

# DESIGN DOC: WRITING ALGORITHMS

*This is one of three game design documents created for the NSF-AISL Pathways funded project, AISL Pathways: The Role of Story in Games to Teach Computer Science Concepts to Middle School Girls (<http://nuweb1.neu.edu/gramshouse/storyteach-project-description/>). Each game is intended to introduce participants to one computer science concept, drawn from the Computer Science Principles framework developed by the College Board (see <http://apcsprinciples.org/>). Each game has three versions: (a) the basic game, which consists of puzzles or problem-solving activities within a game format, (b) game with context, which consists of the same kind of problem-solving activities situated in a fictional setting, that gives meaning to the activities, and (c) game with story, which embeds these activities in a more fully developed narrative, with a plot and resolution.*

**Computer Science Concept:** An algorithm is a series of very clear directions (in a natural language) of how to accomplish a task.

**Learning Objective(s):** A student should be able to both create and understand an algorithm of clear and concise directions to solve a simple problem.

## **Intrinsic Learning Goals**

Both writing and understanding the instructions are factors in success. Players in a relay race become delayed by:

- poorly written instructions (unclear, incomplete, confusing), which might have to be rewritten;
- slowly written instructions (players more skilled in writing algorithms can work faster)
- a player's inability to follow instructions accurately.

## **BASIC GAME: Algorithm Relay Race**

### **Game Objective**

Two teams race to accomplish a series of tasks. The 4 tasks are grouped into 2 halves of the game. There is a winning team for each half of the game.

Players will follow written instructions from the facilitator and then write clear and specific instructions for the next players that explain how to go somewhere, find something, do something, or build something. Players execute the instructions blindly—without seeing or knowing the exact end result.

**Win Condition:** The winning team is the team that finishes the 2 tasks of one half of the game first. Each leg is a task. Reaching the finish line first in the final leg is the winning team of the second half.

## HOW TO SET UP THE GAME

**Players:** Two teams of 4 players each race to complete the same set of tasks in parallel. Each team has two pairs of players (for four players total), Pair A and Pair B. (Teams can be adapted to three or five players if needed, with a pair turned into a solo or a pair turned into a trio.)

### Game Components

- Identical sets of Clue Bags and crates (see “Prototyping the Game”) that hold objects, pictures, messages, and decoys. Each team needs a ClueBag 1, a Cluebag2, A crate for leg 3, and a picture for leg 4
- Blank 5 x 8 note cards (for writing instructions)
- Rooms with access to a hallway (so that objects can be spread out and harder to find)
- Directions for the players in Relay Race  
[https://docs.google.com/document/d/1fMOB\\_I3dpC6z-cOJk7s9UvukPME8HNRjSxBQZBkYje8/edit?usp=sharing](https://docs.google.com/document/d/1fMOB_I3dpC6z-cOJk7s9UvukPME8HNRjSxBQZBkYje8/edit?usp=sharing)

### Preparation

Before the session, secretly from players, prepare and place the final clue item, and a picture for leg 4, in a different room or into the hallway. Prepare the clue bags for leg 1 to have the cat toys and food etc. Prepare the maps for clue bags for leg 2. Prepare the crates with decorations for leg 3.

### Introduction:

Introduce the concept of writing algorithms are like a recipe. As a warm-up, present poorly written instructions (too simple or faulty) to walk a nearby location, such as a different room in the building, or do the PB&J sandwich needs a better algorithm demo.

Ask the group to amend the instructions for clarity, resulting in a list of at least three or four precise steps. Emphasize to students that instructions for the game should follow a similar level of precision.

## RULES OF THE GAME

IN BRIEF, THE RELAY RACE STEPS ARE:

1. Clue Bag #1: Write directions to lay out four objects in precise positions on the floor.
2. Clue Bag #2: Write directions to locate the bag, and then to draw a route on a gridded map.
3. Crate #3: Write directions to decorate a crate.
4. Race (with the assembled crate) Write directions to the final location—the finish line, which is outside the classroom and a bit tricky to find a picture that goes into the crate.

## DETAILED RULES

1. Players all start in the center of the room.
2. The facilitator gives Clue Bags #1 to Pair A from team 1 and Pair A from team 2 (etc for team 3 and team 4). Inside these bags are three objects and a picture that shows how and where to position the objects on the floor. The two Pair A duos simultaneously write precise directions for displaying the objects: their relative position to each other, distances apart, and each object's pose or orientation, and place where the objects were photographed. Mention to them that their Pair B teammates won't be able to see the picture, so the directions need to be clear and complete.
3. Meanwhile, at the same time, the facilitator takes the Pair B to a place in the hall, or another room, or outside, gives Clue Bags #2 to Pair B from team 1 and Pair B from team 2. Inside these bags are two maps. Pair B must write directions to where the bag is now located. Inside the bag is a routeless grid with obstacles, and the other map has a marked route to a ship that the Pair B players must carefully describe, as the second half of the algorithm. . Mention to them that their Pair A counterparts won't be able to see the real route or the location of the ship; again, their directions should be clear and complete about how to locate the ship on the map. The blank grid stays in the bag.
4. When everyone is finished writing, (approx. 20 min) Pair A duos give the picture to the facilitator and their written algorithm to their Pair B teammates. Pair B duos give the map with the route and their written algorithms, to the facilitator.
5. First, with Pair A looking on, Pair B duos follow the written algorithm of their Pair A teammates to display the objects in Clue Bag 1 precisely. If they succeed on the first try, that team is ready to continue to the map algorithm. If the pair B is confused, then pair A writers have to redo their instructions to make them clearer, and the facilitator makes sure the algorithm is improved.
6. Next, with Pair B looking on, Pair A duos are given the algorithm to find the bag with the map. Pair A follow the written algorithm of their Pair B teammates to find the Bag with the map, and then to follow the map, by marking the blank map with the correct route to the ship. If the pair A is confused, then pair B writers have to redo their instructions to make them clearer, and the facilitator makes sure the algorithm is improved.
7. The first team whose players are done with both Clue Bag 1 and Clue Bag 2 win this level of the game!
8. All player pairs return to the middle of the room. The facilitator gives a crate with items for algorithm 3 to Pair B from team 1 and team 2. These contain a set of things to decorate the crate and a picture of the final product (a crate). Again, Pair A duos won't see the picture, and so a clear and complete algorithm on how to decorate the crate is essential.
9. Meanwhile, the facilitator shows Pair A duos where the clue item, and the special prize photo are located, preferably in a different room. Pair A duos must write a step-by-step algorithm for their Pair B teammates on how to navigate to this finish line, and the special prize, without exactly revealing this location.
10. When both pairs are done writing their algorithms (approx. 20 min) , the Pair B duos first decorate the crate according to the instructions. If pair B is confused, then pair A writers

have to redo their instructions to make them clearer, and the facilitator makes sure the algorithm is improved.

11. Next, Pair B gives the last algorithm to their Pair A teammates, who must follow the algorithm to find the clue and the special prize picture, with Pair B watching and adjusting algorithms as needed.
12. The 4 player-team who reaches the finish line first and puts the special object (“Colins” in story mode) inside the crate wins the second level!

## **GAME WITH CONTEXT: Crazy Cat Relay Race**

**Game Objective:** Same as above, except we provide a context to the objective and the clues at each relay race station.

### **Game Context**

A beloved cat has escaped and is on the loose! Which team can find it first? The clues relate to tracking and trapping an escaped cat and the “finish line” is the location of the cat.

**Win condition:** Be the first team to “rescue the cat” to win.

**Players and Rules:** Same as for Basic Game.

### **Game Components**

The same with these adjustments for context (more details below, in story section):

Clue Bag #1: The four objects to position are a food bowl, cat toy, a water bowl, and a border object.

Clue Bag #2: It’s a shipping route map that pinpoints the locale of a stowaway cat aboard a certain tanker, by route and location.

Crate #3: The crate and decorations for transporting cats.

Clue #4: The hidden clue and cat picture to the finish line is the location of the cat.

**Preparation:** In this condition, the warm-up with the poorly written algorithm (see above) becomes a “training exercise” for Cat Rescuers of the World “CROW”—an instruction that students must rewrite for clarity and as an initiation to join the team.

## STORY: THE TRUE TALE OF COLINS THE STOWAWAY CAT



Yep, she was a real cat—a female one, despite the name.

### Story Overview

Who doesn't love a lost cat story with an extraordinary journey and a happy ending?

In a famous TRUE TALE, a friendly calico cat named Colins ends up on a long sea voyage. A bonus: There are news reports, a radio retelling of her story, pictures, and fond memories for students who want to dive deeper.

For our purposes, the stops in the relay race are locations and key events in Colins' great adventure. The story unfolds as kids play. The "final destination" is a surprise ending, and a tearful return of the cat to its owner—a dock worker in New Zealand, where Colins becomes famous and is now memorialized with a stone.

**Players:** The two teams, as above, here represent two international rescue groups—one in Korea and one in New Zealand. Both are working cooperatively against time (the end of the time-limited class period).

### Game Components and Preparation

The CLUE BAGS now become integral to Colin's story and contain additional story bits—a paragraph that furthers the plot and teases what happens next.

**Location 1:**  
**Port Taranaki, New Zealand**

A calico cat belonging to James Gordon MacPherson, a burly dock worker, has disappeared. MacPherson rescued Colins as a kitten, after someone had dumped her in a garbage pail on the docks.

Now, the 9-year-old calico is a popular and much-loved mascot among the workers and everyone is fretting about her fate. Her food bowl has been untouched for several days.

Messages are sent out all over New Zealand: be on the lookout for Colins!

**CLUE BAG #1: LURE-A-CAT KIT**

Colins is a picky eater, despite being a “docks” cat, and you must lay out lures for her precisely. Raw fish in her favorite bowl, a catnip toy, fresh water.

**Location 2:**  
**Somewhere in the Pacific Ocean**

A Korean tanker named Tomikawa reports the presence of a stowaway cat to ocean authorities.

The cat had apparently walked onto the Korean oil tanker when the ship was docked in Port Taranaki, New Zealand. The ship’s engineer fed her fried fish and then lost track of her as the crew readied the ship for departure. The tanker set a course for Korea across the Pacific Ocean.

The disappearance of Colins is a heavily reported story in New Zealand that jumps borders and spreads to the shipping community at large. Hearing the tale, a Korean sailor snaps a picture of a stowaway cat and sends it to New Zealand. He adds that the cat is “friendly” and “healthy” and being well-fed.

Confirmed! The cat is Colins!

**CLUE BAG #2: SHIPPING ROUTE MAP:** Pinpoint the location of the Korean tanker on a map, given a course from the New Zealand port to its destination in Korea.



Colins in the “cat-bird’s seat” on board the Korean tanker.

### **Location 3:**

#### **International Sea Rescue Groups**

A widespread international team (played by our students) is alerted to the situation and informed that it requires their immediate attention.

If Colins reaches Korea, she will be quarantined for six months. The dock workers can’t bear to be away from their beloved cat and, worrying about her care and welfare, lobby hard for a speedy rescue!

They ask the international team to organize a ship-to-ship transfer, in the middle of a vast ocean, to bring Colins home.

Are there any ships in the vicinity? Available? Willing to change course (and thus lose time and money) to rescue a cat?

**Crate #3: DECORATE A CRATE:** If the ship-to-ship transfer happens, Colins will need a proper travel crate. Tip: her favorite color is rose. Locate a bag with the cat crate picture. Follow the written instructions to decorate the crate.

#### **Location 4**

##### **Port Yeosu, Korea**

A ship-to-ship transfer is deemed too dangerous and costly.

Eighteen days and 9,600 km from New Zealand, Colins arrives at the S Korean port of Yeosu and is heading for quarantine. Even after she's released, how will she get back? The Tomikawa is on its final voyage—staying in Korea, forever.

Newspapers and TV stations around the world begin covering the story on a daily basis. With the media's full attention, MacPherson and the dock workers plea for help.

Can anyone figure out a way for Colins to return to New Zealand?

**THE FINISH LINE: CATCH THE CAT:** After properly assembling the crate and making sure it passes the safety inspection (from the proctor), follow written instructions to find and retrieve the cat.

#### **Location 5 (final—ending to the story)**

##### **Port Taranaki, New Zealand**



Their pleas are heard, and Korea Airlines agrees to fly MacPherson to Korea and back, along with his cat, for free. They even upgrade the travelers to first class!

Colins is made honorary ambassador to the Korean port.

MacPherson thanks the Korean sailors for taking great care of Colins, who lives out her long, happy life on the docks as a celebrity. She receives free cat food for life! She even has her own website and a special mailbox to handle letters and cards from all her admirers.

**CATCH THE CAT!:** Go to a different room that's hard to find, far away, WITH your crate, and then Colins is safe! Epilogue: Though Colins is no longer with us, her story survives on the internet, including a recent audio interview with one of the dock workers.