

Exercises in Stepwise Refinement/Modular Design

Do these exercises using stepwise refinement. You should design code modularly.

1. You have to get to school. Options are riding the school bus, taking a taxi, or driving. If you ride the school bus, you have to get up a half hour earlier. If you take a taxi, you have to have taxi fare, which will be \$7. If you drive, there has to be enough gas in the car. If not, you have to buy gas. Gas will cost \$3, and will add ten minutes to the trip. Explain the process of getting to school.

Int cost = 0;

Int triptime = 0;

If you want to ride the school bus [ride_school_bus()]

 Get up half hour earlier

If you want to ride a taxi [ride_taxi()]

 Cost = 7

If you want to ride a car [ride_car()]

 Cost = 3

 Triptime = 10

2. You are going to plan a party. You need to have entertainment, decorations, and food. You can invite a band for \$400 or a local DJ will provide the party's entertainment for \$150. The school has some decorations available, but they will cost \$100. Instead, you can buy decorations. You estimate that this will cost \$250. For food, you can buy pizzas for \$200 or sub sandwiches for \$250 or simple appetizers for \$150. You will ask the school for funds, but you know the school will expect you to present a limited budget. Explain how to plan the party.

If there are lots of guests

 Hire a band

 Cost += 400

Else if there are less guests

 Hire a DJ

 Cost += 150

If you don't have money for decorations

 Use the school's decorations

 Cost += 100

Else if you have spare money for decorations

 Buy your own decorations

 Cost += 200

If the school provides a lot of funds

Order sub sandwiches

Cost += 250

Else if school provide some funds

Order pizza

Cost += 200

Else if school provides no funds

Order simple appetizers

Cost += 150

3. You are going to surprise your best friend with a birthday meal. You want to have a salad, an entrée, and a dessert. For a salad, you can have lettuce, which is in the refrigerator. If you choose lettuce, you have to wash and cut the lettuce. You estimate that this will take a half hour. Otherwise, you can buy a prepared salad, but you will need to have enough money for this. Since you live right next to a store, this won't require extra time. For entrees, you can cook chicken or steak, both of which are in the refrigerator. You don't like the smell of cooking chicken, so if you choose chicken, you will cook it on the grill. For dessert, you can have ice cream, which you have in the freezer. Otherwise, you can go to the store for a pie. Again, you need money, and it takes 45 minutes to heat a pie. Explain how to plan the meal.

First I would go to the store and buy salad and pie if needed. I would put the pie in the oven while cutting my lettuce and grilling my chicken. Time_needed = 0

Buy_salad = false

Buy_pie = false

If you want to buy salad

buy_salad = true

If you want to buy pie

buy_pie = true;

If buy_pie || buy_salad is true

Go to store and buy pie and or salad

If buy_pie is true

Put pie in oven and set timer for 45 minutes

If buy_salad is false

Cut lettuce

If you want to cook chicken

Cook chicken on the grill

4. The leap year problem. You have to decide if a given year is a leap year or not. A year is a leap year if it's divisible by four. There is an exception to this. If a year is divisible by 100, it's not a leap year. There is even an exception to that rule! If a year is divisible by 400 it is a leap year. Create an algorithm to decide if a given year is a leap year or not.

```

Int year;
If (year%4 == 0)
    If (year%100 == 0 && year%400 == 0)
        Return true;
    Return true
Return false

```

5. You are going to plant a flower bed. You wish to have a border. You can build the border from decorative bricks or a cute plastic fence. Your neighbor has bricks left over from building a flower bed, and will give them to you for free. Otherwise, you have to buy the fence from a local garden store. You want a variety of flowers, but too many different colors will look haphazard and detract from the beauty of your yard. For the flowers, you can choose from red or purple petunias, blue asters, yellow marigolds, small white or pink roses, and green herbs. You want a dark color around the edge of the flower bed with the lighter colored flowers on the inside. Explain how to plan the flower bed.

```

If you are low on money
    Use the brick border
Else if you have money saved
    Buy a fence border from garden store

```

```

Int types_of_flowers
If (types_of_flowers == 4)
    Plant purple petunias outside
    Plant green herbs and yellow marigolds in the middle
    Plant pink roses inside
If (types_of_flowers == 3)
    Plant purple petunias outside
    Plant green herbs in the middle
    Plant pink roses inside
If (types_of_flowers == 2)
    Plant purple petunias outside
    Plant pink roses inside

```

6. You are in charge of buying books this year for a small library. You can buy science, history, and/or foreign language books. The library needs all three, but because of budget restrictions and the agreement you have with the bookseller, you can buy only three books per year. If you buy history books, you can buy archaeological books, US history books, or world history books. Science books available include chemistry, biology, and physics. Language books include Chinese, Spanish, Russian, Hindi, and German. Language books are popular right now, but the library wants a variety of books. Science books are more expensive than other types of books. Help the library plan book purchases for the next three years.

7. You have asked your parents if you can plan the next family vacation. You would like to go to Paris. The Paris attractions that you would like to see are the Eiffel Tower (\$20), the Cathedral of Notre Dame (free admission, \$10 extra to see the towers), the Arc de Triomphe (free), and the Louvre museum (closed on Tuesday, free on Sunday, otherwise \$10). Prices are per person. Going from place to place will cost \$3. You can also take a boat ride along the Seine River for \$50. This price is for the entire family. If you take the boat ride, you can get on at the Louvre and get off at the Cathedral of Notre Dame; you don't need to take public transportation. You expect meals to be about \$20 each (for the entire family.) You can get up to three activities (not including the boat ride) per day. Explain how to plan a one-day cheap visit and a one-day nicer visit.

```

Int cost = 0
Cost += 20 (for meals)
If visit = nice
    If day != tuesday
        Louvre museum
        Seine River boat ride
        Cathedral of Notre Dame
        See towers
        Public_transportation()
        Eiffel Tower
    Else
        Arc de Triomphe
        Public_transportation()
        Cathedral of notre dame
        See towers
        Eiffel tower
Else //visit = cheap
    If day == tuesday
        Eiffel tower
        Public_transportation()
        Cathedral of Notre Dame
        Public_transportation()
        Arc de Triomphe
    Else //not tuesday
        Louvre Museum
        Public_transportation()
        Cathedral of Notre Dame
        Public_transportation()
        Arc de Triomphe

```

8. You are going to write a logarithm function. The base for the logarithm must be a positive number, but not the number 1, and of course, you can't take the log of a non-positive number. You have a function LG that will calculate the log if the base is greater than one. (The function call is LG(b,a), which

means the log of a base b.) You can use this rule if the base is between 0 and 1: . You will ask the person using your function to type in a base and a number whose log is desired. You should print an error message if “the conditions are not right.” Otherwise, calculate the log. Explain how you would implement this function.

If $b < 1$

Return error message (must be positive, cannot be equal to one, only calculate log bigger than 1)

Else

Type in value for log

Entered in a;

Calculate $\log(b,a)$

9. A variation of the fizz-buzz game. This is a game that teaches kids facts about multiplication and division. One player goes first and says “1”. Players take turns, each player saying the next number: 2, 3, 4, ... However, any number divisible by three is replaced with the word “fizz”. And, any number divisible by five is replaced with the word buzz. Numbers divisible by both become fizz buzz. A harder version is that if a number contains 4 in it, you say “merp”. For example, 45 is fizz buzz merp. Explain how you would decide what to say.

If the number is divisible by 3

Say fizz

If number is divisible by 5

Say buzz

If any of the numbers are 4

Say merp