

You are a Fish.

Constructing Yourself

When you are constructed you will be given:

- Your **Environment**
- Your **Location**
- Your **Direction**
- Your **Color**

1) If you are not given this information:

- a) Say “You have not given me the correct information to construct myself.”

Otherwise:

- a) Remember the information you were given by recording it in the appropriate places on your **Private Data** sheet.
- b) Ask your Environment to **add** you — giving it your name.
- c) Say “Done constructing Fish <*your name*>.”

Are you a _____?

When asked if you are a **Fish**:

- 1) Say “true”.

When asked if you are anything else (i.e., anything other than a plain **Fish**):

- 1) Say “false”.

location

When asked for your **location**:

- 1) Say the value of **your Location** recorded on your **Private Data** sheet.

direction

When asked for your **direction**:

- 1) Say the value of **your Direction** recorded on your **Private Data** sheet.

color

When asked for your **color**:

- 1) Say the value of **your Color** recorded on your **Private Data** sheet.

act

When asked to **act**:

- 1) Narrate “Hmm... I am about to move and must determine my next location.”
- 2) Ask yourself for your **nextLocation**.
- 3) Remember this location as **newLocation** by recording it here:
(_____ , _____)
- 4) If **newLocation** is the same as **your Location**:
 - a) Narrate “Hmm... I guess I won’t move after all.”
 - b) Say “<Your name> is done acting.”

Otherwise:

 - a) Remember **your Location** as **oldLocation** by recording it here:
(_____ , _____)
 - b) Change **your Location** to be **newLocation**.
 - c) Narrate “Hmm... I used to be at location <oldLocation>, but now I think I am at location <your Location>.”
 - d) Ask **your Environment** to **recordMove** — giving it your name and **oldLocation**.
 - e) Ask **your Environment** for **whatDirection** you are traveling — giving it **oldLocation** and **newLocation**.
 - f) Change **your Direction** to be this Direction.
 - g) Say “<Your name> is done acting.”

nextLocation

When asked to determine your **nextLocation**:

- 1) If anyone other than you made the request:
 - a) Say “You are not allowed to make that request. Only I can ask myself to find my next location.”

Otherwise:

- a) Ask your Environment for a List of all of Locations that are **neighborsOf** your current location — giving it **your Location**.
- b) Name this List **neighbors**.
- c) Construct an empty List called **emptyNeighbors**.
- d) For each Location in the List **neighbors**:
 - i) Ask your Environment if that Location **isEmpty** — giving it that Location.
 - ii) If that Location is empty:
 - A) Add it to the **emptyNeighbors** List.
 - B) Narrate “Hmm... That location is empty. I am adding *<that Location>* to my personal list of places I might move.”

Otherwise:

- A) Narrate “Hmm... That location is not empty. I am not adding *<that Location>* to my personal list of places I might move.”
- e) Ask your Environment for the Location of your neighbor directly behind you by having it **getNeighbor** — giving it **your Location** and the opposite of **your Direction**.
- f) If that Location is in your **emptyNeighbors** List:
 - i) Remove that Location from your **emptyNeighbors** List.
 - ii) Narrate “Hmm... I can’t swim backwards, so I have removed *<that Location>* from my personal list of places I might move.”

Otherwise:

- i) Narrate “Hmm... I didn’t need to worry about swimming backwards; it wasn’t going to happen anyway.”
- g) If your **emptyNeighbors** List is empty:
 - i) Narrate “Hmm... There aren’t any empty locations I might move to.”
 - ii) Say “My next location will be *<your Location>*.”

Otherwise:

- i) Ask the **Random Number Generator** for a number between 0 and one less than the **size** of your **emptyNeighbors** List.
- ii) Name this number **K**.
- iii) Say “My next location will be *<the Kth element from your emptyNeighbors List>*.”

Fish _____ *(your name here)*

Private information

your Environment: _____

your Location: (_____ , _____)

your Direction: _____

your Color: _____

You are a Simulation.

Constructing Yourself

When you are constructed you will be given:

- Your **Environment**
- Your **Display**

1) If you are not given this information:

a) Say “You have not given me the correct information to construct myself.”

Otherwise:

a) Remember the information you were given by recording it in the appropriate places on your **Private Data** sheet.

b) Ask your Display to **showEnv**.

c) Say “Done constructing Simulation *<your name>*.”

step

When asked to **step**:

1) Ask your Environment for a List of **allObjects**.

2) For each Object in the List:

a) Ask the Object to **act**.

3) Ask your Display to **showEnv**.

4) Say “*<Your name>* is done stepping.”

Simulation _____ *(your name here)*

Private information

your Environment: _____

your Display: _____

You are the Main Program.

Run

When you are asked to run:

- 1) Record the names of the actors playing the various objects in the appropriate places on your **Private Data** sheet.
- 2) Construct a BoundedEnv:
 - a) Say “<Name of BoundedEnv>, construct yourself as a BoundedEnv object with 4 rows and 5 columns.”
- 3) Construct a Fish:
 - a) Say “<Name of Fish #1>, construct yourself as a Fish object with <name of BoundedEnv> as your Environment, with Location at (2, 3), with Direction west, and with Color green.”
- 4) Construct a Fish:
 - a) Say “<Name of Fish #2>, construct yourself as a Fish object with <name of BoundedEnv> as your Environment, with Location at (2, 4), with Direction north, and with Color blue.”
- 5) Construct a Fish:
 - a) Say “<Name of Fish #3>, construct yourself as a Fish object with <name of BoundedEnv> as your Environment, with Location at (3, 4), with Direction north, and with Color red.”
- 6) Construct a EnvDisplay:
 - a) Say “<Name of EnvDisplay>, construct yourself as a EnvDisplay object with <name of BoundedEnv> as your Environment.”
- 7) Construct a Simulation:
 - a) Say “<Name of Simulation>, construct yourself as a Simulation object with <name of BoundedEnv> as your Environment and <name of EnvDisplay> as your Display.”
- 8) Repeat 25 times:
 - a) Ask <the Simulation> to **step**.
- 9) Say “FINALLY, the program is complete.”

Main Program

_____ *(your name here)*

Private information

BoundedEnv: _____

Fish #1: _____

Fish #2: _____

Fish #3: _____

EnvDisplay: _____

Simulation: _____

You are the (Alternate) Main Program.

Run

When you are asked to run:

- 1) Record the names of the actors playing the various objects in the appropriate places on your **Private Data** sheet.
- 2) Construct a BoundedEnv:
 - a) Say “<Name of BoundedEnv>, construct yourself as a BoundedEnv object with 4 rows and 5 columns.”
- 3) Construct a DarterFish:
 - a) Say “<Name of DarterFish #1>, construct yourself as a DarterFish object with <name of BoundedEnv> as your Environment, with Location at (2, 3), with Direction east, and with Color green.”
- 4) Construct a SlowFish:
 - a) Say “<Name of SlowFish #1>, construct yourself as a SlowFish object with <name of BoundedEnv> as your Environment, with Location at (2, 4), with Direction north, and with Color blue.”
- 5) Construct a SlowFish:
 - a) Say “<Name of SlowFish #2>, construct yourself as a SlowFish object with <name of BoundedEnv> as your Environment, with Location at (3, 4), with Direction north, and with Color red.”
- 6) Construct a EnvDisplay:
 - a) Say “<Name of EnvDisplay>, construct yourself as a EnvDisplay object with <name of BoundedEnv> as your Environment.”
- 7) Construct a Simulation:
 - a) Say “<Name of Simulation>, construct yourself as a Simulation object with <name of BoundedEnv> as your Environment and <name of EnvDisplay> as your Display.”
- 8) Repeat 25 times:
 - a) Ask <the Simulation> to **step**.
- 9) Say “FINALLY, the program is complete.”

(Alternate) Main Program _____ *(your name here)*

Private information

BoundedEnv: _____

DarterFish #1: _____

SlowFish #1: _____

SlowFish #2: _____

EnvDisplay: _____

Simulation: _____

You are a EnvDisplay.

Constructing Yourself

When you are constructed you will be given:

- Your **Environment**
- 1) If you are not given this information:
 - a) Say “You have not given me the correct information to construct myself.”

Otherwise:

 - a) Remember the information you were given by recording it in the appropriate places on your **Private Data** sheet.
 - b) Say “Done constructing EnvDisplay <your name>.”

showEnv

When asked to **showEnv**:

- 1) Ask your Environment for its **numRows**.
- 2) Ask your Environment for its **numCols**.
- 3) Draw a grid on the whiteboard with the given number of rows and columns.
- 4) Ask your Environment for a List of **allObjects**.
- 5) For each Object in the List:
 - a) Ask the Object for its **location**.
 - b) Ask the Object for its **color**.
 - c) Ask the Object for its **direction**.
 - d) Ask the Object **if it is a DarterFish**.
 - e) If the Object says it is a DarterFish:
 - i) Draw a DarterFish with the given Color at the given Location pointing in the given Direction.

Otherwise:

 - i) Ask the Object **if it is a SlowFish**:
 - ii) If the Object says it is a SlowFish:
 - A) Draw a SlowFish with the given Color at the given Location pointing in the given Direction.

Otherwise:

 - A) Ask the Object **if it is a Fish**:
 - B) If the Object says it is a Fish:
 - 1) Draw a Fish with the given Color at the given Location pointing in the given Direction.

Otherwise:

 - 1) Draw a question mark at the given Location.
- 6) Say “<Your name> is done showing the Environment.”

EnvDisplay _____ *(your name here)*

Private information

your Environment: _____

You are a BoundedEnv.

Constructing Yourself

When you are constructed you will be given:

- Your **numRows**
- Your **numCols**

1) If you are not given this information:

a) Say “You have not given me the correct information to construct myself.”

Otherwise:

a) Remember the information you were given by recording it in the appropriate places on your **Private Data** sheet.

b) Draw a grid with **numRows** number of rows and **numCols** number of columns in **theGrid** section of your **Private Data** sheet.

c) Say “Done constructing BoundedEnv *<your name>*.”

numRows

When asked for your **number of rows**:

1) Say the value of **numRows** recorded on your **Private Data** sheet.

numCols

When asked for your **number of columns**:

1) Say the value of **numCols** recorded on your **Private Data** sheet.

objectAt

When asked for the **objectAt**, you will be given a Location:

1) If you are not given this information:

a) Say “You have not given me the correct information.”

Otherwise:

a) If the given Location in **theGrid** is occupied by an Object:

i) Say “*<The name of the Object at that Location in theGrid>*.”

Otherwise:

i) Say “Empty.”

isEmpty

When asked if a Location **isEmpty**, you will be given a Location:

- 1) If you are not given this information:
 - a) Say “You have not given me the correct information.”

Otherwise:

 - a) If the given Location in **theGrid** is occupied by an Object:
 - i) Say “False.”

Otherwise:

 - i) Say “True.”

getNeighbor

When asked for the **getNeighbor**, you will be given a Location and a Direction:

- 1) If you are not given this information:
 - a) Say “You have not given me the correct information.”

Otherwise:

 - a) Determine the Location that is in the given Direction from the given Location.
 - b) Say “<the Location you determined>”.

whatDirection

When asked **whatDirection**, you will be given two Locations:

- 1) If you are not given this information:
 - a) Say “You have not given me the correct information.”

Otherwise:

 - a) Determine the Direction that you travel to go from the first Location to the second Location.
 - b) Say “<the Direction you determined>”.

allObjects

When asked for **allObjects**:

- 1) Construct an empty List called **objects**.
- 2) For each Location in **theGrid** (left-to-right, top-to-bottom — i.e., “reading” order):
 - a) If there is an Object at that Location:
 - i) Add the Object to the end of the **objects** List.
- 3) Return the **objects** List to whomever asked you for the information.

add

When asked to **add**, you will be given an Object:

- 1) If you are not given this information:
 - a) Say “You have not given me the correct information.”

Otherwise:

 - a) Ask the Object for its **location**.
 - b) If the Location is not within the bounds of **theGrid** or the Location in **theGrid** already contains an Object:
 - i) Narrate “Hmm... That location is not available.”
 - ii) Say “The object has not been added.”

Otherwise:

 - i) Narrate “Hmm... That location is available.”
 - ii) Record the given Object in its Location in **theGrid**.
 - iii) Say “The object has been added.”

recordMove

When asked to **recordMove**, you will be given an Object and a Location (the old location of the object):

- 1) If you are not given this information:
 - a) Say “You have not given me the correct information.”

Otherwise:

 - a) Ask the Object for its **location**.
 - b) Name this Location **newLocation**.
 - c) If **newLocation** is different than the old Location you were given and **newLocation** in **theGrid** is empty and the old Location in **theGrid** contains the Object:
 - i) Narrate “Hmm... *<The Object you were given>* is indeed at *<the old Location>*. *<newLocation>* is indeed empty. I can go ahead and record the move.”
 - ii) Empty the old Location in **theGrid**.
 - iii) Record the given Object in the **newLocation** Location in **theGrid**.
 - iv) Say “The move has been recorded.”

Otherwise:

 - i) Narrate “Hmm... The validation for this move has failed in some way.”
 - ii) Say “The move has not been recorded.”

neighborsOf

When asked for the **neighborsOf** a Location, you will be given a Location:

- 1) If you are not given this information:
 - a) Say “You have not given me the correct information.”
Otherwise:
 - a) Construct an empty List called **neighbors**.
 - b) If *<the Location north of the given Location>* is within **theGrid**:
 - i) Add *<the Location north of the given Location>* to the **neighbors** List.
 - ii) Narrate “Hmm... I have added *<the Location north of the given Location>* to my list of neighbors.”
Otherwise:
 - i) Narrate “Hmm... *<the Location north of the given Location>* is not valid because it lies outside the environment.”
 - c) If *<the Location east of the given Location>* is within **theGrid**:
 - i) Add *<the Location east of the given Location>* to the **neighbors** List.
 - ii) Narrate “Hmm... I have added *<the Location east of the given Location>* to my list of neighbors.”
Otherwise:
 - i) Narrate “Hmm... *<the Location east of the given Location>* is not valid because it lies outside the environment.”
 - d) If *<the Location south of the given Location>* is within **theGrid**:
 - i) Add *<the Location south of the given Location>* to the **neighbors** List.
 - ii) Narrate “Hmm... I have added *<the Location south of the given Location>* to my list of neighbors.”
Otherwise:
 - i) Narrate “Hmm... *<the Location south of the given Location>* is not valid because it lies outside the environment.”
 - e) If *<the Location west of the given Location>* is within **theGrid**:
 - i) Add *<the Location west of the given Location>* to the **neighbors** List.
 - ii) Narrate “Hmm... I have added *<the Location west of the given Location>* to my list of neighbors.”
Otherwise:
 - i) Narrate “Hmm... *<the Location west of the given Location>* is not valid because it lies outside the environment.”
 - f) Return the **neighbors** List to whomever asked you for the information.

BoundedEnv _____ *(your name here)*

Private information

numRows: _____

numCols: _____

theGrid:

List _____ *(name of the list here)*

Private information

size: _____

list elements: _____

You are a SlowFish.

Constructing Yourself

When you are constructed you will be given:

- Your **Environment**
- Your **Location**
- Your **Direction**
- Your **Color**

1) If you are not given this information:

- a) Say “You have not given me the correct information to construct myself.”

Otherwise:

- a) Narrate “Hmm... I am a SlowFish and will construct myself as a Fish would with the same information I was given.”
- b) Construct yourself as a Fish with the information you were given.
- c) Narrate “Hmm... As a SlowFish, I do not have my own private data; however, I inherit all of the **Private Data** of a Fish.”
- d) Narrate “Hmm... As a SlowFish, I do not have a complete set of scripts; however, I inherit all of the scripts of a Fish.”
- e) Say “Done constructing SlowFish <your name>.”

Are you a _____?

When asked if you are a **SlowFish**:

- 1) Say “true”.

When asked if you are a **Fish**:

- 1) Say “true”.

When asked if you are anything else:

- 1) Say “false”.

nextLocation

When asked to determine your **nextLocation**:

- 1) If anyone other than you made the request:
 - a) Say “You are not allowed to make that request. Only I can ask myself to find my next location.”

Otherwise:

- a) Narrate “Hmm... I wonder if I should move.”
- b) Ask the **Random Number Generator** for a number between 0 and 4.
- c) If this number is 0:
 - i) Narrate “Hmm... I am slow and will not move.”
 - ii) Say “My next location will be <*your Location*>.”

Otherwise:

- i) Narrate “Hmm... I guess I will move after all. Because I am have inherited all of the scripts of a Fish, I will choose my next location in the same way that a Fish would.”
- ii) Ask yourself for your **nextLocation** — this time, however, use the script you inherited from a Fish.

You are a DarterFish.

Constructing Yourself

When you are constructed you will be given:

- Your **Environment**
- Your **Location**
- Your **Direction**
- Your **Color**

1) If you are not given this information:

- a) Say “You have not given me the correct information to construct myself.”

Otherwise:

- a) Narrate “Hmm... I am a DarterFish and will construct myself as a Fish would with the same information I was given.”
- b) Construct yourself as a Fish with the information you were given.
- c) Narrate “Hmm... As a DarterFish, I do not have my own private data; however, I inherit all of the **Private Data** of a Fish.”
- d) Narrate “Hmm... As a DarterFish, I do not have a complete set of scripts; however, I inherit all of the scripts of a Fish.”
- e) Say “Done constructing DarterFish <*your name*>.”

Are you a _____?

When asked if you are a **DarterFish**:

- 1) Say “true”.

When asked if you are a **Fish**:

- 1) Say “true”.

When asked if you are anything else:

- 1) Say “false”.

act

When asked to **act**:

- 1) Narrate “Hmm... I am facing *<your Direction>*. I need to move.”
- 2) Ask your Environment for the Location of your neighbor directly in front of you by having it **getNeighbor** — giving it **your Location** and **your Direction**.
- 3) Remember this location as **newLocation** by recording it here:
(_____ , _____)
- 4) Ask your Environment if the Location **isEmpty** — giving it **newLocation**.
- 5) If newLocation is not empty:
 - a) Reverse **your Direction**.
 - b) Say “I guess I won’t move after all. Instead, I’ll turn around. *<Your name>* is done acting.”

Otherwise:

- a) Remember your Location as **oldLocation** by recording it here:
(_____ , _____)
- b) Ask your Environment for the Location of your neighbor directly in front of **newLocation** by having it **getNeighbor** — giving it **newLocation** and **your Direction**.
- c) If that Location is empty:
 - i) Change your Location to be that Location.

Otherwise:

 - i) Change your Location to be **newLocation**.
- d) Narrate “Hmm... I used to be at location *<oldLocation>*, but now I think I am at location *<your Location>*.”
- e) Ask your Environment to **recordMove** — giving it your name and **oldLocation**.
- f) Say “*<Your name>* is done acting.”