TEALS Program

1 Lesson 3.05 — Using Objects & String Processing

1.1 Overview

1.1.1 Objectives — *Students will be able to…*

- **Differentiate** between primitive and object types.
- **Apply** 0-indexing and string processing techniques to predict the output of a program.

1.1.2 Assessments — *Students will…*

- **Complete** WS 3.5

1.1.3 Homework — *Students will…*

- **Read** BJP 3.3 up to "Interactive Programs and Scanner Objects"
- **Complete** self-check questions 19-21

1.2 Materials & Prep

- **Projector and computer**
- Day 1
- **Whiteboard and markers**
- **Classroom copies** of WS 3.5
- Day 2
- Teacher access to CS Awesome **[Unit 2 Lesson 8 Wrapper Classes - Integer and Double Lesson Plan]** Sign up at [CS Awesome AP CSA Java Curriculum]
- Teacher access to CS Awesome **[Unit 2 Lesson 9 Using The Math Class Lesson Plan]**
- Access to Dr. Nguyen **[Math Class And Wrapper Classes]** slide deck
- Access to CS Awesome **[Lesson 2.8 Wrapper Classes - Integer and Double]**
- Access to CS Awesome **[Lesson 2.9. Using the Math Class]**

The handouts for this lesson include notes as well as exercises. If you are working on developing note-taking skills in your classroom, you may prefer to delete the notes from the worksheet (so it is only a sheet of exercises and/or images).

If you teach in an ELL or SpEd classroom, leaving the worksheet as-is will allow students to focus on content instead of translating notes into their notebooks.

1.3 Pacing Guide: Day 1

Section	Total Time
Bell-work and attendance	5min
Intro/Review of objects & string processing	5–15min
Round Robin	35–45min
Paper selection & grade announcement	3min

1.4 Pacing Guide: Day 2

Section	Total Time
Bell-work and attendance	5min
Review of Math class and Intro Random Class	5–10min
Intro of Integer/Double Class and Autoboxing	5–10min
CS Awesome Activities from Lesson 2.8 & 2.9	30–40min

1.5 Procedure Day 1

There are several ways you can teach today's class. You should first check in with your students to see how prepared they are for today's lesson. If students understood most of what they read for homework last night, you can ask students for specific questions, cover only those topics, then move on to the Round-Robin activity. If your class is mostly confused, you can re-teach all of the content, following along the worksheet, and breaking the exercises into 4 parts (as listed on the original worksheet).

1.5.1 Bell-work and Attendance `[5 minutes]`

1.5.2 Introduction/Review of Objects and String Processing `[10 minutes]`

1.5.2.1 Emphasize with students...

1.5.2.2 Content - Advanced programming structures

This activity introduces the concept of objects and classes. This means we are going into some more advanced and complex programming ideas and structures. As you learn about these things, it's important to read through the instructions carefully and to think about the code that you are writing in your programs.

Using advanced programming structures can be tricky, but it will allow you to create some very cool projects!

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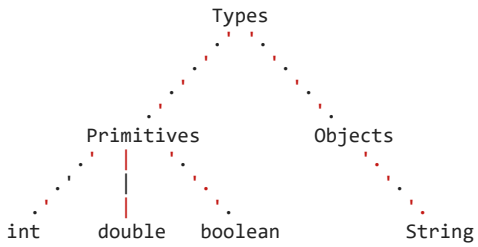
1. Begin with an introduction to the concepts of objects and string processing.

   Using WS 3.5, walk students through the difference between **primitives** and **objects**.

   - Ask students to expand on the atom/molecule metaphor; what "atoms" make up the String "molecule?" (Chars are atoms.)
   - Make sure to emphasize that an object type contains data and behavior (methods), while primitives just contain data.

2. It might help students organize their thoughts if you graphically organize types with the following hierarchy:



3. When explaining the concept of **class**, the car analogy might not resonate with your students (especially if they do not use cars, or live in an area where cars are not common). Since we're not delving into the concept of class too deeply at this point, don't spend too much time on this concept. Additional analogies that have worked:

   - Class: Home, Object (instances of class home) each student's home.
   - Class: Desk, Object each student's desk (can introduce states of desk: messy, neat, crooked, without-a-chair, etc.)

4. When reviewing object methods, remind students that they need to do something with the return value, such as System.out.print.
   - Review dot notation as diagramed
   - Model counting the index positions when you demonstrate the charAt method.
   - Have students predict the output of charAt with different indexes.

5. Break for the first bout of Round Robin (or, if only conducting a quick review, finish reviewing all topics and allow students to do all Round Robin exercises at the end of the introduction.)

In reviewing substring, indexOf, toUpperCase, toLowerCase, and equals methods, work through some additional examples on the board if needed. If providing students the complete worksheet (with notes), encourage them to highlight, circle, or transcribe the definitions or syntax examples into their notebook.

A fun way to assess student understanding is to ask why Java returns `-1` when the search text isn't found. (Answer: `-1` is never a valid index into a String.)

1.5.3 Round Robin `[35-45 minutes]`

1. Round-robin is a drilling and error-checking exercise used with worksheets. At minimum, there should be 1 question for each student (e.g. a class of 15 students would need a worksheet with 15 or more questions). Students write their name on the worksheet, complete the first problem, then pass the paper to the student on the right (or whatever direction you choose). The next student first checks the previous answer, correcting it if need be, then completes the second question. Each student then passes on the paper again. By the end of the exercise, each student has checked and completed each question on the worksheet.

2. The hook is that you choose only ONE worksheet from the pile to grade. All students get a grade from that one worksheet. This keeps students invested throughout the exercise. Advanced students will check questions throughout the whole worksheet, and all students will try their best to catch their own (and others') mistakes, since the whole class shares the randomly-selected-paper's grade.

3. You should time each question/checking interval, and call "SWITCH!" when it is time for students to pass along papers.

   a. Exercise 1 questions (the first 4 questions) should take ~2 minutes each.

   b. Exercise 2 questions (the second 4 questions) should take ~2 minutes each.

   c. Exercise 3 questions (a set of 5 questions) should take ~2 −3 minutes each.

   d. Exercise 4 questions (the last set of 4 questions) should take ~1 minute each.

   Adjust the timing on these questions as needed but try to keep a brisk pace. Part of the engagement factor is the sense of urgency.

1.5.4 Paper selection and grade announcement `[3 minutes]`

If time allows, randomly select the worksheet and announce the class grade with a bit of fanfare, congratulating the class on a job well done.

1.6 College Board Topic Questions

After this lesson, students will be able to answer questions from the College Board Unit 2 Topic Questions 2.8 Wrapper Classes

1.7 Accommodation and Differentiation

To optimize this exercise, you might consider rearranging students (or creating a passing-path) that mixes students of different coding abilities. The advanced students can use the extra time to correct mistakes made by others; if they are sitting in proximity to the student that made the error, they will have a better chance of explaining the correct answer to them.

Due to the brisk pace of the round-robin rotation, there shouldn't be too much down time for any one student. If you do find a student that is looking bored, make eye contact with them as you remind the entire class that everyone should be checking the problems handed to them once they are done with solving their assigned problem.

ELL classrooms may need to allow 2 class periods to complete the round-robin exercise. There are many topics covered during the lesson, and it may be best to introduce vocabulary at a slower rate.

1.8 Misconceptions

- Up to this point, students have been using quoted strings as a primitive type, but `String` is a class in Java. Worksheet 3.5 introduces the String `.equals()` method. Students will need to start thinking of strings as an object and when comparing two strings, use the `.equals()` method. Java is inconsistent in its treatment of strings.

1.9 Procedure Day 2

The AP CS A curriculum is circular in nature where topics are introduced and then reintroduced later in the semester. The Integer and Double classes are introduced here as part of the using classes lesson. Students will use them when in a subsequent unit on ArrayLists when it will be necessary to create Integer and Double objects to store primitives in an ArrayList. Autoboxing and unboxing is introduced here to simplify the need for explicitly calling the constructors.

The Math class is introduced here with the inclusion of the Random class.

1.9.1 Bell-work and Attendance \[5 minutes\]

1.9.2 Introduction of Integer/Double Classes and Autoboxing \[10 minutes\]

The student lesson for Part 2 uses CS Awesomes [Lesson 2.8 Wrapper Classes - Integer and Double]. There you will find the lesson plan and activities to check for student understanding. The teacher lesson plans are accessible by joining the [Teaching CSAwesome google group] and navigating to [Unit 2 Lesson 8 Wrapper Classes - Integer and Double Lesson Plan]. The slide deck for this lesson and Using the Math Class are located on [Dr. Long Nguyen] GitHub at [Math Class And Wrapper Classes]

1.9.3 Introduction of Using the Math Class \[10 minutes\]

The student lesson for Part 2 uses CS Awesomes [Lesson 2.9. Using the Math Class]. There you will find the lesson plan and activities to check for student understanding. The teacher lesson plans are accessible by joining the [Teaching CSAwesome google group] and navigating to [Unit 2 Lesson 9 Using The Math Class Lesson Plan].

1.10 Videos

- BJP 3-3, *Working with Strings Values*
  http://media.pearsoncmg.com/aw/aw_reges_bjp_2/videoplayer.php?id=c3-3
- CSE 142, *Strings* (18:40–33:05)
  https://www.youtube.com/watch?v=Ezp8MU_J9mo&start=1322
- UW AP CS Prep, *Java String Processing*
  https://www.youtube.com/playlist?list=PL_bszZLe8OFfnueQ6fn7wNqu87k3X2Nin

1.11 Forum discussion

Lesson 3.05 Using Objects & String Processing (TEALS Discourse account required)

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