

Introduction to Computational Thinking and Programming with Python

Instructor: Sarom Leang, PhD (Teacher/Professor)

Assistant: Romin Katre

Innovation Hall 203



Pronouns

- Instructor: Sarom Leang, Ph.D. (Instructor/Teacher)
- Assistant: Romin Katre

Schedule

- 10:00 AM – 10:15 AM (Homeroom)
- 10:15 AM – 11:35 AM (G1)
- 11:40 AM – 12:35 PM (Lunch)
- 12:40 PM – 02:00 PM (G2)



Student Expectations

- **NO FOOD**
- **NO DRINKS** (on the table)
- Be respectful to individuals and property
- Be open to learning
- Be open to not understanding
- Be patient with yourself
- Ask questions
- Explore
- **Embrace failure**



Course Overview

- This course introduces the fundamental building blocks of computational thinking and computer programming using the Python language.
- Upon successful completion of this course, students will be able to:
 - Improve their problem-solving skills
 - Write, read, and execute Python code using basic data types and operators



Course Overview (cont.)

Exploratory Topics

- Session #1 – October 23, 2023
 - Entrance Survey
 - How Computers Work
- Session #2 – December 2, 2023
 - Parallel Computing
- Session #3 – February 10, 2024
 - Generative Artificial Intelligence
- Session #4 – March 23, 2024
 - Quantum Computing
- Session #5 – April 20, 2024
 - Future of Computing
 - Exit survey

Topics

- Algorithms and Problem Solving
- Debugging and Troubleshooting
- Loops
- Algorithms and Syntax
- Variables and Conditionals
- Variable Arithmetic
- Conditionals (If/Else)
- Compound Conditionals



Introductions

Choose one:

- Everyone has a story. What is yours?

or

- Answer the following questions:
 - Name (Pronouns)
 - Grade level
 - County and school
 - Do you have any experience in computer programming? If yes, elaborate.
 - What do you hope to get out of this course?



Sarom Leang, PhD (Instructor/Teacher)

- 1982 Coming to America!
Khmer Rouge Genocide
- 1998 EIP Class 7 Scholar
Wakefield High School
- 2004 B.S. Chemistry (Honors, High Distinction), Minor CS
George Mason University
- 2011 Ph.D. Physical Chemistry / Postdoctoral Researcher
Iowa State University
- 2014 Assistant Research Scientist
The Ames Laboratory, Department of Energy
- 2018 Senior Computational Scientist/Senior Software Engineer
EP Analytics, Inc.



Entrance Survey (G1)

- Visit the following URL and answer the survey as best you can:
 - G1 – <http://bit.ly/2023G1Entrance>



Entrance Survey (G2)

- Visit the following URL and answer the survey as best you can:
 - G2 – <http://bit.ly/2023G2Entrance>



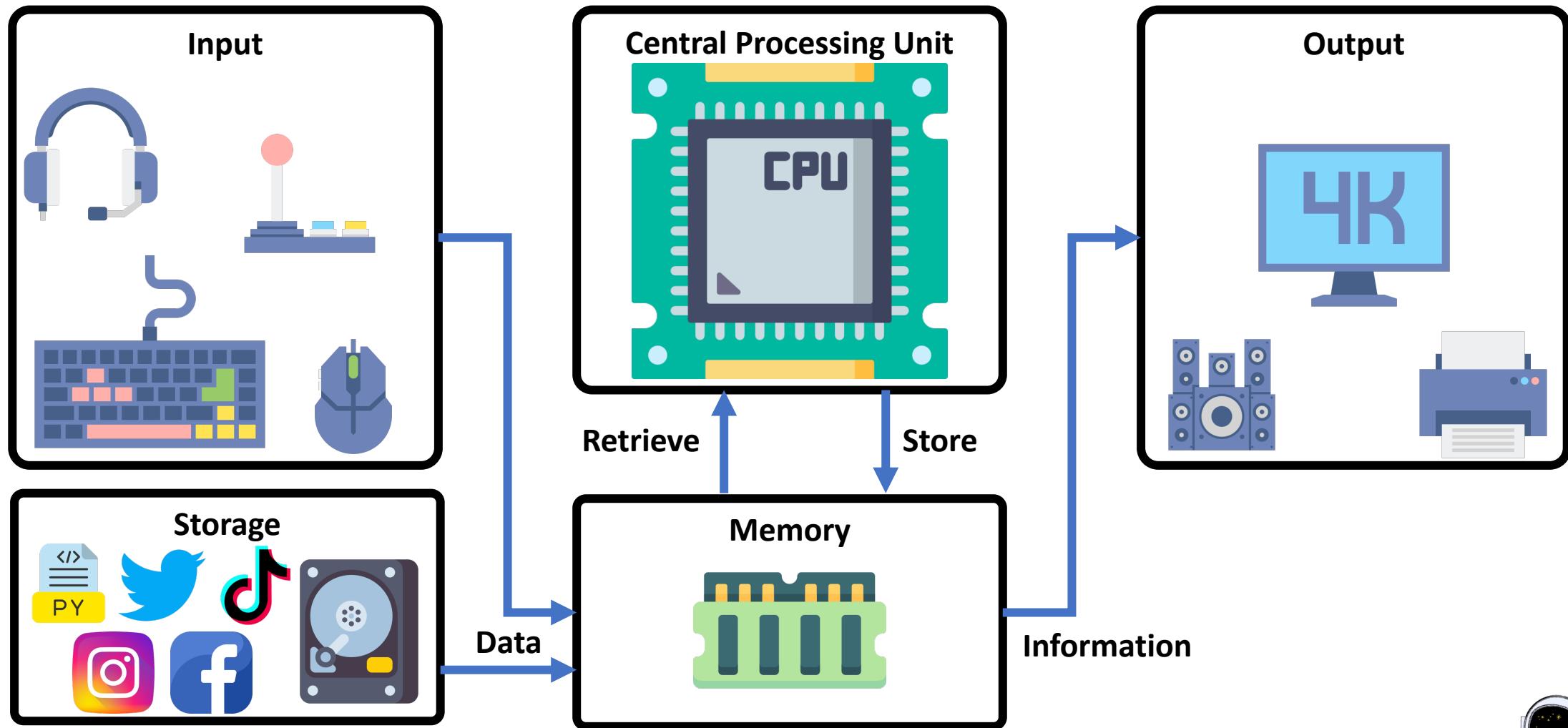
Entrance Survey

- Visit the following URL and answer the survey as best you can:
 - G2 – <http://bit.ly/2023G2Entrance>

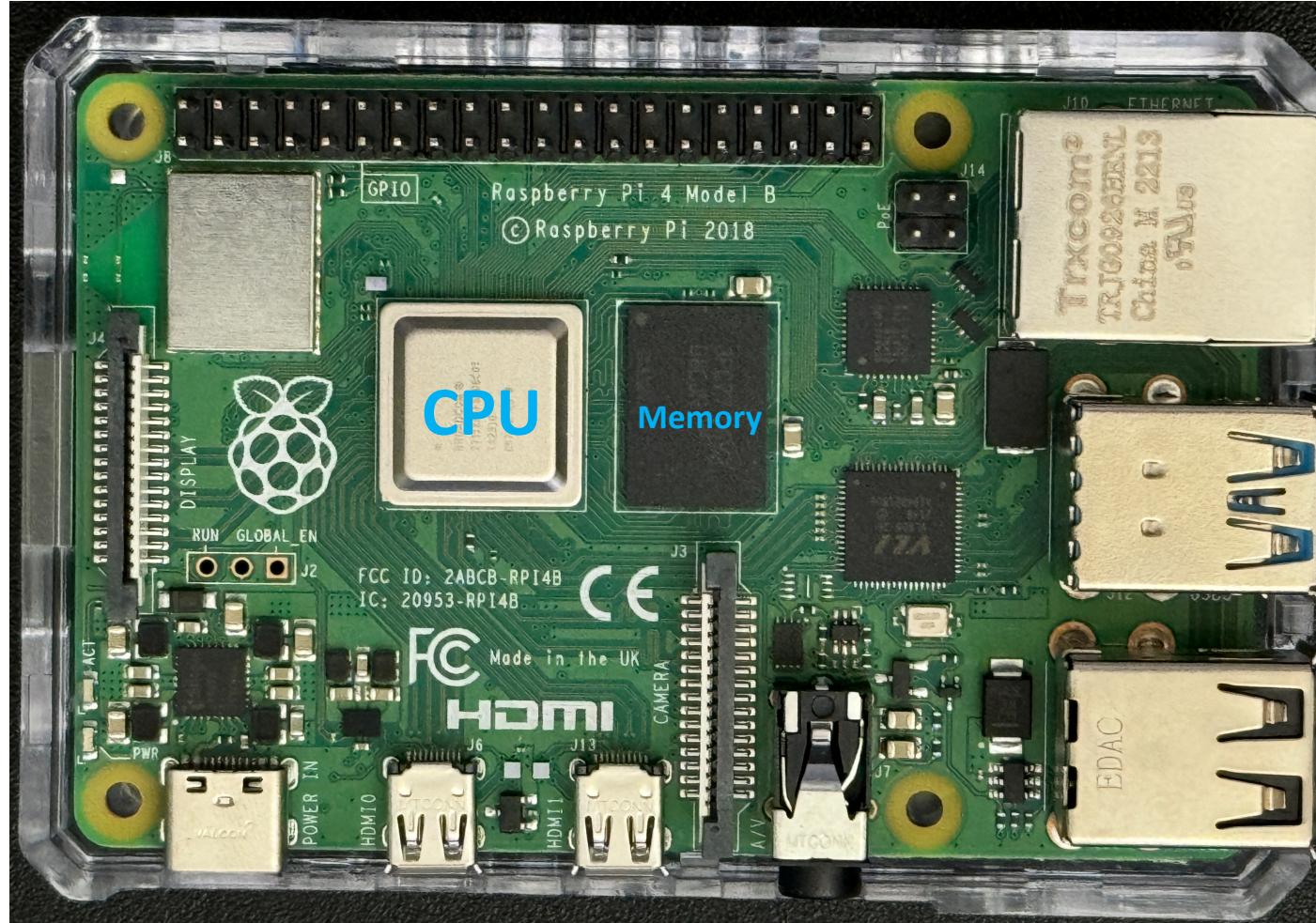


Discussion – How Do Computers Work?

Discussion – How Do Computers Work?



Discussion – How Do Computers Work?



Raspberry Pi

Discussion – How Do Computers Work?

Data

- collection of raw statistics or facts
- unorganized
- does not inherently have meaning
- does not offer a clear enough picture to make decisions

Information

- offers context to those facts, statistics
- is organized
- has purpose due to analysis
- with context, information can help influence decisions

Discussion – How Do Computers Work?

Data

- Website traffic
(hourly/daily/weekly/monthly)
- Spreadsheet with job earnings
- Student test scores
- Annual total rainfall, seawater levels, average temperatures

Information

- Best time to release a new product/announcement
- Spending budget
- Adjust lesson plans
- Determine impact of climate change

Discussion – What is a computer?

- An electronic device that **stores**, **retrieves**, and **processes** data.

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program

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Discussion – What is computer programming?

- The **mental process** of developing a **set of instructions** for a computer.
 - Design and planning
- **What is the physical process called?**
 - Coding

Example – Set of Instructions (For Humans)

- Left hand out and palm up
- Right hand out and palm up
- Flip left hand
- Flip right hand
- Left hand to right shoulder
- Right hand to left shoulder
- Left hand to back of head
- Right hand to back of head
- Left hand to right hip
- Right hand to left hip
- Left hand on left bottom
- Right hand on right bottom
- Wiggle
- Wiggle
- Jump



Example – Set of Instructions (For Computers)

```
r=int(input("Enter upper limit: "))
for a in range(2,r+1):
    k=0
    for i in range(2,a//2+1):
        if(a%i==0):
            k=k+1
    if(k<=0):
        print(a)
```

Discussion – Why learn computer programming?

Discussion – Why learn computer programming?

- Improve your problem-solving skills
- Process large amounts of data (finance, manufacturing, healthcare, science)
- Create/design a web site/application/game
- To better understand computer programs/technology
- As a career (Glassdoor salary search for Washington D.C. area)
 - Software Developer - \$109,099/year
 - Data Scientist - \$118,542/year
 - Software Architect - \$158,895/year
 - Software Manager – \$163,888/year
- As a hobby

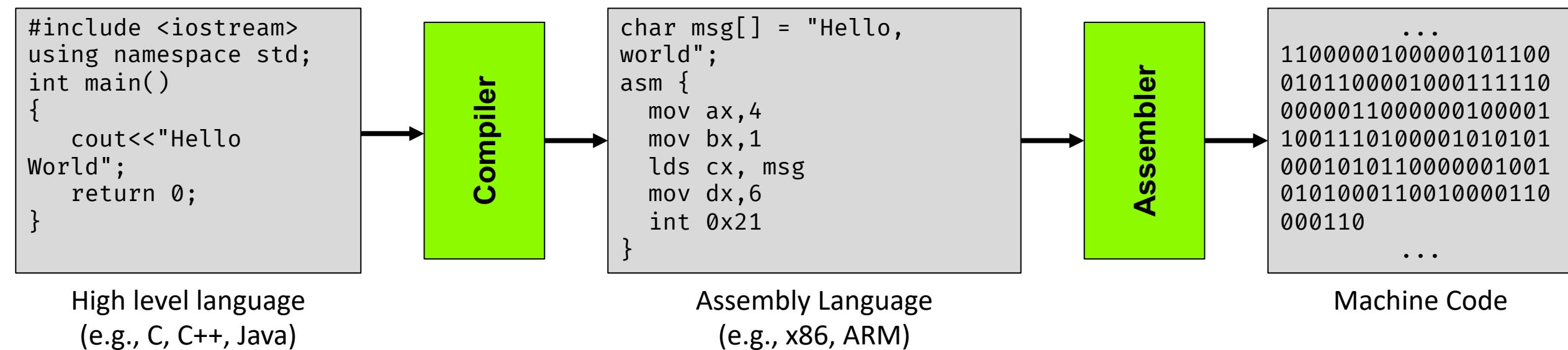


Discussion - What is the impact of computer programming (e.g., world, daily life)?

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- Artificial intelligence/machine learning
- Robotics/automation
- Cybersecurity/threats
- Websites/E-commerce
- Payment processing/transactions
- Mobile Apps
- Weather modeling
- Global positioning system (GPS)
- Data encryption
- Schedule/inventory management
- Social media

Programming for a Computer



High level language
(e.g., C, C++, Java)

Note: Python uses an interpreter to convert Python code to Python bytecode (line-by-line).





Welcome to the world of

OZARIA



Your journey begins...





Today's Journey



Warm-Up: Algorithms & Sequences



Learn how to use Ozaria

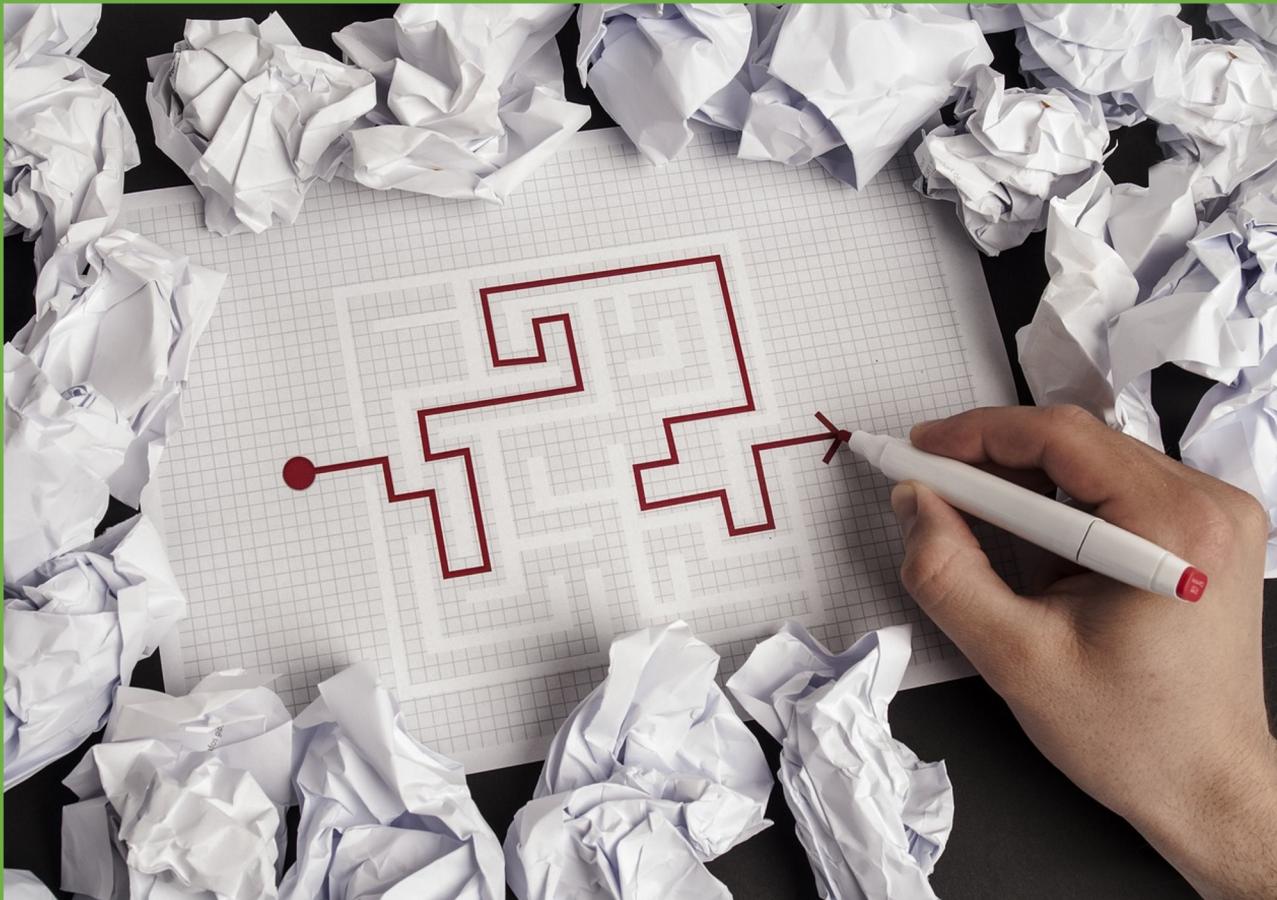


Play Ozaria: Get to the Spirit Lands



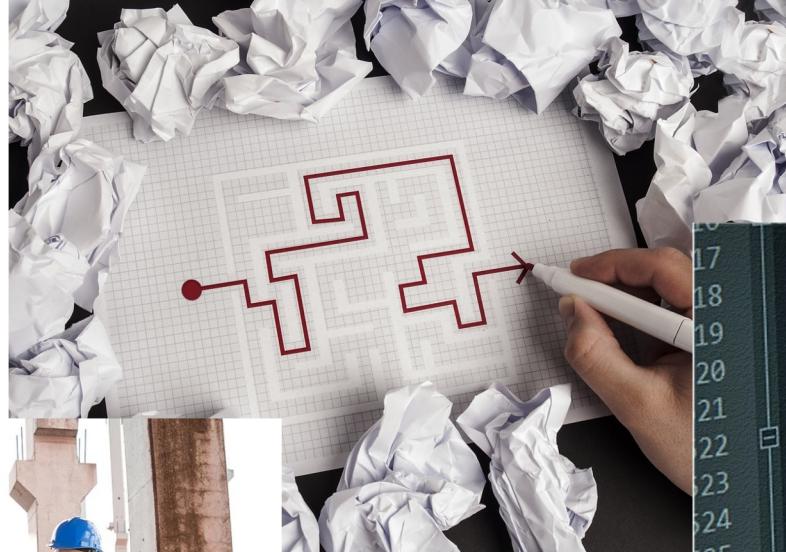
Optional Extension: Design a Map

Algorithms & Sequences



Algorithms

a sequence of instructions that can be used to solve a problem or set of problems



```
string sInput;
int iLength, iN;
double dblTemp;
bool again = true;

while (again) {
    iN = -1;
    again = false;
    getline(cin, sInput);
    system("cls");
    stringstream(sInput) >> dblTemp;
    iLength = sInput.length();
    if (iLength < 4) {
        again = true;
        continue;
    } else if (sInput[iLength - 3] != '.') {
        again = true;
        continue;
    } while (++iN < iLength) {
        if (isdigit(sInput[iN])) {
            continue;
        } else if (iN == (iLength - 3)) {
            again = true;
        }
    }
}
```

Problem Solving with Decomposition

You can solve a complex problem by breaking it down into a sequence of subgoals & steps



What are the subgoals & steps for baking a cake?

Subgoal 1: Make the cake layers

- Measure & combine ingredients
- Make the batter
- Put batter into pans
- Bake the cake layers

Subgoal 2: Make the filling/frosting

- What are the steps?

Subgoal 3: Build the cake

What are the steps?



Concept Check: Subgoals & Sequences

Write down a sequence of subgoals & steps to help the hero get to the exit stairs.



Subgoal 1: ??

- Move right
- Move right
- ???

Subgoal 2: ??

- Move up
- Move right

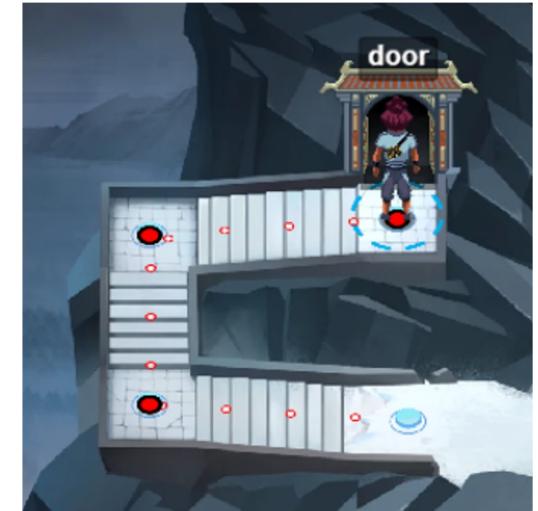
Input & Output

Code is a type of language we use to communicate with computers.

Input



We **input** the code . . .

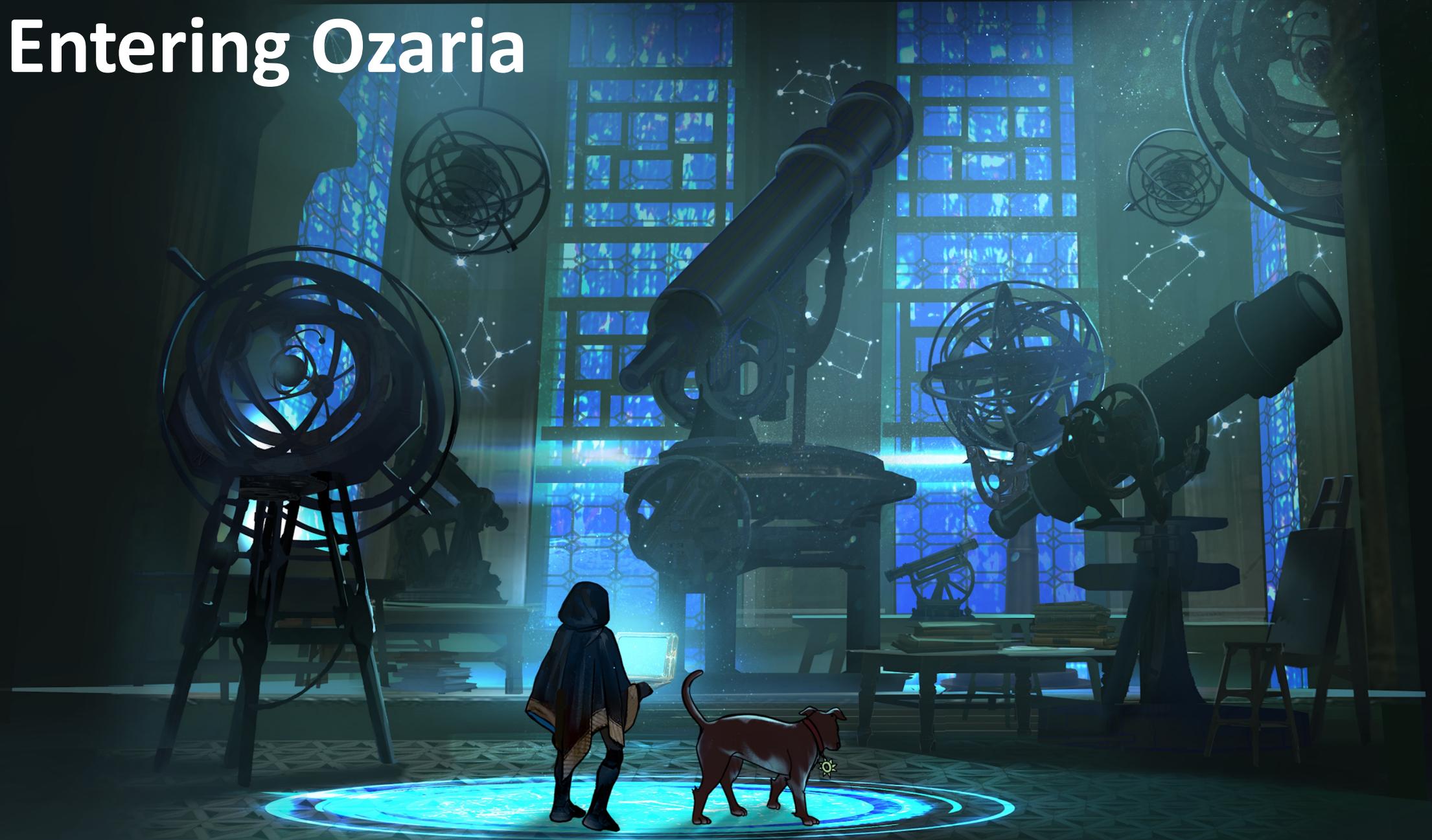


Output

. . . and **outputs** actions and/or results based on that code.

the computer processes or reads the code...

Entering Ozaria



Navigating Ozaria



Change **account settings**, **customize** your hero, or go back to your **dashboard**

Use the **map** to navigate to different parts of the game. **Mouse over a stop** to see the **name** of the level.

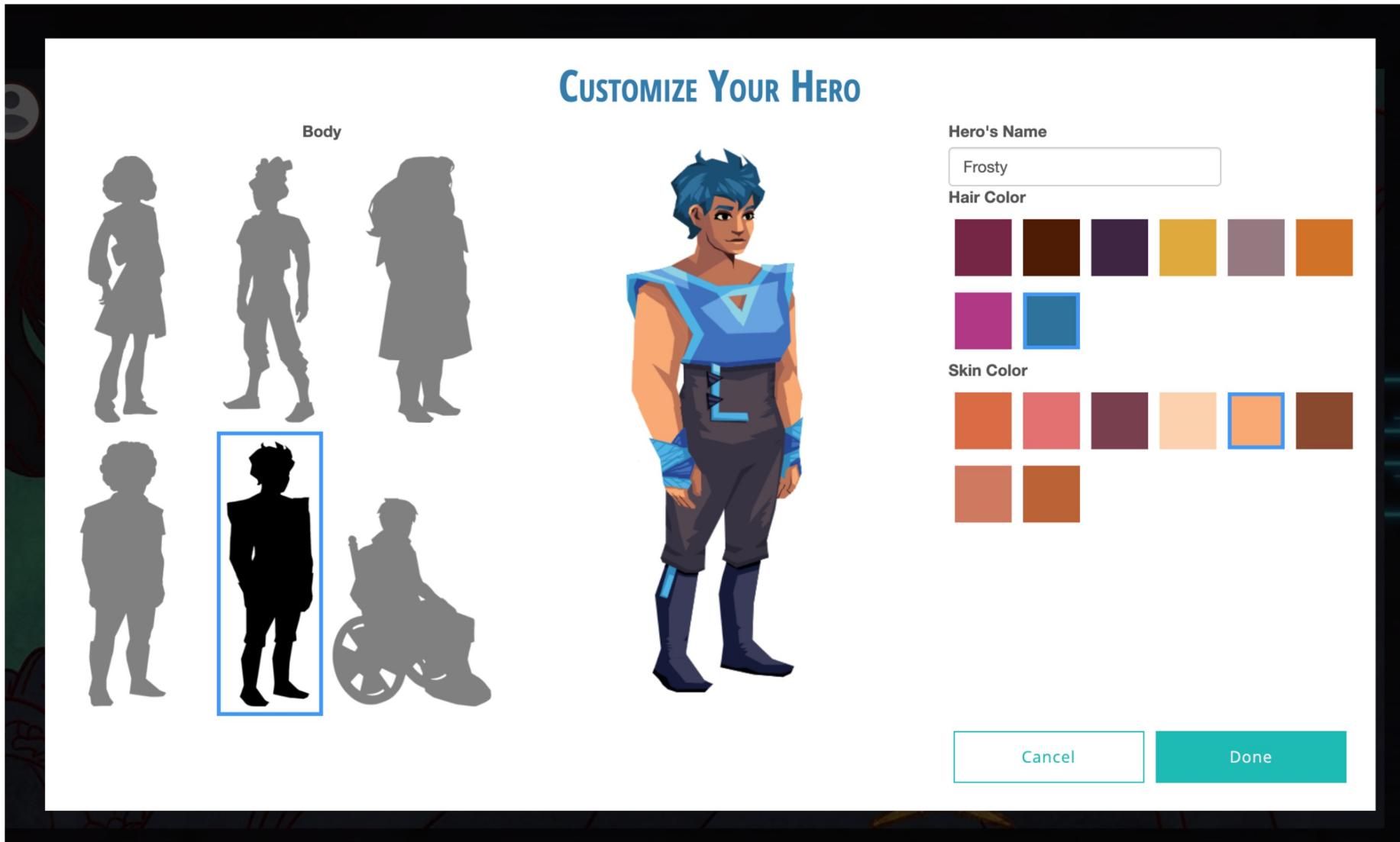
To save space, cinematics and concept checks are organized into **intros**.

→ Returns to **Map**

→ **Maximizes** your Browser

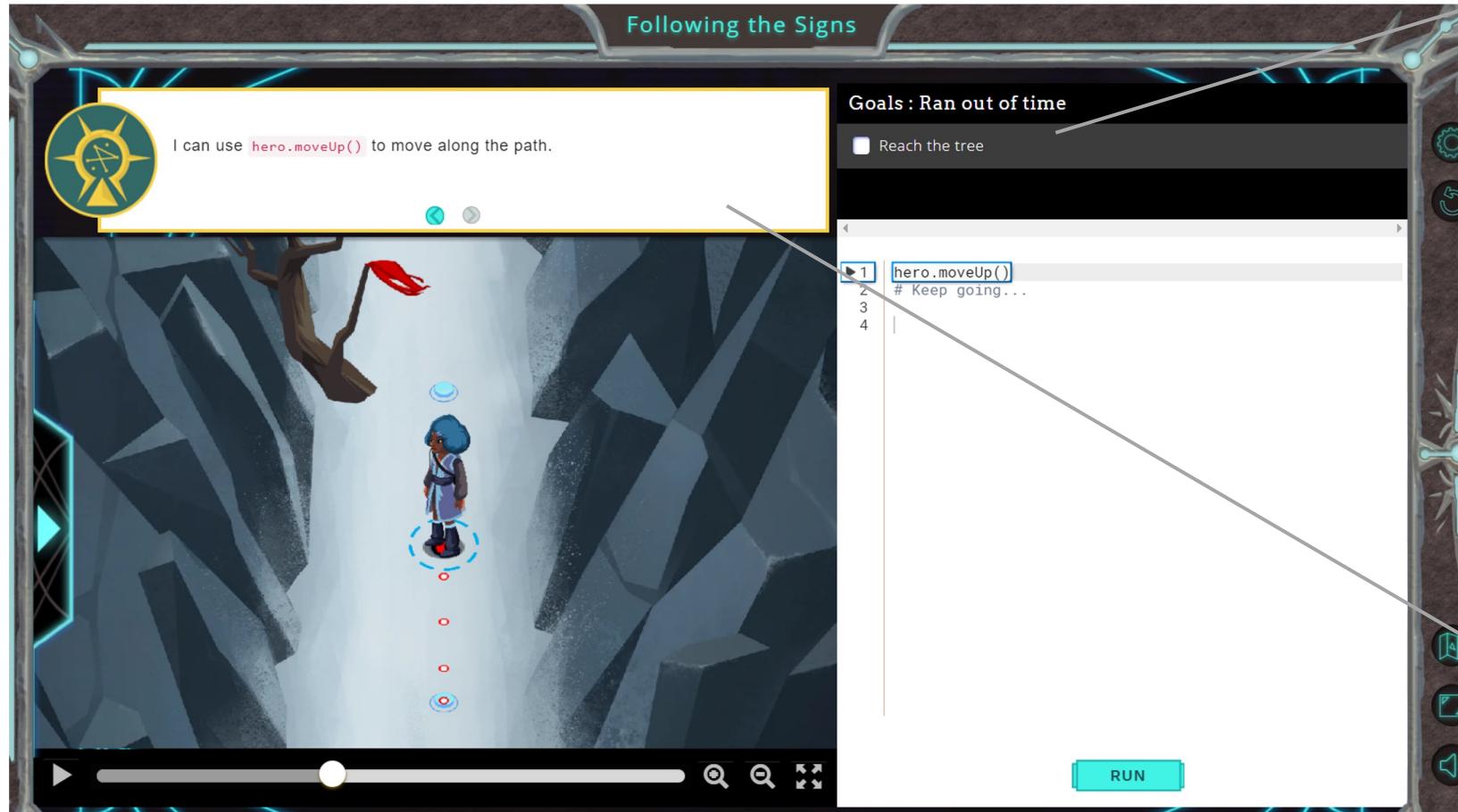
→ Turn the **Volume** On/Off

Customize Your Hero



Navigating Ozaria

Practice Level: Following the Signs



Goals keep track of what you need to do to **complete the level**

Customize your **coding experience**

Restart the level

Use arrows to navigate the tutorial messages. They provide important **hints & instruction**.

Navigating Ozaria

The screenshot shows the Ozaria game interface. On the left is a 3D scene of a character in a snowy, rocky environment. A yellow callout box contains the text: "I can use `hero.moveUp()` to move along the path." On the right is a code editor window titled "Following the Signs". The code editor shows the following script:

```
▶1 hero.moveUp()  
2 # Keep going...
```

Below the code editor are buttons for "RUN" and "STOP". To the right of the code editor are several icons: a gear, a circular arrow, a map, a square, and a speaker. Arrows from the text annotations point to these elements.

The Code Bank gives you more info about the different commands you can use in your code.

Write your code here

Run your program to see what happens

Go backwards and forwards in your program. You can also zoom in and out.



Concept Check: How to Use Ozaria

Following the Signs

I can use `hero.moveUp()` to move along the path.

Goals : Ran out of time

Reach the tree

hero.moveUp()
Keep going...

RUN

3

4

5

6

8

7

Independent Practice



Logging into Ozaria (G1)

1. Go to: <https://www.ozaria.com>
2. Click “Sign Up”
3. Enter in your **class code**
4. **Create an account** or login with your Google account
5. Make sure to **write down your user name!**
6. Click **Continue** to start playing

Students, request a Class Code from your Teacher to create an Account!

Enter Class Code:

XXXXXXXXXXXXXXXXXXXX

Create Student Account

Intro to CS (Python)

Teacher: Charlotte Cheng

Prologue: Sky Mountain [view map](#)

[view my classmates' projects](#)

Continue

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Logging into Ozaria (G2)

1. Go to: <https://www.ozaria.com>
2. Click “Sign Up”
3. Enter in your **class code**
4. **Create an account** or login with your Google account
5. Make sure to **write down your user name!**
6. Click **Continue** to start playing

Students, request a Class Code from your Teacher to create an Account!

Enter Class Code:

XXXXXXXXXXXXXXXXXXXX

Create Student Account

Intro to CS (Python)

Teacher: Charlotte Cheng

Prologue: Sky Mountain [view map](#)

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Continue

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