210CT Week 1 Coursework Tasks
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LEARNING OUTCOMES

1. Understand what we mean by an algorithm and why it is important to study them.

2. Reason about the properties (defined inputs and outputs, correctness, clearness and conciseness and guarantee of algorithm termination) of an algorithm and how they are adhered to.

BASIC/INTERMEDIATE TASKS

1. Write a function that randomly shuffles an array of integers and explain the rationale behind its implementation. Input: [5,3,8,6,1,9,2,7]   (One potential example of) Output: [2,8,3,1,9,7,5,6]
2. Count the number of trailing 0s (number of 0s at the end of the number) in a factorial number. Input: 5 Output: 1,   Input: 10 Output: 2
   Hint: Count the prime factors of 5.
3. For both previous tasks, provide a basic answer (no fancy solution or mathematical proof required) to the following questions:
   a. Does your algorithm have defined inputs and outputs?
   b. Can you guarantee that it terminates?
   c. Is it specified in a clear and concise manner?
   d. Does your algorithm produce the correct result for all instances?

ADVANCED TASK

1. Write a program to predict the number of creatures in a fictional alien invasion. An alien lays X eggs each day (there are no genders in this species) and the eggs hatch after Y days. If X is 3 and Y is 5, how many aliens will there be 30 days after a single alien invades? Hint: Make an array/list and use each slot to represent a day. Put a 1 in the first position and then calculate how many eggs are laid and when they will hatch. Put this value in the correct cell and then add the value for the current day to the following one (they don't die off) and move along.
2. A sparse matrix is a matrix where the number of elements which are zero is bigger than the number of elements which are not zero. Find a way to store sparse matrices, and write the functions to add, subtract, and multiply pairs of such matrices. Do not use predefined functions for the operations on matrices in your programming language of choice.

READING

Korf, R. (2014). How Do You Know Your Search Algorithm and Code Are Correct? *Proceedings of the Seventh Annual Symposium on Combinatorial Search*.