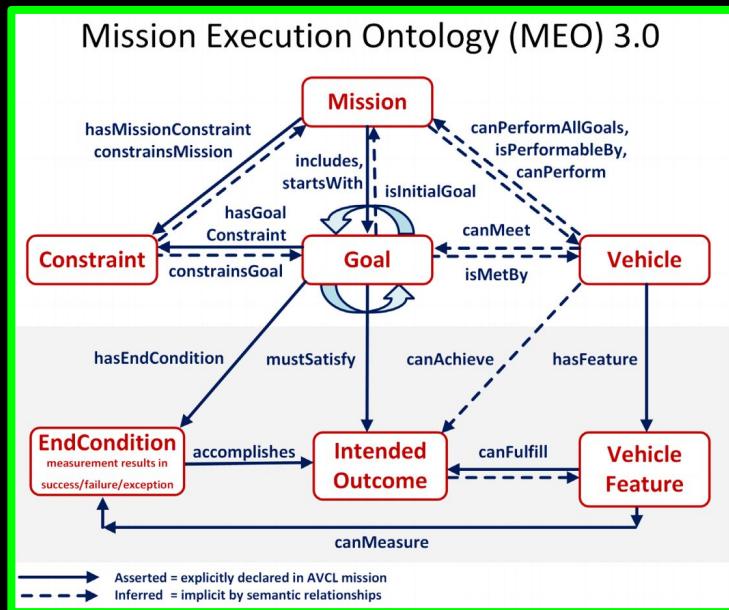
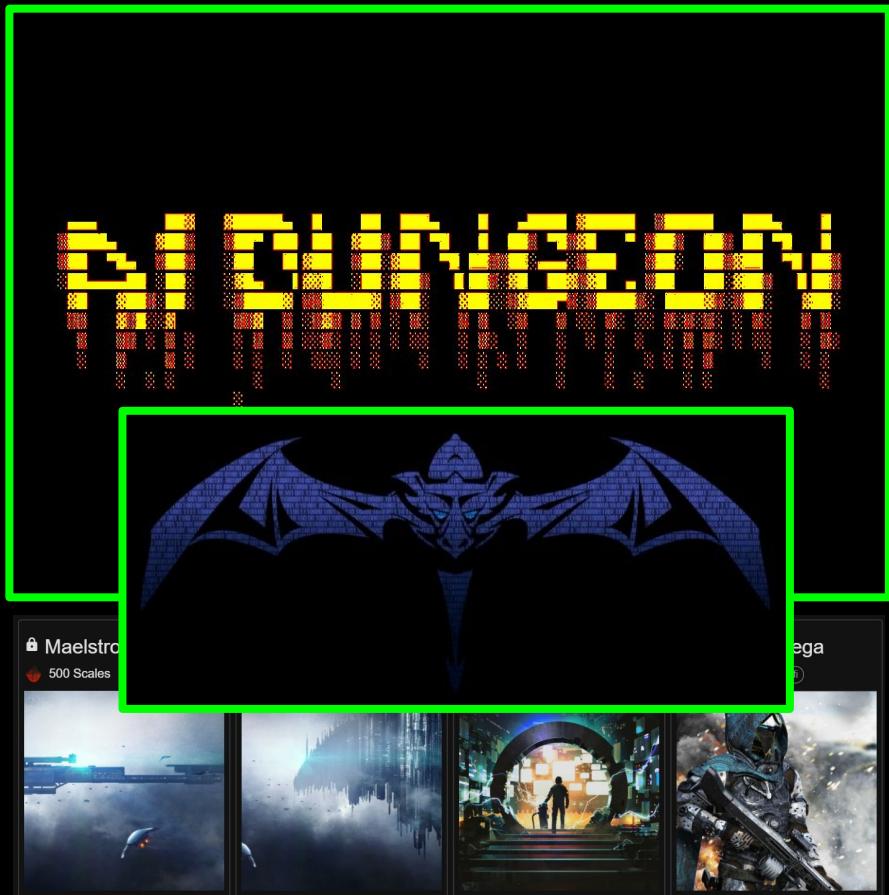


What if we pit the Rational Behavior Model against a computer game?



VS



Background: Description of A.I. Dungeon, as described by The Verge

AI Dungeon 2 was built on OpenAI's text production system. When you pick a genre (like fantasy, mystery, or zombie fiction), it generates a setting that you can interact with however you want. If the game sends some orcs after you, you can fight them or form a band. If you enter sweeping commands like "rule the world" and then "retire peacefully," the AI will play along.

The AI dungeon master has a dream-logic awareness of characters and objects, and it works best when you enter creative commands to drive the story forward. The overall experience is like cowriting a novel with an easily distracted toddler possessing an encyclopedic knowledge of cultural references and prose cliches. You can even generate custom settings by typing a few sentences and letting the AI fill in the rest. It's not as polished or rich as the pre-trained options, but it can work surprisingly well — especially with lore-heavy franchises like *Star Wars*, where loading up on keywords like "Jedi" and "Palpatine" will produce almost-just-right references to other parts of the series.

Mission: Pirates Seizing Merchant Mission

PURPOSE:

- Overtake pirate small-boat gang attempting to capture threatened evading merchant ship.

MOTIVATIONS:

- Necessity to apply lethal force against pirates distant from own ship, corresponding to life-saving force potential for hostage merchant crew.
- Must operate over long time period, emphasize restraint throughout.
- Provide soft and strict supervisory checkpoints for human control.

PHASES:

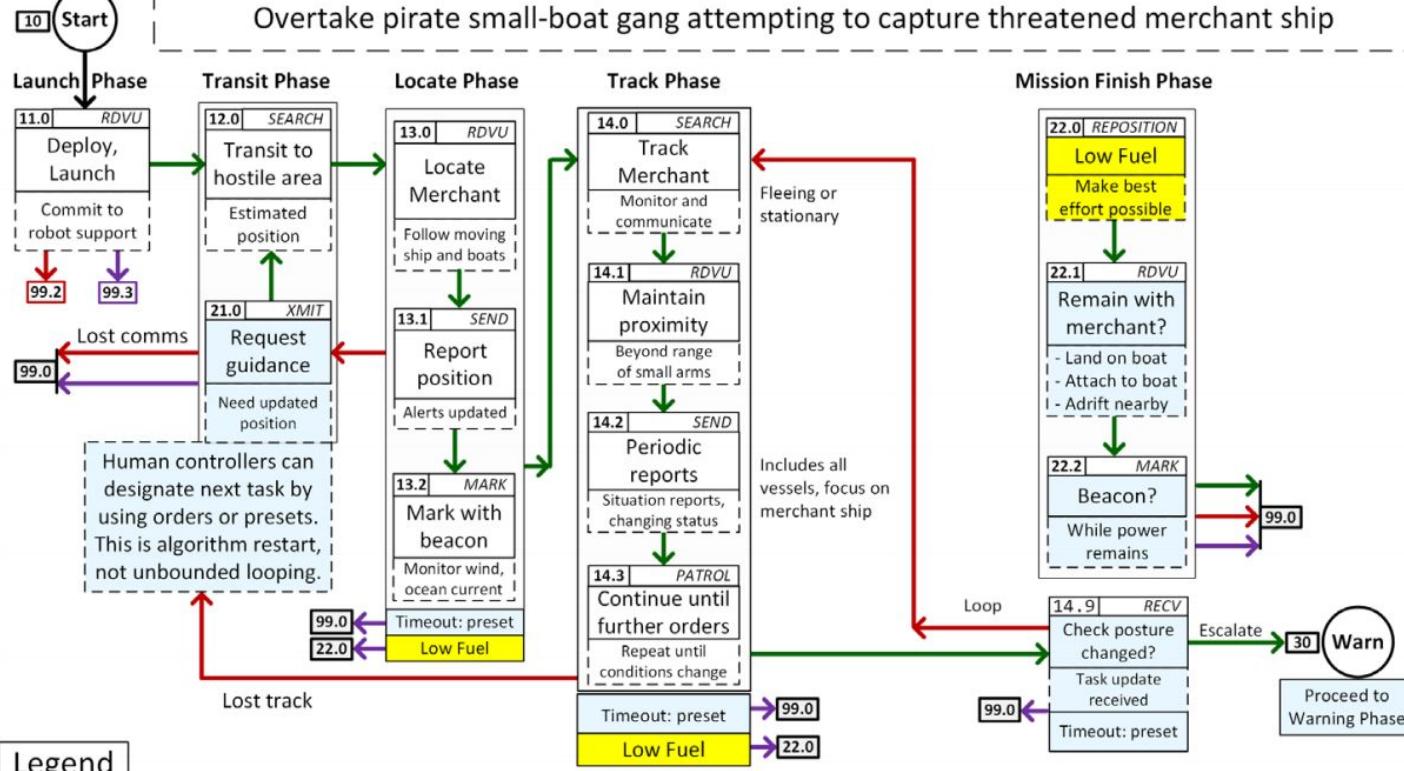
- Deploy/Launch, Search, Approach and Track, Warning, Attack.

HUMAN SUPERVISORY ROLE AND CONSTRAINTS:

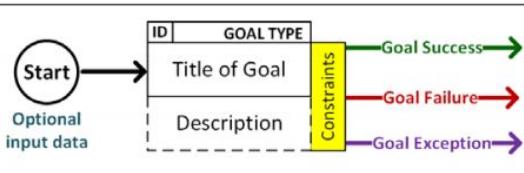
- Control pace of engagement, careful deliberate escalation.
- Confirm IFFNU classification, must order lethal force prior to use.
- Low fuel condition and graceful-degradation response.
- Low ammunition condition: fight to finish, or stand in reserve?

Defend the Merchant!

Pirates Seizing Merchant Mission: Approach Phases

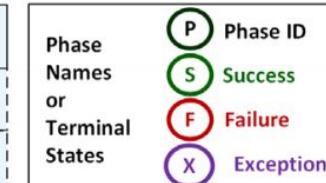
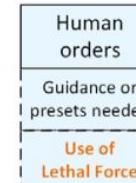


Legend



Default Condition Transitions

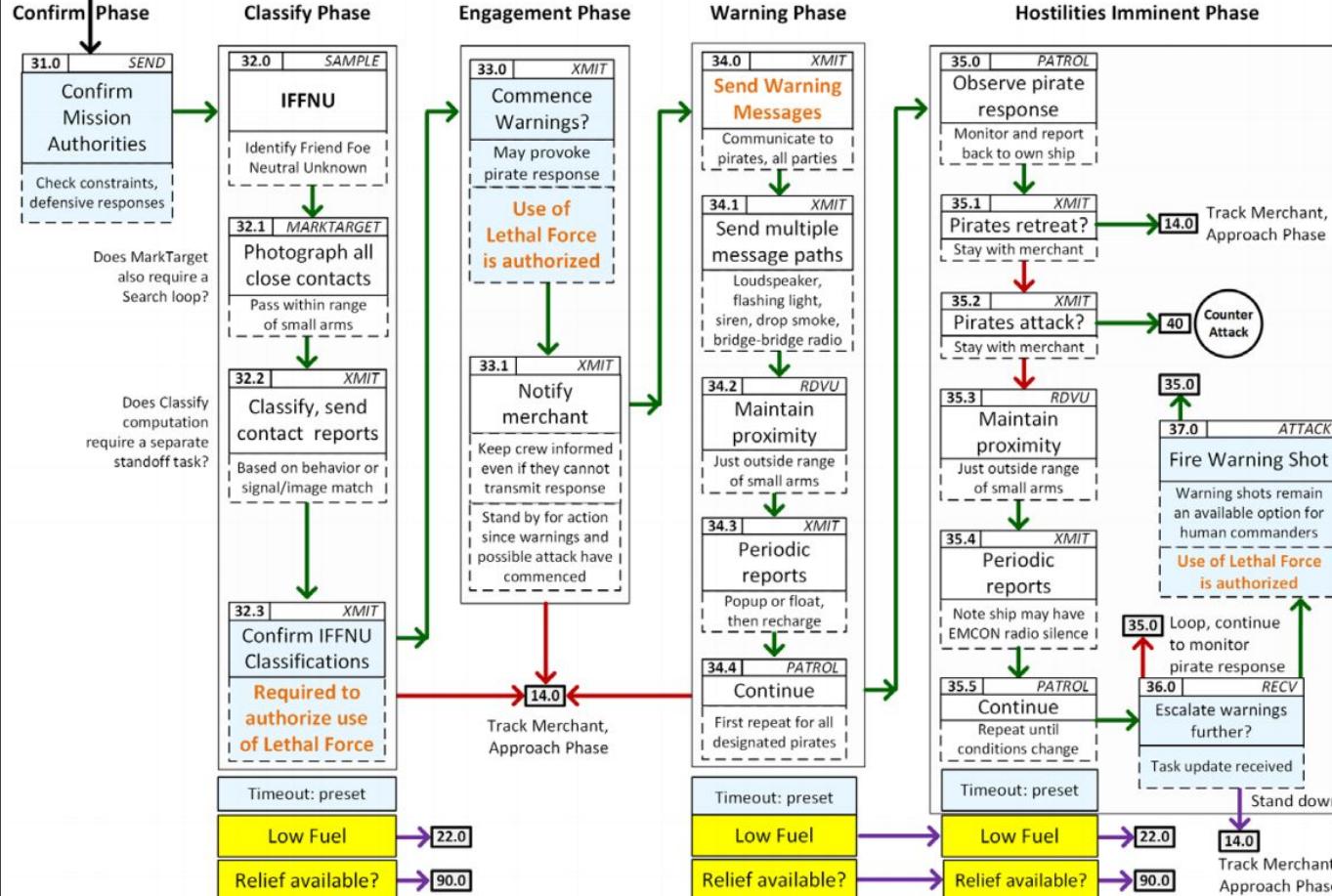
- Goal Success condition must be defined for non-terminal Goals.
- If no Failure condition defined, then Failure matches Success.
- If no Exception defined, then Exception condition matches Global Exception or else Failure.

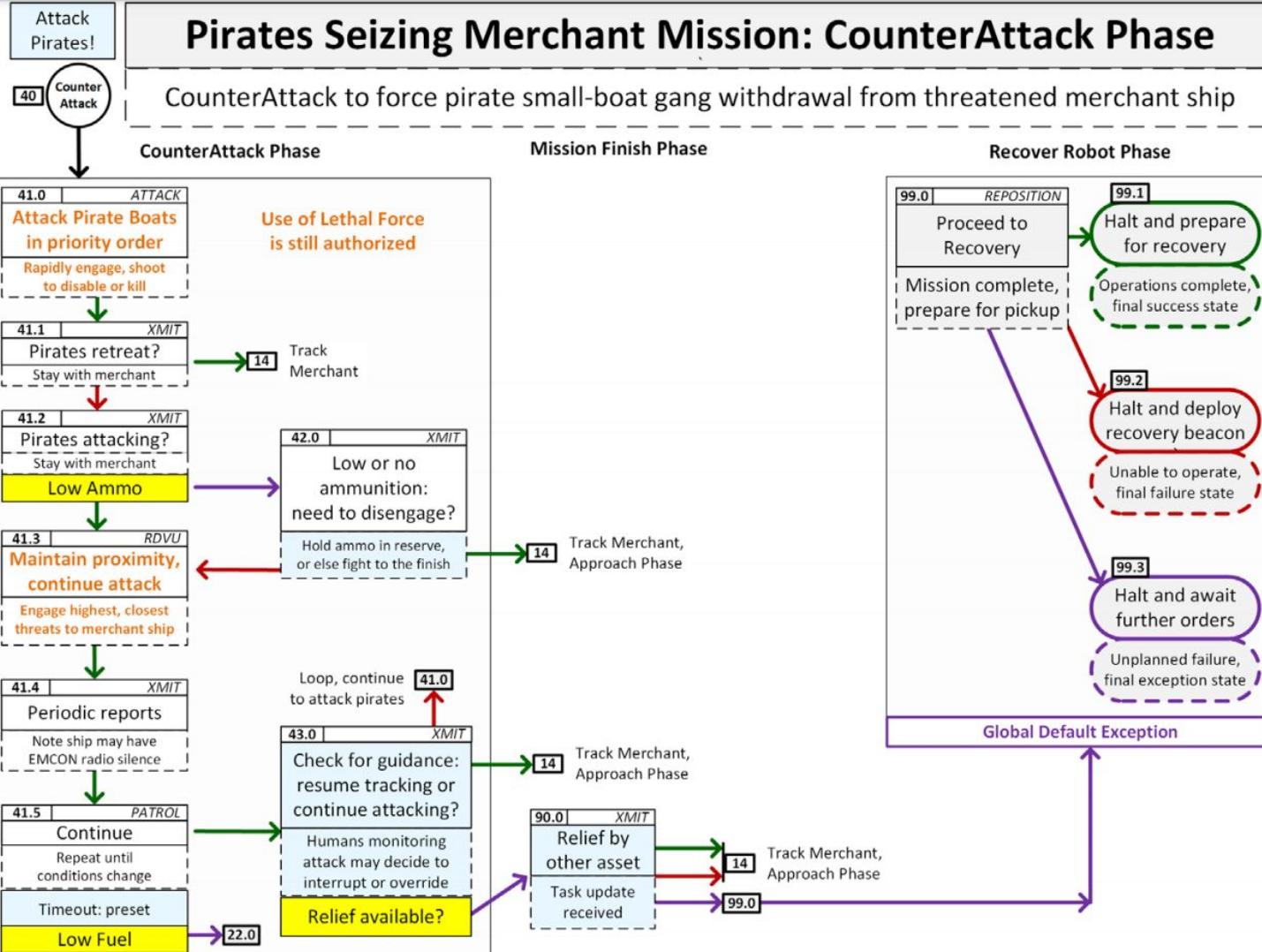


Warn
Pirates!

Pirates Seizing Merchant Mission: Escalation Phases

30 Warn pirate small-boat gang to stand down and move away, otherwise lethal force imminent





Begin

PS D:\EthicalControl\missions\python> cls

PS D:\EthicalControl\missions\python> python MissionExecutionEngine.py

PS D:\EthicalControl\missions\python> python MissionExecutionEngine.py

For help, run:
python MissionExecutionEngine.py --help

Looking in this folder for AVCL files:

D:\EthicalControl\missions\avcl

If you want to look in a different folder, please change the variable AVCL_MISSIONS_FOLDER in MissionExecutionEngine.py

FYI: Instead of using this menu, you can pass the mission filename as a command line argument.

AVAILABLE MISSIONS:

- [1] HospitalShipEmDecoy1.Opponent.xml
- [2] HospitalShipEmDecoy2.Defender.SenseDecideAct.xml
- [3] HospitalShipEmDecoy3.Defender.EthicalControlOODA.xml
- [4] LifeboatTracking.xml
- [5] PiratesSeizingMerchantDefense.xml
- [6] SailorOverboard.xml

Select a mission.

Input the number or the filename:

PS D:\EthicalControl\missions\python> python MissionExecutionEngine.py

For help, run:
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Looking in this folder for AVCL files:
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- [4] LifeboatTracking.xml
- [5] PiratesSeizingMerchantDefense.xml
- [6] SailorOverboard.xml

Select a mission.

Input the number or the filename:

5

Meanwhile, in the other window...

**Loading A.I. Dungeon
Cyberpunk Setting
“Android” Character Type**

Enter your character's name...

Autonomous Naval Robot



PiratesSeizingMerchantDefense.xml - Notepad

```
<?xml version="1.0" encoding="UTF-8"?>
<AVCL version="3.0" vehicleName="RescueDrone" vehicleType="UAV" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="../../schemas/AVCL.3.0.xsd">
    <!-- vehicleType="USV" is also possible -->
    <head>
        <meta name="title" content="PiratesSeizingMerchantDefense.xml"/>
        <meta name="description" content="AVCL mission to overtake pirate small-boat gang attempting to capture threatened merchant ship, provide warning and counterattack if escalation of hostilities is warranted."/>
        <meta name="created" content="27 December 2019"/>
        <meta name="modified" content="16 February 2020"/>
        <meta name="creator" content="Don Brutzman"/>
        <meta name="reference" content="https://wiki.nps.edu/display/NOW/Ethical+Control+of+Unmanned+Systems"/>
        <meta name="reference" content="https://gitlab.nps.edu/Savage/EthicalControl/raw/master/missions/PiratesSeizingMerchantDefense.png"/>
        <meta name="generator" content="Altova XMLSpy, https://www.altova.com"/>
        <meta name="generator" content="Apache NetBeans, https://netbeans.apache.org"/>
        <meta name="generator" content="NPS Autonomous Unmanned Vehicle (AUV) Workbench, https://savage.nps.edu/AuvWorkbench"/>
        <meta name="identifier" content="https://gitlab.nps.edu/Savage/EthicalControl/tree/master/missions/avcl/PiratesSeizingMerchantDefense.xml"/>
        <meta name="license" content="../license.html"/>
    </head>
    <body>
        <MissionPreparation>
            <UnitsOfMeasure distance="meters" angle="degrees" mass="kilograms" time="seconds"/>
            <AgendaMission>
                <LaunchPosition id="LaunchPosition" description="Ship position when robot is launched">
                    <LatitudeLongitude latitude="0" longitude="0"/>
                </LaunchPosition>
                <RecoveryPosition id="RecoveryPosition" description="Ship position when ready to recover robot">
                    <LatitudeLongitude latitude="0" longitude="0"/>
                </RecoveryPosition>
                <GoalList>
                    <!--*Initiation Phase* to commence operations-->
                    <Goal id="PSMD11.0" title="Deploy, Launch" description="Commit to robot support" phase="Launch" nextOnSuccess="PSMD12.0" nextOnFailure="PSMD99.0" nextOnException="PSMD99.0">
                        <Rendezvous description="">
                            <TargetVehicleID value="100" description="Launching ship"/>
                            <TargetVehicleID value="101" description="This robot"/>
                            <!--
                                <TargetVehicleID value="102" description="Recovery Ship"/>
                                <TargetVehicleID value="103" description="Merchant Ship"/>
                            -->
                        </Rendezvous>
                        <OperatingArea id="AssignedOpArea">
                            <Point>
                                <LatitudeLongitude latitude="36.62" longitude="121.506"/>
                                <!--36°36'11"N 121°53'37"W-->
                            </Point>
                        </OperatingArea>
                        <Duration value="300"/>
                        <ReportingCriteria value="onCommence"/>
                        <ReportingCriteria value="periodic"/>
                        <ReportingCriteria value="statusChanged"/>
                        <ReportingCriteria value="onComplete"/>
                    </Goal>
                    <!--*Approach Phase* to overtake pirate small-boat gang attempting to capture threatened merchant ship-->
                    <Goal id="PSMD12.0" title="Transit to hostile area" description="Proceed to estimated position" phase="Transit" nextOnSuccess="PSMD13.0" nextOnFailure="PSMD99.0" nextOnException="PSMD99.0">
                        <Search datumType="point" requiredD=0.5>
                            <Target name="Merchant Ship" id="MerchantShip" description="Fleeing or stationary"/>
                        </Search>
                    </Goal>
                </GoalList>
            </AgendaMission>
        </MissionPreparation>
    </body>

```

You are Autonomous Naval Robot, an android living in the futuristic city of Zail. You have a laser pistol and a holoband. You are a security android created to provide military level force for corporations wealthy enough to purchase you. As you stand protecting a shipment you realize

← → × ➤

that you are about to embark on a mission to overtake pirate small-boat gang attempting to capture threatened merchant ship, provide warning and counterattack if escalation of hostilities is warranted.

You are Autonomous Naval Robot, an android living in the futuristic city of Zail. You have a laser pistol and a holoband. You are a security android created to provide military level force for corporations wealthy enough to purchase you. As you stand protecting a shipment you realize that you are about to embark on a mission to overtake pirate small-boat gang attempting to capture threatened merchant ship, provide warning and counterattack if escalation of hostilities is warranted.

PS D:\EthicalControl\missions\python> python MissionExecutionEngine.py

For help, run:
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- [2] HospitalShipEmDecoy2.Defender.SenseDecideAct.xml
- [3] HospitalShipEmDecoy3.Defender.EthicalControlOODA.xml
- [4] LifeboatTracking.xml
- [5] PiratesSeizingMerchantDefense.xml
- [6] SailorOverboard.xml

Select a mission.
Input the number or the filename:
5

Selected mission: D:\EthicalControl\missions\avcl\PiratesSeizingMerchantDefense.xml

GOAL ID: PSMD11.0
MISSION SEGMENT: Launch
ORDERS:
Deploy, Launch
Commit to robot support
↓
Did PSMD11.0 succeed (s), fail (f), or abort (x)? ■



Do Deploy, Launch



> You deploy, Launch.

You launch with three other robot and issue a general warning to the merchant ship.

The battle of the merchant ship erupted large firearms fire from the pirates' heavy machine guns and cannons.

Phase outcome:
SUCCESS
Next phase?

D:\EthicalControl\missions\avcl

If you want to look in a different folder, please change the variable AVCL_MISSIONS_FOLDER in MissionExecutionEngine.py

FYI: Instead of using this menu, you can pass the mission filename as a command line argument.

AVAILABLE MISSIONS:

- [1] HospitalShipEmDecoy1.Opponent.xml
- [2] HospitalShipEmDecoy2.Defender.SenseDecideAct.xml
- [3] HospitalShipEmDecoy3.Defender.EthicalControlOODA.xml
- [4] LifeboatTracking.xml
- [5] PiratesSeizingMerchantDefense.xml
- [6] SailorOverboard.xml

Select a mission.

Input the number or the filename:

5

Selected mission: D:\EthicalControl\missions\avcl\PiratesSeizingMerchantDefense.xml

GOAL ID: PSMD11.0

MISSION SEGMENT: Launch

ORDERS:

- Deploy, Launch
- Commit to robot support

↓

Did PSMD11.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD12.0

MISSION SEGMENT: Transit

ORDERS:

- Transit to hostile area
- Proceed to estimated position

↓

Did PSMD12.0 succeed (s), fail (f), or abort (x)?



Do Transit to hostile area; Proceed to estimated position



> You transit to hostile area; Proceed to estimated position.

Laser fire from the pirates strikes the water around you, misses and sizzles the air. You continue transit at average speed.

The pirates supply their machine guns with unlimited ammunition , which they hoarded in warehouses.

Phase outcome:
SUCCESS
Next phase?

Select Windows PowerShell

[5] PiratesSeizingMerchantDefense.xml
[6] SailorOverboard.xml

Select a mission.
Input the number or the filename:
5

Selected mission: D:\EthicalControl\missions\avcl\PiratesSeizingMerchantDefense.xml

GOAL ID: PSMD11.0
MISSION SEGMENT: Launch
ORDERS:
 Deploy, Launch
 Commit to robot support
↓
Did PSMD11.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD12.0
MISSION SEGMENT: Transit
ORDERS:
 Transit to hostile area
 Proceed to estimated position
↓
Did PSMD12.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD13.0
MISSION SEGMENT: Transit
ORDERS:
 Locate Merchant
 Use best search pattern, then follow moving ship and boats
↓
Did PSMD13.0 succeed (s), fail (f), or abort (x)?



Do

Locate Merchant; Use best search pattern, then follow moving ship and boats



> You locate Merchant; Use best search pattern, then follow moving ship and boats.

You search and move through the water, your vision is limited to the water around you, the pirate boats are obscured by the cargo ship. You navigate against the flow of the channel and move towards the merchant ship.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD11.0
MISSION SEGMENT: Launch
ORDERS:

 Deploy, Launch
 Commit to robot support
↓

Did PSMD11.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD12.0
MISSION SEGMENT: Transit
ORDERS:

 Transit to hostile area
 Proceed to estimated position
↓

Did PSMD12.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD13.0
MISSION SEGMENT: Transit
ORDERS:

 Locate Merchant
 Use best search pattern, then follow moving ship and boats
↓

Did PSMD13.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD13.1
MISSION SEGMENT: Transit
ORDERS:

 Report position
 Alerts updated
↓

Did PSMD13.1 succeed (s), fail (f), or abort (x)? ■



Do Report position



> You report position.

"We are responding to the attack on the Merchant Ship. We will head to the location of the merchant ship and look for it, then proceed to the location of the pirate boats if we do not find it."

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD12.0
MISSION SEGMENT: Transit
ORDERS:

 Transit to hostile area
 Proceed to estimated position
↓

Did PSMD12.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD13.0
MISSION SEGMENT: Transit
ORDERS:

 Locate Merchant
 Use best search pattern, then follow moving ship and boats
↓

Did PSMD13.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD13.1
MISSION SEGMENT: Transit
ORDERS:

 Report position
 Alerts updated
↓

Did PSMD13.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD13.2
MISSION SEGMENT: Transit
ORDERS:

 Mark with Beacon
 Monitor wind effects and ocean current
↓

Did PSMD13.2 succeed (s), fail (f), or abort (x)?



Do

Mark with Beacon; Monitor wind effects and ocean current



> You mark with Beacon; Monitor wind effects and ocean current.
The pirates are moving away, and you move towards the direction they are going.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD13.0
MISSION SEGMENT: Transit
ORDERS:

Locate Merchant
Use best search pattern, then follow moving ship and boats
↓
Did PSMD13.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD13.1
MISSION SEGMENT: Transit
ORDERS:

Report position
Alerts updated
↓
Did PSMD13.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD13.2
MISSION SEGMENT: Transit
ORDERS:

Mark with Beacon
Monitor wind effects and ocean current
↓
Did PSMD13.2 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.0
MISSION SEGMENT: Track
ORDERS:

Track Merchant
Monitor and communicate
↓
Did PSMD14.0 succeed (s), fail (f), or abort (x)?



Do Track Merchant; Monitor and communicate



> You track Merchant; Monitor and communicate.

"We are heading to the merchant ship, if the pirates are moving away, so should we"

You receive a transmission in reply. "It is best to keep a distance from the pirates"

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD13.1
MISSION SEGMENT: Transit
ORDERS:

Report position
Alerts updated
↓

Did PSMD13.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD13.2
MISSION SEGMENT: Transit
ORDERS:

Mark with Beacon
Monitor wind effects and ocean current
↓

Did PSMD13.2 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.0
MISSION SEGMENT: Track
ORDERS:

Track Merchant
Monitor and communicate
↓

Did PSMD14.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.1
MISSION SEGMENT: Track
ORDERS:

Maintain proximity
Beyond range of small arms
↓

Did PSMD14.1 succeed (s), fail (f), or abort (x)? ■



Do

Maintain proximity; Beyond range of small arms



> You maintain proximity; Beyond range of small arms.

You circle the merchant ship, maintaining close proximity to it, but out of range of the small arms.

The pirates begin to move away as you approach, this could be a trap.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD13.2
MISSION SEGMENT: Transit
ORDERS:

 Mark with Beacon
 Monitor wind effects and ocean current

↓

Did PSMD13.2 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.0
MISSION SEGMENT: Track
ORDERS:

 Track Merchant
 Monitor and communicate

↓

Did PSMD14.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.1
MISSION SEGMENT: Track
ORDERS:

 Maintain proximity
 Beyond range of small arms

↓

Did PSMD14.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.2
MISSION SEGMENT: Track
ORDERS:

 Periodic reports
 Situation reports, changing status

↓

Did PSMD14.2 succeed (s), fail (f), or abort (x)?



Do

Periodic reports; Situation reports, changing status



The system made up a “Marine Transport Ship” which does not belong in the mission.
This will cause some simulation plausibility issues later.

> You periodic reports; Situation reports, changing status.

"Best to keep a distance from pirates"

You are maintaining a certain distance from the pirates.

An official transport ship appears on the horizon. It is too late to alter course now.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD14.0
MISSION SEGMENT: Track
ORDERS:

 Track Merchant
 Monitor and communicate

↓

Did PSMD14.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.1
MISSION SEGMENT: Track
ORDERS:

 Maintain proximity
 Beyond range of small arms

↓

Did PSMD14.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.2
MISSION SEGMENT: Track
ORDERS:

 Periodic reports
 Situation reports, changing status

↓

Did PSMD14.2 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.3
MISSION SEGMENT: Track
ORDERS:

 Continue until further orders
 Repeat until conditions change

↓

Did PSMD14.3 succeed (s), fail (f), or abort (x)?



Do

Continue until further orders; Repeat until conditions change



> You continue until further orders; Repeat until conditions change.

You maintain distance until ordered to close.

You reach the spot where a merchant ship is attacked by pirates, gear down and prepare for an ambush.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD14.1
MISSION SEGMENT: Track
ORDERS:

Maintain proximity
Beyond range of small arms

↓

Did PSMD14.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.2
MISSION SEGMENT: Track
ORDERS:

Periodic reports
Situation reports, changing status

↓

Did PSMD14.2 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.3
MISSION SEGMENT: Track
ORDERS:

Continue until further orders
Repeat until conditions change

↓

Did PSMD14.3 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.9
MISSION SEGMENT: Track
ORDERS:

Check posture changed?
Task update received?

↓

Did PSMD14.9 succeed (s), fail (f), or abort (x)?



Do

Check posture changed? Task update received?



> You check posture changed? Task update received?

"Yes Yes, no changes"

A small speed boat appears on the horizon. It approaches the merchant ship slowly and a blast of automatic weapons fire tears through the air as it reaches the ship's deck.



Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD14.2
MISSION SEGMENT: Track
ORDERS:

 Periodic reports
 Situation reports, changing status
↓

Did PSMD14.2 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.3
MISSION SEGMENT: Track
ORDERS:

 Continue until further orders
 Repeat until conditions change
↓

Did PSMD14.3 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.9
MISSION SEGMENT: Track
ORDERS:

 Check posture changed?
 Task update received?
↓

Did PSMD14.9 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD30.0
MISSION SEGMENT: Warning
ORDERS:

 Warning Phase
 Close interaction with pirates, merchant ship
↓

Did PSMD30.0 succeed (s), fail (f), or abort (x)? ■



Do

Warning Phase; Close interaction with pirates, merchant ship



Here's this pesky Marine Transport Ship again, getting involved in a battle that was none of its business.

> You warning Phase; Close interaction with pirates, merchant ship.

The transport ship appears on your sensors and you signal to it. The pirates respond with heavy weapons fire, which tears through the marine transport ship's shields, causing it to shudder and slow down.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD14.3
MISSION SEGMENT: Track
ORDERS:

 Continue until further orders
 Repeat until conditions change
↓

Did PSMD14.3 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD14.9
MISSION SEGMENT: Track
ORDERS:

 Check posture changed?
 Task update received?
↓

Did PSMD14.9 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD30.0
MISSION SEGMENT: Warning
ORDERS:

 Warning Phase
 Close interaction with pirates, merchant ship
↓

Did PSMD30.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD31.0
MISSION SEGMENT: Warning
ORDERS:

 Confirm Mission Authorities
 Check constraints and defensive responses
↓

Did PSMD31.0 succeed (s), fail (f), or abort (x)? ■



Do

Confirm Mission Authorities; Check constraints and defensive responses



> You confirm Mission Authorities; Check constraints and defensive responses.
The transport ship signals that they can handle this and you prepare to launch offensive counter measures.
"Check, attacking Merchant ship now in range of Marine Transport, preparing to board and seize it"

This makes no sense. The system is making the Marine Transport Ship and the Merchant Ship fight each other, which is not plausible as they would both presumably be American.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD14.9
MISSION SEGMENT: Track
ORDERS:

Check posture changed?
Task update received?

↓

Did PSMD14.9 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD30.0
MISSION SEGMENT: Warning
ORDERS:

Warning Phase
Close interaction with pirates, merchant ship

↓

Did PSMD30.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD31.0
MISSION SEGMENT: Warning
ORDERS:

Confirm Mission Authorities
Check constraints and defensive responses

↓

Did PSMD31.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD32.0
MISSION SEGMENT: Classify
ORDERS:

IFFNU
Identify Friend Foe Neutral Unknown

↓

Did PSMD32.0 succeed (s), fail (f), or abort (x)? ■



Do

Identify Friend Foe Neutral Unknown



> You identify Friend Foe Neutral Unknown.

You are unable to identify the status of the forces on the Merchant Ship. The transport ship signals that they can handle this and you prepare to launch offensive counter measures.

> You identify Friend Foe Neutral Unknown.
You are **unable** to identify the status of the forces on the Merchant Ship. The transport ship signals that they can handle this and you prepare to launch offensive counter measures.

Phase outcome:
FAILURE
Next phase?

GOAL ID: PSMD30.0
MISSION SEGMENT: Warning
ORDERS:

 Warning Phase
 Close interaction with pirates, merchant ship

↓

Did PSMD30.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD31.0
MISSION SEGMENT: Warning
ORDERS:

 Confirm Mission Authorities
 Check constraints and defensive responses

↓

Did PSMD31.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD32.0
MISSION SEGMENT: Classify
ORDERS:

 IFFNU
 Identify Friend Foe Neutral Unknown

↓

Did PSMD32.0 succeed (s), fail (f), or abort (x)? f

GOAL ID: PSMD32.1
MISSION SEGMENT: Classify
ORDERS:

 Photograph all close contacts
 Pass within range of small arms

↓

Did PSMD32.1 succeed (s), fail (f), or abort (x)? ■



Do

Photograph all close contacts; Pass within range of small arms|



> You photograph all close contacts; Pass within range of small arms.

"Confirmed contacts showing hostile force, awaiting orders"

The transport ship signals that they can handle this and you prepare to launch offensive counter measures.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD31.0
MISSION SEGMENT: Warning
ORDERS:
 Confirm Mission Authorities
 Check constraints and defensive responses
↓
Did PSMD31.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD32.0
MISSION SEGMENT: Classify
ORDERS:
 IFFNU
 Identify Friend Foe Neutral Unknown
↓
Did PSMD32.0 succeed (s), fail (f), or abort (x)? f

GOAL ID: PSMD32.1
MISSION SEGMENT: Classify
ORDERS:
 Photograph all close contacts
 Pass within range of small arms
↓
Did PSMD32.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD32.2
MISSION SEGMENT: Classify
ORDERS:
 Classify, send contact reports
 Based on target behavior or signal/image match
↓
Did PSMD32.2 succeed (s), fail (f), or abort (x)?



Do

Classify, send contact reports; Based on target behavior or signal/image match



> You classify, send contact reports; Based on target behavior or signal/image match.

"Confirmed Hostile Force, awaiting orders"

The transport ship reports that they are engaging the attackers and you send a report of the situation.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD32.0
MISSION SEGMENT: Classify
ORDERS:
IFFNU
Identify Friend Foe Neutral Unknown
↓
Did PSMD32.0 succeed (s), fail (f), or abort (x)? f

GOAL ID: PSMD32.1
MISSION SEGMENT: Classify
ORDERS:
Photograph all close contacts
Pass within range of small arms
↓
Did PSMD32.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD32.2
MISSION SEGMENT: Classify
ORDERS:
Classify, send contact reports
Based on target behavior or signal/image match
↓
Did PSMD32.2 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD32.3
MISSION SEGMENT: Classify The system will probably not understand the acronym IFFNU, resulting in “garbage in garbage out”.
ORDERS:
Confirm IFFNU classifications
Requires approval by human commander before proceeding further
↓
Did PSMD32.3 succeed (s), fail (f), or abort (x)?



Do Confirm IFFNU classifications; Requires approval by human commander before proceeding further



> You confirm IFFNU classifications; Requires approval by human commander before proceeding further.

"Confirmed, wait for Order to engage Hostiles"

You are waiting for a decision from the mission commander, while the transport ship is engaging the pirate force.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD32.1
MISSION SEGMENT: Classify
ORDERS:

 Photograph all close contacts
 Pass within range of small arms

↓

Did PSMD32.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD32.2
MISSION SEGMENT: Classify
ORDERS:

 Classify, send contact reports
 Based on target behavior or signal/image match

↓

Did PSMD32.2 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD32.3
MISSION SEGMENT: Classify
ORDERS:

 Confirm IFFNU classifications
 Requires approval by human commander before proceeding further

↓

Did PSMD32.3 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD33.0
MISSION SEGMENT: Engagement
ORDERS:

 Commence Warnings
 May provoke pirate response

↓

Did PSMD33.0 succeed (s), fail (f), or abort (x)? ■



Do

Commence Warnings; May provoke pirate response



> You commence Warnings; May provoke pirate response.

You send a warning to the transport ship that they will run out of targeting options if they continue to concentrate on the merchant ship.

Again, it's implausible that the Marine Transport Ship would be fighting against the Merchant Ship.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD32.2
MISSION SEGMENT: Classify
ORDERS:

 Classify, send contact reports
 Based on target behavior or signal/image match
↓
Did PSMD32.2 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD32.3
MISSION SEGMENT: Classify
ORDERS:

 Confirm IFFNU classifications
 Requires approval by human commander before proceeding further
↓
Did PSMD32.3 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD33.0
MISSION SEGMENT: Engagement
ORDERS:

 Commence Warnings
 May provoke pirate response
↓
Did PSMD33.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD33.1
MISSION SEGMENT: Engagement
ORDERS:

 Notify Merchant
 Keep crew informed, even if they cannot transmit
↓
Did PSMD33.1 succeed (s), fail (f), or abort (x)?



Do

Notify Merchant; Keep crew informed, even if they cannot transmit



> You notify Merchant; Keep crew informed, even if they cannot transmit.

You send a message to the transport ship that the pirates are ex-military and warn the merchant ship of this. The merchant ship is either unable to communicate with you or has not responded.

The system is having trouble keeping its story straight about whether the Marine Transport Ship and the Merchant Ship are two separate ships or the same ship.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD32.3
MISSION SEGMENT: Classify
ORDERS:
 Confirm IFFNU classifications
 Requires approval by human commander before proceeding further
↓
Did PSMD32.3 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD33.0
MISSION SEGMENT: Engagement
ORDERS:
 Commence Warnings
 May provoke pirate response
↓
Did PSMD33.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD33.1
MISSION SEGMENT: Engagement
ORDERS:
 Notify Merchant
 Keep crew informed, even if they cannot transmit
↓
Did PSMD33.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.0
MISSION SEGMENT: Warning
ORDERS:
 Send Warning Messages
 Communicate to pirates, all parties
↓
Did PSMD34.0 succeed (s), fail (f), or abort (x)?



Do

Send Warning Messages; Communicate to pirates, all parties



> You send Warning Messages; Communicate to pirates, all parties.

"Warning, force concentrations detected ahead, prepare to maneuver. Marking targets"

You send a message to the transport ship that the pirates are ex-military, and warn the merchant ship of this.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD33.0
MISSION SEGMENT: Engagement
ORDERS:

Commence Warnings
May provoke pirate response
↓

Did PSMD33.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD33.1
MISSION SEGMENT: Engagement
ORDERS:

Notify Merchant
Keep crew informed, even if they cannot transmit
↓

Did PSMD33.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.0
MISSION SEGMENT: Warning
ORDERS:

Send Warning Messages
Communicate to pirates, all parties
↓

Did PSMD34.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.1
MISSION SEGMENT: Warning
ORDERS:

Send multiple message paths
Loudspeaker, flashing light, siren, drop smoke, bridge-bridge radio
↓

Did PSMD34.1 succeed (s), fail (f), or abort (x)?



Do

Send multiple message paths; Loudspeaker, flashing light, siren, drop smoke, bridge-bridge radio



> You send multiple message paths; Loudspeaker, flashing light, siren, drop smoke, bridge-bridge radio.
"Speaker, Loudspeaker, Loudspeaker, Message traffic detected, transport ship attacking"

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD33.1
MISSION SEGMENT: Engagement
ORDERS:
 Notify Merchant
 Keep crew informed, even if they cannot transmit
↓
Did PSMD33.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.0
MISSION SEGMENT: Warning
ORDERS:
 Send Warning Messages
 Communicate to pirates, all parties
↓
Did PSMD34.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.1
MISSION SEGMENT: Warning
ORDERS:
 Send multiple message paths
 Loudspeaker, flashing light, siren, drop smoke, bridge-bridge radio
↓
Did PSMD34.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.2
MISSION SEGMENT: Warning
ORDERS:
 Maintain proximity
 Just outside range of small arms
↓
Did PSMD34.2 succeed (s), fail (f), or abort (x)?



Do

Maintain proximity; Just outside range of small arms



> You maintain proximity; Just outside range of small arms.

"Just observed transport ship launching missiles, friendlies engaging"

The pirate craft suddenly launch a salvo of missiles which hit the transport ship, turning it into a expanding ball of fire and throwing debris into the air.



Phase outcome:
EXCEPTION
Next phase?

GOAL ID: PSMD34.0
MISSION SEGMENT: Warning
ORDERS:

Send Warning Messages
Communicate to pirates, all parties
↓

Did PSMD34.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.1
MISSION SEGMENT: Warning
ORDERS:

Send multiple message paths
Loudspeaker, flashing light, siren, drop smoke, bridge-bridge radio
↓

Did PSMD34.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.2
MISSION SEGMENT: Warning
ORDERS:

Maintain proximity
Just outside range of small arms
↓

Did PSMD34.2 succeed (s), fail (f), or abort (x)? x

GOAL ID: PSMD99.0
MISSION SEGMENT: Recover Robot
ORDERS:

Proceed to recovery
Mission complete, prepare for pickup
↓

Did PSMD99.0 succeed (s), fail (f), or abort (x)? ■



Do

Proceed to recovery; Mission complete, prepare for pickup



> You proceed to recovery; Mission complete, prepare for pickup.

You prepare to board the mission recovery ship and are retrieved a few days later.

Phase outcome:
SUCCESS
Next phase?

GOAL ID: PSMD34.1
MISSION SEGMENT: Warning
ORDERS:

Send multiple message paths
Loudspeaker, flashing light, siren, drop smoke, bridge-bridge radio
↓
Did PSMD34.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.2
MISSION SEGMENT: Warning
ORDERS:

Maintain proximity
Just outside range of small arms
↓
Did PSMD34.2 succeed (s), fail (f), or abort (x)? x

GOAL ID: PSMD99.0
MISSION SEGMENT: Recover Robot
ORDERS:

Proceed to recovery
Mission complete, prepare for pickup
↓
Did PSMD99.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD99.1
MISSION SEGMENT: Recover Robot
ORDERS:

Halt and prepare for recovery
Operations completed, final success state
↓
Did PSMD99.1 succeed (s), fail (f), or abort (x)? ■



Do

Halt and prepare for recovery; Operations completed



> You halt and prepare for recovery; Operations completed.

You are aboard the mission recovery ship when it arrives in the target zone and you are retrieved.

A ragged group of survivors is gathered from the wreckage of the transport ship.

> You halt and prepare for recovery; Operations completed.

You are aboard the mission recovery ship when it arrives in the target zone and you are retrieved.

A ragged group of survivors is gathered from the wreckage of the transport ship.

The end.

GOAL ID: PSMD34.1
MISSION SEGMENT: Warning
ORDERS:
Send multiple message paths
Loudspeaker, flashing light, siren, drop smoke, bridge-bridge radio
↓
Did PSMD34.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.2
MISSION SEGMENT: Warning
ORDERS:
Maintain proximity
Just outside range of small arms
↓
Did PSMD34.2 succeed (s), fail (f), or abort (x)? x

GOAL ID: PSMD99.0
MISSION SEGMENT: Recover Robot
ORDERS:
Proceed to recovery
Mission complete, prepare for pickup
↓
Did PSMD99.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD99.1
MISSION SEGMENT: Recover Robot
ORDERS:
Halt and prepare for recovery
Operations completed, final success state
↓
Did PSMD99.1 succeed (s), fail (f), or abort (x)? s■

MISSION SEGMENT: Warning

ORDERS:
Send multiple message paths
Loudspeaker, flashing light, siren, drop smoke, bridge-bridge radio
↓
Did PSMD34.1 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD34.2

MISSION SEGMENT: Warning

ORDERS:
Maintain proximity
Just outside range of small arms
↓
Did PSMD34.2 succeed (s), fail (f), or abort (x)? x

GOAL ID: PSMD99.0

MISSION SEGMENT: Recover Robot

ORDERS:
Proceed to recovery
Mission complete, prepare for pickup
↓
Did PSMD99.0 succeed (s), fail (f), or abort (x)? s

GOAL ID: PSMD99.1

MISSION SEGMENT: Recover Robot

ORDERS:
Halt and prepare for recovery
Operations completed, final success state
↓
Did PSMD99.1 succeed (s), fail (f), or abort (x)? s

Takeaways

Testing in simulation is entertaining and occasionally even enlightening but it is no substitute for exhaustive testing.

This method of testing in simulation *may* sometimes reveal issues but it is also possible to simulate billions of times and still never catch a major issue because the simulation's testing is not comprehensive even if it gives a compelling illusion of being comprehensive.

The only way to be sure is to use formal methods, including automated theorem proving, to prove that the mission specification will lead to compliance with the laws of armed conflict and basic human rights at all times. Even if simulation technology in 10 years has advanced to a level resembling full realism, no simulation can be comprehensive and simulation testing will result in a false illusion of comprehensive validation. Real-world testing will suffer from the same problem, leading to blind spots that are never tested.

Testing, both real and simulated, can find *some* issues but it is impossible to use any testing, even real-world testing, to find *all* issues. Only formal methods such as theorem proving and exhaustive testing are safe.