Open in Colab

AG - Actividad Guiada 3

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https://github.com/pachecoleonardo/03MAIR---Algoritmos-de-Optimizacion/tree/master/AG3

In [3]:
```
import urllib.request

file = "swiss42.tsp"

urllib.request.urlretrieve("http://elib.zib.de/pub/mp-testdata/tsp/tsplib/tsp/swiss42.tsp", fil
e)
```

Out[3]:
```
('swiss42.tsp', <http.client.HTTPMessage at 0x7f4a834f9518>)
```

In [5]:
```
!pip install tsplib95
```

```
Collecting tsplib95
  Downloading https://files.pythonhosted.org/packages/d1/4f/6a1cb104ce9b400eed7690641230fab1515b
d475f2dd86d4a3a73f677e3b/tsplib95-0.3.2-py2.py3-none-any.whl
Collecting networkx==2.1 (from tsplib95)
  Downloading https://files.pythonhosted.org/packages/11/42/f951cc6838a4dff6ce57211c4d7f8444809c
cbe2134179950301e5c4c83c/networkx-2.1.zip (1.6MB)
    100% |████████████████████████████████| 1.6MB 17.2MB/s
Requirement already satisfied: Click>=6.0 in /usr/local/lib/python3.6/dist-packages (from tsplib
95) (7.0)
Requirement already satisfied: decorator>=4.1.0 in /usr/local/lib/python3.6/dist-packages (from
networkx==2.1->tsplib95) (4.3.2)
Building wheels for collected packages: networkx
  Building wheel for networkx (setup.py) ... done
  Stored in directory: /root/.cache/pip/wheels/44/c0/34/6f98693a554301bdb405f8d65d95bbcd3e50180c
bfdd98a94e
Successfully built networkx
imgaug 0.2.8 has requirement numpy>=1.15.0, but you'll have numpy 1.14.6 which is incompatible.
albumentations 0.1.12 has requirement imgaug<0.2.7,>=0.2.5, but you'll have imgaug 0.2.8 which i
s incompatible.
Installing collected packages: networkx, tsplib95
  Found existing installation: networkx 2.2
```

```
    Uninstalling networkx-2.2:
      Successfully uninstalled networkx-2.2
Successfully installed networkx-2.1 tsplib95-0.3.2
```

In [0]:
```
import tsplib95
import random
from math import e

problem = tsplib95.load_problem(file)


#Nodos
Nodos = list(problem.get_nodes())

#Aristas
Aristas = list(problem.get_edges())
```

In [7]:
```
print("Nodos",Nodos)
print("Aristas",Aristas)
```

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1, 37), (41, 38), (41, 39), (41, 40), (41, 41)]
```

In [8]:
```
#Devuelve el factorial de un numero
def factorial(n):
    if n == 0:
        return 1
    else:
        return n * factorial(n-1)

#Se genera una solucion aleatoria con comienzo en en el nodo 0
def crear_solucion(Nodos):
  solucion = [0]
  for i in range(len(Nodos)-1):
    solucion = solucion + [random.choice(list(set(Nodos) - set({0}) - set(solucion)))]
  return solucion

#crear_solucion(Nodos)

#Devuelve la distancia entre dos nodos
def distancia(a,b, problem):
  return problem.wfunc(a,b)

#distancia(0,2,problem)

#Devuelve la distancia total de una trayectoria
def distancia_total(solucion, problem):
  distancia_total = 0
  for i in range(len(solucion)-1):
    distancia_total += distancia(solucion[i] ,solucion[i+1] ,  problem)
  return distancia_total + distancia(solucion[len(solucion)-1] ,solucion[0], problem)



solucion =crear_solucion(Nodos)

distancia_total(solucion, problem)
```

Out[8]: 4513

In [15]:
```
def busqueda_aleatoria(problem, N):
  Nodos = list(problem.get_nodes())
```

```
  mejor_solucion = []
  mejor_distancia= 10e100

  for i in range(N):
    solucion =crear_solucion(Nodos)
    distancia = distancia_total(solucion, problem)

    if distancia < mejor_distancia:
      mejor_solucion = solucion
      mejor_distancia = distancia

  print("Mejor solución:", mejor_solucion)
  print("Distancia:", mejor_distancia)
  return mejor_solucion

sol = busqueda_aleatoria(problem, 10000)
```

```
Mejor solución: [0, 26, 31, 33, 14, 5, 12, 7, 16, 6, 28, 18, 10, 21, 39, 37, 36, 17, 19, 13, 2,
4, 27, 29, 11, 9, 24, 20, 1, 32, 15, 40, 41, 23, 8, 35, 34, 25, 3, 22, 38, 30]
Distancia: 3727
```

In [23]:
```
def genera_vecina(solucion):
  #Generador de soluciones vecinas: 2-opt (intercambiar 2 nodos) Si hay N nodos se generan (N-
1)x(N-2)/2 soluciones
  #print(solucion)
  mejor_solucion = []
  mejor_distancia = 10e100
  for i in range(1,len(solucion)-1):
    for j in range(i+1, len(solucion)):
      vecina = solucion[:i] + [solucion[j]] + solucion[i+1:j] + [solucion[i]] + solucion[j+1:]
      distancia_vecina = distancia_total(vecina, problem)
      if distancia_vecina <= mejor_distancia:
        mejor_distancia = distancia_vecina
        mejor_solucion = vecina
  return mejor_solucion


solucion = crear_solucion(Nodos)
print(solucion)
```

```
nueva_solucion = genera_vecina(solucion)
print(nueva_solucion)
```

```
[0, 2, 14, 16, 24, 36, 37, 35, 30, 41, 26, 29, 9, 38, 22, 15, 18, 5, 21, 1, 3, 6, 7, 25, 19, 12,
8, 11, 33, 23, 39, 31, 13, 34, 28, 4, 27, 40, 17, 32, 10, 20]
[0, 2, 14, 16, 17, 36, 37, 35, 30, 41, 26, 29, 9, 38, 22, 15, 18, 5, 21, 1, 3, 6, 7, 25, 19, 12,
8, 11, 33, 23, 39, 31, 13, 34, 28, 4, 27, 40, 24, 32, 10, 20]
```

In [29]:
```
def busqueda_local(problem, N):
  mejor_solucion = []
  mejor_distancia= 10e100

  Nodos = list(problem.get_nodes())

  solucion_referencia = crear_solucion(Nodos)

  for i in range(N):
    vecina = genera_vecina(solucion_referencia)
    distancia_vecina = distancia_total(vecina, problem)

    if distancia_vecina < mejor_distancia:
      mejor_solucion = vecina
      mejor_distancia = distancia_vecina

    solucion_referencia = vecina

  print("Mejor solución:", mejor_solucion)
  print("Distancia:", mejor_distancia)
  return mejor_solucion



sol = busqueda_local(problem, 1000)
```

```
Mejor solución: [0, 1, 7, 17, 31, 36, 35, 20, 32, 5, 13, 19, 16, 14, 26, 18, 41, 23, 40, 24, 38,
33, 34, 30, 29, 22, 39, 21, 9, 8, 10, 25, 11, 12, 28, 2, 27, 3, 4, 6, 15, 37]
Distancia: 1801
```

In [0]:
```
def genera_vecina_aleatorio(solucion):
  #Generador de 1 solucion vecina 2-opt (intercambiar 2 nodos)
```

```
  #Generador de 1 solucion vecina 2-opt (intercambiar 2 nodos)
  #Se puede mejorar haciendo que la elecciÃ³n no se uniforme sino entre las que estÃ©n mÃ¡s pro
ximas
  i = random.choice(range(1, len(solucion)) )
  j = random.choice(list(set(range(1, len(solucion))) - {i}))

  vecina = solucion[:i] + [solucion[j]] + solucion[i+1:j] + [solucion[i]] + solucion[j+1:]
  return vecina

def probabilidad(T,d):
  r=random.random();
  if(r <= (e**(-1*d)/(T*1.0))):
    return True
  else:
    return False

def bajar_temperatura(T):
  return T-1
```

In [36]:

```
def recocido_simulado(problem, TEMPERATURA):
  #problem = datos del problema
  #T = Temperatura

  solucion_referencia = crear_solucion(Nodos)
  distancia_referencia = distancia_total(solucion_referencia, problem)

  mejor_solucion = []
  mejor_distancia = 10e100

  while TEMPERATURA > 0:
    #Genera una solución vecina(aleatoria)
    vecina = genera_vecina_aleatorio(solucion_referencia)

    #Calcula su valor(distancia)
    distancia_vecina = distancia_total(vecina, problem)

    #Si es la mejor solución de todas se guarda
    if distancia_vecina < mejor_distancia:
        mejor_solucion = vecina
        mejor_distancia = distancia_vecina
```

```
    #Si la nueva vecina es mejor se cambia y si es peor se cambia según una probabilidad depend
iente de T y de |distancia_referencia - distancia_vecina|
    if distancia_vecina < distancia_referencia or probabilidad(TEMPERATURA, abs(distancia_refer
encia - distancia_vecina) ) :
      solucion_referencia = vecina
      distancia_referencia = distancia_vecina

    TEMPERATURA = bajar_temperatura(TEMPERATURA)

  print("La mejor solución encontrada es " , end="")
  print(mejor_solucion)
  print("con una distancia total de " , end="")
  print(mejor_distancia)
  return mejor_solucion

sol = recocido_simulado(problem, 10000)
```

```
La mejor solución encontrada es [0, 21, 24, 40, 41, 10, 25, 11, 12, 18, 30, 29, 8, 23, 9, 39, 2
2, 38, 33, 35, 36, 17, 37, 7, 1, 3, 27, 2, 4, 26, 5, 13, 19, 14, 16, 15, 6, 28, 32, 34, 20, 31]
con una distancia total de 1793
```

In [0]:
```
def Add_Nodo(problem, H ,T ) :
  #Establecer una una funcion de probabilidad para
  # aÃ±adir un nuevo nodo dependiendo de los nodos mas cercanos y de las feromonas depositadas
  Nodos = list(problem.get_nodes())
  return random.choice(   list(set(range(1,len(Nodos))) - set(H) )  )


def Incrementa_Feromona(problem, T, H):
  #Incrementar segun la calidad de la soluciÃ³n. AÃ±adir una cantidad inversamente proporcional
 a la distancia total
  for i in range(len(H)-1):
    T[H[i]][H[i+1]] += 1000/distancia_total(H, problem)
  return T

def Evaporar_Feromonas(T):
  #Podemos elegir diferentes funciones de evaporaciÃ³n dependiendo de la cantidad actual y de l
a suma total de feromonas depositadas,...
  #Evapora 0.3 el valor de la feromona, sin que baje de 1
```

```
  T = [[ max(T[i][j] - 0.3 , 1) for i in range(len(Nodos)) ] for j in range(len(Nodos))]
  return T
```

In [39]:
```
def hormigas(problem, N):
  #problem = datos del problema
  #N = NÃºmero de agentes(hormigas)

  #Nodos
  Nodos = list(problem.get_nodes())
    #Aristas
  Aristas = list(problem.get_edges())

  #Inicializa las aristas con una cantidad inicial de feromonas:1
  T = [[ 1 for _ in range(len(Nodos)) ] for _ in range(len(Nodos))]

  #Se generan los agentes(hormigas) que serÃ¡n estructuras de caminos desde 0
  Hormiga = [[0] for _ in range(N)]

  #Recorre cada agente construyendo la soluciÃ³n
  for h in range(N):
    #print("\nAgente:", h)
    #Para cada agente se construye un camino
    for i in range(len(Nodos)-1):

      #Elige el siguiente nodo
      Nuevo_Nodo = Add_Nodo(problem, Hormiga[h] ,T )

      Hormiga[h].append(Nuevo_Nodo)

    #Incrementa feromonas en esa arista
    T = Incrementa_Feromona(problem, T, Hormiga[h] )
    #print("Feromonas(1)", T)

    #Evapora Feromonas
    T = Evaporar_Feromonas(T)
    #print("Feromonas(2)", T)

    #Seleccionamos el mejor agente
  mejor_solucion = []
  mejor_distancia = 10e100
```

```
  mejor_distancia = 10e100
  for h in range(N):
    distancia_actual = distancia_total(Hormiga[h], problem)
    if distancia_actual < mejor_distancia:
      mejor_solucion = Hormiga[h]
      mejor_distancia =distancia_actual


  print(mejor_solucion)
  print(mejor_distancia)


hormigas(problem, 1000)
```

```
[0, 24, 8, 21, 29, 11, 25, 23, 35, 1, 26, 12, 27, 5, 7, 14, 4, 28, 41, 2, 13, 15, 22, 38, 40, 3
0, 20, 34, 31, 10, 16, 37, 36, 17, 33, 39, 6, 32, 19, 18, 3, 9]
3949
```