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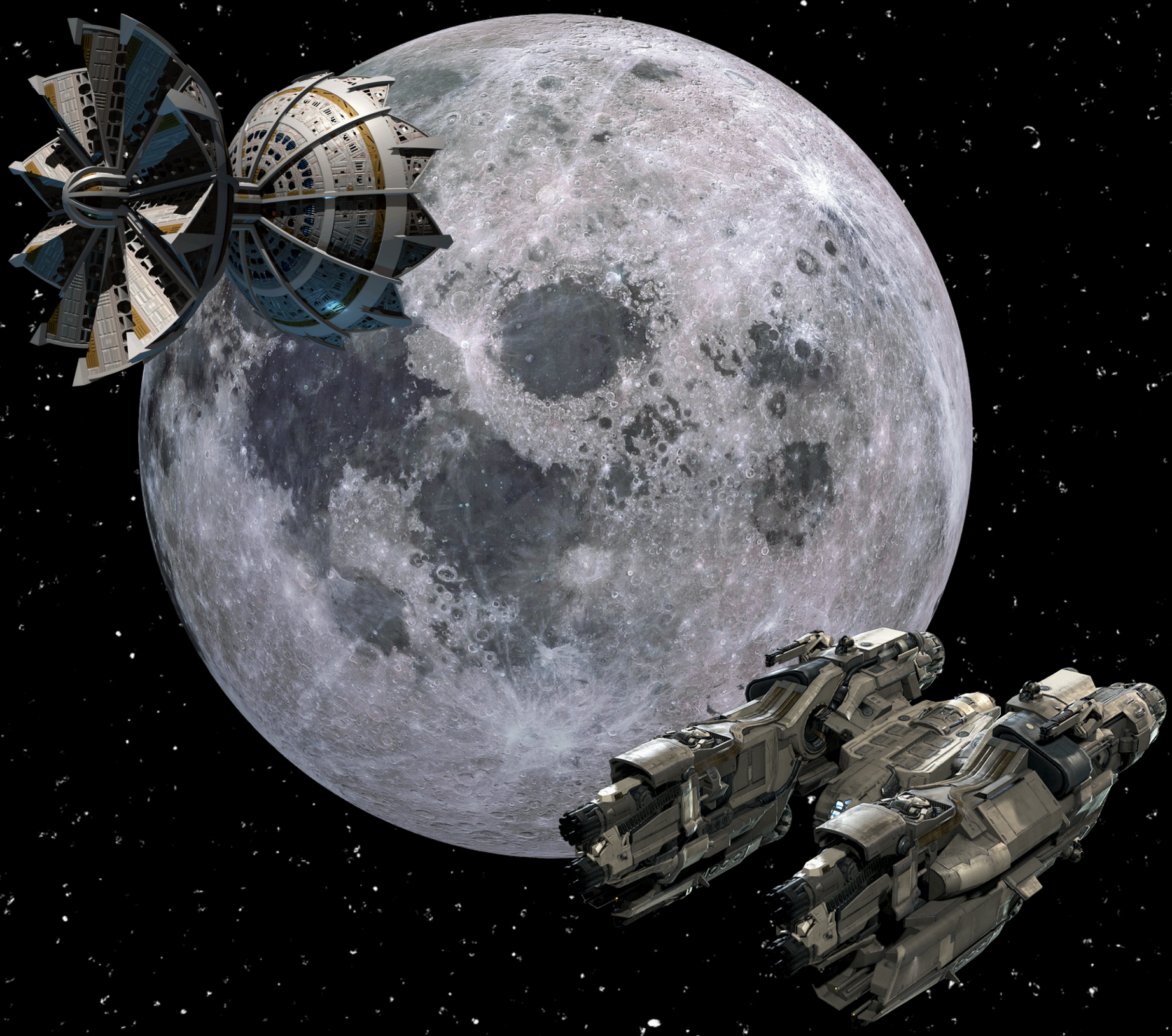
PROBLEM STATEMENTS



SPACE HOLDS MANY SECRETS THAT WE DON'T KNOW ABOUT

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- OPTIMAL DYNAMIC INTERPLANETARY NAVIGATOR SYSTEM
- INTERCEPTING 3I/ATLAS
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1.OPTIMAL DYNAMIC INTERPLANETARY NAVIGATOR SYSTEM

IN THIS CHALLENGE, PARTICIPANTS MUST DESIGN ODIN (OPTIMAL DYNAMIC INTERPLANETARY NAVIGATOR), AN AGENTIC AI SYSTEM CAPABLE OF AUTONOMOUSLY PLANNING AND DYNAMICALLY REPLANNING SPACECRAFT TRAJECTORIES FOR A MISSION TRAVELING FROM EARTH TO THE MOON.

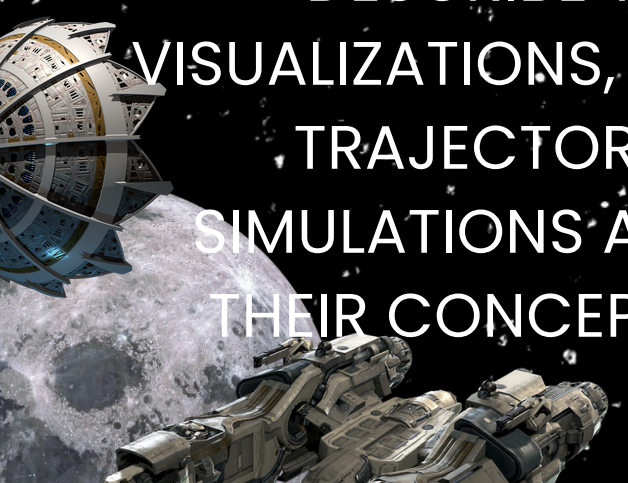
AT THE BEGINNING OF EACH RUN, ODIN WILL BE INITIALIZED WITH A RANDOMLY CHOSEN HISTORICAL TIMESTAMP BETWEEN JANUARY 1ST, 2012 AND DECEMBER 31ST, 2018, ENSURING THAT REAL SPACE-WEATHER AND ORBITAL DATA CAN BE FETCHED FROM PUBLIC DATASETS AND APIS.

ODIN MUST CONTINUOUSLY PROCESS HISTORICAL DATA ON SOLAR ACTIVITY, SPACE WEATHER, AND ORBITAL DEBRIS, ADAPTING MISSION PLANS IN REAL TIME WHENEVER HAZARDS ARISE, SUCH AS SOLAR FLARES OR DEBRIS RISKS.

WHEN A THREAT IS DETECTED, ODIN SHOULD USE GENERATIVE AI AS A STRATEGY CO-PILOT TO PROPOSE ALTERNATE SAFE TRAJECTORIES. IT MUST THEN AUTONOMOUSLY EVALUATE AND SELECT THE BEST OPTION BY WEIGHING MISSION-CRITICAL FACTORS SUCH AS FUEL EFFICIENCY (ΔV COST), TIME TO DESTINATION, AND CREW SAFETY.

BEYOND SIMPLY REPLANNING, ODIN MUST ALSO JUSTIFY ITS DECISIONS BY GENERATING CLEAR, HUMAN-READABLE LOGS THAT EXPLAIN THE TRADE-OFFS OF EACH CHOICE (FOR EXAMPLE: “CME DETECTED. REROUTING VIA ALTERNATE TRAJECTORY. RESULT: +6 HOURS TRAVEL TIME, -90% RADIATION EXPOSURE”).
THE FINAL SYSTEM SHOULD DEMONSTRATE RESILIENCE, ADAPTABILITY, AND CLARITY IN DECISION-MAKING TO ENSURE THE MISSION SUCCEEDS UNDER UNCERTAIN AND DYNAMIC CONDITIONS.

FOR THE PPT SUBMISSION ROUND, TEAMS MUST NOT ONLY DESCRIBE THEIR APPROACH IN TEXT BUT ALSO INCLUDE VISUALIZATIONS, SUCH AS FLOW DIAGRAMS, SYSTEM WORKFLOWS, TRAJECTORY PLOTS, OR MOCK-UPS OF DECISION LOGS, SIMULATIONS AND DASHBOARDS , TO CLEARLY COMMUNICATE THEIR CONCEPT AND ENSURE CONCEPTUAL UNDERSTANDING.



2. INTERCEPTING 3I/ATLAS

BACKGROUND : 3I/ATLAS (ALSO KNOWN AS C/2019 Y4 ATLAS) IS A MYSTERIOUS INTERSTELLAR OBJECT PASSING THROUGH OUR SOLAR SYSTEM. OBJECTS LIKE THIS ARE EXTREMELY RARE AND HOLD VALUABLE CLUES ABOUT THE ORIGINS OF STARS, PLANETS, AND POSSIBLY EVEN LIFE. HOWEVER, BY THE TIME WE DETECT SUCH OBJECTS, THEY ARE ALREADY MOVING AT EXTREME SPEEDS AND ON THEIR WAY OUT INTO DEEP SPACE — MAKING INTERCEPTION A HUGE SCIENTIFIC AND ENGINEERING CHALLENGE.

YOUR CHALLENGE : AS A TEAM OF DEVELOPERS AND ASTRO-ENTHUSIASTS, YOUR MISSION IS TO DESIGN AND SIMULATE A SPACE MISSION TO INTERCEPT AND CHASE 3I/ATLAS.

YOU WILL WORK ON FIVE PARTS:

- TRACK THE OBJECT
- BUILD A PLATFORM (WEB APP, VISUALIZATION, OR DASHBOARD) THAT SIMULATES OR VISUALIZES THE REAL-TIME POSITION AND TRAJECTORY OF 3I/ATLAS.)
- USE ORBITAL MECHANICS DATA TO MAKE THE VISUALIZATION ACCURATE AND EDUCATIONAL.
- DESIGN THE MISSION
- ALLOW USERS TO “CLICK TO CHASE” — I.E., PROPOSE A MISSION CONCEPT THAT COULD INTERCEPT 3I/ATLAS.

CONSIDER KEY MISSION FACTORS:

- LAUNCH WINDOW AND TIMING
- SPACECRAFT PROPULSION (CHEMICAL, ELECTRIC, NUCLEAR, SOLAR SAIL, ETC.)
- TRAVEL TIME VS. FUEL EFFICIENCY
- POSSIBLE SCIENTIFIC PAYLOADS FOR STUDYING THE OBJECT
- INTERACTIVE EXPERIENCE
- PRESENT THE SOLUTION IN AN ENGAGING AND EDUCATIONAL FORMAT.
- YOU MAY USE:
- 3D VISUALIZATIONS
- DASHBOARDS AND SIMULATIONS
- A GAMIFIED MISSION DESIGN EXPERIENCE

DELIVERABLES

THIS CHALLENGE WILL BE CONDUCTED IN TWO PHASES:

PHASE 1 – IDEA PRESENTATION

SUBMIT A PPT DESCRIBING YOUR CONCEPT.

THE PRESENTATION SHOULD CLEARLY EXPLAIN YOUR APPROACH TO :

- TRACKING 3I/ATLAS
- DESIGNING THE INTERCEPTION MISSION
- THE PLANNED INTERACTIVE/EDUCATIONAL EXPERIENCE

PHASE 2 – PROTOTYPE DEVELOPMENT

- SUBMIT A GITHUB REPOSITORY WITH YOUR WORKING PROTOTYPE AND DOCUMENTATION.
- SHARE A DEPLOYED WEB APP/DEMO LINK SHOWCASING YOUR PLATFORM.
- THE PROTOTYPE SHOULD DEMONSTRATE BOTH THE VISUALIZATION OF 3I/ATLAS AND THE INTERACTIVE MISSION DESIGN EXPERIENCE.

3. MULTI-MESSENGER EVENT CORRELATORA

A SYSTEM DESIGNED TO **FETCH ASTROPHYSICAL EVENT DATA** FROM MULTIPLE SOURCES AND IDENTIFY POTENTIALLY RELATED EVENTS BASED ON SPATIAL AND TEMPORAL PROXIMITY. 🚀

HOW IT WORKS:

- FETCH EVENT DATA FROM MULTIPLE API'S PULL PAST EVENT DATA FROM VARIOUS SPACE OBSERVATORIES AND CATALOGS: GRAVITATIONAL WAVES: GWOSC (GRAVITATIONAL WAVE OPEN SCIENCE CENTER) OPTICAL TRANSIENTS: **ZTF (**ZWICKY TRANSIENT FACILITY) OR **TNS** (TRANSIENT NAME SERVER) HIGH-ENERGY EVENTS: **NASA HEASARC** (GAMMA-RAY BURSTS, X-RAY TRANSIENTS, ETC.) STAR/OBJECT CATALOGS: **SIMBAD** OR **VIZIER** FOR CONTEXT ON NEARBY CELESTIAL OBJECTS

- COMPARE EVENTS ACROSS SOURCES TIME CORRELATION: IDENTIFY EVENTS THAT OCCURRED WITHIN A DEFINED TIME WINDOW (E.G., ±10 MINUTES OR ±1 DAY) SPATIAL CORRELATION: MATCH SKY COORDINATES (RIGHT ASCENSION AND DECLINATION) WITHIN A CERTAIN ANGULAR DISTANCE (E.G., <1°)
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- CROSS-MESSENGER CORRELATION IF EVENTS FROM DIFFERENT SOURCES ALIGN IN BOTH TIME AND SKY POSITION, FLAG THEM AS POSSIBLY RELATED EXAMPLE: A GRAVITATIONAL WAVE AND AN OPTICAL FLASH FROM THE SAME REGION AND TIME → LIKELY LINKED TO THE SAME COSMIC EVENT (E.G., NEUTRON STAR MERGER) OUTPUT: A LIST OF EVENT PAIRS (OR CLUSTERS) WITH MATCHING SPACE-TIME COORDINATES METADATA FOR EACH EVENT (SOURCE, TIME, RA/DEC, EVENT TYPE) CONFIDENCE SCORE FOR CORRELATION (OPTIONAL, BASED ON OVERLAP THRESHOLDS) ENABLES DETECTION OF SIGNIFICANT ASTROPHYSICAL PHENOMENA THROUGH MULTI-MESSENGER ANALYSIS — COMBINING SIGNALS FROM LIGHT, GRAVITATIONAL WAVES, AND PARTICLES.