WhiteHat Jr
Live online Coding for Kids

Topic	Data Science 3	
Class Description	**Students will be applying machine learning algorithms and statistics to filter out more planets. Students will be exploring new scientific facts.**	
Class	**C133**	
Class time	**45 mins**	
Goal	● Plot various charts on data ● Filter out more planets ● Learning about calculating speed of a planet	
Resources Required	● Teacher Resources ○ Laptop with internet connectivity ○ Earphones with mic ○ Notebook and pen ● Student Resources ○ Laptop with internet connectivity ○ Earphones with mic ○ Notebook and pen	
Class structure	**Warm Up** **Teacher-led Activity** **Student-led Activity** **Wrap up**	**5 mins** **15 min** **15 min** **5 min**

CONTEXT

- **Review the concepts learned in the earlier classes**

Class Steps	Teacher Action	Student Action
Step 1: Warm Up (5 mins)	Hi <Student Name>! In the last class, we explored the different types of planets and filtered out more planets based on that.	**ESR:** - Terrestrial - Super Earth - Neptune Like - Gas Giant

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<table>
<tr><td></td><td>Can you name the different types of planets?</td><td></td></tr>
<tr><td></td><td>Great! Now in today’s class, we will learn about how we can calculate the speed of a planet and filter out more planets where we wouldn't survive!
Are you excited?</td><td>ESR:
“Yes!”</td></tr>
<tr><td></td><td>Let's get started.</td><td></td></tr>
<tr><td colspan="3">Teacher Initiates Screen Share</td></tr>
<tr><td colspan="3"><u>CHALLENGE</u>
• Teaching the kids how to calculate the speed of a planet!
• Filtering out more planets
• Plotting data</td></tr>
<tr><td>Step 2:
Teacher-led Activity
(15 min)</td><td>(Before beginning the class, make sure to use the same colab that you used in the last class. This is the continuation of that.)</td><td></td></tr>
<tr><td></td><td>Let’s check the headers that we have!

print(headers)</td><td></td></tr>
<tr><td colspan="3">[19] print(headers)
'planet_mass', 'stellar_magnitude', 'discovery_date', 'planet_type', 'planet_radius', 'orbital_radius', 'orbital_period', 'eccentricity', 'solar_system_name'</td></tr>
<tr><td></td><td>Here, we see two headers!
orbital_radius & orbital_period.

Orbital radius is the distance of the planet from the host star.</td><td></td></tr>
</table>

	Orbital period is the time the planet takes to complete one orbit around its Sun!	
	Let's plot a scatter plot to see how these values are for all the planets we are left with (**suitable_planets list**). Before we plot a scatter plot though, we can see that the **orbital_radius (9th column)** has a strange value AU and the **orbital_period (10th column)** is in days or years! Let's understand what AU is first and then we will also have to fix these values in order to perform statistics and plot data. **AU is short for Astronomical Unit** which is roughly the distance between the Sun and the Earth. **1 AU = 1.496e+8** We can go with the AU value but for orbital period, we need to ensure that all the values are with respect to days. This means that the columns that have **years** notation should be converted into **days** by multiplying it with 365 (Number of days we have in an year). We also have a few unknown values for the planet's orbital radius and we need to remove those rows as well!	

```
temp_suitable_planets = list(suitable_planets)
for planet_data in temp_suitable_planets:
 if planet_data[8].lower() == "unknown":
   suitable_planets.remove(planet_data)

for planet_data in suitable_planets:
 if planet_data[9].split(" ")[1].lower() == "days":
   planet_data[9] = float(planet_data[9].split(" ")[0]) #Days
 else:
   planet_data[9] = float(planet_data[9].split(" ")[0])*365 #Years
 planet_data[8] = float(planet_data[8].split(" ")[0])

orbital_radiuses = []
orbital_periods = []
for planet_data in suitable_planets:
  orbital_radiuses.append(planet_data[8])
  orbital_periods.append(planet_data[9])
```

	`` fig = px.scatter(x=orbital_radiuses, y=orbital_periods) fig.show() ``` Let’s go through this line by line. We are first creating a temporary list because we want to remove the planets for whom we do not know the orbital radius. We are doing it in the for loop as well, where we are checking if the value was unknown and if it is, we are removing the element from our list of Suitable Planets. We are then converting all the years and days to days and in float values. We are also converting the astronomical units of orbital radius in float. Finally, we are segregating orbital period and radius for all the planets and plotting a scatter plot with radius on the X-Coordinate and Period on the Y-Coordinate.	

```
temp_suitable_planets = list(suitable_planets)
for planet_data in temp_suitable_planets:
  if planet_data[8].lower() == "unknown":
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for planet_data in suitable_planets:
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  else:
    planet_data[9] = float(planet_data[9].split(" ")[0])*365 #Years
  planet_data[8] = float(planet_data[8].split(" ")[0])

orbital_radiuses = []
orbital_periods = []
for planet_data in suitable_planets:
  orbital_radiuses.append(planet_data[8])
  orbital_periods.append(planet_data[9])

fig = px.scatter(x=orbital_radiuses, y=orbital_periods)
fig.show()
```

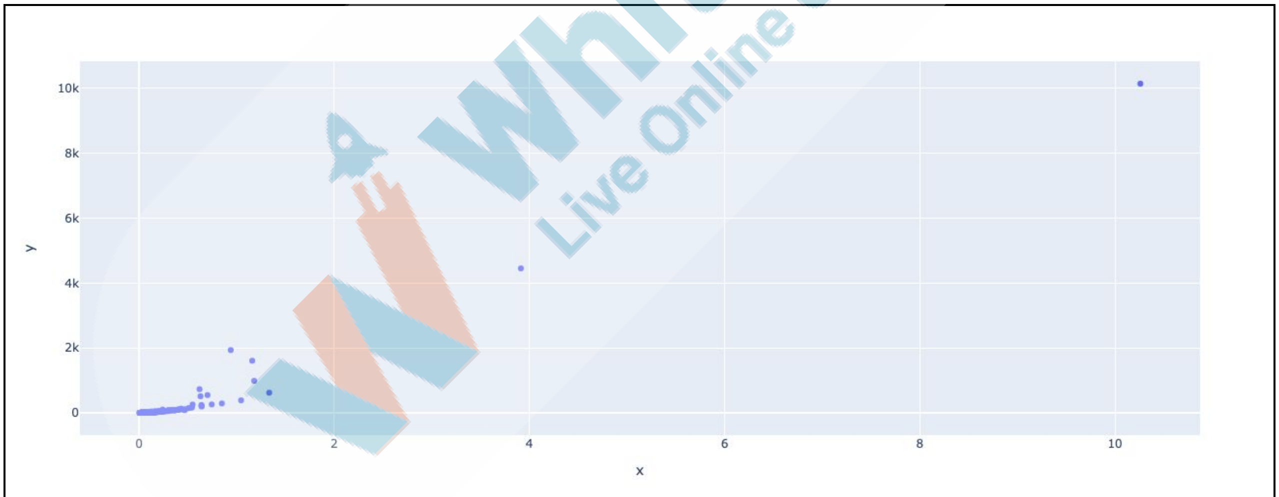

	Here, we can see that most of the suitable planets lie within 2 astronomical units, which is great! Let’s understand a few facts now:	**ESR:** Using Game States

	1. If a planet is too close to its sun, we can say that the planet will be too hot for us to survive. 2. If a planet is too far away from its sun, we can say that the planet will be too cold for us to survive. We call this the **Goldilock Zone.** Goldilock Zone is the habitable zone where the planet is more likely to have just the right conditions to sustain life. For us, we are at the very beginning of the Goldilock Zone whereas Mars is at the end of it. Earth is 1AU from the Sun and Mars is 1.5AU from the Sun. Some studies suggest on average, any planet that lies within 0.38 - 2 AU is likely to be habitable. Let's filter those planets out first! `goldilock_planets = list(suitable_planets) #We will leave suitable planet list as it is` `temp_goldilock_planets = list(suitable_planets)` `for planet_data in temp_goldilock_planets:`	

```
 if planet_data[8] < 0.38 or
planet_data[8] > 2:

goldilock_planets.remove(planet_
data)

print(len(suitable_planets))
print(len(goldilock_planets))
```

Here, we are creating a new list of **suitable_planets** and naming it as **goldilock_planets,** then we are iterating over all the suitable planets and we are removing the planets that have **orbital_radius** less than 0.38 or more than 2.

```
[92] goldilock_planets = list(suitable_planets) #We will leave suitable planet list as it is

     temp_goldilock_planets = list(suitable_planets)
     for planet_data in temp_goldilock_planets:
       if planet_data[8] < 0.38 or planet_data[8] > 2:
         goldilock_planets.remove(planet_data)

     print(len(suitable_planets))
     print(len(goldilock_planets))
```

```
696
25
```

The list of suitable planets gives us 696 and out of those, only 25 are in Goldilock Zone! That's how rare it is! We are really lucky to have Earth!

By the way, can you tell me why the number of suitable planets got reduced from 1452 to 696?

ESR:
Because we removed the planets for which we did not have orbital_radius.

	Awesome! Now, we also know the time it takes to complete one orbit (one complete rotation around the sun). We, as humans, are accustomed to the speed at which our planet completes one revolution around our Sun, therefore we can only survive on the planets that have speed close to ours. Earth travels at the speed of 30km/s. That's whooping but it's a fact! We cannot survive if the Earth increases/reduces its speed a lot. To calculate an exo-planet's speed, we do distance/time We know the time it takes and we also know the radius of the orbit. Using the formula to find the circumference of a circle, we can find out the distance and the speed of the planet! Circumference of a circle - $2\pi r$ $\pi = 3.14$ r = radius of the orbit	
Teacher Stops Screen Share		
	Now it's your turn. Please share your screen with me.	

- **Ask Student to press ESC key to come back to panel**
- **Guide Student to start Screen Share**
- **Teacher gets into Fullscreen**

ACTIVITY ● **Student finds out the speed of all the planets** ● **Student filters out the planets**		
Step 3: Student-Led Activity (15 min)	Given what we have just learned, let's calculate the speed of all the planets that exist in **suitable_planets** list (696). Our Earth revolves around the sun at 30km/s. Similarly, our solar system revolves around the center of the Milky Way galaxy at the speed of 200km/s. You can only imagine how fast we are moving! Given this data, we can assume that if a planet revolves at the speed of 200km/s, we can survive that. We are already surviving such high speeds! That means that the planet that's in the Goldilock zone would take anywhere from 30 to 50 days to complete it's 1 year (1 revolution around its sun). It would be 6-7 times faster than us. Also, make sure that we have the orbital_period in days. We need to convert it into seconds because we want to calculate the speed of the planet in **km/s** which is kilometers per second, instead of kilometers per day.	*Students write code to calculate the speed of all the planets and save it in a list.*

	1 Day = 86400 Seconds We also need to convert our orbital radius from AU to KM. **1 AU = 1.496e+8** *<Help the student in writing the code for this>* Also, filter out the planets that have speed more than 200km/s. `planet_speeds = []` `for planet_data in suitable_planets:` ` distance = 2 * 3.14 * (planet_data[8] * 1.496e+9)` ` time = planet_data[9] * 86400` ` speed = distance / time` ` planet_speeds.append(speed)` `speed_supporting_planets = list(suitable_planets) #We will leave suitable planet list as it is` `temp_speed_supporting_planets = list(suitable_planets)` `for index, planet_data in enumerate(temp_speed_supporting_planets):` ` if planet_speeds[index] > 200:` `  speed_supporting_planets.remove(planet_data)`	

	`` print(len(speed_supporting_planets)) ``` Here, we are first creating a list **planet_speeds** where we will keep all the speeds of the planets. We are then iterating over all the planets and finding its distance and time (and also converting distance from AU to KM and time from Days to Seconds). We are finding out the speed of the planet with the formula and then adding this speed into the list. We are then repeating the same process we did earlier, creating a list **speed_supporting_planets** and then we are creating a temporary version of it to iterate. We are then checking if the speed of the planet (**stored in the planet_speeds and we are finding it with the index of the planet data**) is greater than 200 or not. If it is, we are removing the planet from the list and finally, we are printing the length (number) of the planets whose speed can support us!	

```
[104] planet_speeds = []
    for planet_data in suitable_planets:
      distance = 2 * 3.14 * (planet_data[8] * 1.496e+9)
      time = planet_data[9] * 86400
      speed = distance / time
      planet_speeds.append(speed)

    speed_supporting_planets = list(suitable_planets) #We will leave suitable planet list as it is

    temp_speed_supporting_planets = list(suitable_planets)
    for index, planet_data in enumerate(temp_speed_supporting_planets):
      if planet_speeds[index] > 200:
        speed_supporting_planets.remove(planet_data)

    print(len(speed_supporting_planets))
```

	We find out that there are only 8 planets who can support us in terms of speed. We are indeed very lucky to have Earth as our home planet! Or maybe we are evolved based on the conditions we have here and other planets might be having some alien species too! You never know! What's your take on Aliens?	**ESR:** Varied

Teacher Guides Student to Stop Screen Share

FEEDBACK

- **Appreciate the student for their efforts**
- **Identify 2 strengths and 1 area of progress for the student**

Step 4: **Wrap-Up** **(5 min)**	So, in this class, we learned about how we can calculate the speed of a planet, we also learned about the Goldilock zone and we filtered out even more planets to conclude that • **there are only 25 planets that have the right planet_type, gravity and lies in the habitable zone of its solar system**	**ESR:** varied

	• **there are only 8 planets that have the right planet_type, gravity and the right speed to support us**! How was your experience?	
	Amazing. While working on this project, we also made sure that we are on top of all the concepts we have acquired so far. Next class, we will try to merge these lists and create a data collection. We will also try to explore a little about the suns of these planets!	-
Teacher Clicks ✖ End Class		

Activity	Activity Name	Links
Teacher Activity 1	Solution	https://colab.research.google.com/drive/16jZxvK2pB3eYqxAv9xVaVoUUez_6KhSV?usp=sharing