AP COMPUTER SCIENCE A

Unit 1
Data & Variables

Student Learning Workbook

> **Essential question:** How do programmers represent information, carry out calculations, and communicate results?

This workbook is your programming thinking journal. Use it alongside the course website, CodeHS Cortado, and AP Classroom. Keep your notes, predictions, diagrams, tests, and reflections in one place.

By the end of Unit 1, I can

- Describe an algorithm and a Java program.
- Declare and update variables with suitable data types.
- Evaluate arithmetic, division, remainder, casting, and String expressions.
- Use input/output, library methods, and comments.
- Draw a flowchart, plan pseudocode, test a program, and explain results.

Student: _____ Block: _____

Teacher: _____ Dates: _____

START HERE

Your four learning resources

One lesson sequence. Four connected tools. **Always start on the website**; it tells you which parts of the other systems to use.

1 · WEBSITE

Learn the concept, review diagrams, test examples, find the assignments.

2 · VIDEO

Watch the selected CodeHS and AP Daily videos; pause to record notes.

3 · WORKBOOK

Define, explain, trace, diagram, plan and keep a record of learning.

4 · CODEHS

Write Java, run tests, debug, submit assigned programming work.

The loop

Read and watch → **Predict and plan** → **Code and test** → **Reflect and check**

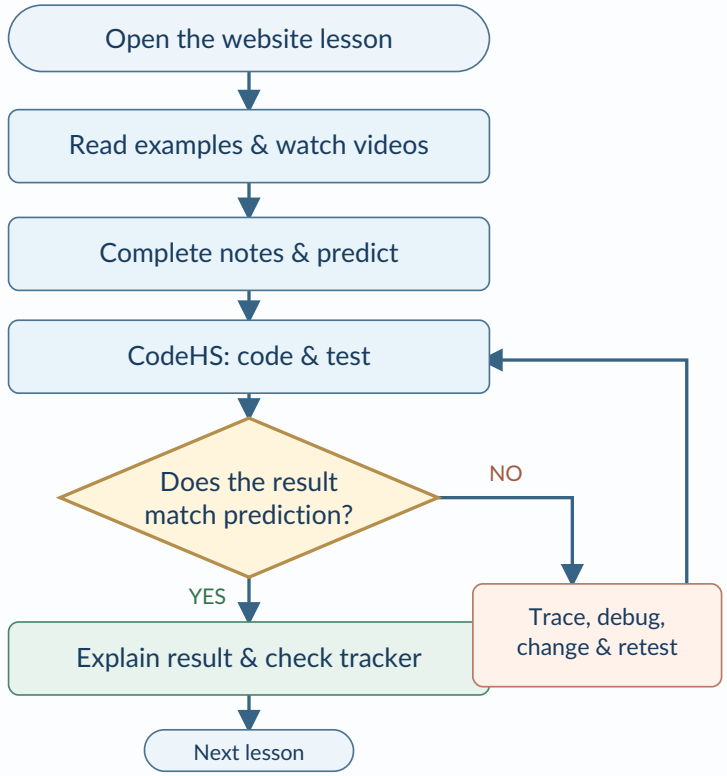
Why would two platforms teach the same idea in different orders? What should you follow?

When an activity seems out of sequence: Stop, return to this unit tracker, and ask the teacher before completing unassigned lessons.

VISUAL LEARNING ROUTINE

How to complete any lesson

A good programmer follows a repeatable process. Use this decision loop every time you learn a new idea.



When the result does not match

No → Read the error message; check types and syntax; trace variable changes; test one modification. Then return to the decision. **Yes →** complete the reflection and check off the assignment.

Where do you return if your CodeHS program gives the wrong output?

Why do you predict before pressing Run?

MODELED EXAMPLE

A complete modeled lesson

Example: Unit 1, Lesson 1.2 — Variables and Data Types. This is what a complete learning cycle looks like.

When	What students do	Evidence
Before coding	Open website 1.2; read the model about storing a lap count.	Write the learning target.
Watch & note	Watch assigned CodeHS 1.2 and AP Topic 1.2 videos.	Define variable, data type, initialize.
Plan & predict	Draw a variable box and trace two updates.	Show each value in order.
Code & test	Complete the specifically assigned CodeHS exercises.	Working program and test evidence.
Reflect	Explain why `int laps = 3;` is appropriate.	One specific written explanation.

```
int laps = 3;
laps = laps + 2;
System.out.println(laps);
```

Model response

Prediction: 5. **Trace:** `laps` starts at 3, the next statement calculates 3 + 2 and stores 5. **Reflection:** I initially treated `=` like algebra; it is an assignment that replaces the stored value.

Write another variable update and explain its result.

MODELED NOTES

STRIDES in computer science

Use all seven parts when appropriate. The workbook prompts will help you collect the most useful information, not just copy a video.

STRIDES	Completed example: Lesson 1.2
S · Subject	AP Computer Science A / Java
T · Topic	Variables and data types
R · Rules	Declare a type and name. Store compatible values. Evaluate the right side before assigning.
I · Illustrations	A memory box shows `laps` containing 3 and then 4.
D · Definitions	A variable is named storage whose value can change.
E · Example	`int laps = 3; laps = laps + 1;`
S · Steps	Choose type → name variable → initialize → update → trace

Before the update

laps → [3]

After the update

laps → [4]

Which STRIDES section is most useful for a flowchart? Why?

Which section helps you record the exact meaning of `=`?

ALGORITHM MODELING

Flowcharts and pseudocode

A **flowchart** visually shows the sequence of an algorithm. **Pseudocode** describes that sequence in short plain-language steps without Java syntax requirements.

Shape or convention	Meaning
Oval / rounded shape	Start or end
Rectangle	Process or calculation
Parallelogram	Input or output
Diamond	Decision with branches
Arrows	Direction and order

Example: calculate a total

INPUT cost → **total ← cost × 1.06** → **DISPLAY total**

```
START
INPUT cost
total ← cost × 1.06
DISPLAY total
END
```

Explain what the arrow `←` means in pseudocode.

Draw the corresponding flowchart using the correct shapes.

MODELED REFLECTION

Predict · Test · Debug · Reflect

Strong workbook notes describe what changed and why. Test the idea with a small example before moving on.

```
int score = 8;
score += 3;
score *= 2;
System.out.println(score);
```

Statement	score after execution
int score = 8;	_____
score += 3;	_____
score *= 2;	_____

Reflection quality matters

Weak: “It worked.”
Strong: “I predicted 19, but the code prints 22. I forgot that the multiplication uses the updated value 11, not the original 8.”

A program prints 22, but you predicted 19. Explain the mistake.

A missing quote mark prevents compilation. Is it a syntax error or a logic error? Explain.

TRACK YOUR PROGRESS

Unit assignment tracker

Check the three boxes in each row as you complete the assigned **video/notes**, **CodeHS practice**, and **workbook reflection**. The activities listed below are selected from Cortado, not whole-module requirements.

Our lesson	Resources	Workbook	Done: V / C / W
1.1 Algorithms & First Java Program	CodeHS 1.1 AP 1.1	pp. 9–11	□ □ □
1.2 Variables & Data Types	CodeHS 1.2 AP 1.2	pp. 12–14	□ □ □
1.3 Expressions & Output	CodeHS 1.3 AP 1.3	pp. 15–17	□ □ □
1.4 Assignment, Input & Updates	CodeHS 1.4 AP 1.4, 1.6	pp. 18–20	□ □ □
1.5 Casting & Numerical Precision	CodeHS 1.5 AP 1.5	pp. 21–23	□ □ □
1.6 Strings & Combining Data	CodeHS 1.15 AP 1.2, intro 1.15	pp. 24–26	□ □ □
1.7 Libraries, Methods & Documentation	CodeHS 1.7 AP 1.7–1.11	pp. 27–30	□ □ □
1.8 Vertical Motion Calculator	CodeHS 1.4 AP Application: 1.1–1.11	pp. 31–34	□ □ □

Important AP Classroom note: This course uses a customized sequence. AP Unit 1 Part 1 (Topics 1.1–1.4) can be assigned after our Lesson 1.4; Part 2 (1.5–1.9) after Lesson 1.7. The full AP Unit 1 assessment requires object topics taught later in our Unit 3.

Video note quality check

- □ I wrote definitions in my own words.
- □ I recorded a useful code example and what it does.
- □ I completed each prediction before running the code.
- □ I can explain my own diagrams and test cases.

Assignment scope: your teacher chooses which of the listed CodeHS and AP Classroom items are required.

LEARN & RECORD

1.1 Algorithms and Java programs

WEBSITE Lesson 1.1 • **CODEHS** 1.1.1 Introduction to Algorithms; 1.1.3 Basic Java Program Structure; 1.1.7 Welcome Program; 1.1.10 Debugging: Quotes
AP CLASSROOM Topic(s) 1.1 (AP Daily video assigned by teacher) • **WORKBOOK** pp. 9–11

Vocabulary

Term	Your definition or example
algorithm	_____
sequence	_____
compiler	_____
syntax error	_____
logic error	_____

How is a recipe similar to an algorithm?

What is the difference between compiling and executing?

VISUALIZE & PLAN

1.1 Model program execution

How Java runs

Write source (.java) → Compile to bytecode → Run on JVM → Observe output

```
public class Main {
    public static void main(String[] args) {
        System.out.println("Hello, world!");
    }
}
```

Circle the class name. Underline the print statement. What text appears in the console?

Write pseudocode for a program that prints your name and favorite subject on separate lines.

Draw a flowchart for writing, compiling, fixing errors if needed, and running a Java program.

APPLY & REFLECT

1.1 Trace, debug and reflect

```
public class Main {
    public static void main(String[] args) {
        System.out.println("Code is a process");
        System.out.println("Test one change");
    }
}
```

Predict the exact output (including both lines).

Why will `System.out.println("Ready);` not compile? Correct it.

Change the program so the second message prints before the first. What changed?

CodeHS activity reflection

Record which assigned Cortado exercise you completed and describe one bug or improvement.

What did the error message or output help you understand?

LEARN & RECORD

1.2 Variables and types

WEBSITE Lesson 1.2 • **CODEHS** 1.2.1–1.2.2 Variables and Primitive Data Types; 1.2.11 Variables About You
AP CLASSROOM Topic(s) 1.2 (AP Daily video assigned by teacher) • **WORKBOOK** pp. 12–14

Vocabulary

Term	Your definition or example
variable	_____
int	_____
double	_____
boolean	_____
String	_____
initialization	_____

Which type would you use for laps completed, time in seconds, and an athlete name? Why?

VISUALIZE & PLAN

1.2 Draw what the computer stores

```
int laps = 3;
double pace = 6.5;
String runner = "Maya";
laps = laps + 1;
```

Before update

laps → [3]
pace → [6.5]

After update

laps → [4]
runner → ["Maya"]

Draw a separate memory box for each variable and label its data type.

Explain why `int count = 2.5;` is not a valid assignment.

Write pseudocode to store a runner name, lap count, and finish time, then display the three values.

APPLY & REFLECT

1.2 Trace, choose and explain

```
int x = 4;
int y = x;
y = y + 3;
System.out.println(x);
System.out.println(y);
```

Statement	x	y
int x = 4;	_____	_____
int y = x;	_____	_____
y = y + 3;	_____	_____

Predict the printed values and explain why changing y does not change x.

What can `boolean isEligible = true;` store that a double cannot represent directly?

CodeHS reflection: Describe a data type you changed and what happened.

LEARN & RECORD

1.3 Expressions and output

WEBSITE Lesson 1.3 • **CODEHS** 1.3.7 Arithmetic Expressions; 1.3.9 Tricky Integer Division; 1.3.13 Exploration: Temperature Conversion
AP CLASSROOM Topic(s) 1.3 (AP Daily video assigned by teacher) • **WORKBOOK** pp. 15–17

Vocabulary

Term	Your definition or example
expression	_____
literal	_____
integer division	_____
modulus	_____
operator precedence	_____

Explain why `17 % 5` is 2, not 3.4.

What is the difference between `print` and `println`?

VISUALIZE & PLAN

1.3 Visualize evaluation order

```
System.out.println(2 + 3 * 4);
System.out.println(17 / 5);
System.out.println(17 % 5);
System.out.println(17 / 5.0);
```

Expression	Result	Reason
2 + 3 * 4	_____	_____
17 / 5	_____	_____
17 % 5	_____	_____
17 / 5.0	_____	_____

Draw an expression tree for `2 + 3 * 4`, showing the first operation.

Write pseudocode that converts a total number of seconds into whole minutes and leftover seconds.

APPLY & REFLECT

1.3 Practice and debugging

```
int total = 125;
int minutes = total / 60;
int seconds = total % 60;
System.out.println(minutes + " min " + seconds + " s");
```

Predict the complete printed line.

A student says `8 / 3` is approximately 2.67. Explain the error and write an expression that produces a decimal answer.

Change 125 seconds to 187. What should the two stored variables become?

CodeHS reflection: Name an expression you tested with two different input values.

LEARN & RECORD

1.4 Assignment, input and updates

WEBSITE Lesson 1.4 • **CODEHS** 1.4.1 Assignment Statements; 1.4.6 User Input; 1.6.5 Basketball Stats Simplification
AP CLASSROOM Topic(s) 1.4, 1.6 (AP Daily video assigned by teacher) • **WORKBOOK** pp. 18–20

Vocabulary

Term	Your definition or example
assignment	_____
input	_____
Scanner	_____
compound assignment	_____
increment	_____

Why is `count = count + 1;` valid Java even though it is not an algebra equation?

Rewrite `total = total * 3;` using compound assignment.

VISUALIZE & PLAN

1.4 Input-process-output diagram




```
import java.util.Scanner;
Scanner input = new Scanner(System.in);
System.out.print("Seconds: ");
double t = input.nextDouble();
```

Identify the input, data type, and variable in the last line.

Write pseudocode for reading distance and time, calculating average speed, and displaying the result. Assume time > 0.

Draw an input-process-output diagram for your algorithm.

APPLY & REFLECT

1.4 Trace updated values

```
int score = 90;
score += 5;
score *= 2;
score--;
System.out.println(score);
```

Statement	score after
int score = 90;	_____
score += 5;	_____
score *= 2;	_____
score--;	_____

Predict the output. What would happen if the multiplication were done first?

A Scanner returns an input as a double, but the program stores it in int without conversion. What problem can occur?

CodeHS reflection: Explain one variable update in your assigned activity.

LEARN & RECORD

1.5 Casting and numerical precision

WEBSITE Lesson 1.5 • **CODEHS** 1.5.2 Casting Example; 1.5.3 Casting Order of Operations; 1.5.8 Range of Variables; 1.5.9 Integer Overflow
AP CLASSROOM Topic(s) 1.5 (AP Daily video assigned by teacher) • **WORKBOOK** pp. 21–23

Vocabulary

Term	Your definition or example
casting	_____
truncation	_____
overflow	_____
round-off error	_____
promotion	_____

How does `(int) 9.8` differ from mathematical rounding?

Why might a computer not store a decimal such as 0.1 exactly in binary floating point?

VISUALIZE & PLAN

1.5 Diagram the conversion

int correct = 17 → int total = 20 → (double) correct / total → result = 0.85

```
int correct = 17;
int total = 20;
double wrong = correct / total;
double right = (double) correct / total;
```

Variable	Stored result	Explanation
wrong	_____	_____
right	_____	_____

Draw two conversion paths showing why wrong and right differ.

Predict `(int)-3.9` and explain the result.

APPLY & REFLECT

1.5 Test cases and precision

```
double value = 7.9;
int whole = (int) value;
System.out.println(whole);
```

Predict the output and rewrite the code to print 8 using `Math.round` (introduced later).

What happens when `int n = 2147483647; n++;` executes?

Give a real-world example where loss of decimal precision matters.

CodeHS reflection: Which operation or cast was most surprising? Why?

LEARN & RECORD

1.6 Strings and data in output

WEBSITE Lesson 1.6 • **CODEHS** 1.2.7 Reference Data Types and Strings; 1.15.1 String Concatenation; 1.15.3 Concatenating Primitives
AP CLASSROOM Topic(s) 1.2, intro 1.15 (AP Daily video assigned by teacher) • **WORKBOOK** pp. 24–26

Vocabulary

Term	Your definition or example
String	_____
concatenation	_____
expression evaluation	_____
escape sequence	_____

Is `String` primitive? Give one way it differs from `int`.

Why do parentheses change the output of a mixed String/number expression?

VISUALIZE & PLAN

1.6 Trace concatenation

```
System.out.println(2 + 3 + " meters");
System.out.println("meters: " + 2 + 3);
System.out.println("meters: " + (2 + 3));
```

Expression	Exact output
2 + 3 + " meters"	_____
"meters: " + 2 + 3	_____
"meters: " + (2 + 3)	_____

Annotate each + sign as either addition or concatenation.

Write pseudocode for a two-line report containing a person name and a distance.

APPLY & REFLECT

1.6 Build a readable report

```
String name = "Maya";
double distance = 12.5;
System.out.println(name + " ran " + distance + " km.");
```

Predict the exact output.

Change the report to display `Distance: 12.5 kilometers` on a new line.

Explain a mistake a programmer might make when combining String and numeric expressions.

CodeHS reflection: What does a useful output label include?

LEARN & RECORD

1.7 Libraries and APIs

WEBSITE Lesson 1.7 • **CODEHS** 1.7.5 Navigating an API; 1.8.4 Bank Account Comments; 1.9.1 Method Signatures; 1.10.2 Basic Calculator; 1.11.3 Exploring the Math Class API
AP CLASSROOM Topic(s) 1.7–1.11 (AP Daily video assigned by teacher) • **WORKBOOK** pp. 27–30

Vocabulary

Term	Your definition or example
library	_____
API	_____
method	_____
parameter	_____
argument	_____
return value	_____

Why is it useful to read API documentation rather than guessing a method name?

How is calling a method different from printing its returned value?

VISUALIZE & PLAN

1.7 Understand method signatures

```
public static double square(double x) {
    return x * x;
}
double answer = square(3.0);
```

Method anatomy

Return type: double → Method: square → Parameter: double x → Call with 3.0

Identify the signature, parameter, argument and return value.

Explain why `double value = square(3.0);` is valid but `int value = square(3.0);` needs a conversion.

Draw arrows showing a value entering a method and a result returning to the caller.

PREDICT & TEST

1.7 Math methods and documentation

```
double a = Math.sqrt(49.0);
double b = Math.pow(2.0, 3.0);
int c = (int) (Math.random() * 6) + 1;
```

Expression	Possible value	Reason
Math.sqrt(49.0)	_____	_____
Math.pow(2.0,3.0)	_____	_____
(int)(Math.random()*6)+1	_____	_____

What type does Math.sqrt return? Can it return an int directly?

Why does adding 1 shift the random range to 1 through 6?

APPLY & REFLECT

1.7 Write useful comments

```
// Convert elapsed seconds into minutes.
int minutes = totalSeconds / 60;
/* The leftover seconds come from the remainder. */
int seconds = totalSeconds % 60;
```

Which comment explains intent rather than merely repeating syntax?

Add a clear comment to code that calculates `height = v0*t - 0.5*g*t*t;`.

What should you look up in an API when calling an unfamiliar method?

CodeHS reflection: Describe one method call and one documentation improvement in your activity.

PROJECT · DEFINE

1.8 Project brief: vertical motion

WEBSITE Lesson 1.8 • **CODEHS** 1.4.5 Freely Falling Bodies (supporting activity); website Vertical Motion Calculator project
AP CLASSROOM Topic(s) Application: 1.1–1.11 (AP Daily video assigned by teacher) • **WORKBOOK** pp. 31–34

Driving question: How can a Java program predict vertical displacement from initial velocity, elapsed time, and gravity? Use the convention: upward positive, g = 9.8 m/s² as a positive magnitude.

The physics model

INPUT v0, t → **COMPUTE y = v0*t - .5*g*t*t** → **DISPLAY y (meters)**

List every input and constant, with units.

What must be displayed so a user can interpret the output correctly?

Explain what the program calculates and what it does not calculate.

PROJECT · DESIGN

1.8 Plan before writing Java

Input-process-output model

INPUT

v0 in m/s; t in seconds

PROCESS

y = v0*t - 0.5*g*t*t

OUTPUT

Vertical displacement y in meters. Positive is above starting point; negative is below it.

Write pseudocode with variable names, units, and a meaningful output sentence.

Draw your own flowchart, using a parallelogram for input/output and a rectangle for the computation.

PROJECT · TEST

1.8 Test cases and predictions

Use **v0 = 20.0 m/s** and **g = 9.8 m/s²**. Predict each displacement before running the program.

t (s)	Predicted y (m)	Observed y (m)
0	_____	_____
1	_____	_____
2	_____	_____
3	_____	_____

Show the full substitution for t = 2 seconds.

What would be a useful additional edge case? Explain what you predict.

If the output differs from your hand calculation, what should you check first?

PROJECT · APPLY

1.8 Implementation and reflection

```
double v0 = 20.0;
double t = 2.0;
double g = 9.8;
double y = v0 * t - 0.5 * g * t * t;
System.out.println("Displacement: " + y + " m");
```

Predict the output, and compare it with your test table.

Describe one test that initially failed and the change that fixed it.

What assumption makes this physics formula useful but imperfect in the real world?

Project completion

Record your program location or CodeHS activity, tested values, and one improvement you could make later.

Project reflection and extension idea

REVIEW & PREPARE

Unit 1 vocabulary and concept review

Without looking at earlier pages, define each concept and connect it to a line of code or concrete example.

Term	Your definition or example
Algorithm	_____
Primitive type	_____
Assignment	_____
Modulus	_____
Casting	_____
Concatenation	_____
API	_____
Return value	_____

Explain one relationship between a flowchart and pseudocode.

Explain why testing boundary or unusual input values is important.

REVIEW · CODE ANALYSIS

Unit 1 trace and debug review

```
int a = 11;
int b = 4;
double c = a / b;
a += 2;
System.out.println("A=" + a + " C=" + c);
```

Predict the exact output.

Change one expression so c becomes 2.75 without changing the types of a and b.

What prints for `System.out.println(3 + 4 + " laps");`?

Identify the error in `int laps = 2.5;` and fix it while preserving the decimal.

Explain what `Math.sqrt(81)` returns, including its type.

A program compiles but displays the wrong value. Is that always a syntax error?

TRANSFER · DESIGN

Independent algorithm challenge

Race pace calculator: A runner finishes 1600 meters in a time entered as minutes and seconds. Write an algorithm that calculates the total seconds and average pace per 400 meters. Do not run code until your plan and prediction are complete.

Identify inputs, intermediate variables, final output, and units.

Draw an input-process-output diagram or a full flowchart.

Write pseudocode for your solution.

For 5 minutes 20 seconds, predict average pace per 400 meters.

SUBMIT & SAVE

My Unit 1 reference sheet

Complete this page in your own words. Keep it for the AP review and future coding projects.

Rules and examples worth remembering

Concept	My example / reminder
Types and assignment	_____
Integer division / remainder	_____
Casting	_____
Strings	_____
Math methods	_____
Comments and testing	_____

One diagram that helps me think

Submission checklist

- ☐ All assigned videos and activities recorded in the tracker.
- ☐ Definitions and notes completed in my own words.
- ☐ Trace tables, pseudocode and flowcharts completed.
- ☐ Vertical Motion Calculator tested with evidence.
- ☐ Reflection and review pages complete.

Classwork rubric: 20 points — Vocabulary/notes 4 · Concepts/diagrams 4 · Pseudocode/design 4 · Trace/debug 4 · Activity reflection/review 4.