Exercise 1 (10 points) Write a program that asks the user to enter a positive integer n, and calculates the sum of the integers 1 + 3 + 5 + 7 + … + (2n-1) and prints out this sum to the screen. For example, when n is 5, 2n-1 is 9, thus the sum of integers is 1+3+5+7+9=25. Your program should be able to handle the invalid case where the input is negative. You must use loop to do this task. Sample Run 1 Enter a positive integer: 5 The sum is: 25 Sample Run 2 Enter a positive integer: -5 The input you gave is not valid. It must be positive.

In [14]:
```
n = int(input("Enter a positive integer: "))
if n <= 0:
    print("The input you gave is not valid. It must be positive.")
else:
    sum = 0
    for i in range(1, 2*n, 2):
        sum += i
    print("The sum is:", sum)
```

```
The sum is: 25
```

Exercise 2 (15 points) Write a program that asks the user to enter a positive integer n, and prints out the following shape. You must use nested loop in your program. The gap between two numbers could be a space or a tab. Sample Run Enter a positive integer: 7 Output: 1 1 2 1 2 3 1 2 3 4 1 2 3 4 5 1 2 3 4 5 6 1 2 3 4 5 6 7

In [ ]:
```
n = int(input("Enter a positive integer: "))
for i in range(1, n+1):
    for j in range(1, i+1):
        print(j, end=" ")
    print()
```

```
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
1 2 3 4 5 6
1 2 3 4 5 6 7
1 2 3 4 5 6 7 8
```

Exercise 3 (15 points) Create a calculator that can add, subtract, multiply or divide depending upon the input from the user, using loop and conditional statements. After each round of calculation, ask the user if the program should continue, if ‘y’, run your program again; if ‘n’, stop and print ‘Bye’; otherwise, stop and print ‘wrong input’. Sample run 1: Select operation: 1. Add 2. Subtract 3. Multiply 4. Divide Enter choice (1/2/3/4): 3 Enter first number: 15 Enter second number: 14 15 * 14 = 210 Do you want to do another calculation (y/n)? n Bye Sample run 2: Select operation: 1. Add 2. Subtract 3. Multiply 4. Divide Enter choice (1/2/3/4): 2 Enter first number: 15 Enter second number: 14 15 - 14 = 1 Do you want to do another calculation (y/n)? y Select operation: 1. Add 2. Subtract 3. Multiply 4. Divide ……. Hints: Make an infinite loop with a stopping criterion.

In [ ]:
```
while True:
    print("Select operation:")
```

```
    print("1. Add")
    print("2. Subtract")
    print("3. Multiply")
    print("4. Divide")

    choice = int(input("Select Operation: 1. Add 2. Subtract 3. Multiply 4. Divi
    if choice in [1, 2, 3, 4]:
        num1 = int(input("Enter first number: "))
        num2 = int(input("Enter second number: "))

        if choice == 1:
            result = num1 + num2
            symbol = "+"
        elif choice == 2:
            result = num1 - num2
            symbol = "-"
        elif choice == 3:
            result = num1 * num2
            symbol = "*"
        else:
            result = num1 / num2
            symbol = "/"

        print("{} {} {} {} {}".format(num1, symbol, num2, "=", result))
    else:
        print("Invalid Input")

    again = input("Do you want to do another calculation (y/n)? ")
    if again == "y":
        continue
    elif again == "n":
        print("Bye")
        break
    else:
        print("Wrong input")
        break
```

```
Select operation:
1. Add
2. Subtract
3. Multiply
4. Divide
1 + 2 = 3
Bye
```

Exercise 4 (20 points) Marble Game Write a program that allows to players to play the marble game using combinations of loop and conditional statements. In the marble game, you ask the user to enter how many marbles to start with. Then, the game begins. The first player must take 1, 2 or 3 marbles. Then the second player goes and must take 1, 2 or 3 marbles. The winner is the player who takes the last marble. Allow two users to play this game and print out the winner (player #1 or player#2). Assume that both players enter valid inputs (1, 2 or 3, and they never try to take more marbles than there are in the pile.) Sample Run 1 How many marbles to start with? 10 Player #1, there are 10 marbles left. How many marbles will you take? 2 Player #2, there are 8 marbles left. How many marbles will you take? 2 Player #1, there are 6 marbles left. How many marbles will you take? 2 Player #2, there are 4 marbles left. How many marbles will you take? 1 Player #1, there are 3 marbles left. How many marbles will you take? 3 Player #1, you took the

last marble and have won! Sample Run 2 How many marbles to start with? 10 Player #1, there are 10 marbles left. How many marbles will you take? 2 Player #2, there are 8 marbles left. How many marbles will you take? 3 Player #1, there are 5 marbles left. How many marbles will you take? 3 Player #2, there are 2 marbles left. How many marbles will you take? 2 Player #2, you took the last marble and have won!

In [ ]:
```
def play_marble_game():
    marbles = int(input("How many marbles to start with? "))
    turn = 1
    while marbles > 0:
        print(f"Player #{turn}, there are {marbles} marbles left. How many marbl
        taken = int(input())
        while taken < 1 or taken > 3:
            print("Invalid input. You must take 1, 2 or 3 marbles.")
            taken = int(input())
        marbles -= taken
        if marbles <= 0:
            print(f"Player #{turn}, you took the last marble and have won!")
        turn = 3 - turn

play_marble_game()
```

```
Player #1, there are 10 marbles left. How many marbles will you take?
Player #2, there are 8 marbles left. How many marbles will you take?
Player #1, there are 5 marbles left. How many marbles will you take?
Player #2, there are 3 marbles left. How many marbles will you take?
Player #2, you took the last marble and have won!
```

Exercise 5 (20 points) Write a program that asks the user to enter a positive integer n as the height of the following shape and prints out this shape. You must use loop to do this task. Sample Run Enter a positive integer: 5 Output:

- *

In [11]:
```
def play():
    n = int(input("Enter a positive integer: "))
    max = (n + 1) * 2

    # main
    for row in range(1, n+1):
        stars = row*2 # 1
        spaces = max - stars
        # stars
        for col in range(1, stars):
            print("*", end=" ")
        # spaces
        for col in range(1, spaces):
            print("_", end=" ")
        # spaces
        for col in range(1, spaces):
            print("_", end=" ")
        # stars
```

```
        for col in range(1, stars):
            print("*", end=" ")
        # new lines
        print("")
        print("")

    # last
    for last in range(0, (max*2) - 4):
        print("*", end=" ")

play()
```

```
*         *
***       ***
*****     *****
*******   *******
*********
```

Exercise 6 (20 points)

In mathematics, the Leibniz formula for π, named after Gottfried Leibniz, states that ∑ (−1) n 2n + 1 ∞

n=0

π 4 Which is, 1 – 1 3 + 1 5 – 1 7

- ⋯ = π 4 Write a program that calculates π. The more terms you sum up, the more accurate result you can obtain. Hints: (1) Make an infinite loop with a stopping criterion (2) If the stopping criterion satisfies, then stop the loop (3) Some simple stopping criteria: a) The number of terms you add up is a large number (e.g., 10000); b) The sum difference between the current one (with one more term) and the previous one is very small (e.g., 0.001)

In [13]:

```
def calculate_pi(terms, tolerance):
    sum = 0
    previous_sum = 0
    for n in range(0, terms):
        current_sum = 4 * (-1)**n / (2*n + 1)
        sum += current_sum
        if abs(sum - previous_sum) < tolerance:
            break
        previous_sum = sum
    return sum

terms = int(input("Enter the number of terms: "))
tolerance = float(input("Enter the tolerance value: "))

result = calculate_pi(terms, tolerance)
print("Approximation of pi: ", result)
```

```
Approximation of pi:  4.0
```