AI_6 Aim: Design a Fuzzy based application using Python.

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In below example I have used Fuzzy logic to determine Fan Speed based on temperature or city.

In Fuzzy Logic objects are not always in one of two states (true or false), but rather in several states at one time.
We can find membership of an object with below formula:
Membership = (val-min)/(max-min)

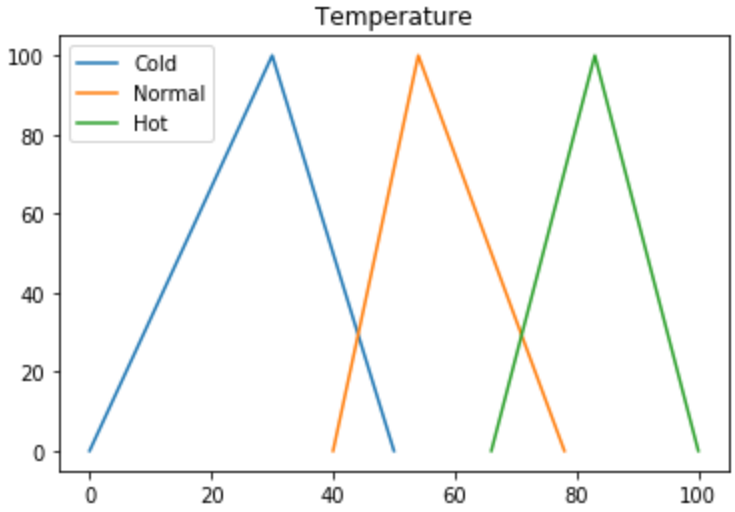
1. Temperature Graph

In [1]:
```
import matplotlib.pyplot as plt
%matplotlib inline

#temprature
cold = [0, 30, 50]
normal = [40, 54, 78]
hot = [66, 83, 100]

percentage = [0, 100, 0]

plt.plot(cold, percentage)
plt.plot(normal, percentage)
plt.plot(hot, percentage)
plt.legend( ["Cold", "Normal", "Hot"] )
plt.title("Temperature")
plt.show()
```

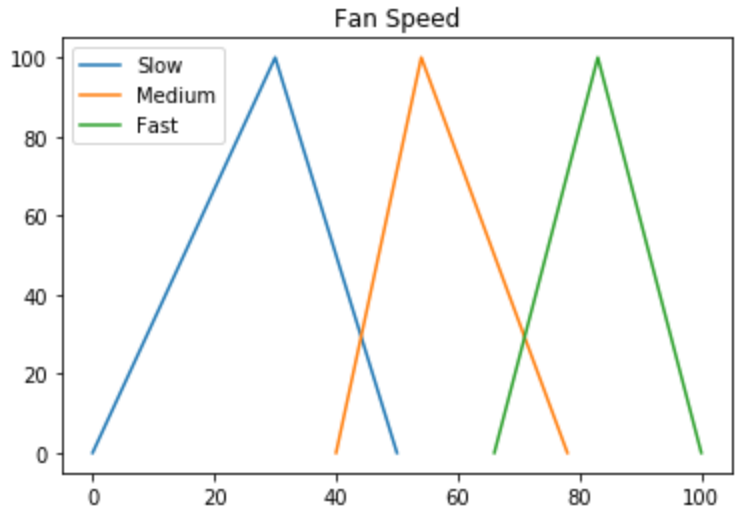


2. Fan Speed Graph

In [2]:
```
#Fan Speed
slow = [0, 30, 50]
medium = [40, 54, 78]
fast = [66, 83, 100]

percentage = [0, 100, 0]

plt.plot(cold, percentage)
plt.plot(medium, percentage)
plt.plot(fast, percentage)
plt.legend( ["Slow", "Medium", "Fast"] )
plt.title("Fan Speed")
plt.show()
```



3. Function definition

In [3]:
```
#FUNCTIONS
def Membership(x,List):
    "Returns the membership of a value in a list."
    top=(float(x)-List[0])
    bottom=(List[-1]-List[0])
    M= top/bottom
    return M
    #print( "Membership: " + str(M) )

def Is(x,List):
    "Returns true if a value is in the value range of a list"
    #If a value is greater than the first item in a list..
    if x >= List[0]:
        #And if it is smaller than the last item in the list...
        if x<= List[-1]:
            #print the membership of the item in the list...
            Membership(x,List)
            #And return True
            return "Yes"
    #No else statement is needed since the return statement will exit the function.
    #Print the membership and return False if the above condition is false.
    Membership(x,List)
    return "No"

#Determine Fan speed based on temperature
def findSpeed(temp):
    "Determine Fan Speed based temperature or city"

    temp_cold = Membership(temp, cold)
    temp_medium = Membership(temp, normal)
    temp_hot = Membership(temp, hot)

    #Fuzzy logic values lies between 0 & 1 (if membership is less than 0 then make it 2
 & filter them)
    if temp_hot < 0:
        temp_hot = 2
    if temp_medium < 0:
        temp_medium = 2
    if temp_cold < 0:
        temp_cold = 2

    if( temp_cold <= temp_medium):
        return "Slow"
    elif( temp_medium <= temp_hot):
        return "Medium"
    else:
        return "Fast"

def document(f):
    #Print the name of a function and its document string.
    print( f.__name__ +': '+ f.__doc__+'\n' )
```

In [4]:
```
# Function Documentation
document(Is)
document(Membership)
document(findSpeed)
```

```
Is: Returns true if a value is in the value range of a list

Membership: Returns the membership of a value in a list.

findSpeed: Determine Fan Speed based temperature or city
```

4. Variable declaration

In [5]:
```
#temprature range
cold = (0, 50)
normal = (40, 78)
hot = (66, 100)

# Average temperature of cities
Mumbai = 88
Pune = 64
Shimla = 17
Jaipur = 90
```

5. Verify function with sample cities

In [6]:
```
print( "Is Shimla cold: " + str( Is(Shimla, cold) ))
print( "Is Shimla normal: " + str( Is(Shimla, normal) ))
print( "Is Shimla hot: " + str( Is(Shimla, hot) ))
```

```
Is Shimla cold: Yes
Is Shimla normal: No
Is Shimla hot: No
```

In [7]:
```
print( "Is Pune cold: " + str( Is(Pune, cold) ))
print( "Is Pune normal: " + str( Is(Pune, normal) ))
print( "Is Pune hot: " + str( Is(Pune, hot) ))
```

```
Is Pune cold: No
Is Pune normal: Yes
Is Pune hot: No
```

In [8]:
```
print( "Is Mumbai cold: " + str( Is(Mumbai, cold) ))
print( "Is Mumbai normal: " + str( Is(Mumbai, normal) ))
print( "Is Mumbai hot: " + str( Is(Mumbai, hot) ))
```

```
Is Mumbai cold: No
Is Mumbai normal: No
Is Mumbai hot: Yes
```

6. Verify Fuzzy Logic with city & temperature

In [9]:
```
print("Fan speed for Shimla: " + str( findSpeed(Shimla) ) )
print("Fan speed for Pune: " + str( findSpeed(Pune) ) )
print("Fan speed for Jaipur: " + str( findSpeed(Jaipur) ) )
print("\n")
print("Fan speed at 20: " + str( findSpeed(20) ) )
print("Fan speed at 60: " + str( findSpeed(60) ) )
print("Fan speed at 90: " + str( findSpeed(90) ) )
```

```
Fan speed for Shimla: Slow
Fan speed for Pune: Medium
Fan speed for Jaipur: Fast


Fan speed at 20: Slow
Fan speed at 60: Medium
Fan speed at 90: Fast
```