**The Great Computer Challenge, 2020**

***Object-Oriented Business Programming,***

***Level 4***

# **Background**

**Object-oriented programming** (**OOP**) is a programming paradigm based on the concept of "objects", which can contain [data](https://en.wikipedia.org/wiki/Data), in the form of fields (often known as *attributes* or *properties*), and code, in the form of procedures (often known as *methods*). A feature of objects is an object's procedures that can access and often modify the data fields of the object with which they are associated (objects have a notion of "this" or "self"). In OOP, computer programs are designed by making them out of objects that interact with one another.

# **Challenge 1: Towers of Brahma**

The Towers of Brahma puzzle originated in an Indian temple in the Himalayas dedicated to the God of Destruction Shiva. This temple exists to this day and within the temple is a large room with three crystal posts that were created at the beginning of life on Earth. Stacked like a cone on one of the posts were 64 golden disks, largest at the bottom and smallest on top. Many thousands of years ago, Shiva instructed the temple monks to move these disks in accordance with Brahma’s rules. To this day they are still meticulously moving these golden disks one at a time. Lord Shive has prophesized that the world will come to an end when the last move is made. Fear not, the world will not come to an end while you work on this problem for the monks estimated that it would take billions of years to complete the move. However, you have but a few hours to solve this and two other problems to win the top prize.

Simply put, the objective of this problem is to move a **specified** number of disks from one tower to another with the assistance of a third tower while observing the following rules:

* 1. There are **n** disks labeled 1, 2,3, 4,…**n** and three towers labeled **A**, **B**, and **C.**
	2. All the disks are initially placed on tower A stacked in ascending order with the smallest (disk 1) on top and the largest (disk n) at the bottom
	3. A larger disk cannot be placed on a smaller one at any time in any of the towers
	4. Only one disk can be moved at a time and it must be the smallest disk on a tower

Your program should prompt and read the number of disks in tower A and then output each move required to move the disks from tower A to tower B. For example, your program input/output for FOUR disks would be

*Enter number of disks:* 4

*Move disk 1 from A to C*

*Move disk 2 from A to B*

*Move disk 1 from C to B*

*Move disk 3 from A to C*

*Move disk 1 from B to A*

*Move disk 2 from B to C*

*Move disk 1 from A to C*

*Move disk 4 from A to B*

*Move disk 1 from C to B*

*Move disk 2 from C to A*

*Move disk 1 from B to A*

*Move disk 3 from C to B*

*Move disk 1 from A to C*

*Move disk 2 from A to B*

*Move disk 1 from C to B*

*Total number of moves: 15*

(25 points) (5 bonus points for including an animation)

# **Challenge 2: United States Census 2020**

It is the year of the census where **every person** living in the 50 states, District of Columbia, and the five territories will be **counted**. Federal funding and resources, and representation in the U.S. House of Representatives is based on this data. While the census questionnaire is expected to be sent to each home by April 1, 2020, your will demonstrate your programming skills by **writing a GUI program that conducts a simple survey of the head of household with some of the expected questions and provide a report.**

Specifically, your program must:

1. Display an invitation (attachment 1) to respond to the Census.
2. Upon accepting the invitation, display buttons to Start Questionnaire or View Report (only available after the first survey has been completed).
3. When the Start Questionnaire button is selected, display the questions listed in attachment 2 with the suggested GUI elements or controls. All questions must be answered for a survey to be submitted. When complete, enable button to Submit. When successfully submitted, make available buttons for Another Resident survey or to View Report
4. If Another Resident is selected, go to step 1.
5. If View Report is selected, use pie charts, bar charts, graphs, and plain text to display
	1. Number of residents surveyed
	2. Chart showing the distribution of number of people in each household (max 5 per household).
	3. A pie chart showing the distribution of dwellings (home, apartment, mobile home).
	4. Average age of the surveyed residents
	5. Pie chart showing the gender distribution of the residents surveyed
	6. Bar chart showing the race distribution
	7. The average income of the surveyed residents

Your program form must have a menu bar with options to start a new survey, view report, and exit the program. Bonus points for creativity.

(30 points)

**Attachment 1**

Dear Resident:

This is your invitation to respond to the 2020 Census. We need your help to count everyone in the United States by providing basic information about all adults, children, and babies living or staying at this address.

The census is so important that your response is required by law.

Thank you for your prompt response.

Sincerely,

Steven D. Dillingham

Director

**Attachment 2**

1. How many people were living or staying in this house, apartment, or mobile home on April 1, 2020?
2. Is this a house, apartment, or mobile home? (radio buttons)
3. What is your age as of April 1, 2020? (text box)
4. What is your gender (Male or Female)? (radio buttons)
5. Are you of Hispanic, Latino, or Spanish Origin? (drop down)
6. What is your race? White, Black or African American, American Indian or Alaska Native, Asian, or other (your choice of control)
7. What is your annual income before taxes and deductions? (text box)

# **Challenge 3: Automated Reservation System**

Siri Airlines is a startup airline operating out of Norfolk, Virginia, that offers thrilling rides in a vintage DC-3. It operates four fantasy flights, SA2017 from Norfolk International to Washington DC National departing 8 AM, flight SA1218 from Washington DC National to New York LaGuardia departing 11 AM, and flight SA1219 from New York LaGuardia to Washington DC National departing 2 PM, and SA2020 from Washington DC National to Norfolk International departing 5 PM. The duration of each flight is 2 hours. The aircraft is configured for 10 rows of premium seating with 4 seats per row. They accept reservations up to three days in advance. Passengers may select flights from Norfolk to Washington DC or New York, Washington DC to New York, New York to Washington DC, or New York to Norfolk. This airline’s inaugural flight starts April 1, 2020 and its accepting reservations for the first three days of April

Your task is to write a GUI program that allows a passenger to make a reservation and select a seat(s) on one of the available flights and display the boarding pass(es). Please keep in mind that reserving a flight from Norfolk to New York or New York to Norfolk will require seats to be selected on two flights.

Required information for a passenger to make a reservation is the first and last name, and a valid mobile telephone number. Available seats are highlighted green in the seating chart while reserved/taken seats are marked in red. Upon successfully seat selection, you are to assign a unique confirmation number (their telephone number) to the reservation. Passengers may choose to view their boarding pass(es) at this time or later.

Each boarding pass must have the airlines name, flight number, day, departure time, boarding time (30 minutes before departure time), passenger name, seat number, and confirmation number. Should a passenger choose to view the boarding pass at a later time, confirmation # and last name is required to access the reservation.

For five bonus points, allow passengers to cancel the reservation or change seating.

(45 points)

# **SOL Correlation**

C/T 9-12.12 Practice reasoning skills when gathering and evaluating data.

A. Employ technology in developing strategies for solving problems.

* Regularly use technology tools to assist in authentic problem-solving activities.
* Investigate and apply expert systems and intelligent agents in real-world situations.

B. Select resources that extend one’s own capability to solve problems and make informed decisions.

* Choose resources that extend one’s own capabilities when solving problems.

C/T 9-12.13 Demonstrate organization and persistence when completing personal and group assignments, activities, and projects.

A. Use digital resources to assist with project planning.

* Use various productivity tools that help with planning and time management.

B. Use digital resources to assist with project management.

* Use productivity tools to assist in tracking and meeting goals.

C/T 9-12.14 Use models and simulations to understand complex systems and processes.

A. Use simulations to understand complex concepts.

* Enhance understanding of concepts and skills by using simulations.

B. Use various digital resources to produce graphical representations of data.

* Complete assignments involving data by using data graphing or imaging tools.

B. Participate in communications among different cultures.

* Contribute during a distance-based communication project that includes individuals from different cultures by leveraging the differences of those cultures to develop solutions to common issues.

C. Participate in online courses, social and learning networks, and virtual worlds.

* Manage goals for learning in an online course.
* Participate in activities that involve social and learning networks and virtual worlds.

***Have fun and thanks for participating in the
Great Computer Challenge, 2020!***