

## **Dominican International School**

AP Computer Science A

SY 2023-24



Grade Level 11/12 1 Year

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#### **Course Description**

AP Computer Science A is equivalent to a first-semester, college level course in computer science. The course introduces students to computer science with fundamental topics that include problem solving, design strategies and methodologies, organization of data (data structures), approaches to processing data (algorithms), analysis of potential solutions, and the ethical and social implications of computing. For more details see the college board AP Computer Science A Course and Exam Description—Summer 2020

#### Requirements

The necessary prerequisites for entering the AP Computer Science A course include knowledge of basic algebra and experience in problem solving. A student in the AP Computer Science A course should be comfortable with functions and the concepts found in the uses of functional notation, such as f(x) 5 x 1 2 and f(x) 5 g(h(x)). It is important that students and their advisers understand that any significant computer science course builds upon a foundation of mathematical reasoning that should be acquired before attempting such a course.

#### **Course Objectives**

The course emphasizes both object-oriented and imperative problem solving and design using Java language. These techniques represent proven approaches for developing solutions that can scale up from small, simple problems to large, complex problems. Students cultivate their understanding of coding through analyzing, writing, and testing code as they explore concepts like modularity, variables, and control structures.

### **Primary Textbook and Other Resources**

- Online access to programming labs, homework, e-text and supplemental videos:
  - https://runestone.academy/runestone/books/published/csawesome/index.html
- Our class site for discussion forums, collaboration, notes and assignments. https://classroom.google.com
- Supplementary documents, activities, labs and examples:
  - The Java<sup>TM</sup> Tutorials
  - o AP CSA Labs We will cover the old labs, Chatbot, PixLab as well as the new labs Steganography, Celebrity and Data. They will be introduced as indicated in the schedule below.
- Physical Copy ~ 5 Steps to a 5: AP Computer Science A 2018 2nd Edition by Dean R. Johnson, Carol A. Paymer, Aaron P. Chamberlain 5 Steps to a 5
- Online ~ CSAwesome Runestone Course https://runestone.academy/runestone/books/published/csawesome/index.html
- AP Classroom AP Checks, Unit Reviews and Videos.https://apclassroom.collegeboard.org/

#### Assessment

Assignments 30% Quizzes 30% Quarter Exam 30%

### **Additional Information:**

#### **Lab Component:**

The course includes a structured-lab component in which students will complete a minimum of 20 hours of hands-on lab experiences. The curriculum has small coding assignments called Programming Challenges in each lesson, which they are encouraged to do using pair programming. In addition, students will complete at least three of the following College Board AP Computer Science A labs, as chosen by their teachers, in the CSAwesome course to complete a minimum of 20 hours:

| MagPie Chatbot Lab (built into the CSA curriculum)  |  |  |
|---|--|--|
| Picture Lab (built into the CSA curriculum)         |  |  |
| Consumer Review Lab (built into the CSA curriculum) |  |  |
| Celebrity Lab                                       |  |  |
| Steganography Lab                                   |  |  |
| Data Lab  |  |  |

#### **AP CS A Exam**

Students who complete this course will be prepared to take the AP CS A Exam in May.

#### LTO's D'TORCH (Truthful, Organized, Reflective, Courageous and Helpful)

In CS classes the categories of the D'TORCH most practiced and assessed are:

- Organized Students utilize Google Classroom to edit, submit and keep track of their assignments.
- Reflective Students will regularly write activity reflections in their online journal.
- Helpful Students are empowered to ask for and provide explanations and give examples to help classmates through particularly difficult problems.

## **Class Expectations**

- Come to class on time and be prepared
- Have a positive attitude and be willing to learn.
- Respect yourself, others, and our school.
- Always complete your work and try your best.
- Actively participate, listen carefully, but don't speak out of turn.
- All assignments must be completed.

#### **Homework and Quiz Rules**

- All assignments must be turned in on the day they are due.
- 1 day late = Maximum of only 60%
- 2+ days late = Project-I & Only 60%
- If a student has been absent, it is his/her duty to find out what work is due, and hand it in a day later.
- All assignments must satisfactorily be completed.
- If you are absent on the day of a quiz, you will only be able to get a maximum of 60%.

#### **Classroom Rules**

- All students are expected to follow the rules. Consequences will follow if rules are broken.
- Read and follow the standard school rules.
- Be on time and neatly dressed, in full school uniform.
- Speak in ENGLISH ONLY.
- Respect your teachers, fellow students and their property.
- Keep your seating space and classroom clean and neat.
- No eating or drinking in the ICT Labs.
- Ask permission to leave the class.
- Neither cheating nor copying in any form will be accepted. Anyone caught doing either during an activity, project
  or assessment will be given a zero.

### **Academic Honesty (Plagiarism)**

HS CS at DIS is adopting the Harvard CS guidelines on academic honesty. From the Harvard Syllabus

"The essence of all work that you submit to this course must be your own. Collaboration on problems is not permitted (unless explicitly stated otherwise) except to the extent that you may ask classmates and others for help so long as that help does not reduce to another doing your work for you. Generally speaking, when asking for help, you may show your code or writing to others, but you may not view theirs, so long as you and they respect this policy's other constraints."

More details can be found at this link: https://cs50.harvard.edu/ap/2023/syllabus/#academic-honesty

## **Weekly Schedule**

| (NB: Depending on time and interest, the teacher may delete and/or add other selections.)           |   |  |
|---|---|--|
| Week / Date   | Topic / Projects / Assessments  |  |
| Week 1 Aug 10 <sup>th</sup> to 11 <sup>th</sup> Only 2 School Days 10 ~ First Day / Orientation Day | Unit 1: Getting Started and Primitive Types  This unit introduces students to the Java programming language and the use of classes, providing students with a firm foundation of concepts that will be leveraged and built upon in all future units. Students will focus on writing the main method and will start to call pre-existing methods to produce output. The use of pre-existing methods for input is not prescribed in the course; however, input is a necessary part of any computer science course so teachers will need to determine how they will address this in their classrooms. Through interactive coding challenges and exercises built into the lessons, students will start to learn about three built-in data types and learn how to create variables, store values, and interact with those variables using basic operations (VAR). The ability to write expressions is essential to representing the variability of the real world in a program and will be used in all future units. Primitive data is one of two categories of variables covered in this course. Reference data will be covered in Unit 2.  1.1. Getting Started  |  |
| Week 2 Aug 14 <sup>th</sup> to 18 <sup>th</sup> 15 ~ Opening Mass                                   | 1.2. What is Java? 1.3. Variables and Data Types 1.4. Expressions and Assignment Statements 1.5. Compound Assignment Operators 1.6. Casting Variables 1.7 to end: Summary, Exercises, Review, AP Classroom U1 Quiz  |  |
| Week 3 Aug 21 <sup>st</sup> to 25 <sup>th</sup>   | Unit 2: Using Objects  In the first unit, students used primitive types to represent real-world data and determined how to use them in arithmetic expressions to solve problems. This unit introduces a new type of data: reference data. Reference data allows real-world objects to be represented in varying degrees specific to a programmer's purpose. Students will learn about modularity in object-oriented programming, which allows us to use abstraction to break complex programs down into individual classes and methods, through interactive coding challenges and exercises built into the lessons (MOD). This unit builds on students' ability to write expressions by introducing them to Math class methods to write expressions for generating random numbers and other more complex operations. In addition, strings and the existing methods within the String class are an important topic within this unit. Knowing how to declare variables or call methods on objects is necessary throughout the course but will be very important in Units 5 and 9 when teaching students how to write their own classes and about inheritance relationships.  2.1. Objects - Instances of Classes  2.2. Creating and Storing Objects: Constructors |  |

|   | 2.3. Calling Methods Without Parameters 2.4. Calling Methods With Parameters 2.5. Calling Methods that Return Values 2.6. Strings   |
|---|---|
| Week 4 Aug 28 <sup>th</sup> to Sep 1 <sup>st</sup>  | <ul> <li>2.7. String Methods</li> <li>2.8. Wrapper Classes - Integer and Double</li> <li>2.9. Using the Math Class</li> <li>2.10 to end: summary, practice, AP Classroom</li> <li>U2 Quiz</li> </ul>  |
| Week 5 Sep 4 <sup>th</sup> to 8 <sup>th</sup> 8 ~ Holy Mass & VIP Induction                                       | Unit 3: Boolean Expressions and If Statements  Algorithms are composed of three building blocks: sequencing, selection, and iteration. This unit focuses on selection, which is represented in a program by using conditional statements. Students will learn that conditional control structures give the program the ability to decide and respond appropriately and are a critical aspect of any nontrivial computer program (CON). Through interactive coding challenges and exercises as well as the MagPie Chatbot Lab, students learn that selection and iteration work together to solve problems. In addition to learning the syntax and proper use of conditional statements, students will build on the introduction of Boolean variables by writing Boolean expressions with relational and logical operators. The third building block of all algorithms is iteration, which will be covered in Unit 4.  3.1. Boolean Expressions  3.2. if Statements and Control Flow  3.3. Two-way Selection: if-else Statements  3.4. Multi-Selection: else-if Statements |
| Week 6 Sep 11 <sup>th</sup> to 15 <sup>th</sup> 12-14 ~ Pre-Exam Days   | 3.5. Compound Boolean Expressions 3.6. Equivalent Boolean Expressions (DeMorgan's Laws)   |
| Week 7<br>Sep 18 <sup>th</sup> to 22 <sup>nd</sup>  | <ul><li>3.7. Comparing Objects</li><li>3.8. Summary and Practice</li><li>3.9. Magpie Chatbot Lab</li></ul>  |
| Week 8 Sep 25 <sup>th</sup> to 29 <sup>th</sup> No Classes 25-28 ~Teacher's Conference 29 – Moon Festival Holiday | 3.10 to end: summary, exercises, AP Classroom<br>Unit Quiz<br>Final Exam U1-U3  |
| Week 9 Oct 2 <sup>nd</sup> to 6 <sup>th</sup> 3 Days of Class 5-6~Q1 Exams  | Review / Semester 1 Project   |

# $\underline{2^{nd}} \underline{\ OUARTER-TENTATIVE\ COURSE\ CONTENT}$

| Week / Date  | rending on time and interest, the teacher may delete and/or add other selections.)  Topic / Projects / Assessments  |
|--|---|
|  | Unit 4: Iteration (Loops)   |
| Week 1 (10) Oct 9 <sup>th</sup> to 13 <sup>th</sup> 3 Days of Class 9-10 – Double 10 Holiday | This unit focuses on iteration using while and for loops. Students will have learned that boolean expressions are useful when a program needs to perform different operations under different conditions. In this unit, they will learn that boolean expressions are also one of the main components in iteration. This unit introduces several standard algorithms that use iteration. Knowledge of standard algorithms makes solving similar problems easier, as algorithms can be modified or combined to suit new situations. |

|  | Iteration is used when traversing data structures such as arrays, ArrayLists, and 2D arrays. Students will be able to determine the number of times that a code segment will execute by doing a run-time analysis and using a code tracing table to keep track of the variables and their values throughout each iteration of a loop and completing the Consumer Review Lab (Skill 2.D). In addition, students will learn that iteration is a necessary component of several standard algorithms, including searching and sorting, which will be covered in later units.  4.1. While Loops 4.2. For Loops 4.3. Loops and Strings 4.4. Nested For Loops 4.5. Loop Analysis  4.6. Practice and Summary 4.7. Consumer Review Lab Methods and Control Structures   |
|--|--|
|  | 4.8 to end, AP Classroom Unit Quiz  Unit 5: Writing Classes  This unit will pull together information from all previous units to create new, user-defined reference data types in the form of classes. The ability to accurately   |
| Week 2 (11) Oct 16 <sup>th</sup> to 20 <sup>th</sup>                             | model real-world entities in a computer program is a large part of what makes computer science so powerful. This unit focuses on identifying appropriate behaviors and attributes of real-world entities and organizing these into classes. Students will build on what they learn in this unit to represent relationships between classes through hierarchies, which appear in Unit 9. The creation of computer programs can have extensive impacts on societies, economies, and cultures. The legal and ethical concerns that come with programs and the responsibilities of programmers are also addressed in this unit. By the end of this unit, students will also understand the importance of documentation when writing program code. Through programming challenges and interactive activities, students will learn about commenting and conditions. Specifically, students will be able to describe pre and post conditions that are necessary for a program to work as intended (Skill 5.D).  5.1. Anatomy of a Java Class 5.2. Writing Constructors 5.3. Comments and Conditions |
|  | 5.4. Accessor Methods 5.5. Mutator Methods   |
| Week 3 (12)<br>Oct 23 <sup>rd</sup> to 27 <sup>th</sup>                          | 5.6. Writing Methods 5.7. Static Variables and Method 5.8. Scope and Access 5.9. this Keyword  |
| Week 4 (13) Oct 30 <sup>th</sup> to Nov 3 <sup>rd</sup> 1 - All Saint's Day Mass | 5.10. Social Impacts of CS 5.11. Unit 5 Summary AP Classroom 5.14. College Board Celebrity and Data Labs (optional) Unit Quiz  |
| Week 5 (14)<br>Nov 6 <sup>th</sup> to 10 <sup>th</sup>                           | Unit 6: Arrays  This unit focuses on data structures, which are used to represent collections of related data using a single variable rather than multiple variables. Using a data structure along with iterative statements with appropriate bounds will allow for similar treatment to be applied more easily to all values in the collection. Just as there are useful standard algorithms when dealing with primitive data, there are standard algorithms to use with data structures. In this unit, students apply standard algorithms to arrays as well as identify errors in program code found in programming challenges and interactive activities throughout the unit (Skill 4.B). Additional standard algorithms, such as standard searching and sorting algorithms, will be covered in the next unit.  |

|  | 6.1. Array Creation and Access  |
|--|---|
|  | 6.2. Traversing Arrays with For Loops   |
|  | 6.3. Enhanced For-Loop (For-Each) for Arrays  |
| Week 6 (15)<br>Nov 13 <sup>th</sup> to 17 <sup>th</sup>                                | 6.4. Array Algorithms (FRQs) 6.5 to end, AP Classroom Unit Quiz   |
| Week 7 (16)<br>Nov 20 <sup>th</sup> to 24 <sup>th</sup>                                | Unit 7: ArrayList  As students learned in Unit 6, data structures are helpful when storing multiple related data values. Arrays have a static size, which causes limitations related to the number of elements stored, and it can be challenging to reorder elements stored in arrays. The ArrayList object has a dynamic size, and the class contains methods for insertion and deletion of elements, making reordering and shifting items easier. Deciding which data structure to select becomes increasingly important as the size of the data set grows, such as when using a large real-world data set. In this unit, students will also learn about privacy concerns related to storing large amounts of personal data and about what can happen if such information is compromised (IOC). Through POGIL group work and interactive activities, students will gain an understanding of how to use computing safely and responsibly which requires being aware of privacy, security, and ethical issues.  7.1. Intro to ArrayLists  7.2. ArrayList Methods  7.3. Traversing ArrayLists with Loops  7.4. ArrayList Algorithms  7.5. Searching Algorithms |
| Week 8 (17)<br>Nov 27 <sup>th</sup> to Dec 1 <sup>st</sup>                             | <ul> <li>7.6. Sorting Algorithms</li> <li>7.7. Ethics of Data Collection and Data Privacy</li> <li>7.8 to end, AP Classroom</li> <li>7.12. College Board Data Lab (optional)</li> </ul>   |
| Week 9 (18) Dec 4 <sup>th</sup> to 8 <sup>th</sup> 8 - Foundation Day Celebrations     | Unit Quiz<br>Final Exam   |
| Week 10 (19) Dec 11 <sup>th</sup> to 15 <sup>th</sup> 3 Days of Class 14-15 ~ Q2 Exams | Review / Semester 1 Project   |
| Dec 19th to Jan 2nd  | Christmas Break   |

## <u>3rd QUARTER – TENTATIVE COURSE CONTENT</u>

| (NB: Depe  | nding on time and interest, the teacher may delete and/or add other selections.)  |
|--|---|
| Week / Date  | Topic / Projects / Assessments  |
| Week 1 (20) Jan 3 <sup>rd</sup> to 5 <sup>th</sup> 3 Days of Class 4 ~ New Year Mass | Unit 8: 2D Arrays In Unit 6, students learned how 1D arrays store large amounts of related data. These same concepts will be implemented with two-dimensional (2D) arrays in this unit. A 2D array is most suitable to represent a table. Each table element is accessed using the variable name and row and column indices. Unlike 1D arrays, 2D arrays require nested iterative statements to traverse and access all elements. The easiest way to accomplish this is in row-major order, but it is important to cover additional traversal patterns, |

|  | such as back and forth or column-major. After completing programming challenges  |
|--|--|
|  | and interactive exercises  |
|  | <ul><li>8.1. Two-dimensional (2D) Arrays</li><li>8.1. Two-dimensional (2D) Arrays</li><li>8.2. Traversing 2D Arrays (nested loops)</li><li>8.3 to end, AP Classroom</li></ul>  |
| Week 2 (21)<br>Jan 8 <sup>th</sup> to 12 <sup>th</sup>                                   | Picture lab and Steganography Lab<br>Unit Quiz   |
| Week 3 (22)<br>Jan 15 <sup>th</sup> to 19 <sup>th</sup>                                  | Unit 9: Inheritance  Creating objects, calling methods on the objects created, and being able to define a new data type by creating a class are essential understandings before moving into this unit. One of the strongest advantages of Java is the ability to categorize classes into hierarchies through inheritance. Certain existing classes can be extended to include new behaviors and attributes without altering existing code. These newly created classes are called subclasses. In this unit, students will strengthen their ability to determine an appropriate program design to solve a problem or accomplish a task (Skill 1.A). Students will learn how to recognize common attributes and behaviors that can be used in a superclass and will then create a hierarchy by writing subclasses to extend a superclass. Recognizing and utilizing existing hierarchies will help students create more readable and maintainable programs.  9.1. Inheritance, Superclass, Subclass 9.2. Inheritance and Constructors 9.3. Overriding Methods 9.4. Super Keyword |
| Week 4 (23)<br>Jan 22 <sup>nd</sup> to 26 <sup>th</sup>                                  | <ul> <li>9.5. Inheritance Hierarchies</li> <li>9.6. Polymorphism</li> <li>9.7. Object Superclass</li> <li>9.8 to end, AP Classroom</li> <li>Review and Practice</li> <li>Unit Quiz</li> </ul>  |
| Week 5 (24)<br>Jan 29 <sup>th</sup> to Feb 2 <sup>nd</sup>                               | Unit 10: Recursion  Sometimes a problem can be solved by solving smaller or simpler versions of the same problem rather than attempting an iterative solution. This is called recursion, and it is a powerful math and computer science idea. In this unit, students will revisit how control is passed when methods are called, which is necessary knowledge when working with recursion. Tracing skills introduced in Unit 2 are helpful for determining the purpose or output of a recursive method. In this unit, students will learn how to write simple recursive methods and determine the purpose or output of a recursive method by tracing.  10.1. Recursion  10.2. Recursive Searching and Sorting  10.3 to end, AP Classroom  Unit Quiz  |
| Week 6 (25)<br>Feb 5 <sup>th</sup> to 9 <sup>th</sup><br>3 Days of Class<br>8-9 ~ CNY    | Elevens Lab  |
| Feb 8th to 16th  | CNY Holiday  |
| Week 7 (26) Feb 20 <sup>th</sup> to 24 <sup>th</sup> 20-24 ~IOWA 22 ~ Ash Wednesday Mass | AP Review Post Test U12PE1-2 Practice Exam 1 MCQ U12PE3 Practice Exam 2 MCQ  |

| 21-23 ~ Pre-Exam Days   | U12PE4 Practice Exam 3 MCQ' U12PE5 Practice Exam 4 MCQ U12PE6 Practice Exam 5 MCQ |
|---|---|
| Week 8 (27) Feb 27 <sup>th</sup> to March3 <sup>rd</sup> 3 Days of Class 27-28 ~ 228 Memorial Day Holiday | U13 Timed practice Exams Exam 1 Review Exam 2 Review Exam 3 Review                |
| Week 9 (28) March 6 <sup>th</sup> to 10 <sup>th</sup> 4 Days of Class 11 - Q3 Exams                       | Final Exam<br>Review  |

## 4th QUARTER – TENTATIVE COURSE CONTENT

| (NB: Depending on time and interest, the teacher may delete and/or add other selections.)            |  |  |
|--|--|--|
| Week / Date  | Topic / Projects / Assessments   |  |
| Week 1 (29) March 11 <sup>th</sup> to 15 <sup>th</sup> 4 Days of Class  11 ~ Q3 Exams 12 ~ Q4 Begins | 14. Mixed Up Code - Free Response Practice 14.1. RandomStringChooser - Part A Parsons 14.1.1. Mixed Up Code Practice 14.1.2. More Mixed Up Code Practice 14.2. RandomStringChooser - Part A 14.2.1. Try and Solve It - Again 14.3. RandomStringChooser - Part B Parsons 14.4. RandomStringChooser - Part B - 2nd time 14.4.1. Try and Solve It - Again 14.5. Exercises |  |
| Week 2 (30) March 18th to 22 <sup>nd</sup> 18-21 ~ Fire Drill  | 15. Free Response Practice 15.1. RandomStringChooser - Part A 15.1.1. Try and Solve It 15.2. RandomStringChooser - Part B 15.2.1. Try and Solve It 15.3. StringCoder - Part A 15.3.1. Try and Solve It 15.4. StringCoder - Part B 15.4.1. Try and Solve It   |  |
| March 25th to Apr 5th  | Easter Holiday   |  |
| Week 3 (31) Apr 8 <sup>th</sup> to 12 <sup>th</sup> 10 ~ Easter Mass                                 | 15.5. StudentAnswerSheet - Part A 15.5.1. Try and Solve It 15.6. StudentAnswerSheet - Part B 15.6.1. Try and Solve It15.6.1. Try and Solve It 15.7. SkyView - Part A 15.7.1. Try and Solve It 15.8. SkyView - Part B 15.8.1. Try and Solve It  |  |
| Week 4 (33)<br>Apr 15 <sup>th</sup> to 19 <sup>th</sup>  | 15.9. Hidden Word - Write Class 15.9.1. Try and Solve It 15.10. ArrayTester - Part A 15.10.1. Try and Solve It 15.11. ArrayTester - Part B 15.11.1. Try and Solve It 15.12. NumberGroup - Part B 15.12.1. Try and Solve It 15.13. NumberGroup - Part C   |  |

| Week 5 (34) Apr 22 <sup>th</sup> to 26 <sup>th</sup> 22-26 ~ AP Mock Exams  | Mock Exams and practice  |
|---|--|
| Week 6 (35) Apr 29 <sup>th</sup> to May 3 <sup>rd</sup> 1-2 ~ Pre-Exam 1-10~ Final Exams (K, 5, 8, 12 only) 4/29 - 5/10 ~ AP Exams            | AP Exams and study   |
| Week 7 (36) May 6 <sup>th</sup> to 10 <sup>th</sup> 1-10~ Final Exams (K, 5, 8, 12 only) 4/29 - 5/10 ~ AP Exams                               | Final Exams, Project and Study   |
| Week 8 (37) May 13 <sup>th</sup> to 17 <sup>th</sup> 2 Days of Class  15-16 ~ Q4 Exams  17 ~ Record Day                                       | Final Exams, Project and Study   |
| Week 9 (38) May 20 <sup>th</sup> to 24 <sup>th</sup> <u>ACTIVITIES</u> : Double check the school calendar and emails from the administration. | 20-24 ~ Student Clearance Days 21 ~ Baccalaureate Mass for Graduating classes 22 & 23 ~ Middle & High School Sports Day 23 ~ Pre-Kindergarten & Gr. 1 - 4 Recognition/Kindergarten Graduation/Gr. 5 Promotion 24 ~ Gr. 6 - 7 Recognition and Gr. 8 Graduation 24 ~ Lower School Sports Day |
| Week 10 (39) May 27th to 31st  ACTIVITIES: Double check the school calendar and emails from the administration.                               | 27 ~ House Culminating Activity 28 ~ Gr. 9-11 Recognition and Gr. 12 Graduation 29 ~ Class Party 30 ~ Last Day of School & Report Card Distribution (half day) 31 ~ Teachers/Staff Meeting   |

The end ~ Have a great summer 😊

