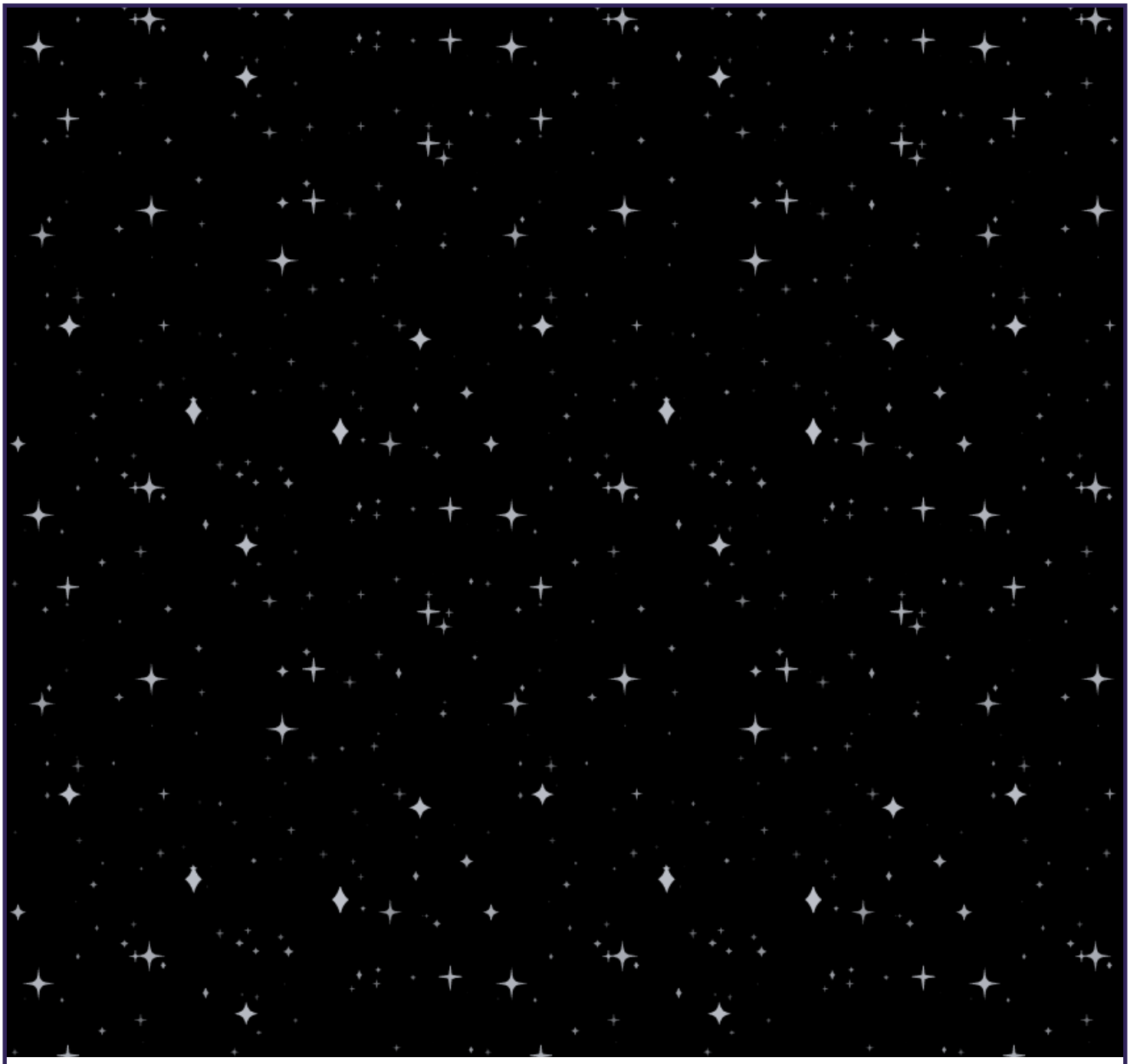

IBM Quantum Challenge Fall 2022

Story

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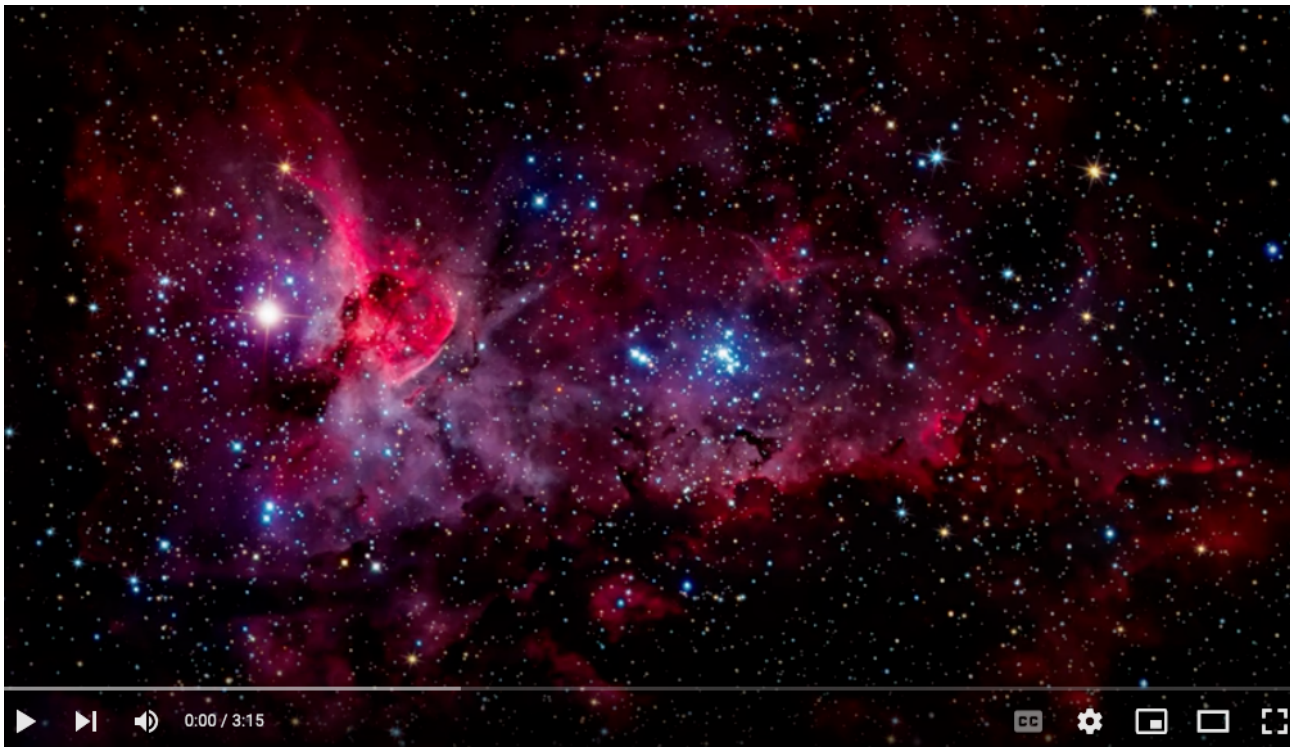
Lab 1

Prologue - Opening Story



Watch the opening story video here: Fall Challenge Opening Story

Chapter 1

Yellow alert. Commotion. You and your crew scramble, trying countless ways to escape the black hole's pull. But your efforts are futile and cost you a lot of fuel.

Technically you are still safe, drifting in a loose orbit around the black hole that decays very slowly. According to your calculations, it will be a few days before you either fall in completely or are spaghettified.

But how on earth will you escape?

After much deliberation, your Chief Science Officer comes up with something you haven't tried yet: a gravity assist maneuver. The starship would essentially slingshot around one of the many planets that orbit the black hole, and use the relative movement to escape the black hole's influence.

It could work.

Just before you give the command to search for a planet suitable for such a maneuver, your comms pick up a scrambled message. Strangely, its signature is the same used on Earth. This shouldn't be possible; you are the first people in space from Earth!

And so, you track down the source beacon a few hundred kilometers away.

To your utter surprise and dismay, you discover a beacon that's identical to the ones your starship carries. How is this possible?

It appears more tattered and worn than yours, as if battered by the relentless sands of time. You check all the beacons you have on board, and discover they are all intact.

You have a feeling this beacon and the message it carries is important, somehow, and divert all efforts to unscrambling and decoding this message.

Your decoding protocol involves unscrambling the message header and inputting the sequence to your comms decoder. Complete the exercises below to successfully build an unscrambling routine and trigger the decoding sequence.

Lab Completion

Congratulations!

You successfully trigger the decoding sequence.

The author and timestamp are unscrambled first, and you discover the message was sent from... you.

From hundreds of years in the future.

The message is one of your own logs, a log you haven't recorded...yet?

Listen to the unscrambled Captain's Log (next page).

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Lab 2

Chapter 2

Listen to the unscramble Captain's Log here: Captain's Log

You blink, stunned. You listen to the message again. And again. Though the voice is distorted and unfamiliar, the message is still unmistakably from you, carried somehow across time. Some sort of looping temporal current, perhaps? You've never heard of such a phenomenon, even in theory.

Instinctively, you know this isn't a hoax. But you ask your engineers to run extensive tests to verify whether your systems really are broken as the message claims, even though you know they must be. After all, the calculations to maintain a safe distance from the black hole had been incorrect, hadn't they?

You and your crew repair your quantum computers and scanners as best as you can with limited resources.

Now you must test whether your repairs are successful. Unfortunately, the precision equipment you would normally use is back home on Earth, and so, you devise a way to test it empirically: by classifying data samples you have on board. It is a primitive solution, but sufficient enough for your purposes.

Complete this lab to test whether your repairs are effective: build a classification routine with a sufficient level of accuracy.

Lab Completion

Congratulations!

You've successfully fixed your quantum computers and scanners. Now you can use them to find your way home.

You use the newly-fixed scanners to analyze your surroundings, and discover there are even more little worlds orbiting the black hole than you first thought.

One of the worlds is your optimal target for a slingshot maneuver.

And one of worlds is where future you is stuck, in its own little bubble of time.

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Lab 3

Chapter 3

With your quantum computers and scanners now working the way they are supposed to, you are ready to identify the optimal planet for your gravity assist maneuver. A well-executed slingshot may just be the key to your escape.

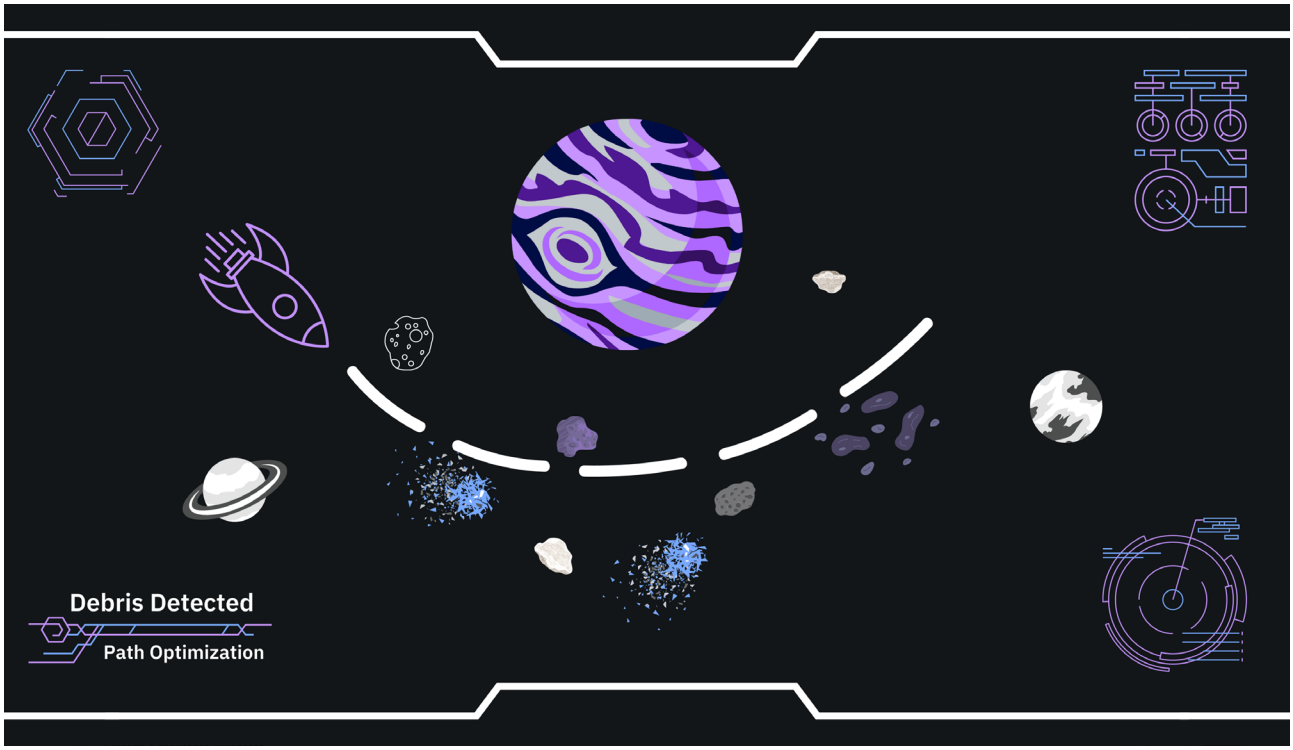
Your optimization protocol reveals one clear winner: a purple gas giant, with glimmering gaseous swirls and a large spot that reminds you of Jupiter. This planet is much different from what your broken systems would've identified if you hadn't repaired them!

As you prepare your ship for the slingshot, you discover a major obstacle: the region around the planet is rife with space debris. Myriads of objects of varying sizes, some as small as sand grains, some as large as beach balls. Metals and silicates and rocks, remnants of asteroid collisions and perhaps even civilizations long-gone. The objects revolve in an expansive region around the planet.

Your slingshot is at risk: with the debris orbiting at speeds over twenty-five thousand kilometers per hour, a collision could be disastrous.

But, you do not lose hope. You have quantum computers that work, you know quantum optimization, and you have a drone on board that could effectively collect any trash you target.

Complete the exercises below in order to clear an optimal path through the space debris by successfully collecting specific orbiting objects with your drones, thus mitigating the risk associated with the slingshot.



Lab Completion

Congratulations!

You've successfully carved a clear path for your slingshot by targeting and collecting certain orbiting objects with your drone.

You are almost ready to perform your slingshot. As you move your starship into position, you wonder curiously about the other you out there.

Have they ceased to exist now that you haven't followed their path by selecting this planet?

Do they somehow exist in an alternate reality?

You can never know.

Nonetheless, you look out the window at the planets you didn't select, and whisper an aching, heartfelt, "Thank you."

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Lab 4

Chapter 4

With your path clear, you are prepared for your slingshot around the planet. But you want to increase your chances of success as much as possible, and it occurs to you there's one last thing you can do before you attempt the maneuver.

You see, one of the magnificent discoveries Earth scientists made while inventing interstellar travel technologies is that certain dense cosmic clouds, especially those containing Hydrogenium (H3+), Interstellar Cycloproenylidene (C3H2), or a combination of them, boost starship velocity without expending extra fuel. Like sledding down a steep hill, or sliding a block across an oiled surface.

If you can find such a patch within the vicinity of your slingshot path, you can increase your chances of escape. It would be as though a hand of cosmic dust pushes your starship, providing more force to your slingshot.

But when your systems were broken, certain memory files were corrupted, and you no longer have the molecular properties your scanners require to identify such patches. You must re-do the calculations. And the more precise your calculations, the more precise your scanners will be!

Complete these exercises to calculate and analyze the various molecular properties required to calibrate your scanner's sensors and potentially discover cosmic clouds that will aide in your escape.

Lab Completion

Congratulations!

Your scanners successfully identify an abundant cosmic cloud close to the tail of your slingshot's path.

You perform the gravity assist maneuver, and you succeed. You escape!

Watch the finale video here: Fall Challenge Finale