



File: SampleExercises-Selection-Loops.doc

Recommended exercises are pointed with blue arrows.

In the first steps, the student analyzing the problem and designing the program constructs algorithms using natural language, pseudocodes and flowcharts. Problem solving strategies, such as, IPO diagrams [IPO], condition-action decomposition [CAD], cursory sketches [CS], trace tables [TT], top down design [TDD], pseudocode [PSC], flowchart [FC] can help to understand and solve the problems. Later, after sometimes a python script (code, program) will be developed.

Ex-1. Selection. [E]. Write an algorithm [PSC, FC]] to decide whether or not to wash your hands.

Ex-2. Selection. [E]. Write an algorithm [PSC, FC] pseudocode to decide if it's time to make lunch. (Please see algorithm in problem #7 and shorten it for this problem)

Ex-3. Selection. [E] Write an algorithm [PSC, FC] pseudocode to print the largest of two given numbers.

Ex-4. Selection. [E] Write an algorithm [PSC, FC] which ask the user for a number, then decide if the number is between 10 and 15, if it is, print the number.

Ex-5. Selection. [M] Write an algorithm [CAD, PSC, FC] to print the smallest of three numbers

Ex-6. Selection. [M] Under the water restrictions of post María events, write an algorithm [CAD, CS, PSF, FC] to decide whether or not to take a shower. Then, decide if you shampoo your hair. Shower are taken from 7:30-9:30 am and shampooing only Monday, Wednesday, and Fridays.



Ex-7. Selection. [H] Test your debugging skills. Debug an algorithm written in pseudocode which decides if it is time to take a shower. Then, decide if you shampoo your hair. Shower are taken from 7:30-9:30 am and shampooing only Monday, Wednesday, and Fridays. The following algorithm has logic errors, please find them:

```

INPUT time, day
IF time >= 7:30 AND time <=9:30
    PRINT 'take a shower'
ELSE
    PRINT 'don't take a shower'
END IF

IF day is Monday or Wed or Friday
    PRINT 'shampoo your hair'
ELSE
    PRINT 'don't shampoo your hair'
END IF

```

Ex-9. Selection. [H] Write an algorithm [CS, PSC, FC] to print the largest of three given numbers. Once you find the largest half the largest and find the largest again. NOTE: You will see later on how to implement a loop into this problem, which will greatly simplify it.


Ex-10. Selection. [H] Write an algorithm [CS, PSC, FC] to decide if a number is between 1 and 10, if it is, print the double of the original number and check whether the result is still between 1 and 10.

Ex-11. Selection. [E] Write an algorithm [CAD, CS, PSC, FC] to decide if a student got attendance bonus. If he has zero absences he gets 3% bonus, if he has 1 absences he gets 2%, otherwise zero bonus.

Ex-12: Selection. [H] Write an algorithm [CAD, CS, PSC, FC] for sizing a Window Air Conditioner unit (size is in BTU). Window air conditioners typically have cooling capacities ranging from 5,000 to 12,500 British Thermal Units (BTUs). As a rule of thumb, an air conditioner needs 20 BTU for each square foot of living space but there are other considerations such as the height of your ceiling and the size of your windows and doorways. To measure your room, multiply the length of the room by the width. Energy Star recommends that you make adjustments for the following circumstances:

- If the room is heavily shaded, reduce capacity by 10 percent.
- If the room is very sunny, increase capacity by 10 percent.
- If more than two people regularly occupy the room, add 600 BTUs for each additional person.
- If the unit is used in a kitchen, increase capacity by 4,000 BTUs.

Test your program for a very sunny 12 by 16 feet master room occupied by a couple.

 **Ex-13. Selection.** [H] Write an algorithm [CAD, CS, PSC, FC] to print the height of the tallest boy in a three-people basketball team. Ask your program to assume the first boy is the tallest, then compare second with tallest and store the taller, repeat the procedure with the third boy.

Ex 14. Selection. [M] Suppose “Banco del Pueblo” offers 1 percent annual interest on balances of less than \$5000, 2 percent for balances of \$5000 or more but less than \$10 000, and 3 percent for balances of \$10 000 or more. Write down an algorithm [CAD, CS, PSC, FC] to calculate a customer’s new balance after one year.

Ex 15. Selection. [M] Chemists define the acidity or alkalinity of a substance according to the formula $\text{pH} = -\log_{10}[\text{H}^+]$ where $[\text{H}^+]$ is the hydrogen ion concentration, measured in moles per liter. Solutions with a pH value of less than 7 are acidic; solutions with a pH value of greater than 7 are basic; solutions with a pH of 7 (such as pure water) are neutral. Suppose that you test apple juice and find that the hydrogen ion concentration is $[\text{H}^+] = 0.0003$. Find the pH value for the apple juice and determine whether the juice is basic or acidic. Write an algorithm [CAD, CS, PSC, FC] to determine the pH of other substances.

Ex-16. Selection. [E] Loudness is measured in decibels, dB. The formula for the loudness of a sound is given by “ $\text{dB} = 10 \log[L / L_0]$ ” where L_0 is the intensity of “threshold sound”, or sound that can barely be perceived. Other sounds are defined frequently in terms of how many times more intense they are than threshold sound. For instance, a cat's purr is about 316 times as intense as threshold sound, for a decibel rating of:

$$\begin{aligned} \text{dB} &= 10 \log(L / L_0) \\ &= 10 \log[(316 L_0) / L_0] \\ &= 10 \log(316) \\ &= 24.9968708262 \cong 25 \text{ decibels.} \end{aligned}$$

Considering that prolonged exposure to sounds above 85 decibels can cause hearing damage or loss, and considering that a gunshot from a .22 mm rimfire rifle has an intensity of about $L = (2.5 \times 10^{13})L_0$. Write an algorithm [CAD, CS, PSC, FC] for a program that determines if you should follow the rules and wear ear protection when relaxing at the rifle range.

Ex-17. [H] Write an algorithm [CAD, CS, PSC, FC] for a program which figures out whether a given year is a leap year. In the Gregorian calendar (our current calendar) three criteria must be taken into account to identify leap years:

1. The year can be evenly divided by 4, and
2. If the year can be evenly divided by 100, it is NOT a leap year, unless;
3. The year is also evenly divisible by 400. Then it is a leap year.

This means that in the Gregorian calendar, the years 2000 and 2400 are leap years, while 1800, 1900, 2100, 2200, 2300 and 2500 are NOT leap years. Also 2016 and 2020 are leap years.

HINT: It is a good idea to decompose the problem using condition-action (CAD) strategy. For instance, this CAD strategy is better shown in a table like the one shown below. Just notice this is part of the solution (in real life you are in charge of constructing a table like this).


	CONDITION			ACTION
Example Year	Div by 4	Div by 100	Div by 400	Leap?
2004	✓	☒		yes
2500	✓	✓	☒	no
2000	✓	✓	✓	yes
2003	☒			no

No cases of Years divided by 400 that are not divided by 100 are found

Ex-18. Selection. [M] Write an algorithm [CAD, CS, PSC, FC] to test if a number is a multiple of 3, 5 or 7. Assume to have the mod (division modulus) or rem function.

Ex-19. Selection. [M] Given an age, write an algorithm [CAD, CS, PSC, FC] to figure out whether someone's a baby, toddler, child, teenager, adult or old codger. Better use the following table:

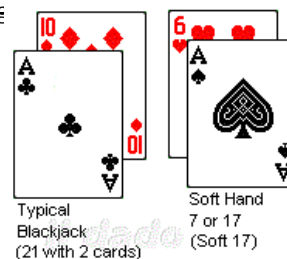
Age	Stage
0- 1	approximately a baby
1- 2	a toddler
2- 12	approximately a child – this period is your childhood
13-17	approximately a teenager (14 = early teens)
18 +	an adult
20-30	in your twenties (24-26 = mid twenties)
30-40	in your thirties (38 = late thirties)
40+	people are middle-aged; in middle age
60 or 65	retirement (= when people stop work; they are retired)
75+	old age (you can also use elderly)

 **Ex-20. Selection.** [M] Given the final score percentage (e.g., 79%), write an algorithm [CAD, CS, PSC, FC] to calculate the grade of a student based on the A through F letter grade system (e.g., C).

Ex-21. Selection [too hard, for beginner programmer]. [H] Write an algorithm [CAD, CS, PSC, FC] for a simple action in a blackjack game. Given a blackjack hand [Hint: Player draws another card (and more if he wishes)], check if it's okay or bust (this is good since J/Q/K morph into 10) Keep it simple. (REF: <https://wizardofodds.com/>)

Marchell offers this primer to anybody playing blackjack:

- Stand when your hand is 12-16 when the dealer has 2-6.
- Hit when your hand is 12-16 when the dealer has 7-Ace.
- Always split Aces and 8s.
- Double 11 versus the dealer's 2-10.
- Hit or double Aces 6.



REF: (<http://www.businessinsider.com/what-you-need-to-know-before-going-broke-at-the-blackjack-table-2012-3>)

How do you play blackjack? The cards 2 through 10 are worth their face value. Kings, queens, and jacks (K, Q, J) are each worth 10, and aces may be used as either 1 or 11. The object for the player is to draw cards totaling closer to 21, without going over, than the dealer's cards. The best total of all is a two-card 21, or a blackjack.

Ex-22. Selection. [E] Write an algorithm [CAD, CS, PSC, FC] for the following situation. Given a blackjack hand, figure out whether to draw another card (if total is under 17 for example).

Ex-23. Selection. [E] Write an algorithm [CAD, CS, PSC, FC] to implement the following. Try a simple game: If you press 'L', turn left, if you press 'R', turn right, if there's a monster (e.g., 'M'), you die.



Ex-24. Selection. TAXI RATES. [H] To put it simply, taxi meters measure distance and time. They then convert



those measurements into a fare. All taxi meters measure the distance a cab covers, plus any time spent waiting. That way, the driver gets compensated for time, so they don't lose out on money just because they're stuck in traffic. It's also why a cab ride from point A to point B may cost you more when there's traffic than when there's not, even if the distance covered is the same.

Each trip is made up of three components:

1. Initial flag (Starting rate, which shows on the meter when switched to hire) is the minimum the customer is going to pay. This buys them a fixed distance or waiting time or a combination of both.
2. Ongoing Drops is the rate that is going to be charged after the initial flag distance. This is made up of the fare increments depending on the distance covered. This is called a progressive tariff, which after the initial flag distance and charge say, goes \$1.50 per mile for two miles and then changes to \$1.30 per mile to the end of the journey.
3. Waiting Time. During this ongoing drop period, waiting time is normally implemented. This normally uses the same drop value, a set waiting time rate would be used if the vehicle was stationery. This also uses a progressive tariff, in the first 2 hours, the rate is \$0.20 per minute and then the tariff decreases to \$0.15 per minute to the end of the trip. When the vehicle starts to move, the customer pays for waiting time PLUS distance charges PLUS initial flag.

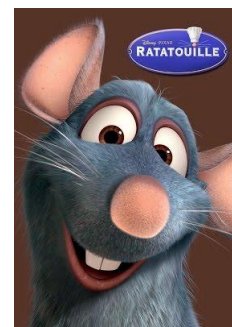
$$\text{Trip Rate} = \text{initial flag} + \text{ongoing drops} + \text{waiting time}$$

Write a flowgorithm flowchart and pseudocode [CAD, CS, PSC, FC] for a program that computes the total trip rate. Consider 0.5 mile as the initial flag.

REAL LIFE: Taxi fares are set by the area the taxi cab operates in -- in other words, it might cost more to travel the same distance or time in one city than it does in another. Fares may also change based on how many people are in the taxi, if the driver has to help you with your bags and if the taxi has to cross state or municipal lines to get you where you're going.

Ex 25. Selection Movie Theater. [H] Write an algorithm [CAD, CS, PSC, FC] that tells the user what type of movie they can attend based on their age, if they are with their parents, if they are students, and their amount of money

Under 13	G
Under 13 w/parent:	G, PG
13 and Over and Under 16:	G, PG
Under 16 w/parent	G, PG, R
16 and Over	G, PG, R
Student	\$4.00
Matinee	\$4.50
Evening	\$6.50



Ex 26. Selection. Bank Account. [H] Write an algorithm [CAD, CS, PSC, FC] that will take as input the user's bank account balance and the type and level of account they have. Based on this information and the below rate table, determine the interest rate they are receiving.

Type of Account	Level	Minimum Balance	Interest Rate
Student	Humble ('Pelao')	\$1	1.0 %

Student	Standard	\$25	1.3 %
Personal	Standard	\$50	1.2 %
Personal	Gold	\$1000	1.9 %
Personal	Gold	\$5000	2.3 %
Business	Standard	\$1500	1.7 %
Business	Platinum	\$10000	2.5%

Ex-27. Selection. Restaurant Tip. [H] Write an algorithm [CAD, CS, PSC, FC] that takes as input the type of restaurant the user ate at, the cost of the meal, the number of people in his/her party, and how good the service was. Determine the dollar amount of the tip, based on:

Base Tip:

Food Truck: 5%
Diner: 12%
Good Restaurant: 15%
Fancy Restaurant: 20%

Additions/Subtractions:

Poor Service: -2%
Good Service: +0%
Excellent Service: +2%

Number of parties:

1-5 in party: +0%
6-10 in party: +3%
more than 10: +5%



E-28. Selection. [H] Construct an algorithm [CAD, CS, PSC, FC] to compute the equation of a line $y=mx+b$,

- Given two points (x_1, y_1) , (x_2, y_2) ; where m is the slope and b the y intercept.
- Given the slope " m " and a point (x_1, y_1) ,
- Given the slope " m " and the y -intercept " b ."

Ex-29. Discriminant review. The discriminant is the part of the quadratic formula underneath the square root symbol: b^2-4ac . The discriminant tells us whether there are two solutions, one solution, or no solutions. The quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

for any quadratic equation like:

$$ax^2 + bx + c = 0$$

The discriminant is the part of the quadratic formula under the square root. The discriminant can be positive, zero, or negative, and this determines how many solutions there are to the given quadratic equation. A positive discriminant indicates that the quadratic has two distinct real number solutions. A discriminant of zero indicates that the quadratic has a repeated real number solution. A negative discriminant indicates that neither of the solutions are real numbers. Write a program that report the solution for a quadratic equation.