

# Unit I: Inheritance, Polymorphism, Abstract Classes, Abstract Methods, and Recursion

Content Area: **Business/Tech.**  
Course(s): **Advance Placement Computer Science A - Java**  
Time Period: **February**  
Length: **20 days**  
Status: **Published**

## Unit Overview

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In this unit, students will learn about the following advance topics in Java:

- Inheritance
- Polymorphism
- Protected Members
- Interfaces
- Abstract Classes
- Abstract Methods
- Recursion

## Enduring Understandings

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- Inheritance and polymorphism are necessary in the development of complex programs and classes.
- Students will learn that recursion is a function that calls itself to solve complex puzzles and algorithms.

## Essential Questions

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TEC.K-12.8.1.A.a	In a world of constant technological change, what skills should we learn?
TEC.K-12.8.1.A.b	How do I choose which technological tools to use and when it is appropriate to use them?
TEC.K-12.8.1.B.a	How can I transfer what I know to new technological situations/experiences?
TEC.K-12.8.1.B.b	What are my responsibilities for using technology? What constitutes misuse and how can it best be prevented?
TEC.K-12.8.2.B.a	How does technology extend human capabilities? What are the positive and negative consequences of technology? Should technologies that produce negative impact continue to be used?
TEC.K-12.8.2.B.b	When are the most sophisticated tools required and when are the simplest tools best?

## Lesson Titles/Objectives

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- Homework: Chapter 13 Review Questions and Exercises
- Homework: Chapter 9 Review Questions and Exercise
- Lesson: Abstract Classes and Methods
- Lesson: Inheritance
- Lesson: Polymorphism
- Lesson: Recursion
- Program: Bicycle Interface
- Program: Character Counter Recursion
- Program: Fibonacci Sequence
- Program: Geometry Inheritance
- Program: Palindrome Recursion
- Program: Ships
- Program: Sports Inheritance
- Program: Super Hero inheritance
- Program: Towers of Hanoi

## Standards

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TECH.8.2.12.E.1	Demonstrate an understanding of the problem-solving capacity of computers in our world.
TECH.8.2.12.E.2	Analyze the relationships between internal and external computer components.
TECH.8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
TECH.8.2.12.E.4	Use appropriate terms in conversation (e.g., troubleshooting, peripherals, diagnostic software, GUI, abstraction, variables, data types and conditional statements).
TECH.8.2.12.E.CS1	Computational thinking and computer programming as tools used in design and engineering.

## Indicators

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## Career Readiness, Life Literacies, & Key Skills

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12.9.3.IT-PRG.1	Analyze customer software needs and requirements.
12.9.3.IT-PRG.2	Demonstrate the use of industry standard strategies and project planning to meet customer specifications.
12.9.3.IT-PRG.3	Analyze system and software requirements to ensure maximum operating efficiency.
12.9.3.IT-PRG.4	Demonstrate the effective use of software development tools to develop software applications.
12.9.3.IT-PRG.5	Apply an appropriate software development process to design a software application.
12.9.3.IT-PRG.6	Program a computer application using the appropriate programming language.
12.9.3.IT-PRG.7	Demonstrate software testing procedures to ensure quality products.
12.9.3.IT-PRG.8	Perform quality assurance tasks as part of the software development cycle.
12.9.3.IT-PRG.9	Perform software maintenance and customer support functions.
12.9.3.IT-PRG.10	Design, create and maintain a database.
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

## Inter-Disciplinary Connections

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- Art
- English
- History
- Math
- Music
- Science

Key Ideas and Details

Craft and Structure

Integration of Knowledge and Ideas

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
SCI.9-12.5.1.12.A	<p>Students understand core concepts and principles of science and use measurement and observation tools to assist in categorizing, representing, and interpreting the natural and designed world.</p> <p>The same solution techniques used to solve equations can be used to rearrange formulas. For example, the formula for the area of a trapezoid, <math>A = ((b_1 + b_2)h)/2</math>, can be solved for <math>h</math> using the same deductive process.</p>

Expressions can define functions, and equivalent expressions define the same function. Asking when two functions have the same value for the same input leads to an equation; graphing the two functions allows for finding approximate solutions of the equation. Converting a verbal description to an equation, inequality, or system of these is an essential skill in modeling.

Some equations have no solutions in a given number system, but have a solution in a larger system. For example, the solution of  $x + 1 = 0$  is an integer, not a whole number; the solution of  $2x + 1 = 0$  is a rational number, not an integer; the solutions of  $x^2 - 2 = 0$  are real numbers, not rational numbers; and the solutions of  $x^2 + 2 = 0$  are complex numbers, not real numbers.

Reading an expression with comprehension involves analysis of its underlying structure. This may suggest a different but equivalent way of writing the expression that exhibits some different aspect of its meaning. For example,  $p + 0.05p$  can be interpreted as the addition of a 5% tax to a price  $p$ . Rewriting  $p + 0.05p$  as  $1.05p$  shows that adding a tax is the same as multiplying the price by a constant factor.

Algebraic manipulations are governed by the properties of operations and exponents, and the conventions of algebraic notation. At times, an expression is the result of applying operations to simpler expressions. For example,  $p + 0.05p$  is the sum of the simpler expressions  $p$  and  $0.05p$ . Viewing an expression as the result of operation on simpler expressions can sometimes clarify its underlying structure.

## Warm-Up

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- Students will enter room log onto computers and load appropriate program(s) for class

## Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

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- Apply Concepts
- Create Programs
- Critically Think
- Debug Programs
- Design hierarchy Charts
- IS: • Extra Time to complete Programs
- IS: • NHS Assistance and Tutoring
- IS: • One on One tutoring during Delsea One
- Organize Hierarchy Chart
- Recall Previous Lessons

## ELL Modifications

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- - Choice of test format (multiple-choice, essay, true-false)
  - Continue practicing vocabulary
  - Provide study guides prior to tests
  - Read directions to the student

- Read test passages aloud (for comprehension assessment)
- Vary test formats

## **IEP & 504 Modifications**

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- - Allow for redos/retakes
  - Assign fewer problems at one time (e.g., assign only odds or evens)
  - Differentiated center-based small group instruction
  - Extra time on assessments
  - Highlight key directions
  - If a manipulative is used during instruction, allow its use on a test
  - Opportunities for cooperative partner work
  - Provide reteach pages if necessary
  - Provide several ways to solve a problem if possible
  - Provide visual aids and anchor charts
  - Test in alternative site
  - Tiered lessons and assignments
  - Use of a graphic organizer
  - Use of concrete materials and objects (manipulatives)
  - Use of word processor

## **G&T Modifications**

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- - Alternate assignments/enrichment assignments
  - Enrichment projects
  - Extension activities
  - Higher-level cooperative learning activities
  - Pairing direct instruction with coaching to promote self-directed learning
  - Provide higher-order questioning and discussion opportunities
  - Provide texts at a higher reading level
  - Tiered assignments
  - Tiered centers

## **At Risk Modifications**

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- Additional time for assignments

- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions
- Space for movement or breaks
- Support auditory presentations with visuals
- Teach time management skills
- Use of a study carrel
- Use of mnemonics
- Varied reinforcement procedures
- Work in progress check

## **Alternative Assessments**

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Performance tasks

Project-based assignments

Problem-based assignments

Presentations

Reflective pieces

Concept maps

Case-based scenarios

Portfolios

## **Benchmark Assessments**

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Skills-based assessment

Reading response  
Writing prompt  
Lab practical

## Formative Assessment

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- Load and Save Programs
- Prepare Workstation

## Summative Assessment

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- Quiz: Protected Members
- Test: Inheritance, Polymorphism, Abstract Classes and Methods
- Test: Recursion

## Resources & Materials

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- College Board. AP Case Study Materials
- Eclipse IDE
- Internet
- Microsoft Office
- Student Handout
- Tony Gaddis: Starting Out with Java: Early Objects. 4/E., 2010, Pearson

## Technology

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- ClearTouch
- CodingBat.com
- Computer
- Eclipse IDE
- Google Classroom
- Google Docs
- Internet

TECH.8.1.12

Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

TECH.8.1.12.A

Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.

TECH.8.1.12.A.CS1

Understand and use technology systems.

TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.D	Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
TECH.8.1.12.E	Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.2.12.B	Technology and Society: Knowledge and understanding of human, cultural and society values are fundamental when designing technology systems and products in the global society.
TECH.8.2.12.C	Design: The design process is a systematic approach to solving problems.
TECH.8.2.12.D	Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.