Genetic Galaxy Defender

Gameplayer's Guide

Genetic Galaxy Defender is a game that helps demonstrate how Evolutionary Algorithms (EAs) can provide adaptation and exporation of a problem space.

This document will help guide players, for a more enjoyable experience.

What it looks like	What it is	What to do	Notes
	Your Ship	Move up and down and shoot Aliens. Prevent the aliens from getting to the left side of the screen.	- You only live once! - Your ammo is limited - A higher score gives a speed bonus - Your speed an ammo increase each Level
	Alien	Shoot it!	- Kill Alien: 3 points - Aliens have health and speed that depends on their equipment/sensor loadout - Each Alien has a "brain" that tells them what to do upon different sensor data - Alien loadouts and brains are adapted after each Level - Alien base health is 2 points, armor gives bonus to this
	Ship Bullet	Make these hit the Aliens	- worth 1 point of damage - after Level 1 there are secondary weapons that look different. Same principle applies.

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Key Mapping

Key	Function
⇧ (up arrow)	Moves your Ship up
⇩ (down arrow)	Moves your Ship down
↵(enter/return)	Start a new game (when you have died)
[spacebar]	Fire your Ship's cannon
"T"	Toggle the equipment details text for each alien
"R"	Resets the current Level (preserving your old score, etc) in case you get hung up or in an impossible situation
"P"	Pauses the game (useful for observing!)
"F"	Toggles between primary and secondary weapons (available after Level 1)

Things to try:

- Really and truly try to kill all Aliens and keep them from crossing to the left side
- Kill only the weak Aliens. You should find that the enemy gets stronger.
- Allow a weak but successful Alien pass through. Then the enemy gets easier.
- Do nothing for a few levels (hide and don't die).
- Keep a record from the Evolution screen to see which equipment is successful.
- Make it to levels 5 and 9, where the weapons get much better.
- Play to level 10 at least twice.

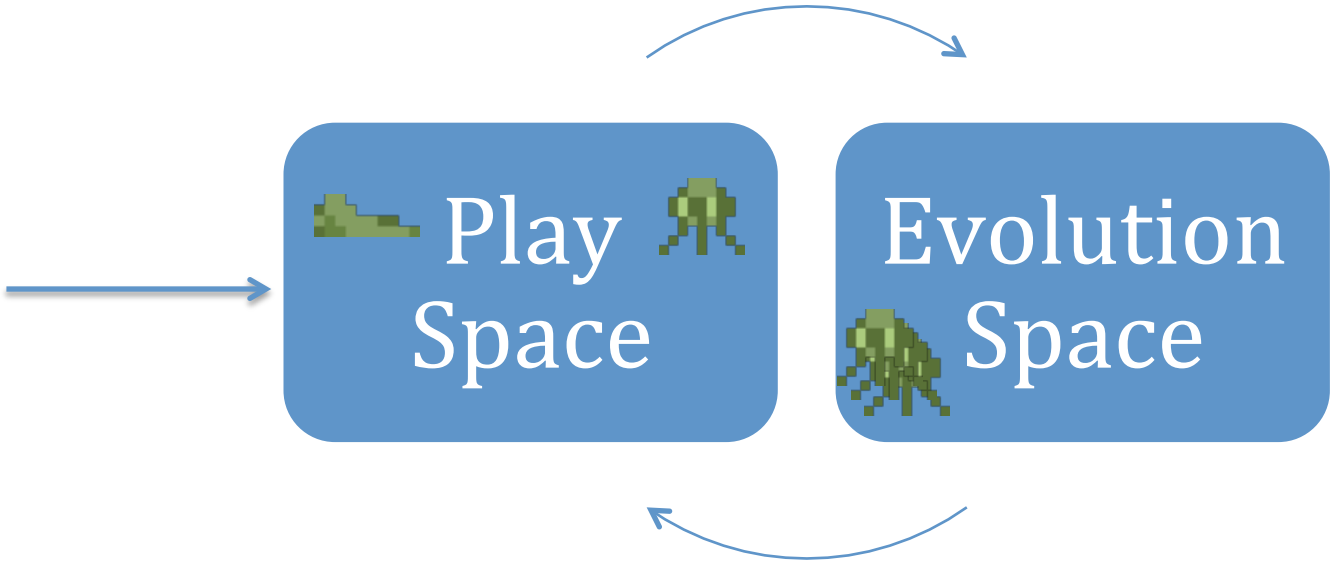
Tips and Advice for playing the game:

- Play multiple times

- Read the equipment loadout at the Evolution screen each time and try to see where crossover and mutation has occurred.
- There are a large number of tips in the game itself. A random tip is displayed after every successful Level.
- Killing weak enemies makes the enemy stronger…
- Annihilating the enemy makes them start over from random bugs!
- If you are overwhelmed, just hide (try the very bottom of the screen).
- Conserve ammo for the weak Aliens if you must.
- If you get hung up on an Alien that has a lot of battery left and you have no ammo, restart the Level.

Gamestate Flow Diagram

The game begins in the Play Space (state) where the player attempts to prevent (a randomly-generated set of) Aliens from reaching the left side of the screen by shooting bullets. At the end of the round the game transitions to the Evolution Space (state) where the Alien(s) that reached the left side of the screen receive fitness assessments, have a chance to be selected for mating, mate, and produce offspring. All survivors, Parents, and Children are then taken back to the Play Space and are the models for any Alien that spawns in the Play Space.



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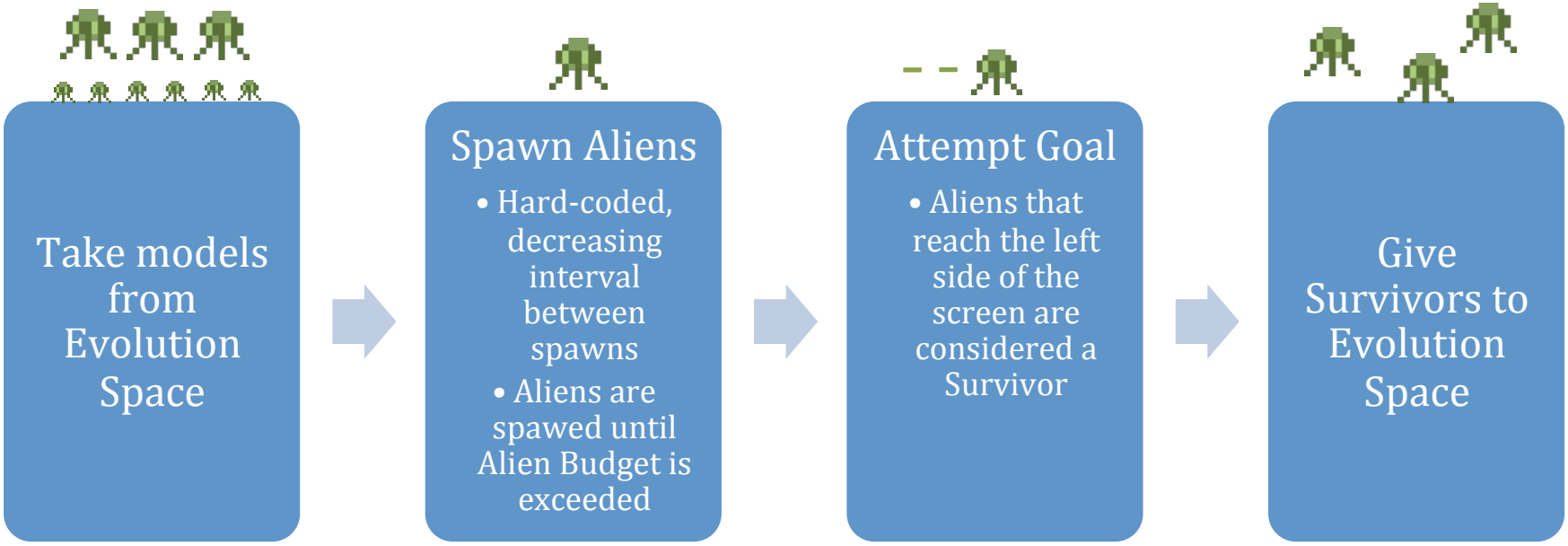
Play Space Diagram

Each round begins and ends in the Play Space (state) where the player (Ship) attempts to prevent Aliens from reaching the left side of the screen by shooting bullets. After this state, the game transitions to the Evolusion Space (state).

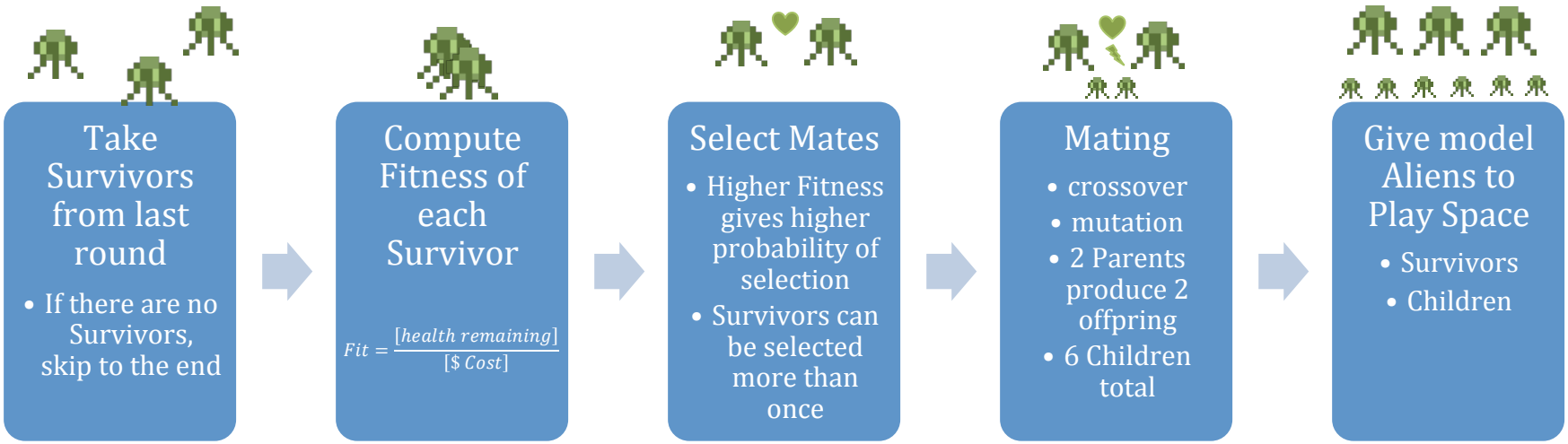


- *Alien Budget is a $ limit set for each round. The first few rounds start with a set budget, then starting around round 3 the budget increases each round. The amount of the budget spent each spawn is equal to the total $ Cost of the spawned Alien.*
- *When Attempting Goal, the Aliens can be shot by the Ship or they can run out of Battery Energy.*
- *Aliens are spawned at a random y position on the right side of the screen.*
- *If there are no Survivors from the previous round (e.g. first round of play, or they were all killed last round) then each spawn will be randomly created*

Genetic Space Defender
Program Design

Evolution Space Diagram

The game begins in the Play Space (state) where the player attempts to prevent (a randomly-generated set of) Aliens from reaching the left side of the screen by shooting bullets. At the end of the round the game transitions to the Evolution Space (state) where the Alien(s) that reached the left side of the screen receive fitness assessments, have a chance to be selected for mating, mate, and produce offspring. All survivors, Parents, and Children are then taken back to the Play Space and are the models for any Alien that spawns in the Play Space.



- *If there is one Survivor, he can mate with himself*
- *Some Survivors may be selected more than once, and some not at all*
- *Exactly 6 Children are produced*
- *During Mating: Equipment, Sensors, and State Transition Tables undergo crossover and mutation.*

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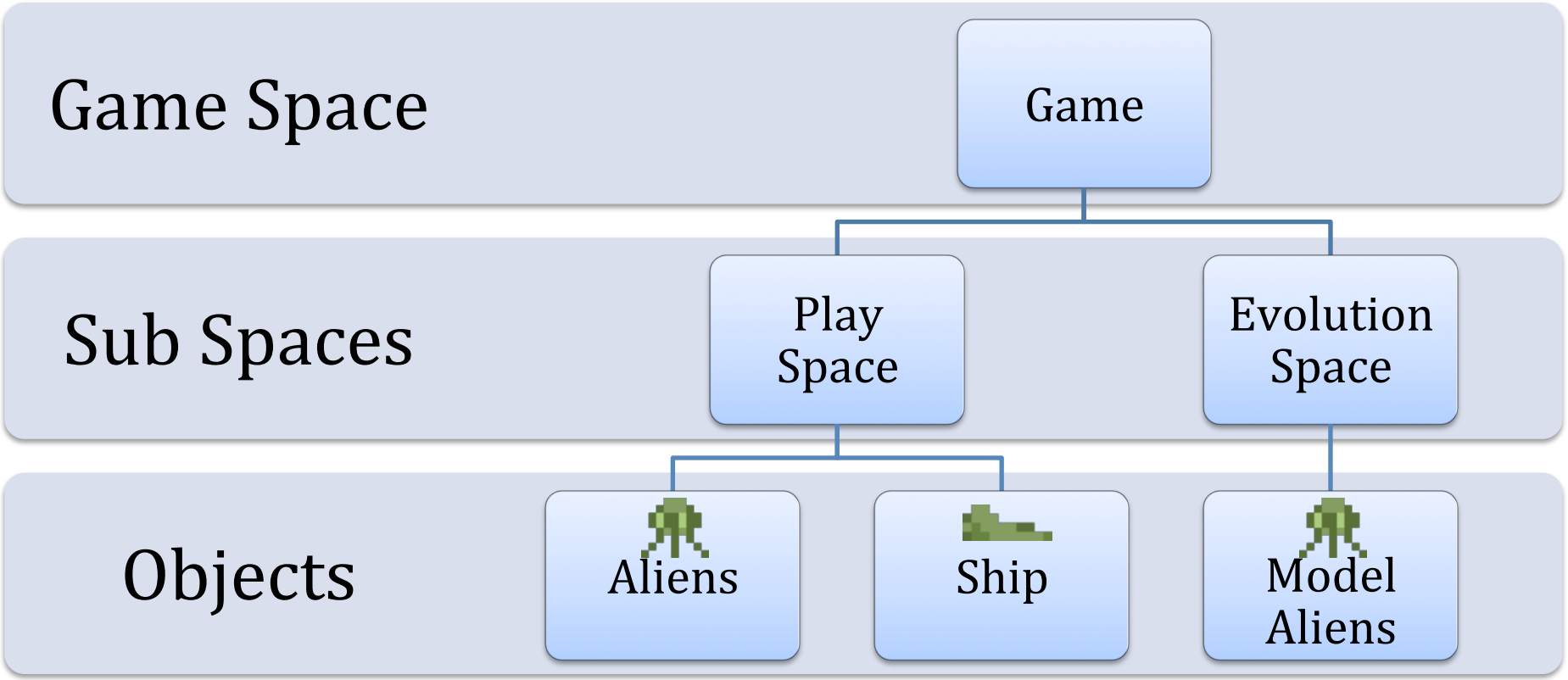
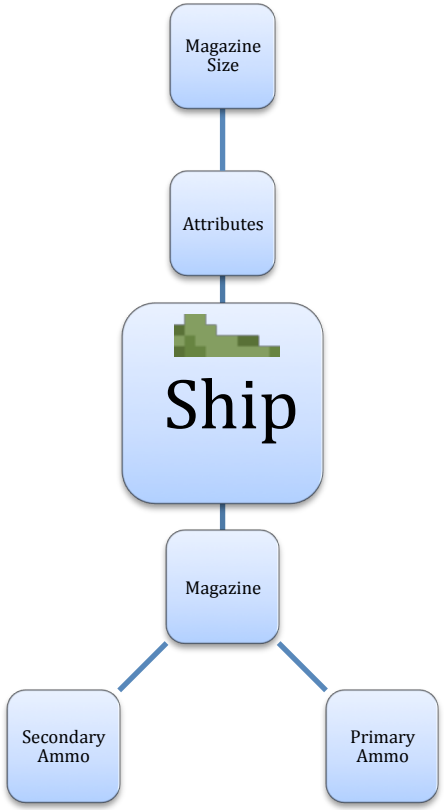
Overall Object Diagram



Ship Object Diagram



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Alien Object Diagram

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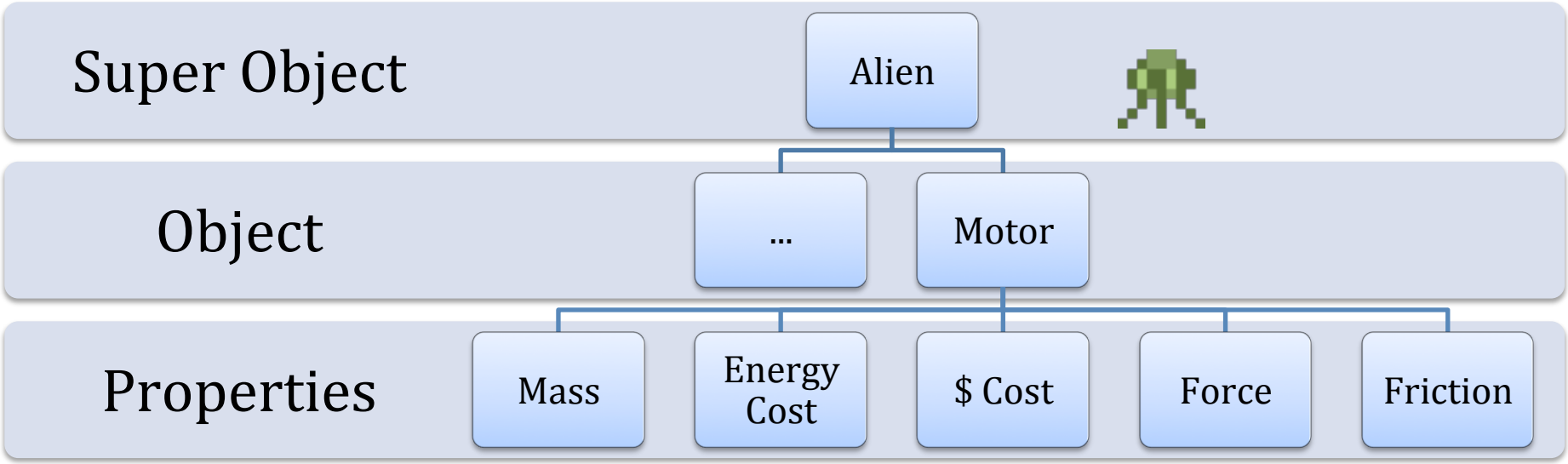
Motor Object Diagram

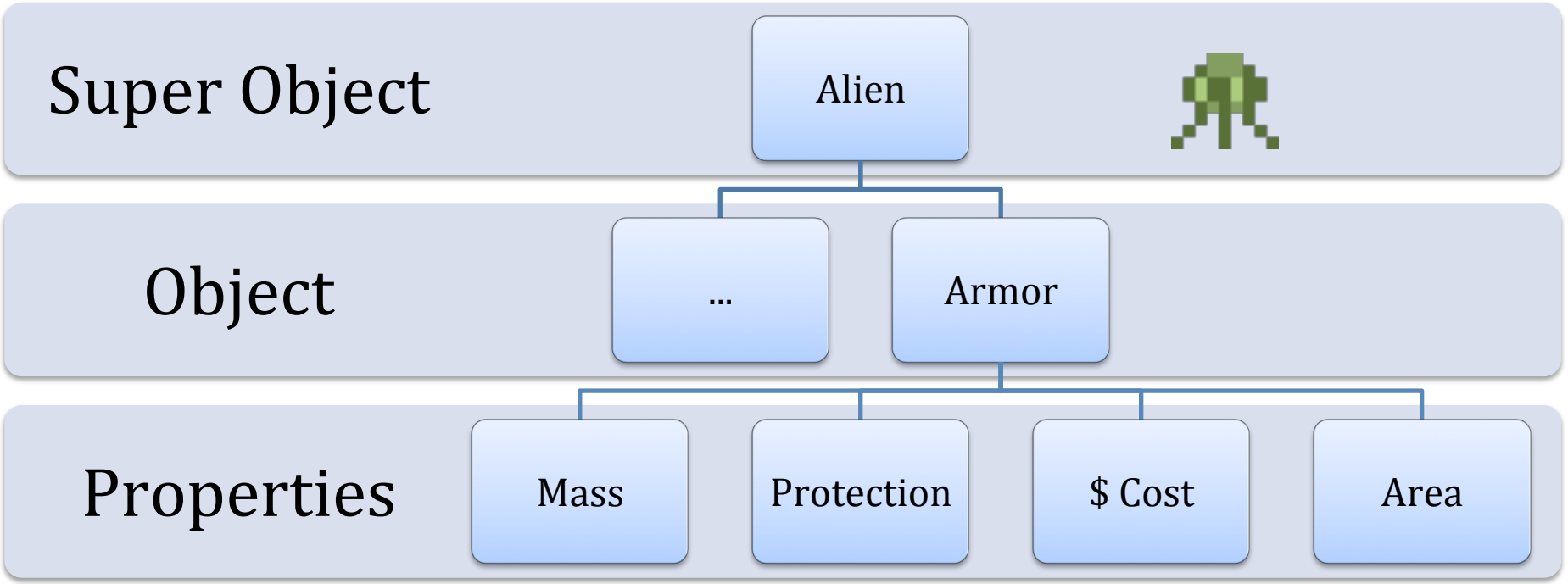
The Motor is an Alien's way to move around the playspace.



- **Mass**: number used to calculate the overall mass of the Alien. Used when calculating speed of Alien.
- **Energy Cost**: number that indicates how much of the battery this uses each time the Alien moves.
- **$ Cost**: positive integer used to calculate the overall cost of the Alien.
- **Force**: number that indicates how much force this motor can exert. Used when calculating speed of Alien.
- **Friction**: positive number that indicates how much friction this mode of transportation has. Numbers 0 to 1 (exclusive) reduce the speed of the Alien. Numbers above 1 increase the speed of the Alien.

Armor Object Diagram

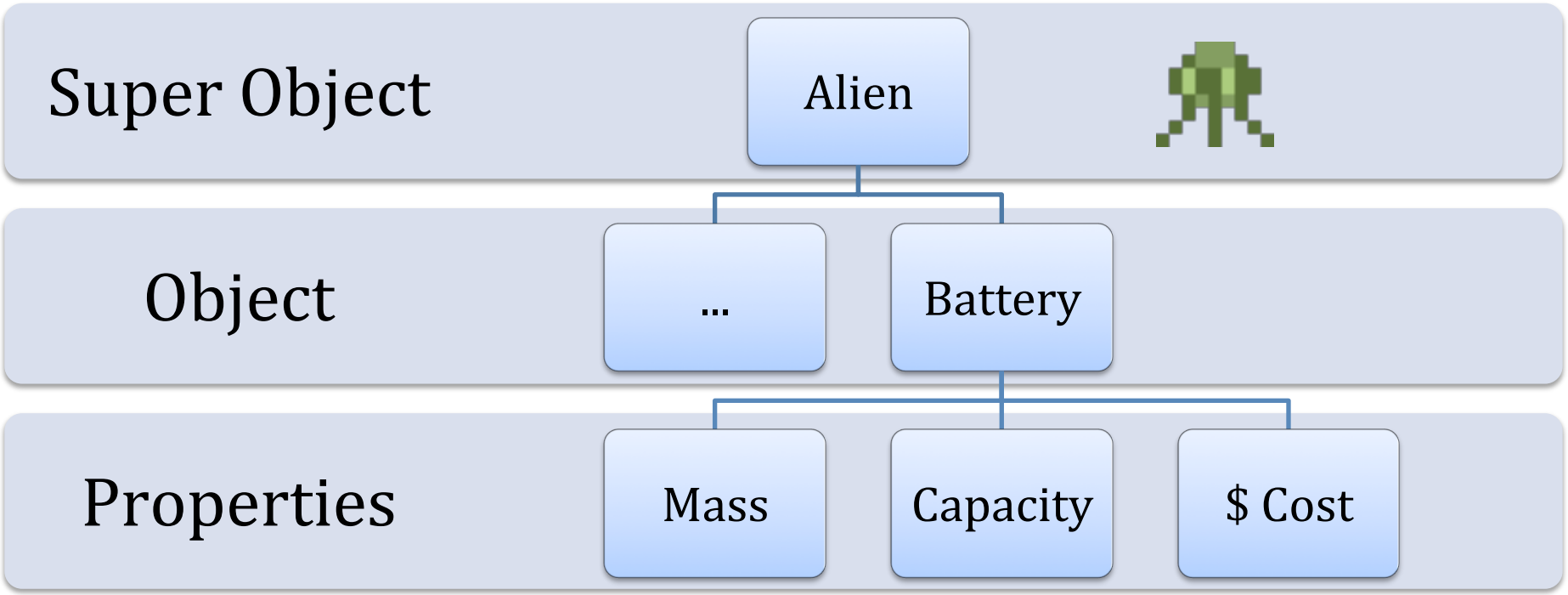
Armor is an opportunity for an Alien to trade Mass and Area (speed) and $ Cost for protection against bullets.



- **Mass**: number used to calculate the overall mass of the Alien. Used when calculating speed of Alien.
- **Protection**: integer added to an Alien's base health
- **$ Cost**: positive integer used to calculate the overall cost of the Alien
- **Area**: number used to calculate overall surface area. Used when calculating speed of Alien.

Battery Object Diagram

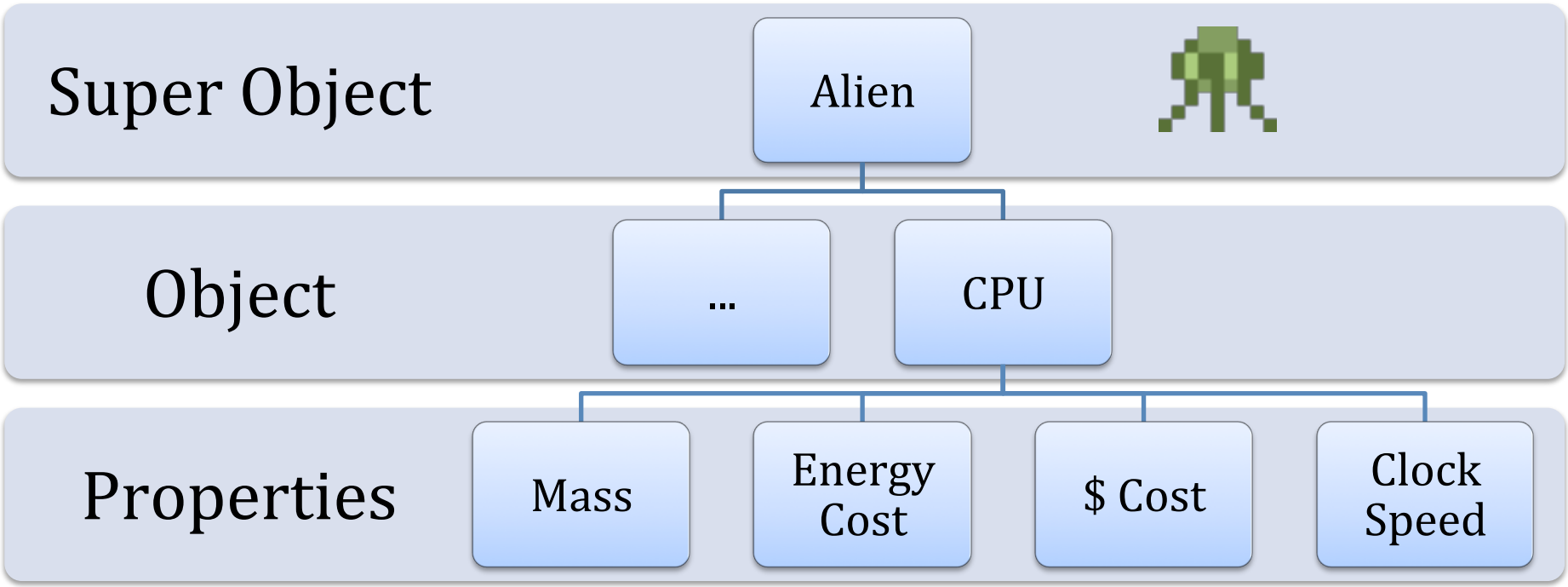
The Battery is an Alien's Energy bank. When the battery is depleted the Alien dies.



- **Mass**: number used to calculate the overall mass of the Alien. Used when calculating speed of Alien.
- **Capacity**: number that indicates how many units of energy this battery can hold.
- **$ Cost**: positive integer used to calculate the overall cost of the Alien.

CPU Object Diagram

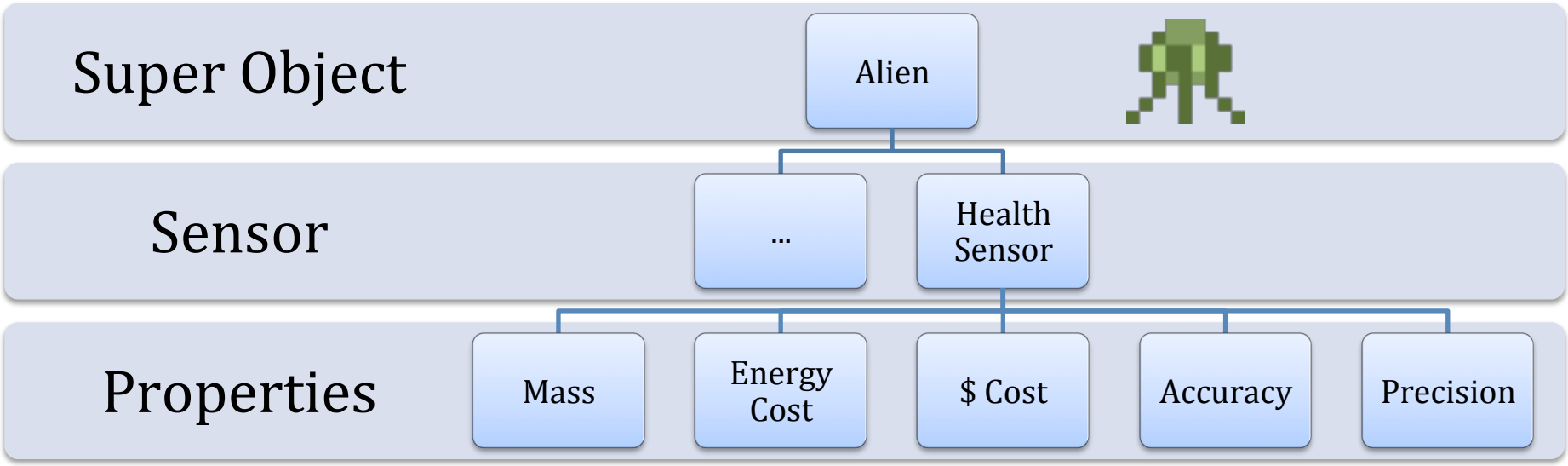
The CPU is an Alien's Central Processing Unit. CPUs enable the Alien to read from equipped Sensors.



- **Mass**: number used to calculate the overall mass of the Alien. Used when calculating speed of Alien.
- **Energy Cost**: number that indicates how much of the battery this uses each time the Alien moves.
- **$ Cost**: positive integer used to calculate the overall cost of the Alien.
- **Clock Speed**: positive integer that determines how often this CPU can allow the Alien to read from his Sensors.

Health Sensor Object Diagram

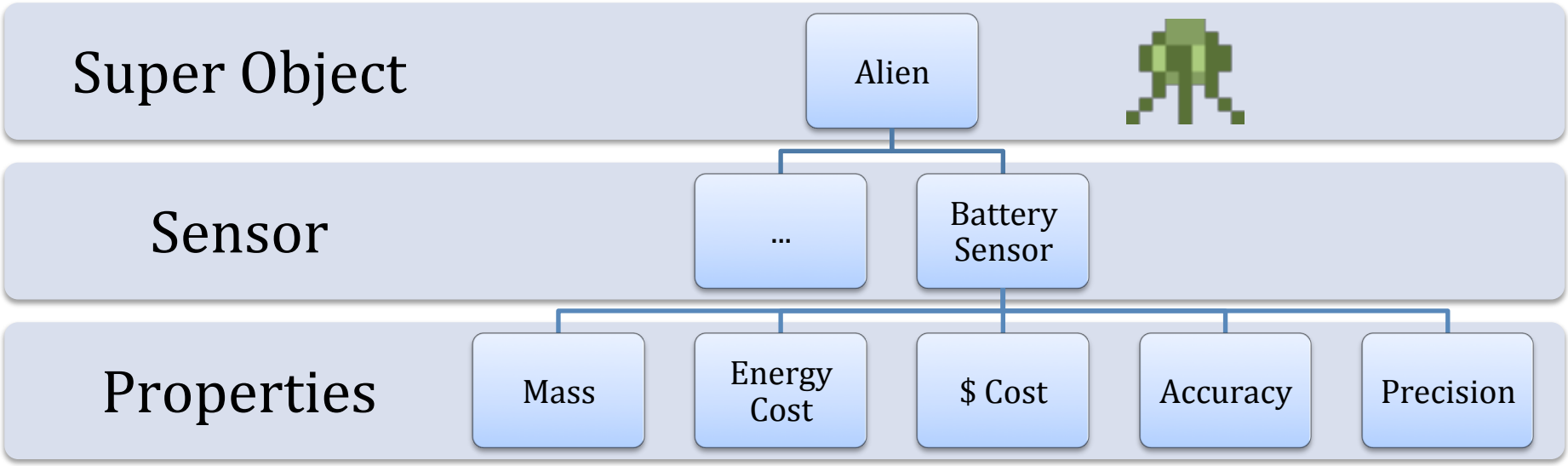
A Health Sensor allows an Alien to take a reading of his Health.



- **Mass**: number used to calculate the overall mass of the Alien. Used when calculating speed of Alien.
- **Energy Cost**: number that indicates how much of the battery this uses each time the Alien moves.
- **$ Cost**: positive integer used to calculate the overall cost of the Alien.
- **Accuracy**: A number that helps determine how close to detected Sensor value will be to the actual value.
- **Precision**: A number that helps determine the range of values returned by the Sensor (precision) for a given value.

Battery Sensor Object Diagram

A Battery Sensor allows an Alien to assess if his battery is low (<15%).



- **Mass**: number used to calculate the overall mass of the Alien. Used when calculating speed of Alien.
- **Energy Cost**: number that indicates how much of the battery this uses each time the Alien moves.
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- **Accuracy**: A number that helps determine how close to detected Sensor value will be to the actual value.
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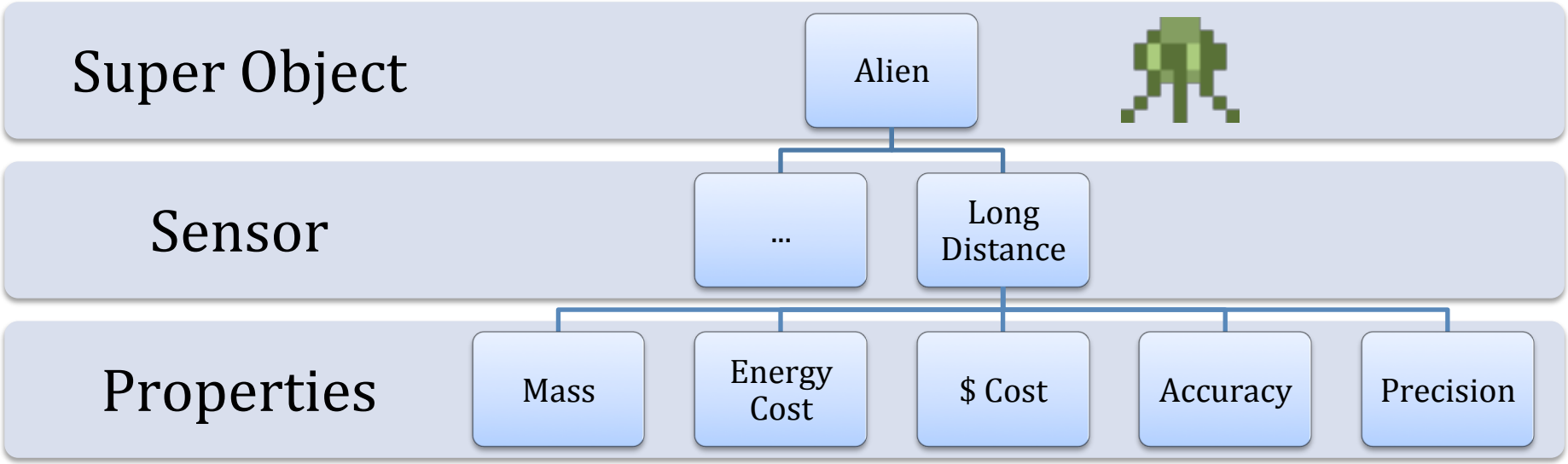
Long Distance Sensor Object Diagram

A Long Distance Sensor allows an Alien to determine if they are a long distance (>75% of overall distance) from the goal area.



- **Mass**: number used to calculate the overall mass of the Alien. Used when calculating speed of Alien.
- **Energy Cost**: number that indicates how much of the battery this uses each time the Alien moves.
- **$ Cost**: positive integer used to calculate the overall cost of the Alien.
- **Accuracy**: A number that helps determine how close to detected Sensor value will be to the actual value.
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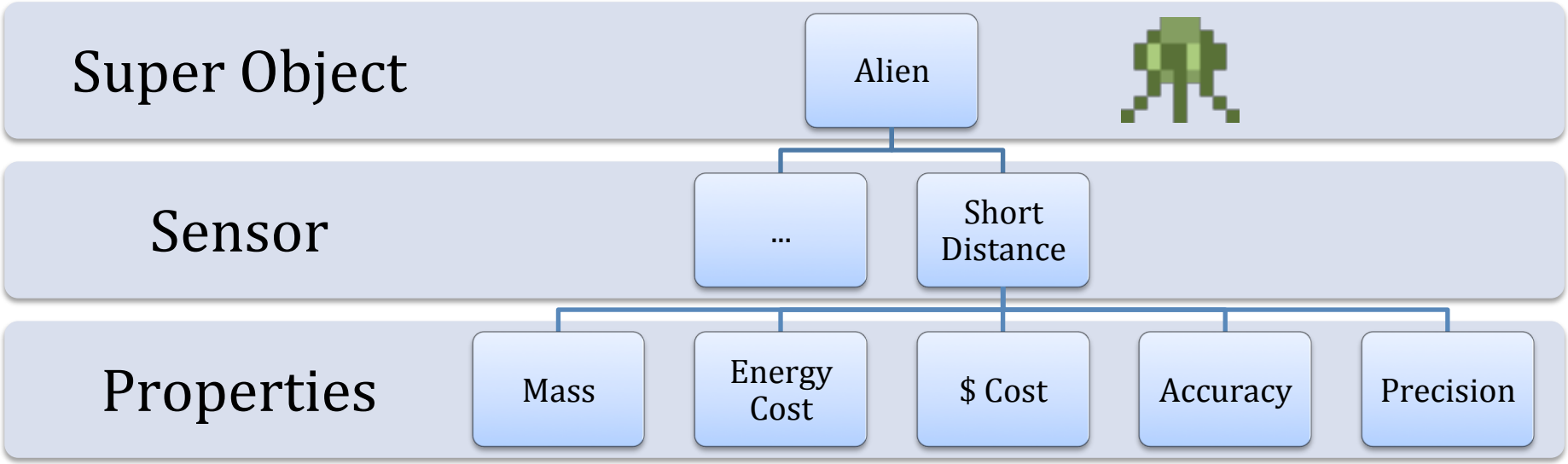
Short Distance Sensor Object Diagram

A Short Distance Sensor allows an Alien to determine if they are a long distance (<25% of overall distance) from the goal area.



- **Mass**: number used to calculate the overall mass of the Alien. Used when calculating speed of Alien.
- **Energy Cost**: number that indicates how much of the battery this uses each time the Alien moves.
- **$ Cost**: positive integer used to calculate the overall cost of the Alien.
- **Accuracy**: A number that helps determine how close to detected Sensor value will be to the actual value.
- **Precision**: A number that helps determine the range of values returned by the Sensor (precision) for a given value.