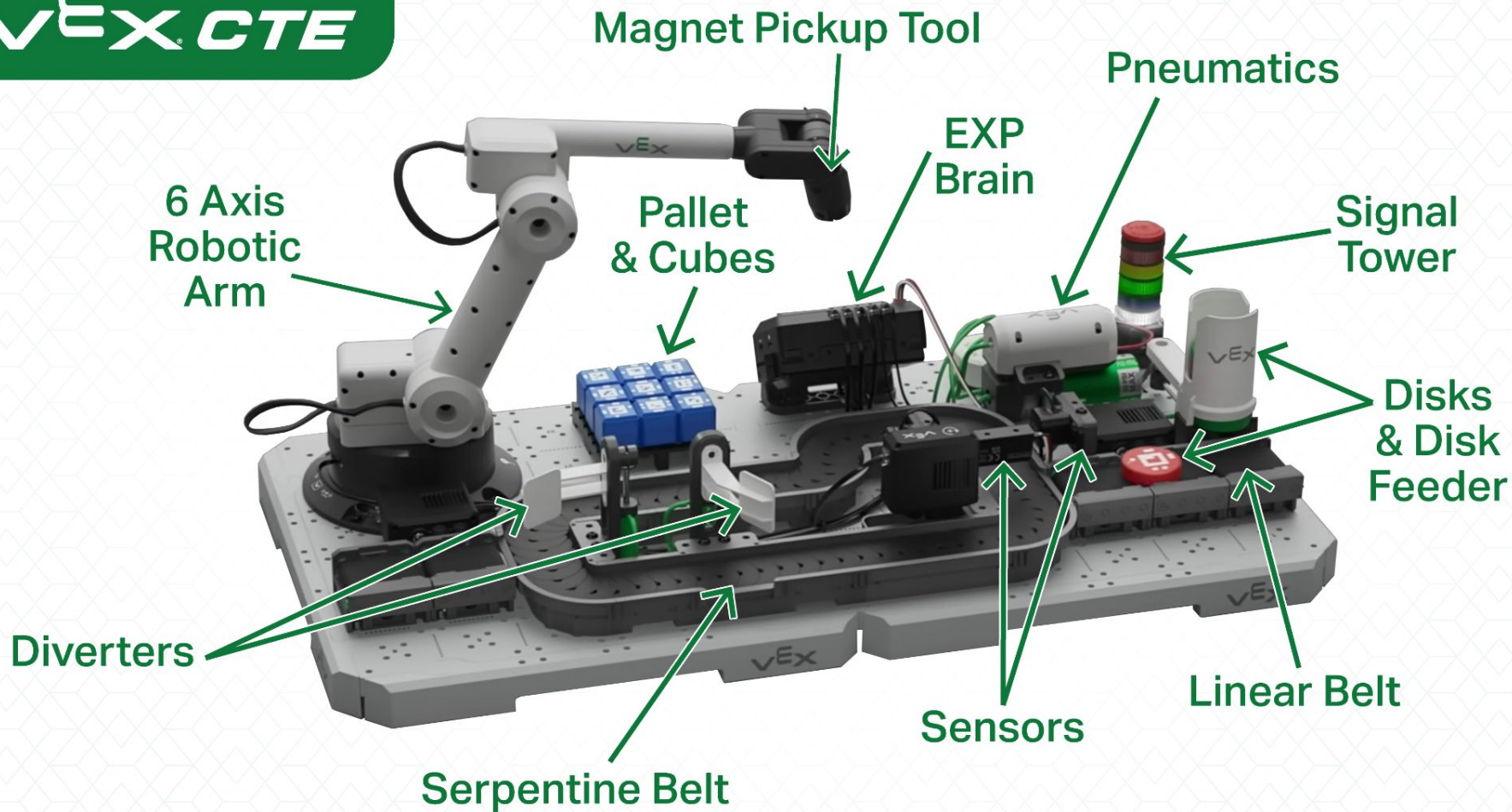
Character Qualities

How students approach their changing environment

- 11. Curiosity
- 12. Initiative
- 13. Persistence/ grit
- 14. Adaptability
- 15. Leadership
- 16. Social and cultural awareness

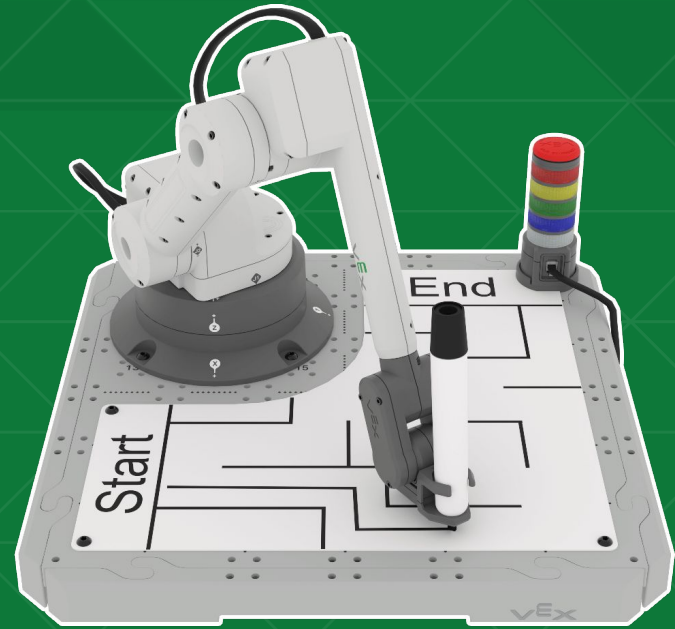
Lifelong Learning

Bugs support creativity, resiliency, and learning.



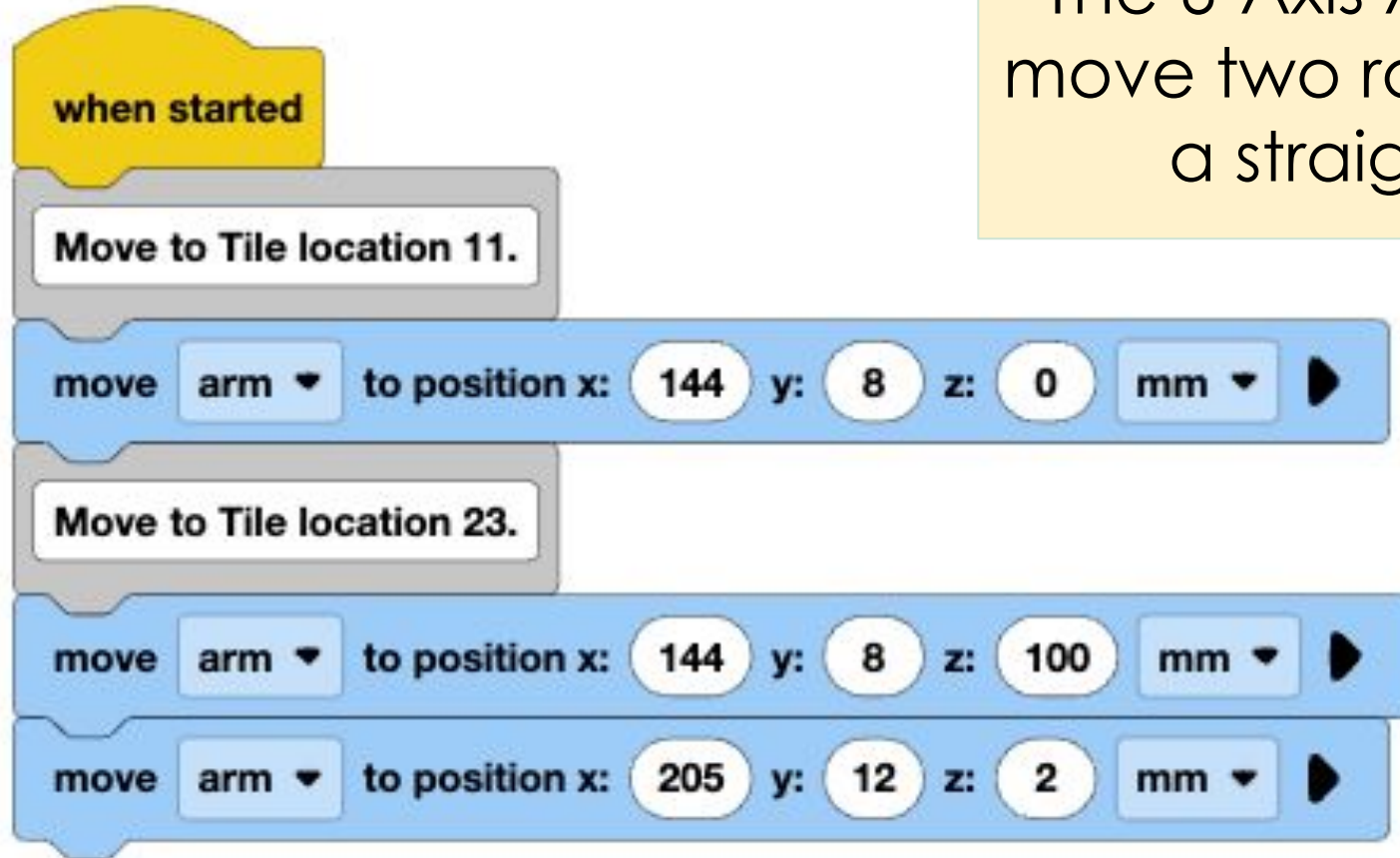
What do you need to know to debug a project?

- What is the intention of the project?
- How are you trying to do that?
- Where does it go wrong?



Find the Bug!

The 6-Axis Arm should move two rows down in a straight line.



when started

Draw a square

set arm end effector to pen

move arm to position x: 200 y: 50 z: 0 mm

wait 1 seconds

increment arm position by x: 0 y: 100 z: 0 mm

wait 1 seconds

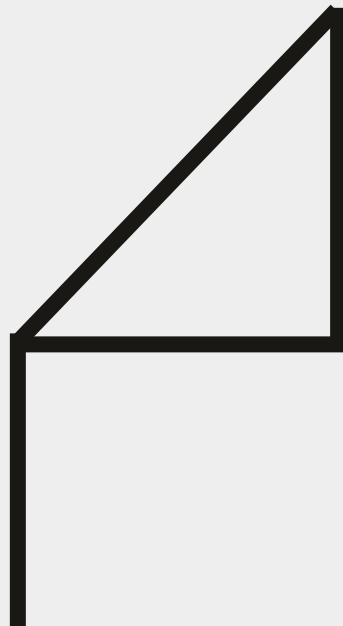
increment arm position by x: -100 y: 0 z: 0 mm

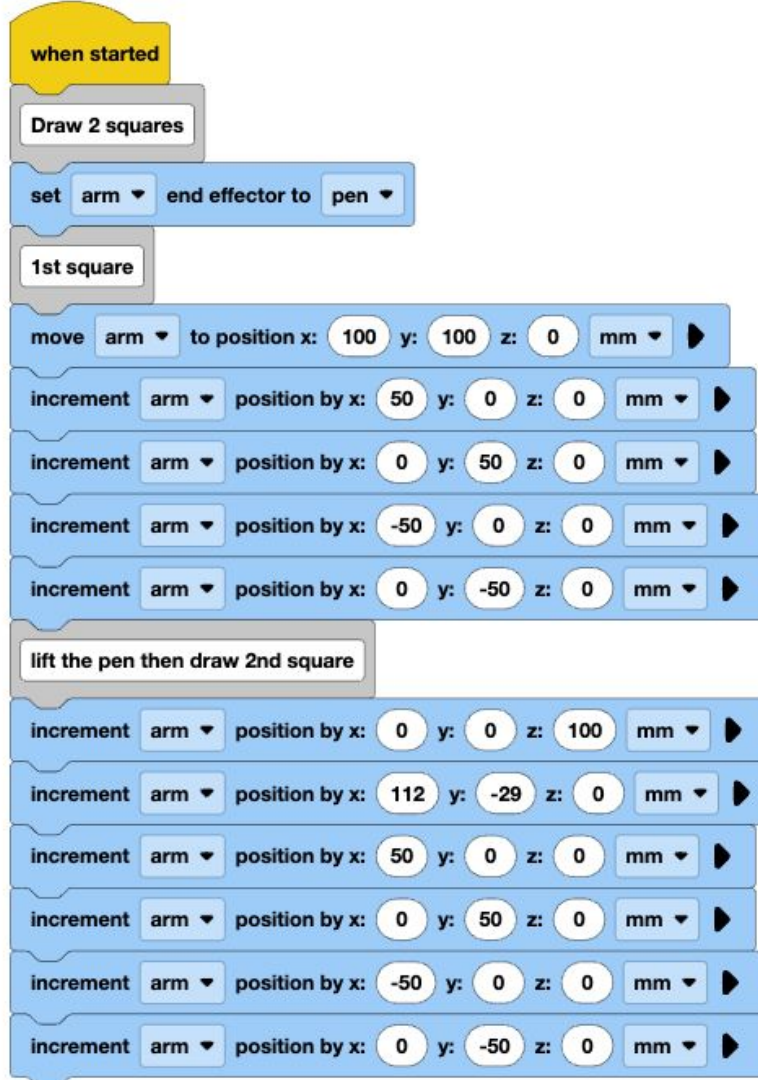
wait 1 seconds

increment arm position by x: 100 y: -100 z: 0 mm

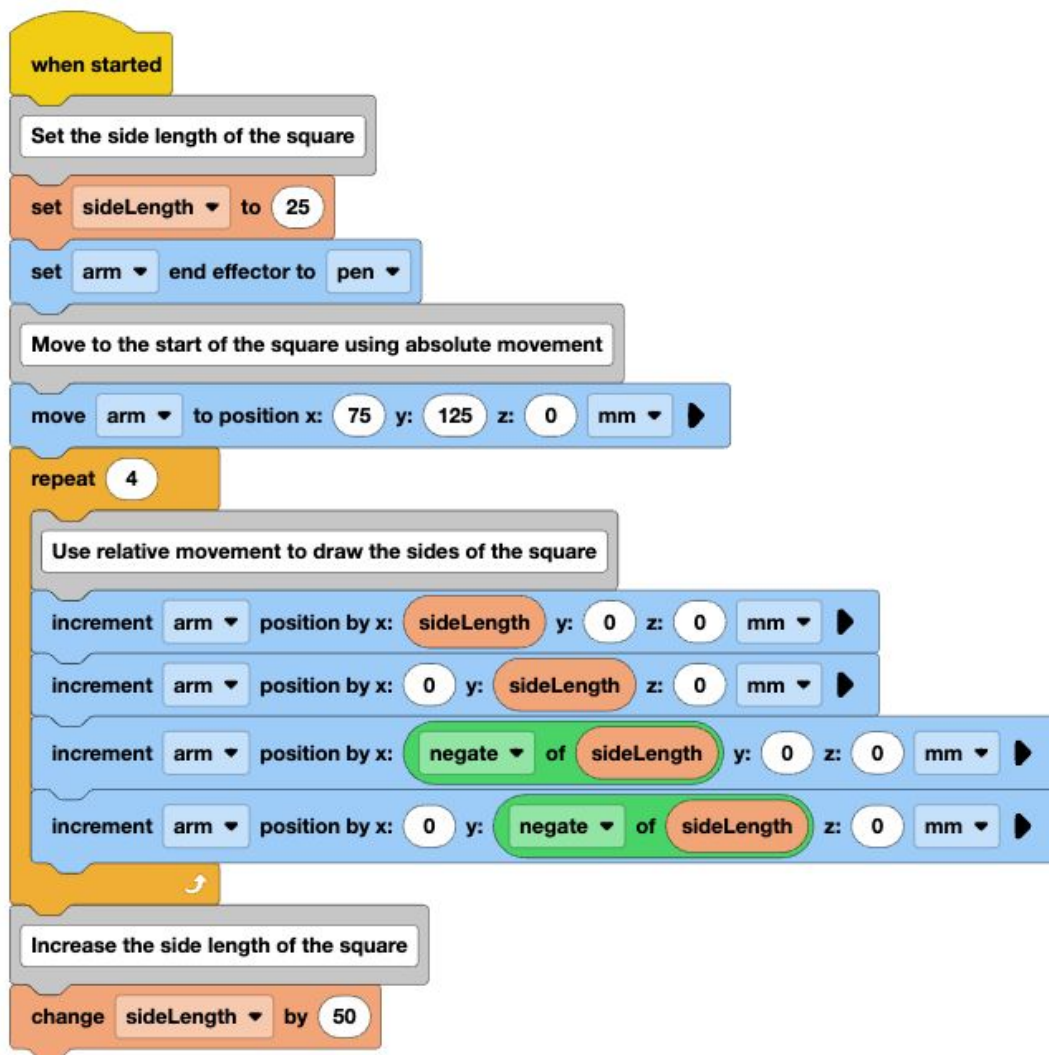
wait 1 seconds

increment arm position by x: 100 y: 0 z: 0 mm

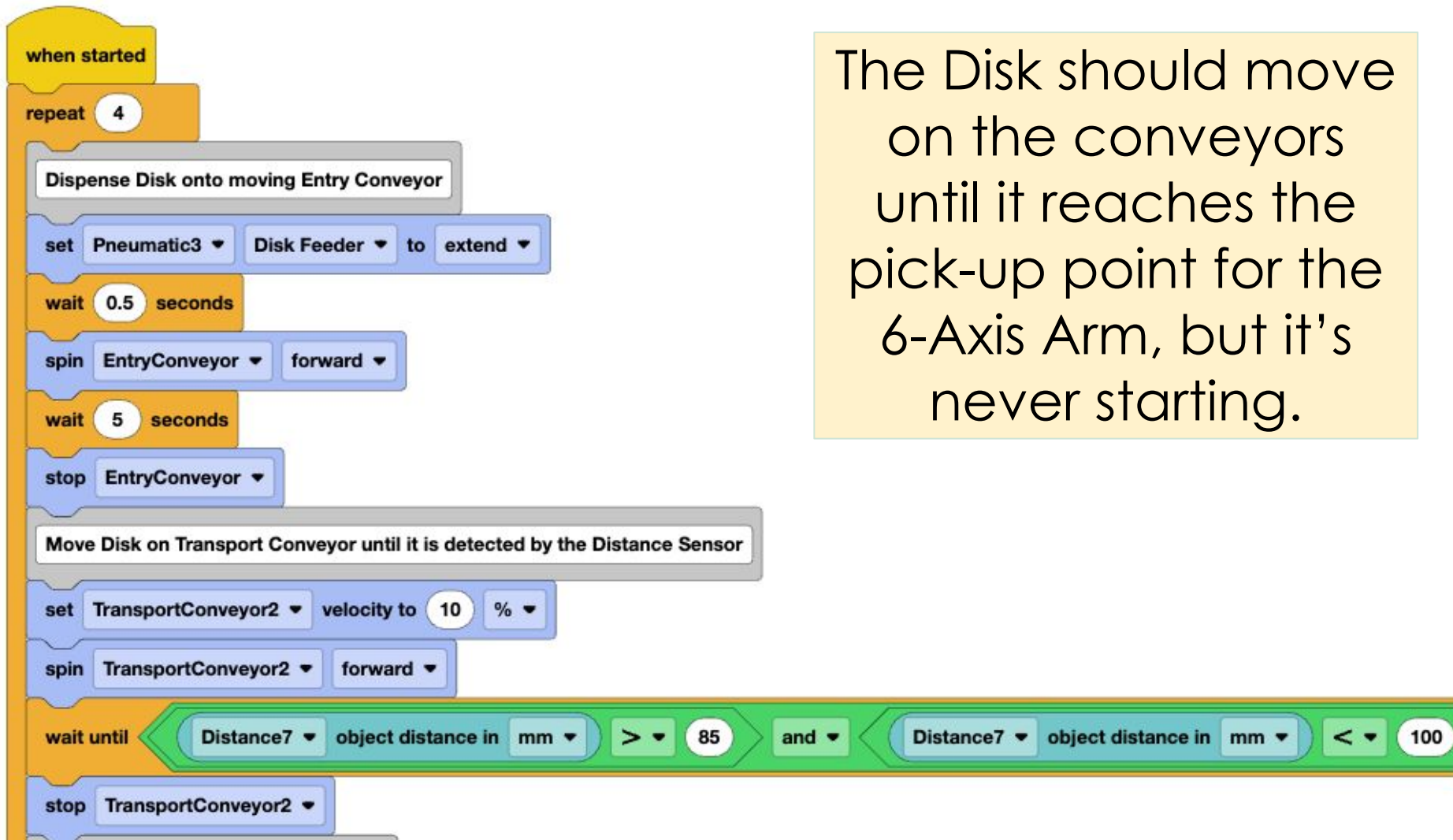




The 6-Axis Arm should draw two squares, but the second one is drawn in the air.



The 6-Axis Arm should draw a spiral, but it just draws the same square multiple times.



The Disk should move on the conveyors until it reaches the pick-up point for the 6-Axis Arm, but it's never starting.

Move Disk on Transport Conveyor until it is detected by the Distance Sensor

set TransportConveyor2 ▾ velocity to 10 % ▾

spin TransportConveyor2 ▾ forward ▾

wait until << Distance7 ▾ object distance in mm ▾ < ▾ 85 >> and >> Distance7 ▾ object distance in mm ▾ < ▾ 100 >>

stop TransportConveyor2 ▾

Move 6-Axis Arm to pick up the Disk

set Arm10 ▾ end effector to magnet ▾

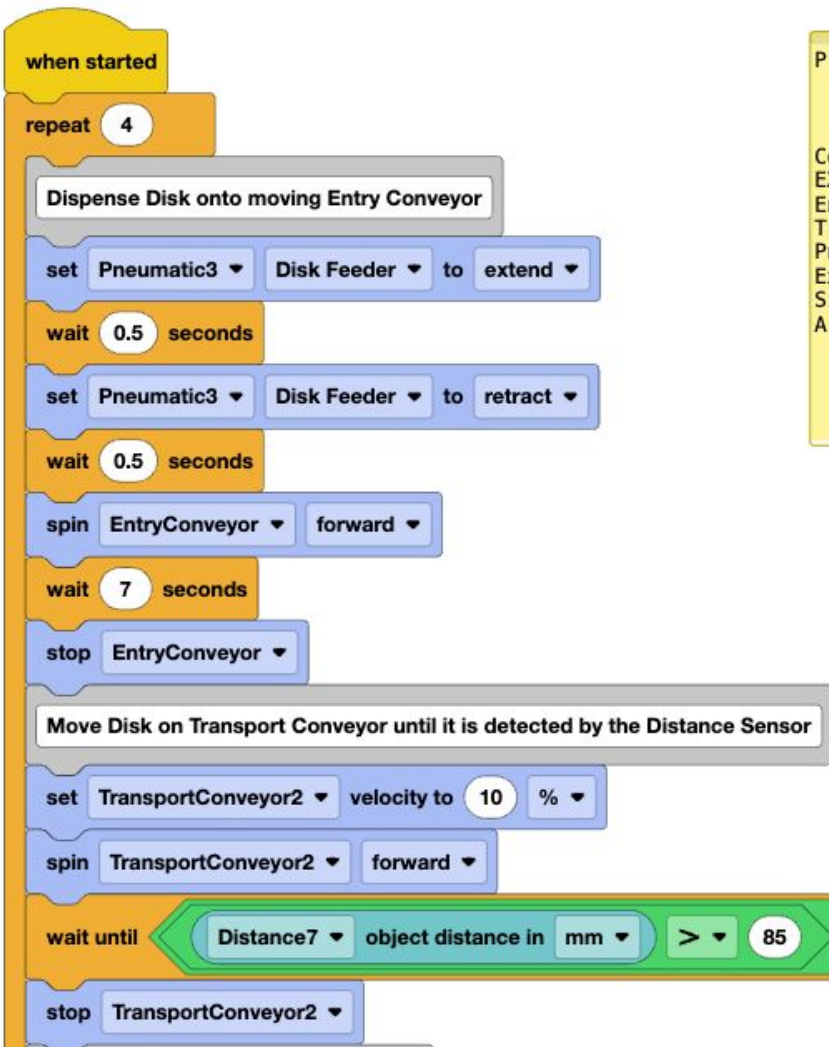
increment Arm10 ▾ position by x: 0 y: 0 z: 100 mm ▾ ▶

move Arm10 ▾ to position x: 104 y: 171 z: 100 mm ▾ ▶

increment Arm10 ▾ position by x: 0 y: 0 z: -65 mm ▾ ▶

set Arm10 ▾ magnet to engaged ▾

The Disk should move to the pick-up location for the 6-Axis Arm but stops as soon as it is detected by the Distance Sensor.



Project: Unit 7 challenge

Configuration:
EXP CTE Workcell Base + Pneumatics
Entry Conveyor in Port 1
TransportConveyor in Port 2
Pneumatic in Port 3
Exit Conveyor in Port 4
SignalTower in Port 6
Arm in Port 10

The Disk should move on the conveyors until it reaches the pick-up point for the 6-Axis Arm but the conveyors don't move.

Project: Unit 7 challenge

Configuration:
EXP CTE Workcell Base + Pneumatics
Entry Conveyor in Port 1
TransportConveyer in Port 2
Pneumatic in Port 3
Exit Conveyor in Port 4
SignalTower in Port 6
Arm in Port 10

object distance in mm < 100

Devices



EntryConveyor

2



TransportConveyor2

1



Pneumatic3

3



ExitConveyor4

4



SignalTower6

6



Arm10

10



Distance7

7



Add a device

What did you notice?

- How was this experience for you?
- How does it feel when you find a bug?
- Can we think about bugs in the same ways we think about challenges?

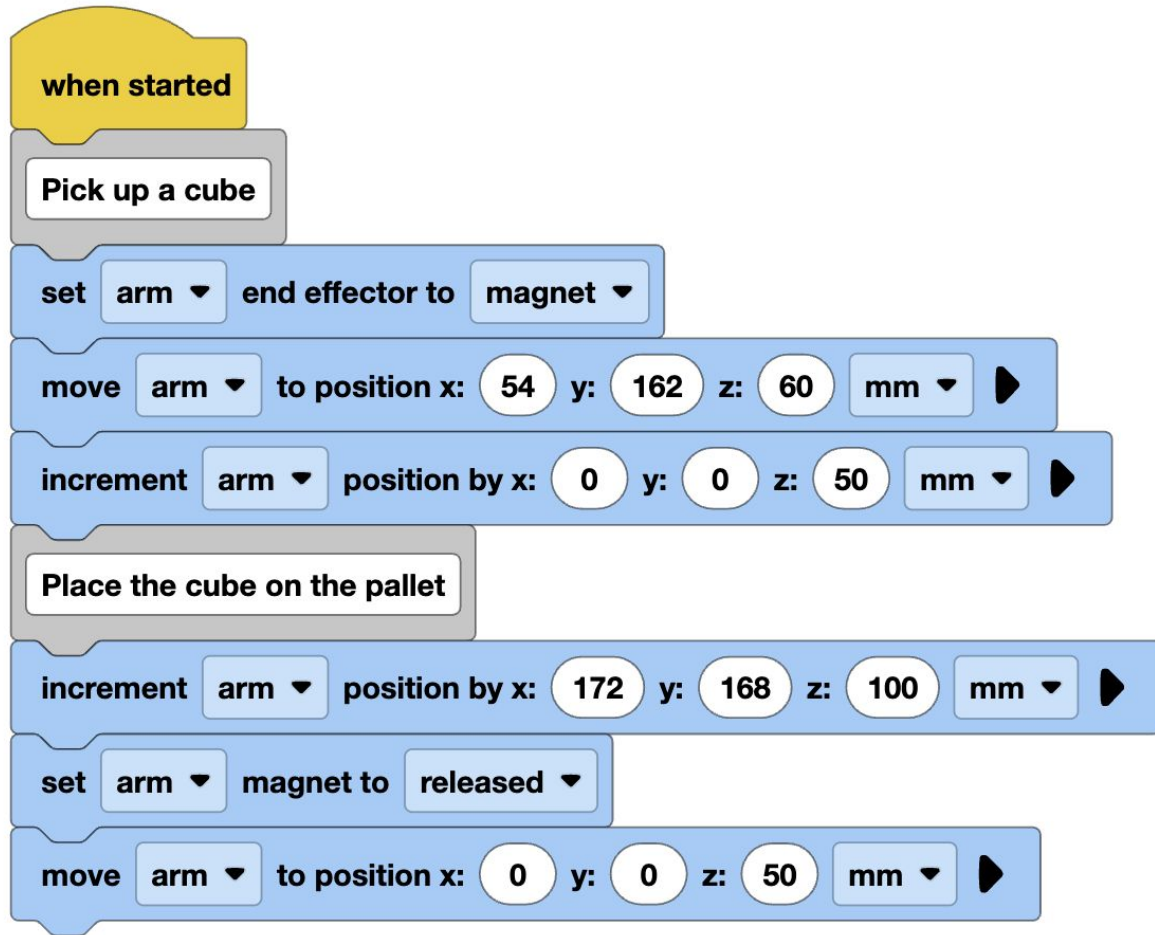


Bug “Buckets”

- Hardware/ configuration
- Parameter problems
- Mathematical problems
- Sequence/Logic
- Sensor knowledge
- Spelling/syntax
- Understanding coordinate plane
- Listening/attention

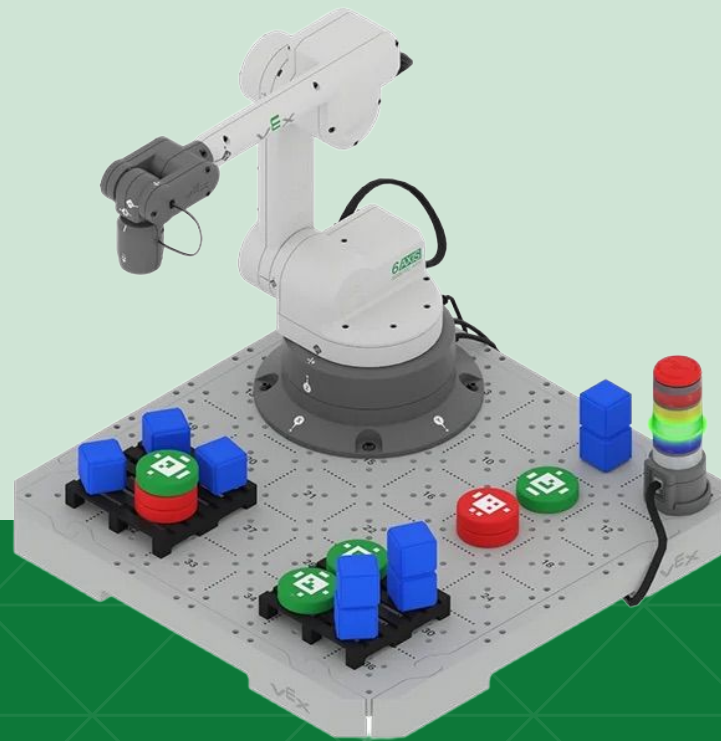
Your turn!

- 1 Cube is on Tile 17.
- You need to move the cube to the pallet.



Debugging Check-in

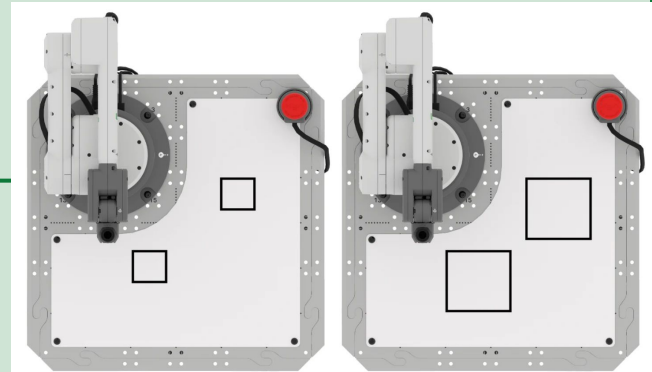
- What were the bugs?
- How did you fix them?
- How did debugging feel for you?



STUMP THE SOFTWARE TEAM!

Create your own bugged project to try to stump our VEXcode Experts!

- **Create a project with 2-3 bugs in it.**
- Think creatively about the bugs you're making!
- Use one of the projects we've talked about or create your own



Bring this experience to **your students**

- **Making bugs demonstrates understanding**
 - You have to know the concept in order to create a bug with it
- **Intention is important**
 - Their ideas are good – execution is the problem
 - Have to know what the coder was trying to do, to debug intentionally

Bring this experience to **your students**

- **There is more than 1 way to fix a bug**
 - Multiple solutions to the same problem helps us all learn
- **Creating bugs builds creativity and resilience**
 - The more you deal with bugs in non-threatening ways, the more persistent and comfortable you become in solving them

Stay Connected

Join me in the **VEX PD+ Community**

@Audra_Selkowitz

Want to Learn More? Join PD+ as an All-Access Member!

Schedule a **1-on-1 Session** in VEX PD+!