Algorithms Activity 1: Introduction

Introduction to POGIL and CSCI 382

Welcome to CSCI 382, Algorithms! This semester we will often use a methodology called POGIL (Process-Oriented Guided Inquiry Learning). Before we jump into learning about algorithms, we'll take a bit of time to learn about how POGIL works. (We will leave the question of *why* we are using POGIL until next time.) You'll also explore the syllabus of CSCI 382 so you know what to expect this semester.

`http://www.pogil.org`

Learning objective: Students will be able to list and explain the roles in a POGIL classroom.

Make sure you are sitting in a team of three or four people. If not, talk to your instructor.

1 If not everyone on your team knows each other already, begin by introducing yourselves. Write down the names of your team members here.

Each member of a POGIL learning team has a specific **role**, although the roles will change from day to day. Figure out which member of your team has most recently had a birthday. That person will be the **manager** for today. The other members of your team, clockwise from the manager, will be the **recorder**, the **reporter**, and the **reflector**. If your team only has three members, one person should take the roles of both recorder and reporter.

2 Figure out which team member has each role for today, and write the roles here.

3 The manager should get the provided **role cards** and distribute them appropriately. Take a few minutes to read over your role card(s). What are the important functions of your role(s)? Write a summary here.

4 Each team member should take one minute to explain the important aspects of their role(s) to the rest of the team.

Model 1: CSCI 382 Syllabus

Visit the CSCI 382 course web page here:

`http://ozark.hendrix.edu/~yorgey/382/`

Learning objective: Students will be able to explain course policies for weekly problem sets, late days, exams, and academic integrity.

Say whether each statement below is true or false. If false, explain what a correct version of the statement would be.

Remember that you should **work together** to come up with responses to the questions. Make sure all team members agree before moving on.

5 Problem sets are due every Friday at 4pm, and should be turned in on Moodle.

6 One week, Amanda has a play performance, three midterm exams, a 100-page paper due, and a visit from her family. As a result, she is not able to finish her Algorithms problem set before the deadline. She must either turn in whatever she has by the deadline, or else take a zero on the assignment.

7 There are three exams in the course, which together account for 50% of your final grade.

8 In this course, which of the following are considered academic integrity violations?

(a) collaborating with another student on a weekly problem set
(b) collaborating with another student to write up solutions to a weekly problem set
(c) looking at another student's code
(d) referring to an online resource
(e) referring to an online resource without citing it
(f) collaborating with another student on the final exam
(g) obtaining a copy of exam questions before an exam

Hint: be sure to also look at `http://ozark.hendrix.edu/~yorgey/ac-integrity-policy.html` (which is also linked from the syllabus).

Model 2: Some Problems

Consider the following scenarios:

(a) You are given a list of 64-bit integers, and asked to sort them in increasing order.

(b) You are given a collection of 2D points, and asked to find the two points which are closest to each other.

(c) You are given a set of (positive and negative) integers, and asked to find a subset which sums to zero (if there is one).

(d) You are given two positive integers a and b and asked to find their greatest common divisor, that is, the largest positive integer which evenly divides both a and b.

(e) You are asked whether there is any way to visit all 48 contiguous US states by car without entering the same state twice.

Learning objective: Students will analyze problems in terms of inputs and outputs.

9 Sort these integers in increasing order:

2850315545522213899	1319900231253041735	6671615477926962880	816074892707851151
3153324888213964873	6478282629679038038	524678787506768624	3299307200078362735

10 Which two of these points are closest to each other?

$$(2,5) \quad (3,1) \quad (4,0) \quad (0,0) \quad (5,7) \quad (6,2)$$

11 Is there a subset of these integers that sums to zero?

$$\{2, 3, -9, -4, 7, -2, -6\}$$

12 What is the greatest common divisor of 90 and 525?

13 What do you think? *Is* there a way to visit all 48 contiguous US states by car without entering the same state twice?

14 For each scenario, identify the *input(s)* to the problem.

(a)

(b)

(c)

(d)

(e)

15 For each scenario, identify the desired *output(s)*.

(a)

(b)

(c)

(d)

(e)

Model 3: Some Algorithms

Consider the following algorithms for solving the problems from Model 2:

(a) List every possible ordering of the given integers. Test each one to see whether it is sorted, and stop as soon as a sorted ordering is found.

(b) List each possible pair of points, and compute the distance between each. Return the points with the smallest distance.

(c) List every subset of the given set, and find the sum of each. If any subset is found with a sum of zero, return it.

(d) (*See question 23*)

(e) List every possible ordering of the 48 states. Check each ordering to see whether every pair of adjacent states in the ordering is also geographically adjacent. If such an ordering is found, output "yes"; else output "no".

Learning objective: Students will write brute-force algorithms to solve search problems.

16 List every possible ordering of the integers $1, 2, 3$.

17 How many possible orderings are there of the integers $1, 2, 3, 4$? (You do not have to list them, but you should explain the reasoning behind your answer.)

18 In general, how many different orderings are there of a set of n distinct integers?

19 How many orderings are there of 20 distinct integers?

20 Suppose we can check one billion (10^9) orderings every second. How long would it take to check every single ordering of 20 distinct integers? Express your answer at a human-understandable scale; for example, say "about 2 hours" instead of "14400 seconds".

21 List all possible pairs of distinct numbers from the list $1, 2, 3, 4, 5$. The order of the two numbers in a pair does not matter.

22 All the algorithms in Model 3 are called *brute force algorithms*. Using one or more **complete English sentences**, write down a definition of what a *brute force algorithm* is.

23 Fill in this description of a brute force algorithm for scenario (d):

List all the _____

and output _____.

24 For which of the scenarios (a)–(e) do you think the given algorithm is the fastest possible algorithm? For which ones do you think a faster algorithm is possible?