H4D PRELIMINARY

PROBLEM TITLE: 60 OG-1
Scheduling: Solving the United States Pilot shortage

BACKGROUND
The United States Air Force is in a crisis situation with Pilot retention. There is a shortage of pilots in the airlines, and among many flying commands in the Air Force. Air Force pilots are leaving the service to join the airlines in large numbers, and one of the main factors in that decision is a lack of stability with flying schedules and for the family. The U.S. Air Force's 60th Operations Group at Travis AFB in Fairfield, CA flies three different aircraft (C-17 Globemaster, C-5 Galaxy, KC-10 Stratotanker) that provide critical airlift, and aerial refueling support all around the world. They were key to the US response efforts for Hurricane's Harvey, Irma, & Maria as well as the Mexico earthquake recovery efforts. Their crews and aircraft transport everyone from diplomatic personnel during evacuations, to the President's motorcade, to missiles to defend against North Korea, and bombs to support combat operations against ISIS.

It takes between five and fifteen crew members per plane to get the mission done. The current process to schedule and approve those personnel for the flights is convoluted, resulting in air crews unaware when and where they are flying until 24 hours in advance. Dedicated pilots rotate as "schedulers," using Microsoft OneNote, physical whiteboards, and an Air Force-specific system, the Global Decision Support System (GDSS), and Graduate Training Integration Management System (GTIMS) to plan the schedules each week, a process that can take up to two days and is constantly under revision.

CHALLENGE
Generate multiple different air crew combinations for flights, based on varying data points to inform schedulers' decision about who is flying when and increase advance notice for pilots of their flight schedules.

LIMITAITONS
- Plane schedule times are not classified, but they are protected from open access for security reasons.

PROBLEM OWNER
U.S. Air Force 60TH Operations Group, 22nd Airlift Squadron

PROBLEM TITLE: AFRL-3
Personnel Recovery - Hydration

BACKGROUND
During combat search and rescue operations, it is not always possible to locate and rescue downed pilots before their supplies run out. Pilots have a limited ready-to-use water supply that only lasts days, which means they soon need to find other sources of water. Space for supplies on aircraft is extremely limited, consisting only of what the pilot can bring on their body when they parachute.

CHALLENGE
Provide a way for pilots shot down in combat to remain hydrated for 28 days until they can be rescued.

LIMITATIONS
- Consider chemical sanitization through iodine tablets, but also consider there may be no ready source of water
- Other options include filtration for salt-water, rapid assessment of viability of filtered water
- At minimum pilots will need to generate 1 liter of water per day (or more)
- Worldwide applicability, both land and sea.
- Consider Metal Organic Frameworks
- System must be compatible with aircraft flight operations and ejection event.

PROBLEM OWNER
U.S. Air Force Research Lab (AFRL), 711th Human Performance Wing & AFwerX

H4D PRELIMINARY

PROBLEM TITLE: ARL-1
Long Range Face Recognition

BACKGROUND
Special Operations Forces (SOF) operators struggle to identify individuals of interest in biometric watch lists. A camera at a great distance, such as an unmanned aerial vehicle (UAV), might pick up imagery of individuals. However, the operator cannot recognize the individual from extended distances and match accurately against imagery of individuals of interest in biometric watch lists. Currently, there is no mature low size, weight, and power (SWaP) capability for long range facial recognition at distances of over 500 meters. Such technology would enable intelligence, surveillance, and reconnaissance (ISR) at long ranges, minimizing risk of discovery to the operator. In order to do so, the robust system would need sufficient hardware to image the face at sufficient resolution, and processing software/algorithms that correct for atmospheric turbulence. The goal is facial detection and recognition in real or near real-time with constrained computing resources.

CHALLENGE
Special Operations Forces (SOF) operators need a way to visually identify individuals of interest on biometric watch lists in real-time from an extreme distance.

LIMITATIONS

- Man-portable system capable of operation in outdoors/unconstrained settings
- Recognition at long standoff distances (threshold: 500 m, objective: 1000 m)
- Pixels on target (recommended minimum of 100 pixels inter-ocular distance)
- Accurate recognition at different facial poses (+-30° yaw angle)
- Technologies that might be relevant
    - Telescope optics and high-resolution cameras
    - Electron-multiplying CCD or intensified CCD for imaging in illumination-challenged settings
    - Atmospheric correction algorithms/software (e.g., lucky region imaging) and hardware
    - Super-resolution algorithms/software

PROBLEM SPONSOR
U.S. Army Research Laboratory, Image Processing Branch

PROBLEM TITLE: AWG-1
Ground Unit Subterranean Awareness

BACKGROUND
During times of war, adversaries of the United States (U.S.) employ subterranean structures and networks to hide resources, launch attacks, shelter from attacks, and move around the battlefield undetected. U.S. and coalition forces discover these structures and networks in disadvantageous circumstances such as while clearing an area after a hard-won fight or by suffering from the advantages they provide to the enemy, namely the ability to fire from a protected and undetected location or the ability to mount an attack from behind. As a result, movement of ground forces across the battlefield is slowed down, which further endangers the units. Additionally, upon discovery of a subterranean structure or network, there is no way for a unit to share the location of the structure or its characteristics with other forces.

The Asymmetric Warfare Group (AWG) believes that operations could be improved and lives saved if ground units are able either to access data on subterranean structures and networks from other entities or to generate that data themselves. Additionally, once that data is acquired they would need to be able to update, track, and share that data.

CHALLENGE
Detect, identify, visualize, and track subterranean structures and networks before U.S. ground units reach them in order to mitigate the advantages they provide adversaries.

LIMITATIONS
- Desirable technical thresholds: Identify the location of subterranean structures and networks. Map those structures and networks. Visualize that data in a handheld device or on a laptop. Share that data with another unit.
- Environmental conditions to consider: both open areas and dense environments; rubble; urban infrastructure; sand, mud, water; congested communications; hostile units.
- Technologies that might be relevant: unmanned ground/aerial vehicles; geographic information systems, ground-penetrating radar; Android Tactical Assault Kit.

PROBLEM SPONSOR
Asymmetric Warfare Group, S32 Group Analysis Cell

H4D PRELIMINARY

PROBLEM TITLE: EPA-2
Greenhouse gas footprint for local transportation

BACKGROUND
Transportation in cars, trucks, and aircraft is one of the largest contributors to greenhouse gas emissions, about 27%. Reducing their use improves air quality, reduces emissions, and saves energy. Federal agencies such as the Federal Transit Administration (FTA) and the Environmental Protection Agency (EPA) collect data from across the country; however, local municipalities and regions do not take their emission footprint into account when making city and transportation planning decisions.

CHALLENGE
Design a way for Environmental Transportation Officers in the Mayor's Office to measure the greenhouse gas footprint of local transportation in order to inform planning decisions in that municipality.

LIMITATIONS

- Describe technical thresholds (but do not write requirements)
- Environmental Conditions
- Technologies that may be relevant
- Other clarifying information

PROBLEM SPONSOR
U.S. Environmental Protection Agency, Office of Transportation and Air Quality, Transport and Climate Division

PRELIMINARY

PROBLEM TITLE:
ERDC-2
Rapidly Deployable Protection

BACKGROUND
In urban, operational environments, the need for protection for US soldiers is increasing as lethal and non-lethal combat resources are becoming more readily available to irrational actors. Soldiers currently deploy at least ten different products, however, the level of protection and weight of the materials range a great amount. Lighter and stronger materials are necessary to meet the need to reduce the load and increase the level of protection.

The Engineering Research and Development Center within the US Army Corps of Engineers would like to explore how to develop a rapidly deployable protection system that provides better personal protection to dismounted troops and that additionally connects together to form a larger structure when needed.

CHALLENGE
Build a rapidly deployable and portable protection system for dismounted troops in operational environments.

BOUNDARIES
- Within the parameters of the Department of Defense's Forced Levels of Protection
- Cannot be something that is wearable

PROBLEM OWNER
US Army Corps of Engineers, Engineering Research and Development Center, Geotechnical and Structure Laboratory

PRELIMINARY

PROBLEM TITLE: ERDC-5
Games for Cyber Defense

BACKGROUND
As global cyber threats evolve and traditional solutions are no longer robust or scalable enough to provide the answer, the US Government needs to explore creative ways to counter its adversaries. One possible strategy is to deploy games for cyber defense, a process which is also known as "Gamification." According to the Gamification Summit of 2013, the term is defined as "using game mechanics and game thinking to engage users and to solve problems." Gamification has been shown to increase attention span, focus, and motivation of participants, and gamified environments have contributed towards domain analysis, exploration, and even solving world hunger.

The US Government houses large networks, which require persistent and effective security. The Engineering Research and Development Center within the US Army Corps of Engineers would like to explore how games designed for cyber defense can be used to detect malicious activity on a network. The long-term goal would be that this gaming environment could be adapted and applied to monitor and protect other similar networks within the US Government.

CHALLENGE
Design a gaming environment that translates data from the cyber security information space into an interactive game space through which cyber security stakeholders (i.e., system users as well as cyber security analysts) may observe cyber behavior and detect anomalous or suspicious activity.

LIMITATIONS
- Architects must define data requirements for a game
- Preference for students with technical backgrounds

PROBLEM SPONSOR
US Army Corps of Engineers, Engineering Research and Development Center